Theories of Everything

In Honor of Ed Keenan

edited by

Thomas Graf
UCLA

Denis Paperno
University of Trento

Anna Szabolcsi
New York University

Jos Tellings
UCLA

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To Ed,
by colleagues, students, and friends,
many in multiple capacities

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A Note on Order

Aldo Antonelli · Robert May

The standard way of formally representing generalization is intended to represent three notions simultaneously: force, scope and order. In:

$$\forall x(\varphi x),$$

the first of these parameters is indicated by the symbol "$\forall$" standing for universal force; replacing it with the symbol "$\exists$" indicates existential rather than universal force. The second parameter is represented by the bracketing; variation comes to the fore when there is more than one indicator of generalization. Thus:

$$\forall x(\exists y(\psi xy)),$$

differs from:

$$\exists y(\forall x(\psi xy)),$$

in the scope of generalization. The last parameter is indicated by the letter immediately adjacent to the generalization symbol. Variation here is indicated by case. Use of miniscules, indicates that the generalization is of the first-order; use of majuscules, that it is of the second-order. Accordingly:

$$\forall F(\forall x(Fx))$$

contains a second-order generalization, in addition to the first-order generalization.

What the standard notation for generalization is designed to do, and indeed excels at, is displaying propositional structure. It graphically represents how the force, scope and order components interact to make up propositions expressing generalization, and it allows us to typify these propositions in a completely discriminable manner. On a glance, universal generalization can be distinguished from existential, first-order from second-order, first-order universal from second-order existential, and so on for the various combinations of the parameters. The beauty of the notation is that the structure over which both the truth-conditions and inferential capacities of generalizations are defined is represented as a single composition of force, scope and order, and it is this that explains its perseverant utility. It characterizes what we mean by the logical form of generalization.

This representational success is a core part of the analytic story about generalization, but it does beg a foundational question: What is it that makes these representations *logical* representations? The answer is readily at hand: it is because they are made up of logical parts, put together in a logical way. Comprehending this answer, however, requires some prior information - we need to know in what sense force, scope and order are logical notions.

This is, of course, a very big question, but there are expectations we have for any account of this logicality: It should position us to answer a range of fundamental questions about the extents of logical force, scope and order. Are universal and existential the only forces, or are there others? Are the possibilities of scope at a factor of $n!$ for n-many operators, or are there limitations? Or perhaps more possibilities than the $n!$ allowed by linearly ordered operators, as in the case of branching quantifiers? What is the difference between orders of generalization; are there orders greater than two? Are there dependencies among these factors — does scope depend on force, or force on order, for instance?

Frege's epochal breakthrough in understanding generalization was the insight that answers to questions of logicality spring from the alignment of force, scope and order with the semantics, syntax and ontology of generalization. As discussed in Heck and May (2013a), initially in *Begriffscchrift*, Frege develops the core representational aspects of generalization. That Frege focuses on propositional structure is unsurprising, given his emphasis in that work on presenting a notation in which the formality of inference is explicitly represented, in which proofs could only be given in a rigorous, gap-free manner. It is only later, however, when Frege, spurred by pointed criticisms in reviews of *Begriffsschift*, engages with Boolean logic that he begins to address logicality in the broader context.[1]

For Frege, the key is that the fundamental logical notion is that of a function; accordingly, what the logical notation — the conceptual-notation — represents is a structure of function and argument. But if in *Begriffsschrift,* Frege was concerned with justifying the formality of these representations, in *Grundgesetze* he takes this for granted, and shifts his attention to explicating what is represented, the functions themselves. Frege characterizes the functions in terms of their arguments, distinguishing between the base case, in which objects are arguments, and higher cases, in which functions themselves are arguments. The base and higher cases are organized hierarchically: The base case is the first-level; functions that take the base-case as arguments are second-level; those that take second-level functions as arguments are third-level, and so on. Frege's notation directly reflects this hierarchical relation. This, when we write:

$$\Theta(f(x)),$$

what we are representing is a second-level function taking a first-level function as argument. Thus, that the functional ontology is hierarchical fixes both the syntax and the semantics of functional representations; it entails that every well-formed logical formula expresses a well-formed proposition.[2]

Within this conception, Frege identifies one hierarchy of special importance for logic, the *conceptual* hierarchy. Concepts, by Frege's lights, are functions that have truth and falsity as their values.[3] Thus, first-level concepts take objects to truth-values, second-level concepts take first-level concepts to truth-values, third-level concepts take second-level to truth-values, and so on. In this context, Frege analyzes generalization as a second-level concept. Thus, the sentence:

[1] This is in 1881, in his paper "Boole's Logical Calculus and the Concept-script". See Heck and May (2013a).

[2] Of course, the irony is that the most well-known system for which this ideal fails is Frege's own.

[3] That is, they are characteristic functions. Since for Frege, truth and falsity are logical objects, concepts are mappings from the logical objects to a specified sub-set of the logical objects. See Heck and May (2013b) for discussion.

All men are mortal,

contains the concept

All ζ are ξ,

which maps a pair of first-level concepts onto a truth-value. Thus, on Frege's view, generalizations express conceptual relations; they are concepts that relate concepts. Their logicality emerges through their definability relative to the functional hierarchy.[4]

Frege's conception of generalization has proved to be extraordinarily fruitful. Notably, we now understand that force distributes over a class of conceptual relations that is inclusive of the generalization relation; these are the generalized quantifiers. From this perspective, universal and existential force are instances of quantificational force, that is, concepts related in terms of the cardinalities of their extensions.[5] Moreover, Frege's way of characterizing scope has been deeply explored within contemporary syntactic theory.[6] For the remainder of this brief note, however, we want to offer some remarks on the third aspect, that of the order of generalization, or as we will now consider the matter, the order of quantification.

On the Fregean conception of quantifiers as conceptual relations, the order of quantifiers is directly given by the conceptual hierarchy. Because quantifiers relate concepts, it follows that their lowest order will be second-level relations, that is, relations between basic first-level concepts. The next order up will be third-level relations, relating second-level concepts, and so on up the discrete steps of the hierarchy. Now Frege's way of rendering the orders of quantifiers can be re-phrased. Rather than classifying the quantifiers in terms of their arguments, they can be classified over the types of things that make up the extensions of the arguments. Done this way, we obtain the familiar categorization of quantifiers as *first order*, *second order*, etc, for every finite order in the theory of simple types. Thus, first-order quantifiers range over a domain of objects; second-order quantifiers range over properties of, or relations among, those objects; third-order quantifiers range over properties of properties, relations among properties, and so on. Here we focus on the distinction between first- and second-order quantifiers.

Roughly speaking, the notion of *order* for a quantifier can be articulated either *syntactically* or *semantically*. The syntactical notion of order for a quantifier is determined by the grammatical category that the terms quantified over occupy, whereas the semantical notion is determined by the type-theoretic level (over a given domain of objects) at which the notions being quantified over can be found. Intuitively, we might think of these notions as locked together, given that the role of the syntactic representation is to reflect the semantic characterization. However, when the syntactic and semantic notions are made bit more clear, it turns out that the boundaries between them, as well as the different orders within each, might in fact be more flexible than the intuitive picture would indicate.

[4] Frege's conception bears more than a passing relation to Boole's although there is a fundamental difference in how they see the relation of primary and secondary propositions. See Heck and May (2013a). Note that in Frege's system we can also define non-relational quantifiers, those that take only a single concept as argument.

[5] In this area, our depth of understanding is very much due to Ed Kennan's seminal contributions to the theory of generalized quantifiers. Although Keenan and Stavi (1986) is often singled out (along with Barwise and Cooper (1981) and Higginbotham and May (1981)), this is a sample of Ed's extensive and extremely influential investigations.

[6] See May (1977, 1985).

Consider a quantified statement of the form $\mathsf{Q}\alpha\Phi(\alpha)$, where Q is either $\exists$ or $\forall$ and α is a syntactical constituent. We leave the syntactical category of α unspecified to allow for the formula $\Phi(\alpha)$ to be obtained by replacing α for constituents of varying categories. If α replaces a constituent of category NP then the quantifier in $\mathsf{Q}\alpha\Phi(\alpha)$, is (syntactically) at the first order; if α replaces a constituent of category VP then the quantifiers is at the second-order, etc. There is in fact a tradition going back to Prior (1971) that emphasizes how items of *any* syntactic category — and not just those of category NP — are available for quantification. Prior points out that such "non-nominal" quantifications are ubiquitous in natural language. Not just second-order quantifiers fall under this heading:

He is something I am not — kind;

but also quantifiers binding constituents of other syntactic categories, for instance AdvP:

I hurt him somehow.

Notice that constituents of category AdvP combine with VP's to return VP's, and thus can be thought of as representing a mapping from properties into properties, an intrinsically higher-order notion.

From a semantic point of view, quantifiers can be given a treatment that is parallel to the syntactic one. First order quantifiers range over individuals members of the universe of discourse D, so that $\exists x\Phi(x)$ is true if some member of D falls within the extension of Φ, and $\forall x\Phi(x)$ is true if every member of D falls within the extension of Φ. At the second-order, $\exists X\Phi(X)$ is true if some subset of D falls within the extension of Φ, and similarly, $\forall X\Phi(X)$ is true if every subset of D falls within the extension D. From this point of view, (codified in the theory of generalized quantifiers), first-order quantifiers such as $\exists$ and $\forall$ denote collections of subsets of the domain, and $\mathsf{Q}x\Phi(x)$ is true if the extension of Φ is among the subsets denoted by Q. And analogously, second-order quantifiers denote collection *of collections* of subsets.

The point to keep in mind is that whether a quantifier is properly characterized, from a semantic point of view, as being first- or second-order is completely determined by the type-theoretic level of the entities it applies to. This is perhaps most clear by considering notions other than quantifiers, such as for instance objectual identity between members of D. There is no question that statements of the form $a = b$ are essentially first-order statements: they hold, or fail to hold, of pairs of (not necessarily distinct) objects. And yet a case can be made that asserting $a = b$ involves higher order notions, in that it implies that every property of a is also a property of b. We propose to express this distinction by saying that the first-order notion of objectual identity *expresses*, but does not *assert*, a second-order claim (see Antonelli and May (2012)).

The same distinction applies in the case of quantifiers, although it might not be as evident unless we broaden our horizon beyond consideration of just the two quantifiers $\exists$ and $\forall$. In particular it is important to look at *binary* first-order quantifiers, i.e., quantifiers that relate two subsets of the domain (syntactically, these are quantifiers that take not one but two formulas as argument, as mentioned). A prime example is the Aristotelian quantifier All, which relates subsets A and B precisely when $A \subseteq B$. While All clearly involves no reference to notions other than first-order, the case is not as clear for other first-order quantifiers.

Consider for instance the “Frege” quantifier F, relating two subsets A and B precisely when there are no more A’s than B’s — or, in Boolos (1981) suggestive rendition, when “for every A there is a (distinct) B.” It is clear that from a semantic point of view, F is a first-order quantifier, just like All: the former, just like the latter, applies to pairs of subsets of D. However, the relation expressed by F involves higher-order notions, since it implies (it is in fact equivalent to) the existence of an injective function mapping the A’s into the B’s. We characterize such a distinction by saying that F expresses — but does not assert — the existence of such a function.

The notion of order of a quantifier, whether specified syntactically or semantically, appears therefore not to be fine-grained enough. Quantifiers that are first-order — in that they represent predicates over, or relations between, subsets of the domain — might in fact be quite different to the extent that they involve higher-order notions. That such a finer-grained classification is needed is clear in fact from considering the vastly different expressive power of quantifiers that are, from a semantic point of view, first-order. Consider the Aristotelian quantifier All in comparison to the Frege quantifier F. The latter does not add to the expressive power of ordinary first-order languages, and in turn can be used to express the generalizations $\forall$ and $\exists$. But the former is vastly more expressive, as discussed in Antonelli (2010). It in allows a categorical characterization of the structure $\mathbf{N}$ of the natural numbers, and is therefore not reducible to ordinary first-order logic.

Frege, to his dismay, gave into the seduction of second-order logic, with its invitation to much richer mathematical results than are available in first-order logic. To Quine, second-order logic, with its bloated ontology of *abstracta*, was repugnant. But what our brief remarks highlight is for both Frege and Quine, the concern is with second-order logic, that is, with systems in which second-order claims are asserted. Expression of second-order notions is fundamentally weaker than asserting them, while still allowing for the mathematical richness that gives logicism its grip on our imagination.

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Affiliations

G. Aldo Antonelli
Dept. of Philosophy
University of California, Davis
antonelli@ucdavis.edu

Robert C. May
Dept. of Philosophy
University of California, Davis
rcmay@ucdavis.edu

The same people ordered the same dishes

Chris Barker

Introduction

In his 1992 paper, 'Beyond the Frege Boundary', Keenan proves that a number of constructions have meanings that cannot be adequately described using ordinary generalized quantifiers. Among these constructions are many simple, utterly colloquial sentences of English involving the words *same* and *different*, such as (the most natural reading of) *Ann and Bill read the same book*. In Keenan's terminology, such constructions lie "beyond the Frege boundary".

More recently, at least two analyses give compositional treatments of some uses of *same* and of *different*, namely, Barker 2007 and Brasoveanu 2011. (See also Barker and Bumford 2012 for a different implementation of the analysis in Brasoveanu 2011, along with a brief comparison with Barker 2007). And sure enough, they each use techniques that rely on more than just ordinary generalized quantifiers. So we're beginning to slowly explore the territory that lies beyond the Frege boundary.

But Keenan draws attention to other examples that are not fully analyzed in any published compositional analysis:

1. The same people ordered the same dishes.
2. Different students answered different questions (on the exam).

The distinctive feature of these examples is that they contain more than one occurrence of *same* or of *different*. Keenan discusses (2) in some detail, suggesting that it has a reading that requires a one-to-one correspondence between students and problems. As for (1), native speakers robustly report that there is an interpretation requiring multiple ordering events during which a certain group of people not only re-ordered a particular set of dishes—each member of the group must have re-ordered the same dish that person ordered on a previous occasion. That is, the truth conditions distinguish between the following two kinds of situations:

```
                       Occasion 1    Occasion 2   (1) True?
                       ----------    ----------   ---------

Situation 1: people    a b c d       a b c d      yes
             dishes    1 2 3 4       1 2 3 4

Situation 2: people    a b c d       a b c d      no
             dishes    1 2 3 4       4 3 2 1
```

Apparently, it is necessary to establish a relation between two sets that is sensitive to an ordering internal to those sets.

The goal of this squib is to explore what the analysis of Barker 2007 has to say about examples involving multiple *same*. The analysis will handle what Keenan calls 'resumptive' uses in which multiple occurrences of *same* distribute over the a single, shared set. I will also offer some tentative speculations about *same* distributing over implicit adverbials, and about cases in which DPs involving *same* may be dependent plurals.

1 Scouting the truth conditions of multiple *same*

The first challenge is to characterize the truth conditions of sentences containing multiple *same*'s.

As is well-known, *same* and *different* have two kinds of uses, deictic and sentence-internal:

3. a. Ann read the same book. DEICTIC
   b. Ann and Bill read the same book. SENTENCE-INTERNAL

Sentence (3a) is supposed to only have a reading on which the book in question closely resembles some contextually salient book (though see discussion below). Sentence (3b) has in addition a reading on which it is true iff there is some book such that Ann and Bill each read it, independently of which books are salient from discourse.

Sentence-internal interpretations involve *same* distributing over some set of entities. In (3b), *same* distributes over the sum of Ann and Bill; but Carlson 1987 shows that *same* can distribute over many different licensors, including the referent of a plural DP such as *the men*, the set corresponding to a quantifier such as *every*, *each*, or *no*, or even over a set of events, as in *Ann read the same book* ***twice***.

The first question about (1), then, is whether the reading in question is deictic or sentence-internal. Barker 2007:442 speculates that the first occurrence of *same* is deictic, referring to the participants of some salient past event. But the second occurrence of *same* appears to be sentence-internal, so that its contribution to the truth of the sentence depends only on the existence of an appropriate set of person-dish correspondences.

If at least the second occurrence of *same* has a sentence-internal interpretation (as I believe it does), this is our first mystery, since it's not clear what that *same* is distributing over. It's not distributing over the people in any simple way, since there is no requirement that any of the people ordered the same dish as each other, in contrast with, e.g., *Those people (all) ordered the same dish*. Rather, there appears to be distribution over at least two ordering occasions, so that each person must order the same dish on the two occasions. But there is nothing overt in the sentence that guarantees multiple dish-ordering events. I will suggest, therefore, that some interpretations of (1) may require positing a silent adverbial meaning.

1.1 Naturally-occurring examples

We can find naturally-occurring examples that have just this kind of implicit dependence on implicit multiple events.

Here's the context for such an example (collected from the internet): "Every five years for the past three decades, John Wardlaw, John Dickson, Mark Rumer, Dallas Burney and John Molony have been meeting at the California lake and taking the same photo." Then we have:

4. In 1987, the now college-educated men sat in the same position on
   the same bench, again with a self-timed camera.

We can be reasonably confident that the intended truth conditions require each member of the group to sit in the same position they occupied in the original photograph based on links to the photographs themselves:

In order to compute the truth conditions, we must distribute *the same position* not only over the sum of the five men, but also over at least two photographing events, so that each man sat in the same position on the same bench in each photograph.

We can also find examples in which multiple occurrences of *same* distribute over entities that are explicitly mentioned in the sentence (as in (5a)):

5. a. You can't put the same foot in the same river twice.
   b. A puzzle of identical twins: The interesting thing is that each brother will give the same answer to the same question.
   c. Economic theory suggests four main reasons why firms in the same industry end up in the same place.
   d. Many animals have hit upon the same adaptations by altering the same genes. Rattlesnakes and boas evolved the ability to sense body heat by tweaking the same gene. Three desert lizards evolve white skins through different mutations to the same gene. The literally shocking abilities of two groups of electric fish have the same genetic basis.
   e. Generic and brand name products may look or taste different but both contain the same amount of the same active drug(s).

f. The vast majority of the genome's sequence is the same from one person to the next, with the same genes in the same places. In other words, my genome is a pretty good approximation of yours, and if scientists sequenced your genome they would learn a lot about mine.
g. Record and mark the alignment of the driveshaft to the front differential so that you can put the same bolt through the same holes of each unit upon reassembly.
h. So we put the same woman, saying the same line, in all of their Yellow Page ads, on other marketing materials, and on the website.
i. Always put the same type of product in the same bag. For instance, you may set aside a few bags for meats, another set for fresh produce and yet another set for ...
j. The baseline is that its your internet service provider that decides what IP you get. but usually they give the same ip to the same computer.

The contribution of multiple-same to the truth conditions of these sentences is by no means uniform. Nevertheless, theses examples give us something to work with as we try to craft an account of at least some multiple-same sentences.

2 Compositional truth conditions for multiple *same*

2.1 Sketch of Barker 2007

In order to apply the account in Barker 2007 to multiple *same*, I must first sketch the basic analysis.

There are two key assumptions. The first is that *same* is a scope-taking adjective. The semantic behavior of a scope-taking adjective is analogous to that of a scope-taking DP: when quantificational DPs take scope, they abstract over the clause that contains them in order to form a new, quantified clause. Their semantic type, then, is $(\mathtt{e} \to \mathtt{t}) \to \mathtt{t}$, where the argument $\mathtt{e} \to \mathtt{t}$ is the type of the abstracted clause. (See, e.g., Keenan 2002 for a discussion of generalized quantifier theory.)

Barker 2007 argues that when *same* takes scope, it is natural to expect that it can abstract over a nominal. So, for example, in *two men with the same name*, *same* abstracts over the adjective position in the nominal *men with the [ ] name*, and it has semantic type $(\mathtt{Adj} \to \mathtt{Nom}) \to \mathtt{Nom}$, where $\mathtt{Adj}$ is the type of an ordinary adjective (namely, $\mathtt{Nom} \to \mathtt{Nom}$), and $\mathtt{Nom}$ is the semantic type of a nominal (namely, $\mathtt{e} \to \mathtt{t}$). The semantic composition of *two men with the same name*, then, is (two (same (λf (men with the (f(name)))))), where f is a variable of type $\mathtt{Adj}$.

The second key assumption is that *same* is polymorphic, and can take scope over other predicate-denoting expressions besides nominals. In particular, the semantic type of a clause with a DP abstracted has semantic type $\mathtt{e} \to \mathtt{t}$, the same semantic type as a nominal. This means that the analysis of a sentence like *The same waiter served the men* proceeds in two conceptual steps.

((the (same (waiter))) (served (the men)))

First, the DP *the men* takes scope:

the-men (λx ((the (same (waiter))) (served x)))

Next, *same* takes scope in between the quantifier *the men* and its nuclear scope:

$$\text{the-men (same } (\lambda f\ (\lambda x\ ((\text{the } (f\ (\text{waiter}))) \ (\text{served } x)))))$$

In Barker 2007, this is called 'parasitic scope', since the scope target of *same* does not even exist until some other scope-taker (here, *the men*) takes its scope first.

Given a parasitic scope analysis of this sort, the value and type of *same* will be as follows:

$$\lambda F \lambda x \exists f . F f x : (\texttt{Adj} \to \texttt{Pred}) \to \texttt{Pred}$$

In words, the denotation of *same* takes as its first argument F a predicate from which an adjective has been abstracted (semantic type $\texttt{Adj} \to \texttt{Pred}$). It returns a function of type $\texttt{Pred}$, where $\texttt{Pred} = \alpha \to \texttt{t}$. When $\texttt{Pred} = \texttt{Nom}$, or when *same* takes parasitic scope under a quantificational DP, then $\alpha = \texttt{e}$, and $\texttt{Pred} = \texttt{e} \to \texttt{t}$. (In later examples, *same* will take scope under a temporal adverbial, in which case α will be the type of an event.) The predicate returned will be true of an entity x just in case there is some adjective function f such that x satisfies the property returned by F applied to f. In the example at hand, this gives:

$$\text{the-men}((\lambda F x . \exists f . F f x)(\lambda f(\lambda x((\text{the}(f(\text{waiter})))\text{served}(x)))))$$

which reduces to

$$\text{the-men}(\lambda x . \exists f . (\text{the}(f(\text{waiter})))(\text{served}(x)))$$

This semantics assumes that the values of expressions with semantic type $\texttt{e}$ can be either atomic individuals or proper mereological sums (in the familiar sense of Link 1983), so that the variable x can range over individual men, or else over sets (sums) of men. On the given interpretation, then, *The same waiter served (all) the men* is predicted to entail that the relevant set of men has the property that a set has if there exists a way of choosing a waiter such that that waiter served each member of the set.

2.2 Application to multiple same

The unmodified analysis makes a number of predictions about sentences involving multiple occurrences of *same*.

6. [No matter how many times we ran the experiment,]
   The men (all) put the same object in the same box.

The analysis proceeds as above.

$$(\text{put}(\text{the}(\text{same}(\text{object})))(\text{in}(\text{the}(\text{same}(\text{box}))))(\text{the-men}))$$

First, the subject *the men* takes scope in order to create a scope target for the two occurrences of *same*:

$$\text{the-men}(\lambda x(\text{put}(\text{the}(\text{same}(\text{object})))(\text{in}(\text{the}(\text{same}(\text{box}))))(x)))$$

Next, one of the *same*'s takes parasitic scope:

$$\text{the-men}(\text{same}(\lambda f(\lambda x(\text{put}(\text{the}(f(\text{object})))(\text{in}(\text{the}(\text{same}(\text{box}))))(x)))))$$

And finally, the other *same* takes parasitic scope:

$$\text{the-men}(\text{same}(\lambda f(\text{same}(\lambda g(\lambda x(\text{put}(\text{the}(f(\text{object})))(\text{in}(\text{the}(g(\text{box}))))(x)))))))$$

Substituting the denotation for *same*, and then performing beta reduction, we have:

$$\text{the-men}(\lambda x \exists f \exists g.(\text{put}(\text{the}(f(\text{object})))(\text{in}(\text{the}(g(\text{box}))))(x)))$$

These truth conditions say that *The men put the same object in the same box* will be true just in case there is a way of choosing an object and a way of choosing a box, and it is true of the sum of the men that they put that object in that box. This will be true if each man puts the unique distinguished object in the unique distinguished box. This is a 'resumptive'-style reading, on which multiple *same*s take parasitic scope under the same licensor, and distribute over the same sum entity.

2.3 Approaching 'respectively'-style readings for multiple same

The example explored in the previous section involves singular DPs (*object* and *box*). If we use plural DPs, we have

7. The men put the same objects in the same boxes.

The analysis just described predicts a reading on which there is choice f of a set of objects and a choice g of a set of boxes such that each man x put the unique set f(objects) into the unique set g(boxes), though without each man necessarily using the same object-to-box function.

But this is not at all satisfactory, since it is not a 'respectively' style reading, which would require each man to put each object into a specific matching box on multiple occasions. (See Gawron and Kehler 2004 for some of the complexities of providing truth conditions for sentences involving *respectively*.) To build up to a respectively reading, consider:

8. John put the same object in the same box twice.

Here, the *same*'s take scope parasitic on the quantificational operator *twice*. The truth conditions guarantee that there is some object and some box such that the pair of events in question are such that each one instantiates John putting that object in that box. One unique object, one unique box, one unique person, two distinct events.

Next, consider:

9. The men put the same object in the same box twice.

There are a variety of readings, depending on relative scopes. If *twice* takes widest scope, and the remaining elements take scope as in the previous section, we get the same situation repeated twice. That is, on each occasion, there was a unique object and a unique box that the entire group of men used, though there is no requirement that it was the same object or box on both occasions.

However, if *twice* takes widest scope, and the *same*'s take parasitic scope on *twice* instead of on *the men*, then there must be a single distinguished object and a single distinguished box such that each man put that object in that box—in this case, the special object and box must remain constant across both occasions. Although such a reading might exist, this still is not the reading of interest.

Finally, imagine that *the men* takes widest scope, but the *same*'s take scope parasitic on *twice*:

$$\text{the-men}(\lambda x(\text{twice}(\text{same}(\lambda f(\text{same}(\lambda g(\lambda e(\text{put}(\text{the}(f(\text{object})))(\text{in}(\text{the}(g(\text{box}))))(x)(e)))))))))$$

Then it must be distributively true of each man that there was a particular object and a particular box that that man interacted with twice. Each man must use the same object and the same box on both occasions, but there is no need for different men to focus on the same objects and boxes.

But if the speaker knows there were more than one object and more than one box involved, English requires the use of the plural (see Zweig 2008 for detailed discussion of the semantics and pragmatics of dependent plurals).

10. The men put the same objects in the same boxes (twice).

I'm suggesting that on the described scoping, these are dependent plurals, with no implication that any individual man manipulated more than one object or more than one box.

A brief digression: If we suppose that adverbial quantifiers such as *twice* can be implicit, this predicts that even purportedly deictic-only sentences such as *Ann read the same book* should be able to be analyzed as sentence-internal if we postulate a silent adverbial. But in a sufficiently rich context, this may in fact be possible. Imagine that legal protocol requires eye witnesses to confront two lineups (identity parades) containing the same people in different costumes. An identification is only persuasive if the eye witness selects the same suspect out of both lineups. After the double lineup procedure, The DA asks the police lieutenant (without knowing or caring who was in the lineup):

11. So, did Ann pick the same guy?

Here, the implicit adverbial would be something like *out of both lineups* or *on both occasions*.

Finally, we can consider the original Keenan-style sentence that started our investigation, *The same people ordered the same dishes*. I will tentatively renew the speculation in Barker 2007:442 that the first *same* is deictic, as in *Five people went to dinner; a week later,* ***the same people*** *went to dinner again.* If so, then if we allow ourselves an implicit adverbial like *on both occasions*, we can give the deictic *the same people* widest scope, the implicit adverbial intermediate scope, and the second occurrence of *same* scope parasitic on the implicit adverbial, with *dishes* as a dependent plural (no individual ordered more than one dish):

$$\text{those-men}(\lambda x(\text{twice}(\text{same}(\lambda f(\lambda e(\text{ordered}(\text{the}(f(\text{dish})))(x)(e)))))))$$

The truth conditions require that it is distributively true of a certain set of people that for each person x, there is a way f of choosing a dish such that x ordered the $f(\text{dish})$ on both occasions.

Conclusion

In this squib, I have shown how the analysis of Barker 2007 makes explicit predictions about the interaction of sentences containing multiple *same*'s with the scope of a variety of elements in the sentence. This brief investigation by no means settles the status of multiple-same sentences; at best, I have only shown how it is possible to discuss how a range of interpretations can arise from a compositional treatment. Much of the discussion here is highly speculative—but so it goes in the uncharted lands beyond the Frege boundary.

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Affiliation

Chris Barker
New York University
chris.barker@nyu.edu

Why Eilam (2011) and Brasoveanu (2010) can and should be combined

Dorit Ben Shalom and J.-R. Hayashishita

Inverse scope readings, defined as readings that reverse the surface syntactic order of quantifiers, have been a puzzle for a very long time. Traditionally, there have been two opposing positions on the relationship between inverse scope readings and surface scope readings (readings that do respect the syntactic order of quantifiers). One position, traced back to Keenan (1975), assumes that while surface scope readings come for 'free' from sentence syntax, inverse scope readings are somehow 'special'. We may understand this position to mean that sentence syntax can generate surface scope readings but not inverse scope readings, and the emergence of inverse scope readings requires an additional mechanism. The other position, originated by May (1977), maintains that surface and inverse readings are derived similarly by sentence syntax.

While the field predominantly has been adopting the latter position, we believe that the choice is merely a matter of convenience; there is no concrete evidence that the latter positions is preferred to the former. It has been pointed out by Liu (1990), Ben Shalom (1993), and Hayashishita (1999; 2004; 2012), among others, that the availability of inverse scope readings is more limited than that of surface scope readings.

One option is to capture the limited availability of inverse scope readings by elaborating on sentence syntax (e.g., Szabolcsi 1997 Beghelli & Stowell 1997) or some filter mechanism imposed on sentence syntax (e.g., Fox 2000). To our knowledge, there have been no such attempts that successfully capture the relevant data. But pursuing it does not require a specification of a special mechanism.

Another option is to spell out the syntax and semantics of the special mechanism, a tall order. In this squib, we would like to argue that most, if not all, of the necessary ingredients are already 'on the market', and hint of a way one might be able to try and combine them to get the desired specification.

A key ingredient in this recipe is the quite old claim that inverse scope readings involve the notion of 'topic'. If that is accepted, what is still needed can be enumerated as follows:

1. A specification of the conditions under which a quantifier can serve as topic (e.g., Cresti 1995)
2. A model of the grammar that allows topichood to affect the input to semantics (e.g., Erteschik-Shir 1997)
3. A specification of how topichood affects that input (cf. Eilam's 2011 assumption that topics are the highest nodes in the relevant syntactic structure)
4. A compositional dynamic semantics that can in principle incorporate a notion like 'topic' (e.g., Brasoveanu 2010)

If this combination can be effected, one could have a quite 'traditional' account of inverse scope readings, using a combination of already existing tools.

Finally, there is also a small side benefit: if Brasoveanu (2010) interprets structures where syntactic and semantic order of quantifiers match, it would not need to assume lexical entries like WAS BITTEN for verbs like 'bite' to effect inverse scope readings. Much work still remains, but perhaps no wheel needs to be re-invented.

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Affiliation

Dorit Ben Shalom
Department of Foreign Literatures and Linguistics
Ben Gurion University of the Negev
doritb@bgu.ac.il

J.-R. Hayashishita
Department of Languages and Cultures
University of Otago
j-r.hayashishita@otago.ac.nz

Dynamic Logic in Natural Language

Johan van Benthem

1 When the world was young

Around 1980, a small band of logicians and linguists started collaborating in hopes of getting at the essences underlying natural language semantics by mathematical means. My high esteem for Ed Keenan's seminal work, and my long association with him personally, go back to that period, even though I have strayed from the path of natural language since. This is a good occasion to look back – and also ahead. I will give a biased bird's eye's view of the history as I see it, then say something about where I have traveled in the meantime, then discuss the possibilities for a safe return.

2 Abstract mathematics meets concrete language

Montague gave us the first comprehensive logical framework for thinking about natural language semantics, but it was mainly a highly abstract machinery for puzzle fitting. What came afterwards, in the work of Ed Keenan (and other pioneers whose names are all part of a public record that I need not repeat here), was the detailed investigation of concrete categories of linguistic expressions – most notably, quantifiers. Also, moving beyond semantic laws for specific categories, many insights came to light about general linguistic phenomena such as logicality, monotonicity, or iteration, that still capture audiences today, as I find every time that I lecture about these topics. I vividly remember the excitement at the time in bringing together mathematical structure and the facts of natural language: the eternal hope of science for finding a harmony between pure beauty and understanding the empirical structure of the world. Ed sought that harmony mainly using methods from algebra, I myself preferred model theory – but those are details, the spirit is the same.

3 From description to function

The main emphasis in this approach to semantics was on the expressive power of natural languages, that is the extent to which they *describe the world*. This focus singled out certain kinds of expression for special attention: logical constants as describing complex facts, generalized quantifiers as structuring what we say about objects, and, say, temporal expressions expressing how things proceed through time. But in the 1980s, semantics also developed innovations that shift this perspective. Discourse representation theory is already more about what you do with language, rather than its expressive power, and this theme of *functions of language use* is even clearer in paradigms like dynamic semantics or game theoretical semantics. In this more functional perspective, the issue becomes understanding, not how much natural language can say about the world, but how good it is at facilitating the major purposes that it serves for us: communication and general coordination of behavior. If you wish, the aim becomes ‘functional completeness’ for procedures used by humans rather than ‘expressive completeness’ with respect to the world. This richer view is still developing today, and interestingly, it also has counterparts in computational formalisms – the third partner in Montague’s Circle of natural and formal languages. Computational languages and models today are connected by a web of automata and games of verification and comparison, whose theory is transforming traditional subjects like formal language theory or model theory. My own ‘semantic automata’ for quantifiers around 1985 were already a step in this direction, and it is perhaps no coincidence that they have been reviving recently.

4 Enter new disciplines

Modeling functions of language may be a less focused enterprise than earlier work in formal semantics, since mining a function of natural language, or a form of its dynamic use, is harder than mining, say, a syntactic lexicon. On the other hand, what helps is that we now enter a territory where other disciplines are active, not just linguistics. Functions such as information transfer, learning, or more general forms of communication exhibit natural process structure that can be, and has been, studied on its own, in epistemology, in computational studies of agent systems, or in game theory.

5 Enter new logics

Process structure involves information states, transitions, and agents. This quickly leads us to other streams in logic than the type theories or intensional logics traditionally employed in formal semantics, including various systems of dynamic logic (and others might well be relevant). In particular, in recent years, I have been involved with *dynamic epistemic logics* of information-driven interactive agency and the resulting interfaces between logic, computer science, and game theory. These systems move many new topics into the scope of explicit logical analysis, such as the effects of events of getting hard or soft information, acts of inference, questions and answers, but also events that change preferences, or the working of strategies, all important features of rational agency.

6 A natural duality

I find the two perspectives on language outlined here very natural companions. They also represent the two main historical functions of logic: as a medium for world description, but also as an account of argumentative procedure. For instance, when you take your first course in logic, you will see these dual aspects reflected in the two ways you can think of propositional logic: as a theory of complex facts and classifications, or as a theory of discourse control describing how you refute or outwit opponents. The same two faces return in our best accounts of the very logical constants. Sometimes, they are ways of structuring invariants (in the line of the permutation invariance for linguistic expressions that Ed and I have mainly concentrated on over the years), but equally fundamentally, they are expression of functional control, as one can see in game-theoretic views of the Boolean operations as choices or role switchers. Again, this duality is far from completely understood or explored, and personally, I am now inclined to think of even punctuation markers like ? , ! like bona fide function-oriented logical operations.

7 The dynamic repertoire of natural language

But natural language has not gone away in all this. While it is true that most work in agent systems or game theory (or related areas of philosophy such as social epistemology or ethics) does not pay systematic attention to how things would be said in linguistic form, there remains the undeniable fact that much of what rational (and not so rational) agents do is soaked in natural language, being either triggered by or at least facilitated by what people say. I am getting more and more interested in getting clearer on this, though it does seem to involve a shift in the focus of attention.

8 Which lexical items?

Traditionally, we have chosen a few expressions to lavish our attention on. These were the logical constants, perhaps because of their mathematical pedigree, the quantifiers perhaps for similar reasons, and the occasional odd verb for its philosophical credentials, such as “know”. But if our core interests come to include information and communication, why would this be the only, or even the most obvious choice of lexical items to focus on right at the start? In a functional perspective, we want to understand the semantics of expressions reflecting the rich human repertoire of cognitive attitudes: knowing, believing, supposing, doubting, seeing, etc. Of course, some authors in philosophical logic have done quite a bit of this – I am not claiming that we have to start from scratch. I also observe that the current semantic literature has sophisticated accounts of epistemic modals “may” and “must”, partly triggered by concerns in philosophy, and these are now opening the way to the study of a much wider range of plausibilistic and probabilistic expressions going beyond the traditional agenda of formal semantics. Still, to mention one more potential case of bias beyond lexical selection, traditional semantics has focused on ‘hard information’ that is totally reliable, but this is only a tiny fraction of actual language use. A much better paradigm for understanding how language functions might be ‘soft attitudes’ like belief, based on plausibility rather than on truth. If belief revision and learning are of the essence in human behavior, their ‘correction dynamics’ might be expected to be at the heart of the functioning of natural language, too.

9 Action features at center stage

Returning to function and cognitive action again, even sticking to knowledge, from a dynamic perspective, this is just a temporary attitude that gets transformed continually by new dynamic actions. Thus, “know” becomes a member of a close family of verbs like “concluding”, “learning”, and perhaps even “giving up” and “forgetting”. Likewise, still in this same family of function words, we would expect the core to include actions like assert, reject, agree, observe, see, correct, … Speech act theories have addressed several of these, but they went only so far. What the experience in dynamic-epistemic logic of the last decade has shown is that these expressions are just as logical as traditional ones in admitting complete logics with a perspicuous model theory. And they may be more important to understanding natural language than rarified intricacies of ambiguity or branching in quantification, that never seem to prevent anyone from learning foreign languages, or from communicating successfully across linguistic barriers.

10 A return to semantics of natural language?

One of my many promises to myself (and maybe now also to Ed) has been a return to logical semantics of natural language in this double sense of logical: descriptive and functional. But this may involve more than doing semantics of more lexical items or further syntactic constructions, whether static or dynamic in the preceding senses. The functional picture of language involves modeling the basic *types of agent* and the nature of the *processes* that they are involved in. There is no need to suppose that all crucial aspects of this are encoded in syntax, or that what is encoded in syntax is the same across human languages. This broader desideratum has already been noted in the literature on Amsterdam-style dynamic semantics for natural language, where the nature of the linguistic agents and the precise processes underpinning the idea of information change have remained mostly implicit so far. Here dynamic-epistemic logics take a more explicit approach modeling communicative actions of any sort, harder or softer, more private or more public, whether or not corresponding precisely to linguistic utterances – though, Heaven knows, more structure may have to be added. Yes, I know that some people call this further enterprise pragmatics, and hence something that can be safely set aside as work for others. But if modern logic can deal with both, why separate what seems a natural unity in the way we use natural language?

Whether the above represents a return to natural language in the sense of the 1980s may be a moot point then, though I do think of that exciting period as opening horizons, and not as fixing some orthodox view of what can legitimately be studied. Moreover, one of the things that has always set Ed's work apart in the field (and made it so original) has been its abstraction level, and its search for *semantic universals* of expressive power that transcended the details of the formal systems of the day. I would think that the above thoughts, viewed as a search for logical universals of functional power, are in the same spirit – whether concrete natural language syntax is our main guide or other, less obvious, and perhaps more subtle, invariants of linguistic practice.

Affiliation

Johan van Benthem
University of Amsterdam Stanford University
johan@science.uva.nl johan@csli.stanford.edu

Reciprocal Reflexives

Daniel Büring

The German plain reflexive *sich*, when anteceded by a plural DP, can receive a reciprocal interpretation. This is possible only if *sich* occurs in direct or indirect object function, but not when it is the object of a preposition. This squib illustrates this pattern in detail and outlines an analysis that treats *sich* as an intransitivizing element, along the lines of Keenan (1988, 2007).

Introduction

German, Spanish, and Polish, among others, allow for reflexive as well as reciprocal interpretations of transitive sentences with plural subjects and reflexive objects:

(1) a. Die Anwälte hassen sich.
the lawyers hate SICH
b. Los abogados se odian.
the lawyers SE *hate*
'The lawyers hate themselves.' or 'The lawyers hate each other.'

(2) Chłopcy rozmawiali ze sobą.
boys talk with SOBA
'The boys talks to themselves/each other.' (Reinders-Machowska 1992:p.139)

Similarly, various languages are reported to have only one morpheme to express reflexivity and reciprocity. The resulting sentences are thus regularly ambiguous; an example is (3) from Nyulnyul (McGregor 1999:p,91), where the circumfix *mar-nyj* does double duty:

(3) Ku- rr irrjiwar arri ku- li- rr- mi- jal- inyj.
2 AUG *three no 2-* IRREALIS AUG REF/REC *see* REF/REC
'Don't you three look at each other!' or '…yourselves!'

One natural analysis for TRANSITIVE 'SICH' SENTENCES like (1-a), henceforth TSSs, assumes a specific combination of CUMULATION and REFLEXIVIZATION. As is well-known, transitive sentences with plural subject and objects are true as soon as each part of the subject denotation stands in the transitive relation expressed by the verb to at least one part of the object denotation, and *vice versa*; thus (4) can truly describe a dance in which each girl leads exactly one boy, and each boy is lead by a girl:

(4) The girls lead the boys.

(5) formalizes this property, where relation R models a transitive verb meaning (see e.g. Scha 1984):

(5) Cumulation
For each $R \in \{0,1\}^{E^E}, Cum(R)$ is the smallest function s.t.
a. for all $x, y \in E$ if $R(x)(y) = 1, Cum(R)(x)(y) = 1$, and
b. if $Cum(R)(a)(b) = 1$ and $Cum(R)(c)(d)$, then $Cum(R)(a+c)(b+d) = 1$
where $a+b$ is the group consisting of a and b

A group can be modelled as a set, a (plural) individual, or something else; nothing in the following hinges on this, as long as groups are also members of domain E. Using obvious names for constants of a semantic interpretation language, (4) can be analyzed as $\mathbf{Cum}(\mathbf{lead})(\mathbf{theBoys})(\mathbf{theGirls})$:

Reflexivization is defined in (6) (cf. Keenan 1988, 2007):

(6) Reflexivization
For each $R \in \{0,1\}^{E^E}, Rx(R)$ is that function in $\{0,1\}^{E^E}$ s.t. for all $a, b \in E, Rx(R)(a)(b) = 1$ iff $R(a)(b) = 1$ and $a = b$

The reflexive *sich* and its cross-linguistic counterparts can now be modelled as a family of arity-reducing functions:

(7) a. $[\![\text{sich}_1]\!] = \lambda R2 \in \{0,1\}^{E^E}.Rx(R)$
b. $[\![\text{sich}_2]\!] = \lambda R3 \in \{0,1\}^{E^{E^E}}.\lambda z \in E.Rx(\lambda y.R(y)(z))$

These meanings are put to work in (8); *sich*$_1$ reflexivizes a transitive predicate in (8-a), and the higher, dative argument of a ditransitive in (8-b); *sich*$_2$ reflexivizes the lower, accusative argument of a ditransitive in (8-c).[1] Other members of this family will probably be necessary for other syntactic configurations, a matter I will not go into here (see sec.4 of Keenan 2007).

(8) a. Eddie bekleckert sich.
E. *spills on* SICH-ACC
'Eddie is spilling on himself.'
b. Lilli wünscht sich ein rotes Geschenk.
L. *wishes* SICH-DAT *a* *red gift*
'Lilli would like a red present for herself.'
c. Summer zeigt sich der Menge.
S. *shows* SICH-ACC *the crowd*
'Summer presents herself to the crowd.'

1 German, Basic Analysis

The German pattern can now be analyzed as follows: For the reciprocal reading of *sich*, reflexivization applies *after* cumulation. Thus, (1-a) is true if every lawyer hates a lawyer,

[1] For perspicuity, *sich* here and below is glossed for case where relevant, even though it does not show morphological case marking; the glosses are based on what case a non-reflexive DP in structurally identical examples would bear.

and is hated by a lawyer. It should be clear that this is true whenever any reciprocal readings is true:[2]

(9) $Rx(Cum(hate))(theLawyers)$

The analysis is not complete, though. Note that (9) does not provide a reciprocal reading, but merely a VAGUE reading, which subsumes the truth conditions of a true reciprocal reading. This does not necessarily jibe with speakers' intuitions, according to which there is a genuine reciprocal *reading* for TSSs; and indeed I think these intuitions are accurate, as I will now try to show.

One way to substantiate this intuition is via ellipsis, as in (10):[3]

(10) a. Die Brautleute kauften sich teure Geschenke.
the bride and groom bought SICH *expensive gifts*
'The bride and groom bought each other/themselves expensive gifts.'

b. Der MC kaufte sich teure Geschenke, und die Brautleute auch.
the MC bought SICH *expensive gifts and the bride and groom too*
(i) 'The MC bought himself expensive gifts, and bride and groom bought themselves expensive gifts, too.'
(ii) *'The MC bought himself expensive gifts, and bride and groom bought each other expensive gifts, too.'

c. Die Brautleute kauften sich teure Geschenke. Der MC auch.
the bride and groom bought SICH *expensive gifts the MC too*

(10-a) is a TSS, and most naturally interpreted reciprocally. In (10-b), the first conjunct is singular, meaning 'the MC bought himself expensive gifts'; the second conjunct can only be understood reflexively: bride and groom each bought themselves expensive gifts, too. The reciprocal meaning ('they bought each other expensive gifts') is impossible.

(10-c) starts off with the same clause. Due to the strong preference for the reciprocal reading in this particular example, the second sentence in (10-c) feels zeugmatic. It forces a (re)interpretation of the first conjunct as reflexive, just as in (10-b). These effects in (10-b,c) would be unexpected if one semantic construal covered both reflexive and reciprocal situations.

Another indication that reflexive and reciprocal interpretations of TSSs are semantically distinct comes from negation. According to (9), the negation of a TSS will be true if *neither* the reciprocal nor the reflexive reading is true. This again seems too strong; intuitively, sentences like (11) do not imply that they don't love themselves anymore, that neither resembles themselves, nor that the victims didn't know themselves:[4]

(11) a. Sie lieben sich nicht mehr.
they love SICH *not any more*

[2] I say 'any' reciprocal reading, because for groups of more than two, there are ostensibly a number of reciprocal readings, see Dalrymple, Kanazawa, Kim, Machombo, and Peters (1998); Keenan and Razafimamonjy (2001); Langendoen (1978); Lichtenberk (1985) a.o.

[3] German does not allow VP ellipsis, so we use bare argument ellipsis here.

[4] Many examples were found on the internet by googling frames with the subject *die beiden*, 'the two of them', hence the abundance of that phrase.

‘They don’t love each other any more.’

b. Die beiden sind Geschwister, aber sie ähneln sich nicht.
the both are siblings but they resemble SICH *not*
‘The two of them are siblings, but they don’t much resemble each other.’

c. Die Opfer kannten sich nicht.
the victims knew SICH *not*
‘The victims didn’t know each other.’

I therefore propose that in the absence of *sich*/**Rx**, relations are marked as *non-reflexive* by default; this has in fact been proposed to account for so-called Condition B effects, i.e. the prohibition against covalued coarguments without reflexive marking (see e.g. Jacobson 2007). (12) defines such an operation of ‘irreflexivization’:

(12) Irreflexivization:
For any $R \in \{0,1\}^{E^E}, \bar{x}(R)$ is that functions in $\{0,1\}^{E^E}$ s.t. for all $a, b \in E, \bar{x}(R)(a)(b) = 1$ iff $R(a)(b) = 1$ and $a \neq b$.

The reciprocal reading of a TSS would now the be represented not as in (9), but as in (13):

(13) $Rx(Cum(\bar{x}(R)))$

The true reflexive reading, on the other hand, would be as in (14):

(14) $Cum(Rx(R))$

(13) in fact seems to be the only combination of the three operators **Rc, Cum, x̄** that leaves a non-empty *R*, at least for relations over individuals.

2 English

For languages like English, which do not allow reciprocal readings for TSSs, it has to be assumed that neither (9) nor (13) are available, so that (14) is the only available interpretation for a reflexivized relation. More cautiously, the basic, singular relation is reflexivized, then pluralized (e.g. by cumulation).

It is not obvious what should be responsible for this difference. It is suggestive that the English reflexive is a complex reflexive; it morphologically resembles the emphatic reflexive in other Germanic languages, including German, which has the emphatic reflexive forms *sich selbst* (reflexive) and *er/sie/es… selbst* (non-reflexive). Notably, these forms can generally occur wherever the parallel simple pronoun can occur (with the exception of non-thematic *sich*, similar to English *behave*), but never yield reciprocal readings:

(15) Die Anwälte hassen sich selbst.
the lawyers hate SICH *self*
‘The lawyers hate them*selves*.’ (not: ‘…hate each other’)

It must be emphasized, though, that the English reflexives, though resembling German emphatic reflexive morphologically, are not interpreted emphatically. I will thus not speculate further on the reason for the absence of reciprocal readings for English TSSs.

3 Supporting Evidence: Chaining

We have gone to great lengths above to derive the reciprocal reading using a regular reflexive meaning for *sich*, while at the same time deriving a genuine ambiguity —rather than a vagueness— between the two interpretations. An obvious alternative would be to assume that *sich* is simply ambiguous between a reflexive and a reciprocal meaning.

While we cannot show that this alternative analysis is *not* correct, we can find suggestive evidence that *sich* and *einander*, 'each other', are not synonymous even on *sich*'s reciprocal interpretation, and that the difference between their interpretive options is as expected on the perspective developed above, according to which reciprocal readings of TSSs involve reflexivization of a cumulated relation.

Our evidence involves so-called CHAINING READINGS. These are cross-linguistically common for *each other* type reciprocals, but systematically absent for TSSs:

(16) a. The children chased each other out of the room.
b. Die Kinder jagten einander aus dem Zimmer.
the children chased each other out of the room
c. #Die Kinder jagten sich aus dem Zimmer.
the children chased SICH *out of the room*
'The children chased themselves out of the room.'
d. Die Kinder jagten sich kreuz und quer durch das Zimmer.
the children chased SICH *across and through through the room*
'The children chased each other back and forth through the room.'

The English sentence (16-a) naturally describes a scenario in which the children run out of the room one after the other. On this reading, not every child chases another (the first one doesn't), and not every child is chased by another (the last one isn't). Such chaining scenarios are regularly describable by reciprocals in the languages of the world (Dalrymple et al. 1998; Lichtenberk 1985, 1999:a.o.), including German, cf. (16-b). However, the same scenario can*not* be described by (16-c), which has a reflexive in place of the reciprocal in (16-b). Notably, a reciprocal reading for *sich* is possible with the verb *jagen*, 'chase', in general, as in (16-d). The difference is that (16-d) describes a scenario in which each child is sometimes the chaser, sometimes the chased. (In fact, a similar reading *is* remotely available for (16-c), if we assume that the children go in and out of the room repeatedly, switching roles of chaser and chasee.)

Note now that (17-a) (as well as (17-b)) are true in a scenario of chasing each other through the room (i.e. (16-c)), so long as each child is chasing as well as chased at one time or another:

(17) a. $Cum(chase)(theChildren)(theChildren)$
b. $Cum(\bar{x}(chase))(theChildren)(theChildren)$

Therefore it is also predicted that (18-a) (and (18-b)) —our proposed representations for the reciprocal readings of the TSS— are true in such a situation:

(18) a. $Rx(Cum(chase))(theChildren)$
b. $Rx(Cum(\bar{x}(chase)))(theChildren)$

The chaining scenario, as elaborated above, on the other hand, is strictly ‘weaker’ than that. That is to say, none of (17) or (18) is met when the first child is chased by the second, the second by the third etc., but no one chases the last, and none is chased by the first.

I take this state of affairs to be an argument for the idea pursued here that the reciprocal reading of TSSs is indeed a cumulative reading. The alternative, according to which *sich* is ambiguous between a reflexive and a *bona fide* reciprocal would wrongly predict, *ceteris paribus*, that *all* readings found with reciprocals —including the chaining readings— should be found with reflexives as well.

4 Distributional differences

Reciprocal readings of TSSs seem possible whenever the reflexive occurs as a grammatical object, i.e. as a DP. We saw examples of reciprocal *sich* in direct object as in (1-a) above; similar examples can be found for indirect objects, be they recipients as in (10-b), malefactives, as in (19), or ‘raised possessors’ as in (20):

(19) Die beiden Firmen machen sich Konkurrenz.
the both companies make SICH-DAT *competition*
‘The two companies compete with each other.’

(20) 1 Million Menschen treten sich auf die Füße — Erfahrungsbericht über Loveparade
1 million people step SICH-DAT *on the feet report about love parade*
‘One million people stepping on each other’s feet — a first-hand report from the Love Parade.’

In other cases, *sich* could conceivably analyzed as the subject of a small clause, (21), or the argument of a predicative AP, (22):

(21) a. Die Beiden finden sich anziehend.
the both find SICH-ACC *attracting*
‘They are attracted to each other.’

b. Die beiden haben sich lieb.
the both have SICH-ACC *dear*
‘They like each other.’

(22) a. Die beiden waren sich todfeind.
the both were SICH-DAT *dead enemy*
‘The two of them were nemeses (to each other).’

b. Die beiden waren sich geistig ebenbürtig.
the both were SICH-DAT *mentally equal*
‘They were intellectually equal to each other.’

Finally, reciprocal *sich* is found as the subject in *accusativus cum infinitivo* (AcI) constructions under *lassen*, ‘let’:

(23) Sie lassen sich nicht ausreden und reden dazwischen.
they let SICH-ACC *not finish and talk in between*

‘They don’t let each other finish and interrupt.’

(23) Sind sie aber beide zusammen drin, lassen sie sich nicht in Ruhe.
are they but both together inside let they SICH-ACC *not in quiet*
‘But if they are both in there together, they don’t leave each other alone.’

What all of these examples illustrate is that reciprocal *sich* seems possible in any object function reflexive *sich* is possible in, regardless of whether it reflexivizes on a co-argument or not.

This strikingly contrasts with the systematic unavailability of reciprocal readings for *sich* as an object of a preposition, as in the (b)-examples in (24)–(26):

(24) a. Die Angeklagten beschuldigen sich.
the defendants accuse SICH
‘The defendants accuse each other’ (or: ‘. . . accuse themselves’)
b. Die Angeklagten schieben die Schuld auf sich.
the defendants push the guilt on SICH
‘The defendants accuse themselves.’

(25) a. Endlich haben sie sich gefunden.
finally have they SICH *found*
‘Finally, they found each other.’ (or: ‘. . . found themselves’)
b. Endlich haben sie zu sich gefunden.
finally have they to SICH *found*
‘Finally they found themselves.’

(26) a. Die Patienten müssen sich beschreiben.
the patients must SICH *describe*
‘The patients have to describe each other.’ (or: ‘. . . describe themselves.’)
b. Die Patienten müssen von sich berichten.
the patients must of SICH *report*
‘The patients have to report about themselves.’

Other environments in which a reciprocal reading for reflexives seems systematically absent are inside DPs and within coordinations, but I will not investigate these case further here.

(24)–(26) present semantically rather minimal pairs, which have a DP object in the (a)-examples, and a PP in the thematically parallel position in the (b)-examples. Whereas *sich* in the (a)-sentences is easily interpreted as reciprocal, this is entirely impossible in the (b)-sentences. This contrast is very clear (clearer than many other binding contrasts in German) and applies, as far as I found, to any DP object *vis-à-vis* PP object in German.

In all of the (b)-examples in (24)–(26), *sich* can be replaced by *einander*, ‘each other’, to yield a reciprocal reading (there is thus nothing wrong semantically or pragmatically with such a reading).

It is also worth noting that the reflexives in the PPs in (24)–(26) are simple reflexives, not emphatic ones (*sich selbst*); these sound natural in these examples and have a perfectly clear (albeit non-reciprocal) meaning.

Many other object-like PPs in German sound odd with simple reflexives, such as *sprechen mit*, 'talk to', in (27):

(27) a. ??Peter spricht mit sich.
P. speaks with SICH
b. Peter spricht mit sich selbst.
P. speaks with SICH *self*
'Peter talks to himself.'

For these, it could be argued that the reciprocal reading is impossible because simple reflexives are impossible, and emphatic reflexives, as discussed above, never allow for a reciprocal readings. However, *die Schuld auf X schieben, zu X finden* and *von X berichten*, the verbs used in (24)–(26), are *not* of this kind. They do sound natural with simple reflexives, as in the example above. Still, they clearly lack the reciprocal reading. So the lack of reciprocal readings for reflexives in PPs cannot be reduced to a general ban on simple reflexives in PPs.

Additionally, the PP objects in such examples are available for cumulation. This can be seen in (28-a–c), which all have a natural cumulated reading on which each defendant implicates some police person, each person finds some desk (presumably their own), and each patient describes some symptoms (again presumably their own):

(28) a. Die Angeklagten schieben die Schuld auf die Polizisten.
the defendants push the guilt on the police
'The defendants accuse the police.'
b. Sie habe zu den Schreibtischen gefunden.
they have to the desks found
'They found their desks.'
c. Die Patienten müssen von den Symptomen berichten.
the patients must of the symptoms report
'The patients have to report about their symptoms.'

But if (regular) reflexivization and cumulation are each available for the PP internal DP positions, it remains mysterious why the reciprocal reading, which supposedly results from combining them, are not available here. One possibility is that while both processes are available separately, it is for some reason impossible to apply them both, in particular reflexivization *after* cumulation (as we assumed was possible in the case of simple TSS):

(29) a. $Cum(\lambda x.\lambda y.y$ pushes the guilt onto $x)$
but not: $Rx(Cum(\lambda x.\lambda y.y$ pushes the guilt onto $x))$
b. $Cum(\lambda x.\lambda y.y$ finds the way to $x)$
but not: $Rx(Cum(\lambda x.\lambda y.y$ finds the way to $x))$
c. $Cum(\lambda x.\lambda y.y$ reports about $x)$
but not: $Rx(Cum(\lambda x.\lambda y.y$ reports about $x))$

It is unclear, though, what should block the combination of two otherwise available and generally combinable operators. Therefore, in the last section, I will speculate on a different line of explanation.

5 Speculation: Towards an Analysis

Consider again a sentence with a plural subject and *sich* inside a PP:

(30) Die Schauspieler reden gern über sich.
the actors talk like about SICH
'The actors like to talk about themselves.'

As noted above, this sentence cannot mean 'the actors like to talk about each other'. It can either mean that each actor likes to talk about her- or himself, or that the actors like to talk about the actors in general. This latter reading could be analyzed either as a collective reading —'each actors likes to talk about the actors'— or as a cumulative reading —'each actor likes to talk about some actor(s) and each actor is a favorite subject of some of the others'.

Whether or not these two are indeed semantically different readings is not important for our purposes (see e.g. Lasersohn 1995; Roberts 1991:for discussion). What is crucial is that such a reading is indeed somewhere between a reciprocal and a reflexive reading.

It is therefore worth exploring the following line of analysis: *sich* inside PPs can have a reflexivized cumulated reading, but —unlike *sich* in TSSs— not a truly reciprocal reading. Recall that we analyzed the reciprocal reading for *sich* as the reflexive cumulative reading *minus* the singular reflexive reading. Formally:

(31) the actors talk about *sich*

a. strictly reflexive reading:
$Cum(Rx(talk-about))(theActors)$
'the actors are a group of individuals that each talk about themselves'

b. reflexive cumulative reading:
$Rx(Cum(talk-about))(theActors)$
'each actor talks about some actor(s), and is talked about by some actors'

c. *reflexive cumulative irreflexive reading:
$Rx(Cum(\bar{x}(talk-about)))(theActors)$
'the actors are a group of people that each talk about some group members (and are talked about by some), but not themseves' (aka. the actors talk about each other)

I will assume for the remainder of this section that this is an empirically adequate way of modelling the data. The next question then is what explains the (un)availability of these different construals. We hypothesized above that two-(and more)place predicates are irreflexivized by default, in particular whenever they are not (directly) combined with a reflexivizer like *sich*/**Rx**. What I suggested earlier in this section is that a predicate like *sprechen über*, 'talk about', is not so irreflexivized, yielding a vague, reflexivized cumulated reading. So, more formally, the question to answer is: what prevents irreflexivization in these cases?

To motivate the analysis to be explored in this section, let me make a detour to reflexives inside nominals, as in (32):

(32) Die Patienten betrachten Bilder von einander / sich.
the patients look at pictures of each other SICH

In such environment —as mentioned in passing above—, no reciprocal readings for reflexives are possible either, just as with reflexives inside PPs. The available readings —again just as we argued with PPs— are strictly reflexive or collective (the pictures show several or all of the patients).

Betrachten here denotes a relation between individuals (patients) and objects (pictures). The object DP *Bilder von sich*, 'pictures of SICH', denotes, or quantifies over, pluralities consisting of pictures of the patients. As before, every patient has to see some picture, and every picture has to be seen by some patient. Even if the predicate 'see' is irreflexivized, there can still be pairs of patients and their *pictures* in its extension (just not of patients and themselves). Therefore the cumulative reading here is a truly vague reading, not a reflexive *or* a reciprocal one. This is represented in (33):

(33) $Rx(Cum(\lambda y[(\bar{x}(betracht))(\text{pictures of } y)]))(thePatients)$

So in this kind of case, we have a rather natural explanation for the fact that we get a vague reading ('the patients looked at pictures of the patients'), as well as a truly reflexive one ('each looked at pictures of her/himself'), but not a reciprocal one (which would be the vague minus the strictly reflexive): what is irreflexivized is the relation between lookers and things they look at, whereas what is cumulated and reflexivized is the relation between lookers and the things depicted on the pictures they look at. With plain transitives, on the other hand, these two relations fall into one (the one expressed by the transitive verb), yielding a reciprocal reading.

How could we extend this to the case of prepositional complements, as e.g. in *sprechen über*, 'talk about'? Assume that *sprechen* —not *sprechen über*— denotes a relation between individuals (the speakers) and whatever kind of thing an *about* PP denotes, which for want of a better term[5] we will call an ABOUTEE. Crucially, aboutees are not individuals, or more carefully speaking, are not identical to the denotation of the object DP of an *about* PP, but rather a different, more abstract sort of individuals. For concreteness, let us assume that there is a bijection from (traditional) individuals to aboutees, so that we can write **about(a)** for the aboutee corresponding to individual **a**. Intuitively, we can think of **about(Ed)** as 'the subject of Ed' as in 'Kim talked about the subject of Ed', translated as **talk(about(Ed))(Kim)**.[6]

A translation of *the actors talks about the movie* would now look as in (34):

(34) $(Cum(\bar{x}(talk)))(about(theMovie))(theActors)$

For *die Schauspieler sprachen über sich*, 'the actors talked about SICH ', we get (35):

(35) $(Rx(Cum(\lambda y.\bar{x}(talk)(about(y)))))(theActors)$

[5]avoiding the obvious but already-used-otherwise choices 'theme', 'topic' and 'subject'

[6]An alternative would be to model **about** as a function from indivdiuals to *sets* of aboutees, so that 'talking about Ed' would be modelled as the set of individuals who talk about *some* element of **about(Ed)**, i.e. having *about Ed* be a generalized quantifier over Ed-aboutees; as far as I can see, nothing in the present context hinges on that choice.

As before, **talk** is irreflexivized by $\bar{\mathbf{x}}$ by default here. However, what is irreflexivized is the relation between talkers and aboutees, not a relation between talkers and the things/people they talk about. Since aboutees are distinct from ordinary individuals, $\bar{\mathbf{x}}$ is in fact trivially satisfied. Cumulation and reflexivization, on the other hand, do not operate on the relation expressed by *talk*, but the relation expressed by *talk about*.

So according to this line of analysis, what happens with reflexives inside PPs is that the relation that is cumulated and reflexivized (by *sich*) is different from the relation that is irreflexivized by default $\bar{\mathbf{x}}$. The former corresponds to the relation expressed by *talk about* (as one would have expected), the latter to the relation expressed by *talk* alone. This latter case of irreflexivization turns out to be in fact trivial, since the denotation of PPs like *about DP* turns out to be something different from ordinary individuals.

In order to apply this analysis to all kinds of PPs, we obviously have to assume a different sort of individual for the various PP denotations. In some cases, this seems more plausible than in others. For example, *finden* in *finden zu* as in (25-b) ('they finally found to SICH') would —quite plausibly, one may argue— express a relation between an individual and some kind of path (the path to that individual in the case of a reflexive), where as in (25-a) ('they finally found SICH') it denotes a relation between ordinary individuals. But by the same token, *verliebt* in (36-b) must denote a relation between an individual (the faller-in-love) and something other than an ordinary individual (the denotation of *in DP*), whereas *lieben* in (36-a) denotes the plain and expected relation between two individuals (the lover and the beloved):

(36) a. Die beiden lieben sich.
the both love SICH
'The two of them love each other.'
b. Die beiden sind in sich verliebt.
the both are in SICH *fallen in love*
'They have fallen in love with themselves.' (not: '... with each other')

It should be noted that virtually all of the PPs discussed in this squib are formally and idiosyncratically selected by the verbs; that is to say, there is no transparent reason why *verliebt* selects *in* and not *mit*, 'with' or *zu*, 'to'. The prepositions do not make any discernible semantic contribution to these sentences. It therefore seems *prima facie* plausible to treat them as semantically vacuous, and indeed the implicit consensus among semanticists seems to be to treat these V+P combinations as essentially transitive relations which for irrelevant morphosyntactic (and possibly diachronic) reasons happen to be expressed by V+P, rather than transitive V —much like English *rely on* or *believe in*. The analysis explored in this section —for better or for worse— explicitly disavows this intuition and treats all of these prepositions as *bona fide* semantic functions from one kind of individual to another (aboutees, paths, in-love-with-ees etc.).[7]

Apart from such concerns of general plausibility, it should be noted that these PPs are not EXEMPT ENVIRONMENTS in the sense of Pollard and Sag (1992) or Reinhart and Reuland (1993) —unlike those headed by semantically 'loaded' Ps like *behind*, or the typical

[7] To make matters worse, some prepositions would have to be assumed to have different meanings depending on the verb that selects them. For example *auf*, 'on(to)' in *achten auf*, 'pay attention to', would presumably map individuals to other things ('attendees') than in *freuen auf*, 'look forward to' ('look-forwardees'... ?).

picture nominals like (32) that we modelled this analysis on. The DP position inside PP complements show complimentary distribution between reflexive and non-reflexives, and are taken by the authors just cited as genuinely thematic, much in the sense alluded to in the previous paragraph. On the present analysis, this fact remains mysterious, since we assumed that a ban on co-valued pronominals would follow from the default application of $\bar{\mathbf{x}}$, the irreflexivizer. But since $\bar{\mathbf{x}}$ is, by assumption, *not* applied to the relation expressed by V+P, but that expressed by V alone, no Condition B effects are predicted, i.e. it is not predicted that e.g. (37) cannot mean 'the actors talked about themselves':

(37) Die Schauspieler sprachen über sie.
the actors talked about them

In sum, the idea to treat the absence of reciprocal readings for reflexives in PP complements as a semantic fact having to do with the intervention of a semantically contentful preposition —in analogy with nominals— is conceptually daunting, but also empirically incomplete, in that it needs to be supplemented with something to take care of Condition B effects in these environments, such as the syntactic conditions put forth in e.g. Pollard and Sag (1992) or Reinhart and Reuland (1993), a.o.

Summary

This squib has documented in detail the use of reflexive *sich* in German to express reciprocal meanings. In the first sections, I proposed to analyze these are involving a regular reflexivizer meaning along the lines of Keenan (1988, 2007), combined with, first, regular cumulation of relations, and, second, a local irreflexivization to get as from a general cumulative to a genuine reciprocal meaning.

In the second half of the paper, we documented the distribution of such readings; they turn out to be available in all contexts in which the reflexive occurs as the syntactic argument of a verb, and to be unavailable for reflexives inside PPs and DPs. We speculated on an analysis that analogizes all of these case to picture noun reflexives. For the case of PP complements, however, this raised a number of tricky questions, which we have to leave for future research.

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Affiliation

Daniel Büring
Department of Linguistics
University of Vienna
daniel.buring@univie.ac.at

An Extra-Strong NPI?

Pantoute in Québec French

Heather Burnett · Mireille Tremblay

The goal of this paper is to identify a pattern of negative polarity item (NPI) distribution that, to our knowledge, has yet to be discussed in the literature. In particular, we will lay out the basic distribution of the adverb *pantoute* (pronounced /pã.tʊt/), which can be roughly translated as English *at all*, in the variety of French spoken in the province of Québec. Although, in this paper, we will exemplify the relevant empirical pattern with naturally occurring examples from a Québécois literary corpus[1] and native speaker judgements, it is our understanding (based on consultation with other speakers) that etymologically related elements in other dialects of French (ex. European French *du tout*; Acadian French *en tout* etc.) show a similar pattern[2].

We can first observe that, like English *at all*, *pantoute* cannot appear in an assertion in which it is not c-commanded by an appropriate negative operator. One such appropriate operator is the sentential negation marker *pas* 'not'. Thus, based on the contrast in examples such as (1) and (2), we can conclude that *pantoute* is some kind of negative polarity item.

(1) a. *C'est vrai *pantoute*.
It is true PANTOUTE.
'**It's true at all.*'

b. *I veut m'écouter *pantoute*!
He wants me listen PANTOUTE
'**He wants to listen to me at all.*'

c. *T'es grosse *pantoute*.
You're fat PANTOUTE
'**You're fat at all.*'

d. *Y ont les mêmes paroles que par icitte *pantoute*.
They have the same words than around here PANTOUTE
'**They have the same words as around here at all.*'

(2) a. C'est **pas** vrai *pantoute*.
It is not true PANTOUTE
'*It's not true at all.*'
Safarir: le magazine de l'humour illustré. (1987) (p.46)

[1] The literary examples presented in this paper come from the *fichier lexical* of the *Trésor de la langue française au Québec* (`http://www.tlfq.ulaval.ca/`).

[2] Luis Alonso Orvalle (p.c.) also reports that the Spanish expression *en absoluto* patterns like *pantoute/du tout* in French.

b. I veut **pas** m'écouter *pantoute*!
He wants not refl listen PANTOUTE
'He doesn't want to listen to me at all.'
Rodolphe Girard. (1904). *Marie Calumet*. La bibliothèque électronique du Québec. (p.120)

c. T'es **pas** grosse *pantoute*... t'es juste... disons, en chair.
You're not fat PANTOUTE... you're just... say, in flesh
'You're not fat at all... you're just... shall we say, healthy.'
Michel Tremblay. (1974) *Bonjour, là, bonjour.* Leméac. (p.86)

d. Pis les Français, des fois y te parlent pis tu sais pas ce
And the French, some times they you speak and you know not what
qu'y veulent dire, y ont **pas** les mêmes paroles que par icitte
that they want say, they have not the same words that around here
pantoute.
PANTOUTE
'And the French, sometimes they talk to you and you don't know what they're trying to say, they don't have the same words as around here at all.'
Richard Levesque. (1979). *Le vieux du Bas-de-fleuve*. Castelriand inc. (p.24)

In addition to sentential negation, *pantoute* is licensed by some other negative operators. In particular, *pantoute* (like *at all*) can be licensed by *p(l)us* 'no more' (3), *rien* 'nothing' (4), and *sans* 'without' (5).

(3) a. Mais le jeu est **pus** *pantoute* comme y était.
But the game is no more PANTOUTE as it was
'But the game is no longer at all as it was.'
Richard Levesque. (1979). *Le vieux du Bas-de-fleuve*. Castelriand inc. (p. 30)

b. Mais, une fois que t'es mariée, ma fille, y'a **plus** de baisage
But, one time that you're married, my girl, there is no more of screwing
pantoute.
PANTOUTE
'But, once you're married, my girl, there's no more screwing at all.'
Mailhot, Laurent and Doris-Michel Monpetit. (1980). *Monologues québécois, 1890-1980*. (p.192)

c. Pis quand y sont **pus** bons *pantoute*, y font comme les
Then when they are no more good PANTOUTE, they make like the
joueurs de hockey qui se pognent des jobs de dépisteurs: y deviennent
players of hocky that refl get some jobs of depisteurs: they become
fonctionnaires.
civil servants
'Then when they aren't good at all anymore, they act like hockey players and get themselves 'depisteur' jobs: they become civil servants.'
Richard Levesque. (1979). *Le vieux du Bas-de-fleuve.* Castelriand inc. (p.39)

(4) a. Ensemble, on peut tout faire, séparés on est **rien** *pantoute*.
Together, we can everything do, separated we are nothing PANTOUTE
'Together, we can do everything, separated we are nothing at all.'

Janette Bertrand. (2007) *Le bien des miens*. Libre Expression. (p.131)

b. Aie! j'y pense, je t'ai **rien** offert *pantoute*...
Aie! I of-it think, I you have nothing offered PANTOUTE
Aie! Now that I think about it, I gave you nothing at all... ''
Richard Levesque. (1979). *Le vieux du Bas-de-fleuve*. Castelriand inc. (p.25)

c. Si l'enfer ressemble au club ousque j'travaille, ça m'fait **rien** *pantoute* d'aller passer mon éternité là, moé!
If Hell ressembles the club where I work, it doesn't bother me at all to spend my eternity there!
Michel Tremblay. (1972). *Les belles-soeurs*. Leméac. (p.15)

(5) I'mettaient leurs bateaux à l'eau **sans** y toucher *pantoute*.
they put their boats at the water without them touching PANTOUTE
'They put their boats in the water without touching them at all.'
Émile Seutin. (1968). *Description grammaticale du parler de l'Ile aux Coudes*. (p.131)

However, this is where the similarities between *at all* and *pantoute* end. In particular, English *at all* can be licensed by expressions denoting downward entailing functions that are not anti-additive[3], but, as shown in (6), *pantoute* cannot be licensed by these elements. In other words, while *at all* is what is often called a *weak* NPI, *pantoute* appears to be a *strong* NPI, i.e. an expression that is licensed only by anti-additive denoting expressions (cf. Zwarts (1998)).

(6) a. *T'es-**tu** allé à l'école *pantoute* aujourd'hui?
You were Q gone to the school PANTOUTE today
Compare English: *'Did you go to school **at all** today?'*

b. ***Si** t'allais à l'école *pantoute* aujourd'hui, je serais content.
If you went to the school PANTOUTE today, I would be happy.
Compare English: *'If you went to school **at all** today, I would be happy'*.

c. ***Peu** d'enfants sont allés à l'école *pantoute* aujourd'hui.
Few of students were gone to the school PANTOUTE today
Compare English: *'Few students went to school **at all** today.'*

However, *pantoute* shows a distribution that differs from that of classic examples of strong NPIs. To see the difference, consider the case of the expression *de la journée* 'all day' (lit. 'of the day') in European and Québec French. As discussed in Corblin, Déprez, de Swart, and Tovena (2004), *de la journée* is impossible in affirmative sentences and underneath weak NPI licensors (7).

3

(i) A function F is **downward entailing** iff for all properties A, B, if $A \subseteq B$, then $F(B)$ implies $F(A)$.

(ii) A function F is **anti-additive** iff F is downward entailing and, for all properties A, B, $F(A) \wedge F(B)$ implies $F(A \vee B)$.

(7) a. *J'ai mangé **de la journée**.
I have eaten of the day
'**I have eaten all day.*'

b. *Est-ce que Jean est venu **de la journée**?
Q that Jean is come of the day
'**Did John come all day?*'

However, *de la journée* is licensed by the full range of anti-additive quantifiers, as shown in (8).

(8) a. J'ai **pas** mangé *de la journée*.
I have not eaten of the day
'I haven't eaten all day'

b. **Personne** a mangé *de la journée*.
No one has eaten of the day
'No one has eaten all day.'

c. J'ai **rien** mangé *de la journée*.
I have nothing eaten of the day
'I haven't eaten anything all day.'

d. **Aucun** étudiant a mangé *de la journée*.
No student has eaten of the day
'No student has eaten all day.'

e. Je suis allé **nullepart** *de la journée*.
I was gone nowhere of the day
'I went nowhere all day.'

In contrast, although *pantoute* is licensed by some anti-additive quantifiers (*pas* 'not', *p(l)us* 'no more', *rien* 'nothing', and *sans* 'without' cf. (2)-(5)), it is not possible under other anti-additive elements such as *personne* 'no one', *jamais* 'never', *aucun étudiant* 'no student', and *nullepart* 'nowhere', as shown in (9). Thus, *pantoute* is subject to stricter restrictions than other strong NPIs, making it what we might call an *extra-strong* NPI.

(9) a. ***Personne** est venu *pantoute*.
No one is come PANTOUTE
Compare English: 'No one came at all.'

b. *J'y suis **jamais** allé *pantoute*.
I there am never gone PANTOUTE
Compare English: I've never been there at all.

c. ***Aucun** étudiant est venu *pantoute*.
No student is come PANTOUTE
Compare English: 'No student came at all'.

d. *Je suis allé **nullepart** *pantoute* aujourd'hui.
I am gone nowhere PANTOUTE today
Compare English: 'I went nowhere at all today.'

We can further observe that the split in the set of anti-additive quantifiers with respect to the licensing of *pantoute* is preserved in negative concord contexts. Like other Romance languages, Québec French is a negative concord language; that is, sentences with multiple negative quantificational expressions and neutral focus are interpreted as only containing a single semantic negation ((10), cf. Vinet (1998), Corblin and Tovena (2003), and Martineau and Déprez (2004) (among others) for a description of the Québécois negative concord system).

(10) Personne a rien vu.
No one has nothing seen.
'No one saw anything.'

Unlike in the standard dialect, sentential negation (*pas*) participates in the negative concord system in Québec French. Thus, in most sentences with negative quantifiers, a *pas* can be freely added without changing the the meaning of the sentence[4].

(11) a. J'ai rien vu. ≡ J'ai **pas** rien vu.
I have nothing seen. I have not nothing seen.
'I didn't see anything.'
b. Personne est venu. ≡ **Pas** personne est venu.
No one is come Not no one is come
'No one came.'
c. Je suis allé nullepart. ≡ Je suis **pas** allé nullepart.
I have gone nowhere I have not gone nowhere
'I went nowhere.'

However, the non-expletive nature of Québécois *pas* is revealed through the distribution of *pantoute*: although bare *personne* cannot license *pantoute*, when this element is modified by *pas* (12), the sentence is greatly improved (although it remains less than perfect for some speakers).

(12) a. *Personne est venu pantoute.
No one is come PANTOUTE
b. **Pas** personne est venu pantoute.
Not no one is come PANTOUTE
'No one came at all.'

In summary, we have shown that *pantoute* in Québec French has a distribution that is more

[4]The distribution of *pas* with other negative elements is, however, subject to certain structural restrictions that are not particularly relevant here. For example, *pas* can both c-command an N-word and appear in the scope of an other N-word (i), but it cannot appear in the scope of an N-word without also c-commanding one (ii).

(i) a. Y'est **pas** venu personne.
There is not come no one.
'No one came.'
b. Personne a **pas** rien lu.
No one has not nothing read
'No one read anything.'

(ii) *Personne est **pas** venu.
No one has not come

restricted than both the distribution its English counterpart *at all* and the distribution of other strong NPIs in the language (ex. *de la journée*). The licensing patterns that were discussed are summarized in table 1.

LICENSOR	AT ALL	DE LA JOURNÉE	PANTOUTE
pas/not	✓	✓	✓
p(l)us/no more	✓	✓	✓
rien/nothing	✓	✓	✓
sans/without	✓	✓	✓
personne/no one	✓	✓	×
aucun étudiant/no student	✓	✓	×
jamais/never	✓	✓	×
nullepart/nowhere	✓	✓	×
Other downward entailing expressions	✓	×	×

Table 1: The licensing patterns of *at all*, *de la journée*, and *pantoute*.

In the final part of the paper, we highlight some additional features of *pantoute* that a full analysis of this puzzling lexical item must take into account. Although, when it is used in assertations, this element has a very restricted distribution, *pantoute* has additional uses outside assertive contexts that are unusual for a polarity element. For example, as shown in the dialogues in (13) and (14), *pantoute* can used as an answer to a yes-no question. Note that, although bare *pantoute* is acceptable in these environments, the expression *pas pantoute* 'not PANTOUTE' is also possible.

(13) a. **-Père:** Veux-tu me sacrer patience toé, c'est tu une honte d'aller voir un psychiâtre?
-Father: *Leave me alone, will you, is it shameful to go see a psychiatrist?*
b. **-Maurice:** *Pantoute.*
-Maurice: *Not at all.*
Barette. (1973). *Papa*. (p.57)

(14) Par exemple y disaient: "As-tu peur d'un mort, toi, Joseph?" J'répondais: "*Pantoute*, moi j'ai pas peur des morts. Les morts ça n'revient pas ça."
'For example they said: "Are you afraid of a dead man, Joseph?" I responded: "Not at all, me I'm not afraid of the dead. The dead don't come back."
Brodeur, René and Robert Choquette. (1979). *Villages et visages de l'Ontario français*. Office de la télécommunication éducative de l'Ontario. Éditions Fides.

Finally, *pantoute* can be used as an exclamation to indicate that the speaker is in disagreement with their interlocutor, as shown in (15) and (16).

(15) a. **-Père:** Moé, j'ai jamais été capable de parler, ni avant, ni pendant, ni après!
-Father: *'I have never been able to talk, neither before, nor during, nor after!'*
b. **-Mère:** C'est normal ça Ernest!
-Mother: *'That's normal Ernest!'*
c. **-Père:** *Pantoute!*
-Father: *'Not at all!'*

Barette. (1973). *Papa*. (p.88)

(16) a. **-M. Ménard:** J'arrive!. . . J'ai gagné.
Mr. Ménard: *'I'm coming!. . . I won.'*

b. **-M. Tremblay:** Pantoute! Ça fait un bon bout d'temps qu'j'ai feni.
-Mr. Tremblay: *'Not at all! It has been some time since I've finished.'*
Marie Laberge. (1981). *Ils étaient venus pour. . .* VLB éditeur. (p.71)

We therefore conclude that *pantoute* can also be licensed by certain discourse configurations in addition to a very restricted set of negative quantificational elements. However, we leave a full analysis of this element's semantics and its licensing patterns to future research.

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Affiliation

Heather Burnett (corresponding author)
Département de linguistique et de traduction
Université de Montréal

Institut Jean Nicod
École normale supérieure, Paris
heather.susan.burnett@gmail.com

Mireille Tremblay
Département de linguistique et de traduction
Université de Montréal
mireille.tremblay.4@umontreal.ca

Nominal Tense in Tsou: *Nia* and Its Syntax/Semantics[*]

Henry Y. Chang

This paper investigates nominal tense (NT) in the Formosan language Tsou. In light of the NT diagnostics proposed in Nordlinger and Sadler (2004), this paper analyzes the nominal temporal marker *nia* as an instance of Independent NT (INT), heading a DP-internal tense phrase (TP). The INT-analysis explains nicely why (i) *nia* makes a temporal distinction of past versus nonpast within a noun phrase, (ii) *nia* cannot be replaced by a verbal tense/mood auxiliary, (iii) the meaning of *nia* is rather abstract—*nia* applies widely to nouns of various kinds, including nouns denoting artifacts, location and time, (iv) *nia* is normally preceded by a case marker, (v) a verb is required to undergo nominalization upon patterning with *nia*, (vi) *nia* is compatible both with definite and indefinite noun phrases, (vii) *nia* can co-occur either with a realis auxiliary or an irrealis auxiliary. These findings may advance our understanding of Tsou nominal structure on the one hand and shed new lights on the universal nominal structure on the other (cf. Cinque 2005, 2011).

Keywords: Tsou, nominal temporal marker, independent nominal tense, past versus nonpast, nominal structure.

1 Introduction

It is generally held that temporal information is characteristic of verbal categories and normally marked on them. However, recent studies have shown that temporal marking is also possible and productive with nominal categories across many genetically unrelated languages. The major debate in this connection is whether nominal temporal markers are instances of nominal tense (Nordlinger and Sadler 2004, 2008, Tonhauser 2007, 2008). Taking the debate as a backdrop, this paper examines in details the nominal temporal marker *nia* in Tsou and explores the analysis of *nia* as an instance of nominal tense (hereafter, NT).

Tsou is an Austronesian language spoken in the southwest highlands of Taiwan with a population of around 4,600 people (up to December 2011). The language is mildly endangered. Readers are referred to Zeitoun (2005) and H. Chang (to appear) for further

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updated information about its basic grammar.

Given this paper is concerned with temporality, it would be helpful to provide a brief introduction to Tsou grammatical system of tense, aspect, and modality (TAM). In Tsou, unlike in other Formosan languages, clausal TAM is typically encoded on the sentence-initial auxiliary rather than on the lexical verb following it (Zeitoun et al. 1996, Huang and Huang 2003). The auxiliary distinguishes between realis mood and irrealis mood.[1] In realis mood, the auxiliary additionally differentiates grammatical transitivity. The auxiliary system is summarized in Table 1 below.

Reality Status	**Realis**		**Irrealis**			
Focus	**INTR**	**TR**	**INTR or TR**			
Immediate	mi-, mio, mo	i-	Habitual	Predictive	Hypothetical	Counterfactual
			--------	te-, tena, ta-	nte	--------
Remote	mo(h)- moso	o(h)-	la-	--------	--------	nto(h)-, ntoso

Table 1. The tense, aspect, and modal system in Tsou[2]

The paper is organized as follows. Section 2 briefly reviews the NT literature, with special focus on the diagnostics and classification of NT. Section 3 investigates the semantics of *nia*. Section 4 analyzes *nia* as an NT marker in light of the diagnostics developed in Nordlinger and Sadler (2004). Section 5 fleshes out the syntactic structure of *nia*-phrases. Section 6 concludes the paper by discussing its typological/theoretical implications as well as pointing out some directions for future study.

2 Literature review

Nordlinger and Sadler (2004) presents one of the most updated and comprehensive surveys of NT. In this typological paper, they survey NT in 15 languages across various language families. They establish the following four criteria for identifying NT:

(1) Nordlinger and Sadler (2004:778-779)

(i) **Temporal distinction**: Nouns (or other NP/DP constituents) show a distinction in one or more of the categories of tense, aspect, and mood (henceforth, TAM), where these categories are standardly defined as they would be for verbs (e.g. Crystal 1997).

(ii) **Productivity**: This TAM distinction is productive across the whole word class and not simply restricted to a small subset of forms.

(iii) **Encoding on arguments/adjuncts**: The TAM distinction is not restricted to nominals functioning as predicates of verbless clauses but is encoded on arguments and/or adjunct NP/DPs in clauses headed by verbs.

(iv) **Not as a syntactic clitic**: The TAM marker is a morphological category of the nominal word class and cannot be treated as a syntactic clitic that merely attaches phonologically to the NP/DP.

[1] To use Huang and Huang's (2003) terminology, the TAM might alternatively distinguish between future tense and nonfuture tense.

[2] This table is taken from Zeitoun (2005: 279), with the original opaque terminology of focus replaced by the more transparent terminology of transitivity.

According to (1i), NT makes a temporal distinction, most notably, a past-nonpast distinction. In (1ii), NT markers distinguish themselves from derivational affixes such as the English *ex*-. In spite of its temporal encoding, the prefix *ex*- cannot be treated as an instance of NT in that it is not productive—it is limited to terms of non-kinship relations (e.g. *ex-wife*) and terms of occupations (e.g. *ex-manager*). Criterion (1iii) excludes the case where temporal marking is restricted to nominals that behave syntactically as predicates. Criterion (1iv) differentiates NT markers from syntactic clitics like the English *'ll* in *I'll*. In the next section, I apply these criteria to the nominal temporal marker *nia* in Tsou.

Moreover, Nordlinger and Sadler (2004) classify NT into two types: Independent NT (hereafter, INT) and propositional NT (hereafter, PNT). In INT, temporal interpretation is intrinsic to the noun phrase in which the NT marker occurs, whereas in PNT, temporal interpretation extends over to the clause-level. The INT-PNT division is useful to our investigation of Tsou NT, as will be illustrated in details in subsequent sections.

On the other hand, Tonhauser (2007, 2008) challenges Nordlinger and Sadler's NT analysis from a semantic viewpoint. Tonhauser argues that NT cannot be classified into the category of tense since it is not interpreted in the same way as verbal tense. In this paper, I leave Tonhauser's approach aside for two reasons. First, as will become clearer shortly, the NT marker in Tsou appears to serve the typical function of tense, this is, to locate a situation in time (Comrie 1999). This, as a first approximation, suggests that it behaves like verbal tense. Still, I leave its formal semantic representation for future study. Second, it seems to me that Tonhauser's approach is vaguer and hence more difficult to follow.

To the best of my knowledge, there has been no publication on NT in the Formosan literature thus far. Pan (2010) gives a detailed description of temporal grammar in Tsou. One of his major findings is that temporal expressions can be case-marked in the same manner as arguments. However, he does not address the issue of NT.

3 The semantics of *nia.*

In Tsou, nouns can be temporally marked by the morpheme *nia*, which Tung (1964) treats as a lexical item meaning 'passed-away' or 'ancient'. However, the interpretations of *nia* phrases are much wider than previously thought. In what follows, I summarize the functions of *nia*.

3.1 Change of existence (COE)

In this function, *nia* is used to encode an entity that used to exist prior to utterance time. In (2a), *nia* is associated with a person described by the kinship term *amo* who passed away prior to the utterance time. Likewise, in (2b), *nia* marks the proper name *beoku* and suggests that he is no longer alive.[3]

(2) Kinship term and proper name

a. kuhcu	to	**nia**	amo-'u	(na)	eni[4]
fur.clothing	GEN	PST	father-1S.POSS	ABS	this

'This is my deceased father's fur clothing.'

---

[3] This paper follows The Leipzig's Glossing Rules, with the following amendments: BA=benefactive applicative, COS=change of state, DT=downtoner, EMP=emphatic marker, NLMZ=nominalizer, NPST=nonpast, PLN=place name, and REAL=realis.

[4] For typographic convenience, this paper substitutes *x* for the high unrounded vowel *ɨ*/*ʉ*, *ng* for the velar nasal, and *'* for the glottal stop.

b. moso la nana aacni yuso na la-si kexpx no
INTR HAB reportedly always two ABS HAB-3S bag GEN
nia beoku
PST PN
'It is said that the late Beoku's bags used to be always two (in a pair).'

This is the sense which Tung (1964) glosses as 'pass-away/ancient', a sense comparable to the English adjective *late*, as indicated in the translations. I label this function as change of existence (COE), which is intended for something that used to exist.

The COE function of *nia* is also observed with terms of occupations and artifacts, as in (3).

(3) Terms of occupation and artifacts
a. mi-cu kuzo 'o **nia** icangaya ta tapangx
INTR-COS bad ABS PST chief GEN PLN
'The chief of the Tapangx village passed away.'
b. i-si haf-a to chumu 'o **nia** hiapeoza ne eovokutana
TR-3S bring-TR ERG water ABS PST bridge LOC PLN
'The Eovokutana Bridge was washed away by the flood.'

Note that Tung's characterization does not work for (3b), while it holds true of (3a). The washed-away bridge is neither 'dead' nor 'ancient' in the usual sense. Still, the entities encoded by *nia* in (3a)-(3b) share the property of change of existence—they used to exist but are gone prior to the speech time.

3.2 Change of identity (COI)

In this function, *nia* encodes an entity that used to hold a certain identity/post, but lost it prior to the utterance time. In (4a), *nia* is concerned with an individual who used to be Mo'o's wife but broke up with him prior to the utterance time; in (4b), *nia* describes an individual who used to be a township chief but left the post prior to the speech time. I label this function as change of identify (COI).

(4) Terms of realation/occupation
a. 'a **nia** (la) vcongx to mo'o (na) taini
EMP PST HAB spouse GEN PN ABS 3S.ABS
'She is Mo'o's ex-wife.'
b. 'a **nia** (la) ngocoo (na) taini
EMP PST HAB township.chief ABS 3S.ABS
'He is an ex-township chief.'

In this usage, *nia* functions like the English prefix *ex*-: both involve COI. Tung's glossing leaves this function unexplained. In both cases, the individuals are still alive rather than dead or ancient.

3.3 Change of possession (COP)

In this function, *nia* describes an entity that used to belong to some individual but ceased to hold the relation prior to the speech time. I label this function as change of possession (COP). In (5a), the COP applies to a building; in (5b), it applies to an animal.[5]

(5) Artifacts and animal

a.

nia	la	emoo-'u	(na)	eni
PST	HAB	house-1S.POSS	ABS	this

lit. 'This is my former/old house.'
'This house used to be mine.'

b.

tonoi	'o	**nia**	av'u-'u
that	ABS	PST	dog-1S.POSS

lit. 'That is my former/old dog.'
'That dog used to be mine.'

Semantically, *nia* in this function is roughly equivalent to the English adjectives *former* and/or *old*. Tung's analysis falls short in accounting for this function. The *nia*-phrase does not refer to an ancient building in (5a); neither does it denote a dead dog in (5b). It is evident that an alternative analysis is in order. I shall return to this in section 4.

3.4 Change of shape (COSH)

In this usage, *nia* refers to an entity that used to be in good shape but broke down before the utterance time. I label this function as change of shape (COSH).[6] Note that COSH usually applies to artifacts and natural kinds, as illustrated in (6a-c) and (7).

(6) Artifacts

a.

mi-cu	aemo'x	si	**nia**	ca'hx
INTR.REAL-COS	fall.apart	ABS	PST	chair

'The chair already fell apart.'

b.

i-ta	tupuz-a	si	mi-cu	kuzo	ci	**nia**	ca'hx
TR.REAL-3S	burn-TR	ABS	REAL-COS	bad	REL	PST	chair

'He burned the broken chair.'

c.

mi-cu	kxhtosx	si	**nia**	ufi.
REAL-COS	harden	ABS	PST	rice cake

'The rice cake has become stiff.'

(7) Natural kinds

mi-cu	tmuchumu	si	**nia**	yuho
REAL-COS	turn.into.water	ABS	PST	snow

'The snow has turned into water.'

---

[5] Tsou has a family name called *Niahosa*, which is arguably derived from *nia* plus *hosa* 'village'. In this case, *nia* seems to be in its COP function, meaning literally 'old'—*Niahosa* means 'old village'. This analysis receives empirical support from the following examples. In (i), the two words *nia hosa* are kept separate and intended for the reading 'old village'. In contrast, in (ii), they are fused together into a compound and intended for a family name.

(i)

oh	la	yon-i	no	nia	takupuyanx	'o	**nia**	**hosa**	ne	sinvi.
REAL	HAB	stay-LA	GEN	PST	PN	ABS	PST	village	LOC	PLN

'The Takupuyanx family used to live at the Sinvi's old village.'

(ii)

na	nia	atuhcu	mameoi	ta	**niahosa**	zou	bania	na	ongko-si
TOP	PST	mainly	elderly	GEN	PN	EMP	PN	ABS	name-3S.GEN

'As for Niahosa's main ancestor, his name was Bania.'

According to my language consultants, the Niahosa family were the early habitants of the old village and hence named after it.

[6] The abbreviation COSH distinguishes itself from the aspectual abbreviation COS, with the latter standing for change of state.

Unlike the other functions discussed above, *nia* in this function does not seem to have a lexical equivalent in familiar languages like English. In the contexts comparable to those like (6-7), English normally does not employ a nominal temporal expression. It is more natural to refer to the artifact in (6a) as ‘the chair’ instead of ‘the former chair’ (‘the late/ex- chair’ is even worse). The same comment also applies to (6b-c). Likewise, English typically refers to the natural object in (7) as ‘the snow’ rather than ‘the former snow’. Another two potential translations, ‘the late snow’ and ‘the ex-snow’, are utterly nonsense.

3.5 Change of function (COF)

As in its COSH function, *nia* in this function also applies to artifacts and natural kinds. However, *nia* encodes a change of function (COF) rather than a change of shape. In (8a), the bed did not break down; instead, it has changed its typical function from being a sleeping place to a place for storage. Likewise, in (8b), the tree may not change its shape, but it must involve a change of function—a change from a natural object to a building material.

(8) Artifacts and natural kinds

a.	os-’o	si-i	to	macucuma	’o	**nia**	hopo-’u
	TR-1S	put-LA	OBL	things	ABS	PST	bed-1S.POSS

‘I put things on my (former) bed.’

b.	os-’o	teai	teova	’o	**nia**	evi	to	voyu
	TR-1S	make	hut	ABS	PST	wood	GEN	PN

‘I built a hut from Voyu’s woods.’

A similar COF also applies to parts of animal. In (9a), it is the bearskin that underwent COF, a shift from animal skin to feather clothing; in (9b), there is a change from goat flesh to roasted meat.

(9) Parts of animals

a.	mi-ta	maceofx	to	**nia**	feo’u	no	cmoi.
	INTR-3S	wear	OBL	PST	fur	GEN	bear

‘He wears the bearskin clothing.’

b.	i-ta-cu	chu-a	’o	**nia**	fou-moatx’nx.
	TR-3S-COS	roast-TR	ABS	PST	meat-goat

‘He has roasted the goat meat.’

In this function, *nia* indicates that something used to have a typical function but lost it prior to the utterance time. As in its COSH function, *nia* in this function is typologically rare. It does not have a lexical equivalent in familiar languages like English.

3.6 Summary and discussion

I have shown that *nia* seems to perform various functions in Tsou, as summarized in Table 2.

Functions	Semantic description of *nia*-phrase	Terms of application	Rough English equivalents
COE	an entity that used to exist	people, animal, artifacts	*late* (for people only)
COI	an entity that used to hold a certain identity/post	terms of relation/occupation	*ex-, former*
COP	an entity that used to belong to someone	artifacts, animal	*former*, *old*
COSH	an entity that used to be in good shape	artifacts, natural kinds	None
COF	an entity that used to hold a typical function	artifacts, natural kinds, parts of animal	None

Table 2. The functions of *nia*

Among other things, an important message from Table 2 is that *nia* encodes a wider range of functions than any lexical temporal expression can do. The meaning of *nia* is rather abstract and general—it locates a state at a time prior to the utterance time. This points to the conclusion that *nia* functions like a grammatical category rather than a lexical category. Its seemingly multiple functions/meanings are arguably inferred from the contexts with which it is associated rather than its inherent senses. Consider *nia ca'hx* for example. It means 'a broken chair' in (6a) (in its COSH function) but 'a chair that used to exist' in the subsequent example (23b) (in its COE function). Most importantly, the semantic shift is pragmatically dependent and thus largely predictable: in (6a), *nia* goes with the verb of destruction *aemo'x* 'fall apart' and hence obtains the COSH reading; in (23b), *nia* patterns with an existential verb and thus derives the COE reading. In what follows, I provide further evidence in support of this observation.

4 *Nia* as a nominal tense marker

In this section, I treat *nia* as a NT marker in light of Nordlinger and Sadler's diagnostics for NT. The diagnostics were already introduced in (1), repeated below as (10).

(10) Nordlinger and Sadler (2004:778-779)

(i) **Temporal distinction**: Nouns (or other NP/DP constituents) show a distinction in one or more of the categories of tense, aspect, and mood (henceforth, TAM), where these categories are standardly defined as they would be for verbs (e.g. Crystal 1997).

(ii) **Productivity**: This TAM distinction is productive across the whole word class and not simply restricted to a small subset of forms.

(iii) **Encoding on arguments/adjuncts**: The TAM distinction is not restricted to nominals functioning as predicates of verbless clauses but is encoded on arguments and/or adjunct NP/DPs in clauses headed by verbs.

(iv) **Not as a syntactic clitic**: The TAM marker is a morphological category of the nominal word class and cannot be treated as a syntactic clitic that merely attaches phonologically to the NP/DP.

In the subsequent sections, I shall apply these criteria one by one.

4.1 A temporal distinction

As summarized in Table 2, *nia* consistently locates a state that holds of an entity at a time prior to the utterance time, with the state concerning an entity's existence, belonging, bearing an identity/post, being in a good shape, or holding a typical function. In these contexts, *nia* usually translates into 'passed-away', 'ancient', 'ex-', 'former', 'late', 'old', and the like. In this respect, *nia* denotes a past reading and contrasts with an irrealis auxiliary. As illustrated in (11a), *nia* is associated with a(n) ex-wife/husband, whereas the irrealis auxiliary *tena* is intended for a fiancé/fiancée, as in (11b).

(11) Past vs. non-past

a. 'a **nia** la vcongx-'u (na) taini (Past)
EMP PST HAB spouse-1S ABS 3S.ABS
'She/he is my ex-wife/-husband.'

b. zou taini 'o **tena**-'u vcongx (Nonpast)
EMP 3S ABS IRR-1S spouse
'He/She is my fiancé/fiancée.'

A similar temporal contrast is also attested in (12): (12a) refers to an ex-chief but (12b) a chief-to-be.

(12) Past vs. non-past

a. 'o **nia** la kingatu zou mo'o (Past)
TOP PST HAB chief EMP PN
'Mo'o is the ex-chief.

b. 'o **tena** la kingatu zou mo'o (Nonpast)
TOP IRR HAB chief EMP PN
'Mo'o is the chief-to-be.'

Thus, *nia* passes the first test of making a temporal distinction.

4.2 Productivity

Unlike the English *ex*-, *nia* is not restricted to terms of non-kinship relation and occupation; it applies to a wide variety of nominals, as summarized in Table 2. In addition, *nia* also applies to event nouns, as shown below in (13).

(13) *Nia* and event nouns

a. 'o **nia** hia mayasvi ne-noaa'o o'a mo
TOP PST NMLZ war rite long.time.ago NEG REAL
totiski ta hia-mayasvi maitan'e
same OBL NMLZ-war rite today
'The way Mayasvi was held long time ago is not the same as the way it is held nowadays.'

b. 'o **nia** hia esvxtx ne moso auyu toxsvxsvxtx, o'a
TOP PST NLMZ decide SUB REAL first discuss NEG
i-to hioa
TR-1P work(TR)
'We did not carry out the resolution made in the last meeting.'

In the case of a ritual in (13a), *nia* is likely to encode a COSH—a past ritual is different from the current one. On the other hand, in the case of a resolution in (13b), *nia* seems to represent a COF—a past resolution does not perform its expected function.

Furthermore, *nia* can even mark locative and temporal nouns, as illustrated in (14).

(14) Locative and temporal nouns

a. te-'o uh to **nia** **'o-'ochia-'u**
IRR-1S get.to OBL PST RED-tea-1S.POSS
'I will go to my old tea field.'

b. mi-'o maine'e to **nia** **taseona-si** ne moso meesi
REAL-1S return OBL PST morning-3S SUB REAL rite
'I went home in the morning on that day when the rite was held.'

This accords with the observation that *nia* behaves like a grammatical category rather than a lexical category. There is no question that *nia* passes the productivity test of NT.

4.3 Encoding on arguments

The reader might have already noticed that *nia* can be preceded by case markers of various kinds. In (9b), repeated below as (15a), the *nia*-phrase is led by the absolutive case marker *'o*; in (2a), repeated below as (15b), the *nia*-phrase is preceded by the genitive case marker *to*; in (9a), repeated below as (15c), the *nia*-phrase is marked by the oblique case marker *to*.

(15) *Nia* and case markers

a. i-ta-cu chu-a **'o** **nia** fou-moatx'nx.
REAL-3S-COS roast-TR ABS PST meat-goat
'He has roasted the goat meat.'

b. kuhcu **to** **nia** amo-'u (na) eni
fur.clothing GEN PST father-1S.POSS ABS this
'This is my deceased father's fur clothing.'

c. mi-ta maceofx **to** **nia** feo'u no cmoi.
INTR-3S wear OBL PST fur GEN bear
'He wears the bearskin clothing.'

This indicates that *ni*a-phrases normally surface as arguments.

For a few *nia*-phrases that are not case-marked, they should occur as DPs as well. Consider (11a) for instance, repeated below as (16a). In (16a), the *nia*-phrase should occur as a DP and function as a nominal predicate. Witness the fact that *nia* in this usage cannot alternate with the verbal realis auxiliary *moso*, which Huang and Huang (2003) take as a marker of nonfuture tense, as illustrated in (16b).

(16) *Nia* vs. *moso*

a. 'a **nia** (la) vcongx to mo'o (na) taini
EMP PST HAB spouse GEN PN ABS 3S.ABS
'She is Mo'o's ex-wife.'

b.* 'a **moso** (la) vcongx to mo'o (na) taini
EMP REAL HAB spouse GEN PN ABS 3S.ABS
Intended for 'She is Mo'o's ex-wife.'

It is thus concluded that *nia* is nominal rather than verbal, despite its temporal reading. The observation receives further support from examples such as (13a-b), repeated below as (17a-b), where *nia* requires that the co-occurring verb must be nominalized. As noted in M. Chang (2002), the morpheme *hia* is a syntactic nominalizer that turns a verb into a noun.

(17) *Nia* and nominalized verbs

a. | ’o | **nia** | *(**hia**) | mayasvi | ne-noaa’o | o’a | mo |
|---|---|---|---|---|---|---|
| TOP | PST | NMLZ | war rite | long.time.ago | NEG | REAL |

totiski	ta	hia-mayasvi	maitan’e
same	OBL	NMLZ-war rite	today

‘The way Mayasvi was held long time ago is not the same as the way it is held nowadays.’

b. | ’o | **nia** | *(**hia**) | esvxtx | ne | moso | auyu |
|---|---|---|---|---|---|---|
| TOP | PST | NLMZ | decide | SUB | INTR.REAL | first |

toxsvxsvxtx,	o’a	i-to	hioa
discuss	NEG	TR-1P	work(TR)

‘We did not carry out the resolution made in the last meeting.’

It is now evident that *nia* passes the Encoding-On-Argument test.

Before moving on to the next diagnostic, I would like to point out that while *nia* freely patterns with arguments, it does not go with locative and temporal adjuncts. As in (18), *nia* is not compatible with the locative and temporal adjuncts *ne ’o’ochia* and *ne taseona*.

(18) *Nia* incompatible with adjuncts

a.* | te-’o | uh | **ne** | **nia** | **’o-’ochia-’u** |
|---|---|---|---|---|
| IRR-1S | get.to | LOC | PST | RED-tea-1S.POSS |

‘I will go to my old tea field.’

b.* | ’a | mo-’u-cu | bonx | ne | **nia** | taseona |
|---|---|---|---|---|---|
| EMP | REAL-1S-COS | eat(INTR) | PST | PST | morning |

‘I have eaten this morning.’

Compare (18a-b) with (14a-b). The lesson is that the sentences will be grammatical once the locative/temporal marker *ne* is replaced by an oblique case marker. While I have no clear idea about the mechanism underlying the contrast, I think that it should have something to do with the argumenthood of the *nia*-phrase: a *nia*-phrase that receives oblique case-marking is identified as an argument but one that receives locative case-marking as an adjunct. Another way out is to replace *nia* with a realis auxiliary, as in (19).

(19) *Nia* replaced by *mo*

a. | ’a | mo-’u-cu | bonx | ne | **mo** | taseona |
|---|---|---|---|---|---|
| EMP | REAL-1S-COS | eat(INTR) | SIB.PST | REAL | morning |

maitan’e
today

‘I have eaten this morning.’

b. | mi-’o | uh | ne | tfuya | ne | **mo** | taseona |
|---|---|---|---|---|---|---|
| REAL-1S | get.to | LOC | PLN | PST | REAL | morning |

‘I went to Tfuya in the morning.’

This departs from Nordlinger and Sadler’s third test, where arguments and adjuncts are treated alike.

4.4 Not as a syntactic citic

Unlike the English reduced form of the future tense auxiliary *’ll*, *nia* does not behave like a clitic. Despite being phonologically unstressed, *nia* does not attach to the highest syntactic head of its phrase. Note that it patterns with elements of various kinds and its neighboring elements are not uniformly syntactic heads, as shown above. Moreover, there is evidence that *nia* surfaces as a syntactic head by itself. As shown in (20a), *nia* can attract the aspectual clitic *n'a*, just like typical syntactic heads such as the irrealis auxiliary *te*, as in (20b).

(20) *Nia* can host a clitic

a.	mi-cu	aemo'x	'o	**nia-n'a**	imucu	
	REAL-COS	fall.apart	ABS	PST-DT	PLN	

'The few people who used to live in Imucu have scattered around.'

b.	**te-ko-n'a**	tuocos-neni	a'o	no	huphina-si	pohe-taini
	IRR-2S-DT	ask-BA	1S.ABS	OBL	price-3S.GEN	corn-3S.GEN

'You should ask the price of his corns for me.'

It is obvious that *nia* also meets the fourth criterion.

4.4 Summary

We have shown that *nia* satisfies all of the four criteria for NT proposed by Nordlinger and Sadler (2004). This leads to the conclusion that *nia* should occur as an instance of NT. Specifically, *nia* should represent past tense within a determiner phrase (DP), anchoring a state denoted by the DP prior to the utterance time. In the next section, I take a close look at the syntactic structure of *nia*-DPs.

5 *Nia* as INT head

5.1 Nia as T

Given its NT-encoding and clitic-hosting, *nia* presumably heads a tense projection (TP) within a DP. Note also that *nia* precedes the habitual aspectual marker *la*, as shown in (4), repeated below as (21).

(21) Terms of relation/occupation

a.	'a	**nia**	la	vcongx	to	mo'o	(na)	taini	
	EMP	PST	HAB	spouse	GEN	PN	ABS	3S.ABS	

'She is Mo'o's ex-wife.'

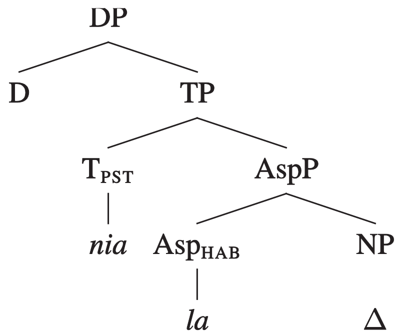
b.	'a	**nia**	la	ngocoo	(na)	taini
	EMP	PST	HAB	township.chief	ABS	3S.ABS

'He is an ex-township chief.'

This suggests that *nia* should be situated above an aspectual phrase (AspP), as schematized below:[7]

[7] For the time being, I assume with Tang (2006: 965) that a possessor is either generated in spec of NP or adjoined to N' instead of being merged high above as D in Formosan languages (cf. Cardinaletti 1998 and Alexiadou et al. 2010). This will account for, among other things, the fact that a bound possessor attaches to the head noun rather than the T head, as in (2a), (5a,b), (8a), (11a), and (14a) above.

(22) The syntactic position of *nia*



It should be noted hat *nia* is not merged in D. Although most of the *nia*-phrases are definite, indefinite ones are also possible, as illustrated in (23a-b).

(23) *Nia* and indefinites

a. pan to **nia** la huyu no fuzu tan'e
there OBL PST HAB trail GEN wild.pig here
'There used to be wild pig trails here.'

b. pan to **nia** ca'hx tan'e
there OBL PST chair here
'There used to be a(n) old/broken chair here.'

In other words, *nia*-phrases can be either definite or indefinite. This indicates that *nia* does not encode definiteness and hence does not represent D. This observation is echoed by the fact that *nia* can optionally co-occur with a demonstrative, as in (24).

(24) *Nia* and demonstratives

a. mi-cu aemo'x 'e **nia** ca'hx (**eni**)
REAL-COS fall.apart ABS PST chair this
'This chair already fell apart.'

b. mi-cu kxhtosx 'e **nia** ufi (**eni**)
REAL-COS harden ABS PST rice cake this
'This rice cake has become stiff.'

Neither does *nia* represent Case, since it is usually preceded by a case marker, as already illustrated extensively above.

5.2 Nia as INT head

Recall that NT is of two types: INT vs. PNT. The question is which type of NT *nia* represents. My data indicate that *nia* basically represents INT rather than PNT.

Note that the tense interpretation of *nia* is typically restricted to the noun phrase it is associated with. Thus, *nia* can pattern with a matrix irrealis auxiliary, despite its past tense reading, as illustrated in (25a-b).

(25) *Nia* and matrix irrealis

a. **teav'a** payo'-a 'o **nia** hia toxsvxsvxtx
NEG.IMP(TR) forget-TR ABS PST NMLZ discuss
'Don't forget the resolution of the last meeting.'

b. **ta-'u** tupuz-a si mi-cu kuzo ci **nia** ca'hx
IRR-1S burn-TR ABS REAL-COS bad REL PST chair
'I will burn the broken chair.'

This suggests that the tense interpretation of *nia* is internal to its DP and that it does not affect the temporal reading of the matrix clause.

However, it is noteworthy that *nia* can go beyond its DP and scope over the whole sentence once the sentential temporal auxiliary is missing. Existential constructions are a case in point. Existential constructions are notoriously known as one of the very few exceptions that do not start with a temporal auxiliary in Tsou (Zeitoun 2005, H. Chang 2009, among others). Surprisingly, *nia* seems to behave like an instance of PNT in existential constructions—it determines the temporal interpretation of the sentence. As in (26a-b), the two existential sentences are unambiguously in past reading with *nia*: (26a) means 'there used to be wild pig trails' rather than 'there are old wild pig trails'; (26b) means 'there used to be a broken chair' rather than 'there is a broken chair'.

(26) *Nia* and PNT

a. pan to **nia** la huyu no fuzu tan'e
there OBL PST HAB trail GEN wild.pig here
'There used to be wild pig trails here.'

b. pan to **nia** ca'hx tan'e
there OBL PST chair here
'There used to be a(n) old/broken chair here.'

In this case, *nia* seems to be representing PNT instead of INT. It is not immediately clear at this point how the exception comes about. I leave it for future investigation.

6 Conclusion

It has been established in the preceding sections that *nia* functions as a marker of INT and heads a DP-internal TP. More specifically, *nia* overtly encodes past tense in the nominal system, with the nonpast tense morphologically unmarked. These findings have far-reaching typological and theoretical implications.

First, the findings lead to a conclusion that Tsou is a language like Somali (Lecarme 2004, 2008) that exhibits a morphological NT. In this regard, Tsou differs typologically from familiar languages like English. In the Formosan literature, there was no report of NT in the past. This study represents the first attempt of its kind. It is desirable to investigate whether other Formosan languages are also of this morphological NT type.

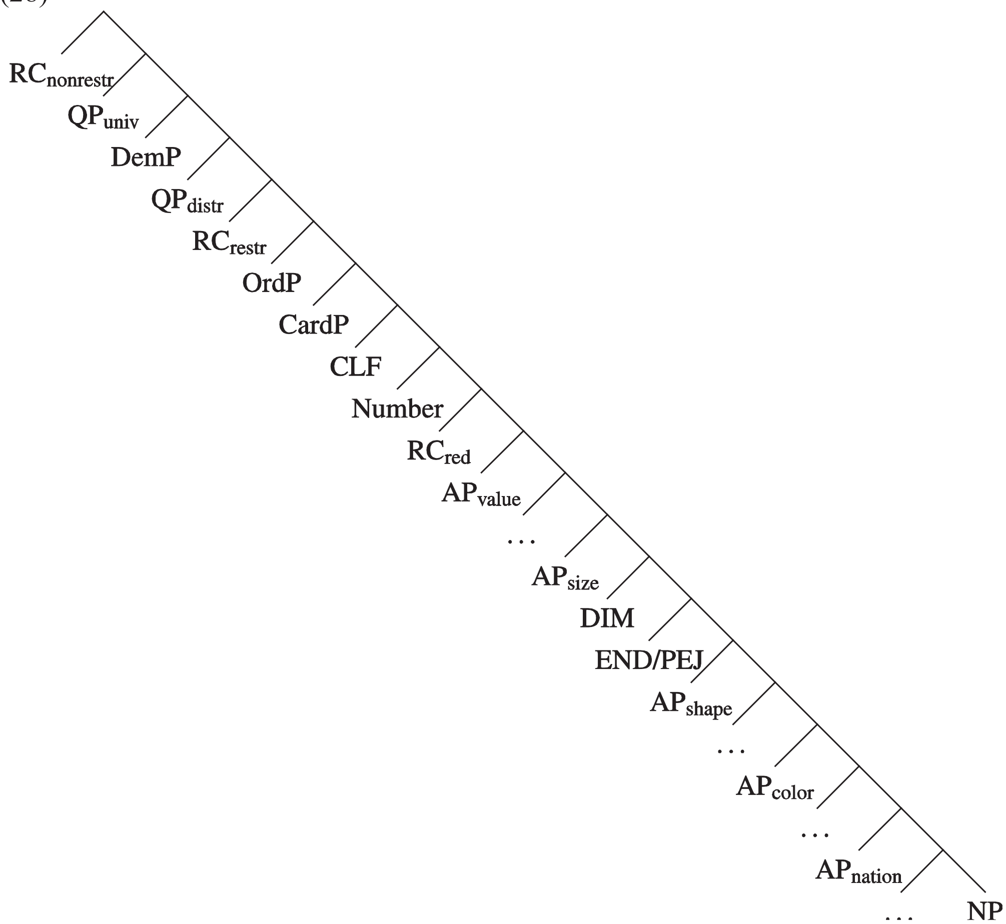
Second, Cinque (2005, 2011) advocates a universal nominal structure, as schematized in (28) on the next page.

What concerns us is that there is no TP projection in the structure. However, our findings strongly suggest that TP might be built into the universal nominal structure. It has been illustrated above that *nia* is situated below D and DEM (demonstrative). There is further evidence that *nia* should be placed above number phrase (NumP) and restrictive relative clause (RC_{restr}). As in (27), *nia* precedes rather than follows the numeral relative clause *yuso ci*:

(27) *Nia* before a numeral relative clause

pan to **nia** **yuso** **ci** ca'hx tan'e
there OBL PST two REL chair here
'There used to be two chairs here.'

(28)



Given the widely observed DP-CP (complementizer phrase) parallelism, D is expected to take TP as its complement on a par with C. Along this line of thought, our discovery of a DP-internal TP in Tsou is a pleasantly welcome result.

Finally, let us discuss what we should go next. In section 4.3, it has been noted that *nia* distinguishes arguments from adjuncts. As a matter of fact, Tsou adjuncts have their distinct temporal markings from *nia*, that is, *ne* versus *ho* (Pan 2010, among others). As in (29a-b), *ne* encodes a past event but *ho* a nonpast (typically future) event.

(29) *Ne* vs. *ho* = past vs. non-past

a.	mi-'o	uh	ne	maibayx	**ne**	taseona
	REAL-1S	get.to	LOC	Chiayi	PST	morning
	'I went to Chiayi this morning.'					
b.	ta-'u	uh	ne	maibayx	**ho**	taseona
	IRR-1S	get.to	LOC	Chiayi	NPST	morning
	'I will go to Chiayi in the morning.'					

Note also that a temporal concord between the temporal adjuncts headed by *ne/ho* and the matrix auxiliary must be observed—the past *ne* must pattern with a realis auxiliary and the nonpast *ho* must go with an irrealis auxiliary. Otherwise, ungrammaticality will arise, as in (30a-b).

(30) Temporal concord constraint

a.* **ta-'u** uh ne maibayx **ne** taseona
IRR-1S get.to LOC Chiayi PST morning
Intended for 'I will go to Chiayi this morning.'

b.* **mi-'o** uh ne maibayx **ho** taseona
REAL-1S get.to LOC Chiayi NPST morning
Intended for 'I went to Chiayi this morning.'

This implies that the temporal readings induced by *ne/ho* are sentential/propositional rather than restricted to their own phrases. It is very likely that they might involve PNT. Further inquiry along this line of research is desirable.

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Affiliation

Henry Y. Chang
Institute of Linguistics
Academia Sinica, Taiwan
henryylc@gate.sinica.edu.tw

En deçà de la frontière de Frege?

Isabelle Charnavel · Dominique Sportiche*

Introduction

We discuss French sentences such as (1a), the English counterpart of which, in (1b), is discussed in Keenan (1992):

(1) a. Différents élèves ont répondu à différentes questions
b. Different pupils answered different questions

We propose that they have a wider range of interpretations than assumed in Keenan (1992), which bears on the question of the reducibility of functions denoted by paired *different* as above.

1 Reducibility

The discussion around this kind of sentence centers on the reducibility of some type 2 functions to the composition of two type 1 functions. What does this mean?

To think about this question, assume informally that a type 1 function is a function mapping a n dimensional space into an n-1 dimensional space, a type 2 function is a function mapping a n dimensional space into an n-2 dimensional space, and more generally:

a type p function is a function mapping an n dimensional space, $n \geq p$ into an n-p dimensional space.

For example, to use geometric intuition (in ordinary space), the inside of a sphere is a three dimensional object. Intersecting it with a straight line going through it (yielding all the points of the line that are inside the sphere) is a type 2 operation, since the result is a one dimensional object.

Is the function "intersect with a straight line" in ordinary space reducible to the composition of two type 1 functions?

The answer is positive: a straight line can be seen as the intersection of two planes P1 and P2. Intersecting the sphere with the first plane P1 and then intersecting the result with the second plane P2 is going to yield exactly the same result as intersecting the sphere with the straight line. But, crucially, intersecting the sphere with a plane is a type 1

* A Ed, pour toutes ces années de conversations stimulantes and sheer fun, avec juste un brin de géométrie.

operation as it maps the inside of the sphere (a 3 dimensional object) to the points on the plane that are inside the sphere (a 2 dimensional object). And intersecting this 2 dimensional object with the other plan is also a type 1 operation as it will yield the points on the line inside the sphere (a 1 dimensional object).

In the sentence, *John admires Mary*, the function F= (John, Mary) maps the binary relation *admire* (which is a set of pairs, that is 2-dimensional) to true (or to false), if John admires Mary (or not). True (or false) is of dimension zero (it is a constant). So F is of type 2.

F is reducible as it can be seen as the composition of two functions: the function M=(Mary) which maps the binary relation *admire* (a set of pairs, 2-dimensional) to the set of people who admire Mary (a set of individuals, 1-dimensional); and the function J=(John) which maps a set of individuals (e.g. the set of people who admire Mary) to true – 0-dimensional – if its intersection with the set {John} is not empty, (and to false otherwise).

In other words, we can write: F (admire) = J [M [admire]].

Intuitively, if we think of the relation *admire* as a set of pairs (x,y), a function of type 2 on *admire* will be reducible if, in the subset of pairs (p, q) it maps to true (or to false), the choice of a q does not depend on the choice of a particular p. In other words, there should be a p-independent way, a general rule, to pick the q associated with a given p.

Keenan (1992) convincingly shows that there are unreducible type 2 functions in English (and by extension in some other languages) but we will suggest that this is too strong in the particular kind of case illustrated by sentence (1a).

According to Keenan (1992: 202), a sentence such as (1) would "mean (on its weakest reading) that there are at least two pupils and for all distinct pupils x, y, the questions that x answered are not exactly the same as the questions y answered": accordingly, the iterated use of *different* guarantees (minimally) a one-to-one match between pupils and subsets of questions (as well as the existence of at least two pupils). Call this interpretation *Keenan's weakest reading*. Thus to know which questions were answered, we need to know which pupil we are talking about: different pupils and different questions are not interpreted independently. The discontinuous (different pupils … different questions) mapping the binary relation *admire* to true (or false) is thus an unreducible type 2 function.

Note that if Keenan's weakest reading is indeed the weakest, sentence 1 could in principle be true if there were 3 pupils and 2 questions in total, but not if there were 4 pupils and 2 questions: this is because the power set of a set or cardinality is $2^2=4$; since each student answered at least one question, there should be 4 non empty distinct subsets of questions to distinguish the 4 students which is not the case.

Although we will not elaborate here, one reason that sentences such as in (1) is significant is that unlike many (all?) other cases of unreducible type 2 functions, this case, if it is indeed unreducible, can't (at least can't simply) be handled in terms of ordinary scope and binding relations: the grammatical descriptive apparatus must be enriched beyond (the equivalent of) variable binding.

We will, for French at least, disagree with Keenan (1992) regarding what the weakest reading of (1a) is. In fact we argue that the meaning of (1a) is much less specified, allowing all sorts of interpretations one of which is Keenan's weakest reading. We only discuss French, but we believe (from informal surveys) that this holds of English too.

2 Plurals

First let us make a detour and look at the following French sentence:

(2) a. Ils ont dit qu'ils étaient malades
b. They said that they were sick

It can have the following range of interpretations:

(i) each man said that he himself was sick, or
(ii) each man said that all the men were sick, or
(iii) each man said that all the other men were sick, or
(iv) each man said that some other men were sick or
(v) each man said that some set of men (including himself or not)

In other words, (2) can be read as e.g. object distributive reflexive as in (i), object non distributive as in (iii), strong or weaker reciprocal as in (ii) or (iv) and many intermediate situations as in e.g. (v). And different contexts can make certain interpretations more salient than others. The following sentence :

(3) a. Ils ont promis de ne pas être à leurs enterrements
b. They promised not to be at their burials

makes the reading corresponding to (iii) most salient, that corresponding to (i) a joke and that corresponding to (v) not easily accessible.

This behavior seems general when plurals are involved. Thus, the same type of ambiguity can be found in what is sometimes described as ambiguous reflexive/reciprocal constructions in French:

(4) a. Les enfants se regardent (disons, dans un miroir)
b. The children are looking at themselves (say, in a mirror)

Such a sentence can also be read as e.g. object distributive reflexive as in (i), object non distributive as in (iii), strong or weaker reciprocal as in (ii) or (iv) and many intermediate situations as in e.g. (v) :

(i) each child is looking at himself, or
(ii) each child is looking at all of the other children, or
(iii) each child is looking at the whole group of children, or
(iv) each child is looking at some other children, or
(v) each child is looking at a set of some children (including himself or not).

If we change the verb to *jalouser* (feel jealous towards)

(5) a. Les enfants se jalousent
b. The children are feeling jealous of themselves/each other

The interpretations corresponding to (ii) or (iii) above clearly remain. That corresponding to (i) seems unavailable, while judgments are less clear for (iv) and (v). The unavailable or non salient interpretations have in common that the denotation of the object overlaps with that of the subject, in other words, there is a subject/object disjoint reference effect.

How should this be coded? The only difference between (4a) and (5a) is a lexical one (*jalouser* vs. *regarder*) and *jalouser* is not intrinsically (conceptually) antireflexive, although it is unusual to be jealous of oneself. This suggests that which interpretation is rejected is more a matter of pragmatics than of literal meaning. If true, we should be able to set up a context, linguistically or otherwise allowing the seemingly unavailable interpretations. An indeed, it is quite possible for the subject and object of *jalouser* or of *jealous* to be coreferential, as e.g. in the sentences below, which can be read like (i) above:

(6) a. Comment peuvent-ils se jalouser (eux-mêmes)? Est-ce une marque de folie ?
b. How can they be jealous of themselves? Is this a symptom of craziness?

We conclude that such constructions as (4a) or (5a) are not ambiguous between reflexive and reciprocal interpretations. They involve two coreferent plurals (say the subject and *se*) and yield the many interpretations the co-occurrence of two plurals allow.

Following Beck (2000), we can model what is happening in terms of cover. Under such an approach, the difference between these interpretations is due to the availability of different covers where a cover is a set of subsets of a set S, the union of which subsets yields S; see Schwarzschild, 1996, for more details). Indeed many possible covers of the set of children are available, some being pragmatically selected based on salience: depending on what is relevant in the context, the children can be divided into different kinds of subsets (the classification can be based on different criteria, e.g. the age of children, their heights, their clothes, or along the dimension of the children themselves {children looked at by one child, children looked at by another child, etc...}, or indeed totally arbitrary covers corresponding e.g. to a particular perceived situation as children looking at themselves in some arbitrary way in a mirror (one looking at himself, another looking at two other children, a third at himself an another child, etc…).

3 Différent … différent…

Let us now come back to (the French version of) (1). Consider first such sentences as below, each with only one instance of *différent*, in French in (7a), its English counterpart in (7b), and paraphrases in (7c) and (7d):[1]

(7) a. Différents élèves ont répondu
b. Different pupils answered
c. Pupils who are different from each other answered
d. A variety of pupils answered

[1] In French, the adjective *différent* could also be post nominal (with a pural indefinite article: *des étudiants différents*) with the same reading. However, a post nominal *différent* would also allow so-called external readings in which the pupils, say, are different from some entity introduced in the discourse. External readings are not relevant here, but see Charnavel (2012) for recent discussion.

(8) a. J'ai répondu à différentes questions
b. I answered different questions
c. I answered questions which were different from each other
d. I answered a variety of questions

These are perfectly fine sentences, e.g. appropriate (although not very informative) answers to questions such as Who answered? or What happened at your interview? respectively. Given these paraphrases we would expect sentence (9a) (=1a) with two instances of *différent* to have the meaning indicated in (9b) or (9c):

(9) a. Différents élèves ont répondu à différentes questions
b. Pupils different from each other answered questions different from each other
c. A variety of pupils answered a variety of questions

Even though it may not be the most immediately salient reading, such a meaning is without question available. In fact it is difficult to see how this meaning could be blocked as it is one arising from the normal, compositional interpretive rules.

Given that such a meaning is available, where the subject and the object are interpreted independently of each other, and given that both the subject and the object are plurals (there should be at least two pupils - as Keenan notes - and two questions, these properties possibly being implicatures, see Spector, 2006) this leads, as we just saw, to many different interpretations depending on the covers chosen.

What would correspond to Keenan's weakest reading, is the choice of a cover along the dimension of the pupils {questions answered by one pupil, questions answered by another pupil, etc..} just in case no two pupils answered exactly the same questions.

But this is by no means the only cover available. Weaker (and also stronger) interpretations than Keenan's weakest reading seem to us available in ordinary usage for such sentences. For example, in a context in which there are 17 pupils and 4 questions, sentence (9a) seems to us to be an appropriate answer to the question "who answered what" even if two pupils answered exactly all the same questions. In fact, it seems fine (although perhaps not as informative as one could wish on the part of the speaker) if any number of students answered exactly all the same questions including the case in which all of them answered exactly the same questions.

Conclusion

If this is right, the (different… different) type 2 function is reducible as there is no semantic dependency between what questions are answered and who answers them. If we are right, such functions as (différent .. différent …) in fact lie "en deçà" of the Frege boundary.

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Affiliation

Isabelle Charnavel
Department of linguistics
Harvard University
icharnavel@gmail.com

Dominique Sportiche
Department of Linguistics, UCLA
Institute for the Study of Cognition, Institut Jean Nicod
École Normale Supérieure, Paris
Dominique.Sportiche@gmail.com

So how long have each other known us anyway?

Bernard Comrie

Or, if myself were to express me in more normal English: So how long have we known each other anyway? – if I were to express myself in more normal English. It has long been known that in reflexive and reciprocal constructions, it is usual cross-linguistically for the antecedent to be higher on the hierarchy of semantic roles (agent > patient; experiencer > stimulus) than the anaphor, as in English examples (1) and (2), as opposed to the ungrammatical (3) and (4), and indeed this has even been hypothesized to be a universal (e.g. Haspelmath 2007: 2096, among many others).

(1) If I were to express myself in more normal English ...
(2) So how long have we known each other anyway?
(3) *If myself were to express me in more normal English ...
(4) *So how long have each other known us anyway?

For instance, in Tagalog (following Schachter 1977: 292–293), whether one uses actor-focus as in (5) or directional-focus as in (6), 'grandfather' as experiencer must be antecedent rather than the stimulus reflexive pronoun. The configuration found in (1) and (2) will henceforth be referred to as "standard", that found in (3) and (4) as "nonstandard".

(5) Nag-aalala ang lolo sa kaniyang_sarili.
AF-be.worried F grandfather D REFL
(6) In-aalala ng lolo ang kaniyang-sarili.
DF-be.worried A grandfather F REFL
'Grandfather is worried about himself.'

The Tsezic languages, a branch of the Nakh-Daghestanian (East Caucasian, Northeast Caucasian) language family spoken in the west of the Republic of Daghestan in the Russian Federation, seem to provide clear counterexamples to this generalization (Comrie et al. 2011). Thus, in Bezhta, (7) is the only way to express this particular reciprocal, i.e. only the nonstandard version is possible..

(7) pat'imat-na rasul-na sidi<l>_hosso b-āc-ca.
Patimat-and Rasul-and RECIP<LAT> HPL-love.PL-PRS
'Patimat and Rasul love each other.'

In an experiencer construction like (7), the experiencer appears in the lative case, the stimulus in the absolutive (with no case suffix), as in (8), so that in (7) it is clear that the antecedent 'Patimat and Rasul' is stimulus (in the absolutive), while the reciprocal pronoun is experiencer (in the lative).

(8) di-l kid y-ac-ca.
me-LAT girl II-love-PRS
'I love the girl.'

Table 1 (adapted from Comrie et al. (2011), including some additional Tsez material collected by Diana Forker) shows the possibilities for experiencer and stimulus as antecedent or anaphor in reflexive and reciprocal constructions in the four Tsezic languages on which we have sufficient data. (For the fifth language, Hunzib, we lack sufficient data to be able to draw reliable conclusions).

	Reflexive		Reciprocal	
	Antecedent	Reflexive	Antecedent	Reflexive
Tsez	Stim	Exp	Stim	Exp
	Exp	Stim	(Exp	Stim)
Hinuq	Stim	Exp	Stim	Exp
	Exp	Stim	Exp	Stim
Khwarshi	Stim	Exp	Stim	Exp
	Exp	Stim	(Exp	Stim)
Bezhta	Stim	Exp	Stim	Exp
	Exp	Stim	*	*

Table 1: Reflexive and reciprocal constructions with experiencer predicates

In the table, a simple entry of the form "Stim Exp" or "Exp Stim" means that the given combination is possible. An entry in parentheses means that the combination is possible but less preferred or subject to further restrictions. An asterisk means that the combination is not possible. It is clear from the table that the nonstandard configuration, where the semantic role lower on the hierarchy, namely stimulus, is antecedent, is always possible, while the standard configuration is sometimes possible, sometimes possible but less preferred, and in one case (Bezhta reciprocals) disallowed. The standard configuration is more likely in reflexive than in reciprocal constructions, a fact which I simply note without further discussion.

From the detailed interaction Ed Keenan and I had in the King's College Research Centre in the period 1970–1974 – for those interested in the answer to the question posed in the title, we first met a year before, en route separately to Madagascar and Russia – I received at least two take-home messages for which I am eternally grateful. The first is that linguistic typology constitutes a scientifically insightful approach to language, and I think neither Ed nor the rest of the readership of this volume will need further explication of what this meant for me. The other is the importance of studying the logic behind the semantics of natural language expressions, something which is much less visible in my work, in part because it is an area in which I do not consider myself particularly competent, but something that nonetheless continues to haunt me. I therefore present the typological contribution of nonstandard reflexive and reciprocal constructions to Ed in the hope that he will be able to run with their integration into the semantics-logic interface.

Perhaps a couple of further observations are worth making before turning over the question. First, the reflexive and reciprocal pronouns do seem to be noun phrases. They decline in the full range of cases that are available to other noun phrases with human reference. So in Bezhta example (9), with the nonstandard configuration, the reciprocal pronoun is in the ergative case, as befits the subject/agent of a transitive verb.

(9) kid-na öžö-nä sid<i>_hos b-iyaƛ’e-yo.
girl-and boy-and RECIP<ERG> HPL-kill.PL-PST
‘The girl and the boy killed each other.’

Thus one cannot, for instance, claim that the reflexive or reciprocal pronouns are adverbs (of the type ‘reciprocally’ or ‘jointly’) rather than noun phrases.

Second, the constituent order properties of the examples are interesting. In the Tsezic languages in general, an argument higher on the hierarchy of semantic roles will precede one lower, i.e. agent precedes patient, experience precedes stimulus (as in (8)). However, the alternative order is also possible. In reflexive and reciprocal constructions, whether one uses the nonstandard or the standard configuration, it is usual for the antecedent to precede the anaphor, which in the case of the nonstandard configuration means that the stimulus will precede the experiencer (as in (7)), that the patient will precede the agent (as in (9)). However, again, the alternative order is also possible, especially in the non-standard configuration; in the standard configuration, however, the order with the anaphor before the antecedent may be less preferred or even rejected.

Finally, one suggestion that has been made is that the nonstandard configuration is purely a morphological phenomenon. I am not sure how the details would work out, but it is alternative approach that should be borne in mind.

Abbreviations

A	actor (as used in Philippine linguistics)
AF	actor-focus (as used in Philippine linguistics)
D	directional (as used in Philippine linguistics)
DF	directional-focus (as used in Philippine linguistics)
ERG	ergative
Exp	experiencer
F	focus (as used in Philippine linguistics)
HPL	human plural
II	gender II (incl. human female) singular agreement prefix
LAT	lative
PL	plural
PRS	present
PST	past
RECIP	reciprocal
REFL	reflexive
Stim	stimulus

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Affiliation

Bernard Comrie
Max Planck Institute for Evolutionary Anthropology, and
University of California, Santa Barbara
comrie@eva.mpg.de

Intensional quantifiers

Robin Cooper

Introduction

In their classic paper on quantifiers Keenan and Stavi (1986) argue that determiners like *many* and *few* represent intensional relations between properties. In previous work using the rich type theory TTR (type theory with records), for example, Cooper (2011), I have introduced quantifiers as a relation between intensional properties but reduced this to the classical extensional relations between sets. This seems to be missing an opportunity offered by the intensional type theory. However, it seems that the nature of the intensionality in these examples is different from that to be found in attitude reports.

1 Keenan and Stavi's original examples

Keenan and Stavi (1986) discuss the examples in (1).

(1) a. Many lawyers attended the meeting this year
    b. Many doctors attended the meeting this year

In a situation where the set of lawyers attending the meeting this year is identical with the set of doctors attending the meeting this year it is still possible for the two sentences to get different truth values if for example 1000 doctors normally attend the meeting but only 500 show up this year making (1b) arguably false whereas only 20 lawyers normally attend the meeting and this year's showing of 500 is exceptionally many, making (1a) arguably true.

2 Treating quantifiers in TTR

TTR (type theory with records, Cooper 2012) is a *rich* type theory which adopts many ideas and techniques from Martin-Löf type theory, while at the same time using a more classical set-theoretic foundation familiar to traditional formal semantics. The "richness" lies in the fact that the type theory provides a greater variety of types than, for example, Montague's type theory. In addition to types for basic ontological classes such as individuals, sets and functions of various kinds, a rich type theory provides types corresponding to classifications of objects including, in the case of TTR, also situations. Fundamental to this kind of type theory is the notion of *judgement* that an object a is of type T, $a : T$. Types, in particular types of situations, may play the role of propositions, following the so-called "propositions as types" dictum. Truth corresponds to a type being non-empty (having a witness), that is the set $\{a \mid a : T\}$ for a type T is not the empty set. Types are objects in their own right which are not defined in terms of their extension. That is, $\{a \mid a : T_1\} = \{a \mid a : T_2\}$ does not imply $T_1 = T_2$. Types can be constructed from other objects and may be structured objects with components. Predicates are a kind of type constructor. Thus if a and b are of type *Ind(ividual)*, hug(a,b) could be regarded as the type of situation in which a hugs b. It will be true that a hugs b just in case this type is non-empty.

Following this view, we can treat determiner relations, as predicates, q, which are type constructors which combine with two properties, P_1, P_2 to make a type, $q(P_1, P_2)$. Properties are treated basically as functions from individuals to types.[1] An individual *a has a property P* just in case $P(a)$ is a non-empty type. Thus the hyperintensionality of types is transmitted to properties: if it is the case that for any a, a has P_1 iff a has P_2 this does not imply that $P_1 = P_2$. However, in Cooper (2011) and other preceding work I have not exploited this intensionality but rather shown how this type-theoretic view of quantifiers can be related to classical extensional generalized quantifier theory. That is, a type $q(P_1, P_2)$ is required to be non-empty just in case the classical extensional quantifier relation corresponding to q holds between $\{a \mid a \text{ has } P_1\}$ and $\{a \mid a \text{ has } P_2\}$. This is obviously missing an opportunity for the analysis of intensional quantifier relations.

3 Is there just one kind of intensionality?

The claim we make for the kind of intensionality offered by this type theory is that it does not fall prey to the problems of the classical possible worlds approach in that two distinct types can be logically equivalent. It shares this with property theory and other theories which decouple propositions (here modelled as types) from sets of possible worlds. This yields a finer grain for intensional objects but there is always the question of whether the result is too fine grained. Our claim is that you are in a better position starting with an intensional system with too fine a grain rather than one with too coarse a grain. If the grain is too fine you can always look for equivalence classes which will correspond to what you need for semantic analysis. If you start from a system with too coarse a grain there is nothing you can do except add in additional structural objects to make the distinctions which are not there. (This is what has happened in various approaches to structured meanings.)

However, a problem seems to arise with fine grained intensionality when it comes to intensional quantifier relations. Consider a variant of example (1) where the noun arguments are logically equivalent.

(2) a. Many large prime numbers have been discovered by computer generation
    b. Many large numbers divisible only by themselves or one have been discovered by computer generation

It seems to me hard to imagine a situation where (2a) and (2b) have different truth values. At the very least it has a different feel to it than the doctors and lawyers example in (1). No such problems arise in a corresponding example involving an attitude verb.

(3) a. Sam believes that a large prime number has been discovered by computer generation

[1] Actually, in Cooper (2011) and elsewhere in TTR a property takes a record containing an individual to a record type, but the complication with records and record types is not relevant to the present discussion.

b. Sam believes that a large number divisible only by itself or one has been discovered by computer generation

It is easy to imagine a situation where (3a) and (3b) have different truth values. This causes me to speculate that there is not just one "intensional grain" at work in the language. One approach to making the distinction between the two kinds of intensionality could be based on the analysis of *many* and *few* in Lappin (2000) which involves crucial reference to normative situations which would not be used in the analysis of intensionality for the attitudes case. I would, however, prefer a commitment to normative situation types rather than normative situations. It seems like this should be related to work that Lappin and I (together with Simon Dobnik and Staffan Larsson) have in progress on probabilistic type theory.

Conclusion

The example we have seen here is one where the grain seems different for intensional quantifier relations and attitude relations. I wonder if in addition the individuation of intensional objects can depend on context and the knowledge resources available to agents. I would like to be able to argue that a system like type theory which introduces a basic very fine grain and then requires you to create equivalences to coarsen the grain is in a better position to deal with varying grains than a theory that commits you to a coarse grain from the beginning.

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Affiliation

Robin Cooper
Department of Philosophy, Linguistics and Theory of Science
University of Gothenburg
cooper@ling.gu.se

On the position of interrogative phrases and the order of complementizer and clause

Matthew S. Dryer

Earlier versions of generative grammar, dating back to Bresnan (1970), proposed that wh-movement moves interrogative phrases into the position of complementizers. While the dominant view in generative grammar since Chomsky (1986) has been that wh-movement is movement into Spec of CP, the purpose of this paper is to examine typological evidence bearing on the earlier view, of movement into the position of complementizers. It investigates crosslinguistic patterns in the position of complementizers and the position of wh-phrases to determine whether there is any correlation between the two. While this does not appear to impact the more recent view of movement to Spec of CP, the patterns described here are of possible independent interest, both to generative linguists and to typologists.[1] I argue that while the typological evidence initially appears to support the idea of a relationship between these two word order parameters, on more careful consideration, I conclude that there is no evidence of a correlation.

Crosslinguistically, we find some languages which normally place wh-phrases at the beginning of sentences, as in English, while other languages normally leave such phrases in situ (Dryer 2011), as in (1) from Khwarshi (a Daghestanian language spoken in Russia).[2]

(1) Khwarshi (Khalilova 2009: 461)

obut-t'-i	uža-l	hibo	b-ez-i?
father-OBL-ERG	boy.OBL-LAT	what	III-buy-PAST.WITNESSED

'What did the father buy his son?'

There is a third type of language that usually places wh-phrases at the beginning of sentences, though it is apparently optional. For example, Curnow (1997) reports that interrogative phrases are normally initial in Awa Pit, a Barbacoan language of Ecuador and Colombia, as in (2a), but occasionally are non-initial, as in (2b).

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[1] In am indebted to Guglielmo Cinque for helping clarify for me the claims of generative grammar relevant to this paper.

[2] In some verb-final languages, especially in Asia, but apparently not common outside of Asia, it is common for wh-phrases to appear immediately before the verb. In this paper, I will treat such languages as languages with in-situ wh-phrases. In effect, what I refer to as languages with in-situ wh-phrases are simply languages which do not have a rule that normally places wh-phrases at the beginning of sentences.

(2) Awa Pit (Curnow 1997: 315, 316)

a.

mɨn=pa	kwizha=ta=ma	comida	kwin-ta-w?
who=POSS	dog=ACC=Q	food	give-PAST-LOCUT:SUBJ

'Whose dog did you give food to?'

b.

Libardo=na	mɨn-a=ma	ta-zi?
Libardo=TOPIC	who-ACC=Q	give-NONLOCUT

'Who did Libardo pay?'

In the remainder of this paper, I will collapse languages in which wh-phrases are obligatorily or almost always initial with languages like Awa Pit, in which wh-phrases are usually initial, since I assume that for both types of languages, generative linguists would posit a rule of overt wh-movement.[3]

We also find crosslinguistic variation in the position of complementizers. While there are languages which place complementizers at the beginning of clauses, as in English, there are other languages which place complementizers at the end of clauses, as in (3) from Canela (a Ge-Kaingang language spoken in Brazil).

(3) Canela (Popjes and Popjes 1986: 165)

cu-te	i-mã	amji	jarẽ	[cu-mã	a-kĩn	na]
3-PAST	1-TEMPRY	self	told	3-TEMP	2-like	COMP

'He told me that he likes you.'

It should be noted that many languages do not employ complementizers (by which I mean separate words marking complement clauses), either using finite clauses but without a complementizer, as in Begak (an Austronesian language of Sabah), illustrated in (4), or some sort of nominalization, as in Hup (a Nadahup language of Brazil), illustrated in (5), where the subordinate verb is marked with the nominalizer *-n'ɨ̌h*.

(4) Begak (Goudswaard 2005: 338)

K-ingog	ku	[ikow	pədtos].
ACTOR.NONVOLUT-hear	1SG.GEN	2SG.NOM	ill

'I heard that you were ill.'

(5) Hup (Epps 2008: 850)

ʔãh	hipãh-nɨ́h	[naw	ʔam	ʔɨd-n'ɨ̌h]=ɨ̃́.
1SG	know-NEG	good	2SG	speak-NMZ=DECL

'I didn't know you spoke (Portuguese) so well!'

Under the view that wh-movement is normally movement into complementizer position, we might expect to find a crosslinguistic relationship between the position of

[3] This is in contrast to Dryer (2011), in which languages like Awa Pit are grouped with languages without obligatory initial wh-phrases. In this paper, it makes more sense to group them with languages with in-situ wh-phrases since they might be analysed by generative linguists as having optional wh-movement.

wh-phrases and the position of complementizers. Consider the four logically possible types of languages in (6) defined by the two values given in the preceding paragraph for these two typological parameters.

(6) a. Languages with clause-initial complementizers and in situ wh-phrases
b. Languages with clause-initial complementizers and initial wh-phrases
c. Languages with clause-final complementizers and in situ wh-phrases
d. Languages with clause-final complementizers and initial wh-phrases

If wh-movement is normally movement into complementizer position, then this makes a prediction about the relative frequency of the four language types in (6). Namely, it predicts that we should find few if any languages of type (6d): if complementizer position in a language is clause-final, then there is no complementizer position at the beginning of sentences for wh-phrases to move into. There clearly are ways to get around this if there are languages of this sort, but we would still expect to find somewhat fewer languages of this sort. More precisely, we might expect the ratio of languages of type (6c) to languages of type (6d) to be higher than the ratio of languages of type (6a) to languages of type (6b). In other words, we would expect to find languages with initial wh-phrases to be proportionally more common among languages with initial complementizers than among languages with final complementizers.

Evidence is presented in this paper, based on my current typological database, that this prediction is borne out at best weakly.[4] The relevant numbers of languages are given in Table 1.[5]

CompS & In-Situ-Wh	108
CompS & Initial-Wh	61
SComp & In-Situ-Wh	23
SComp & Initial-Wh	4

Table 1. Position of complementizers and position of interrogative phrases

Table 1 shows four instances of SComp&Initial-Wh languages. One of these is Canela; example (3) above illustrates the clause-final complementizer while (7) illustrates an initial wh-phrase (Popjes and Popjes 1986: 153 state explicitly that wh-phrases occur initially).

(7) Canela (Popjes and Popjes 1986: 157)

jũm mãri capi cakôc xàte
about what Capi speak NMLZR
'About what did Capi speak?'

[4] My current database is an update on the data given in Dryer (2011) and other chapters by myself in Dryer and Haspelmath (2011), but also includes data on some features not represented in the WALS atlas, such as the order of complementizer and clause discussed in this paper.
[5] In some of my other papers (e.g. Dryer 1992), I cite data in terms of genera grouped into continental-sized areas. For reasons of simplicity, I cite data in this paper simply in terms of numbers of languages, though geographical and genealogical factors can skew such numbers. For reasons discussed in detail elsewhere (Dryer 1989, 2009), one cannot apply statistical tests like the Chi-Square test to data in tables like Table 1.

A second is Khoekhoe (also known as Nama, a Khoisan language spoken in Namibia); (8a) illustrates a clause-final complementizer, while (8b) and (8c) illustrate the fact that interrogative words are obligatorily initial in Khoekhoe; (8c), with the interrogative word in situ, is reported by Hagman (1977: 142) to be ungrammatical.[6]

(8) a.

tsĩ́i	//'ĩipàkxm̀	ke	kè	mĩ́í-pa	!úũkxm̀	ta	!xáisà.
and	1DU.MASC	DECL	REMOTE.PAST	tell-APPLIC	1DU.MASC	go	COMP

'And we told him that we were going.' (Hagman 1977: 138)

b.

taré'e=p	//'ĩipà	kè	≠'ṹi ?
what=3SG.MASC	3SG.MASC	REMOTE.PAST	eat

'What did he eat?' (Hagman 1977: 142)

c.

* //'ĩipà	taré'e	kè	≠'ṹi ?
3SG.MASC	what	REMOTE.PAST	eat

'What did he eat?' (Hagman 1977: 142)

The other two SComp Initial-Wh languages are Urarina (Olawsky 2006) and Osage (Quintero 2004).

At first sight, the numbers in Table 1 might seem to support the predictions: languages with clause-final complementizers but initial wh-phrases are clearly by far the least frequent type among the four types, with only four cases. However, this is due, at least in part, to the relative frequency among each of the two pairs of typological parameters underlying the typology. First, CompS languages are far more common than SComp languages, outnumbering them by 169 to 27 in Table 1. Second, languages with in situ wh-phrases are about twice as common as languages which normally place wh-phrases in initial position, outnumbering them by 131 to 65. Since SComp&Initial-Wh languages have the less common value for both of these parameters, we would expect them to be the least common of the four types, even if there is no relationship between the position of complementizers and whether a language has initial wh-phrases.

On the other hand, while we might expect SComp&Initial-Wh languages to be the least common of the four types even if there is relationship between the two parameters, we might still expect them to be more common than they are. If the ratio of In-Situ-Wh

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[6] It would be of interest to investigate the relationship between the position of wh-phrases in embedded questions and the position of complementizers. Unfortunately I have very little data on this question. However, the following example from Khoekhoe illustrates an embedded question with *mấapá* 'where' at the beginning of the clause and the complementizer *!xáisà* at the end of the clause.

(i)

siíkxm̀	ke	//'ĩiku	tsĩ́i-à	mĩ́í-pa	tama	kè
1DU.EXCL.MASC	DECL	3PL.MASC	either-SUBORD	tell-APPLIC	NEG	REMOTE.PAST

hấa	'ií	mấapá=kxm̀	ta	!úū	!xáisà
PERF	PAST	where=1DU.MASC	IMPERF	go	COMP

'We didn't tell them either where we were going.' (Hagman 1977: 142) languages to Initial-Wh languages were the same among SComp languages as it is among CompS languages, then since the ratio among CompS languages is 116 to 53 or about 2.19 to 1, we might expect the distribution among the 27 SComp languages to be more like 19 In-Situ-Wh languages and 8 Initial-Wh languages. But we find only four Initial-Wh languages among the SComp languages, which is only one half of what we might expect if there were no relationship. So perhaps the data in Table 1 does suggest some relationship between these two parameters.

However, the situation is more complicated than this. The order of complementizer and clause and the position of wh-phrases both correlate with the order of object and verb. The data in Table 2 provides clear evidence of a relationship between the order of object and verb and the order of complementizer and clause.

OV&CompS	37
OV&SComp	32
VO&CompS	162
VO&SComp	1

Table 2. Order of object and verb and position of complementizers

Table 2 shows that among OV languages, the two orders of complementizer and clause are about equally common (37 CompS and 32 SComp).[7] But among VO languages, my database contains only one instance of an SComp languages: the other 162 VO languages in this sample are CompS.[8]

Table 3 provides evidence of a correlation between the order of object and verb and whether the language employs initial wh-phrases.

OV&In-Situ-Wh	320
OV&Initial-Wh	95
VO&In-Situ-Wh	259
VO&Initial-Wh	167

Table 3. Order of object and verb and position of interrogative phrases

Table 3 shows that among OV languages In-Situ-Wh languages outnumbers Initial-Wh languages by 320 to 95, over 3 to 1. And while In-Situ-Wh outnumbers Initial-Wh among VO languages as well, by 259 to 167, the ratio is much less than with OV languages. The same point can be made perhaps even more clearly by comparing In-Situ-Wh languages with Initial-Wh languages. Among In-Situ-Wh languages, OV is slightly more common than VO (by 318 to 259). But among Initial-Wh languages, VO is more common by 166 to 95 (or almost 2 to 1). In short, apart from the skewing that

[7] Table 2 shows evidence of another asymmetry among OV and VO languages: complementizers are more common in VO languages than in OV languages, in this data by 163 languages to 69. This asymmetry does not appear to be relevant to this paper.

[8] The sole instance in my database of a VO language with final complementizer is Hkongso, a Tibeto-Burman language of Burma (Wright 2009).

results from the fact that In-Situ-Wh is more common than Initial-Wh, we find a correlation between VO and Initial-Wh and between OV and In-Situ-Wh[9].

The fact that both the order of complementizer and clause and the position of wh-phrases correlate with the order of object and verb leads to a reinterpretation of the data in Table 1. The fact that SComp and In-Situ-Wh are each associated with OV means that we expect more SComp&InSituWh languages simply due to the fact that both values are associated with OV. And the fact that CompS and Initial-Wh are each associated with VO means that we expect more CompS&Initial-Wh languages simply due to the fact that both values are associated with VO. Hence the correlations with the order of object and verb favour CompS&Initial-Wh and SComp&InSituWh and disfavour CompS&InSituWh and SComp&Initial-Wh. Table 4 repeats the data from Table 1, but indicates the two types that are favoured by the correlations with the order of object and verb.

CompS & In-Situ-Wh	108	
CompS & Initial-Wh	61	favoured, since both types are associated with VO
SComp & In-Situ-Wh	23	favoured, since both types are associated with OV
SComp & Initial-Wh	4	

Table 4. Position of complementizers and position of interrogative phrases

Earlier in this paper, I suggested that the fact that the ratio of the third to the fourth line in Table 1/4 is greater than the ratio of the first to the second line seems to provide weak support for the claim that there is a crosslinguistic relationship between the order of complementizer and clause and the position of wh-phrases. However, we now have an alternative explanation for this fact: the correlations with the order of object and verb favour two types and this leads us to expect the ratio of the third to the fourth line in Table 4 to be greater than the ratio of the first to the second line. Hence, there is no reason to interpret the data in Tables 1 and 4 as providing weak support for the idea that there is crosslinguistic relationship between wh-movement and complementizer position.

The same point can be made in another way. Table 5 elaborates on the data in Tables 1 and 4, by restricting attention to OV languages. (Looking at VO languages would be unhelpful since almost all the VO languages in my sample are CompS.)

OV & CompS & In-Situ-Wh	30
OV & CompS & Initial-Wh	2
OV & SComp & In-Situ-Wh	22
OV & SComp & Initial-Wh	4

Table 5. Position of complementizers and position of interrogative phrases in OV languages

Table 5 shows a different pattern from Table 1. It is now the case that the ratio of the third to the fourth line (22 to 4) is less than the ratio of the first to the second line (30 to

[9] The relationship between the position of wh-phrases and order of object and verb is implied by Universal 12 of Greenberg (1963): "If a language has dominant order VSO in declarative sentences, it always puts interrogative words or phrases first in interrogative word questions; if it has dominant order SOV in declarative sentences, there is never such an invariant rule."

2). In other words (although the difference in numbers is small), OV languages with Initial-Wh are *more* likely than languages with In-Situ-Wh to be SComp, exactly the opposite of what we might expect if there is a crosslinguistic relationship between wh-movement and complementizer position.

Now one might argue that the infrequency of OV&CompS&Initial-Wh languages is simply due to the fact that CompS and Initial-Wh are both associated with VO word order, so we would not expect to find many such languages among OV languages. However, the data in Table 2 shows that the two orders of complementizer and clause are about equally common in OV languages, CompS being slightly more common. Thus, if there were a relationship between the position of complementizers and whether wh-phrases are initial, we would expect to find more Initial-Wh languages among OV&CompS languages than among OV&SComp languages. But we don't.

My conclusion is that the crosslinguistic evidence does not support the idea that there is a crosslinguistic relationship between wh-movement and complementizer position. This is apparently unproblematic under the view that wh-movement is movement to Spec of CP, but unexpected under the older view that wh-movement is movement to Comp.

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Affiliation

Matthew S. Dryer
Department of Linguistics
University at Buffalo
dryer@buffalo.edu

Proof-theoretic type interpretation: a glimpse to proof-theoretic semantics

Nissim Francez

Dedication: To Ed Keenan, a champion of model-theoretic semantics, on the occasion of his retirement, with best wishes for a long continual of scientific work.

1 Introduction

A foundation of model-theoretic semantics (MTS) for natural language (NL), ever since Montague's seminal work, is the typing of meanings, most often expressed in some variant of the simply-typed λ-calculus. Types are interpreted in what is known as Henkin models, whereby basic types τ are interpreted as denoting arbitrary sets D_τ, except for the type t (of sentential meanings), denoting the two-valued boolean algebra of truth-values $D_t = \{t, f\}$. Functional types (τ, σ) denote $D_\sigma^{D_\tau}$ the collection of all functions from the domain type D_τ to the range type D_σ.

The aim of this note is the presentation of new results; rather, it is the highlighting, in a nutshell, of a proof-theoretic interpretation of types, originating in Francez, Dyckhoff, and Ben-Avi (2010), used by *proof-theoretic semantics (PTS)* for NL, thereby opening a small window to the latter theory of meaning, unfortunately very little known to most linguists.

Before presenting the details of the proof-theoretic type interpretation, I recapitulate the essence of the PTS as applied to NL:

- *For sentences, replace the received approach of taking their meanings as* **truth conditions** *(in arbitrary models) by an approach taking meanings to consist of* **canonical derivability conditions** *(from suitable assumptions).* In particular, this involves a "dedicated" proof-system in natural deduction (ND) form, on which the derivability conditions are based. In a sense, the proof system should reflect the "use" of the sentences, and should allow recovering pre-theoretic properties of the meanings of these sentences such as entailment and assertability conditions. For some discussion of the criticism of MTS as a theory of meaning see Francez and Dyckhoff (2010).

  An important requirement is that the ND-system should be *harmonious* (see Francez and Dyckhoff (2010) for a discussion of harmony of NL ND-rules), in that its rules have a certain balance between introduction and elimination, in order to qualify as meaning conferring.

- For *sub-sentential phrases*, replace their denotations (extensions in arbitrary models) as their meanings, by their **contributions** to the meanings (in our explication, derivability conditions) of sentences in which they occur. This adheres to Frege's *context principle*, made more specific by the incorporation into a TLG (see Francez et al. (2010) for the process of extracting meanings for sub-sentential phrases from sentential meanings).

2 Sentential meanings: the proof-theoretic type interpretation of type *t*

The proof-theoretic meaning for NL sentences is based on a "dedicated" natural-deduction proof-system, with *introduction* rules (I-rules) and *elimination* rules (E-rules) for the various constructs of the NL in case. For a sentence S containing such a construct, an I-rule defines how can be S derived from other sentences, while an E-rule defines which (immediate) conclusions can be derived from S (possibly using other auxiliary sentences. For "primitive" sentences (containing *no* construction), the meaning is assumed *given*. In Francez and Dyckhoff (2010), such an ND-system is presented for an extensional fragment of English containing intransitive and transitive verbs, (count) nouns, determiners, (intersective) adjectives, relative clauses, proper names and a copula. The paper also presents an extension with intensional intransitive verbs with an unspecific object.

Suppose such an ND-system N is given. *derivations* (ranged over by $\mathscr{D}$) are defined recursively by iterating applications of rules. A derivation is from a (possibly empty) collection Γ of sentences, to a *conclusion* S. *derivability* (in N) of S from Γ is denoted by $\Gamma \vdash_N S$. Derivations are depicted as a tree, with members of Γ as leaves and S as the root.

There is a special kind of derivations (underlying the definition of sentential meanings) called em canonical derivations. Such derivations consist of the most *direct* way of concluding S.

Canonical derivation: A derivation (in N) is *canonical* iff its last rule application is of an I-rule. Canonical derivability of S from Γ is denoted by $\Gamma \vdash_N^c S$. Let $[\![S]\!]_\Gamma^c$ denote the (possibly empty) collection of canonical derivations of S from Γ.

Sentential meanings: The (reified) *meaning* of a sentence S is defined by

$$[\![S]\!] =^{df.} \lambda \Gamma . [\![S]\!]_\Gamma^c$$

Thus, the meaning of S consists of *all* its canonical derivations from arbitrary Γs. Some properties of this prof-theoretic meanings are summarized below.

- The meaning of a sentence does not depend on any special "logical form", different from its surface form.
- The meaning is of a finer granularity then the MTS truth-conditions, for example nor rendering logically equivalent sentences as having the same meaning.
- Such meanings may serve as more adequate arguments for propositional attitudes than the corresponding truth-conditions of MTS.
- Most importantly, such meanings do not impose any *ontological commitments* like the ones that are imposed by the structure of models. They are expressed using purely syntactic, formal expressions.

Based on these reified proof-theoretic meanings, the proof-theoretic interpretation of type t can now be defined as follows.

Proof-theoretic interpretation of type t:

$$D_t =^{df.} \{[\![S]\!] \mid S \text{ in the language}\}$$

Thus, the inhabitants of type t are all the sentential meanings.

For some purposes, those proof-theoretic meanings are *too fine grained*. There is a natural equivalence relation that can be imposed to somewhat coarsen the granularity of meanings.

Grounds of assertion: Every Γ s.t. $\Gamma \vdash_N^c S$ is a *grounds for assertion* of S. Let $G[\![S]\!] =^{df.} \{\Gamma \mid \Gamma \vdash_N^c S\}$ be the (possibly empty) collection of all grounds of assertion for S.

Thus, S is warranty asserted by anyone in posession[1] of some $\Gamma \in [\![S]\!]$. When '$\vdash_N$' is decidable (which most often is the case), warranted assertion is effective.

Using grounds of assertion, the following natural equivalence relation on meanings can be imposed.

$$S_1 \equiv_G S_2 \text{ iff } G[\![S_1]\!] = G[\![S_2]\!]$$

Thus, sentences with identical grounds of assertion are rendered as having equivalent meanings.

3 Sub-sentential meanings: more types and their proof-theoretic interpretation

As described in detail in Francez and Dyckhoff (2010), a natural ND-system for NL uses a denumerable collection $\mathscr{P}$ of *individual parameters*. These are syntactic objects, not used in the NL itself, only in its extension for purposes of expressing rules and derivations. Meta-variables in boldface font, **j, k**, range over individual parameters; syntactically, such parameters are dps; $S[\mathbf{j}]$, containing a parameter in some dp-position, is a *pseudo-sentence*, present only in the proof-language extending the NL. Let p be a basic type, with $D_p = \mathscr{P}$. Type p is the counterpart of the the Montagovian type e; however, while D_e is *arbitrary*, D_p is *fixed*, containing only syntactic inhabitants. The general type of a predicate is the functional type (p,t).

There is a means for forming certain *subtypes*, for some of the more frequently used functional types, where the argument parameter has to occupy some position in a pseudo-sentence type (i.e., preventing constant functions).

- t_p is a subtype of (p,t), s.t. $D_{t_p} = \{\lambda \mathbf{j}.[\![S[\mathbf{j}]]\!] \mid S[\mathbf{j}]\ a\ (pseudo)sentence\}$.
- $t_{p,p}$ is a subtype of $(p,(p,t))$, s.t. $D_{t_{p,p}} = \{\lambda \mathbf{k} \lambda \mathbf{j}.[\![S[\mathbf{j},\mathbf{k}]]\!] \mid S[\mathbf{j},\mathbf{k}]\ a\ (pseudo)sentence\}$.
- n is a subtype of (p,t), s.t. $D_n = \{\lambda \mathbf{j}.[\![\mathbf{j}\ \ is\ a\ X]\!] \mid X\ a\ noun\}$.

Note that there are two different predicate types. One, t_p is *verbal*, and the other, n, which is basic, is *nominal*. This distinction plays a major role in the definition of the type of *determiners* (see below).

[1] A cognitive term, left unexplicated here.

3.1 Meanings of nouns and verbs

The meanings of nouns and verbs originate from (given) meanings of ground pseudo-sentences. For verbs, the ground sentence is the sentence headed by the verb. Accordingly, the meaning of an intransitive verb P of type t_p is $[\![P]\!] = \lambda \mathbf{j}.[\![\mathbf{j}\ P]\!]$. Similarly, the meaning of a transitive verb R of type $t_{p,p}$ is $[\![R]\!] = \lambda \mathbf{k}\lambda \mathbf{j}.[\![\mathbf{j}\ R\ \mathbf{k}]\!]$. The meaning of a noun X of type n is given by $[\![X]\!] = \lambda \mathbf{j}.[\![\mathbf{j}\quad \textit{is a}\ X]\!]$.

3.2 Meaning of determiners

A (regular) determiner combines with a (count) noun and a verb-phrase to form a sentence. The meaning of a determiner is *extracted* (as described precisely in Francez et al. (2010)) from the sentential meanings in which the determiner occurs. Their general form of the proof-theoretic meaning of a basic determiner D is

$$[\![D]\!]^{df.} = \lambda z_1^n \lambda z_2^{t_p} \lambda \Gamma. \bigcup_{\mathbf{j}_1,\ldots,\mathbf{j}_m \in \mathscr{P}} I_D(z_1)(z_2)(\mathbf{j}_1)\cdots(\mathbf{j}_m)(\Gamma)$$

Here z_1 is the meaning of a noun, say X, z_2 is the meaning of a verb-phrase, say V, and I_D is a function applying the I-rule corresponding to D to derivations of the noun and the vp. The result is the meaning of the sentence $S = D\ X\ V$. For example, for $D = \textsf{every}$, $z_1 = [\![\textsf{girl}]\!]$ and $z_2 = [\![\textsf{smiles}]\!]$, one gets

$$[\![\textsf{every}]\!]([\![\textsf{girl}]\!])([\![\textsf{smiled}]\!]) = [\![\textsf{every girl smiled}]\!]$$

as expected.

In Francez (2012), determiners are studied in detail. There, the proof-theoretic meaning of complex determiners like *possessives* and *coordinated determiners* is given too. For handling *negative* determiners such as no, the PTS moves to *bilateralism*, where *denial* is taken on par with assertion. I-rules are provided both for asserting and for denial. This is reflected in a change of sentential meanings, “hidden” under the inhabitants of type t.

The main result of Francez (2012) is the following theorem.

Theorem: (conservativity) Every determiner is conservative in at least one of its argument.

Thus, instead of *stipulating* the conservativity of determiners, as is the case in the MTS using generalized quantifiers as dp-denotations, conservativity is proved! Note that the proof-theoretic meaning as defined above is much more restrictive than the MTS counterpart. The is no way to express non-conservative GQs such as the following. Let A and B be arbitrary subsets of the domain E of any model.

$$G_1(A)(B) \Leftrightarrow |A| > |B|, \quad G_2(A)(B) \Leftrightarrow |A| = |B| \quad G_3(A)(B) \Leftrightarrow (E - A) \subseteq B$$

Another discrepancy of determiners cannot arise: dependency of their MT-denotation on the cardinality of the domain. For example, a definition like

$$[\![D]\!] = \{ \begin{array}{ll} [\![\textsf{every}]\!] & |E| \geq 100 \\ [\![\textsf{some}]\!] & |E| < 100 \end{array}$$

4 Conclusions

This note presented a proof-theoretic interpretation of types, not using models, entities or any other ontologically committing sort of machinery. Only syntactic expressions, resulting from derivations in an ND-system, are used. Another example, using an additional primitive type (not ontologically committing to anything), handling *non-specific* objects of intensional transitive verbs, such as

every lawyer needs a secretary

known to be hard (and controversial as to the right models and truth-conditions needed) in MTS, can be found in Francez and Dyckhoff (2010).

This note presents in a nutshell only some of the main ideas involved in applying PTS to NL. Readers interested in fuller presentation, including many concrete examples, are encouraged to read the cited papers.

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Affiliation

Nissim Francez
Technion - Israel Institute of Technology
francez@cs.technion.ac.il

An Algebraic Perspective on the Person Case Constraint

Thomas Graf

Introduction

Graf (2011) and Kobele (2011) proved independently that Minimalist grammars can express all constraints that are definable in weak monadic second-order logic (MSO), i.e. the extension of first-order logic with quantification over finite sets. The proof takes as its vantage point the well-known equivalence between MSO and finite-state tree automata and then shows how such automata can be emulated in the Minimalist feature calculus. On the one hand this is a welcome result, as numerous phenomena that seem bewildering to linguists can now be understood as merely arising from the unexpected MSO-like power of the feature calculus. On the other hand, it also exacerbates the overgeneration problem — there are infinitely many patterns that are MSO-definable yet are not realized in any known language. For example, it is a relatively easy exercise to write an MSO-formula that is satisfied in a tree only if assigning each leaf l the value 0 or 1 depending on whether the length of the shortest path from the root to l is even or odd yields a string that is the binary encoding of the longest sentence in Hermann Broch's *The Death of Virgil* (which allegedly contains over a thousand words). Seeing how the feature calculus is the essential component in capturing the expressivity of MSO, it is a natural idea to look for empirically motivated restrictions that might curtail its excessive power.

As a first step in this direction, I show here how the attested variants of the Person Case Constraint can be treated with MSO in a unified fashion if one posits certain plausible restrictions on the algebra of person features. The general upshot is that the different Person Case Constraints correspond to specific preorders over the set of person features, and that these preorders form a particular class of presemilattices.

1 Monadic Second-Order Logic and the Person Case Constraint

In a variety of languages such as Catalan, French, Spanish, and Classical Arabic, the grammaticality of direct object (DO) and indirect object (IO) clitic combinations is contingent on the person specification of said clitics (I abbreviate the person features by 1, 2, and 3, respectively). This is illustrated below for French, where a 3IO clitic may combine with a 3DO clitic, but not a 1DO clitic.

(1) Roger **me/le* *leur* a presésenté.
Roger 1SG/3SG.ACC 3PL.DAT has shown
'Roger has shown me/him to them.'

This pattern is commonly referred to as the *Person Case Constraint* (PCC; Kayne 1975; Bonet 1991, 1994). Languages differ with respect to the combinations they allow, giving rise to four attested variants of the PCC:

- *Strong PCC* (S-PCC): DO must be 3. (Bonet 1994)
- *Ultrastrong PCC* (U-PCC): DO is less local than IO, where 3 is less local than 2 and 2 less local than 1. (Nevins 2007)
- *Weak PCC* (W-PCC): 3IO combines only with 3DO. (Bonet 1994)
- *Me first PCC* (M-PCC): If IO is 2 or 3, then DO is not 1. (Nevins 2007)

The patterns generated by these constraints are listed in Tab. 1, following the presentation in Walkow (2012). Note that I omit the diagonal here as these IO-DO combinations commonly show special morphological behavior such as spurious *se* in Spanish.

IO↓/DO→	1	2	3
1	NA	*	✓
2	*	NA	✓
3	*	*	NA

IO↓/DO→	1	2	3
1	NA	✓	✓
2	*	NA	✓
3	*	*	NA

IO↓/DO→	1	2	3
1	NA	✓	✓
2	✓	NA	✓
3	*	*	NA

IO↓/DO→	1	2	3
1	NA	✓	✓
2	*	NA	✓
3	*	✓	NA

Table 1: Variants of the PCC from left to right and top to bottom: S-PCC, U-PCC, W-PCC, M-PCC

All four PCC types are MSO-definable. First, observe that every PCC must be restricted to CPs, because all combinations of pronouns are licit as long as these pronouns occur in distinct clauses. Hence we define a predicate $\text{ClauseMate}(x,y)$ which holds iff every node labeled CP reflexively dominating x reflexively dominates y, and the other way round. In formal terms, $\text{ClauseMate}(x,y) \Leftrightarrow \forall z[\text{CP}(z) \rightarrow (z \triangleleft^* x \leftrightarrow z \triangleleft^* y)]$, where $\triangleleft^*$ is the reflexive transitive closure of the immediate dominance relation $\triangleleft$. Moreover, we define two predicates $\text{DO-Clitic}(x)$ and $\text{IO-Clitic}(x)$ that only hold of nodes labeled with DO clitics and IO clitics, respectively. In French, this would be $\text{DO-Clitic}(x) \Leftrightarrow \mathit{me}(x) \vee \mathit{te}(x) \vee \ldots \vee \mathit{les}(x)$ and $\text{IO-Clitic}(x) \Leftrightarrow \mathit{me}(x) \vee \mathit{te}(x) \vee \ldots \vee \mathit{leur}(x)$. The same method can be used to define predicates $1(x)$, $2(x)$, and $3(x)$ for first, second, and third person clitics. Each PCC variant then corresponds to a closed formula $\pi := \forall x,y[\text{ClauseMate}(x,y) \wedge \text{DO-Clitic}(x) \wedge \text{IO-Clitic}(y) \rightarrow \phi]$, where ϕ is a disjunction of valid person combinations. In the case of, say, the S-PCC, $\phi := (3(x) \wedge 1(y)) \vee (3(x) \wedge 2(y))$. Obviously we can impose additional configurational requirements on x and y, but these aren't of particular interest here. The basic point is that the existence of something like the PCC is far from baffling: it is easily expressed in MSO, and since our grammar formalism can enforce all MSO-definable constraints, it is only natural for them to be realized in some languages.

What is surprising, though, is that only four PCC variants seem to exist. This is significantly less than the $2^6 = 64$ logical possibilities, all of which are MSO-definable. In the next section, I argue that this is less puzzling once one realizes that the four attested versions can be derived from a natural class of algebras.

2 Algebraic Characterization

The definition of the U-PCC above differs from the others in that it consists of two parts: a general constraint “DO is less local than IO” and a metric for computing locality. Without any further assumptions about what counts as a locality metric, this modular way of stating PCCs can trivially be extended to the other three types, as each metric need merely reproduce the finite relation encoded by the respective combinations table on the previous page. Surprisingly, though, the relevant metrics turn out to be anything but arbitrary. Slightly rephrasing the U-PCC, we can take the universal component of all PCCs to be given by the *Generalized PCC* (G-PCC): IO is not less local than DO. In MSO terms, $\phi := \neg(y < x)$ in the formula π above. The crucial parameter is the relation denoted by $<$. It turns out that for each PCC it can be equated with reachability in some directed graph G in Fig. 1 such that $x < y$ iff x is reachable from y in G. In the case of the S-PCC, for instance, $1 < 2$, $2 < 1$, $3 < 1$, and $3 < 1$. Clearly reachability is transitive and in general not antisymmetric. Recall furthermore that I previously excluded the diagonal from the discussion of the PCC, so we may assume that every node is reachable from itself, making reachability reflexive. A binary relation that is transitive and reflexive but not necessarily antisymmetric is called a *preorder*. So the space of 64 possible combinations can be narrowed down to those that are the result of interpreting $<$ in the G-PCC as a preorder over the set $\{2,2,3\}$.

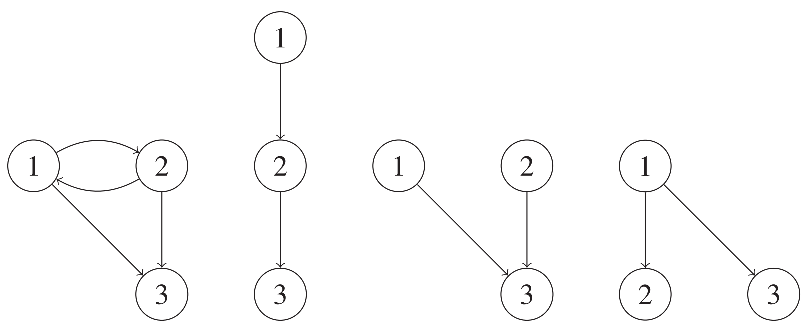

Figure 1: Graphs for the attested variants of the PCC (S-PCC, U-PCC, W-PCC, M-PCC)

This space is still too big, though, as a relation that does not order 2 with respect to 1 and 3 could still be a preorder, but would not be a suitable locality metric for our purposes. A limited amount of connectedness has to be enforced. Totality would be too strong a requirement, since the W-PCC and the M-PCC rely on two specific nodes not being ordered with respect to each other. The astute reader will have noticed, though, that all PCCs form semilattices except the S-PCC, which has both $1 < 2$ and $2 < 1$ yet $1 \neq 2$. However, the S-PCC is still a *presemilattice*.

Definition 1. Let $\sqsubseteq$ be a preorder on some set A. A binary operation $\sqcap$ ($\sqcup$) is called a *meet* (*join*) operation if for all $a,b \in A$, $a \sqcap b$ ($a \sqcup b$) is a greater lower bound (least upper bound) of $\{a,b\}$ with respect to $\sqsubseteq$; note that $a \sqcap b$ ($a \sqcup b$) need not be unique. We call $\langle A, \sqsubseteq, \sqcap \rangle$ a *meet presemilattice* (a *join presemilattice* for $\sqcup$).

So we can restrict the possible class of relations even further to those that define presemilattices over $\{1,2,3\}$.

But once again this class is too big. This time the overgeneration is due to the fact that all three person features are treated as equals, which fails to exclude orders that are the image of one of the four intended presemilattices under some non-trivial permutation of $\{1,2,3\}$. Two rather natural conditions on the distribution of 1 and 3 suffice to patch this loop-hole and finally give us a full characterization of the relevant locality metrics.

- *Top*: For all x, $1 < x$ implies $x < 1$.
- *Bottom*: There is no x such that $x < 3$.

In other words, 3 is always minimal, 1 always maximal. These properties correlate with certain facts from binding theory, where first and second person reflexives are less restricted in their distribution than third person reflexives, and with resolved agreement between finite verbs and coordinated subjects, where the person inflection on the verb must be first person if one of the conjuncts is first person.

3 Some Mathematically Motivated Conjectures

From a mathematical perspective it would be more appealing if *Top* and *Bottom* were duals of each other. That is to say, *Bottom* should be paired with *Top*$'$, or *Top* with *Bottom*$'$.

- *Top*$'$: There is some x such that $x < 1$.
- *Bottom*$'$: For all x, $x < 3$ implies $3 < x$.

Switching from *Top* to *Top*$'$ is tantamount to downgrading the maximality requirement of 1 to a non-minimality condition. Similarly, replacing *Bottom* by *Bottom*$'$ weakens the minimality requirement of 3 into a non-maximality condition. It follows that these revised axioms still allow for all four attested PCCs, but they also bring in new ones.

Coupling the original *Bottom* with *Top*$'$ allows for one more ordering, depicted in Fig. 2. This ordering is essentially the U-PCC in which the position of 1 and 2 has been switched.

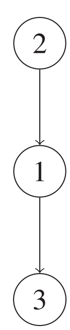

Figure 2: A variant of the U-PCC obtained by replacing *Top* with *Top*$'$

There are some languages in which 2 is apparently more local than 1. Nishnaabemwin, for example, affixes its verb with an inverse marker if the direct object is more local than the subject (Béjar and Rezac 2009:50).

(2) a. n-waabm-ig
1-see-3.INV
'He sees me.'

b. g-waabm-ig
2-see-3.INV
'He sees you.'

The marker also occurs if the object is 2 and the subject is 1, but not the other way round, where a default marker is used instead (Béjar and Rezac 2009:49). This indicates that 2 is indeed more local than 1.

(3) a. g-waabm-in
2-see-1.INV
'I see you.'

b. g-waabm-i
2-see-DFLT.1
'You see me.'

Unfortunately I do not know if any such language shows PCC effects, and even if it did, the odds that it would have the modified U-PCC rather than one of the alternatives are rather slim.

If instead of *Top*′ and the original *Bottom* one goes with *Top* and *Bottom*′, two new patterns emerge. The first one is an extension of the M-PCC that adds $2 < 3$ and $3 < 2$ to

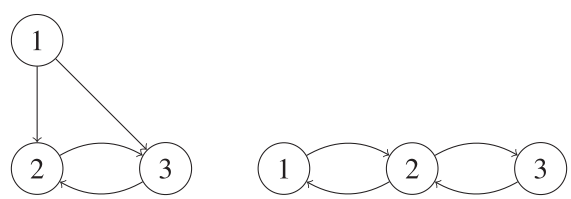

Figure 3: A variant of the M-PCC and a new one that blocks all clitic combinations

the ordering. Consequently, all combinations of 2 and 3 are blocked, so that DO clitics may only combine with 1IO clitics. Rather than the M-PCC's ban against 1DO with 2/3IO, then, we obtain a requirement for 1IO. Such a PCC might exist in sign languages, where second and third person pronouns are arguably more closely related than in spoken language due to the pointing mechanism employed by the former.

The other new PCC uses the relation $\{1,2,3\} \times \{1,2,3\}$, so all elements are equally local and no two clitics may be combined. Martin Walkow (p.c.) points out that this PCC might be active in languages that disallow cliticization of more than one object, such as Cairene Arabic (cf. Shlonsky 1997:207).

Conclusion

The results of Graf (2011) and Kobele (2011) have opened up Minimalist grammars in a way that makes it very easy to add all kinds of linguistically motivated constraints to the formalism. At the same time, adding unnatural constraints has become just as simple. As the power of Minimalist grammars with respect to constraints stems from their feature calculus, a better understanding of the feature algebras in language will be helpful in delineating the set of viable constraints. In this squib I have taken a first step towards this goal by showing how the attested variants of the PCC can be viewed as a unified constraint against indirect objects being less local than direct objects; the differences between these PCCs follow from which presemilattice is taken to underly the notion of locality.

Acknowledgements

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Affiliation

Thomas Graf
Department of Linguistics
UCLA
tgraf@ucla.edu

Have: An Essentialist Semantics

Javier Gutiérrez-Rexach

1 Copulas and relations

One of the cornerstones in the study of the (in)definiteness restriction is the well-known contrast emerging in existential sentences. Indefinite (weak) determiners can occur in existential constructions whereas strong determiners cannot (Milsark 1977; Keenan 1987; Reuland and ter Meulen 1987; etc.).

(1) a. * There is(are) the/all the/each/every/most statue(s) in the garden.
 b. There are some/two/fewer than three/many statues in the garden.

Keenan (1987) observes that this same contrast can be attested in the complements of the verb *have*, when this verb has an existential interpretation:

(2) a. Kim has four/fewer than four/many cars.
 b. * Kim has most of the/each/every car.

There is cross-linguistic variation in the choice of the verbal copula used to express the HAVE relation. Many languages use *be* instead of *have*. For example, Turkish and Latin use *be* systematically and most other languages (including English) do so at least in certain constructions. There are also languages where a copula is not required (some Bantu languages, Malagasy for certain constructions, etc). Morphological weakening or "bleaching" of the copular verb correlates with a language's ability to express certain semantic relations (kin, possession, etc.) through morphological cases. For example, in Turkish the meaning of *have* is expressed by the copula plus a genitive DP (Lees 1972; Kelepir 2007) — this option is also possible in English, and other languages for possessive constructions: *This is ours* = *We have this*. In Latin, where the copular verb is *be* (*essere*), possessive meaning is expressed via dative case marking on the postcopular DP (Bauer 1996): *Libri sunt mihi* 'The books are mine'. Finally, in certain Malagasy *have*-constructions there actually is no copula linking the two terms of the *have*-relation (Keenan and Ralalaoherivony 2000):

(3) Marary znaka Rabe.
 Sick child Rabe
 'Rabe has a sick child.'

(4) Be asa manahirana aho.
 big work bother 1sgNom.
 'I have a lot of bothersome work.'

Evidence of this sort is the source for the Benveniste/Kayne generalization (Benveniste 1971; Kayne 1993), which concludes that *have* is the syntactic amalgam of a light or contentless copula and a preposition — cf. also Szabolcsi (1983), Freeze (1992), Uriagereka (1996), Arregi (2004). In this squib, it will be argued that this analysis is also on the right track from a semantic viewpoint. In other words, *have* is used to express a variety of relations between the subject and the object.

2 Existence, proper and restricted

Let us start with a revisitation of Keenan's (1987) generalization: Existential-*have* sentences are like existential-*there* sentences in expressing an assertion of existence. More concretely, one consequence of this generalization is that sentences such as those in (5) are assertions of existence, as the respective paraphrases in (6) show. In this respect, they are equivalent to those in (7):

(5) a. John has a dog.
    b. John has four cousins.

(6) a. A dog (owned by John) exists.
    b. John's four cousins exist.

(7) a. There is a dog owned by John.
    b. There are four cousins of John.

In considering these equivalences, there is an element that introduces an apparent asymmetry. In most existential-*there* sentences, an XP modifier restricts the assertion of existence to those individuals in the universe under consideration satisfying the denotation of the XP. The assertion of existence does not normally affect the whole universe but rather a "slice" of it, making contrastive statements such as (8) possible:

(8) There are two students in the garden. There is another one inside the house.

The presence of the restricting modifier is critical. If it is omitted, the discourse becomes odd:

(9) There are two students. ??There is another student inside the house.

The only way of improving (9) is to accommodate a restrictive (locative) element. On the other hand, it seems that in existential-*have* environments it is more difficult to accommodate such a restriction. For example, (10) is not felicitous if the chair under discussion has four legs:

(10) The chair has three legs. #The chair has another leg too.

Nevertheless, to claim that *have*-sentences are incompatible with an explicit or implicit restriction would be incorrect. The occurrence of a restriction depends on the interpretation of the sentence (on the type of relation expressed by *have*). The modifying adjunct can at times express an explicit spatio-temporal restriction, as in (11a) or a property of the object (11b):

(11) a. John has four cousins in the army. Another one is unemployed.
b. The chair has three iron legs. The other one is made of wood.

This restriction delimits the predication relation (the assertion of existence). We can then distinguish two types of assertions of existence: pure (unrestricted) and restricted. In the case of existential-*there* sentences only the restricted existence reading seems to be possible. This idea would receive support from proposals that consider *there* as an expression of a contextual parameter (Freeze 1992; Hoekstra and Mulder 1990; etc.). The presence of this parameter would make possible the 'intrusion' of a pragmatically-conditioned restriction.

3 Locative, essential and accidental readings

It has been observed that *there*-constructions have a locative-deictic reading that is quite different from the existential one, as in (12) (Lakoff 1987):

(12) a. There is a man on the porch.
b. There is Harry on the porch.

What sentence (12) asserts is not an existential statement, but one that indicates the (spatial) location of Harry or is uttered while pointing at Harry. In this respect, the locative-deictic interpretation of *there*-sentences is not merely a variant of the restricted-existence reading that we considered in the previous section. The main contrast with existential sentences is that the locative-deictic reading does not satisfy the definiteness restriction, as the grammaticality of (12b) shows. Any other variant with a definite or strong determiner would also be grammatical: *There are those books on the table*, etc. Additionally, the postcopular DP is not "discourse new" and the sentence normally has a characteristic intonational contour, where *there* receives the main pitch/focus accent and loses its clitic-like character, becoming a deictic term. This property is shared by other languages (Kayne 2008). *Have*-sentences exhibit the same behavior as *there*-constructions in this respect. A sentence such as (13) is a genuine locative-*have* construction:

(13) There you have the apple.

Sentence (13) is generally uttered to indicate the location of the apple under discussion, normally in a deictic fashion, i.e. accompanying its utterance with a pointing gesture. Locative-*have* sentences do not obey the definiteness restriction either and require the insertion of the prosodically strong counterpart of there. Hornstein, Rosen, and Uriagereka (2002) claim that the predication relation established between the postcopular DP and the PP coda or adjunct is not semantically uniform. They link the two resulting readings to a contrast between what they call *integral predication* and *standard predication*. Consider (14), which can be interpreted as either (15a) or (15b):

(14) There is a Ford motor in my truck.

(15) a. My truck runs on a Ford motor.
b. A Ford motor is loaded in my truck (in the trunk).

The reading in (15a) corresponds to the integral-predication relation. Here we will label this reading the *essential interpretation*. The object of the existential predicate refers to an essential part of the truck. On the other hand, (15b) would be a manifestation of the standard predication relation or what we will be calling the *accidental or contingent interpretation* of (14). In this case, the object is only contingently related to the truck. The associated property is only an accidental property of the truck, subject to contextual variation. This is why we are calling this reading accidental. The predicate in (14) establishes the positional relation of the motor with respect to (inside) the truck. It is important to highlight the fact that we say that the reading is accidental and we are not saying that it emerges "accidentally". We are referring to the philosophical (and semantic) distinction betwen essential and accidental properties, the latter being those non-essential properties that may be associated with an entity (Carnap 1956; Bennett 1969; Gorman 2005). This distinction overlaps but is not equivalent to the individual-level/stage-level distinction (Carlson 1977), since there might be properties that are essential but are instantiated by a stage-level predicate. This characterization appears to be a better fit than the one proposed by Hornstein et al. (2002), given that the relation that is established betwen the subject and the object in (15a) is essential: One does not exist without the other. Establishing such a relation would be impossible in (16), and the only available reading would be the accidental one:

(16) There are two cans of soda in my truck.

The preference for one reading or other is also related to contextual factors. Whether I have two cans of soda, a newspaper or a CD in my truck is subject to circumstantial variation. On the other hand, having a motor is an essential property of this truck or of any truck, and actually having one motor brand or other also identifies the model/type or brand of the truck. It is interesting to note that if we express (14) with a *have*-construction, only the essential reading seems to be allowed:

(17) My truck has a Ford motor.

Nevertheless, as it was the case above, this asymmetry between *there*-constructions and *have*-constructions is only apparent. Adding a circumstantial adjunct/secondary predicate dilutes the difference. For example, adding the modifier *in its trunk* forces the accidental reading (*My truck has a Ford motor in its trunk*) and adding the modifier *following factory specifications* would trigger the essential reading (*My truck has a Ford motor installed following factory specifications*). Thus, it seems that an apparent asymmetry is again the result of the greater ability of *there* to associate with a contextual parameter. There are other factors determining the emergence of one reading or other, such as the nature of the object. For example, (18) only seems to have the accidental reading:

(18) My truck has a dent.

4 Essences and varieties

The essential reading is not uniform in nature. There are several well-known varieties, depending on the relation established between the subject and the object:

- Possession: He has a house.
- Inalienable possession: A donkey's skeleton has 300 bones.
- Part-whole: This house has four windows.

- Container-containee: That glass has wine.

When we say that these relations are essential in nature, we are referring to properties that could in principle be essential for the subject, the object or both. Nevertheless, what we will be defending here is that *have*-predication relates the essential attribute directly to the object and only indirectly to the subject. For example, a house and (its) windows are essentially related by the whole-part relation; or a glass and an amount of wine by the container-containee relation. What is not implied, of course, is that it is essential for a house to have four windows or for a glass to have wine, etc. There is an asymmetry in how the predicating relation takes place. Furthermore, the nature of the relation between subject and object is lexically and contextually determined. Sometimes it is difficult to determine to which subtype an essential relation under consideration belongs, as more than one might be instantiated. Not all relations have existential-*there* equivalents. For example the partwhole and container-containee relations exemplified above have existential-*there* correlates, as in (19).

(19) a. There are four windows in this house.
b. There is wine in that glass.

On the other hand, inalienable-possession relations are normally not expressed through an existential *there*-sentence:

(20) * There is a leg in Peter.

Furthermore, not all essential relations allow the same type of restriction or certain specific restrictions. For example, the possession relation can be (spatially) restricted, as in (21). This possibility is not available for inalienable-possession and whole-part relations, as shown in (22).

(21) He has a house in New York.

(22) a. * Peter has a leg in…
b. * The glass has wine in…

There are additional semantic constraints that go beyond the definiteness restriction and are a by-product of the nature of the complement. For example, when the relevant essential relation is the container-containee relation, if the containee is expressed by a mass noun, no determiner is allowed, even if it is a weak determiner. Some measure phrases (two tons) and partitive determiners are allowed:

(23) a. The glass has wine/*a wine.
b. The boat has wood/two tons of wood.

A related restriction seems to be satisfied by inalienable-posession relations (Guéron 2003): (24a) is grammatical, because *leg* is a count noun.

(24) a. Peter has one/two legs.
b. * Peter has leg.

5 Towards a semantics for *have*

There are several theories that attempt to explain the main structural and semantic data related to *have* and its associated internal argument. A majority of these theories can be described as incorporation theories, although their assumptions and goals are very different. Syntactic incorporation theories are based on the idea that there is an X^0-movement operation incorporating the object noun into the verb. The possibility of having weak DPs as complements is explained by an additional hypothesis on determiner transparency for weak determiners. In other words, weak determiners would not block the incorporation of the object into the verb (cf. Baker 1988). Other authors defend the hypothesis that bare nominal complements are headed by null determiners (Longobardi 2001), so the asymmetry is related to the requirements associated with a null head (government, etc.).

Semantic incorporation approaches also come in two varieties: type-shifting theories or theories of lexical incorporation (van Geenhoven 1998); and mode of composition theories (Chung and Ladusaw 2003; Farkas and de Swart 2003). For both types of theories, indefinites have to be treated a properties. Theories of semantic incorporation focus on the interaction of the verb and its complement and somewhat downplay the importance of the coda. Contrastingly, in Keenan's (1987) proposal, the role of the coda is critical in determining the truth conditions of existential-*have*:

(25) A VP[*have*] of the form [*have* NP XP] is interpreted as a function mapping an individual *x* to True iff the denotation of the XP is a member of the generalized quantifier denoted by the (transitive) NP applied to *x*.

Let us consider the truth conditions for (26) according to the above definition:

(26) John has three friends in the government.

Sentence (26) would be True iff the property denoted by *in the government* (the set of individuals serving on the government in a particular situation) is a member of the generalized quantifier denoted by *three friends (of John)*. The main properties of Keenan's account are the following ones: (I) Quantificational force clearly comes from the complement; (II) the role of the XP coda becomes critical in determining the interpretation of the structure; and, finally, (III) the semantic content of *have* is light (membership). This account also takes care of what Sæbø (2009) calls 'the pertinence problem': The subject binds a variable in its complements. For example, in (26) above the three friends have to be friends of John (the subject). In what follows, I will develop a more elaborate account of the semantics of *have* that assumes the main features of Keenan's account.

6 *Have* and essential properties

I will assume that the basic semantic content of *have* is that of a light or bleached verb (Szabolcsi 1986). It denotes a function relating two generalized quantifiers or set of properties (Keenan and Westerståhl 1997; Peters and Westerståhl 2006). This core bleached meaning explains why some languages use a single copula (*be*) for attribution and relational predication and why in some languages no copula is used at all (Doron 1983). The hypothesis that a zero element is associated with a bleached meaning seems more accurate than assuming that it can typeshift and be the expression of several (contentwise-heavy) semantic relations.

The main issue becomes how to characterize the emergence of a relation between subject and object and why this relation is sometimes characterizing or essential and sometimes it is not. Let us consider the following examples:

(27) Peter has two cousins.

(28) Peter has a headache.

(29) a. ?? Peter has a tear.
b. Peter has a tear in his eye.

(30) a. ?? Peter has an apple.
b. Peter has an apple in his pocket.

In (27) the relation established between the subject and the object is that of kinship. If somebody is a cousin, he necessarily has to be somebody's cousin. Similarly, in (28) for something to be a headache it has to be a physiological process undergone or experienced by an individual. In other words, there is no headache if no individual is experiencing it. In (29) and (30) a coda is neeeded to establish the proper relation. The role of *have* (or of *be*/$\emptyset$) is to connect the two terms of a relation, but the nature of such a relation is given by the object. The relationship that associates the object and the subject has to be one that is essentially/contingently associated with the object. In sum, a sentence of the form [NP_1 *have*$_{ES}$ NP_2] establishes an essential relation between the two NPs: kinship, inalienable possession, etc. When the relation is not essential, the context or the XP modifier can supply the relevant relation.

We can say that 'to be in a kinship relation with Peter' is an essential property of *two cousins* in (27); and 'being experienced by Peter' is an essential property of *a headache* in (28). In general, [NP_1 *have*$_{ES}$ NP_2] is True iff one of the essential properties of NP_2 is to be in an essential relation R with NP_1. Formally, for arbitrary quantifiers Q and numbers *i*, let Q_{NPi} be the generalized quantifier denoted by the noun phrase NP_i, and $ES(Q_{NPi})$ the set of essential properties of Q_{NPi}. Then,

(31) [NP_1 *have*$_{ES}$ NP_2] is True iff $\exists A \in ES(Q_{NP2})$ such that $Q_{NP2}(A) \in Q_{NP1}$

The issue of what counts as an 'essence' or, putting it differently, of which requirements have to be satisfied by a property in order to count as essential has been the subject of an extensive philosophical debate. Here I will adopt Lebiniz's criterion that there is no essence without existence (Plantinga 1974; Zalta 2000). A property of an individual can be considered essential for that individual iff that individual cannot exist without such property. If this property were lacking, the individual in question would be a different one. Generalizing, we say that a property P is essential for a generalized quantifier Q iff it is a requirement for the existence of Q. In other words, P is an essential property of a generalized quantifier Q iff P is a member of Q iff the property of existence is a member of Q. Formally, let Q_{NPi} be the generalized quantifier denoted by NP_i and E the property of existence — the denotation of the predicate exist (Barwise and Cooper 1981; Keenan 1987). Then, for any property $P \in Q_{NPi}$, the following can be stated:

(32) P is an essential property of Q_{NPi} ($P \in ES(Q_{NPi})$) iff $P \in Q_{NPi}$ iff $E \in Q_{NPi}$.

From this characterization, it would follow that those sentences where the attribution of an essential property takes place satisfy the definiteness restriction and, in the case of *have*-sentences, Keenan's generalization also holds. Let us see why. Only existential generalized quantifiers (those for which $E \in Q$) occur in existential constructions. Given that a quantifier has to be existential for an essential property to be one of its members, if P is essential for Q, then Q has to be a (generalized) existential quantifer. Stating it differently, only generalized existential quantifiers have essential properties as members. The intuition behind this hypothesis seems clear. For example, it would be an essential property of *a cousin* to be in the kinship relations with someone. On the other hand, the same could not be said of *this particular cousin*, of *every cousin* etc. since E is not a member of these quantifiers in every model. This is so either because non-existential quantifers are partial or not defined in some models (such is the case of definites) or because they are vacuously true in empty universes (such is the case with universal quantifiers). From the above discussion, the following semantic characterization of *have* emerges:

(33) $have_{\mathrm{ES}}$ denotes the function f such that for any generalized quantifiers Q_1, Q_2, $f(Q_2)(Q_1) = \text{True iff } \exists P \in ES(Q_2) \text{ such that } Q_2(P) \in Q_1$.

It follows as a theorem that Q_2 is existential. Let us consider sentence (34):

(34) The house has four windows.

This sentence establishes an essential predication relation: being in a part-whole relation. It is an essential property of windows to be part of a building, i.e. the range of the whole-part relation (or its "passivization", Keenan and Faltz 1985):

(35) $RG(\lambda y \lambda x[\textsc{whole-part}(x,y)]) = \lambda y \exists x[\textsc{whole-part}(x,y)]$

Let Q_1 be the denotation of *the house*. Then, the house has the property 'be in a whole-part relation with four windows', i.e. the generalized quantifier THE_HOUSE has as a member the set $\textsc{four\_windows}(\lambda y \lambda x[\textsc{whole-part}(x,y)]) = \lambda x \exists_4 y[\textsc{whole-part}(x,y) \,\&\, \text{House}(y)]$. In general, let Q_1, Q_2 be generalized quantifiers, R a relation, and ES(Q) the set of essential properties of Q. Then,

(36) $have_{\mathrm{R-ES}}$ (have R essentially) denotes the function f such that $f(R)(Q_2)(Q_1) = \text{True iff } RG(R) \in ES(Q_2) \,\&\, Q_2(R) \in Q_1$.

Consider now the following examples:

(37) a. Peter has a house.
b. Peter has a house in the Bahamas.

(38) Peter has my pencil in his pocket.

The essential property P for *a house* in (37a) is 'being owned by somebody', i.e. the range of the possession/ownership relation: $RG(\lambda y \lambda x[\textsc{own}(x,y)]) = \lambda y \exists x[\textsc{own}(x,y)]$. Let PETER be the denotation of *Peter*, (the individual generated by Peter; Keenan 1995). Then, PETER has the property 'own a house', i.e. $\textsc{a\_house}(\lambda y \lambda x[\textsc{own}(x,y)]) = \lambda x \exists y[\textsc{own}(x,y) \,\&\, \textsc{house}(y)]$. Sentence (37a) is only a statement about home-ownership. On the other hand, (37b) and (38) are slightly different. (37b) is also a statement about home-ownership, but restricted to a particular location. Since the definiteness restriction is satisfied (**Peter* *has the house in the Bahamas*), we conclude that what is being predicated is an essential (characterizing) property, namely, ownership. Although structurally similar, sentence (38) is very different from a semantic point of view. The speaker only states the location of a particular pencil inside his pocket. As a matter of fact, (38) does not entail or implicate that Peter owns my pencil now, quite the contrary. What we can infer from the above contrasts is that we have to distinguish the notions of essence, restricted essence and location. All of them can be expressed with *have*-sentences, but their semantic ingredients are distinct.

The transition from one reading to another is a matter of degree, and it is also a by-product of contextual restriction: restriction to a (context) set. The role of the modifying adjunct is to introduce a context set restricting the predicated property. When the restricted property is still an essential property (the property is still in the set ES), then the 'restricted essence' reading arises. When the property is no longer essential (it is not in ES), we get the locative reading. Context can be treated as a set-theoretical parameter (Peters and Westerståhl 2006). The notion of restricted essence or of a restricted essential property is defined as follows: Let Q be a generalized quantifier, E the property of existence and C a context set (usually expressed by the XP adjunct). Then, for any property $P \in Q$,

(39) P is an essential property of Q in C ($P \in ES^C(Q)$) iff
$P \in Q$ iff $(E \cap C) \in Q$ iff $C \in Q$.

When *have* is the copula used in restricted essential predication, nothing changes in the characterization of *have*. The only difference is that the relation attributed to the object quantifier is an essential property restricted to a context set. Formally, let Q_1, Q_2 be generalized quantifiers, R a relation, and for any quantifier Q, ES(Q) the set of essential properties of Q. Then,

(40) $have_{\text{R-ES-C}}$ (have R essentially in C) denotes the function f such that
$f(R)(C)(Q_2)(Q_1) = \text{True}$ iff $RG(R) \in ES^C(Q_2)$ & $Q_2(R) \in Q_1$.

Let us see how this would work in a concrete example. In sentence (41), a birthmark is in an essential part-whole relation with John.

(41) Peter has a birthmark on his left leg.

The predicative relation expressed here is not merely between John and his birthmark. The adjunct *on his left leg* situates the appropriate whole where the birthmark is. In our terms, the relevant essential relation is 'whole-part' restricted to 'left leg'. The adjunct PP *on his left leg* determines the relevant context: The property of having a birthmak is an essential property of Peter's leg (i.e. it is an essential property of Peter "restricted" to his leg):

(42) HAVE-ON-HIS-LEFT-LEG (A_BIRTHMARK) (Peter) = True iff
RG(WHOLE-PART) $\in ES^{\text{LEFT\_LEG}}$(A_BIRTHMARK) &
A_BIRTHMARK(WHOLE-PART) $\in$ PETER

In the locative reading, the relevant relation is not an essential property of the object (neither properly nor in a restricted sense). No restriction is imposed with respect to the relation associating subject and object. Formally, let Q_1, Q_2 be generalized quantifiers, and R a relation. Then,

(43) $have_{\text{R-LOC}}$ denotes the function f such that $f(R)(Q_2)(Q_1) = \text{True}$ iff
$RG(R) \in Q_2$ & $Q_2(R) \in Q_1$.

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Affiliation

Javier Gutiérrez-Rexach
The Ohio State University
gutier@gmail.com

Prospects for a Syntactic Analysis of Conservativity

Peter Hallman

Recent suggestions that the conservativity property of natural language detemerminers is related to the copy theory of movement are reviewed. It is found that copy theory in its present form is not sufficient to guarantee that non-conservative determiners have trivial truth conditions in quantifier raising constructions. Possible augmentations of copy theory are discussed.

Keywords Generalized Quantifier Theory, Copy Theory, Conservativity

Introduction

The model theoretic tradition in semantic analysis maintains that determiners denote functions from properties to sets of properties, where in an extensional model a property is a set of individuals. For a determiner d and properties p and q I write '$d(p,q)$' for '$[d(p)](q)$' and refer to p as d's 'restrictor' and to q as its 'nuclear scope'. Barwise and Cooper (1981) and Keenan and Stavi (1986) claim that natural language determiners denote 'conservative' functions. The denotation of a conservative determiner function is insensitive to that portion of the nuclear scope that is not included in the restrictor. Keenan and Stavi define conservativity as in (1a). Put another way, conservative determiners display the equivalency in (1b) for any choice of p and q.

(1) a. A function f is *conservative* iff for all properties p, q $p \in f(q)$ iff $(p \wedge q) \in f(q)$.
b. $[\![d(p,q)]\!] = [\![d(p, p \wedge q)]\!]$

Fox (2002) and Sportiche (2005) entertain the possibility that the conservativity property of determiners falls out from the copy theory of movement (Chomsky 1993) in combination with the fact that natural language determiners are what Barwise and Cooper call 'sieves', that is, functions that are neither always true nor always false, which Sportiche characterizes as a prerequisite for learnability. This claim is evaluated here. It is found that copy theory in its present form is not sufficient to derive the conservativity property but that in combination with an additional stipulation the suggestion made by Fox and Sportiche is feasible.

1 The Semantic Consequences of Copy Theory

To capture reconstruction effects within a theory of syntactic movement, Chomsky (1993) claims that movement of a term leaves a copy of that term in the extraction site. Fox (2002) claims that moved DPs are interpreted by a transform that he calls 'Trace Conversion', defined in (2), where the expression $\lambda y(y = x)$ modifes Pred and x is the variable bound by the moved quantifier. Raising of the quantifier *every boy* in (3a) derives the representation in (3b), which is interpreted by trace conversion as in (3c).

(2) (Det) Pred $\rightarrow$ the [Pred $\lambda y(y = x)$]

(3) a. a girl talked to every boy
b. every boy$_x$ [a girl talked to [every boy]$_x$]
c. every boy$_x$ [a girl talked to [the [boy $\wedge$ $\lambda y(y = x)$]]]

In a footnote, Fox remarks that for a determiner D that is not conservative, "figuring out the truth value of D(A,B) requires verifying membership in B for individuals that are not members of A. However, given the copy theory of movement and Trace Conversion, the (characteristic function of the) second argument of D is a partial function defined only for elements that are members of A. It is reasonable to assume that this situation would yield systematic presupposition failure" (p. 67).

Sportiche (2005) claims that while determiners are base generated in functional structure above the verb phrase, the determiner's restriction is base generated in a theta position, where it is subject to selectional constraints locally imposed by the predicate. The base structure of the sentence *Every cat slept* is roughly that in (4a), in which the determiner *every* is VP external and the restriction *cat* is in a VP internal theta position. Movement of *cat* into the restriction of *every* leaves a copy in the theta position, deriving the representation in (4b). The two VP internal predicates are interpreted intersectively, so that the representation in (4b) asserts that every cat is a cat who slept.

(4) a. [$_{\text{TP}}$ every [$_{\text{VP}}$ cat sleep]]
b. [$_{\text{TP}}$ every cat [$_{\text{VP}}$ cat sleep]]

Sportiche remarks that if D were non-conservative, then "if the syntactic structure of D NP VP really is D NP [NP V'], such a sentence would always be false for any NP, since it would say that [some non-NPs] have the property NP (and the property V')" (p. 85).

Consider the hypothetical determiner *flish* with the denotation in (5a). *Flish* is true of properties p and q iff there are more than three q's that are not p's. The sentence *Flish linguists are vegetarians* is true if there are more than three vegetarians who are not linguists (5b). For *flish* to be conservative, the expression *flish(linguist,vegetarian)*, which has the truth conditions spelled out in (5b), would have to be equivalent to the expression *flish(linguist, linguist* $\wedge$ *vegetarian)*, which has the truth conditions spelled out out in (5c). That this is not so is evident. *Flish* is non-conservative.

(5) a. $[\![$flish(p,q)$]\!]$ = 1 iff $|[\![$q$]\!]$-$[\![$p$]\!]| \geq 3$
b. $[\![$flish(linguist, vegetarian)$]\!]$ =1 iff there are more than three vegetarians who are not linguists
c. $[\![$flish(linguist, linguist $\wedge$ vegetarian)$]\!]$ = 1 iff there are more than three vegetarians who are linguists who are not linguists

Consider now the interpretation of this hypothetical non-conservative determiner in intensional contexts. (6) asserts, according to (5a), that there are more than three things that seem to be in the garden that are not unicorns (i.e., several non-unicorns seem to be in the garden).

(6) Flish unicorns seem to be in the garden.

On the Fox/Sportiche account, (6) has the LF in (7), with a representation of the quantifier restrictor inside the nuclear scope.

(7) Flish unicorns [seem to be unicorns in the garden]

This LF is interpreted as the assertion that there are more than three things that seem to be unicorns in the garden, that are not in fact unicorns. This assertion is likely to be true in the real world if three things that could be mistaken for unicorns are in the garden, but would be false if there were only two non-unicorns in the garden or if three things in the garden actually did turn out to be unicorns. As cases like this show, positing a copy of the quantifier restriction in the base position of the quantifier does not alway lead to the systematic contradiction equivalent in effect to the conservativity restriction. That copy theory does not always produce structures that mimic conservativity is evident in the side-by-side comparison in (8). (8a) is the interpretation imposed on (6) by conservativity. (8b) is the LF postulated by Fox and by Sportiche.

(8) a. flish(unicorns, unicorns $\wedge$ seem to be in the garden)
b. flish(unicorns, seem to be unicorns in the garden)

There is a difference in the scope of the 'double' of the quantifier restriction in the two formulas. The restriction is predicate external in (8a) and predicate internal in (8b). (8b) does not restrict the meaning of *flish* to the conservative (systematically contradictory) one.

2 Possible Directions

Fox casts his copy of the quantifier restriction as a definite description to ensure that the result of Trace Conversion is individual-denoting. Trace Conversion creates an LF with an occurrence of the word *the*. Though Fox does not elaborate on the interpretation of this term, his paraphase of (9a) as (9b) suggests that *the* in his formula has roughly the same meaning as its metalanguage counterpart, which is arguably world invariant.

(9) a. every boy a girl talked to every boy [derived structure]
b. For every boy x, there is a girl who talked to *the boy x* [interpretation after trace conversion]

Definite descriptions presuppose the existence of an instance of the restrictor property, so that, for example, *the unicorn* in (10) is understood to be an actual unicorn though it may or may not actually be in the garden (Strawson 1950).

(10) It seems that the unicorn is in the garden.

The fact that definite descriptions do not interact with intensional operators would ensure that traces, if they are definite descriptions, always attribute the property denoted by the restrictor of their antecedent to a real-world entity. Then (7) would denote the contradictory assertion that there are more than three *actual* unicorns in the garden, that are not unicorns. But the existence presupposition of definite descriptions is too strong a requirement for the trace of raised quantifiers, since it would commit to the existence of an instance of the quantifier restriction whenever movement obtains. Movement has arguably obtained in (11a), where the subject *no unicorn* occurs to the left of the auxiliary (Koopman and Sportiche 1991). But however the trace conversion in (11b) is interpreted, the function of *the* there does not have the effect of asserting the existence of a unicorn in the real world. If it did, (11a) would make the contradictory assertion that no unicorn will be the unique real-world unicorn on exhibit at the state fair this year. The term *the* in Fox's Trace Conversion is therefore not the English word *the*, and the existence presupposition of the English word *the* will not help us derive conservativity.

(11) a. No unicorn will be on exhibit at the state fair this year.
b. no unicorn$_x$ will be [the [unicorn $\wedge$ $\lambda y(y = x)$]] on exhibit at the state fair

Sportiche mentions a similar issue in connection with the example in (12) (modified slightly from his (147), p. 85).

(12) Which democrat doesn't John think won?

The fact that the individual in question is a democrat is not necessarily asserted to be part of the thought attributed to John. That is, (13a) represents a better characterization of the meaning of (12) than (13b). If (12) were interpreted along the lines of (13b), then we could answer "Bill" if John does not think that Bill is a democrat, regardless whether he thinks he won.

(13) a. For which democrat *x*, John doesn't think that *x* won
b. For which democrat *x*, John doesn't think that *x* is a democrat and *x* won

Sportiche claims that the restriction of *which* and its copy are not two distinct objects for the purposes of semantic computation and consequently cannot differ in the value of their world variable. An implementation of this idea might look like the following. Assume that *think* is interpreted along the lines presented in Heim and Kratzer's (1998) implementation of Hintikka's (1962) analysis of the meaning of *believe*. The sentence *John thinks that x won* is represented in (14), where "dox$_w$(John, w')" reads "w' is compatible with what John believes in w".

(14) $[\![\text{John thinks that x won}]\!]^w = \forall w'\ \text{dox}_w(\text{John}, w') \rightarrow [\![x \text{ wins}]\!]^{w'}{=}1$

If we coordinate *x won* with *x is a democrat* we get the problem that Sportiche describes—that we have attributed to John the belief that *x* is a democrat (15).

(15) $\forall w'\ \text{dox}_w(\text{John}, w') \rightarrow [\![x \text{ wins}]\!]^{w'}{=}1 \text{ and } [\![x \text{ is a democrat}]\!]^{w'}{=}1$

If we assume as Sportiche suggests that the description *democrat* inherits the world variable of its antecedent—the value with respect to which the matrix clause is interpreted (the 'real' world)—we get (16).

(16) $\forall w' \; \mathrm{dox}_w(\mathrm{John}, w') \rightarrow [\![x \text{ wins}]\!]^{w'}{=}1$ and $[\![x \text{ is a democrat}]\!]^{w}{=}1$

We could extend this characterization to the problem that (7) presents, taking *seem* to quantify over worlds experientially accessible to an implicit experiencer *y*.

(17) $\forall w' \; \mathrm{exp}_w(y, w') \rightarrow [\![x \text{ is in the garden}]\!]^{w'}{=}1$ and $[\![x \text{ is a unicorn}]\!]^{w}{=}1$

Now the descriptions *democrat* and *unicorn* contain no variables bound within the scope of the world quantifiers *think* and *seem* respectively. We have, in effect, semantically removed these descriptions from the world-creating predicate in which they occur in the surface structure. The 'in situ' description is for all practical purposes interpreted outside the scope of the clausemate intensional predicate. In configurational terms, we interpret a representation like (18a) (cf. (8b)) as if it were the one in (18b) (cf. (8a)).

(18) a. $[\ldots p \ldots]_q$
b. $[p \wedge q]$

Without a semantic intervention of the type Sportiche suggests, the in situ copy of the raised quantifier in each of these cases is too low in the structure to have the effect of the representation in (18b). That is, the problem with the copy theory explanation of conservativity arises because of the low scope of the copy. Consequently, copy theories of movement would straightforwardly derive the conservativity restriction if they raised the copy, or, more plausibly, if they required a raised quantifier to adjoin a copy of its restriction to its nuclear scope *en passant* (whether or not it also leaves a copy in the base position), deriving a representation like (19b) from (19a), where Q is any quantifier (recall though that according to Sportiche only the restriction is included in the base structure in (19a), not the quantifier).

(19) a. [seems to be Q unicorn in the garden]]]
b. [Q unicorn$_i$ [[unicorn]$_i$ [seems to be unicorn$_i$ in the garden]]]

If this is so, then movement could in fact be held indirectly responsible for the conservativity property of determiners, though the lowest copy would play no role in this effect, and we still need a way of ensuring that the lowest copy is interpreted with respect to the same world as its antecedent. The fact that movement is successive cyclic presents a possible explanation for the representation in (19b), but I know of no evidence specifically corroborating the intermediate step in that representation.

Conclusion

I conclude that the copy theory of movement in its present form does not readily lend itself to an explanation for the conservativity property of natural language determiners. In a revised theory which posits an obligatory final step of movement through a position directly below the ultimate landing site, the conservativity restriction could be characterized as an aftereffect of the resulting syntactic structure, but the copy in the base position plays no role, and in fact must be effectively invisible for some purposes.

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Affiliation

Peter Hallman
Linguistics Institute
University of Vienna
peter@peterhallman.com

How to compare major word-classes across the world's languages

Martin Haspelmath

1 Introduction

In this paper, I argue that major word-classes, such as nouns, verbs and adjectives, cannot be compared across languages by asking questions such as those in (1) and (2). Such questions are routinely asked by linguists (functionalists and generativists alike), but these are the wrong questions (cf. Croft 2000), because they make presuppositions which are not valid.

(1) language-particular questions
   Does language X have a noun-verb distinction?
   Does language X have a verb-adjective distinction?
   Does language X have a noun-adjective distinction?

(2) cross-linguistic questions
   Do all languages have a noun-verb distinction?
   Do all languages have a verb-adjective distinction?
   Do all languages have a noun-adjective distinction?

Questions like these would make sense only if we could define noun, verb and adjective as cross-linguistic categories, but cross-linguistic categories do not exist (Croft 2001, Haspelmath 2007, 2010). Categories represent language-particular generalizations and cannot be carried over from language to another one.

This categorial particularist position has been stated clearly by Keenan & Stabler (2003: 1):

> "On our approach different languages do have non-trivially different grammars: their grammatical categories are defined internal to the language and may fail to be comparable to ones used for other languages. Their rules, ways of building complex expressions from simpler ones, may also fail to be isomorphic across languages."

But still, we want to compare languages and extract generalizations from all the observed diversity. Keenan & Stabler propose an approach that is similar to the line of thinking pursued here in that it identifies linguistic invariants without assuming (as many linguists do) that all languages are built from the same building blocks. I will not compare their approach to mine in detail, leaving that as a task for future research.

Edward Keenan has often asked to what extent natural languages differ from logic, and if so, why (e.g. Keenan 1974). In predicate logic, there is no difference between nouns, verbs and adjectives. A formula such as (3), with a predicate *P* and an argument *n*, would be used to render sentences like 'Charles is a teacher', 'A naked one is playing', or 'The netting is plentiful'.

(3) *P (n)*

But intuitively, despite the semantic similarity of such predicational sentences, linguists agree that grammars of natural languages do show differences between different word-classes. But they rarely agree about the precise number of such word-classes and about cross-linguistic trends. Why is this so? In this paper, I argue that these problems are to a large extent due to a simple misunderstanding, namely that grammatical categories are cross-linguistic entities. The fundamental insight is due to Croft (1991), (2000), (2001: ch. 2), but even though Croft's work has been widely cited and read, many linguists have not drawn the necessary consequences from his arguments yet. And the way I formulate the approach is somewhat different from Croft's.

I will end up concluding that word-classes cannot be compared directly across languages because of their language-particular nature, but it is not difficult to find strong cross-linguistic trends in the domain of word-class coding.

2 Terminological preliminaries

Before getting to the heart of the issue in the next sections, let us consider some terminological issues in the present section.

The first thing to observe is that while the three terms *noun*, *verb* and *adjective* are used universally and uniformly among linguists (and have been in universal and uniform use in the current senses for over a century), the general term *word-class* that is used here is not nearly as widespread. Alternative terms with considerable currency are *part of speech* and *lexical category*.

The term *part of speech* goes back to classical antiquity (Greek *ta mérē tou lógou*, Latin *partes orationis*) and reflects a period of linguistics that did not distinguish clearly between speech and language, and between classes and items. In modern parlance, grammarians talk about elements of *sentences* (not of *speech*), and about *classes* of such elements, not about "parts" of a sentence. Furthermore, we nowadays distinguish between immediate constituents (of which a sentence has only a few, often as little as two) and ultimate constituents (words or elementary morphs). Nouns, verbs and adjectives are classes of ultimate constituents, not classes of larger, phrasal constituents. Thus, the term *part of speech* is about as opaque semantically as the term *accusative* (which has nothing to do with accusation), but because of its transparent syntax, its opacity is even more confusing. For these reason, I would not recommend it, but of course it has a venerable tradition behind it. The term is enjoying considerable popularity, especially in typological circles (e.g. Anward et al. 1997, Hengeveld et al. 2004, Hengeveld & van Lier 2010).[1]

In generative grammar, the term *syntactic category* has been used for classes of constituents (from the word level to the sentence level) since Chomsky (1957); see Rauh (2010) for a detailed account. However, nouns, verbs and adjectives were not considered an interesting issue in generative linguistics for the first few decades; it was simply assumed by almost everyone that all languages have them. In Croft (1991), the term *syntactic category* is used for nouns, verbs and adjectives in a typological context. Since the 1990s, the terminal-node categories have generally been divided into functional categories and lexical categories, so nouns, verbs and adjectives came to be known as *lexical categories* (e.g. Davis & Matthewson 1999, Baker 2003, Chung 2012). This term

[1] Interestingly, Hengeveld & van Lier (2010) us the compound term *parts of speech class*, rather than the old term *part of speech* itself.

is more in line with modern terminology, but in view of the ambiguity of the term *lexical*[2] and the vagueness of the term *category*, it is not an improvement over the simple term *word-class*.

In this paper, the term *word-class* is used for language-particular categories such as English Nouns or Japanese Verbal Adjectives. (I normally capitalize labels of language-particular categories, cf. Haspelmath 2010: §6).

Note that I will limit myself to major word-classes, iognoring classes such as adpositions, adverbs, particles and interjections.

3 First problem: different criteria in different languages

If one adopts a categorial universalist position, i.e. compares languages starting out with the assumption that they will basically have the same categories, one must be willing to apply different criteria in different languages. For example, to identify "nouns" in Ancient Greek, English and Mandarin Chinese, quite different criteria are commonly applied. This can be seen in (4a-c).

(4) a. Greek Noun (Dionysius Thrax, Ars minor, 2nd c. BCE)
ὄνομά ἐστι μέρος λόγου πτωτικόν, σῶμα ἢ πρᾶγμα σημαῖνον
'a Noun is a case-inflected part of speech that denotes a thing or an action'

b. English Noun (Quirk et al. 1985: 72)
a Noun is a word that can follow determiners like *the, this* and *that*

c. Mandarin Chinese Noun
a Noun is a word that can follow a classifier

That the same category should be reflected in different kinds of formal properties in different languages is perhaps not exactly what one would expect, but universalists do not take it as evidence against the assumption that all languages have the same categories. As long as SOME criteria can be found for noun status, universalists are content.

But which properties can be taken as evidence for category assignment? There are no constraints on this – each linguist can make their own choices (this is what Croft 2009 calls "methodological opportunism"). The method is thus subjective and not rigorous (cf. also Post 2008: 377-78). Rigorous comparison requires that languages be compared in terms of concepts that apply in the same way to all languages. We will see some examples of the nonrigorousness of the approach below.

4 Second problem: major classes vs. subclasses

If one starts out by asking whether a language has a distinction between nouns and verbs, or between verbs and adjectives, one presupposes that nouns, verbs, and adjectives can only be major classes. But what if their relationship can equally be described as a

[2] *Lexical* can mean (1) 'relating to the lexicon' (e.g. *lexical rule, lexical exception*), and it can mean (2) 'relating to words' (e.g. *lexical stress*). To the extent that the lexicon is conceived of as the repertoire of words, these two senses are closely related, but if the lexicon is thought of as a list of all elements that are not fully derivable by rule (as is routinely done by linguists), then *lexical* can also be used for idiomatic phrases or even sentences.

subclass relationship? In actual fact, this is very often the case. If two classes share a property that another class lacks, one can say that the two classes form a macro-class on the basis of this property.

In this way one can, for instance, argue for collapsing nouns and adjectives into a macro-class if they have some similarities. This is in fact the traditional view in Western linguistics, going back all the way to the earliest grammatical descriptions of Greek and Latin. Latin words such as *homo* 'man' and *novus* 'new' were long regarded as belonging to the category *nomen* (Greek *onoma*, cf. 4a above), which was on a par with *verbum*, *praepositio*, etc. (see 5). This category was later subcategorized into *nomen substantivum* and *nomen adjectivum*, but it was only in 19th century linguistics that substantives and adjectives were regarded as word-classes on a par with verbs and prepositions.[3]

(5) verbum nomen adverbium praepositio etc.

nomen substantivum nomen adjectivum

On the basis of the criteria that were usually considered, this was a very reasonable decision. As Table 1 shows, substantives and adjectives in Latin share many properties that oppose them to verbs (case, intrinsic number, no person, no tense, predicative copula, referential use), so we can say that Latin has two major word classes Nomen and Verbum.

Table 1: Latin *Nomina* and *Verba*

	Nomen		Verbum
	Substantivum	Adjectivum	
inflection	+	+	+
case	+	+	–
intrinsic number	+	+	–
person	–	–	+
tense	–	–	+
copula in predicative use	+	+	–
referential use	+	+	–
attributive use	–	+	–
comparative construction	–	+	–

On the other hand, Substantiva and Adjectiva differ with respect to the last two criteria in Table 1, attributive use and use in comparative constructions (which is possible only for adjectives). The Nomen class thus has two subclasses, Nomen Substantivum and Nomen Adjectivum.

But since Nomina and Verba also share at least one property that opposes them to other words (particles, prepositions, interjections, etc.), namely the possibility to inflect, one might say that the real major classes in Latin are the Flectibilia (inflectible words) and the Nonflectibilia (uninflectible words, which themselves of course fall into several subclasses based on other criteria). This is shown in Table 2.

[3] For some reason, substantives came to be called *nouns* in English (where the term *substantive* is rarely used), while in German, the term *nomen* fell out of (common) use.

Table 2: Latin *Flectibilia* and *Nonflectibilia*

	Flectibile			Nonflectibile
	Nomen		Verbum	
	Substantivum	Adjectivum		
inflection	+	+	+	–
case	+	+	–	
intrinsic number	+	+	–	
person	–	–	+	
tense	–	–	+	
copula in predicative use	+	+	–	
referential use	+	+	–	
attributive use	–	+	–	
comparative construction	–	+	–	

Linguists do not normally set up major word classes that comprise both thing words and action words, but if we go strictly by the criteria of individual languages, there is no justification for this. Limiting major word-classes to noun-like, adjective-like and verb-like classes can be justified only by the assumption that all languages have the categories that we know from school.[4] Some linguists do this only because they do not think very hard about the differences between languages, but for others, it is an explicit programme. Thus, Chomsky (2001) formulated the principle in (6).

(6) Uniformity Principle
In the absence of compelling evidence to the contrary, assume languages to be uniform, with variety restricted to easily detectable properties of utterances. (Chomsky 2001: 2)

But what would be compelling evidence against the assumption that all languages have nouns, verbs and adjectives as word classes, if just any kind of criterion can be applied (cf. §3)? Would the fact that we have not found a difference between thing words and property words count as compelling evidence? Surely not, because one can always suspect that there is some minute difference which has not come to our attention yet.

And what would be compelling evidence against the assumption that nouns, verbs and adjectives are major word classes in all languages where these can be distinguished in some way? How could one, for instance, argue that Substantiva and Adjectiva are subclasses of Nomina in Latin rather than major word classes? Intuitively, the number and "weight" of the properties which they share should play a role, but there is no rigorous way of making the distinction between major classes that share properties and subclasses. That the distinction is not a substantive one but purely a notational distinction was noted by the first thorough cross-linguistic study of major word-classes, Schachter (1985):

> "One might wish to say that in some languages, such as Nootka and Tagalog, nouns and verbs have enough in common grammatically for there to be some question about whether to regard them as two subclasses of a single part of speech rather than two distinct parts of

[4] Or perhaps by the fact that noun-like, adjective-like and verb-like classes are reasonably large, open classes about which one could write separate sections or even chapters in grammar books. But this is a practical consideration with no significance for the nature of language(s).

> speech. Since it seems to be essentially **a matter of terminology**, it need not concern us further." (Schachter 1985: 13; boldface mine)

Thus, the Uniformity Principle seems to inevitably lead us to the conclusion that all languages have the properties of English school grammar (cf. Haspelmath 2012). Rigorous cross-linguistic research must accept that languages differ considerably, and must try to find similarities, and maybe even universal trends, despite these differences.

5 How to compare languages: not with categories, but with comparative concepts

We thus cannot presuppose that "noun", "verb" and "adjective" are universally available cross-linguistic categories, because categories of grammar are language-particular. They express language-particular generalizations, or in other words, they are defined with respect to language-particular criteria, and thus they can never be equated across languages. Each language has its own categories (Boas 1911, Lazard 1992, Dryer 1997, Croft 2001, Haspelmath 2007). The questions in (1) and (2) can thus be compared with questions such as those in (7):

(7) a. What is the line of succession to the German throne?
 b. How many states are there in France?
 c. Who is San Marino's Minister of Aviation?

These are the wrong questions, because the political organization of countries is different, so categories cannot be equated across countries. Germany has no monarchy, so (7a) can be asked about Belgium, but not about Germany. France is divided into departments (not into states), so (7b) can be asked about the U.S., but not about France, and San Marino has a different set of ministries than other countries. The presuppositions are not fulfilled, so one cannot ask these questions.

In the domain of political organization, countries nowadays often equate their categories to make communication easier. Thus, each country has a "head of state" (whatever the local designation or role in the political system), and for official state visits the heads of state meet and obey certain international rules of protocol. To some extent, these equations then influence the political systems of different countries.

Linguists also often equate categories across languages to make it easier to talk about them, but this has no influence on the languages, of course.[5] If the extension of terms that are familiar from one language to use in the description of another language is purely for reasons of convenience (it is easier to remember the term "Verb" than the term "category number 3"), then there is no problem. But equating categories across languages in a deeper sense (i.e. for purposes of language comparison) is not possible, because categories are defined by language-particular criteria, as seen in (4a-c). Clearly, then, languages cannot be compared directly on the basis of their grammatical categories. We need a *tertium comparationis* that is not language-particular, but is universally applicable.

To be universally applicable, comparative concepts can be defined on the basis of meaning or sound, but not on the basis of meaning-sound combinations, because these are language-particular.

A very simple definition of comparative concepts for major word-classes is a semantic one:

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[5] However, when bilingual speakers equate the categories of the languages they speak, this may of course lead to mutual accommodation (contact-induced grammatical change).

(8) a. a noun is a word that denotes a thing or place
b. a verb is a word that denotes an action or process
c. an adjective is a word that denotes a property

Typologists have in fact generally worked with this kind of definition, e.g. when determining noun-adjective order or verb-object order in a large number of languages (Greenberg 1963, Dryer 2005a, 2005b).

However, here I would like to propose a more narrowly defined set of concepts, given in (9). Further below (§10) I will explain these notions in more detail.

(9) a. thing-root: a root that denotes a physical object (animate or inanimate)
b. action-root: a root that denotes a volitional action
c. property-root: a root that denotes a property such as age, dimension or value

Unlike the comparative concepts in (8), those in (9) have labels that remind us of their semantic basis. But this is merely a notational difference. It is often more practical to use opaque terms like those in (8). If it is clear that one is talking about comparative concepts, not about language-particular descriptive categories, then using grammar-derived nonsemantic terms such as "noun" does not do much harm.

6 Widely asked wrong questions

As we saw in the introduction, linguists often ask questions such as those in (10) and (11) (repeated from (1)-(2) above):

(10) language-particular questions
Does language X have a noun-verb distinction?
Does language X have a verb-adjective distinction?
Does language X have a noun-adjective distinction?

(11) cross-linguistic questions
Do all languages have a noun-verb distinction?
Do all languages have a verb-adjective distinction?
Do all languages have a noun-adjective distinction?

Some linguists have answered no, and others have answered yes. Table 3 gives a summary of recent work that addresses these questions.[6]

[6] I say "recent work", because the question of word-class universality is an old one, going back at least to the first half of the 19^{th} century. At the time, it was often said that Indo-European languages are particularly elaborate and developed in their word-class distinctions, and non-Indo-European languages with less developed inflection, or less distinctive inflection for nouns and verbs, were said to lack noun-verb distinctions (e.g. Müller 1861-64).

Table 3: Answers to the questions in (10) and (11) in the literature

		NO	YES
noun-verb distinction	**ALL languages**	**Hengeveld 1992**	**Baker 2003, Dixon 2010.2**
	Iroquoian	Sasse 1988, 1991	Mithun 2000
	Salishan	Kuipers 1968, Kinkade 1983	van Eijk & Hess 1986, Davis & Matthewson 1999, Beck 2012+
	Mundari	Hoffmann 1903, Hengeveld 1992	Evans & Osada 2005
	Tagalog	Gil 2000, Himmelmann 2008, Kaufman 2009	Aldridge 2009, Richards 2009
	Polynesian	Mosel & Hovdhaugen 1992	Vonen 2000
noun-adjective distinction	**ALL languages**	**Evans & Levinson 2009**	**Baker 2003, Dixon 2004**
	Quechua	Weber 1989, Hengeveld 1992	Floyd 2011
verb-adjective distinction	**ALL languages**	**Evans & Levinson 2009**	**Baker 2003, Dixon 2004**
	Mandarin Chinese	McCawley 1992	Paul 2005
	Chamorro	Topping 1973	Chung 2012
	Caribbean English Creole	Sebba 1986, Winford 1997	Seuren 1986

The general trend seems to be that earlier work has tended to deny word-class distinctions, whereas more recent work has tended to (re-)assert word-class distinctions of the familiar type (e.g. Sasse 1988 vs. Mithun 2000 for Iroquoian, Kinkade 1983 vs. Davis & Matthewson 1999 for Salishan, McCawley 1992 vs. Paul 2005 for Mandarin Chinese, etc.). Thus, earlier linguists tended to be lumpers, whereas more recently they have tended to be splitters. It appears that the categorial universalist approach has gained in popularity in recent decades. However, as I will show in the next sections for three examples, the claims that a language is really more like English are often not justified by actual properties of the language, but by a categorial universalist approach. But as we saw earlier, such an approach is incompatible with rigorous cross-linguistic comparison.

7 A wrong question: Are there adjectives in Quechua? (Floyd 2011)

To see what sorts of problems arise if one presupposes the existence of verbs, nouns and adjectives as cross-linguistic categories, we will now look at some concrete examples, beginning with "adjectives" in varieties of Quechua.

Weber (1989: 35-36) adopted a lumping approach and claimed that Huallaga Quechua has no noun-adjective distinction. Both thing-roots and property-roots can be used for reference (as in 12), both thing-roots and property-roots require the copula *ka-* when used predicatively (as in 13), and both thing-roots and property-roots can be used prenominally for attributive use (as in 14).

(12) a. *rumi-ta* *rikaa* (reference use)
stone-ACC see.1SG
'I see the stone.'

b. *hatun-ta* *rikaa*
big-ACC see.1SG
'I see the big one.'

(13) a. *Taqay* *rumi* *ka-yka-n.* (predication use)
that stone be-IMPFV-3
'That is a stone.'

b. *Taqay* *hatun* *ka-yka-n.*
that big be-IMPFV-3
'That is big / a big one.'

(14) a. *rumi* *wasi* (attribution use)
stone house
'stone house'

b. *hatun wasi*
big house
'big house'

This view of Quechua was adopted by a number of other authors, especially by comparative linguists (e.g. Schachter & Shopen 2007, Hengeveld & van Lier 2008). This view is of course not new at all, but corresponds to the centuries-old view that adjectives and substantives are subclasses of the major class *nomen* (see above §4).

Now Floyd (2011) argues that Quechua does have an adjective-noun distinction after all, i.e. the contrast between Weber's and Floyd's view is not unlike the contrast between the earlier Western grammarians and the more modern ones. Floyd points out a number of ways in which property-roots behave differently from thing-roots. For example, adjectives precede nouns, but not vice versa (Floyd 2011: 53):

(15) a. *Chaypi* *shuk* *yurak* *wasi-ta* *riku-ku-ni.*
there one white house-ACC see-PROG-1SG
'There I see a white house.'

b. **Chaypi* *shuk* *wasi* *yurak-ta* *riku-ku-ni.*
there one house white-ACC see-PROG-1SG

This can be described by saying that there are two word-classes noun and adjective, and that nouns cannot attributively modify adjectives.

But one could alternatively say that there is just a single class of *nomina* (justified by the coding patterns in (12)-(14)), and that different subclasses behave somewhat differently with respect to ordering. We need different subclasses of property-words anyway, because in many languages, they are not fully free in their ordering. For example, in German the ordering in (16a) is perfect, while the ordering in (16b) is very odd (English is of course quite similar).

(16) German
 a. *ein schönes großes* 'a beautiful big one'
 b. *?*ein großes schönes* 'a big beautiful one'

More generally, word-classes almost always have subclasses whose members behave somewhat differently. This is a very important point that is often overlooked.

Floyd (2011) justifies the recognition of adjectives and nouns by the additional phenomena that he takes into account. If one just looks at the paradigm in (12)-(14), one may conclude that thing-words and property-words belong to a single class, but if more facts are considered, then differences emerge. Word-classes must behave in the same way with respect to all "morphosyntactic possibilities":

> "Rather than relying on just one or a few specific features, the basic criterion for establishing a lack of word class distinction that I will respect here is that the morphosyntactic possibilities should be the same for all members of the proposed macro-class exhaustively across the lexicon." (Floyd 2011: 26)

But if one takes into account ALL features, then one gets many small subclasses. Instead of a "verb" class, one would typically have classes of intransitive verbs, monotransitive verbs, ditransitive verbs, stative verbs, dynamic verbs, and others, or rather (because of cross-classification) stative intransitive verbs, dynamic intransitive verbs, stative monotransitive verbs, dynamic monotransitive verbs, and so on. Instead of a single "noun" class, one would have count nouns, mass nouns, kinship terms, body-part terms, relational nouns, collective nouns, abstract nouns, and so on.

Linguists who prefer to say that adjectives and substantives are different (major) word-classes do not of course deny that there may be some similarities between them that are not shared by verbs or other word-classes. Everyone has to do some lumping, but how far does the lumping go? There does not seem to be an objective way of deciding. Thus, the distinction between the two approaches (ancients vs. moderns, Weber vs. Floyd) boils down to a distinction of terminological preferences.

8 A wrong question: Are there verbs in Tagalog? (Kaufman 2009)

A lack of a noun-verb distinction seems even more radical than a lack of an adjective class, so this issue seems even more important (cf. Evans & Osada 2005). Austronesian languages, and especially Tagalog, have been prominent in these debates, most recently Kaufman (2009) and the commentaries published in the same journal issue (e.g. Aldridge 2009, Richards 2009). Kaufman notes that in Tagalog, action-roots and thing-roots behave alike in reference and predication constructions, as there is no copula in (17b), and the referential use of the action-root does not require more than the nominative marker *ang*.

(17) a. *Nag-íngay ang áso.* (action-predicate & thing-referent)
 AGENTVOICE-noise [NOM dog]
 'The dog made noise.'

 b. *Áso ang nag-íngay.* (thing-predicate & action-referent)
 dog [NOM AGENTVOICE-noise]
 'The one who made noise is a dog.'

Moreover, property-roots behave in the same way:

(18) a. *Ma-bilis* *ang* *áso.* (property-predicate & thing-referent)
STATIVE-quick [NOM dog]
'The dog is quick.'

b. *Áso* *ang* *ma-bilis.* (thing-predicate & property-referent)
dog [NOM STATIVE-quick]
'The quick one is a dog.'

And in attribution, all three root-groupings also behave alike, requiring nothing but the linker morpheme *-ng/na* between the head and the attribute.

(19) a. *ang* *áso* *-ng* *ma-bilis* (thing-referent & property-attribute)
NOM dog LK STAT-quick
'the quick dog'

b. *ang* *áso* *-ng* *nag-íngay* (thing-referent & action-attribute)
NOM dog LK ACTORVOICE-noise
'the dog who made noise'

c. *ang* *ma-bilis* *na* *nag-ínay* (property-referent & action-attribute)
NOM quick LK ACTORVOICE-noise
'the quick one who/which made noise'

d. *ang* *nag-íngay* *na* *áso* (action-referent & thing-attribute)
[NOM AGENTVOICE-noise] LK dog
'the noise-maker who is a dog' (= 19b)

Kaufman concludes that Tagalog has a single macroclass of Nouns. But unsurprisingly, if we adopt Floyd's principle of complete identity of behaviour, then we cannot say that Tagalog has just a single word-class. Most strikingly, action-roots take aspect-modality inflection and voice affixes (e.g. the prefix *nag-*), while thing-roots do not have these possibilities. These morphological differences are very salient, so linguists who have claimed that Tagalog is unlike English with respect to its word-classes have usually said that Tagalog makes no distinction between "syntactic word-classes", only between "morphological word-classes".

But note that aspectual and voice marking is non-uniform across the class of "verbs" in many languages, and that in all languages, verbs have inflectional subclasses. So in the absence of clear criteria that determine what constitutes a major class and what constitutes a subclass, one could maintain that the syntactic uniformity seen in (16)-(18) justifies the postulation of a single major world-class (Verb, or Noun; Kaufman chooses the latter label), with subclasses based on (less important) morphological criteria.

However, there is evidence that syntactically, too, not all roots behave alike: In some contexts a copula seems to be required with thing-roots (Richards 2009: 141), e.g. when the predicate is a complement of a verb of desire:

(20) a. *Ayo-ko* *na-ng* *l-um-angoy.*
notwant-1SG now-LK swim-ACTORVOICE
'I don't want to swim anymore.'

b. *Ayo-ko* *na-ng* *maging* *doktor*
notwant-1SG now-LK be doctor
'I don't want to be a doctor anymore.' *(*Ayoko nang doktor.)*

But again, this could be described by setting up different subclasses of the broad (macro-)Noun category, if one decided to give more weight to the criterion of behaviour in ordinary predicative, attributive and referential contexts. Again, there is no objective, rigorous way of deciding.

9 A wrong question: Are there adjectives in Chamorro? (Chung 2012)

According to Topping (1973)'s structuralist (categorial particularist) analysis of Chamorro, this language has two word-classes, Class I (transitive verbs) and Class II (intransitive verbs, nouns, adjectives). Class I is basically identified by the fact that is combines with preposed subject person forms (cf. preposed *hu* in 20a), while Class II words combine with postposed subject person forms (cf. postposed *yu'* in 20b).

(21) a. ***Hu*** *li'i' i dångkulu na tåotao.* (Class I)
1SG see the big LK person
'I saw the big person.' (Chung 2012: 11)

b. *H<um>åhanao* ***yu'*** *gi chalan.* (Class II, action-root)
<AGR>go.PROG 1SG LOC road
'I was going on the road.' (Chung 2012: 11)

Not only action-roots, but also thing-roots and property-roots combine with postposed subject person forms in this way, so with regard to this criterion, all Class II roots behave alike, justifying Topping's classification.

(22) a. *Laña' na puñeta-n tåotao* ***hao***. (Class II, thing-root)
INTJ COMP expletive-LK person 2SG
'My, what a (expletive) person you are.' (Chung 2012: 11)

b. *Dångkulu* ***gui'***. (Class II, property-root)
AGR.big 3SG
'I was going on the road.' (Chung 2012: 11)

Now Chung (2012) claims that on closer inspection, Chamorro has nouns, verbs and adjectives after all. In particular, within Class II, we can distinguish a Noun subclass, because only Nouns can be incorporated, can be prefixed with *mi-* and do not allow subject-predicate agreement. Moreover, we can also distinguish between an Adjective and a Verb subclass, because only Verbs allow a specific external argument. The latter distinguishing criterion is a very subtle one, and it is possible that Topping simply missed it: Chung finds that normally, neither Nouns, nor Adjectives, nor Verbs allow nonspecific (bare indefinite) subjects, so neither 'A teacher knows us', 'A shirt is nice', nor 'A teacher is a good person' is possible in Chamorro. The subject must be specific, as indicated by the specific article *i* (cf. 21a). However, when the predicate is a Noun or an Adjective, this requirement is relaxed: Only the POSSESSOR of the subject has to be specific, so that sentences like (23) are possible, even though the head of the subject noun phrase is a bare indefinite (and lacks the definite article *i*).

(23) *Bunitu* *maru'* *Josephine.*
AGR.pretty box.kite Josephine
'Josephine's box kite is pretty.' (Chung 2012: 23)

With verbs, even such "semi-specific" subjects are not possible, the subject has to be fully specific. This feature therefore distinguishes Verbs from Adjectives and Nouns, and Chung takes it as sufficient to claim that Chamorro does have the classical verb-noun-adjective system that is familiar from English.

The ways in which the different kinds of roots differ can this be summarized as in Table 4.

Table 4. Six features of different kinds of roots in Chamorro

	features	'see'-type roots	'go'-type roots	'big'-type roots	'person'-type roots
1	passive	+	–	–	–
2	postposed subject person form	–	+	+	+
3	incorporatable	–	–	–	+
4	prefixable with *mi-*	–	–	–	+
5	subject-predicate agreement	+	+	+	–
6	specific external argument required	+	+	–	–

Clearly, if all these criteria have the same weight, then quite a few different ways of setting up major classes are possible (see Haspelmath 2012), and it is not immediately clear which of the major-class divisions, if any, is better than others.

But Chung does not even ask this question – she primarily asks whether Chamorro can be described/analyzed with the English-type category system that Baker (2003) also argued was universal. Thus, she basically adopts the Uniformity Principle in (6) and asks whether there is sufficient evidence against the hypothesis that Chamorro is like English. A complete lack of formal differentiation between action-roots and property-roots might be reason for the universalist to worry. But Chung has found a piece of evidence for Adjectives (the possibility of "semi-specific subjects), and she takes this as supporting the universalist view.

The problem is not so much that the distinguishing criterion seems particularly far-fetched in this case (much more so than the criteria adduced by Floyd and Richards for the splitting approach in Quechua and Tagalog) – the more general problem is that there is no constraint on what kinds of criteria can be used to set up major categories, and that different criteria are used for different languages. This leads to arbitrary, subjective decisions, and to a nonrigorous methodology.

Instead of asking whether Chamorro can be described with nouns, verbs and adjectives, one might ask whether English, or for that matter all languages, can be described in the Chamorro manner, using Class I (words with objects) and Class II (words without objects). Clearly, the difference between these two types of words is not as salient in all languages as it is in Chamorro (in most languages, pronominal subjects are not coded differently Class I and Class II), but if just any kind of criterion is sufficient to make the distinction, then surely one will find some way of distinguishing between transitive and intransitive words in all languages (if only by the fact that only transitive words can take objects).

10 Comparing languages on the basis of root-groupings

I hope that the above considerations and examples have shown that languages cannot be compared on the basis of language-particular word-classes, because different criteria are used in different languages to establish the word-classes. The cross-linguistic questions in (2) are the wrong questions

Moreover, we have seen that there is no good basis for distinguishing between major classes and subclasses in particular languages. Floyd, Richards and Chung have all made valid observations on Quechua, Tagalog and Chamorro that previous research had overlooked (or at least not highlighted), but this does not invalidate the earlier observations that Quechua, Tagalog and Chamorro are interestingly different from English.

So how can we capture the valid insights of this earlier research, how can we set up comparative concepts that allow us to express the interesting differences between languages in a more general way? Above in §5 I proposed that languages should be compared on the basis of the following semantically based notions:

(9) a. thing-root: a root that denotes a physical object (animate or inanimate)
b. action-root: a root that denotes a volitional action
c. property-root: a root that denotes a property such as age, dimension or value

These comparative concepts appear to have nothing to do with the formal categories of language that linguists pride themselves on being able to discover. However, there are many different kinds of formal categories. Why should some of them be privileged over others? Why should some classes be called *parts of speech*, even though speech has many diverse parts, or *word-classes*,[7] even though words can be grouped into classes on the basis of many different criteria? Why should thing-roots, action-roots and property-roots have a special status? There are two answers to this. (The second answer will be given in the next section.)

The first answer has to do with the habits of linguists. Even though we rarely admit it, the concepts in (9a-c) are at the basis of what we normally do. If we found strong evidence for grammatical classes of words that have nothing to do with things, actions and properties, we would not call them word-classes. For example, suppose a language has a class of prefixing words such as 'father', 'mouth', 'kill', and 'eat', and a class of non-prefixing words such as 'tree', 'knife', 'swim' and 'sit', we would not say that these are word-classes, even if the prefixing vs. non-prefixing distinction is important for a number of different regularities in the language. Thus, while saying that "nouns refer to things, verbs to actions and adjectives to properties" may sound naive, from a cross-linguistic perspective, this really is the meaning of these terms.

But why do I suggest that the comparative concepts should be formulated in terms of *roots*, rather than words (as in (8) above)? The problem is that the traditional conception of word-classes is based on the difference between inflected words (word-forms) and lexemes. Word-classes are normally LEXEME CLASSES.[8]

[7] Note that I hyphenate *word-class* in the more specific sense, in order to distinguish it from ad hoc word classes of other kinds. This is also the reason why I hyphenate the terms *thing-root*, *action-root* and *property-root*.

[8] It has sometimes been said that word-class is a property of inflected words, so that an inflected form of a verb lexeme could be an adjective (i.e. a participle), or an inflected form of a verb could be a noun (i.e. a verbal noun) (see Haspelmath 1995). Should one say that participles (such as German *helf-end* 'who helps') are only adjectives, even though they are forms of the lexeme

But this presupposes that one can make a consistent distinction between inflection and derivation. For example, if the English adverb-forming suffix *-ly* is regarded as an inflectional suffix, then *quickly* is an inflected adverb form of the (adjectival) lexeme *quick*, hence it is an adjective. But if the suffix *-ly* is regarded as a derivational form, then *quickly* is a derived adverb lexeme. It turns out that there is no good general way of distinguishing between the two kinds of processes (Plank 1994, Dixon 2010.1: §5.3), so we cannot make this distinction the basis of our definition. Another serious problem is that there is no good general way of distinguishing inflectional affixes from separate clitic words (Haspelmath 2011).

The solution that I propose here is to consider just the roots in a cross-linguistic context. All languages have a substantial number of thing-roots (e.g. tree, door, child), action-roots (e.g. run, talk, break) and property-roots (e.g. good, old, small). These groupings of roots typically behave similarly (i.e. 'tree' behaves like 'door', 'run' behaves like 'talk', 'good' behaves like 'old', etc.). Thus, we can limit our typological research to roots, and specifically to ways in which languages express the three major root-groupings (thing-roots, property-roots, action-roots).

Of course, languages have many complex expressions ("words") that behave like the roots, and in descriptions of individual languages, we want to describe these, too. So we want to say that both *break* and *enlarge* are Verbs in English, that both *king* and *kingdom* are Nouns, and that both *red* and *reddish* are Adjectives. Likewise, languages have many words (often even roots) that behave like verbs but are not actions (e.g. English *to love),* words that behave like nouns but are not things (e.g. *war*), and words that behave like adjectives but do not denote properties (e.g. *royal*). Thus, if we limit our cross-linguistic comparison to roots, and to roots denoting things, actions and properties, we compare languages only with respect to a part of their vocabulary.

This is a price that we pay for our methodological rigour: The great advantage is that we can readily identify roots in any language (as opposed to "words", which cannot be identified rigorously across languages)[9], and we can readily identify things, actions and properties[10] (as opposed to "nouns", "verbs" and "adjectives"). But it is easy to see that the phenomena that are still in our purview are at the core of what we are interested in, so while we may lose the fringes, we retain the core. And as a general point, we have to keep in mind that language comparison cannot be all-encompassing anyway: Languages are comparable with respect to many of their features, but we can never draw all features into the comparison. Language comparison is a different enterprise from language description, which must be all-encompassing (all aspects of a language have to be described). Language comparison often works with even smaller core phenomena, e.g. Haspelmath (2005), which considers just the verb 'give', rather than the broader heterogeneous domain of all ditransitive constructions.

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helfen 'to help'? Or should one say that they are verbs at the lexeme level, and adjectives at the inflectional level of the word-form? There is no clear answer to this, but the view adopted widely by linguists (often implicitly) has been to say that only the lexeme word-class of a word counts, i.e. inflection does not influence the word-class assignment. (The issue loses much of its relevance in view of what is said further in the text.)

[9] A further terminological remark: In the present context, *root* can simply be equated with *morph* ('smallest meaningful piece of form'), because linguists will normally call morphs which refer to things, actions or properties *roots* (rather than *affixes*). (There is sometimes some question about how to delimit roots from affixes, cf. Haspelmath 2002: 19-20, and in a cross-linguistic context, it seems best to define roots as 'morphs that denote things, actions, or properties'.)

[10] 'Property' is perhaps not as clear a concept as 'thing' and 'action', so we could limit ourselves to the four core types of properties identified by Dixon (1977): age ('old'), dimension ('small'), value ('good'), colour ('red').

Thus, I propose that we compare languages with respect to their root-groupings, i.e. with respect to the grammatical behaviour of thing-roots, action-roots and property-roots. These could be called "root classes", but I choose the term *root-grouping* to remind us that these are very special kinds of classes, namely semantic classes of ontological categories of a particular type.

The term *word-class* is retained for language-particular syntactic classes of roots (and other similar elements, often called "words" in language-particular descriptions). But what can be compared is root-groupings, so a typology of word-classes will really be a typology of root-groupings.

As was noted earlier, these comparative concepts are used, for example, in typological work such as Dryer (2005a, 2005b) on adjective-noun order and on verb-object order. Dryer does not quite present it in this way, but in practice, there is no difference. This kind of approach was also adopted by Greenberg (1963), though he was even less explicit about his defining criteria. In addition to allowing us to compare word order across languages, the concepts in (9) can also be used to ask questions about coding, e.g. Which languages use a copula when predicating a thing-root? Are there languages that require a copula with property-roots, but not with thing-roots? This will be briefly discussed in the next section.

11 Comparing languages on the basis of typical associations of root-grouping and propositional-act type

In the last section, we asked why thing-roots, action-roots and property-roots should have special status. The second answer that we can give to this is that in languages in general, they tend to behave in a special way in the three major propositional-act types reference, predication, and attribution (we already saw these in the Tagalog examples in (17)-(19)). In particular,

– when thing-roots are used referentially, they tend to lack special function-indicating coding such as nominalization,

– when action-roots are used as predicates, they tend to lack special function-indicating coding such as copulas, and

– when property-roots are used as attributes, they tend to lack special function-indicating coding such as relative-clause marking or possessive marking.

Thus, the shaded cells in Table 5 show expressions with no extra function-indicating coding, whereas the other cells all have some overt marking (given in boldface in the table; only the elements in the shaded cells lack this special coding). English is quite typical in this regard.

Table 5. Root-groupings and propositional-act types (Croft 1991: 67)

	reference	predication	attribution
thing-roots	WATER	(that) **is** water	(colour) **of** water
action-roots	**the** runn-**ing**	(it) RUN(-s)	runn-**ing** (water)
property-roots	the wet-**ness**	(water) **is** wet	WET (water)

Thus, the coding of the root-groupings in the different propositional-act types is quite fundamental to the nature of word-classes. It is probably only because of these striking and highly regular coding similarities that the terms "noun", "verb" and "adjective" have been adopted from Latin into other languages in the Western tradition.

Against this background, we can understand what motivates the lumpers: Weber, Kaufman and Topping noted that in Quechua, Tagalog and Chamorro, the distinctions made in English in Table 5 are not made in the same way. In Quechua, thing-roots behave in the same way as property roots in attribution, and in Tagalog, even all three root-classes behave in the same in all three propositional-act functions. These are thus salient differences that need to be expressed in some way, because the languages are lumpers not only with respect to English, but also with respect to the cross-linguistic trand.

Since the patterns in Table 5 are very general across languages, one can also set up other kinds of comparative concepts, as in (24).

(24) a. nouns are roots used for **reference** without special coding (reference-roots)
b. verbs are roots used for **predication** without special coding (predication-roots)
c. adjectives are roots used for **attribution** without special coding (attribution-roots)
d. manner adverbs are roots used for adverbation without special coding (adverbation-roots)[11]

This is more or less the approach taken by Hengeveld (1992), Hengeveld et al. (2004), Hengeveld & van Lier (2008), van Lier (2009), and Hengeveld & van Lier (2010). This sort of definition of comparative concepts allows Hengeveld and associates to formulate some interesting generalizations, summarized by the parts-of-speech hierarchy in (25):

(25) parts-of-speech hierarchy:
predication > reference > attribution > adverbation

The more to the left a propositional act is on the hierarchy, the more likely it is that a language has a specialized word-class for that propositional act. Thus, if a language has a specialized class of nouns (roots used for reference without coding), it also has a specialized class of verbs (roots used for predication without coding), and so on.

12 A brief history of thinking about word-class universality

The study of word-classes has a long history, and in this last section I would like to briefly recall a fascinating account of this history by Bossong (1992), which has not become as widely known as it deserves. Bossong observes that over the centuries, the pendulum has swung back and forth between a particularist and and a universalist approach to language diversity. This is summarized in Table 6.

Table 6: The pendulum of particularism and universalism

Antiquity + Renaissance (particularism):
interest only or primarily in language-particular description, no universal claims – but little awareness of categorial differences between languages

Middle Ages + Enlightenment (universalism):
ambitious claims about universal categories of language and thinking – but no interest in differences between languages

19th century (particularism):
ambitious claims about languages differing from each other in their categories, and thus

[11] Hengeveld's appropach is different from Croft in that it also takes into account manner adverbs. For these, a new kind of function (called „adverbation" here; this is my term, not Hengeveld's) needs to be set up.

in their thinking – but no attempt at rigorous description (Latin categories often carried over to other languages in practice)

First phase of 20th century (particularism):
rigorous description of languages of different types, with the new insight that each language has its own categories (Franz Boas, Edward Sapir, Ferdinand de Saussure)

Second phase of 20th century (universalism):
ambitious claims about universal categories of language and thinking (Noam Chomsky) – and serious attempts to find the categories of English (or Latin) in all other languages

I would hope that the two approaches will soon be married happily, as in (26):

(26) **21st century (particularism and universalism):**
respect for differences between languages, no ethnocentrism, no confusion of universal categories and universal trends

If one recognizes that language description and language comparison are two distinct enterprises, one can show respect for the differences in descriptions, but at the same time bring out the generalizations in comparative work.

13 Conclusion

Languages differ in more ways than we might naively suspect. But they also show many striking similarities that seem to reflect their functional unity. These similarities cannot be captured by setting up a set of universal categories and asserting that languages make all (or many, or some) of these categorial distinctions. Equating categories across languages but using different criteria in different languages is not a rigorous methodology. It leads to arbitrary, subjective decisions and unresolvable debates.

What needs to be done is to compare languages in terms of a special set of comparative concepts. Very promising work of this kind in the domain of word-classes, root-groupings and propositional-act functions has been done by Bill Croft and Kees Hengeveld, but many linguists are still trying to ask questions such as those in (1) and (2) which cannot be answered, because they are the wrong questions.

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Affiliation

Martin Haspelmath
Max Planck Institute for Evolutionary Anthropology
Leipzig, Germany
haspelmath@eva.mpg.de

Two Last Resort Phenomena in Senaya (Neo-Aramaic)

Laura Kalin

I present novel data from Senaya (Neo-Aramaic of Iran; McPherson, Ryan, and Kalin 2012) revealing two last resort phenomena that pose a theoretical puzzle for existing theories of last resort mechanisms. In Senaya, non-canonical aspectual morphology can be used independently of aspect for argument licensing. Following a thorough empirical look at Senaya's core aspectual properties, I lay out a preliminary account of how Senaya's last resort mechanism functions broadly, and suggest ways that this mechanism might be incorporated into the syntax.

Keywords Neo-Aramaic, syntax, agreement, aspect, last resort

Introduction

In this paper, I lay out novel data revealing two last resort phenomena in the Neo-Aramaic language Senaya, originally spoken in the city of Sanandaj in Iran. I show that theoretically accounting for the behavior of these last resort phenomena is not straightforward, and that existing theories of last resort phenomena (in particular, Rezac (2011)) cannot fully account for Senaya. As an alternative to previous accounts, I present two possible ways to implement this last resort mechanism dynamically in the syntax, one involving selection, and the other involving the activation of a φ-probe.

Giving a linguistic phenomenon the label 'last resort' is crucially tied to the following two properties. First, the phenomenon must appear in response to an impending failure in the derivation. Second, the phenomenon can *only* appear in precisely these environments (where otherwise there would be ungrammaticality), and is not a general/freely-available strategy. For example, when there is a 'stranded affix', an Aux may be inserted as a last resort to provide a host for it (Lasnik 1981; Chomsky 1991; Halle and Marantz 1993; Schütze 2003; Bjorkman 2011). Senaya's two last resort mechanisms both crucially involve the addition of an agreement locus to facilitate argument licensing; elsewhere these loci cannot be freely added, but rather are tied directly to aspect.

This paper is laid out as follows. In §1, I present a brief syntactic sketch of Senaya, from both an empirical standpoint and a theoretical standpoint (following work by Kalin and McPherson (2012) and Kalin and van Urk (2012)). In §2, I introduce Senaya's last resort phenomena. In §3, I discuss the puzzle presented by Senaya's last resort mechanisms, and propose ways to resolve this puzzle.

All data in this paper come from McPherson, Ryan, and Kalin (2012).

1 Brief syntactic sketch of Senaya

Senaya is an SOV Semitic language which is head-marking and has a NOM/ACC alignment. I begin by detailing Senaya's basic morphology, §1.1, and then turn to the aspectual contrasts, §1.2; Senaya distinguishes three basic aspects: perfective (§1.2.2), imperfective (§1.2.3), and progressive (§1.2.4). At the end of the section, I review previous analyses of Senaya's basic syntax, §1.3.

1.1 Morphology overview

Senaya has several different verbal bases formed by means of root and pattern morphology. Examples of these can be seen in Table 1.

Table 1: *Senaya verbal bases*

Root	Imperfective	Perfective	Infinitive	Imperative
r-k-w ('to ride')	raakw	rkuu	rkaawa	rkuu
q-ṭ-l ('to kill')	qaaṭl	qṭeel	qṭaala	qṭol
sh-t-y ('to drink')	shaaty	shtee	shtaaya	shtii(m.)/shtee(f.)

The bases that I will be most concerned with are the perfective and imperfective bases, as they participate centrally in all aspects, §1.2. Concatenative morphology that can be added onto these verbal bases includes agreement morphology, the enclitic auxiliary, the past tense suffix -*waa*, and an assortment of tense, mood, and aspectual prefixes.

The two paradigms for agreement on verbal bases across Neo-Aramaic are termed the S-suffixes and L-suffixes (e.g., Khan 2002, 2008). S-suffixes are the 'simple' suffixes while L-suffixes all begin with an *l*, historically an accusative/dative preposition (Doron and Khan 2012). Paradigms for these agreement suffixes are given in Tables 2-3.

Table 2: *S-suffixes in Senaya*

	Singular	Plural
1st p.	-en(m.)/-an(f.)	-ox
2nd p.	-et(m.)/-at(f.)	-iiton
3rd p.	-∅(m.)/-aa(f.)	-ii

Table 3: *L-suffixes in Senaya*

	Singular	Plural
1st p.	-lii	-lan
2nd p.	-lox(m.)/-lax(f.)	-looxon
3rd p.	-lee(m.)/-laa(f.)	-luu/-lun

There is obligatory agreement with all subjects as well as definite, specific, and/or pronominal (indirect or direct) objects (henceforth DSP objects). Which suffixes surface to mark these arguments depends on the aspect of the verb and the presence of arguments that require agreement. I return to this in detail in §1.2.

The enclitic auxiliary *y*[1] surfaces in four distinct environments: (i) on predicate adjectives and nominals, (ii) in the progressive, (iii) in ditransitives, and (iv) on infinitives. The auxiliary takes a single agreement suffix.[2] I return to the auxiliary in §1.2.4.

[1] The auxiliary *y* has three allomorphs, *y*, *ii* and ∅: *y* (the underlying morpheme and elsewhere allomorph) vocalizes to *ii* preceding a consonant, and *ii* deletes following a vowel (i.e., *y* deletes in the frame V__C).

[2] Agreement on Aux resembles a mix of S- and L-suffixes, but has a unique form for third person past tense. Thus, for the purposes of this paper, I take the auxiliary to have its own idiosyncratic inflectional paradigm.

The maximal structure of a verb is laid out in (1).

(1) Neg – T/A/M Prefix – **VerbBase** – S-suffix – Past – L-suffix = Aux – Agr

1.2 Aspectual contrasts

In this section, I briefly justify the use of the terms 'perfective' and 'imperfective' for the aspectual bases in Senaya. I then go through each aspect in turn to detail how the verbal complex looks in these instances.

I will briefly preview the crucial observations from this section. First, there is an aspect split between the perfective and imperfective in Senaya. The perfective verb base has exactly one agreement slot, which is always filled with subject agreement in the form of an L-suffix. The perfective base cannot host agreement with an object; this will lead to the first last resort mechanism discussed in §2. The imperfective verb base has exactly two agreement slots: the first is filled with subject agreement in the form of an S-suffix, and, when there is a DSP object, the second slot is filled with object agreement in the form of an L-suffix. The imperfective base cannot host agreement with a second object (i.e., in ditransitives); this will lead to the second last resort mechanism discussed in §2.

1.2.1 Terminology

It has been argued extensively that verbal bases in Neo-Aramaic are aspectual (Krotkoff 1982; Hoberman 1989; Coghill 1999). Below, I will show that in Senaya the perfective and imperfective bases correlate with the properties canonically associated with these aspects.

The imperfective base surfaces to express habitual events and/or durative events in the present or future, (2a). For past tense habitual or durative events, the past tense morpheme *-waa* is suffixed to the imperfective base, (2b).[3] (Ignore agreement marking for now.)

(2) a. Axnii (kod yooma) xelya shaat-ox.
we each day milk drink.IMPF-S.1PL
'We drink milk (every day).'
b. Aana &el suusii rakw-an-waa.
I on horse ride.IMPF-S.1FS-PAST
'I used to ride horses.'

The perfective base surfaces to express completed events as a whole, (3a). Adding the past tense marker to the perfective, (3b), results in a distant past interpretation.

(3) a. Aawa (temal) mpel-ee.
he yesterday fall.PFV-L.3MS
'He fell (yesterday).'
b. Aana &el suusii rkuu-waa-lii.
I on horse ride.PFV-PAST-L.1SG
'I rode a horse (a long time ago).'

[3] I use the following abbreviations: 1, 2, 3 = 1st, 2nd, 3rd person, AUX = auxiliary, AGR = agreement, DFLT = default, F = feminine, IMPF = imperfective, INDIC = indicative, L = L-suffix, M = masculine, NEG = negation, PAST = past, PERF = perfect, PFV = perfective, PL = plural, S = S-suffix, S(G) = singular. The transcription system used for Senaya contains the following non-standard characters: sh = /ʃ/, ṭ = /tˁ/, & = /ʕ/, ' = /ʔ/.

Further confirming this classification of the perfective and imperfective is the (in)felicity of negating the endpoint of the event in the two aspects, (4)-(5). (Ignore for the moment the complexity of the (b) examples, and simply take them to express perfective aspect.)

(4) a. Temal aana xa kolbe sooy-an-waa... (imperfective)
yesterday I one shack build.IMPF-S.1FS-PAST
'Yesterday I built a shack (for a while)...'
b. ...walii laa-tm-xalṣ-an-ee.
but NEG-TM-finish.IMPF-S.1FS-L.3MS
'...but I didn't finish it.'

(5) a. Temal aana xa kolbe meswee-lii... (perfective)
yesterday I one shack build.PFV-L.1SG
'Yesterday I built a shack...'
b. #...walii laa-tm-xalṣ-an-ee.
but NEG-TM-finish.IMPF-S.1FS-L.3MS
#'...but I didn't finish it.'

Just as is canonically found in imperfective aspect, the use of the imperfective base in (4a) can felicitously be followed with a negation of the endpoint (culmination) of the event, (4b). In addition, as expected, the negation of the endpoint of a perfective verb, (5), is infelicitous.

I now go through each aspect's agreement profile in turn, starting with the perfective verb base.

1.2.2 Perfective aspect

The perfective verb base can host agreement with exactly one argument, the subject, and agreement appears in the form of an L-suffix. Subjects of unergatives, (6a), unaccusatives, (6b), and transitives, (6c) all pattern alike; non-DSP objects do not trigger agreement, (6c).

(6) PERFECTIVE *L-suffix = subject:*
a. Axnii dmex-**lan**.
we sleep.PFV-**L.1PL**
'We slept.'
b. Axnii pleq-**lan**.
we leave.PFV-**L.1PL**
'We left.'
c. Axnii xa ksuuta ksuu-**lan**.
we one book write.PFV-**L.1PL**
'We wrote a book(fem.).'

Since DSP objects obligatorily trigger agreement, and yet the perfective base can only host one agreement morpheme, it follows that an agreeing object is banned from appearing with the perfective base:

(7) *Axnii oo ksuuta ksuu**(-laa/-a)-lan(-laa/-a)**.
we that book write.PFV**(-L/S.3FS)-L.1PL(-L/S.3FS)**
Intended: 'We wrote that book(fem.).'

Object agreement cannot be omitted, and no matter how the suffixal arrangement is restructured, object agreement is completely impossible on the perfective base.

The first last resort strategy that I introduce in §2 deals precisely with how the language enables a DSP object to appear in perfective aspect.

1.2.3 Imperfective aspect

The imperfective verb base can host agreement with up to two arguments. Subject agreement appears closest to the verb, in the form of an S-suffix. Object agreement (when induced) appears following subject agreement, in the form of an L-suffix. Just as on the perfective base, subjects of unergatives, (8a), unaccusatives, (8b), and transitives, (8c-d) all pattern alike; non-DSP objects do not trigger agreement, (8c), but DSP objects do, (8d).

(8) IMPERFECTIVE *S-suffix = subject; L-suffix = object:*

a. Axnii damx-**ox**.
we sleep.IMPF-**S.1PL**
'We sleep.'

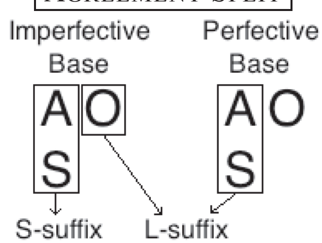
b. Axnii palq-**ox**.
we leave.IMPF-**S.1PL**
'We leave.'

c. Axnii xa ksuuta kasw-**ox**.
we one book write.IMPF-**S.1PL**
'We write a book(fem.).'

d. Axnii oo ksuuta kasw-**ox-laa**.
we that book write.IMPF-**S.1PL-L.3FS**
'We write that book(fem.).'

Comparing the perfective base with the imperfective base, an aspect-based agreement split can be seen, schematized in (9). (A = transitive subject; O = transitive object; S = intransitive subject.)

(9) AGREEMENT SPLIT



The subject marking of the perfective is the object marking of the imperfective (L-suffixes), while a unique series of agreement markers surfaces for imperfective subjects (S-suffixes). Interestingly, unlike most aspect based splits, there is no ergativity on either side of the split. This will factor centrally into Kalin and van Urk's (2012) analysis of Senaya's basic syntax, presented in §1.3.1.

1.2.4 Progressive aspect

The final core aspect to be discussed is progressive. The progressive is formed by adding the enclitic auxiliary onto the imperfective verb base (with its two agreement slots). The auxiliary also hosts its own single agreement slot, resulting in a total of three potential agreement slots. The auxiliary may double agreement already present, instantiate new agreement, or simply show default agreement. I go through all of these possibilities in turn.

In an intransitive progressive, (10a), or transitive progressive with a non-DSP object, (10b), the auxiliary simply doubles subject agreement, while the imperfective verb base hosts subject agreement as normal.

(10) a. Aanii damx-**ii**=∅-**luu**.
they sleep.IMPF-**S.3PL**=AUX-**3PL**
'They are sleeping.'
b. Axnii xa ksuuta kasw-**ox**=y-**ox**.
we one book write.IMPF-**S.1PL**=AUX-**1PL**
'We are writing a book.'

In a transitive progressive, the agreement configuration is much more complex. The auxiliary may double agreement with the subject (just as in (10)), (11a), or may agree with the object while the object agreement slot on the verb base is filled with default *-lee* (L.3MS), (11b), or may host default agreement while object agreement appears on the verb base, (11c). It is not grammatical for object agreement to be doubled, (11d). There is no consistent discernible change in meaning.

(11) a. Axnii oo ksuuta kasw-**ox-laa**=y-**ox**.
we that book write.IMPF-**S.1PL-L.3FS**=AUX-**1PL**
'We are writing that book(fem.).'
b. Axnii oo ksuuta kasw-**ox-lee**=∅-**laa**.
we that book write.IMPF-**S.1PL-L.DFLT**=AUX-**3FS**
c. Axnii oo ksuuta kasw-**ox-laa**=∅-**lee**.
we that book write.IMPF-**S.1PL-L.3FS**=AUX-**DFLT**
d. *Axnii oo ksuuta kasw-**ox-laa**=∅-**laa**.
we that book write.IMPF-**S.1PL-L.3FS**=AUX-**3FS**

This variation will not be of further interest in this paper. As a final note on progressives, the strategy in (11b) (where object agreement appears on the auxiliary) is only possible when the object is third person (Kalin and McPherson 2012).

1.3 Previous analyses

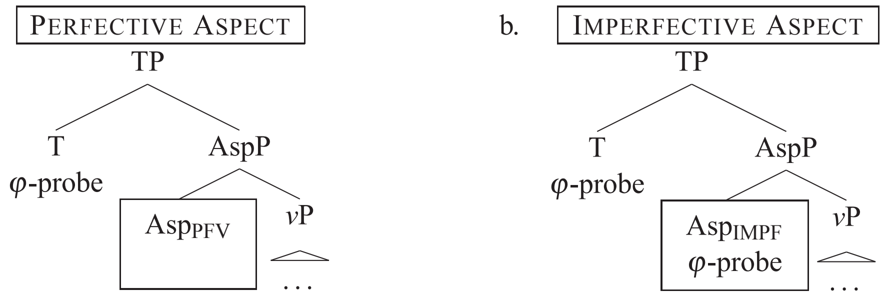
In this section I outline the basic syntax of Senaya, building off of analyses by Kalin and van Urk (2012), §1.3.1, and Kalin and McPherson (2012), §1.3.2.

1.3.1 Kalin and van Urk 2012

Kalin and van Urk (2012) argue that the basic difference between perfective and imperfective in Senaya is the presence of a φ-probe on Asp. In particular, there is a φ-probe on Asp in the imperfective but not the perfective. In both aspects, T also carries a φ-probe.

This is schematized in (12).

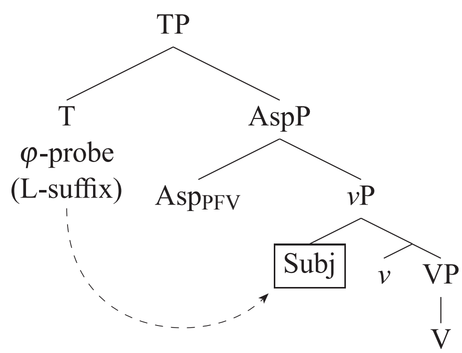
(12) a. b.



Agreement with Asp spells out as an S-suffix, and agreement with T spells out as an L-suffix.

This derives the empirical agreement split in the following way. In the perfective, there is exactly one φ-probe, on T. This φ-probe establishes an agree relation with the highest argument, whether that be the only argument (in an intransitive) or the subject (in a transitive). Since agreement is with T, this agreement spells out as an L-suffix. (13) depicts agreement in the perfective with an unergative subject.

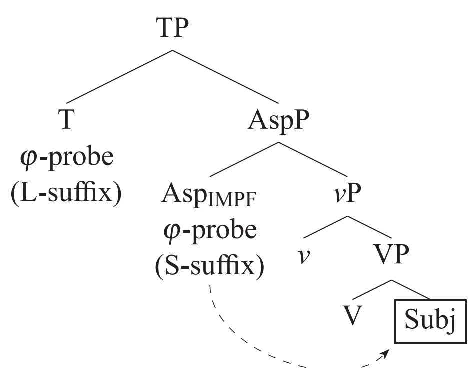
(13)



Kalin and van Urk (2012) take indefinite/nonspecific objects to pseudoincorporate into the verb as NPs (along the lines of Massam (2001) and Dayal (2011)), and hence they do not need to (nor are they able to) agree.

In the imperfective, the additional φ-probe on Asp stops T from agreeing with the subject. Starting with an intransitive, it is easy to see that the φ-probe on Asp will be closer to the single argument, whether it is merged as an agent or theme, as in the unaccusative (14).

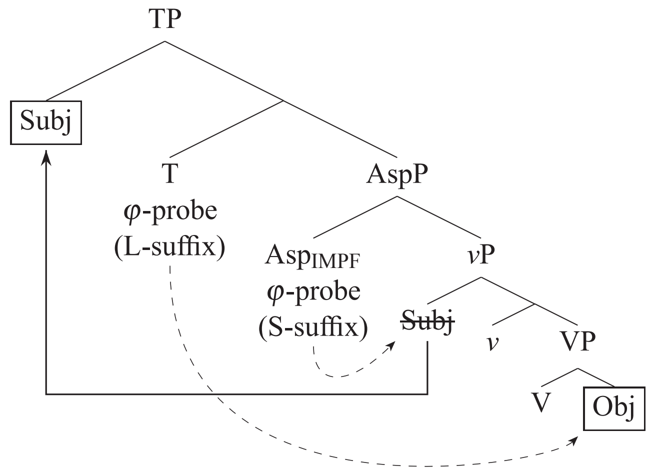
(14)



Agreement with the single argument of an intransitive in the imperfective thus spells out with an S-suffix. The failed agreement of T in (14) spells out as null but does not result in a crash (following proposals by Preminger (2011) and Halpert (2011)).

In an imperfective transitive, both φ-probes come into play. First, Asp probes the higher argument, the subject, resulting in subject agreement in the form of an S-suffix. Next, T's EPP feature targets the subject and the subject raises to spec-TP. Finally, T probes and encounters the object, resulting in object agreement in the form of an L-suffix.

(15)



Kalin and van Urk take *v* to be completely inactive in Senaya, neither instantiating agreement nor inducing spellout of a VP phase.

In support of these structures, Kalin and van Urk note that the morpheme order – S-suffix closer to the verb base than L-suffix – reflects the syntactic structure, where Asp is closer to V than T is. Further, S-suffixes appear inside of the past tense morpheme, (16), a fact also predicted by these structures, since Asp is below T.

(16) Ooya k-axl-**aa**-<u>waa</u>-**lee**.
she INDIC-eat.IMPF-**S.3FS**-<u>PAST</u>-**L.3MS**
'She used to eat it.'

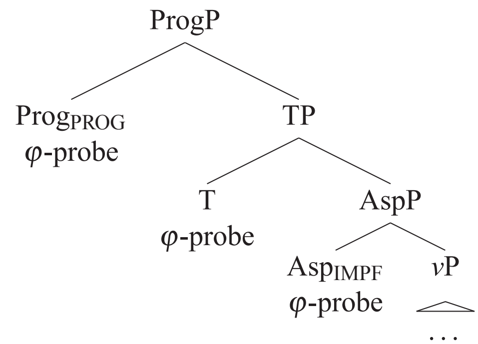
In sum, Kalin and van Urk propose to derive Senaya's aspectual split via the extra φ-probe on Asp in the imperfective, which they relate to recent proposals on split ergativity (Coon 2010; Coon and Preminger 2011). Since perfective subjects and imperfective objects are both probed by T, they show identical agreement (L-suffixes); imperfective subjects uniquely agree with Asp, and hence are marked with a unique agreement series (S-suffixes).

1.3.2 Kalin and McPherson 2012

Kalin and McPherson (2012) argue for another layer of structure, above TP, overtly realized in progressives. Kalin and McPherson pretheoretically label this projection AuxP, which I will call ProgP. Progressive Prog, which I will annotate $\text{Prog}_{\text{PROG}}$, carries a φ-probe, leading to its overt expression upon agreement, (17). Non-progressive (i.e., semantically empty) Prog, annotated Prog_0, does not (canonically) carry a φ-probe.[4]

[4]There is a lot of evidence for the high position of Prog, as represented in (17), e.g., Prog has the potential to agree with the subject or direct object, and progressive aspect necessitates Aux insertion, suggesting that Prog

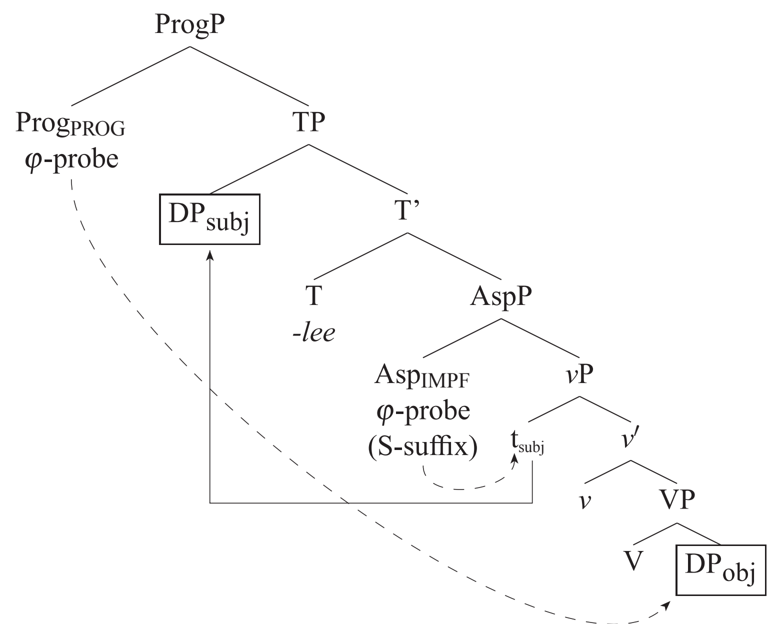
(17)



Relevant for this paper is the structure of transitive progressives in which object agreement appears on the Aux/Prog (see §1.3.3 for why Aux appears here). Kalin and McPherson propose the structure in (19) for the derivation of (11b), repeated in (18):

(18) Axnii oo ksuuta kasw-**ox-lee**=∅-**laa**.
we that book write.IMPF-**S.1PL-L.DFLT**=AUX-**3FS**
'We are writing that book(fem.).'

(19)



Asp agrees with the subject, as usual. T is filled with the dummy agreement morpheme *-lee*, and so does not do any probing/agreeing. Prog probes the object, resulting in object agreement on the auxiliary (see §1.3.3). In addition, the object in (19) is restricted to third person. Kalin and McPherson argue that this is a Person Case Constraint effect (Bonet 1991; Anagnostopoulou 2003; Béjar and Rezac 2003), resulting from defective intervention of the subject on Prog's path to the object, which prevents licensing of first/second person objects.

Finally, I adopt the following condition, adapted from Kalin and McPherson (2012):

is stranded (Bjorkman 2011). An important question here involves whether it is desirable to posit Prog above T. It may turn out that the nature of Prog is different from that of Asp; for example, perhaps Prog constitutes a higher aspectual verb and not simply a functional projection on the spine. I put aside this question here and treat Prog and Asp alike, as functional heads that are part of the extended inflectional domain of T.

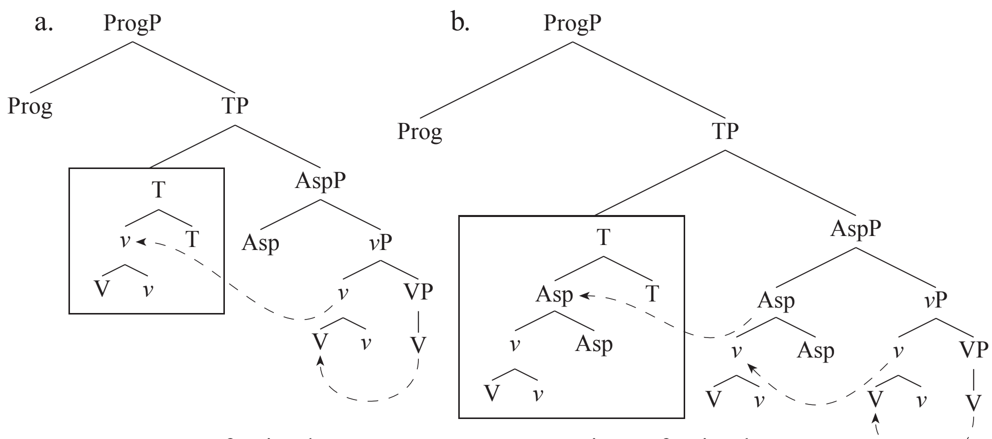
(20) **Argument-licensing condition:** Every argument DP[5] must enter into an Agree relation with (at least) one unique φ-probe.

This condition accounts for the fact that subjects and DSP (direct and indirect) objects must trigger agreement (at least once), and if they do not, the derivation crashes. The condition in (20) dictates that there must be (at least) one φ-probe in a structure for every (DSP) DP that needs licensing.

1.3.3 Head movement and Aux in Senaya

I augment Kalin and van Urk (2012) and Kalin and McPherson (2012) with a proposal about head movement in Senaya. In particular, I propose that there is head movement of V to T in tensed clauses. Further, I make the following two assumptions about head movement in Senaya: (i) Asp is only an eligible target of head movement when it is ‘active’ / ‘marked’ (i.e., contains a φ-probe), following e.g., Bjorkman (2011), and (ii) V cannot head-move any higher than T.

The first of these assumptions allows me to make the following generalization: when the head complex following head movement is V+*v*+T, (21a), this spells out as the ‘perfective’ base form of the verb; when the head complex following head movement is V+*v*+Asp+T (differing only in having incorporated Asp, which in turn results from an active Asp containing a φ-probe), this spells out as the ‘imperfective’ base form of the verb, (21b).[6]

(21)


Box → perfective base   Box → imperfective base

In this way, the ‘aspectual’ verb form can be seen as arising from the precise make-up of the head-complex in T, which in turn is driven by which inflectional heads are syntactically ‘active’ (and crucially, whether Asp is ‘active’).

The second of my two assumptions (head movement stops at T) allows me to derive the profile of Aux insertion in Senaya. In particular, I adopt the Bjorkman (2011) view of

[5]Recall that Kalin and van Urk (2012) take non-DSP objects to pseudo-incorporate into the verb as NPs (Dayal 2011; Massam 2001), and as such to be exempt from the licensing requirements on DPs.

[6]This same result can be achieved without skipping heads, assuming that the morphology can be sensitive to the presence or absence of a φ-probe on the incorporated Asp head. Under this alternative view, V+*v*+Asp+T spells out as the perfective base while V+*v*+Asp$_{\varphi}$+T spells out as the imperfective base. Crucially, it cannot be Asp$_{\mathrm{IMPF}}$ and Asp$_{\mathrm{PFV}}$ that are the deciding factor for the spellout of the verbal complex, precisely because in last resort environments there is a mismatch between morphology and aspect, §2.

auxiliaries, in which an Aux is inserted to host stranded inflectional material, in response to something like Lasnik's (1981) Stranded Affix Filter. Since head movement stops at T, any inflectional material generated above T will be 'stranded', triggering the insertion of Aux. Thus, in progressives (where agreement is generated on Prog, above T), Aux must be inserted to host this agreement.[7] This take on Senaya's Aux is supported by the fact that Aux also surfaces in copula clauses, cliticized to predicate nominals and adjectives: in these instances, there is no verbal element, and so any material generated above the predicate will be stranded (e.g., past tense, φ-agreement on T), again triggering Aux insertion.

2 Last resort phenomena in Senaya

At last we are in a position to understand Senaya's last resort phenomena, which I have hinted at in previous sections. The first last resort mechanism is the move from the perfective base to the imperfective base when there is a DSP object in perfective aspect, §2.1. The second is the move from the imperfective verbal complex to the progressive verbal complex (with an Aux) in all ditransitives (be they perfective, imperfective, or progressive), §2.2.

2.1 Last resort use of the imperfective

As mentioned in §1.2.2, the perfective base is only able to host a single agreement morpheme, data repeated in (22) from (6c) and (7):

(22) a. Axnii xa ksuuta ksuu-**lan**.
we one book write.PFV-**L.1PL**
'We wrote a book(fem.).'
b. *Axnii oo ksuuta ksuu**(-laa/-a)-lan(-laa/-a)**.
we that book write.PFV**(-L/S.3FS)-L.1PL(-L/S.3FS)**
'We wrote that book(fem.).'

The result of this limitation is that object agreement is completely impossible to mark on the perfective base, and therefore DSP objects are banned with the perfective base, (22b).

This limitation differs crucially from the imperfective base, which can host up to two agreement morphemes, and therefore can grammatically appear with a non-DSP or DSP object, data repeated in (23) from (8c)–(8d):

(23) a. Axnii xa ksuuta kasw-**ox**.
we one book write.IMPF-**S.1PL**
'We write a book(fem.).'
b. Axnii oo ksuuta kasw-**ox-laa**.
we that book write.IMPF-**S.1PL-L.3FS**
'We write that book(fem.).'

[7] In the precise mechanism of Bjorkman (2011), a head's features are transferred to the next lower (marked) head via (a version of) Agree. Thus, inflectional material that is generated one head above the final landing site of *v*/V's head movement actually is not stranded (since it is transferred down one head); rather, inflectional material is stranded if it is more than one head away from the upper bound of head movement. In my system, this would translate to head movement going no higher than Asp, such that any material above T is stranded.

It is not, however, impossible to express a DSP object in the perfective (as was attempted unsuccessfully in (22b)). Exceptionally, in these instances, the imperfective base can be used to express perfective aspect; additionally, the prefix *tm-* appears on the imperfective verb base, indicating that despite the use of the imperfective base, the clause is perfective. Agreement then takes the same form it would have in the imperfective, cf. (23b). This is shown in (24).

(24) Axnii oo ksuuta *tm*-kasw-**ox-laa**.
we that book *TM*-write.IMPF-**S.1PL-L.3FS**
'We wrote that book(fem.).'

I will refer to verbs like those in (24) (consisting of *tm-* plus an imperfective base, with a perfective interpretation) as *tm*-perfectives.

Both the 'dummy' imperfective verb base and *tm-* are unavailable except in this type of derivation: it is impossible to use this construction when there is no DSP object, (25).

(25) *Axnii xa ksuuta *tm*-kasw-**ox**.
we one book *TM*-write.IMPF-**S.1PL**
'We wrote a book(fem.).'

The strategy for expressing perfective aspect in (24) can thus be seen as a "last resort" strategy, surfacing only when the primary strategy for expressing perfective aspect (i.e., with the perfective verb base) is unavailable.

2.1.1 Evidence for perfectivity

One might wonder whether *tm*-perfectives are truly perfective, or whether they retain some imperfective-like properties. There is ample evidence that the former is the case: verbs like those in (24) are truly perfective. I will illustrate a few of the relevant diagnostics.

First, imperfective verbs with a DSP object do not entail completedness, (26), cf. (4). On the other hand, *tm*-perfectives do entail completedness, (27), just as regular perfectives do, (5).

(26) a. Temal aana oo kolbe sooy-an-waa-lee... (imperfective)
yesterday I that shack build.IMPF-S.1FS-PAST-L.3MS
'Yesterday I built that shack (for a while)...'
b. ...walii laa-tm-xalṣ-an-ee.
but NEG-TM-finish.IMPF-S.1FS-L.3MS
'...but I didn't finish it.'

(27) a. Temal aana oo kolbe *tm*-sooy-an-waa-lee... (*tm*-perfective)
yesterday I that shack *TM*-build.IMPF-S.1FS-PAST-L.3MS
'Yesterday I built that shack (for a while)...'
b. #...walii laa-tm-xalṣ-an-ee.
but NEG-TM-finish.IMPF-S.1FS-L.3MS
'...but I didn't finish it.'

Second, the adverbials compatible with *tm*-perfectives pattern with those compatible with perfectives, not imperfectives. For example, the adverbial *qoome* 'tomorrow' is compatible with the imperfective but not a regular perfective or *tm*-perfective, (28).

(28) a. Axnii (qoome) oo ksuuta kasw-ox-laa. (imperfective)
we tomorrow that book write.IMPF-S.1PL-L.3FS
'We (will) write that book(fem.) (tomorrow).'
b. Axnii (*qoome) xa ksuuta ksuu-lan. (perfective)
we tomorrow one book write.PFV-L.1PL
'We wrote a book (*tomorrow).'
c. Axnii (*qoome) oo ksuuta *tm*-kasw-ox-laa. (*tm*-perfective)
we tomorrow that book *TM*-write.IMPF-S.1PL-L.3FS
'We wrote that book(fem.) (*tomorrow).'

Third, when the past tense morpheme *-waa* is suffixed to a *tm*-perfective, the interpretation is distant past, just like when *-waa* is suffixed to a regular perfective, and unlike when it is suffixed to an imperfective, (29).

(29) a. Axnii oo ksuuta *tm*-kasw-ox-waa-laa. (*tm*-perfective)
we that book *TM*-write.IMPF-S.1PL-PAST-L.3FS
'We wrote that book(fem.) a long time ago.'
b. Axnii xa ksuuta ksuu-waa-lan. (perfective)
we one book write.PFV-PAST-L.1PL
'We wrote a book a long time ago.'
c. Axnii oo ksuuta kasw-ox-waa-laa. (imperfective)
we that book write.IMPF-S.1PL-PAST-L.3FS
'We were writing that book(fem.).'

I conclude, then, that *tm*-perfectives are true perfectives on the aspectual level, despite the last resort use of the imperfective verb base in forming *tm*-perfectives.

2.2 Last resort use of the progressive

The second last resort mechanism in Senaya, like the one just discussed, employs a 'bigger' aspect in order to express additional DSP objects. Recall that Senaya's agreement split is three way: there is one agreement slot on the perfective base, two on the imperfective base, and three in the progressive verbal complex (the two from the imperfective plus one on Aux). Thus, just as a transitive with a DSP object causes problems for the perfective base, a ditransitive with two DSP objects cause a problem for the imperfective base.

On the surface, ditransitives in Senaya with two DSP objects are surprising in several ways. First, ditransitives necessitate the addition of the Aux onto the imperfective base, making the ditransitive verbal complex look just like the progressive verbal complex. Second, Aux agrees with the lowest argument, the direct object. Third, the direct object is limited to third person (following the person restriction on object agreement on the Aux, §1.2.4/§1.3.2). Finally, ditransitives are aspectually ambiguous: they can receive either an imperfective or progressive interpretation. All of these properties can be seen in (30).

(30) a. Aanii an klooche k-eew-**ii-lii**=∅-**luu**
they those cookies INDIC-give.IMPF-**S.3PL-L.1SG**=AUX-**3PL**
'They (will) give me the cookies.' (imperfective)
∼ 'They are giving me the cookies.' (progressive)

b. Aana oo ksuuta maxw-**an-ox**=ii-**laa**.
I the book show.IMPF-**S.1FS-L.2MS**=AUX-**3FS**
'I (will) show you the book.' (imperfective)
∼ 'I am showing you the book.' (progressive)

Empirically, it looks like Aux (which usually indicates a progressive) surfaces in ditransitives so that an additional argument can agree.

Perfective ditransitives use the progressive verbal complex, too. However, they again come along with the prefix *tm*-, and so do not result in any aspectual ambiguity.

(31) a. Aanii an klooche *tm*-eew-**ii-lii**=∅-**luu**
they those cookies *TM*-give.IMPF-**S.3PL-L.1SG**=AUX-**3PL**
'They gave me the cookies.' (perfective)
b. Aana oo ksuuta *tm*-maxw-**an-ox**=ii-**laa**.
I the book *TM*-show.IMPF-**S.1FS-L.2MS**=AUX-**3FS**
'I showed you the book.' (perfective)

Otherwise these perfective ditransitives look just like those in (30), with the direct object marked on the Aux and restricted to third person.

2.2.1 Evidence for aspectual ambiguity

Again, one might wonder whether ditransitives (of the sort without *tm*-, (30)) are truly aspectually ambiguous, or whether they are actually fully progressive. And again, there is evidence that the former is the case: verbal complexes like those in (30) are truly ambiguous between being imperfective and progressive.

It is harder to tease the imperfective and progressive apart, given their aspectual similarity, than it is to tease the perfective and imperfective apart, §2.1.1. The evidence here thus comes mainly from adverbials. Recall that plain imperfectives are compatible with *qoome*, 'tomorrow'. Progressives are not compatible with *qoome* but are compatible with *da&aana*, 'right now', which the imperfective is not compatible with, (32)-(33). Ditransitives are grammatical with either *qoome* or *da&aana*, (34).

(32) Aana (qoome / *da&aana) on talmiide molp-an-uu.
I tomorrow / *right.now the students teach.IMPF-S.1FS-L.3PL
'I (will) teach the students (tomorrow).' ≁ *'I teach the students right now.'

(33) Aana (*qoome / da&aana) on talmiide molp-an-uu=y-an.
I *tomorrow / right.now the students teach.IMPF-S.1FS-L.3PL=AUX-1FS
'I am teaching the students (right now).' ≁ *'I am teaching the students tomorrow.'

(34) Aana (qoome / da&aana) oo ksuuta maxw-an-ox=ii-laa.
I tomorrow / right.now the book show.IMPF-S.1FS-L.2MS=AUX-3FS
'I (will) show you the book (tomorrow).' (imperfective)
∼ 'I am showing you the book (right now).' (progressive)

I thus conclude that ditransitives are truly aspectually ambiguous between being imperfective (in which case the use of Aux is a last resort) and progressive (in which case Aux would be present independently).

2.3 *When to use which last resort operation*

Both last resort mechanisms in Senaya are, in a sense, valency-increasing operations: they take a deficient verb (one that cannot host agreement with all the arguments that require it) and increase its agreement potential. Interestingly, however, the choice of which mechanism to employ is fixed: to increase the agreement potential of a perfective base, the imperfective base is used; to increase the agreement potential of an imperfective base, the Aux is added. Notably, it is not possible to add Aux to a perfective base to facilitate object agreement:

(35) *Axnii oo ksuuta ksuu-**lan**=ii-**laa**.
we one book write.PFV-**L.1PL**=AUX-**3FS**
'We wrote the book(fem.).'

In the following section, this piece of data is addressed at a theoretical level along with the other properties of Senaya's last resort phenomena.

3 The theoretical puzzle

In this section I present the intuitive components of a proposal for how to theoretically account for Senaya's last resort phenomena, §3.1, and then home in on the questions raised and why a more precise formulation is far from straightforward, §3.2. I conclude by proposing two ways to account for Senaya's last resort phenomena directly in the syntax, one of which stays close to the intuitive account, §3.3.1, and one of which leaves the 'last resort' nature of these phenomena behind, §3.3.2.

3.1 *The components of an intuitive account*

Intuitively, the data seem to suggest that both last resort phenomena in Senaya result from the last resort activation of a potential Agree locus (i.e., Asp or Prog) that is inactive in a canonical aspect.[8] In other words, as a last resort to enable DSP objects to agree, $\mathrm{Asp}_{\mathrm{PFV}}$ and Prog_0 can each carry a φ-probe, though canonically they do not.

Assuming an account of the morphology as presented in §1.3.3, there can thus be a mismatch between the aspectual semantics and the verbal base. Whenever Asp is 'active' (regardless of whether it underlyingly carries a φ-probe, $\mathrm{Asp}_{\mathrm{IMPF}}$, or is a last-resort activated $\mathrm{Asp}_{\mathrm{PFV}}$), the verbal complex will spell out morphologically with the 'imperfective' verb base; the morphology only reacts to the 'activity' of Asp, not to whether Asp is perfective or imperfective. Whenever Prog is active (regardless of whether it underlyingly carries a φ-probe, $\mathrm{Prog}_{\mathrm{PROG}}$, or is a last-resort activated Prog_0), there will be stranded material in Prog that will require (post-syntactic) Aux insertion, as is typical of canonical progressives.

Further, there seems to be an implicational relationship between active Agree loci:

(36) *Senaya's Implicational Activity Hierarchy:* $\mathrm{T} \ll \mathrm{Asp} \ll \mathrm{Prog}$

[8] On an intuitive level, this is very similar to a proposal by Rezac (2011:Ch. 5) for regulating Person Case Constraint repairs and Dependent Case. However, I will show in §3.2 that Rezac's precise account does not work for Senaya.

What this hierarchy states is that T can be active (i.e., bear a φ-probe) without Asp or Prog being active, as is the case in canonical perfective aspect. If Asp is active, then T is too; this is the case in canonical imperfective aspect.[9] Finally, if Prog is active, then Asp and T must both be active as well, as is found in canonical progressive aspect.

The implications of (36) are desirable on two fronts. First, (36) accounts for why the progressive is built on the imperfective base form of the verb: Asp must also be active if Prog is. Second, (36) accounts for why the last resort strategy of activating a φ-probe on an extant functional head obligatorily activates Asp before Prog. This accounts for the ungrammaticality of the following example, repeated below from (35):

(37) *Axnii oo ksuuta ksuu-**lan**=ii-**laa**.
we one book write.PFV-**L.1PL**=AUX-**3FS**
'We wrote the book(fem.).'

(37) is ungrammatical because Prog is active but Asp is not, contra the hierarchy in (36).

The implicational hierarchy in (36) can be seen as related to the aspectual spectrum in (38a), adapted from Coon (2010), with Senaya's implicational hierarchy in (38b):

(38) a. ← simple clause || complex clause →
Perfective ≪ Imperfective ≪ Progressive
b. T ≪ Asp ≪ Prog

Coon argues for placing these three aspects on a scale of (potential) structural complexity, stated in terms of additional structure. Expanding on Coon's definition of "additional structure" to mean something more general – for my purposes, general enough to include the addition of probes as increasing structural complexity – then Senaya's implicational hierarchy maps directly onto the hierarchy of aspects in (38a): T is the canonical head active in the perfective (i.e., bearing a φ-probe), Asp is additionally active in the imperfective, and Prog is additionally active in the progressive. The increase in complexity of the clause in Senaya, then, results from introducing features (φ-probes) onto the existing clausal structure.

Finally, to account for the appearance of *tm-* in all and only last resort perfectives, I propose that there is a second aspectual projection, Perf(ect)P, directly above AspP (following, e.g., Iatridou et al. (2003)). Independent evidence for this projection in Senaya comes from the perfect prefix *gii-*, which can attach to a perfective verb base, (39).[10]

(39) Axnii xa ksuuta gii-ksuu-lan.
we one book PERF-write.PFV-L.1PL
'We have written a book.'

Notably, *gii-* and *tm-* cannot co-occur, suggesting they compete for exponence of the same head. In order to flag the clause as perfective (in lieu of the use of the perfective base), *tm-* is spelled out on the Perf head, potentially through a local selectional relationship: Perf

[9] Recall that I adopt the assumption from Kalin and van Urk (2012) that when T's φ-probe fails to find an appropriate goal, it spells out as null. Thus, in an imperfective intransitive or progressive intransitive, even though there is no L-suffix on the verb base, I still assume that T is underlyingly active.

[10] Perfect and perfective are formally distinct aspects: perfective aspect expresses an event as a whole, while perfect aspect relates two times, "on the one hand the time of the state resulting from a prior situation, and on the other the time of that prior situation" (Comrie 1976:52).

spells out as *tm-* in the context of an Asp whose φ-probe has been activated as a last resort.

Broadly speaking, Senaya's last resort phenomena function as follows:

(40) a. *Perfective with one DSP object:* T is canonically active in perfective aspect, but there are two arguments that need licensing. Asp is activated to enable licensing of both arguments by unique φ-probes.
$\rightarrow$ Imperfective verb base used for perfective (with *tm-*)

b. *Imperfective with two DSP objects:* T and Asp are canonically active in imperfective aspect, but there are three arguments that need licensing. Prog is activated to enable licensing of all three arguments by unique φ-probes.
$\rightarrow$ Progressive verbal complex used for imperfective

c. *Perfective with two DSP objects:* T is canonically active in perfective aspect, but there are three arguments that need licensing. Asp and Prog are activated sequentially, enabling all three arguments to agree with unique φ-probes.
$\rightarrow$ Progressive verbal complex used for perfective (with *tm-*)

While this proposal sounds descriptively reasonable thus far, snags appear when trying to precisely implement this in the syntax.

3.2 Why Senaya presents a puzzle

Last resort mechanisms pose a number of crucial questions about how last resort phenomena interact with the syntax. What triggers a last resort mechanism? Conditions on the morphology, on PF, on LF, on spell out, on numerations? Intimately related with the answer to the previous question is how last resort mechanisms 'fix' a derivation: in the post-syntax, dynamically in the syntax, or directly in the numeration (either right off the bat or after a crash at spell out)?

Various answers to these questions have been given. Perhaps the most well-known last resort phenomenon is *do*-support, which has been argued to take place in the post-syntax, triggered by a morphological well-formedness filter (Lasnik 1981; Chomsky 1991; Halle and Marantz 1993). While this solution works well for *do*-support or a more general notion of Aux insertion triggered by morphological needs (Schütze 2003; Bjorkman 2011), it falls short of explaining how an argument that needs licensing in the narrow syntax could be helped by a post-syntactic mechanism.

Rezac (2011) offers a theory of last resort phenomena that is more powerful, and is triggered precisely by argument-licensing needs. Rezac proposes the last resort mechanism $\mathfrak{R}$ to account for cross-linguistic Person Case Constraint repairs, which rescues derivations by activating a potential Agree/Case locus. This operation is stated in (41):

(41) $\mathfrak{R}$ (for Agree/Case): A[n] uninterpretable feature (probe) may enter the numeration on a potential Agree/Case locus if needed for Case-licensing. (Rezac 2011:219)

What $\mathfrak{R}$ states is that an uninterpretable feature (specifically, a φ-probe) can be added to the numeration (onto a head with Case-licensing potential that is already in the numeration) when this uninterpretable feature is needed for convergence at spellout. The addition of this φ-probe is triggered in response to a crash at the interface of the syntax with LF or PF, where DPs that have not been Case-licensed are ‘illegible’.

$\mathfrak{R}$ operates on phases, defined as triggered by an active φ-probe locus, which serves as the phase head. When a phase fails to converge, $\mathfrak{R}$ disassembles the structure in that phase and inserts a φ-probe into the phase’s numeration. The phase is then reassembled from scratch, but has a new chance to converge thanks to the additional Agree/Case locus.

Rezac’s (2011) account as it stands cannot account for Senaya. The fundamental reason for $\mathfrak{R}$’s failure in Senaya is $\mathfrak{R}$’s reliance on phases. To illustrate this, I will walk through a sample derivation in this system, applied to Senaya, for a clause with perfective aspect and a DSP object (which empirically results in a *tm*-perfective), (42).

(42) Failed derivation of *tm*-perfective with $\mathfrak{R}$

a. Starting numeration: DP_{subj}, DP_{obj}, V, *v*, Asp, T_{φ}, Prog
b. Structure building: $[_{TP}\ T_{\varphi}\ [_{AspP}\ Asp\ [_{vP}\ DP_{subj}\ v\ [_{VP}\ V\ DP_{obj}\ ]]]]$
c. T probes: $[_{TP}\ T_{\varphi}\ [_{AspP}\ Asp\ [_{vP}\ DP_{subj}\ v\ [_{VP}\ V\ DP_{obj}\ ]]]]$
d. T spells out AspP as a phase → CRASH! (Unlicensed DP_{obj})
e. $\mathfrak{R}$: disassemble phase, activate φ on Asp in numeration
f. New numeration: DP_{subj}, DP_{obj}, V, *v*, Asp_{φ}, T_{φ}, Prog
g. Structure building: $[_{AspP}\ Asp_{\varphi}\ [_{vP}\ DP_{subj}\ v\ [_{VP}\ V\ DP_{obj}\ ]]]$
h. Asp probes: $[_{AspP}\ Asp_{\varphi}\ [_{vP}\ DP_{subj}\ v\ [_{VP}\ V\ DP_{obj}\ ]]]$
i. Asp spells out *v*P as a phase → CRASH! (Unlicensed DP_{obj})[11]
j. $\mathfrak{R}$: applies but fails because there is no potential φ-probe locus in this phase
k. Irreparable structure / fatal crash

A similarly failed derivation holds of the last resort use of $Prog_{\varphi}$. $\mathfrak{R}$ thus fails to account for Senaya.[12]

Since the Senaya data cannot be explained by $\mathfrak{R}$ (the mechanism with the most potential to handle this data, to my knowledge), Senaya presents a significant puzzle.

3.3 New solutions

In this section, I briefly propose two new accounts of Senaya’s last resort phenomena. The first is similar to Rezac’s (2011) $\mathfrak{R}$ and the account in §3.1, maintaining the insight that that the derivation is saved via the last resort activation of a φ-probe. The second is a purely selectional account, reducing the last resort nature of these phenomena to selectional properties of lexical items, going against the intuitive proposal in §3.1.

[11] One might imagine that this particular step of the derivation involves the object raising above Asp, which would prevent the crash, but there is no evidence for a high position of the object in such derivations. Further, this stipulation would do nothing to prevent a crash if there is also a DSP indirect object, in which case both objects would have to raise above Asp to prevent a crash, and then the direct object would have to move above T in the next cycle to prevent a crash in the next phase.

[12] There are also several independent problems with Rezac’s account. First, $\mathfrak{R}$ falls short of accounting for Person Case Constraint repairs in several types of languages, including Georgian (repair by camouflage) and Finnish (repair by accusative activation). Second, $\mathfrak{R}$ fails to predict the location of repairs both crosslinguistically and within languages, which may alternate based on the features of the arguments in the illicit configuration (Walkow 2012). Third, it seems conceptually undesirable to allow a phase to crash and be reassembled from scratch; ideally last resort mechanisms would be achieved without such a powerful mechanism.

3.3.1 A last resort probe account

In order to theoretically implement the account in §3.1, what is needed is a way for Asp and Prog to be sensitive to the presence of DSP objects. In the case of Asp, this results in a certain countercylicity. In a canonical perfective, T would agree with the subject. However, in a *tm*-perfective (where there is a DSP object), Asp has to agree with the subject before T can, so that T is freed up to agree with an object. Asp therefore must be 'activated' before the derivation knows that anything has gone wrong.

This first proposal solves this countercyclicity problem by making Asp sensitive to the presence of a DSP object. To accomplish this, a new mechanism is introduced into the grammar, whereby a functional head may contain a probe which searches its c-command space and, upon encountering an argument of the relevant type, activates a φ-probe on that head. I will annotate such a probe 'LR' (for Last Resort), and will describe its properties in more detail below. This account adopts the insight from Rezac's (2011) $\mathfrak{R}$ that the derivation is saved via the last resort activation of a φ-probe. However, it does not make use of the idea that this involves spelling out, failing, adding something to the numeration, and trying again. Rather, I propose that the φ-probe activation happens dynamically in the syntax, as structure is being built. Reliance on phases (which fails for Senaya) is thus removed from the system.

Under the present proposal, there are two lexical entries for Asp, (43).

(43) Lexical entries for Asp heads in Senaya (last resort probe account)

a. $\mathrm{Asp}_{\mathrm{PFV,LR}}$: selects *v*P
b. $\mathrm{Asp}_{\mathrm{IMPF}\varphi}$: selects *v*P

The perfective Asp head, (43a), always contains an LR probe, as indicated. What Senaya's LR probe does is seek out DSP objects which have not yet agreed, and upon finding such an object, LR activates a φ-probe, directly on the head on which LR resides, in this case $\mathrm{Asp}_{\mathrm{PFV}}$. If LR does not find a goal succesfully, nothing happens. Thus, both $\mathrm{Asp}_{\mathrm{PFV}}$ and $\mathrm{Asp}_{\mathrm{IMPF}}$ can carry φ-probes: the former only does so upon the LR probe successfully finding a goal, while the latter always does so.

There are two corresponding lexical entries for Prog, (44), very similar to those in (43).

(44) Lexical entries for Prog heads in Senaya (last resort probe account)

a. $\mathrm{Prog}_{0,\mathrm{LR}}$: selects TP
b. $\mathrm{Prog}_{\mathrm{PROG}\varphi}$: selects TP

The non-progressive Prog head, (44a), always contains an LR probe. When LR probes and successfully finds a DSP object which has not yet agreed, it activates the φ-probe on Prog_0. $\mathrm{Prog}_{\mathrm{PROG}}$, on the other hand, always carries a φ-probe.

As in the intuitive account presented in §3.1, following the head movement proposal in §1.3.3, there can be a semantic and morphological mismatch. As far as Asp is concerned, the morphology is only sensitive to a φ-probe on Asp (or lack thereof), and so apparent imperfective morphology can actually be triggered by an underlying perfective Asp head, so long as that perfective Asp head carries a φ-probe. The path of head movement thus determines the form of the verb base, while the head's aspectual feature value determines the meaning (perfective or imperfective). Similarly, Aux insertion is only sensitive to the presence or absence of a φ-probe on Prog, not to the semantic features of Prog.

This mechanism functions for Senaya as follows.

(45) Derivation of *tm*-perfective under the LR probe account

a. Starting numeration: $\mathrm{DP_{subj}}$, $\mathrm{DP_{obj}}$, V, v, $\mathrm{Asp_{LR}}$, T_{φ}, $\mathrm{Prog_{LR}}$

b. Structure building: $[_{\mathrm{AspP}}\ \mathrm{Asp_{LR}}\ [_{v\mathrm{P}}\ \mathrm{DP_{subj}}\ v\ [_{\mathrm{VP}}\ \mathrm{V}\ \mathrm{DP_{obj}}\ ]]]$

c. Asp's LR probes: $[_{\mathrm{AspP}}\ \mathrm{Asp_{LR}}\ [_{v\mathrm{P}}\ \mathrm{DP_{subj}}\ v\ [_{\mathrm{VP}}\ \mathrm{V}\ \mathrm{DP_{obj}}\ ]]]$

d. Asp's discovery of a DSP object that has not yet agreed triggers φ-activation

e. Asp's φ probes / is eliminated: $[_{\mathrm{AspP}}\ \mathrm{Asp}_{\varphi}\ [_{v\mathrm{P}}\ \mathrm{DP_{subj}}\ v\ [_{\mathrm{VP}}\ \mathrm{V}\ \mathrm{DP_{obj}}\ ]]]$

f. Structure building: $[_{\mathrm{TP}}\ \mathrm{T}_{\varphi}\ [_{\mathrm{AspP}}\ \mathrm{Asp}\ [_{v\mathrm{P}}\ \mathrm{DP_{subj}}\ v\ [_{\mathrm{VP}}\ \mathrm{V}\ \mathrm{DP_{obj}}\ ]]]]$

g. T's EPP attracts subj: $[_{\mathrm{TP}}\ \mathrm{DP_{subj}}\ \mathrm{T}_{\varphi}\ [_{\mathrm{AspP}}\ \mathrm{Asp}\ [_{v\mathrm{P}}\ \cancel{\mathrm{DP_{subj}}}\ v\ [_{\mathrm{VP}}\ \mathrm{V}\ \mathrm{DP_{obj}}\ ]]]]$

h. T's φ probes: $[_{\mathrm{TP}}\ \mathrm{DP_{subj}}\ \mathrm{T}_{\varphi}\ [_{\mathrm{AspP}}\ \mathrm{Asp}\ [_{v\mathrm{P}}\ \cancel{\mathrm{DP_{subj}}}\ v\ [_{\mathrm{VP}}\ \mathrm{V}\ \mathrm{DP_{obj}}\ ]]]]$

i. Building: $[_{\mathrm{ProgP}}\ \mathrm{Prog_{LR}}\ [_{\mathrm{TP}}\ \mathrm{DP_{subj}}\ \mathrm{T}\ [_{\mathrm{AspP}}\ \mathrm{Asp}\ [_{v\mathrm{P}}\ \cancel{\mathrm{DP_{subj}}}\ v\ [_{\mathrm{VP}}\ \mathrm{V}\ \mathrm{DP_{obj}}\ ]]]]]$

j. Prog's LR probes, does not find a DSP object that has not yet agreed

k. Derivation converges[13]

If there were an additional DSP object, in step (j), Prog's LR probe would successfully find a goal and would activate $\mathrm{Prog_0}$'s φ-probe.

This account has several potential problems. First, how is it that the LR probe knows when it finds a DSP object? It is possible that LR is Case-relativized, but that would require detailing a Case system for Senaya that is independent of its Agree system, since Case would have to feed Agree; such a Case system could perhaps be adapted from Preminger (2011). Second, is this LR probe too powerful? Are there similar probes elsewhere in the syntax? And finally, can this account be extended to other instances of last resort φ-probe activation crosslinguistically? These questions are left open here.

3.3.2 A selection account

A very different way to account for Senaya is to say that the structure size of vP (or an equivalent projection) correlates with the number of DSP objects. With this additional information encoded on vP, it is possible to build Senaya's seemingly last resort behavior into the lexicon via selectional properties of particular heads, effectively taking away the last resort nature of these phenomena.

Under the selection account, there are vPs of three different sizes – $v\mathrm{P}_0$ (no DSP objects), $v\mathrm{P}_1$ (one DSP object), $v\mathrm{P}_2$ (two DSP objects) – and three lexical entries for Asp:

(46) Lexical entries for Asp heads in Senaya (selection account)

a. $\mathrm{Asp_{PFV}}$: selects $v\mathrm{P}_0$

b. $\mathrm{Asp}_{\mathrm{PFV}\varphi}$: selects $v\mathrm{P}_1$ or $v\mathrm{P}_2$

c. $\mathrm{Asp}_{\mathrm{IMPF}\varphi}$: selects any vP ($v\mathrm{P}_0$,$v\mathrm{P}_1$,$v\mathrm{P}_2$)

What these lexical entries provide is a way to distinguish between two perfective Asp heads, (46a) and (46b). The first of these, which does not bear a φ-probe, can only combine with a vP which contains no DSP objects. The second of these, which does bear a φ-probe, can

[13] For simplicity I have omitted *tm*- as the head of PerfP in this derivation; I assume that in step (f), Perf spells out as *tm*- when its sister is an AspP whose head is perfective but has been activated by LR.

only combine with a *v*P which contains at least one DSP object. Asp_{IMPF} always carries a φ-probe, as in earlier analyses of Senaya (Kalin and van Urk 2012). Assuming an account of the verbal morphology which reflects the presence or absence of a φ-probe on Asp (rather than the semantic aspect of the Asp head), §1.3.3, this will correctly derive the appearance of the imperfective base when there is a DSP object in the perfective, but the appearance of the perfective base when there is no DSP object.

Such an account, however, runs into several problems. First, it is not clear how plausible it is for *v*P to encode its (DSP) arguments in the way needed for this account: are there any independent properties of these *v*Ps that indicate that they are different sizes structurally? Second, when the Prog head is considered, it is much harder to characterize the local environments in which Prog contains a φ-probe (while not being progressive). Just like Asp, Prog must be sensitive to *v*P size ($v\text{P}_0$,$v\text{P}_1$,$v\text{P}_2$), in that non-progressive Prog_{φ} can only occur in a clause with $v\text{P}_2$; in other words, the only way to get a 'fake' progressive is when there are two DSP objects. However, Prog is not local to *v*P the way that Asp is, so the selection of $v\text{P}_2$ by non-progressive Prog would have to be long distance. Finally, if the first two problems can be resolved, then this selectional account may turn out to work well for Senaya, but the account cannot straightforwardly be extended to other extremely similar last resort phenomena in languages with Person Case Constraint repairs.

The selection account has a major advantage over the last resort probe account: it does not introduce a new mechanism into the grammar, designed specifically to deal with last resort phenomena. Deciding between these proposals, or alternatively, finding a new way to account for Senaya's last resort phenomena, is left open for future research.

Conclusion

In this paper, I have demonstrated that there are two last resort phenomena in Senaya which cannot straightforwardly be captured in existing last resort frameworks. I proposed two potential ways to account for this: (i) a last resort probe analysis, in which Senaya's two last resort heads – Asp and Prog – are endowed with an LR probe that searches its c-command space for DSP objects which have not yet agreed; and (ii) a selectional analysis, in which different versions of Asp select different sizes of *v*P. Both accounts have their problems, but merit further research, in particular to see whether either offers improved empirical coverage over previous accounts of last resort phenomena.

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Affiliation

Laura Kalin
University of California, Los Angeles
laura.kalin@gmail.com

Two restrictions on possible connectives

Roni Katzir · Raj Singh

Introduction

If languages could lexicalize arbitrary truth tables as sentential connectives, we should be able to find a great variety of connectives in the world's languages. However, very few connectives are typologically attested, as has long been known. For example, no known language lexicalizes *if-and-only-if*, *not-and*, or McCawley (1972)'s *schmor*, a connective that returns true exactly when two or more of its arguments are true. In fact, Gazdar (1979) makes the point that the only *bona fide* non-unary connectives are $\wedge$ and $\vee$. This typological puzzle calls for an explanation, and indeed several proposals have been suggested in the literature.[1]

We examine two approaches to restricting the possible connectives. Both follow McCawley (1972), and more specifically Gazdar (1979), in assuming that connectives can only see the set of truth values of their syntactic arguments. As Gazdar notes, this eliminates sensitivity to ordering and repetitions. The first approach, growing out of Gazdar and Pullum (1976) and Gazdar (1979), takes the notion of *choice* as its starting point: if O is a connective and A its argument, then $O(A) \in A$. For example, if all the arguments are true, $A = \{1\}$, and $O(A)$ is 1. We will refer to this as the *choice-based approach*.[2] The second approach, growing out of Keenan and Faltz (1978, 1985), takes *ordering* as its starting point: the domain of truth values is assumed to be ordered, with $0 < 1$, and a connective can only choose the maximum or minimum element within its argument. We will refer to this as the *ordering-based approach*.[3]

In the classical domain, choice and ordering seem to predict the same sentential connectives. The perspectives they offer are different, though, offering the hope of divergent predictions if we go beyond the classical domain. A tempting place to look is non-classical semantics, used to implement the Frege-Strawson program for presupposition.[4] The challenge here is that there are many trivalent extensions of the classical operators, but only one

[1] A similar state of affairs holds with respect to other logical operators. See Barwise and Cooper (1981), Higginbotham and May (1981), Keenan and Stavi (1986), and van Benthem (1984) for discussion of the case of quantificational determiners.

[2] This is a generalization of Gazdar and Pullum's notion of *confessionality*, which requires that if A is $\{0\}$ then $O(A) = 0$.

[3] For a more general discussion, we should replace *maximum* with *supremum* (least upper bound) and *minimum* with *infimum* (greatest lower bound). We stay with *maximum* and *minimum* here to keep the discussion simple. We should note that Keenan and Faltz and much work inspired by it assume that the appropriate structures form Boolean algebras. This stronger assumption is incompatible with the trivalent extensions discussed below.

[4] See van Fraassen (1966) and Keenan (1972) for early proposals.

(the system of Peters (1979), modelling Karttunen (1974)) is attested in natural language.

At the time of the original proposals providing the basis for the choice-based and ordering-based approaches, the extension to trivalent semantics seemed unattractive: both approaches are committed to symmetric semantics, while the projection patterns of the connectives is inherently asymmetrical. Following Schlenker (2007, 2008), however, recent work on presupposition projection has explored the idea of a modular architecture in which a symmetric core is stated separately from an incrementalization procedure. Specifically, Fox (2008) and George (2008) provide incrementalizations of symmetric trivalent operators. This new direction allows us to return to the two explanatory accounts for binary connectives and compare their trivalent extensions. At first, as we will see, only the ordering-based approach seems to remain explanatory in the trivalent domain. We then notice that an epistemic perspective used by Fox (2008) and George (2008) allows the choice-based approach to eliminate the gains of the ordering-based approach and become explanatory once again. We conclude that the match goes on.

1 The projection problem

The projection problem for presupposition is the problem of predicting the presuppositions of a complex sentence from its constituent parts. The second conjunct in (1) carries the presupposition that John has a wetsuit, but the conjunction as a whole appears to have only the conditional presupposition that if John is a scuba diver, he has a wetsuit.[5,6] A similar state of affairs holds in (2), this time with disjunction: the disjunction as a whole inherits only the conditionalized version of the presupposition of the second disjunct. The sentences below are modeled after Karttunen (1973, 1974), whose characterization of the empirical facts of presupposition projection set the stage for much of the subsequent work on the subject.

(1) (It is possible that) John is a scuba diver, and his wetsuit is blue

(2) Either John is not a scuba diver, or his wetsuit is blue

Presupposition projection has been handled within a variety of different frameworks. Peters (1979) has observed that Karttunen's characterization of the projection facts can be captured by extending the classical 2-by-2 truth tables for the binary connectives to 3-by-3 tables, as in (3). A third option for each conjunct, marked $\circledast$, appears for each argument of the connective, as well as for the outcome, and represents presupposition failure. This failure can be thought of as undefinedness (possibly cashed out in terms of partiality of a function), a new truth value, or perhaps most usefully as uncertainty about which of the two classical truth values holds.

[5]The projection of the presupposition in the unembedded version of (1) is obscured by the fact that it is also entailed by the sentence. We have added the optional embedding *It is possible that* to highlight that this entailment is not relevant. For ease of exposition, we will mostly ignore this embedding below and refer to the unembedded version.

[6]We ignore here the stronger, unconditional presuppositions sometimes observed in sentences similar to these. Accounting for such unconditional presuppositions, called the *proviso problem* by Geurts (1996), has been a matter of lively debate. See Beaver (2001), Heim (2006), Singh (2007), and Schlenker (2011) among others.

(3)

and	0	⊛	1
0	0	0	0
⊛	⊛	⊛	⊛
1	0	⊛	1

or	0	⊛	1
0	0	⊛	1
⊛	⊛	⊛	⊛
1	1	1	1

To compute the presupposition of a conjunctive sentence of the form *p and q*, such as the unembedded version of (1), we look at the truth table for conjunction and compute the conditions under which the result is not presupposition failure (that is, not ⊛). It is easier to start by looking at when it *does* denote ⊛. This happens in one of two cases: (a) $[\![p]\!] = ⊛$, regardless of q (that is, failure in the first conjunct always projects), and (b) $[\![p]\!] = 1$ and $[\![q]\!] = ⊛$. In our example, p is not presuppositional, while q presupposes that John has a wetsuit.[7] Since p is not presuppositional, the (a) case is irrelevant, and the conjunction will denote ⊛ only in the (b) case: if $[\![p]\!] = 1$ and $[\![q]\!] = ⊛$. That is, the conjunction will denote ⊛ exactly when p is true and John does not have a wetsuit. The conjunction presupposes that it does *not* denote ⊛: that either $[\![p]\!] = 0$ (recall that p is not presuppositional, so it cannot denote ⊛) or that John has a wetsuit. This amounts to the presupposition that if John is a scuba diver, then he has a wetsuit, which matches Karttunen's characterization of the facts. The reasoning for (2) is similar.

The Peters tables in (3) are asymmetric, reflecting important observations by Karttunen (1973) and Stalnaker (1974) that suggest a left-to-right asymmetry in projection. Here is an early example:

(4) (Karttunen 1973 ex. 16)
  a. Jack has children and all of Jack's children are bald
  b. # All of Jack's children are bald, and Jack has children

Similarly, reversing the linear order of the two conjuncts in (1) seems to project the strong presupposition that John has a wetsuit rather than the weaker conditional presupposition of the original example:

(5) (It is possible that) John's wetsuit is blue, and he is a scuba diver

Peters (1979) used evidence of this kind to motivate the asymmetry in (3). In (4a), for example, the first conjunct satisfies the presupposition of the second conjunct. For the sentence to be ⊛, we need the first conjunct to be 1 (if it is 0, the whole conjunction is 0; it is not presuppositional and so cannot be ⊛) and the second conjunct to be ⊛. (4b), on the other hand, is odd, a judgment that has been taken to point to an inability of the second conjunct to help the first. Peters (1979)'s solution is to make presupposition failure in the first conjunct fatal, regardless of what follows.

2 The overgeneration puzzle

As pointed out by Gazdar (1979) and Heim (1983), extending the classical operators to account for presupposition projection raises an overgeneration problem:[8] we can imagine

[7] This is not quite right. In both cases, p presupposes at least that John exists, and q probably presupposes that he has a unique wetsuit. We ignore this to keep the presentation simple.

[8] The overgeneration problem was further discussed by Soames (1989) and Heim (1990) (citing a personal communication from Mats Rooth), who point out that Heim (1983)'s proposal is not explanatory in this sense.

various projection behaviors associated with the same given classical operator, and yet there is just one actual projection behavior attested across speakers and across languages for each operator. For example, we can imagine a variant of English, English$'$, in which a conjunction presupposes everything that at least one of its arguments presupposes. This would make (1) presuppose that John has a wetsuit. Or there could be a different variant of English, English$''$, in which a conjunction would presuppose only what both of its arguments presuppose. This would make (1) presuppose nothing. Such variants of English (or of other languages) are unattested. An explanatory theory should derive the actual projection behavior for a given operator in a principled way and explain why other imaginable projection options are absent.

In the framework of Peters (1979), the overgeneration problem can be stated as follows. There is a 3-by-3 truth table extending the classical table for conjunction (or disjunction, etc.) which accounts for the observed pattern of presupposition projection. But there are many other imaginable 3-valued extensions of the same classical table that would result in other, unattested projection patterns. In fact, a third truth value gives rise to a 3×3 table in which only 4 cells are already determined by the classical table, so each of the remaining 5 cells can in principle have any of the three available truth values. This means $3^5 = 243$ possible extensions for any classical binary connective such as *and* and *or*. Why is it that speakers and languages do not vary with respect to the extension that they choose?

3 Choice, ordering, and trivalence

Interest in the overgeneration puzzle for presupposition projection has been revived by Schlenker (2007, 2008), who offered a first comprehensive explanatory account. This has spurred work on explanatory theories of projection within different frameworks, leading to semantic accounts by Fox (2008) and George (2008), a pragmatic account by Chemla (2009), and an extension of Heim (1983)'s original system by Rothschild (2008), among other proposals. The overgeneration puzzle has been treated separately in the literature from the typological puzzle for connectives in the classical domain. In fact, as far as we can tell, the explanatory accounts just mentioned can extend XOR, *nand*, or any of the other unattested classical connectives just as easily as they can extend the attested ones. On the other hand, both of the approaches for restricting the classical connectives also suggest interesting restrictions on the possible trivalent extensions. Both approaches treat their input as a set, which means that both rule out any asymmetric connective. Moreover, both select the output from within the set, which limits the operators even further: if the input is the set $\{0, \circledast\}$, for example, the output cannot be 1. In total, this brings us down from the original 243 potential extensions for each connective to just four for each:

(6)

$\wedge_1$	0	$\circledast$	1
0	0	0	0
$\circledast$	0	$\circledast$	$\circledast$
1	0	$\circledast$	1

$\wedge_2$	0	$\circledast$	1
0	0	$\circledast$	0
$\circledast$	$\circledast$	$\circledast$	$\circledast$
1	0	$\circledast$	1

$\wedge_3$	0	$\circledast$	1
0	0	0	0
$\circledast$	0	$\circledast$	1
1	0	1	1

$\wedge_4$	0	$\circledast$	1
0	0	$\circledast$	0
$\circledast$	$\circledast$	$\circledast$	1
1	0	1	1

(7)

$\vee_1$	0	$\circledast$	1
0	0	$\circledast$	1
$\circledast$	$\circledast$	$\circledast$	1
1	1	1	1

$\vee_2$	0	$\circledast$	1
0	0	$\circledast$	1
$\circledast$	$\circledast$	$\circledast$	$\circledast$
1	1	$\circledast$	1

$\vee_3$	0	$\circledast$	1
0	0	0	1
$\circledast$	0	$\circledast$	1
1	1	1	1

$\vee_4$	0	$\circledast$	1
0	0	0	1
$\circledast$	0	$\circledast$	$\circledast$
1	1	$\circledast$	1

The choice-based approach stops here, leaving us with $4 \times 4 = 16$ different presuppositional systems for speakers to consider (since any choice of $\wedge$ in (6) is compatible with any choice for $\vee$ in (7)).

The ordering-based approach goes one step further. Recall that on this approach, the entries are min and max rather than arbitrary truth tables. If the three-valued domain is ordered, we will have a unique extension to each operator. The orderings to consider are the following:

(8) a. $\circledast < 0 < 1$
b. $0 < \circledast < 1$
c. $0 < 1 < \circledast$

If we accept any of the orderings in (8), the ordering-based approach gives us exactly two simplex trivalent connectives: (8a) licenses $\wedge_2, \vee_3$; (8b) licenses $\wedge_1, \vee_1$; and (8c) licenses $\wedge_3, \vee_2$. If we follow Beaver and Krahmer (2001) in accepting (8b), we obtain $\wedge_1$ and $\vee_1$. These two tables are those introduced in Kleene (1952) and known as *Strong Kleene*.[9]

4 Descriptive adequacy and linear asymmetry

The pattern of projection for the Strong Kleene operators predicted by the ordering-based approach (and for the additional operators predicted by the choice-based approach) can be computed using the same reasoning discussed in section 1. For example if p is non-presuppositional and q presupposes r the prediction of the Strong Kleene system is that both *p and q* (as in (1)) and *q and p* (as in (5)) presuppose $p \rightarrow r$, and that both *p or q* and *q or p* presuppose $\neg p \rightarrow r$. The other connective licensed by the choice-based approach make different predictions, but they, too, can only predict symmetric patterns of projection.

The predicted symmetry flies in the face of all the standard work on projection since Karttunen (1973), mentioned earlier, which might explain why trivalence was not used to attempt to decide between the choice-based and ordering-based approaches. Recently, however, Schlenker (2007) has argued for a more modular system, which includes both symmetric projection and an incrementalization procedure. Much of the work following Schlenker has maintained this modular view, in which a symmetric core is embedded within a bigger incremental system, and Fox (2008) describes a general procedure for incrementalizing a symmetric system. The rough idea is this: when we process a sentence from left to right, we must always be sure that the sentence does not end up denoting $\circledast$; if we are not sure, the result is presupposition failure for the sentence, even if this local uncertainty is resolved later on. In a conjunction of the form *p and q*, this requirement leads to the following difference between p and q. Suppose p suffers from presupposition failure, and suppose that q is false. As mentioned above, we can easily determine the truth value of the whole conjunction: *p and q* is false, regardless of p. However, this certainty is obtained only after we have processed q. Earlier in the sentence, when we have just processed p, it is still possible, according to our information at that point, that the whole conjunction would suffer from presupposition failure (this would happen, for example, if the

[9] The choice of $\wedge_2$ and $\vee_2$ is known as *Weak Kleene*. Following Krahmer (1998), the asymmetric Peters tables in (3) above are sometimes referred to as *Middle Kleene*.

second conjunct turned out to be true). Due to this local inability to ensure that $\circledast$ is avoided, the whole conjunction suffers from presupposition failure. In other words, presupposition failure in the first conjunct always projects. Things are different with the second conjunct, q. Let us reverse the scenario just described and assume that p is false and that q suffers from presupposition failure. The same global ability to resolve the uncertainty applies: one of the conjuncts is false, and so the whole conjunction is false. However, as discussed by Fox (2008), since the uncertainty appears in the second (and final) conjunct q, this global elimination of uncertainty is the same as local elimination of uncertainty: by the time we process q we already know that p is false, and so we are never in doubt as to whether our uncertainty about q will affect the larger structure. As in the symmetric case, $\circledast$ is avoided, and the presupposition failure in the second conjunct does not project. Incrementalizing the Strong Kleene connectives yields exactly the asymmetric Peters tables listed above. Experimental support for the modular view is provided by Chemla and Schlenker (2012).

If this is indeed the correct direction, we can now incrementalize the symmetric connectives derived by the choice-based and the ordering-based approaches and try to compare the two. When we do so, the ordering-based approach derives a different asymmetric system for each of the three orderings in (8), while the choice-based approach overgenerates by again deriving four different possibilities for each connective, which yields sixteen different systems in total.

5 An epistemic equalizer

At this point it might look like we have what we were looking for. The choice-based account and the ordering-based one were both explanatory accounts in the classical domain, but only the latter remained reasonably explanatory in the trivalent extension we just saw. If we could stop here, we would have an argument for the ordering-based approach.

As discussed by Fox (2008) and George (2008), however, there is an epistemic perspective, due to Kleene (1952), that can make any account of the classical operators explanatory in the trivalent domain. If we conjoin p and q, where p is false and the truth value of q is unknown (but is either true or false), we can already conclude that *p and q* is false. Similarly, the disjunction of p and q, where p is true and the truth value of q is unknown (but either true or false) is true. On the other hand, conjoining p and q, where p is true or unknown and where q is unknown does not allow us to determine whether the result is true or false, and so the result will be unknown. Similarly for disjunction of a false or unknown p with an unknown q. This natural perspective allows us to derive the complete Strong Kleene tables from the tables for the classical connectives based on considerations of knowledge.

Note that this epistemic perspective does not obviate the need for an explanatory account of the classical domain. It does, however, eliminate the hard-earned gains of the ordering-based approach in the trivalent domain, bringing us right back to our starting point.

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Affiliation

Roni Katzir	Raj Singh
Department of Linguistics	Institute of Cognitive Science
& Sagol School of Neuroscience	
Tel Aviv University	Carleton University
rkatzir@post.tau.ac.il	raj_singh@carleton.ca

Notes on Malagasy causatives

Hilda Koopman

Introduction

There are two known scope puzzles in Malagasy *amp-* causatives (Andrianierenana 1996:68f and Randriamasimanana 1986). In this squib, I sketch how these puzzles fall out from structure building merge, and compositional interpretation.

The first puzzle concerns certain right adjoined adverbs, which can be interpreted below or above the causative:

(1) n.amp.i.homehy azy indroa aho
PST.CAUS.AT.laugh ACC.3 twice NOM.1
'I made [him laugh twice].' CAUSE > twice
'I twice [made him laugh].' CAUSE < twice

A proper understanding of the structure of *amp* causatives yields a straightforward, and unsurprising account for this ambiguity in light of von Stechow (1996).

The second puzzle concerns the possible scopes of negation *tsy* in *amp* causatives. Though *tsy* must precede the *amp* causative, it appears to be able to scope not just above the causative, but also, and this is the puzzle, below the causative:

(2) a. tsy m.amp.a.tory ahi io fanafody io
NEG PRES.CAUS.AT.sleep ACC.1 DEM medicine DEM
'This medicine doesn't make me sleep.'
b. tsy m.amp.a.tory ahy ny kafe
NEG PRES.CAUS.AT.sleep ACC.1 D coffee
'Coffee makes me not sleep.'

It is widely assumed that scope is determined by merge (i.e. c-command). Since *tsy* precedes the *amp* causative, merges with tensed marked forms, hence c-commands the causative, the causative should *always* be interpreted in the scope of negation, period. How then can this apparent low scope interpretation arise from structure building and interpretation?

1 Amp causatives and the first puzzle

A first step towards understanding these puzzles, consists of unpacking the structure of *-amp* causatives (Keenan and Polinsky 1998). The analysis will share most features with

Paul (2000), Travis (2010) and Ntelitheos (2006).

Malagasy *amp* causatives are build on a tenseless active (AT) voiced form:

(3) n.amp.[i.homehy] azy aho
PST.CAUS.[AT.laugh] ACC.3 NOM.1
'I made him laugh.'

(4) n.amp.[a.tory] ahy io fanafody io
PST.AMP.CAUS.[AT.sleep] ACC.1 DEM medecine DEM
'This medicine made me sleep.'

While *amp* is typically glossed as CAUS, this gloss does not represent a linguistic analysis. *Amp* is clearly not monomorphemic, in fact, it is not even a constituent. It hides further substructure, consisting (minimally) of a complex agent nominalization preceded by an AT voice prefix.

A productive agent nominalizer /p/ (orthographic mp-) combines with a tenseless active-voiced verb to form an agent nominalization. /p/ itself consists of two parts: the *f*-nominalizer and, a floating /m/ that leaves its mark in the change of [f] to [p].

m-i-hehy	laugh	mpihehy	(one) who laughs
mi-homehy	laugh	mpihomehy	(one) who laughs
m-a-tory	sleep	mpatory	(one) who sleeps
m-i-jery	look at	mpijery	spectator, one (who) watches
m-iara miasa	be together work	mpiara miasa	(ones) who work together

These agent nominalizations are best translated as relative clauses. They contain a surprisingly large verbal syntactic structure (surprising here from the perspective of English -er nominals), with accusative pronouns and DPs, adverbial modifiers, and even "object shift", a process which results in a definite direct object following an adverb (Ntelitheos 2006:49f). Importantly, however, they exclude the tense (or participial markers) — m- for present, n- for past, h- for future — as well as any elements that merge with these tense forms, in particular the negation *tsy*. This rules out any analysis for the low scope interpretation of *tsy* as merging with or within the agent nominalization causative, with some mysterious kind of raising to a position preceding the causative (i.e. *tsy* would be interpreted low, but pronounced high).

The agent nominalization, basically a subject relative clause, is an open predicate that in turn merges with a subject. This yields the inner segment of the causative structure for (3), labeled here as a VP (with simplified structure), rather than a nominal small clause:

(5) n. an. [$_{VP}$ [mp. [i.homehy] azy]] aho
PST. AT [$_{VP}$ [*mp* [AT.laugh] ACC.him]] NOM.I
≈ I made [him become someone who laughs].
'I made [him laugh].'

What category exactly merges with this VP constituent? The structure contains *an*,[1] which behaves like an AT voice as it combines with tense/aspect. However since AT voice markers combine with lexical predicates without exception, it is surprising that this construction contains no such expressed predicate. We expect some predicate in $\boxed{?}$.

[1]Or perhaps the AT voice marker -a, if the appearance of the nasal is due to a floating nasal in the agent nominalization.

(6) a. [n an $\boxed{?}$ [$_{VP}$ [$_{agent\ nominal}$ mp [i homehy]] azy] aho]
b. [PST an $\boxed{?}$ [$_{VP}$ [$_{agent\ nominal}$ who [$_{AT\ VoiceP}$ laughs]] ACC.3] NOM.I]

Since this structure also contains an additional argument (either a cause, or an agent), the subject in the VP carries accusative case, and the construction receives a causative interpretation, the most parsimonious analysis is one in which $\boxed{?}$ equals a causative verb *v*, albeit silent, and *an* is analyzed as the AT voice marker typical of transitive verbs, which tense combines with.

This structure allows an immediate understanding of the scopal ambiguities in (7): it is a trivial case of structural ambiguity. If a modifier like *ndroa* 'twice' is attached to the lower VP, it yields the reading where *twice* modifies just the lower VP. If it is attached to the causative *v*P, it yields an interpretation where *twice* modifies the causative:

(7) n.an.mp.i.homehy azy indroa aho
PST.AT.mp.laugh ACC.3 twice NOM.1

(8) a. n.an.$\boxed{v}$ [[mp.i.homehy azy] indroa] aho
'I made [him laugh twice].' CAUSE > twice
b. n.an.[$\boxed{v}$ [mp.i.homehy azy]] indroa] aho
'I twice made him laugh.' CAUSE < twice

Thus, from a structural and interpretative point of view, everything points towards the presence of a silent verb that contributes the causative meaning, as well as a cause or an agent. It merges with a VP small clause complement, determines accusative case on the subject of the small clause complement, and combines with the AT voice *an*, which is probably the most expected form for a transitive causative predicate.

Rather than assuming *an* itself is homophonous between AT voice and a causative, all the properties fall out in a parsimonious way if the structure contains a silent (transitive) verb. In this way the presence of the silent linguistic material can be diagnosed by the linguistic signature it leaves on the environment and the interpretation.

2 Negation and amp causatives: the second puzzle

What exactly is the semantic contribution of the silent causative verb? Since languages in general have various causative verbs (*make*, *let*, *get*, *have* ...), is there any reason to assume the silent predicate must be equivalent to the meaning of a particular causative, corresponding to say *make*? Could the meaning be vaguer, or could there be more than one silent transitive verb able to fill the *v* slot in this environment?

Relevant here is that there is a context in which *amp* must occur, which lacks a causative interpretation altogether. This is the case for the reciprocal suffix which has to combine with *amp* for verbs that are build on AT forms starting with -i, as in the example below. As Keenan and Polinsky (1998) comment: "The occurrence of *amp* has no causative interpretation, it is purely epenthetic."

(9) m- if- an- mp- i- jery Rabe sy Rasao
m- if- an- mp- AT- look.at Rabe and Rasoa
'Rabe and Rasoa are looking at each other.'

Under the view presented here, a purely epenthetic story is unlikely: if the structure contains the AT voice suffix, it must also contain a *v* that it combines with, which in turn combines with an agent nominalization. We expect some semantic contribution of *v*. It could be some other type of transitive *v* — perhaps an agent introducing a verb akin to *do* — which induces some kind of control in these particular complex reciprocal *amp* structures. The question what the semantic contribution would be exactly depends on the precise analysis of this construction, but what is clear is that a causative meaning can be absent.

That a causative meaning can be absent in such contexts, provides a way to analyze the surprising negative scope examples, with negation apparently taking scope below the causative. Rather than assuming that the causative is always a *make* causative, the silent causative could be compatible with a *let* causative meaning. Since *not let* is logically equivalent to *make not*, this would allow maintaining the most general and strongest theory of scope. *Tsy* always takes scope over the causative: there simply is no other option given the syntactic structure. Low scope of negation must therefore be result in some other way. I suggest it arises from negation combining with a causative verb with a *let*-like meaning. More abstractly, it must arise from the semantic interaction of the structural components in the structure, which must include silent elements.

This solution is in fact foreshadowed in Abinal and Malzac's remarkable (1888) dictionary: "[...C]et adverbe de négation placé devant certains verbes prend le sens de suppression, d' enlèvement [...]" Abinal and Malzac (1987), which they illustrate with *tsy nampandry ahy ny aretina halina* 'La maladie m'a empêché de dormir hier soir', 'Sickness prevented me from sleeping last night'.

This raises questions for future research: are these readings freely available? If not, why not? How widespread is the *let* interpretation, i.e. what independent interpretative evidence can be found for *let* interpretations beyond the negative *amp* causatives with apparent low scope? And if such readings turn out to be available only in restricted contexts, why would this be the case? What exactly is the semantic difference between *make* and *let*? How are these verbs built up? Does (silent) modality (possibility versus necessity) have any role to play in these interpretations? Does quantification (perhaps existential versus universal)? More broadly, what are the properties of modality and quantification in Malagasy and how to they interact with negation?

I hope we will have many opportunities to continue further issues of these questions in the future!

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Affiliation

Hilda Koopman
Department of Linguistics
UCLA
koopman@ucla.edu

Joint Knowledge

Marcus Kracht

Joint knowledge of a group is the maximal knowledge that members of a group can attain only by talking to each other. I propose a formal approach and show how — at least in principle — group members can find out whether a proposition is jointly known.

1 The Problem

On the one hand, communication serves to distribute knowledge. On the other hand, knowledge is presupposed in communication. This is not a contradiction. The knowledge that is presupposed in communication is the so called *common knowledge*, while that which is communicated cannot be, by pragmatic principles. If φ is known by everyone, the Principle of Informativeness discourages utterance of φ. As Williamson (2000) argues, an assertion is licit only when what gets communicated is known to the speaker. This means that it should not be known to the hearer (as far as the speaker knows, that is). The effect of the communication is that it makes the assertion common knowledge, see Balbiani, Baltag, van Ditmarsch, Herzig, Hosi, and de Lima (2008). The knowledge that can be so attained is limited to what is known by all the speakers. This I call *joint knowledge*. This is the same as the "implicit knowledge" defined in Halpern (1987), but that term strikes me as unfortunate. A proposition is known jointly by a group if it follows from the union of all the propositions known individually. The aim of this paper is to investigate this notion.

2 Definitions

Let G be a set, the group of *agents*. For each $a \in G$, let K_a be the operator "a knows that". I take it that K_a satisfies the postulates of some modal logic, be it KT (Williamson (2000)), $\mathsf{S4}$ (Hintikka (1962)) or $\mathsf{S5}$ (Fagin, Halpern, Moses, and Vardi (1995)). All these conditions are equivalent to universal elementary conditions on Kripke-frames. I use the notation of propositional dynamic logic (PDL, see Goldblatt (1987)). So, K_a is based on a so-called "program" κ_a, $a \in G$, which gets interpreted as a relation between states, called here as usual *worlds*. We present the arguments assuming tacitly that K_a satisfies $\mathsf{S5}$, the relation associated with κ_a is an equivalence relation $E_a \subseteq W \times W$, but little hinges on that. Given $w \in W$, the w-alternatives for a are all b for which $a \, E_a \, b$. These are also called the epistemic alternatives for a at w. What is known to a at w is what is true in all w-alternatives for a. Thus $K_a\varphi$ is tantamount to $[\kappa_a]\varphi$. The more alternatives w has, the less is known to a.

It follows that knowledge *increases* when the E_a gets refined (so that the equivalence classes shrink). Now, for a group $H \subseteq G$ denote by "$C_H\varphi$" the fact that it is common knowledge for all $a \in H$ that φ. The standard definition is this. C_H is based on a program γ_H defined by

(1) $$\gamma_H := (\bigcup_{a\in H} \kappa_a)^*$$

This is to say that $C_H\varphi$ is nothing but $[\gamma_H]\varphi$. As we close the union (reflexively and) transitively, this is again an equivalence relation. Common knowledge satisfies again the postulates of S5. Notice that nothing less than the transitive closure suffices, and it has been argued that these steps of iteration are strictly required in pragmatics. (See also the problems of imperfect communication in Halpern (1987).)

The definition of joint knowledge is however much simpler.

Definition 1. Let U_a be the set of propositions known to a and let $H \subseteq G$ be nonempty. The **joint knowledge of** H, U_H, is the deductive closure of $\bigcup_{a\in H} U_a$. "$J_H\varphi$" is short for $\varphi \in U_H$.

J_H is based on the program ι_H, which is defined as follows.

(2) $$\iota_H := \bigcap_{a\in H} \kappa_a$$

Notice that we require that H is not empty. If you are desperate, let $\iota_\varnothing$ be the total relation on the frame. For a world w' to be a w-alternative according to what the members of H know jointly, it must be an alternative for every member of H, for everyone needs to agree on the alternatives to the world w. Since the intersection of equivalence relations is again an equivalence relation, J_H also satisfies S5. This generalises to the weaker logics KT and S4 as a consequence of the following observation.

Theorem 2. *Let P be a variable for binary relations, x_i variables over worlds. Let $\varphi = \varphi(P,\bar{x})$ be a second order formula relations of the following kind. It is made from formulae of the form $x_i\, P\, x_j$ using conjunction, disjunction, and restricted and unrestricted universal quantification (which have the form $(\forall x_i)(x_i\, P\, x_j \to \cdot)$ and $(\forall x_i)$, respectively). If R and S are relations on a set M satisfying φ, then also $R \cap S$ satisfies φ.*

Proof. Let φ^R (φ^S, $\varphi^{R\cap S}$) be the result of inserting R (S, $R \cap S$) for P in φ. By induction on the formulae we show that for every first-order valuation β sending variables to worlds, $\langle \mathfrak{M}, \beta\rangle \vDash \varphi^R$ and $\langle \mathfrak{M}, \beta\rangle \vDash \varphi^S$ implies $\langle \mathfrak{M}, \beta\rangle \vDash \varphi^{R\cap S}$. For the atoms, this is clear. If $w\, R\, v$ and $w\, S\, v$ then $w\, (R \cap S)\, v$. The inductive steps for conjunction and disjunction are straightforward. Suppose now that $\langle \mathfrak{M}, \beta\rangle \vDash (\forall y)(x\, R\, y \to \varphi^R)$ and $\langle \mathfrak{M}, \beta\rangle \vDash (\forall y)(x\, S\, y \to \varphi^S)$. Choose a w and let $\beta'(y) := w$ be a y-variant of β. If w is not a $(R \cap S)$-successor of $\beta(x)$, we trivially have $\langle \mathfrak{M}, \beta'\rangle \vDash (x\, Py \to \varphi)^{R\cap S}$, since this formula is nothing but $(x\, (R \cap S) y \to \varphi^{R\cap S})$. Thus, let us assume that $\beta(x)\, (R \cap S)\, w$. Then $\beta(x)\, R\, w$ and so $\langle \mathfrak{M}, \beta'\rangle \vDash \varphi^R$. By the same reasoning, $\langle \mathfrak{M}, \beta'\rangle \vDash \varphi^S$. Hence $\langle \mathfrak{M}, \beta'\rangle \vDash \varphi^{R\cap S}$, by inductive assumption, and so $\langle \mathfrak{M}, \beta'\rangle \vDash (x\, P\, y \to \varphi)^{R\cap S}$ also in this case. β' was an arbitrary y-variant of β. Hence $\langle \mathfrak{M}, \beta\rangle \vDash (\forall y)(x\, Py \to \varphi)^{R\cap S}$. Unrestricted quantification is similar. □

Notice how joint knowledge can be defined without an auxiliary notion (as the E_G operator, which codifies "everybody in the group knows", whose transitive closure is

C_G). Reflexivity is $(\forall x)(x\ R\ x)$, symmetry $(\forall x)(\forall y)(x\ R\ y \to y\ R\ x)$ and transitivity is $(\forall x)(\forall y)(x\ R\ y \to (\forall z)(y\ R\ z \to x\ R\ z))$, and so all three conditions are of the form required by the theorem.

The axiomatisation of common knowledge proceeds by axiomatising the closure, which is already part of PDL. The intersection is not part of PDL, however. The extension of PDL with intersection is not straightforward, since intersection is not modally definable, see Passy and Tinchev (1991) for a discussion. Adding the axiom $\langle \alpha \cap \beta \rangle \varphi \to \langle \alpha \rangle \varphi \wedge \langle \beta \rangle \varphi$ is not enough (the converse implication is clearly false), and something much stronger needs to be added as well, for example nominals, for it simply encodes that $\alpha \cap \beta$ is contained in α and β, not that it is identical to them.

3 Communicating Knowledge

The main point of this paper is however not the axiomatisation of joint knowledge. The question is its role in communication. We refer here to the framework of Brandt and Kracht (2011) for communication in a network. A network consists of a set G of agents together with with a set $\mathscr{C} \subseteq \wp(G)$ of so-called *channels*. The communication structure of Brandt and Kracht (2011) further adds an addressing mechanism, whose role can be ignored here. A channel $C \in \mathscr{C}$ allows to transmit a message from one member of C to all other members. To make matters simple, we allow only the following kinds of messages to be sent: "$?\varphi$", the question whether φ is true, to which recipients may answer with "yes" (if they know that φ), "no" (if they know that $\neg\varphi$) or "don't know" (if they neither know that φ or that $\neg\varphi$); further, "$!\varphi$", the announcement that φ is true. To stay with the symmetrical flavour of Brandt and Kracht (2011), "$!\varphi$" must be followed by the acknowledgment "ok" by each recipient. As usual, we assume that all participants adhere to the pragmatic rules, in particular we assume that they only answer truthfully.

The communicative steps always leave an effect. We concentrate here on the accumulation of knowledge and leave the message scheduling out of consideration. We will however later see that certain protocols are more apt than others for the accumulation of knowledge. The announcement "$!\varphi$" as well as the answers to the question "$?\varphi$", if received by b via a channel C allow b to eliminate certain epistemic alternatives. Thus, if a formal model is required, it will be a dynamically changing Kripke-frame. However, it is not necessary to spell out the details to make the arguments clear.

In what follows I shall be concerned only with knowledge of nonmodal propositions, as it is not subject to change by rounds of communication. Thus, the formula φ unless otherwise indicated is assumed to be nonmodal.

There are basically two ways in which joint knowledge can become common knowledge. The first is described in Balbiani et al. (2008). Some speaker, a, sends out the message "$!\varphi$" through the channel $H \in \mathscr{C}$. After that, φ is common knowledge for the group H. This is the "push"-method, where someone distributes the knowledge. I should stress that this method is not as straightforward as it appears. In practice, we need to know not only that a sent out "$!\varphi$" via some channel C. It must namely also presupposed that the structure of the network is common knowledge. To see this, think about some newsletter broadcast through the net by some administration. Suppose I get that email and wonder whether a also got it. This in turn requires that I know whether a is part of the email-list address to which this message was sent. (The possibility of registering black carbon copies in email messages complicates the picture a bit. Basically, a recipient of an email knows about all recipients except other black carbon copy recipients.) Additional worries may be whether or not a has actually read and understood the message. Even face to face communication is not innocent in that respect. Even if there is no logical addressing mechanism involved, people can hear the message only if they are close enough, for example. And we may not always know who is within hearing distance (think your house and someone in an adjacent room, or even wiretapping). It is therefore far from clear who physically gets the message; that is, it is not clear what channel is actually being used.

Once all that is granted, however, as is done in this framework, then the broadcast really turns the message into common knowledge among the members of the channel *as long as the return acknowledgement is sent through that same channel as well*. The second method is where some a wants to know whether φ holds and sends out a request, "$?\varphi$", through the channel H. This is the "pull"-method. It turns out, though, that getting an answer to one's question is not that easy. One problem is that the channel might not reach everyone from the intended group H, so that what we get is not what the entire set of agents know, but something weaker. The network structure plays an important role in how we can gain access to knowledge. I shall ignore these complications in the sequel.

To start we make even more drastic simplification and assume that each subset $H \subseteq G$ is a channel. To see that even in this simplified scenario matters are still not so trivial, let us assume that b knows that p_0, but not whether p_1, while c knows that p_1 but not whether p_0, and a wants to know whether or not $p_0 \wedge p_1$ is true. If a simply sends out the request "$?(p_0 \wedge p_1)$" through the channel $\{a,b,c\}$ then he would get no further. Neither b nor c are in a position to answer his request and reply with "don't know". However, if a sends out *two* requests, say "$?p_0$" followed by "$?p_1$", he will reach his goal. b answers "yes" to his first request and c answers "don't know", while b answers "don't know" to the second request, while c answers "yes". After all this is done, a knows that $p_0 \wedge p_1$. Moreover, if the replies are sent through the same channel, b and c also know this. For then c knows that b answered the question "$?p_0$" by "yes", and b knows that c answered the question "$?p_1$" by "no". If furthermore the senders and channels of the messages are common knowledge, then $p_0 \wedge p_1$ becomes common knowledge of $\{a,b,c\}$.

Consider now a second scenario. b knows that $\neg p_0 \vee p_1$, c knows that $p_0 \vee \neg p_1$ and d knows that $p_0 \vee p_1$. In this situation, asking either "$?p_0$" or "$?p_1$" gets a no further. None of the others can answer positively or negatively to these questions. It seems then that what a must ask depends on what the others know. Fortunately, the situation is not that bad. Here is a strategy that always works.

Let "φ" be the formula about which a wants to know whether it is true. Consider a conjunctive normal form δ of φ. This is a conjunction $\delta = \bigwedge_{j \in n} \chi_j$ of maximal disjunctions χ_j. A *maximal disjunction* is a formula of the form st_P, where P is a subset of the set $\mathrm{Var}(\varphi)$ of variables of φ:

$$\text{(3)} \qquad \mathrm{st}_P := \bigvee_{p \in P} p \vee \bigvee_{p \in \mathrm{Var}(\varphi) - P} \neg p$$

Now suppose that $\varphi \leq \mathrm{st}_P$, that is, that φ implies st_P. Then if I know φ I also know st_P.

Moreover, by standard modal principles (distribution of K_a over conjunction),

(4) $$K_a\varphi \leftrightarrow \bigwedge_{j\in n} K_a\chi_j$$

Hence, to obtain knowledge of φ it is enough if I obtain knowledge of every maximal disjunction implied by φ.

Let's consider such a disjunction st_P. If a asks b about st_P, the following may occur: b answers "yes" if b knows that st_P, b answers "no" if b knows that $\neg\,\mathrm{st}_P$, and "don't know" otherwise. What however are circumstances in which b knows neither st_P nor $\neg\,\mathrm{st}_P$ for any P? These are circumstances in which the knowledge of b concerning the variables $\mathrm{Var}(\varphi)$ is zero, that is, if τ is a formula in the variables of $\mathrm{Var}(\varphi)$ that is known by b, then τ is a tautology. For if b does not know $\neg\,\mathrm{st}_P$, then some alternative world does not satisfy $\neg\,\mathrm{st}_P$. That is, some alternative satisfies st_P. If this is the case for all $P \subseteq \mathrm{Var}(\varphi)$, b in effect knows nothing. Thus, as long as b knows something, he can answer "yes" or "no" to some of a's questions.

It follows after some reflection that the following strategy works for a independently of what the other agents know. For all subsets $P \subseteq \mathrm{Var}(\varphi)$ such that $\varphi \leq \mathrm{st}_P$ a needs to send out the question "$?\,\mathrm{st}_P$". If he gets the reply "yes" at least once, st_P is jointly known. If no recipient answers "yes", st_P (and therefore φ) is not jointly known. φ is jointly known if (and only if) every such disjunct is jointly known.

Notice that the answer "no" played a subordinate role. Indeed, b will answer "no" just in case his epistemic alternatives all satisfy $\neg\,\mathrm{st}_P$. In that case, the joint knowledge (since it is not inconsistent) is exactly $\neg\,\mathrm{st}_P$. For a he could reach that conclusion also by looking at the "yes" answers of b: b will answer "yes" to all st_Q where $Q \neq P$. Hence the above communication game can also be played with the following convention. There are only two answers to "$?\varphi$": "yes", when the addressee does know that φ, and "no", when the addressee does not know that φ (but it is unclear whether or not he knows $\neg\varphi$). Even more can be concluded: the strategy works even when a does not know what the answer "no" factually means. The only thing that a needs to know is that "yes" means that the addressee knows that φ. (This situation is not uncommon. It is very often not clear whether people simply deny a claim or whether they wish to assert its falsity.)

4 Network Structure

The structure of the network has been assumed to be trivial, namely the powerset of G. What if that is not the case? Let us go back to the initial scenario where a sends out the request "$?\varphi$" through the channel H. This may be interpreted as a request to get to know whether or not φ is joint knowledge *for the group H only*. But mostly a simply intends to get an answer but cannot reach everyone through a channel. Such is the case if $H \notin \mathscr{C}$. There are two ways to look at the matter. The first option is that a is indeed interested in knowing what the group H knows. In that case he can simply send out the request "$?J_H\varphi$", thus indicating that he wishes to know whether or not φ is joint knowledge of the group H. This requires that knowledge operators are transitive, however, since a asks what the individuals know about the joint knowledge of φ not about their knowledge of φ directly. Let us grant however that knowledge is transitive. It is to be seen whether that is a solution to a's predicament. Let us consider the case $\varphi = \mathrm{st}_P$. Suppose b is asked to answer "$?J_H\,\mathrm{st}_P$". If st_P is not an epistemic alternative for b, b knows that $\neg\,\mathrm{st}_P$, and therefore he also knows that $\neg J_H\,\mathrm{st}_P$ if $b \in H$. (If $b \notin H$, he has no first hand knowledge of $J_H\,\mathrm{st}_P$, but may acquire it in the communication process.) So he will answer "yes". In the other case, the answer may be "no" or "don't know", depending on how much b knows about other people's knowledge. a can thus obtain full knowledge about $J_H\varphi$.

This shows how a can find out about what is jointly known by some group. This runs into difficulties, however, as soon as the group H is not a channel or $a \notin H$. Clearly, this can be the case. For example, let $H = \{a_i : i < n\}$ and the network only has the channels $\{a_i, a_{i+1 \mod n}\}$ (so the network is a cycle of length n) and $a = a_0$. In this case a can only send messages to a_1 and a_{n-1}, but not to, say a_2, if $n > 3$. In this situation, a_0 needs to rely on the willingness of the others to complete the task. To achieve this, we need to change the protocol.

Specifically, we need to assume that when a_0 sends a query "$?J_H\varphi$" to a_1 and a_1 cannot reply "yes", then a_1 will take up the matter and ask around to find out more. So, a_1 will ask in particular a_2 who either knows the answer or goes to ask a_3, and so on. This looks like a valid algorithm. However, it has a drawback. There is no guarantee that it terminates. Initially, one may think that once the request took a full round to finally reach a_0, a_0 could simply interrupt the chain and not send out any more requests. However, some messages might bypass a_0. To see this, let me change the network a little bit. Let $\mathscr{C} := \{\{a_i, a_{i+1 \mod n}\} : i < n\} \cup \{\{a_{n-1}, a_i\} : i < n-1\}\}$. Suppose the query moves around the circle and finally reaches a_{n-1}. If a_{n-1} does not know the answer, he will contact one of the a_i, and so set the entire chain once again in motion.

Further problems concern the fact that since everyone is allowed to issue a request it is not clear whether the request for "$?\varphi$" that reaches a_0 is actually a follow-up to a request he initiated (rather than a_1 or a_2). In the absence of an external scheduling mechanism, calls into the network will not die out if everyone is maximally cooperative. An example is where everyone knows that $p_0 \leftrightarrow p_1$, but does not know whether p_0 (and p_1) or $\neg p_0$ (and therefore $\neg p_1$). If someone issues the request $?p_0$, the algorithm will run forever. Still, the surprising fact is that if a is chosing his requests carefully enough, termination is guaranteed. Let the protocol for queries of the form "$?J_H\varphi$" be as follows. If $b \notin H$, b will not give an answer and instead issue the same query to all channels, unless b knows the answer offhand to be "yes" or "no". (Here we take advantage of the communication, because answers to queries force updates across the network.) If $b \in H$ and the answer to the query is "yes" or "no" (because of this epistemic alternatives), that answer is sent and no further action is taken. In the remaining case, b will not send out this answer and instead send out "$?J_H\varphi$" to all channels. Upon receiving the answer "yes" or "no", b will answer back to a with that same answer. This means that the answer "don't know" is in fact never used.

Call H totally connected if for every a and b there is a chain of channels connecting a and b. Alternatively, let $a\, V_{\mathscr{C}}\, b$ if there is a $C \in \mathscr{C}$ such that $a, b \in C$. H is totally connected if and only if $V_{\mathscr{C}}^{*} = H^2$.

Theorem 3. *Let G be totally connected and $H \subseteq G$. Assume that φ is jointly known by H. The maximally cooperative protocol for "$?J_H\varphi$" terminates if for all $P \subseteq \mathrm{Var}(\varphi)$ sender sends out the request "$?J_H\,\mathrm{st}_P$" for all $\mathrm{st}_P \geq \varphi$ in addition.*

Proof. Here is the catch. Suppose that st_P is true in every epistemic alternative for b. Then

b knows that st_P and he will answer the request "$?J_H\,\mathrm{st}_P$" with "yes". His answer will get known to the entire channel to which the request has been sent. $\neg\,\mathrm{st}_P$ will cease to be an alternative for members of that channel. Thus, effectively, after a few rounds $\neg\,\mathrm{st}_P$ will be eliminated throughout H. The protocol will then require termination. If all requests are sent out, and φ is jointly known, then at some point all alternatives incompatible with φ will eventually be eliminated. At this point the answer to the question becomes known to everyone. $\square$

This is reminiscent of the muddy children paradox. The more answers appear the more knowledge is acumulated and allows to give answers to questions to which no helpful answer existed before. The glitch here is that a clever initialisation by a can help to make even the maximally cooperative process terminate without scheduling "from above". However, the problem is that for this algorithm to terminate we need that φ is known. We cannot eliminate it. Suppose for example that $\varphi = p_0$ and no one in the entire network knows either p_0 or $\neg p_0$. Then the algorithm never terminates because no one is in a position to answer the request.

To remedy this, we propose a different algorithm. Instead of asking "$?J_H\,\mathrm{st}_P$", a sends out the requests "$J_{\{b\}}\,\mathrm{st}_P$" for every $b \in H$. Since b can always answer this question, this is garanteed to terminate. The proof is now easy. Since b can be reached (by connectedness) the request will eventually reach b provided that all members of the network try to pass on requests to as many members as they are connected to.

Theorem 4 (Guaranteed Termination)**.** *Let G be totally connected and $H \subseteq G$. The maximally cooperative protocol for "$?J_H\varphi$" terminates if for all $P \subseteq \mathrm{Var}(\varphi)$ and all $b \in H$ sender sends out the request "$?J_{\{b\}}\,\mathrm{st}_P$" in addition.*

Consider again the query "$?J_H p_0$" in a network where no one knows p_0 or $\neg p_0$. In this situation, b will respond "don't know" to the question $?J_b p_0$", and also to the question "$?J_b\neg p_0$". From this one can infer that both p_0 and $\neg p_0$ are possibilities for b. The algorithm terminates for the simple reason that there is no supposition that anyone other than b himself will know more about what b knows. That is to say, we assume that the protocol will not make b send out a request for help on questions about his own knowledge.

Notice that the "envelope" J_H and $J_{\{b\}}$ is crucial in allowing the participants to route the requests. At the same time—because the message is interpreted as given verbatim—they distort the original query because they ask about what the individuals know to be their knowledge rather than asking about their knowledge directly. In other words, we assume that knowledge satisfies $\mathsf{S4}$.

Finally, there is a different solution to the problem. Change the protocol as follows. On receiving the request "$?J_H\varphi$" an agent b will do the following. If b knows the answer he will reply. Otherwise he will send out the request "$J_{H-\{b\}}\varphi$" to all channels, provided that this is not empty. However, $H - \{b\} = \varnothing$ exactly when $H = \{b\}$. In that case, b will give the answer as best as he can. I call this the *group distribution protocol*.

Theorem 5 (Guaranteed Termination)**.** *Let G be totally connected and $H \subseteq G$. The group distribution protocol for "$?J_H\varphi$" terminates if for all $P \subseteq \mathrm{Var}(\varphi)$ and all $b \in H$ sender sends out the request "$?J_{\{b\}}\,\mathrm{st}_P$" in addition.*

How can we see that this is correct? At first, the query "$J_H\,\mathrm{st}_P$" will be sent out into the network and will distribute itself unchanged until it reaches some $a \in H$. This will then create another query, namely "$?J_{H-\{a\}}\,\mathrm{st}_P$". And so on, until a query of the form "$?J_{\{b\}}\,\mathrm{st}_P$" is issued that eventually reaches b. b will answer the query, and the answer will propagate through the network until everyone knows it. At this point the query "$?J_{\{b\}}\,\mathrm{st}_P$" will no longer be propagated and will die out. When finally all such queries have been propagated, the answer to "$?J_H\,\mathrm{st}_P$" becomes known throughout the network, and the algorithm terminates. When this has happened for all st_P, the answer will be known for φ as well.

5 Conclusion

This paper is a modest attempt to characterise the notion of joint knowledge and show how agents can find out whether a proposition is or is not jointly known by a group. In closing, I would like to point out some wider significance of this endeavour.

Humans are thirsty for knowledge. Research or daily experience both continue to give us new insights and knowledge. Thus, it is not to be expected that all joint knowledge can one day become common knowledge given enough communication. What is more, there is so much accumulated knowledge that it is not even possible to store all knowledge everywhere. Thus, we seek to distribute the knowledge in a network so as to share the burden of storing it. There is no difference in principle between a bunch of humans and a server farm, in fact. There is a tradeoff between distributing knowledge in a network and storing it at each location separately. Similarly, as humans we need to balance knowing something by heart and having it available from somewhere on need. The terms of the tradeoff are not logical: I have shown how we can get the desired answer. The tradeoff is in terms of effort, of which I have said nothing above. I shall leave that to another occasion.

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Affiliation

Marcus Kracht
Universität Bielefeld
marcus.kracht@uni-bielefeld.de

Compositional Asymmetry and the Functional Principle

A Theme from Keenan

William A. Ladusaw · Sandra Chung

Introduction

In this squib we return to some points made in Chung and Ladusaw 2006 about evidence for compositional asymmetry in homage to Ed Keenan's long and influential career of bringing formal semantic theory together with the analysis of Austronesian languages. In that paper, we present evidence from Chamorro for elaborating the inventory of modes of semantic composition. Here we put this notion of compositional asymmetry in the context of a tradition rooted in Keenan's early work.

1 Keenan's 1974 Functional Principle

Keenan 1974 argues that structural parallels across constructions can be recognized as reflections of underlying logical analysis that divides each construction into a functional expression and its argument. The Functional Principle states a referential asymmetry that gives primacy to the argument over elements in the functional expression: "The reference of the argument expression must be determinable *independently* of the meaning or reference of the function symbol; functions which apply to the argument however may vary with the choice of argument (and so need not be independent of it)" (Keenan 1974: 298).

Under Keenan's analysis, subjects of clauses, heads of restrictive relative clauses, and possessors in possessive constructions are analyzed as the argument to a functional expression. Patterns of pronominalization, scope, and agreement are viewed as grounded in the "referential independence" of the argument expression. This independence is broadened beyond simple referring expressions, as in the case of heads of restrictive relative clauses: "By 'head NP' we mean whatever NP in surface specifies the domain of objects that the restricting function applies to" (Keenan 1974: 307, note 1).

We view the Functional Principle as an early illustration of the value of grounding explanations of cross-linguistic generalizations in the formal analysis of the interface of syntactic structure with compositional semantic interpretation.

Chung and Ladusaw 2004 (hereafter C&L) develops an approach to semantic composition in which arguments can compose with predicate expressions without fully semantically saturating those predicates. To highlight the role of semantic incompleteness in the patterning and interpretation of various syntactic structures, C&L elaborates the inventory of available semantic composition operations beyond simple Function Application to include operations that combine property contents. Here we discuss Restrict, which composes a predicate with the property content of an indefinite, and

Modify, which is used for predicate modification.

In Chung and Ladusaw 2006, we discuss data from Chamorro, an Austronesian language of the Mariana Islands, that show that the domain specification and narrowing induced by Restrict and Modify have asymmetrical effects. Here we discuss the asymmetrical interpretation of doubled objects in incorporation and relate it to Keenan's Functional Principle.

2 Object Incorporation in Chamorro

C&L examines object incorporation in Chamorro is some detail. This construction is formed from the verbs of possession (*gäi-* 'have' and *täi-* 'not have'), which select two arguments: one corresponding to the possessor and the other to the possessed. The possessor argument is linked to the subject; the possessed (internal) argument is linked to an obligatorily incorporated object. In (1), the incorporated object is bracketed.

1. Hayi gäi-[patgun]?
   who? WH[nom].agr.have-child
   'Who has a child?

This incorporated object can be doubled by an independent DP, illustrated by the italicized DP in (2).

2. Hayi gäi-[patgun] *si Carmen*?
   who? WH[nom].agr.have-child Carmen
   'Whose child is Carmen? (lit. Who child-has Carmen?)

Under the C&L analysis, the verb of possession in both (1) and (2) is combined with the incorporated object using the operation Restrict. The property denoted by the incorporated object specifies the domain of the possessed but does not fully saturate the possessive predicate. This is what allows the referential extra object to saturate the predicate, with the entailment that Carmen is drawn from the domain specified by the incorporated object.

The extra object in incorporation can itself be a property-denoting indefinite DP, as illustrated in (3):

3. Kao gäi-[atungu'] médiku?
   Q agr.have-friend doctor
   'Does she have any doctors as friends? (lit. Does she friend-have doctors?)

The concern of Chung and Ladusaw 2006 is to show that even though both the incorporated object and the extra object are property-denoting expressions that are composed with the predicate using Restrict, the order of composition matters. In brief, *friend-having doctors* means something different from *doctor-having friends*. It is the incorporated object that determines the relationship between the possessor and the possessed and this does not change with the narrowing of the domain property expressed by the extra object.

3 The persistence of the domain argument

These doubled objects in incorporation can provide a way of testing the relevance of Keenan's Functional Principle (FP). Given that the possessive predicate is a functional expression and the incorporated object is its argument, the FP would demand that the incorporated object be "referentially independent." But once combined with the possessive predicate, the incorporated object is contained in a functional expression that in turn takes as its argument the extra object, which the FP would likewise demand be referentially independent.

The FP can be viewed as predicting the asymmetrical interpretation of the construction, under the assumption that the independence of the incorporated object (in the sense intended by the FP) persists even though this argument is part of a larger functional expression. The domain specified for the possessive relation remains the domain that is narrowed through further modification. The fact that this argument becomes part of a larger functional expression does not make it available to vary with the extra object.

It may be that this referential independence is limited to constructions in which a domain is specified and subject to further modification. Reflexive and reciprocal arguments are certainly referentially dependent upon arguments that enter the semantic composition later. As noted in Chung and Ladusaw 2006, these cases are reminiscent of the conservativity of determiners, in the sense of Keenan and Stavi 1986 (p. 275).

Conclusion

It is always fruitful to talk with Ed.

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Affiliation

William A. Ladusaw
Linguistics Department
UC Santa Cruz
ladusaw@ucsc.edu

Sandra Chung
Linguistics Department
UC Santa Cruz
schung@ucsc.edu

An Operational Approach to Fine-Grained Intensionality

Shalom Lappin

Classical intensional semantic frameworks, like Montague's Intensional Logic (IL), identify intensional identity with logical equivalence. This criterion of co-intensionality is excessively coarse-grained, and it gives rise to several well known difficulties. Theories of fine-grained intensionality have been been proposed to avoid this problem. Several of these provide a formal solution to the problem, but they do not ground this solution in a substantive account of intensional difference. Applying the distinction between operational and denotational meaning, developed for the semantics of programming languages, to the interpretation of natural language expressions, offers the basis for such an account. It permits us to escape some of the complications generated by the traditional modal characterization of intensions.

Keywords denotational semantics, fine-grained intensionality, functional programming, λ-calculus, modality, operational semantics, provable equivalence

Introduction

Classical intensional semantic representation languages, like Montague (1974)'s Intensional Logic (IL) do not accommodate fine-grained intensionality. Montague, following Carnap (1947), characterizes intensions as functions from worlds (indices of worlds and times) to denotations, and so reduces intensional identity to equivalence of denotation across possible worlds. Logically equivalent expressions are semantically indistinguishable. This is too course a criterion for semantic identity. Logical equivalence is not a sufficient condition for intersubstitutability in all contexts.

(1)a. Every prime number is divisible only by itself and 1. $<=>$

b. If $A \subseteq B$ and $B \subseteq A$, then $A = B$.

(2)a. John believes that every prime number is divisible only by itself and 1. $<\neq>$

b. John believes that if $A \subseteq B$ and $B \subseteq A$, then $A = B$.

To avoid this difficulty a fine-grained theory of intensionality must be able to distinguish between provable equivalence and intensional identity.

1 Intensional Identity

Fox and Lappin (2005, 2010) propose Property Theory with Curry Typing (PTCT) as an alternative intensional semantic representation framework. It is a first-order system that consists of three components: (i) an untyped λ-calculus, which generates the language of terms, (ii) a rich Curry typing system for assigning types to terms, (iii) and a first-order language of well-formed formulas for reasoning about the truth of propositional terms, where these are term representations of propositions. A tableaux proof theory constrains the interpretation of each component of this federative representation language, and it relates the expressions of the different components. Restrictions on each component prevent semantic paradoxes. A model theory allows us to prove the soundness and completeness of the proof theory.

The terms of the untyped λ-calculus encode computable functions. These correspond to the intensions of the representation language. Identity in the λ-calculus is defined in terms of the α, β, and η conditions for substitution.

PTCT uses two notions of equality: intensional identity and extensional equivalence. $t \cong_T s$ states that the terms t, s are extensionally equivalent in type T. In the case where two terms t, s are propositions ($t, s \in \mathsf{Prop}$), then $t \cong_{\mathsf{Prop}} s$ corresponds to $t \leftrightarrow s$. If two predicates of T are extensionally equivalent ($t \cong_{(T \Longrightarrow \mathsf{Prop})} s$), then t, s each hold of the same elements of T. Therefore $\forall x(x \in T \rightarrow ({}^{\mathsf{T}}t(x) \leftrightarrow {}^{\mathsf{T}}s(x)))$, where ${}^{\mathsf{T}}t(x)$ asserts that the proposition represented by the term $t(x)$ is true.

$t =_T s$ states that two terms are intensionally identical in type T. As noted, the rules for intensional identity are essentially those of the $\lambda\alpha\beta\eta$-calculus. We are able to derive $t =_T s \rightarrow t \cong_T s$ for all types inhabited by t, s, but not $t \cong_T s \rightarrow t =_T s$. Therefore PTCT avoids the reduction of provable equivalence to intensional identity. Two terms can be provably equivalent by the proof theory, but not identical. In this case, they remain intensionally distinct.

PTCT allows us to sustain both the logical equivalence of (1)a and (1)b, and the non-equivalence of (2)a and (2)b. The former are provably equivalent, but they correspond to non-identical propositional terms in PTCT.

The proof theory of PTCT induces a prelattice on the terms in Prop. In this prelattice the members of an equivalence class of mutually entailing propositional terms (terms that encode mutually entailing propositions) are non-identical and so correspond to distinct propositions.[1] While this result achieves the formal property of fine-grained intensionality, it does not, in itself, explain what intensional non-identity consists in, beyond the fact that two distinct expressions in the language of terms are identified with different intensions. This leaves us with what we can describe as a problem of ineffability. Intensional difference is posited as (a certain kind of) inscriptional distinctness in the λ-calculus of terms, but this reduction does not offer a substantive explanation of the semantic properties that ground the distinction. Intensional difference remains ineffable.

[1] Fox, Lappin, and Pollard (2002); Fox and Lappin (2005); Pollard (2008) construct higher-order hyperintensional semantic systems using an extended version of Church's SST and a prelattice of propositions in which the entailment relation is a preorder.

2 Expressing Intensional Difference Operationally

We can characterize the distinction between intensional identity and provable equivalence computationally by invoking the contrast between operational and denotational semantics in programming language. Two simple examples illustrate this contrast.

For the first example take the function $predecessorSet(x)$, which maps an object in an ordered set into the set of its predecessors. So, for example, if $x \in \{0,1,2,3,4,5\}$, $predecessorSet(x) = PredSet_x \subset \{0,1,2,3,4,5\}$ such that $\forall y \in Pred_x(y < x)$.

It is possible to define (at least) two variants of this function, $predSet_a$ and $predSet_b$, that are denotationally equivalent but operationally distinct. $predSet_a$ is specified directly in terms of an immediate predecessor relation, while $predSet_b$ depends upon a successor relation.

(3)a. $predSet_a(x) = PredSet_x$, if
$\forall y(y \in PredSet_x \rightarrow predecessor(y,x))$.

b. $predecessor(y,x)$ if
$predecessor_{immediate}(y,x)$; else

(i) $predecessor(y,x)$ if
$predecessor_{immediate}(y,z)$, and
$predecessor(z,x)$.

(4)a. $predSet_b(x) = PredSet_x$, if
$\forall y(y \in PredSet_x \rightarrow successor(x,y))$.

b. $successor(x,y)$ if
$successor_{immediate}(x,y)$; else

(i) $successor(x,y)$ if
$successor_{immediate}(x,z)$, and
$successor(z,y)$.

The second example involves functions $g : \Sigma^* \rightarrow \{1,0\}$ from Σ^*, the set of strings formed from the alphabet of a language, to the Boolean values 1 and 0, where $g(s) = 1$ if $s \in L$, and 0 otherwise. Let g_{csg1} be defined by the Definite Clause Grammar (DCG) in (5), and g_{csg2} by the DCG in (6).[2]

[2] See Pereira and Shieber (1987) for an explanation of Definite Clause Grammars. The DCG in (5) is from Gazdar and Mellish (1989). Matthew Purver and I constructed the DCG in (6) as a Prolog programming exercise for a computational linguistics course that I gave in the Computer Science Department at King's College London in 2002.

(5) $S \rightarrow [a],\ S(i).$
$S(I) \rightarrow [a],\ S(i(I)).$
$S(I) \rightarrow Bn(I),\ Cn(I).$
$Bn(i(I)) \rightarrow [b],\ Bn(I).$
$Bn(i) \rightarrow [b].$
$Cn(i(I)) \rightarrow [c],\ Cn(I).$
$Cn(i) \rightarrow [c].$

(6) $S \rightarrow A(I),\ B(I),\ C(I).$
$A(i) \rightarrow [a].$
$A(i(I)) \rightarrow [a],\ A(I).$
$B(i) \rightarrow [b].$
$B(i(I)) \rightarrow [b],\ B(I).$
$C(i) \rightarrow [c].$
$C(i(I)) \rightarrow [c],\ C(I).$

Both these DCGs define the same context-sensitive language $\{a^n b^n c^n |\ 1 \leq n\}$, the language whose strings consist of n occurrences of a, followed by n bs, and then n cs. The number of as, bs, and cs match in all strings. Each DCG uses a counting argument I for a non-terminal symbol to build up a stack of indices i that gives the successive number of occurrences of as, bs, and cs in a string. But the grammar in (5) counts from the bottom up, adding an i for each non-terminal that the recognizer encounters. By contrast the grammar in (6) imposes the requirement that the three stacks for the non-terminals A, B, and C be identical, and then it computes the indices top down. The two grammars are computationally distinct, and using each of them to recognize a string can produce different sequences of operations, of different lengths and relative efficiency. Therefore, g_{csg1} and g_{csg2} are operationally distinct, but denotationally equivalent. They compute the same string set through different sets of procedures.

Recall that the terms of PTCT are λ-expressions that encode computable functions. We have identified these with the intensions of words and phrases in a natural language. Given the distinction between denotational and operational meaning we can now interpret the non-identity of terms in the representation language as an operational difference in the functions that these terms express. But a class of such terms can still be provably equivalent in the sense that they yield the same values for the same arguments by virtue of the specifications of the functions that they correspond to. This provides a straightforward account of fine-grained intensionality in PTCT which avoids taking intensional difference as ineffable.

3 An Alternative Operational Approach

Muskens (2005) suggests a similar approach to hyperintensionality. He identifies the intension of an expression with an algorithm for determining its extension.[3] There are two major points of difference between Musken's theory and the one proposed here. First, he

[3] Duží, Jespersen, and Materna (2010) also adopt an operational view of hyperintensionality within Tichý (1988)'s Transparent Intensional Logic. However, the computational details of their account are left largely unspecified. Both Muskens (2005) and Duží et al. (2010) regard their respective proposals as working out Frege's notion that an intension is a rule for identifying the denotation of an expression.

embeds his account in a logic programming approach, which he seems to take as integral to his explanation of hyperintensionality, while I have developed my analysis in a functional programming framework. This is, in fact, not an issue of principle. The same algorithm can be formulated in any programming language. So, for example, the definitions of $predSet_a$ and $predSet_b$ correspond to two Horn clause definitions in Prolog for variant predecessor predicates, `predecessorA(Y,X)` and `predecessorB(Y,X)`.

(7)
```
predecessorA(Y,X) :- predecessorImmediate(Y,X).
predecessorA(Z,X) :-
predecessorImmediate(Y,X),
predecessorA(Y,Z).
```

(8)
```
predecessorB(Y,X) :- successor(X,Y).
successor(X,Y) :- successorImmediate(X,Y).
successor(X,Z) :-
successorImmediate(X,Y),
successor(Y,Z).
```

Similarly, the DCGs in (5) and (6) that we used to define g_{csg1} and g_{csg2}, respectively, are (close to) Prolog executable code.

However, the functional programming formulation of the operational view of fine-grained intensionality follows straightforwardly from PTCT, where the untyped λ-calculus generates the intensional terms of the semantic representation language, and these encode computable functions. PTCT also offers rich Curry typing with weak polymorphism, and a logic of wffs for reasoning about truth and entailment, within a first-order system. The fact that it implies the operational account of intensional difference without further stipulation renders it attractive as a framework for developing computational treatments of natural language semantic properties.

The second, more substantive point of difference concerns the role of modality (possible worlds) in characterizing intensions. Muskens develops his hyperintensional semantics on the basis of Thomason (1980)'s Intentional Logic. In this logic Thomason proposes a domain of propositions as intensional objects, where the set of propositions is recursively defined with intensional connectives and quantifiers. He posits a homomorphism that maps propositions (and their constituents) to their extensions, and he constrains this homomorphism with several meaning postulates that restrict this mapping.[4] Muskens modifies and extends Thomason's logic by specifying a homomorphism between the intensional expressions of the logic and their extensions across the set of possible worlds. Propositions are mapped to the set of worlds in which they are true. As the homomorphism can be many-to-one, distinct propositions can receive the same truth-value across worlds.[5]

[4]Fox and Lappin (2005) point out that Thomason's logic is problematic because it does not characterize the algebraic structure of the domain of propositions. It does not offer a proof theory that defines entailment for propositions, and so it leaves the relation between intentional identity and extensional equivalence crucially under determined.

[5]Fox et al. (2002); Fox and Lappin (2005); Pollard (2008) adopt a similar view for the fine-grained higher-order logics that they construct. They define worlds as untrafilters in the prelattice of propositions, and they take the truth of a proposition, relative to a world, to be its membership in such an ultrafilter. As entailment in the prelattice is defined by a preorder, distinct propositions can belong to the same set of ultrafilters.

By contrast, PTCT adopts Thomason's non-modal strategy of mapping propositions to truth-values. It does this by using a truth predicate to form a wff $^{\mathsf{T}}(\phi)$ to assert the truth of the proposition that the term $\phi \in \mathsf{Prop}$ represents. Therefore, like Intentional Logic, PTCT de-modalizes intensions. This is a positive result. It is not clear why, on the fine-grained view, possible worlds must be essentially connected with the specification of intensions.

On both Musken's account and the one proposed here, the content of an intension is the set of computational operations through which it determines its denotational value, where these do not make essential reference to possible worlds. In the case of a proposition, the denotation that it determines is a truth-value, rather than a truth-value relative to a world. There may be independent epistemic, or even semantic reasons for incorporating possible worlds into one's general theory of interpretation, but worlds are not required for an adequate explanation of fine-grained intensionality. On the contrary, such an account must dispense with the original characterization of intensions as functions from worlds to extensions in order to explain the persistence of intensional difference beyond provable equivalence. Therefore, a radically non-modal view of fine-grained intensionality offers the cleaner approach.

Conclusion

While theories of fine-grained intensionality may avoid the reduction of intensional identity to provable equivalence, many of them do not go beyond a bare inscriptionalist treatment of intensional difference. Therefore they leave this notion ineffable. On the proposal developed here intensional difference is the operational distinctions among computable functions, and extensional identity is the denotational equivalence of the values that functions compute. This account grounds fine-grained intensionality in a way that naturally accommodates cases of intensional difference combined with provable denotational equivalence.

Given that PTCT uses the untyped λ-calculus to generate the Curry typed term representations for the intensions of the language, and these terms encode computable functions, the proposed operational characterization of intensional difference is already implicit in this semantic framework.

This account yields a radically non-modalized view of intensions in which possible worlds play no role in their specification or their interpretation. An intension is identified directly with the sequence of operations performed in computing the value of the function that expresses it. Fine-grained intensionality becomes the operational contents of computable functions.

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Affiliation

Shalom Lappin
King's College London
shalom.lappin@kcl.ac.uk

Quantificational prepositions[1]

Bert Le Bruyn · Henriëtte de Swart · Joost Zwarts

In this note we discuss a couple of Dutch prepositions that systematically combine with a common noun phrase, without any determiner. We explore whether we can analyze these prepositions as having 'incorporated' a determiner, semantically speaking, and discuss the consequences of this analysis for the status of bare nominals, the demarcation of syntactic and semantic categories, and the relation between form and meaning.

1 D(eterminer)s and det(erminer)s

In contrast to the increasingly narrow notion of determiner ('D') in generative syntax, leaving sometimes only a lonesome article (e.g. Leu 2008), there is a very broad notion of determiner ('det') in generalized quantifier theory. Apart from the usual suspects, Keenan & Stavi (1986:253-6) include basically any expression that can combine with a following common noun to form a complete noun phrase, such as:

(1) only the most liberal and the most conservative, all but the two tallest, more than twice as many male as female, neither the tallest nor the strongest

Add the noun *students* to these and what you get is a full noun phrase.

We know how fruitful it has been for the programme of formal semantics to cast the determiner net so wide. Furthermore, in most cases, more complex dets can be compositionally derived from simpler ones. The adjectival det *most liberal* (as in *most liberal delegates*) can be given an interpretation by doing function composition of the interpretation of *most* and the interpretation of *liberal*, i.e. $\mathbf{most}\circ\mathbf{liberal}$ or $\lambda X.\mathbf{most}(\mathbf{liberal}(X))$. The border between determiners and adjectives is not always clear, as the much debated status of words like *many* and *few* shows. That is the lower, right hand border of the category of determiners, but there are also disputes at the upper, left hand border. The word *only* in the sentence *Only dogs bark* has been argued not to be a determiner, because it does not satisfy conservativity, but should rather be treated as the kind of focus particle that combines with all sorts of phrases.

2 *Per* noun

There is another border issue at the 'left periphery' of the noun phrase that, as far as we know, has not received much attention. Take the following example (from the British National Corpus):

[1] We gratefully acknowledge the Netherlands Organization of Scientific Research NWO for financial support (grant 360-70-340).

(2) The law exempted only one son per family.

The preposition *per* takes a bare nominal here and uses it to express something like 'for every' ('For every family the law exempted only one son'). Although the determiner is structurally missing, it seems to be carried along, semantically speaking, by the preposition *per*, as a kind of portmanteau for 'for every', a quantificational preposition, in other words. It suggests that the domain of determiners partly encroaches on the domain of prepositions. We already know that there is formal interaction between prepositions and determiners from contraction patterns like those in French (e.g. *au* < *a le*) or German (e.g. *zum* < *zu dem*).

There are two reasons why this semantic phenomenon exemplified by *per* is not so conspicuous. The first reason is that it easily gets lost in the big and confusing problem area of bare nominals in general. Even when considering only prepositional phrases, there are all sorts of cases (like *to school*, *for president*, *by train*) that might obstruct our view and it takes some effort to sort out the different types of determinerless PPs. The second reason is that cases like (2) are in fact quite limited in English. They are more common in Dutch (and other 'continental' languages). Therefore, to get a better view on the phenomenon of quantificational determiners, we will consider determinerless PPs in Dutch and isolate a relevant subclass.

3 Dutch bare PPs

'Bare PP' is quite a loose term for a constituent that consists of a preposition followed by a common noun that in other circumstances is accompanied by a determiner, but that can not or need not have one in this construction. Building on Van der Beek (2005) and Baldwin et al. (2006) we can distinguish three major types.[2] (The terminology is ours.)

1 *PN-based bare PPs*: aan kant (at side, 'in place'), buiten spel (outside game, 'offside'), in scène (in scene, 'faked'), op slot (on lock, 'locked'), van slag (off stroke, 'upset')
2 *N-based bare PPs*: op school ('at school'), uit bed ('out of bed'), aan tafel ('at the table'), naar zolder ('to the attic'), aan wal ('ashore')
3 *P-based bare PPs*: als eenvoudige infanterist ('as a common infantryman'), per auto ('by car'), per kilometer ('per kilometre'), richting centrum ('towards the centre'), zonder vergunning ('without a license')

The first class consists of PN combinations that have a non-compositional semantics and that are not part of a wider pattern. Neither the preposition nor the noun can be varied, so we can treat them as fully fixed idiomatic expressions.

The second class is based on an idiosyncratically delineated class of common locative nouns. The preposition can be varied, e.g. *uit bed* 'out of bed', *naar bed* 'to bed', *in bed* 'in bed', but not the noun (compare *naar zolder* 'to the attic' with *naar *(de) kelder* 'to the basement' and *op school* 'at school' with *op *(de) universiteit* 'at university'). The interpretation has a compositional core, but with a type of pragmatic enrichment that has mainly to do with stereotypical use (see Stvan 1998 for the parallel situation in English and Aguilar-Guevara 2013 for further discussion). These bare nouns alternate with so-called *weak* definites (Carlson & Sussman 2005), like *the hospital* in *Alex is in the hospital* or *the store* in *Robin went to the store* in English, that do not refer to a uniquely

[2] Additional work on Dutch bare PPs was done by Paenen (2009) and Van der Klis (2010).

given hospital or store in the context, but that rather describe interaction with a kind of general 'institute'. Aguilar-Guevara & Zwarts (2011) analyze such definites as referring to *kinds*. This kind-based analysis can be extended to cases like *prison* in *Alex is in prison* or *church* in *Robin went to church* that behave in very much the same way, apart from the lack of the article, which is an idiosyncratic property of the noun. The conclusion is then that the bareness of *bed* in *in bed* is a property of the noun and not of the preposition.

The third class of bare PPs contains the types that we are interested in. The noun here varies, while the preposition is fixed. About a dozen prepositions in Dutch have the ability to combine with a bare common noun in a more or less productive way. Sometimes the nouns are restricted to a particular semantic class, like means of transportation (*per auto* 'by car', per vliegend tapijt 'by flying carpet'), clothing items (*in bikini* 'wearing a bikini', in rok 'wearing a skirt'), or journeys (*op kruistocht* 'on a crusade', op vakantie 'on a holiday'), or they can't be modified, like *richting centrum* lit. direction centre 'towards the centre'. We set these cases aside because they are not fully productive. In other cases, see (3) and (4), the bare noun seems to function as the predicate of a noun phrase elsewhere in the sentence and the preposition is almost a kind of copula (Emonds 1984):

(3) Ik ben als bedelaar geboren.
I am as beggar born
'I was born a beggar'

(4) Ik ben opgeleid tot monteur.
I am trained to mechanic
'I was trained to be a mechanic'

In such constructions the bareness is closely connected to the general predicative role of the nominal (Stowell 1989) and therefore somewhat independent of the preposition. When we also set these cases aside we are left with the prepositions *per* 'per', *zonder* 'without', *met* 'with', and *vol* 'full of', to which we will now take a closer look.

4 *Per*, *vol*, *met* and *zonder*

These four prepositions have in common that they must or can take a bare non-predicative noun in a productive way without any sortal or structural restrictions. The following examples show these PPs in a postnominal position:[3]

(5) a. één appel per (*de/*een) mand
one apple per (the/a) basket
'one apple per basket' ('every basket <u>has</u> one apple')

b. de mand vol (*de) appels
the basket full (*the) apples
'the basket full of apples' ('every part of the basket <u>has</u> apples')

c. een mand met (een) handvat
a basket with (a) handle ('a basket <u>having</u> a handle')

d. een mand zonder (een) handvat
a basket without (a) handle ('a basket not <u>having</u> a handle')

All of these prepositions are loosely based on a general semantic relation that could be characterized as 'having' or 'being with'. This relation is not only spatial (proximity

[3] The preposition *vol* 'full of' differs from the combination *vol met* 'full with' in never allowing a determiner: *vol met de beste muziek* lit. full with the best music 'full of the best music', but **vol de beste muziek* lit. full the best music.

or close contact), but it often seems to bring along richer, functional relations between the two relata.

However, there are differences between *per* and *vol* on the one hand and *met* and *zonder* on the other hand. First, as illustrated in (5), for *per* and *vol* determiner omission is obligatory, while for *met* and *zonder* it is optional. Second, *per* and *vol* impose restrictions on the number of the noun they combine. *Per* only occurs with singular count nouns (6a), *vol* only with mass and plural nouns (6b), *met* and *zonder* with all sorts of nouns (6cd).

(6) a. (één persoon) per stoel/*per stoelen/*per meubilair
(one person) per chair/per chairs/per furniture
'(one person) per chair'
b. (een kamer) *vol stoel/vol stoelen/vol meubilair
(a room) full chair/full chairs/full furniture
'(a room) full of chairs/furniture'
c. (een mand) met handvat/met gaten/met kant
(a basket) with handle/with holes/with lace
d. (een mand) zonder handvat/zonder gaten/zonder kant
(a basket) without handle/without holes/without lace

Note that *per* is different from the other prepositions in typically requiring a numerically specified set over which it can distribute the units denoted by its complement noun. For example, in *honderd kilometer per uur* 'a hundred kilometres per hour' the quantity denoted by *honderd kilometer* is distributed over the units denoted by *kilometer*.

5 *Per* as a quantificational preposition

As Zimmermann (2002) notes, constructions with *per* parallel distributive constructions with universal quantifiers:

(7) a. drie bewakers <u>per</u> gevangene (Dutch)
b. three guards <u>for every</u> prisoner (English)
c. drie Bewacher <u>je</u> Gefangenen (German)

The analogy can be brought out nicely if, building on Zimmermann (2002), all three constructions are analyzed as involving, semantically speaking, a preposition and a determiner. In (7b) both are analytically expressed, but in (7a) and (7c) there is only one word expressing the semantic composition.[4] This distributive quantifier immediately explains why *per* selects only singular count nouns: that is exactly what we see with the distributive quantifier *each* too.

In order to isolate the lexical specification of *per*, let us start with the logical form in (8a). In order to account for the universal quantifier taking wide scope over the numeral we treat the numeral together with the *per* PP as one complex determiner (8b), that can be derived by taking the *per* PP as a function from determiners to determiners (8c), which ultimately gives us the rather complex interpretion of *per* given in (8d).

[4] The morpheme *je* corresponds to the first part of the regular universal determiner *je-der* in German.

(8) a. Eén appel per mand is rot. 'One apple per basket is rotten.'
$\forall x.\mathbf{basket}(x) \rightarrow \exists y.\mathbf{apple}(y) \wedge \mathbf{have}(x,y) \wedge \mathbf{rotten}(y)$
b. één … per mand 'one … per basket'
$\lambda X.\lambda Y.\forall x.\mathbf{basket}(x) \rightarrow \exists y.X(y) \wedge \mathbf{have}(x,y) \wedge Y(y)$
c. per mand 'per basket'
$\lambda D.\lambda X.\lambda Y.\forall x.\mathbf{basket}(x) \rightarrow D(X)(\lambda y.\mathbf{have}(x,y) \wedge Y(y))$
d. per 'per'
$\lambda N.\lambda D.\lambda X.\lambda Y.\forall x.N(x) \rightarrow D(X)(\lambda y.\mathbf{have}(x,y) \wedge Y(y))$

This interpretation clearly shows how universal distributive quantification is packaged together with a general locative relation in one lexical item. It is also interesting to note that *per* only associates with certain determiners:

(9) a. Alex geeft twee colleges per week.
Alex gives two classes per week
b. Alex geeft ?veel/weinig colleges per week.
Alex gives many/few classes per week
c. Alex geeft *alle/de meeste colleges per week
Alex gives all/most classes per week

What the precise class of determiners is, how it can be characterized (e.g. intersective), and how that characterization can be derived from the workings of *per*, is something we will have to leave until another occasion.

6 *Vol* as a quantificational preposition

Our analysis of this preposition can only be very rough. We assume that its meaning involves universal quantification over parts of a contained space, given a proper, context-senstitive partition of that space. Filling a space with something means that *every* part of such a partition of that space is *occupied* by sums of that something. In the following representations, the universal quantifier $\forall$ takes care of the first condition, the sum operator σ takes care of the second part and it enforces the restriction to cumulative (plural and mass) nouns.

(10) a. (een) mand vol appels
$\lambda x.\mathbf{basket}(x) \wedge \forall y.\mathbf{part}(y,x) \rightarrow \mathbf{apples}(\sigma z.\mathbf{have}(y,z))$
b. (een) mand vol fruit
$\lambda x.\mathbf{basket}(x) \wedge \forall y.\mathbf{part}(y,x) \rightarrow \mathbf{fruit}(\sigma z.\mathbf{have}(y,z))$
c. *(een) mand vol appel
$\lambda x.\mathbf{basket}(x) \wedge \forall y.\mathbf{part}(y,x) \rightarrow \mathbf{apple}(\sigma z.\mathbf{have}(y,z))$
d. vol: $\lambda N.\lambda M.\lambda x.M(x) \wedge \forall y.\mathbf{part}(y,x) \rightarrow N(\sigma z.\mathbf{have}(y,z))$

How does this work? The universal quantification in (10a) and (10b) is true for a basket that is full of apples, because for any portion of space *y* inside the basket that is not too small, the sum of objects in that portion, given by $\sigma z.\mathbf{have}(y,z)$, is always a member of the denotations **apples** and **fruit**.[5] The reason is, of course, that corresponding to bigger and smaller regions of space these denotations contain both smaller and bigger

[5] We assume that the plural denotation also includes the atoms.

sums of objects to fill those regions. However, the universal quantification in (10c) is always falsified, because there will always be a portion of space *y* in the basket that does not contain a single apple (but more apples, or an apple part, or no apple at all). Intuitively, the denotation **apple** is ruled out because its quantized structure does not allow the smaller and bigger regions of space to be filled.

Interestingly, the range of the universal quantifier in a structure *M vol N* is not *N*, but *M*, in a sense. There is no universal quantification over apples or fruit in (10), but over basket parts. There might be a similarity here with the focus particle *only*, which also has universal quantification over the expression that is not its direct argument:

(11) a. M is [vol N] = 'all of M is N'
b. [only N] M = 'all M is/are N'

Related to this is the observation that the complement of *vol* is not the ground, as with most prepositions, but the figure (Talmy 2000:333), that is, the object that is moving:

(12) a. Smoke (F) slowly filled the room (G).
b. The room (G) slowly filled with smoke (F).

So, although *vol* carries along a universal quantifier, its restriction is not the nominal that follows it but the nominal that precedes it, but it is still the ground of the spatial relation and not the figure. The cumulative reference property of *vol* is not a direct selectional restriction, but it follows indirectly.

7 *Met* and *zonder* as quantificational prepositions

The English prepositions *with* and *without* occur less frequently in corpora without an article than their counterparts in French (*avec*, *sans*), German (*mit*, *ohne*), and Dutch (*met*, *zonder*). These are not marginal prepositions, but they have a high frequency and many different senses (see, for example, Kiss et al. 2010 for German *ohne*).

One possibility is to analyze the bare use of *met* and *zonder* as involving an incorporated existential determiner (with an additional negation for *zonder*):

(13) a. (een) mand met handvat
$\lambda x.\mathbf{basket}(x) \wedge \exists y.\mathbf{handle}(y) \wedge \mathbf{have}(x,y)$
a'. met: $\lambda N.\lambda M.\lambda x.M(x) \wedge \exists y.N(y) \wedge \mathbf{have}(x,y)$
b. (een) mand zonder handvat
$\lambda x.\mathbf{basket}(x) \wedge \neg\exists y.\mathbf{handle}(y) \wedge \mathbf{have}(x,y)$
b'. met: $\lambda N.\lambda M.\lambda x.M(x) \wedge \neg\exists y.N(y) \wedge \mathbf{have}(x,y)$

This immediately accounts for the lack of the determiner and the indefinite existential force that the bare nominal has. However, the disadvantage is that we need two entries for *met* and *zonder*, a normal version and quantificational version, with the existential determiner incorporated.

Other possibilities include postulating a zero existential determiner, a type shift in the spirit of Chierchia (1998) or trying to extend the analyses Partee and Landman have proposed for existential *have* in a number of joint and individual papers (see Partee 1999 and Landman 2004). We leave the exact analysis for future research, while concluding that it is at least possible to treat *met* and *zonder* as quantificational prepositions in a straightforward way.

8 The level of bareness

In addition to their determiner, bare nominals across many different constructions and languages are often argued to lack also their number specification, i.e. they are essentially mass nouns. For some authors this is connected to the strong theoretical claim that number specifications come from the syntax and that nouns come from the lexicon with an unspecified mass denotation (e.g. Borer 2005, Bale and Barner 2009). It is only when an article like *a* or plural morphology is added to a noun that it gets countability and number. The prediction is then that a noun without either determiners or number marking has a mass denotation. The lexicalist alternative to this constructionalist view is of course that noun roots come out of the lexicon with a clear identity (although there might be shifts between mass and count). Bare PPs form an interesting testing ground for these views.

The Dutch bare PPs that we have discussed challenge the constructionalist view and support the lexicalist view. The first observation is that we find diminutives in bare PPs, which in Dutch are always count:

(14)	a.	tien euro per boekje	
		ten euro per book-DIM	‘ten euro per booklet’
	b.	een jurk met/zonder jasje	
		a dress with/without jacket-DIM	‘a dress with/without a jacket’

However, for the constructionalists it is possible to view the diminutive suffix as part of the syntax of number (De Belder 2008). To the extent that that is a feasible option, this argument loses its force.

The second observation is that *per* and *vol* select for nouns with particular number properties. *Per* takes singular count nouns, *vol* takes the complementary class. If we use a noun that does not fit, then this makes the familiar shifts to the opposite class (grinding or sorting):

(15)	a.	de prijs per bier	
		the price per beer	‘the price for every glass/kind of beer’
	b.	een bord vol kip	
		a plate full chicken	‘a plate full of chicken’

It is not clear how such selections are possible in a constructionalist framework if the noun is a completely unspecified. The only possibility would be to assume that there can be number syntax in prepositions. In other words, *per* does not only incorporate a universal quantifier, but also a singular count specification.

The third observation is that we find mass/count ambiguities with *met* and *zonder* without any overt marking:

(16)	a.	een graf zonder steen	
		a grave without stone	‘a grave without (a) stone’
	b.	een fles met glas	
		a bottle with glass	‘a bottle with (a) glass’

Where does the ambiguity come from if there is no overt marking? From the lexicon, says the lexicalist view. The constructionalist view seems to have no way to account for this ambiguity.

The final observation concerns adjectives that only occur with count nouns and that we also find in bare PPs:

(17) a. een riem zonder vierkante gesp
a belt without square clasp ‘a belt without a square clasp’
b. de paaltjes met ronde knop
the poles with round knob ‘the posts with a round knob’

It is not clear how the distribution of such adjectives can be determined if all nouns are essentially mass.

So we conclude that bare PPs also provide motivation for a view that locates the mass/count distinction primarily in the lexicon.

Conclusion

Having taken a closer look at four bare PPs in Dutch, we can conclude that there is clear evidence that one preposition (*per*) is at the same time functioning as a universal determiner. Another preposition (*vol*) also has universal quantificational force, but the noun that this quantifier ranges over is not its object, but its subject, in a sense. The situation with *met* and *zonder* does not unequivocally point to an incorporated quantifier, although this is a possible analysis.

The phenomena that we have discussed indicate that categories might not always be nicely separated, not paradigmatically, but also not syntagmatically. The item *per* is both a preposition *and* a determiner, and the same can be said perhaps of German *je* and English *a* (*an apple a day*), which, given their combinatorial possibilities, cannot be just determiners. Seen from another angle this means that syntactic and semantic elements do not line up in a one to one fashion as some models would like it.

There are many interesting questions that remain after a short paper like this. We have suggested that the prepositions discussed here are all based on a general ‘have’ relation. If that is true, then the question is why this would be so, and how it relates to the fact that also in bare object constructions in other languages this ‘have’ relation has been found to be important (Espinal & McNally 2011). One also wonders whether there might not be a system, like the square of oppositions, underlying these prepositions, given the way universal and existential quantification, and negation figure. Another question concerns the historical development and cross-linguistic distribution of bareness in this domain. Given that English *with* and *without* seem different from their continental counterparts, one wonders what drives the omission of the article. In the case of *per*, it might be a remnant from the determinerless Latin source, but this cannot be the case for *zonder*, *ohne* and *sans*, which are quite different items.

In other words, quantificational prepositions constitute a domain where the semantics of quantification and the syntax of prepositions interact in an unusual, but interesting way, raising questions about synchronic and diachronic aspects of the mapping between meaning and form in this domain.

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On a Special Type of Antecedentless Relative Clause in English

Hyunoo Lee

Introduction

In this squib I would like to discuss a special type of antecedentless relative clause, hereafter called ARC, in English, exemplified in (1).

(1) a. What is *the farthest that we can see with the naked eye*?
 b. This hotel is *the closest that is within walking distance to the famous Neuschwanstein castle*.
 c. *The nearest they could get* was about 15 miles from the summit.

The construction in question has the typical form of *the + farthest/closest/nearest + (that)*, where the superlative of an adjective of distance is optionally followed by the complementizer *that*. What is most striking about the ARC is that the expected antecedent head noun is missing. It is also worthy to note that different syntactic environments favor different complementizers o*r wh*-relative pronouns and that no *wh*-relative adverbs are allowed in the ARC.

(2) a. John Wayne Airport is the closest which/?that is in Irvine.
 b. What is the farthest ø/that/?which we can see with the naked eye?
 c. The closest ø/that/*when they came to winning a major trophy was in the 1967–68 season.

In what follows, I first give a descriptive account of the external distribution of ARCs and the grammatical functions that the relative pronouns or operators can take in these relative clauses. I then put forth a proposal about the derivation of ARCs. I finally close the squib with a brief discussion of some theoretical implications of ARCs.

1 External Distribution of ARCs

The distribution of ARCs is very similar to that of nominal relative clauses. Consider some examples of the latter in (3).

(3) a. *What happened* upset Judy.
 b. They took *what the chairman offered them*.
 c. Here is *where I met my wife for the first time*.
 d. You can give it to *whoever you'd like to*.

The italicized clauses in (3) are called nominal relative clauses by Quirk et al. (1985) and fused relatives by Huddleston, Pullum and Peterson (2002). They serve as subject, as in (3a), or as object, as in (3b), or as subject complement, as in (3c), or as prepositional complement, as in (3d). The paradigm in which ARCs occur shows that they can have the same grammatical functions as fused relatives.

(4) a. *The nearest that they came to making a challenge* was just before the election of Giacomo da Carrara in July 1318.
    b. She tried to stand up again and *the farthest she went* was hitting her chin on her cold chest.
    c. *The closest that you can get to the sun without burning up* is approximately 69 miles.
(5) a. If you want to explain *the farthest they've reached*, that's fine too.
    b. Calculate *the closest they will be, in subsequent motion and the time this will occur*.
    c. He tossed the brightly colored magazine in the trash, thinking of *the closest they'd gotten*.
(6) a. About 3-4 feet is *the farthest you can go to have clean audio*.
    b. This is *the closest that you can come to flying an old plane*.
    c. Point Nemo is *the farthest you can get from land without being in outer space*.
(7) a. I'll take you farther than to *the farthest they've been*.
    b. These are pictures taken from *the closest they would let me get*.
    c. One of *the closest they have come to success in the European Championships* came in 1996.

In (4) the ARCs serve as subject, while in (5) they serve as object. The examples in (6) illustrate the subject complement use of ARCs, whereas those in (7), the prepositional complement use.

2 What Can Be Relativized in the ARC

The way the relative pronoun or operator functions within the ARC is also similar to the way the relative pronoun does so in a fused relative clause. Compare the (a) sentences with the (b) sentences in (8)-(9).

(8) a. Whoever wins this game wins $100,000.
    b. This capture software is probably the closest that is free.
(9) a. They tasted what I bought.
    b. Scenery like that is the closest you can imagine to the definition of *heaven*!
(10) a. He's happy with what he is.
    b. Every material unit is at its peak usefulness at the center of its symmetry, and at its least usefulness, the farthest it is from its center of symmetry.
(11) a. Where they went was San Francisco.
    b. The nearest they can get to a dessert is by eating a fruit in season after the main meal.
(12) a. I have never thought of what they solved it with.
    b. They say the closest they can do it for is £829.

In the fused relative clause in (8a), the *wh*-element functions as subject, and in the ARC in (8b), the relative pronoun or operator is supposed to function as subject. Just as *what* is considered the object of the verb *bought* in (9a), the relative pronoun or operator is thought of as the object of the verb *imagine* in (9b). Note that the subject complement can be relativized not only in the fused relative clause, as in (10a), but also in the ARC, as in (10b), even though the latter case is much more difficult to observe. However, examples like (11b) show that adverbials are quite easily relativized in the ARC as well as in the fused relative clause. What is relativized in (11a) is the adverbial of goal, but in (11b) it is the adverbial of manner. Finally, the examples in (12) illustrate that the prepositional complement can be relativized in both clauses. However, there is a striking difference between the two clauses in that relativizing the prepositional complement is extremely rare in the ARC.

A few more words seem to be necessary on the relativization of the adverbial in the ARC. Consider (13).

(13) a. The farthest they can make it outside their offices is inside a transit station.
b. You can stretch the fingers to the farthest they can go.
c. The nearest they came to publication before the present century was when Rheticus set up a few pages in type, around the year 1557.
d. The nearest they approached to the idea was through their descriptions of a few disconnected groups of animals.
e. The nearest they came to such an explanation was to refer to either an offender's poor health or low intelligence.

In the ARC in (13a), the adverbial of location is relativized, but in the ARC in (13b), the adverbial of goal is relativized. In the ARC in (13c), it is the adverbial of time that is relativized. What is relativized in (13d) is the adverbial of means, but in (13e) it is the adverbial of reason.

3 Syntactic Derivation of ARCs

I have so far shown that the ARC is on a par with the fused relative clause with respect to the external distributions in which they occur and the way the relative pronoun or operator is interpreted internally. But unlike the fused relative clause, the ARC is a DP headed by a determiner D and involves an adjective such as *nearest*, *closest* or *farthest*. This implies that the ARC is most probably derived by movement of the relative pronoun or operator and subsequent ellipsis of a relevant head noun.

In fact, there is a wide range of evidence in favor of the claim that the ARC is just a type of relative clause that involves movement of the relative operator. Consider (14) and (15).

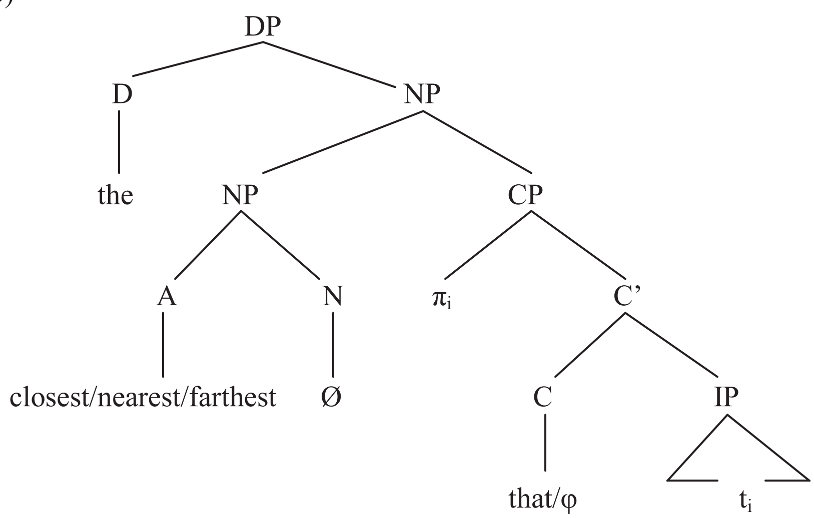
(14) a. The closest they say this asteroid could come would be 19,000 miles.
b. The nearest we can say we have been to that is the 3-0 win over Russia.

(15) a. The nearest you believe has this service is Doetinchem.
b. *The nearest you believe that has this service is Doetinchem.
c. *The nearest you believe the claim that has this service is Doetinchem.

In both (14a) and (14b), the relative operator is said to originate from the complement clause of the verb *say*, which suggests that the dependency between the relative operator and the gap in the ARC can be unbounded. The ungrammaticality of (15b) and (15c) indicates that the dependency in question is governed by whatever constraint or principle is supposed to govern the dependency observed in the adnominal relative clause.[1]

The facts above naturally lead us to propose that the ARC is derived in the same fashion that adnominal relatives are, but with subsequent deletion of the antecedent head noun up to recoverability, as depicted in (16).

(16)



where Ø represents a missing head noun, φ, an empty comlementizer, and π_i and t_i, a relative operator and its trace, respectively

As expected, a relative operator or pronoun originates in IP and moves to the specifier position of the complementizer *that* or an empty complementizer φ. Subsequent ellipsis of the antecedent head noun results in the structure in (16).

4 Some Theoretical Implications

What remains to be accounted for is how the antecedent head noun of the ARC is deleted or elided. Before I address this issue, let me first briefly discuss two general approaches to ellipsis: syntactic/semantic and pragmatic.

The syntactic/semantic approach states that every constituent marked for ellipsis must stand in a certain relationship with a linguistic antecedent. In the syntactic approach, the relevant relationship is one of morphosyntactic identity, and in the semantic approach, it is one of mutual entailment. Cf. Hankamer and Sag (1976), Merchant (2001), Potsdam (2003), and Frazier (2008). Consider (17).

[1] The ungrammaticality of (15b) illustrates the *that*-trace effect, and (15c) is in violation of Subjacency. For more details, see Chomsky (1981).

(17) Speaker A: (attempts to stuff a 9-inch ball through a 6-inch hoop)
Speaker B: It's not clear that you'll be able to.
(18) Speaker A: I'm going to stuff this ball through this hoop.
Speaker B: It's not clear that you'll be able to.

In (18) the elided VP in speaker B's utterance has a linguistic antecedent, *stuff this ball through this hoop*, in speaker A's utterance. In (17), however, there is no such linguistic antecedent for the elided VP in speaker B's utterance, resulting in the incompatibility of the utterance with the indicated context. Given this contrast, Hankamer and Sag (1976) propose that VP ellipsis is allowed only when an elided VP has a linguistic antecedent.[2]

Let us now consider (19), which illustrates the pragmatic approach to ellipsis.

(19) a. Water, please.
b. Give me water, please.

Suppose a customer in a restaurant utters (19a) to a waiter. Even though it is uttered out of the blue, the waiter will be able to understand utterance (19a) as a directive like (19b). In other words, the common background of the conversationalists fills in the missing part of utterance (19a).

In the remainder of this squib, I claim that some instances of the ARC can be best dealt with by the syntactic constraint on ellipsis, and others, by the semantic/pragmatic account. Consider (1b) and (8b), repeated as (20a) and (20b), respectively.

(20) a. This hotel is the closest ~~hotel~~ that is within walking distance to the famous Neuschwanstein castle.
b. This capture software is probably the closest ~~capture software~~ that is free.

As indicated, the missing antecedent head noun is necessarily understood to be *hotel* in (20a) and *capture software* in (20b). In both examples, the deleted head noun has a linguistic antecedent which is identical to it. Consider now the examples in (13), repeated as (21).

(21) a. The farthest they can make it outside their offices is inside a transit station.
b. You can stretch the fingers to the farthest they can go.
c. The nearest they came to publication before the present century was when Rheticus set up a few pages in type, around the year 1557.
d. The nearest they approached to the idea was through their descriptions of a few disconnected groups of animals.
e. The nearest they came to such an explanation was to refer to either an offender's poor health or low intelligence.

In each of the sentences, the missing antecedent head noun does not have a linguistic antecedent, and no extrasentential antecedent is available. In fact, for the elided head nouns in (21), no intrasentential or extrasentential antecedents are necessary. Even if any of the sentences in (21) is uttered out of context, the meaning of the sentence or the way it is used makes it possible to retrieve the missing part of it. For example, regardless of in

[2] I will leave it an open question whether the constraint on VP ellipsis is syntactic or semantic. I have just cited these examples to illustrate the syntactic/semantic approach to ellipsis.

what context (21e) is uttered, we can always identify the elided head noun as *reason*.

There is empirical evidence in support of the claim that there are two sources for the ellipsis of the antecedent head noun in the ARC. Consider (22).[3]

(22) a. Lee's youngest son ran away with Dawn's oldest s~~on~~.
b. Although John's friends were late for the rally, Mary's ~~friends~~ arrived on time.

In both sentences, the ellipsis of a head noun is allowed by the occurrence of the same lexeme. Giannakidou and Stavrou (1999) argue that the sentences are instances of genuine ellipsis. They further note that this kind of ellipsis is productive, while the type of ellipsis triggered pragmatically, as in (19) is not and thus limited to conventional situations. Given this fact, let us compare the examples in (20) and those in (21). It is clear that the ellipsis shown in the former is a productive process but the ellipsis shown in the latter is not.

Whether the ellipsis exemplified by (21) is triggered semantically or pragmatically is not clear at this moment, what is obvious is that we can deduce what material is missing whenever we hear utterances like those in (21). The meaning of the rest of the sentence may be enough to retrieve the antecedent head noun in the ARC, or we may use utterances like those in (21) only in a finite number of conventional situations.

Conclusion

In this squib, I discussed a special type of antecedentless relative clause in English, which may illustrate genuine ellipsis of a head noun. I argued that this relative clause is derived by movement of a relative operator or pronoun and subsequent deletion of an antecedent head noun. I further showed that the ellipsis of the antecedent head noun in this construction supports not only the syntactic approach to ellipsis but also the semantic/pragmatic one.

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[3] (22a) is from Yakubovich (2004), and (22b), from Lobeck (1995).

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Affiliation

Hyunoo Lee
Dept. of English Education
Inha University
hylee@inha.ac.kr

Gap in “Gapless” Relative Clauses in Korean and Other Asian Languages

Chungmin Lee · Jeong-Shik Lee

This paper attempts to argue that the so-called gapless relative clause (GRC) in Korean (Chinese and Japanese as well) can best be dealt with by the Generative Lexicon Theory (GLT) put forward in Pustejovsky (1995). There arises a superficial conflict in the construction: the GRC, with no apparent gap, contains a relative verb that does not directly relate to the head noun in terms of cause-effect relation required between the GRC and the following head noun. The paper shows that this incomplete realization of the cause-effect relation can be fully recovered from the lexical-semantic(-pragmatic) information specified under the GL framework. Thus, the qualia structure of GLT can successfully fill the meaning of the best hidden relative verb in the GRC for the correct interpretation

Keywords: “gapless” relative clauses, Generative Lexicon Theory, qualia structure, agentive/telic role, Korean

Introduction

In Korean (Chinese and Japanese as well) the so-called gapless relative clauses (GRC) have been discussed in Cha (1997, 2005), J. Lee 2012, and others, representatively illustrated in (1, 2, and 3) (Adn = adnominal).

(1) *cause-effect relation with sensory head noun*
[sayngsen-i   tha-nun]   naymsay
fish-Nom   burn-Adn   smell
‘the smell that comes from fish burning’

(2) *cause-effect relation with non-sensory head noun*
[thayphwung-i   cinaka-n]   huncek
typhoon-Nom   pass-Adn   trace
‘the trace left after a typhoon hit’

(3) *cause-effect relation with non-natural phenomenon*
[apeci-ka   so-lul   phal-un]   ton
father-Nom   ox-Acc   sell-Adn   money
‘the money obtained by selling an ox’

It is observed that there exists a semantic cause-effect relation holding between the GRC and its modifying head noun: the content of the adnominal GRC constitutes *cause* and the denotation of its head noun *effect*. Without the cause-effect relation, the GRC is not allowed (e.g., [*sayngsen-I tha-nun*] ?**hyangki* ('fragrance)/?**moyang* ('appearance') /**huncek* ('trace)).

GRC is different from a typical relative clause (RC) like (4) containing a gap which is externally realized as a head noun.

(4) [apeci-ka △ phal-un] so (△=*so* 'ox')
father-Nom sell-Adn ox
'the ox that father sold'

Also, GRCs are different from noun complements in examples like (5) in that they are not a complement of the head noun:

(5) [apeci-ka so-lul phal-ass-ta-nun] somwun/ sasil/cwucang
father-Nom ox-Acc sell-Past-Dec-Adn rumor/fact/claim
'the rumor/fact/claim that father sold an ox'

Thus, GRCs in Korean are different from regular RCs, and they are not noun complements; therefore, as most researchers claim, GRCs are like gapless clausal modifiers for the following head nouns (Yoon, JH 1993, Cha 1997, 1998, 2005 in Korean and papers for Japanese and Chinese).

In this paper, we for the first time claim that for the correct, coherent interpretation in GRCs like (3), for example, the required cause-effect relation should be fully realized by the addition or coercion of a verb like *pel*- 'earn,' which comes from the agentive role in the qualia structure of *ton* 'money,' in conjunction with the main event predicate *phal*- 'sell,' as shown in (6).

(6) [apeci-ka [[so-lul phal-a] [pel]-n]] ton
father-Nom ox-Acc sell earn-Adn money
'the money that father earned by selling an ox'

We then argue that the meaning of the hidden verb *pel*- 'earn' in (3) can be successfully recovered from the reservoir containing the lexical-semantic (-pragmatic) information of the given lexical items specified under the GL framework. In section 1, we observe more related phenomena to claim that recovering the hidden verb has actual empirical bearing as seen in examples like (6). In section 2, we elaborate the current proposal in detail within the GLT, offering the lexical-semantic information of the elements of the GRC construction. In section 3, we briefly discuss cross-linguistic implications of the proposed GL analysis. Finally, section 4 concludes the paper.

1 Some Related Phenomena

The typical relative clause (RC) in Korean can appear in the pseudo-cleft , as in (7) (cf. (4)).

(7) [apeci-ka phal-n kes-un] so-i-ta.
father-Nom sell-Adn KES-Top ox-be-Dec
'What father sold is an ox.'

The GRC, however, cannot appear in the **pseudo-cleft**, as in (8, 9, 10) (cf. (1, 2, 3)).

(8) *[sayngsen-i tha-nun kes-un] naymsay-i--ta.
fish-Nom burn-Adn KES-Top smell-be--Dec
'What fish burns is the smell.' (Lit.)

(9) *[thayphwung-i cinaka-n kes-un] huncek-i-ta
typhoon-Nom pass-Adn KES-Top trace- be-Dec
'What a typhoon passed is the trace.' (Lit.)

(10) *[apeci-ka so-lul phal-n kes-un] ton- i-ta.
father-Nom ox-Acc sell-Adn KES-Top money-be-Dec
'What father sold an ox is the money.'

The pseudo-cleft fact displayed in the above examples indicates that head nouns are not the elements of the GRCs, and indicates that GRCs are gapless clausal modifiers for the following head nouns.

The regular RC can appear as a predicate of the relative head noun, whatever grammatical role it may take in the RC, in the form of a topic construction (C. Lee 1973), as in (11). C. Lee argues that an RC head is realized via a topic in the relevant RC.

(11) ku so-nun [apeci-ka phal-ass-ta].
the ox-Top father-Nom sell-Past-Dec
'The ox, father sold it.'

The GRC, however, cannot form a **topic construction** in which the topic of the relative head noun and its comment predicate cohere, as in (12, 13, and 14). This is a crucial and decisive piece of evidence showing that we need a coerced predicate for compositionality and coherence.

(12) *ku naymsay-nun [sayngsen-i tha-n-ta].
the smell-Top fish-Nom burn-Pres-Dec
'As for the smell, fish burns.' (Lit.)

(13) *ku huncek-un [thayphwung-i cinaka- ass-ta].
the trace-Top typhoon-Nom pass- Past-Dec
'As for the trace, a typhoon passed.' (Lit.)

(14) *ku ton-un [apeci-ka so-lul phal- ass-ta].
the money-Top father-Nom ox-Acc sell Past-Dec
'As for the money, father sold an ox.' (Lit.)

We point out that the fact that relative noun heads cannot serve as topics with GRCs in (12, 13, 14), compared with regular RCs like (11), is due to the lack of additional predicate that can fully realize the aforementioned cause-effect relation in the predicative position. This is corroborated by the following representative example where this relation is fully realized.

(15) ku ton-un [apeci-ka so-lul phal-a pel-ess-ta].
the money-Top father-Nom ox-Acc sell earn-Past-Dec
'The money, father sold an ox and earned it.'

In the above example, the verb *pel-* 'earn' is coerced from *ton* 'money' as an agentive quale and added to realize the effect fully. The same kind of saving effect is found in the pseudo-cleft, as representatively illustrated in (16).

(16) [apeci-ka so-lul phal-a pel-n kes-un] ton-i-ta.
father-Nom ox-Acc sell earn-Adn KES-Top money-be-Dec
'What father earned by selling an ox is money.'

Thus, overt coercion of the addition of the relevant predicate is necessary in the **topic** and **pseudo-cleft** constructions for coherence. Putting the head noun in the prominent topic position or in the highlighted focused position is a crucial test to see what is missing conceptually. Although the GRC construction may allow the addition in question by hitting on compatible verbs with no principled basis, as in (17, 18, 19), this construction does not necessarily superficially require it, as seen in (1, 2, 3).

(17) [sayngsen-i tha-a na-nun] naymsay
fish-Nom burn arise-Adn smell
'the smell that comes from fish burning'

(18) [thayphwung-i cinaka-a namki-n] huncek
typhoon-Nom pass leave-Adn trace
'the trace left after a typhoon hit'

(19) [apeci-ka so-lul phal-a pel-n] ton
father-Nom ox-Acc sell earn-And money
'the money that father earned by selling an ox'

It thus appears that in the GRC construction, the head noun and the main event predicate in the GRC are close enough to allow the cause-effect relation to be covertly coerced and recovered in the absence of the additional predicate that helps fully realize the relation. In the next section, we discuss the matter in question in some detail. We will show that GLT can serve the purpose.

Note also that in languages like English where the head noun precedes the RC, GRCs and RCs corresponding to (1, 2, 3) and (17, 18, 19), respectively, are not allowed:

(20) a. *the smell that fish burns
b. *the smell that fish burns and arises
cf. the smell that arises from fish burning

(21) a. *the trace that a typhoon passed
b. *the trace that typhoon passed and is left
cf. the trace that is left from typhoon passing

(22) a. *the money that father sold an ox
b. *the money that father sold an ox and earned
cf. the money that father earned from selling an ox

We attribute this contrast to the different word order between the relative head noun and the RC: in English type European languages, unlike in Korean type East Asian languages, the head noun and the main event predicate in the GRC or RC are not close enough, so the cause-effect relation is not allowed to be covertly coerced and recovered. The same is also found in the non-appearance of GRCs in pseudo-clefts and in the predicative position in Korean, as shown in (8, 9, 10) and (12, 13, 14). So the contrast under consideration can find a deeper reason.

2 How GL Can Account for the Gap in GRC

One might postulate the predicate *pel-* 'earn' in the underlying structure of GRCs like (3), repeated below, by taking notice of the overt presence of examples like (6), repeated below.

(3) [apeci-ka so-lul phal-n] ton
father-Nom ox-Acc sell--Adn money
'the money obtained by selling an ox'

(6) [apeci-ka [[so-lul phal-a] [pel]-n]] ton
father-Nom ox-Acc sell earn-Adn money
'the money that father earned by selling an ox'

Based on the fact that (3) and (6) have almost the same interpretation, ellipsis may be claimed to be involved in deriving (3) from (6) (J. Lee 2012).

But this analysis does not seem to have any repertoire of deep explanatory devices for the above state of affairs. On the other hand, the GL mechanism offers a fundamental answer to the question of where the verb *pel-* 'earn' comes---it is exactly the agentive quale of the (social artifact) noun head *ton* 'money,' which can be represented as follows:

(23) AGENTIVE (*ton* 'money') = $\lambda z \lambda x \lambda y \lambda eT$ [*pel-* 'earn' (eT, z, x, (by)y)]

In (23), *ton* 'money' is something (x) that an agent (z) *earns by* (causal means) doing something (y). The interpretation 'the money which father earns by selling an ox' can be easily obtained by applying this Agentive quale. Thus argument coherence of identity between the agent 'father' of the ox-selling causal event that appears in the adjunct clause and the agent 'father' of the money-earning effect that appears in the event phrase or clause is well observed (Pustejovsky 1995). The temporal ordering is also kept by precedence or overlap of the causal event compared to the result event.

We assume that basically the same GL approach can extend to other head nouns like *naymsay* 'smell' and *huncek* 'trace' in the GRCs in (1, 2). These nominal heads have similar cause-effect relations with their perceptual effects. They can be represented by some verbs of arousal, being emitted (by), or result (or leaving behind), etc. to apply to (1, 2) and justify the coerced event functions that show up in (17) and (18). The connective can be the simultaneity marker *–myense* 'when,' 'while,' showing the causing event can directly or almost simultaneously emit perceptual nominals such as smell (of burning fish), sound, and shape.

In (6) a limited set of verbs can appear in place of *pel-* 'earn,' including verbs like *malyenha-* 'prepare,' *mantul-* 'make,' *pat-* 'receive'; all these verbs share the basic meaning of 'obtaining (money as a result of selling an ox in a given context).' The specific choice of a particular verb is determined in a given context. The default is *pel-* 'earn.'

We further extend our analysis to the following interesting contrast:

(24) a. [apeci-ka so-lul phal-a kaph-un] ton
father-Nom ox-Acc sell pay.back-Adn money
‘the money that father paid back by selling an ox’
b. *[apeci-ka so-lul phal-a kkwu-/ ilh-/ cwup-un] ton
father-Nom ox-Acc sell borrow-/lose-/ find-Adn money
‘the money that father borrowed/lost/ found by selling an ox’

In (24a) the cause-effect relation indirectly holds between the causing event *so-lul phala* ‘selling an ox’ and the following additional verb *kaph*- ‘pay.back’ by the mediation of the verb *pel*- ‘earn,’ as illustrated in (25).

(25) [apeci-ka [[so-lul phal-a] [pel-e] [kaph-]]--un] ton
father-Nom ox-Acc sell earn pay.back-Adn money
‘the money that father paid back by selling an ox and thereby earned’

In other words, the agentive quale of the noun head *ton* ‘money,’ namely, the verb *pel*- ‘earn,’ is consistent with the verb *kaph*- ‘pay.back’ conjunctively as a following event, so this verb can follow the verb licensed by the agentive quale defined above. But this addition is irrelevant to the original GRC. (25) entails (⇒) (24a) but not (24b). Interestingly, example (3), reproduced at the beginning of this section, cannot be interpreted as meaning (24a). This fact confirms our proposal. Since the agentive quale of the noun head *ton* ‘money’ is determined as the verb *pel*- ‘earn,’ with the causing event (in the *–a* adjunct) accompanied, the interpretation of (3) is to be different from (24a) in which the verb *kaph*- ‘pay.back’ is separately added, as seen in (25).

In (24b), on the other hand, the verbs *kkwu*- ‘borrow,’ *ilh*- ‘lose,’ and *cwup*- ‘find’ do not constitute a natural effect of the causing event, *so-lul phal-a* ‘selling an ox,’ so there arises a conflict in the information structure. More specifically, the agentive quale of the noun head *ton* ‘money,’ namely, the verb *pel*- ‘earn,’ is inconsistent with the above verbs, so these verbs cannot be licensed by the agentive quale defined above.

3 Some Cross-linguistic Implications

It is reported that GRCs are also observed in Chinese (Zhang 2008, Tsai 2008, among others) and Japanese (Murasugi 1991, Matsumoto 1997, among others).

(26) Chinese
a. [Lulu tan gangqin] de shengyin
Lulu play piano DE sound
‘the sound which (is produced by) Lulu’s playing the piano’
b. [mama chao cai] de weidao
Mom fry vegetable DE smell
‘the smell from Mom’s vegetable-frying’

(27) Japanese
a. [dereka-ga doa-o tataku] oto
someone-Nom door-Acc knock sound
‘the noise of someone knocking at the door’
b. [sakana-ga yakeru] nioi
fish-Nom burn smell
‘the smell that a fish burns’ (Lit.)

We suggest that the current proposed analysis developed from Korean exactly apply to the same GRCs in these East Asian languages. The most common previous analysis is that the GRC is a simple gapless clausal modifier for the following noun head. Murasugi (1991) and Tsai (2008), among others, claim that the so-called GRCs in Japanese and Chinese, respectively, are not really RCs but just complex noun phrases with gapless adnominal clauses.

Our GL approach, however, offers a more specific, deeper RC analysis on this phenomenon: the agentive quale of the noun heads like *sound* and *smell* above can covertly coerce or recover the appropriate relative predicates that help fully realize the required cause-effect relation. For example, *sound* is something (x) that an agent (z) *produces by* (causal means) doing something (y); *smell* is something (x) that is *produced by* (causal means) doing something (y).

Zhang (2008) proposes that the GRC is a subject and the following head noun is a predicate in Chinese. Interesting though the proposal is, we do not buy it since different morphology in Korean does not point to it, as can be seen in (1, 2, 3), in which the predicate in the GRC ending with the modifying adnominal maker *–(nu)n*, not being a nominalizer, cannot make the GRC a subject in Korean. Even if the GRC turns into a nominal with the addition of the nominal *kes* after the predicate in question, as seen in the pseudo-clefts in (8, 9, 10), the GRC cannot still function as the subject.

According to Tsai (2008: 116-118), Ning (1993) proposes the VP adjunct analysis for GRCs in Chinese, treating the overtly added or coerced verbal part as a VP adjunct containing a gap. Thus, in the following corresponding Korean examples, repeated below as (28, 29, 30), the phrase enclosed by bracelets is a VP adjunct and contains a trace left by the usual relative movement involved.

(28) [sayngsen-i tha-a {t na-nun}] naymsay
fish-Nom burn arise-And smell
'the smell that comes from fish burning'

(29) [thayphwung-i cinaka-a {t nam-un}] huncek
typhoon-Nom pass leave-Adn trace
'the trace left after a typhoon hit'

(30) [apeci-ka so-lul phal-a {t pel-n}] ton
father-Nom ox-Acc sell earn-And money
'the money that father earned by selling an ox'

Contrary to Ning, our analysis shows that the causing event is rather realized as an adjunct. The morphological marker *–a* (or, *–myense*) attached to the main event predicate confirms this analysis since it appears at the end of the adjunct clause. This is further syntactically evidenced by the well-known fact that extraction out of an adjunct produces a bad result. The fact that the above examples are good refutes Tsai's VP-adjunct analysis. Notice that the clause containing the main event predicate does not involve any gap, which suggests that this main predicate clause is in turn an adjunct. Since there is no gap here, there arises no adjunct island violation. Thus, Tsai's argument against Ning's wrong adjunct approach is in fact based on false ground.

Zhaojing (2012:(6), a paper for the GLAL workshop) claims that the following noun modification construction from Chinese just involves the Formal Qualia modifier:

(31) hongse de yanjing
red eye
'red eyes'

Here we can basically agree with Zhaojing that the construction involves Formal Qualia, if the color red is meant to be an inherent property of the eyes. The question is whether this construction could involve any role like Agentive, as implicated by our analysis. The color red here seems to be meant to involve some result of inchoative change from non-red to red because of drinking or other causes. The non-change situation does not but the change situation does involve Agentivity. Nevertheless, the construction could be analyzed as containing a subject gap because it constitutes an intransitive sentence with a stative predicate. This comes from the corresponding Korean example given below.

(32) pwulk-un nwun
red-Ad eye
'red eyes'

What we note is the presence of the modifying adnominal marker *–un* attached to the attributive adjective as well as to attributive (G)RCs. Without this marker, the phrase is illicit. Thus it would not be implausible to assume the adjectival modifier here is in fact a clause, as has also been suggested in Kaynean approach.

Then, we can ask why the three Far Eastern languages share the GRC phenomenon (we are not aware of other languages that possibly share the same phenomenon) but not other languages such as English. English also can have the underlying structure "the money which father earned by selling an ox" but it not be realized as a coherent surface such as "the money which father sold an ox." The Agentive role predicate "earn" cannot elide in languages like English. "Selling an ox" in the underlying structure is a complement clause of an Instrument 'by' and the social artifact 'money' cannot easily project the Agentive role to associate it with the surface predicate 'sell an ox' grammatically and interpretively.

4 Residues

4.1 How about purpose (telic) quale?

On the other hand, we have been curious with one anonymous GL workshop reviewer about whether other qualia roles such as a telic role can involve in GRC and we tentatively say that the range of GRCs under discussion does not involve any purpose (telic) role. This is because of the head noun Agentive cause-effect relation required between the GRC and the head noun. However, a purpose (telic) quale does not seem to be entirely excluded in some less common contexts. Consider (33) (Prashant Pardeshi p.c.). The purpose of an artifact commercial is to draw the audience's attention intensively in a very short period of time.

(33) hwacangshil-ey mot ka-nun commercial
toilet-to not able go-Ad
'a commercial that attracts our attention so intensively that we cannot go to the toilet.'

However, if commercial interruptions in a soap opera are used to go to the toilet, the failure of their purpose must be due to the attraction of the soap opera program (Allan Kim p. c. and C. Lee share this intuition). All Agentive interpretations of our GRCs, together with the first telic interpretation of (33), can be based on the lexical-semantic content, but the second telic interpretation of (33) is heavily context-dependent and may be pragmatic. The head NP in (33) must be a subject in a causal adjunct clause in a bi-clausal structure.

An aspectual elliptical clause can form a regular RC easily, requiring a coerced purpose (telic) or Agentive role, as in (34). The coerced predicate *read* or *write* is based on the qualia structure lexical-semantic specification of the artifact nominal *book*. Suppose the subject of (34) is a goat. Then, the coerced predicate in that particular context may be *chew* or *eat*, calling for pragmatics.

(34) Mary-ka shicak-ha-n chayk
M –Nom begin-do-Ad book
'A book Mary began {to read, to write}.'

4.2 How about in the Keenan-Comrie Noun Phrase Accessibility Hierarchy?

One may well say that because the Keenan-Comrie Noun Phrase Accessibility Hierarchy treats mono-clausal relative clauses (Keenan and Comrie 1977), based on non-GRCs, the hierarchy is not relevant to the underlyingly bi-clausal and superficially gapless Asian language relative clauses. The hierarchy is about how a grammatical relation NP is accessible to relativization in competition with others in a clause. However, we can suggest that the hierarchy encompass gap-like head NPs in recovered bi-clausal relative clauses in Asian languages; the hierarchy is purported to be semantically based. From a coherent qualia based bi-clausal sentence, an NP in the main clause of the sentence can undergo a relativization operation to form a modifying relative clause with a head NP. So, GRCNP may be at the bottom of the hierarchy, as follows:

(35) Accessibility Hierarchy (AH)

SU > DO > LO > OBL > GEN > OCOMP **> GRCNP**

But it is interesting to note that the same original hierarchy may work recursively in the Agentively coerced main clause within the bi-clausal structure. For that kind of recursivity, the coerced main clause verb better be an intransitive verb *na-* 'come out' for the higher SU 'smell' than the transitive verb *nay-* 'emit' for the lower DO 'smell' in (17). For the sake of causation argument coherence, however, the transitive verb treatment seems more adequate. In either case, argument coherence in cross-clausal causation holds.

The operation of relativization coincides with that of topicalization but Instrumental is slightly odd in topicalization and innocuous in relativization in Korean (C. Lee 1973), as follows:

(36) a. ?(ku) tokki-nun Mary-ka ku namwu –rul pey –ess –ta
the ax -Top M –Nom the tree –Acc bend –Past-Dec
'the ax, Mary bent the tree with it.' (Intended)
b. Mary-ka ku namwu –rul pey – n tokki
M –Nom the tree –Acc bend -Pre ax
'the ax with which Mary bent the tree.'

GRC in general involves InstrumentCOMP clause and a coerced Agentive event role predicate derived from the lexical specification of the relative head noun. The formation of oblique Instrumental adjunct clause and coercion of an Agentive event that involves the argument head noun are complex processes that make the phenomenon rare.

In sum, we found that the coerced event function has not been proposed yet, and claim that our GL qualia structure analysis can encompass GRCs in East Asian languages like Chinese, Japanese, and Korean.

Conclusion

We attempted for the first time to demonstrate how GL can well account for the mysterious phenomenon of “gapless” relative clauses that appear in at least three Asian languages by means of the event function coercion from the qualia structure enrichment of lexical meanings. We need further studies in the direction of incorporating pragmatic/discourse factors that should also be involved in coherent interpretations of such interesting phenomena.

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Affiliation

Chungmin Lee
Departement of Linguistics
Seoul National University
clee@snu.ac.kr

Jeong-Shik Lee
Department of English Language and Literature
Wonkwang University
jslee@wku.ac.kr

The Count-Mass Distinction of Abstract Nouns in Mandarin Chinese

Feng-hsi Liu

1 Concrete nouns

The issue of whether nouns in Mandarin Chinese can be distinguished into count and mass nouns has been debated in recent literature. Unlike English, Mandarin Chinese is a language where nouns are not obviously count nouns or mass nouns. In fact, syntactically nouns in Mandarin are similar to mass nouns in English, as they cannot combine directly with numerals, but must combine with classifiers; they do not have singular/plural morphology[1], and the same quantifier occurs with nouns that denote individuals and nouns that denote non-individuals. To date, there have been two views on the status of nouns in Chinese. In the first view, advocated by Chierchia (1998) and Krifka (1995), all of the nouns in Chinese are mass nouns. In this view, bare nouns denote a semi-lattice of sets of individuals and sets of pluralities (according to Chierchia), or kinds (according to Krifka), but not individuals. The second view is proposed by Cheng and Sybesma (1998, 1999), who argue that Mandarin Chinese does have a count-mass distinction. The distinction is encoded on classifiers, which perform a task similar to count syntax in English. Count nouns occur with count (individual) classifiers, while mass nouns occur with mass classifiers (measure words). In a recent study, Liu (to appear) argues for a third view: The count mass distinction in Mandarin Chinese does exist, but it cannot be made solely on the basis of the classifier or measure word that accompanies a noun. Rather, we need to resort to quantification in order to decide the status of a noun.

Whether a noun takes an individual classifier or a measure word is not a reliable indicator of the countability of nouns because the distinction between the two types of words is not always clear-cut (Tai and Wang 1990). For example, *kuai* 'chunk' occurs with nouns that refer to chunky things such as rocks, e.g. *yikuai shitou* 'a rock', and it also occurs with *rou* 'pork', e.g. *yi kuai rou* 'a piece of pork'. If *kuai* is considered a classifier, it would mean that *rou* 'pork' is a count noun, which does not seem to be supported. On the other hand, if *kuai* is a classifier in *yikuai shitou* 'a rock', but a measure word in *yi kuai rou* 'a piece of pork', it would mean that *kuai* is sometimes a classifier and sometimes a measure word. This indeterminacy shows that ability of a noun to take *kuai* does not necessarily tell us whether it is a count noun or a mass noun.

To remedy the situation, Liu (to appear) adopts an idea, suggested in a number of studies (Gordon 1985, Bloom 1999, Barner and Snedeker 2005), that a good tool with which to explore the count-mass issue is quantification. In particular, how quantity is interpreted when nouns are quantified offers clues to their count-mass status. Besides the ability to take classifiers, she proposes two more tests as diagnostics, including the

[1] The suffix *-men* has sometimes been considered a plural marker (e.g. Li and Thompson 1981, A. Li 1999). However, Iljic (1994) argues that *-men* is not a plural marker, since it not only has a limited distribution, it also has a narrow interpretation, being definite and discourse-bound.

quantifier *henduo* ‘a lot, many/much’ and the quantifier *yidian* ‘some, a little/a few’. The idea is to see whether the two quantifiers are interpreted on the basis of number or volume when they occur with a noun. A number interpretation would indicate a count noun, while a volume interpretation would indicate a mass noun; and if a noun allows both interpretations, it would be a flexible noun, which could function either as a count noun or a mass noun. This results in the following division:

(1)a. Count nouns: *yizi* ‘chair’, *beizi* ‘cup’, *jiaju* ‘furniture’, *yifu* ‘clothes’, *lazhu* ‘candle’
b. Flexible nouns: *shengzi* ‘rope’, *zhizhang* ‘paper’, *shuiguo* ‘fruit’, *mianbao* ‘bread’
c. Mass nouns: *shazi* ‘sand’, *jiangyou* ‘soy sauce’, *kele* ‘coke’, *chaye* ‘tea’, *doufu* ‘tofu’

One consequence of the analysis is that *rou* ‘pork’ is a mass noun, despite the fact that it occurs with the classifier *kuai*. *Henduo rou* ‘lots of pork’ and *yidian rou* ‘some pork’ both refer to volume, rather than number of pieces.

This analysis, however, only covers concrete nouns. The question then arises whether abstract nouns in Mandarin Chinese can also be distinguished into count nouns and mass nouns, and if so, what the criteria are. Could the analysis proposed for concrete nouns be extended to abstract nouns? These are the issues that I will address in this note. I will show that the count-mass distinction can be made among abstract nouns, and to do so we also need to make use of quantification. As with concrete nouns, classifiers alone are inadequate as a marker of the count-mass distinction, but unlike the case of concrete nouns, it is not because of indeterminacy; rather, it is because of false identification.

2 Abstract nouns

I will take abstract nouns to be nouns that denote what Lyons (1977) refers to as second-order entities and third-order entities. Second-order entities include events, processes and states-of-affairs, while third-order entities include concepts, ideas and propositions. Thus abstract nouns include nouns such as *xingfu* ‘happiness’, *naixin* ‘patience’, *xiangfa* ‘idea’, and deverbal nouns, such as *guli* ‘encouragement’, *liaojie* ‘understanding’. To find out their count-mass status, I will apply two of the three tests that are used on concrete nouns, with some modifications: whether nouns take a classifier with the numeral *yi* ‘one’, and how they are interpreted when quantified by *henduo* ‘a lot’, with or without a classifier. The third test, involving *yidian* ‘some’, is not used because it does not occur with most of the abstract nouns.

One notable difference between concrete nouns and abstract nouns is the number of classifiers that occur with the two types of nouns. There are more than 100 classifiers for concrete nouns (Gao and Malt 2009), while the number of classifiers for abstract nouns is much smaller, including the following:

(2) Some of the classifiers that occur with abstract nouns

	meaning	nouns it is associated with
ge	general classifier	method, function, contribution
dian	point	suggestion, request, criticism,
men	branch	knowledge, art
xiang	item	suggestion, decision, order
chang	occasion	misunderstanding
ci	frequency	opportunity, failure

The last two classifiers, *chang* 'occasion' and *ci* 'frequency' are event classifiers. They are included here as individual classifiers because they individuate events. On the other hand, words that denote kinds, e.g. *zhong* in *yi zhong jingshen* 'a kind of spirit', are measure words, not (individual) classifiers.

A more important difference between the concrete nouns and abstract nouns lies in how classifiers accompany nouns. With concrete nouns, a classifier occurs with the numeral *yi* 'one' as well as a demonstrative such as *zhe* 'this', e.g. *yi liang che* 'one car', *zhe liang che* 'this car'; however, with abstract nouns, a classifier that occurs with a demonstrative may not occur with the numeral *yi* 'one', as illustrated in (3-4):

(3) a. zhe ge kuaile 'this happiness'
b. zhe ge cunzai 'this existence'

(4) a. ?*yi ge kuaile 'a happiness'
b. ?*yi ge cunzai 'an existence'

Assuming that *kuaile* 'happiness' and *cunzai* 'existence' are mass nouns, the contrast between (3) and (4) shows that compatibility between an abstract noun and a classifier may not be a strong enough test, as even *kuaile* 'happiness' and *cunzai* 'existence' would pass the test. Therefore, to apply the first test, I will include *yi* 'one' as well: Does an abstract noun occur with *yi* 'one' followed by a classifier, e.g. *yi ge* 'one-classifier', *yi ci* 'one time', *yi chang* 'one occasion'? The idea is to see if an abstract noun has the potential to be counted. This test separates abstract nouns into two groups, ones that occur with *yi*-classifier and ones that do not, as illustrated in (5):

(5) a. Occur with *yi*-classifier
gongneng 'function', *jihui* 'opportunity', *cuowu* 'mistake', *nuli* 'effort',
guli 'encouragement', *renshi* 'understanding', *xinxin* 'confidence',

b. Do not occur with *yi*-classifier
renci 'kindness', *xingqing* 'disposition', *xie'e* 'evil', *naixin* 'patience'
xinlao 'hard work', *zhongcheng* 'loyalty',

The next test is a test of quantity, modifying the nouns in (5) with the quantifier *henduo* 'a lot'. First we consider what quantity means for abstract nouns. When nouns are concrete, *henduo* N is interpreted in two ways: by number or by volume; when nouns are abstract, two differences from concrete nouns can be observed. First, some of the nouns do not occur with quantifiers, e.g. **henduo renci* 'a lot of kindness'; secondly, for the nouns that do occur with quantifiers, the resulting phrases may have a number interpretation, but they do not have the volume interpretation, since these nouns do not denote an entity with a volume in the first place. For example, *henduo xinxin* 'a lot of confidence' refers to a high degree of confidence; similarly, *henduo shijian* 'some time' refers to a large amount of time. Thus abstract nouns can be measured in a variety of ways, including number, degree, time, distance, frequency, etc. When an event denoting noun is measured by frequency, a frequency classifier is required, e.g. *ji ci baifang* 'a few visits', but not **henduo baifang* 'many visits. Therefore, in the test I include an optional classifier following *henduo* to accommodate event-denoting nouns. The test is to find out whether a noun can be quantified by *henduo* or *henduo*-classifier, and in the former case, if it is interpreted by number. A 'yes' answer means the resulting phrase is interpreted by number or can be modified by *henduo*-classifier, which itself is also interpreted by number (due to the occurrence of the classifier); and a 'no' answer means that the resulting phrase cannot be so quantified or is not measured by number. The results of both the *yi*-classifier test and the *henduo*-(classifier) test are given in (6):

(6)	*yi*-classifier	*henduo* (classifier)	
(a) *gongneng* 'function'	yes	yes	count
jihui 'opportunity'	yes	yes	
cuowu 'mistake'	yes	yes	
(b) *nuli* 'effort'	yes	yes/no	count or mass
guli 'encouragement'	yes	yes/no	
(c) *xinxin* 'confidence'	yes	no	mass
renshi 'understanding'	yes	no	
(d) *renci* 'kindness'	no	no	mass
xingqing 'disposition'	no	no	

The data in (6) shows that abstract nouns are divided into four groups on the basis of the two tests: (a) nouns that take *yi*-classifier and are interpreted by number when quantified; (b) nouns that take *yi*-classifier and may or may not be interpreted by number; (c) nouns that take *yi*-classifier but are not interpreted by number when quantified; and (d) nouns that neither take *yi*-classifier nor are interpreted by number when quantified. I will take nouns in the (a) group as count nouns, and those in the (c) and (d) groups as mass nouns; the former can be counted while the latter cannot. What about nouns in the (b) group, including *nuli* 'effort' and *guli* 'encouragement'? They can be quantified on the event reading, taking the frequency classifier *ci*, but they cannot be quantified on the result reading. I will take these nouns as either count or mass, depending on their interpretation.

The results demonstrate that the occurrence of a classifier with an abstract noun does not necessarily indicate the latter is a count noun. This is the same conclusion that is reached with concrete nouns. A classifier, even when modified by *yi* 'one', does not always individuate the noun it occurs with. This of course does not mean that classifiers do not in general individuate; rather, it means that classifiers also serve other functions. W. Li (2000) proposes that numeral-classifiers, in particular *yi*-classifier, in Chinese serve a discourse function of foregrounding the NPs they occur with, although her data mainly comes from concrete nouns. Biq (2004) suggests that in on-line production *yi ge* N 'one-classifier N', where the noun is nominalized, e.g. *zuo yi ge fenbie* 'to make a distinction', is often preferred over the more concise *fenbie* 'to distinguish', because the former allows the speaker more time to express what s/he wants to say. Thus in spontaneous speech *yi ge* N may serve a processing function. Further work may show that *yi ge* N (abstract) also has discourse functions similar to what W. Li (2000) finds with concrete nouns.

If classifiers by themselves or *yi*-classifier are not markers of count nouns, the question then arises whether there are syntactic or morphological features that mark count and mass nouns. Liu (to appear) says that with concrete nouns count and mass nouns are partially encoded syntactically. The inability to be modified by the quantifier *yidian* 'some' points to concrete nouns, and the inability to take a classifier points to mass nouns. The latter property also applies to abstract nouns, as shown in (6). In addition, the property in (7) distinguishes count from mass in abstract nouns:

(7) Abstract count nouns permit modification by quantifiers with a number that is higher than one, followed by a classifier; abstract mass nouns do not permit such modification.

(8) a. san ge gongneng ‘three functions’
b. liang ci jihui ‘two opportunities’
c. si ge cuowu ‘four mistakes’

(9) a. *san ge xinxin ‘three confidences’
b. *liang ge renshi ‘two understandings’
c. *liang ge renci ‘two kindness’
d. *san ge xingqing ‘three dispositions’

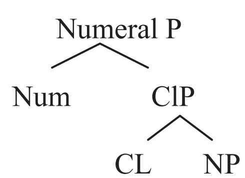
(10)a. ?san zhong xinxin ‘three kinds of confidence’
b. liang zhong renshi ‘two kinds of understanding’
c. liang zhong renci ‘two kinds of kindness’
d. san zhong xingqing ‘three kinds of disposition’

(11)a. *ji ge nuli ‘a few efforts’
b. *duo ge guli ‘many encouragements’
c, ji ci nuli ‘a few times of effort’
d. duo ci guli ‘many times of encouragement’

(8) demonstrates that nouns of the (a) group in (6) can indeed be modified with a quantifier with a number higher than one, followed by a classifier, while (9) shows that nouns in the (c) and (d) groups cannot be so modified. (10) shows that at least some of the mass nouns can be modified by a quantifier, followed by a measure word, and (11) shows that the two words in the (b) group, the deverbal nouns *nuli* ‘effort’ and *guli* ‘encouragement’, can be modified in the event reading, but not in the result reading.

If (7) is on the right track, it suggests that for abstract nouns classifiers indeed play a role in encoding the count-mass distinction; it is just that they cannot perform the job alone, but must combine with a number. To find out if a noun is countable, the number cannot be ‘one’ because some mass nouns can be modified by *yi ge* ‘one-classifier’ even though they cannot be counted, e.g. *you yi ge renshi* ‘to have an understanding’. Thus count and mass nouns may have the same structure, as in (12)[2]:

(12)



When Num-CL is filled by *san ge* ‘three-classifier’, for example, we have a count noun; when Num-CL is filled by *yi ge* ‘one-classifier’ or *san zhong* ‘three-measure word’, the noun could be count or mass, as illustrated in (13):

(13)a. yi ge fangfa ‘one method’ count
b. yi ge renshi ‘an understanding’ mass
c. san zhong fangfa ‘three kinds of methods’ count
d. san zhong renshi ‘three kinds of understanding’ mass

[2] The Numeral Phrase corresponds to the Quantity Phrase in Borer’s (2005) framework.

Recall the count-mass status is determined on the basis of two tests: the ability to take *yi*-classifier and whether *henduo* (Classifier) N ‘a lot N’ is interpreted by number. Only when a noun passes both tests is it a count noun. It is therefore not the structure that distinguishes count from mass nouns, but the material that fills the Num and CL nodes that identifies a noun as a count noun[3].

In short, in Chinese abstract nouns can be distinguished into count and mass nouns. The distinction is partially encoded on the Numeral Phrase, which goes beyond the classifier itself. Compatibility with a classifier is a necessary condition for count nouns, but it is not a sufficient condition. Classifiers serve a range of functions beyond individuating, and as such they are not reliable indicators of the count-mass status of a noun. Therefore, as in the case of concrete nouns, to find out whether an abstract noun in Mandarin is count or mass, we need to resort to quantification.

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[3] This encoding does not work for concrete nouns, however. This is because even when the number is above one, and CL is an individual classifier, the noun could still be a mass noun, e.g. *san kuai rou* ‘three pieces of meat’.

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Affiliation

Feng-hsi Liu
University of Arizona
fliu@email.arizona.edu

Notes on the Niuean perfect

Lisa Matthewson · Heidi Quinn · Lynsey Talagi

1 Introduction[1]

This squib presents preliminary findings on the semantics of the Niuean perfect. Niuean is a Polynesian language spoken in Niue and by Niueans in diaspora, the latter located primarily in New Zealand. Previous research has identified two elements which separately or together mark the perfect aspect in Niuean: a pre-verbal particle *kua,* and a post-verbal particle *tuai* (Seiter 1980, Massam 2009). However, the semantics of the perfect have not been fully investigated in prior research.

We will show that the Niuean perfect is partially similar to an English perfect, in that it induces present relevance effects and disallows certain past adverbials. However, it diverges from the English perfect in other ways. As noted by Bauer (1997) for the related language Māori, the Niuean perfect can induce inchoative readings; it also allows present in-progress readings. In these latter respects it displays similarity with perfects in some Salish languages (Davis 2006, Kiyota 2008, Turner 2012), and with the Japanese *teiru* construction (Ogihara 1998, Nishiyama 2006, among many others).

Unreferenced data in this squib represent the third author's judgments as a native speaker of Niuean, from the village of Lakepa.

2 Prior research

According to Seiter (1980:7), the pre-verbal particle *kua* 'indicates perfect aspect, i.e. expresses a completed event whose relevance continues into the present, or a past or future point of reference.' Perfect aspect can also be rendered by the post-verbal *tuai,* or by *kua* and *tuai* together (Seiter 1980:8). These basic facts are illustrated in (1-3).[2,3]

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[2] Data are presented in the Niuean orthography. *g* is a velar nasal, and *t* is pronounced [s] before front vowels (Seiter 1980:x). There is inter-speaker variation in vowel length; some vowels in our data have different lengths from those found in other sources. Abbreviations not covered by the Leipzig Glossing Rules: DIR1 = toward speaker; HAB: habitual; PERS: personal article; PRO: pronominal.

[3] Data from Seiter (1980) do not always match our third author's judgments. This may be due to language change in the intervening 30 years, or to dialect differences.

(1)

Kua	oti	lā	ia	e	vahega
PRF	finish	just	3SG	ABS	class

‘The class has/is just finished.’

(2)

Hau	**tuai**	e	tehina	haau
come	**PRF**	ABS	brother	your

‘Your little brother has come.’ (Seiter 1980:8)

(3)

Kua	uku	hifo	foki	**tuai**	a	au	ke he	toka
PRF	dive	down	also	**PRF**	ABS	1SG	to	bottom

‘I have dove down to the bottom before.’ (Seiter 1980:24)

Overt tense morphology is optional in Niuean. According to Seiter (1980:9), *tuai* is incompatible with tense marking, and the only tense marker *kua* can co-occur with is the rare past marker *na* (glossed by Massam 2009 as ‘past uncertain/ongoing truth’). Seiter writes that *na kua* gives an explicit past perfect, but past perfect readings arise even in the absence of *na,* as shown in (4).

(4)

He	mogo	ne	hoko	mai	au,	**kua**	fitā	he	kai	he	tau	faoa	e
at	time	PAST	arrive	DIR1	1SG	**PRF**	already	COMP	eat	ERG	PL	people	ABS
tau	kai	ne	fiafia	au	ki	ai							
PL	food	PAST	like	1SG	to	PRO							

‘When I arrived, the people had already eaten the food I like.’

A future perfect is shown in (5); we set past and future perfects aside from now on.

(5)

Ka	liu	mai	a	koe,	**kua**	momohe	**tuai**	a	mautolu
when	return	DIR1	ABS	2SG	**PRF**	sleep.PL	**PRF**	ABS	1PL.EXCL

‘When you return, we shall have gone to sleep.’ (Seiter 1980:8 / McEwen 1970:48)

In addition to the prototypical perfect uses illustrated so far, *kua* allows present state readings, as shown in (6).

(6)

Kua	ita	mai	a	Pita	ki	a	au
PRF	angry	DIR1	ABS	Pita	to	PERS	me

‘Pita’s angry at me.’ (Seiter 1980:18)

Seiter characterizes this as an extension of the perfect meaning, ‘the state being viewed as the ongoing effect of some completed event’ (1980:8). Finally, Seiter observes (1980:9, following McEwen 1970) that in past narratives, *kua* may freely alternate with past marking.

From a syntactic perspective, the Niuean perfect has been investigated by Massam (2009), as part of her examination of the TAM system. We set the syntax of *kua* and *tuai* aside in this squib, although we would like to point out one interesting fact: *kua* appears to the right of epistemic modals (7), but to the left of deontic ones (8). (The first half of this generalization was noted by Seiter 1980:13.) This supports the frequently-advanced hypothesis that epistemic modals sit higher in the tree than root modals (Cinque 1999, Hacquard 2006, among many others).

(7) a. *Liga* **kua** fano **tei**
EPISTEMIC **PRF** go **PRF**
'He/she/they might have left.'

b. ?? **Kua** *liga* fano tei.

(8) a. **Kua** *lata* a koe ke tunu e talo
PRF *DEONTIC* ABS 2SG SBJV cook ABS taro
'You should cook the taro.'

b. * *Lata* **kua** a koe ke tunu e talo.

3 *Tuai* is *tei*

Before beginning our semantic discussion, it is important to note that the *tuai* discussed by Seiter and Massam is, in the speech of our third author, *tei.* This perfect *tei* is distinguishable phonologically, syntactically, and semantically both from another *tuai* ('long ago', as in (9)), and from the pre-verbal element *tei(tei)* 'almost', as in (10). Unlike all other instances of the phoneme /t/ before front vowels – which are pronounced as [s] – the /t/ in the perfect *tei* is pronounced [t].

(9) Fā hī ika he vaha *tuai*
HAB catch.fish fish at time *long.ago*
'I used to fish a while back.'

(10) **Kua** *tei(tei)* oti **tei** e vahega
[sei(sei)] [tei]
PRF *almost* finish **PRF** ABS class
'The class is nearly finished.'

The perfect use of *tei* is not mentioned in Seiter (1980), Sperlich (1997), or Massam (2009), but Seiter's grammar does contain a few examples of it (1980:52,180,191). Our third author has a prescriptive judgment that perfect *tei* may not be strictly 'correct', but it is overwhelmingly preferred in her speech over *tuai.* Whether the *tuai/tei* contrast reflects a dialect difference or language change remains a topic for future research.

4 (Non-)occurrence with past-time adverbials

Perfects in some languages, including English, disallow a subset of past-time adverbials, typically those which pick out a particular past time interval (Klein 1992, Giorgi and Pianesi 1997, Chung 2012, among others). The same is true of the Niuean perfect, as shown in (11-14). All these examples are good with the past tense marker *ne* or with no TAM marking (in which case they receive simple past translations in English).

(11)??**Kua** hau a Tom *i* *ne* *afi*
PRF come ABS Tom *on* *PAST* *day*
'Tom has arrived yesterday.'

(12) ***Kua** fano a Tom ki Hawaii *he tau kua mole*
PRF go ABS Tom to Hawaii *at year PRF pass*
'Tom has gone to Hawaii last year.'

(13) ***Kua** fano a Tom ki Hawaii *he ua e tau ki tua*
PRF go ABS Tom to Hawaii *at two of year at back*
'Tom has gone to Hawaii two years ago.'

(14)??**Kua** hau e tehina haau *i nī nei*
PERF come ABS younger.sibling your *on earlier.on*
'Your younger sibling has come earlier.'

In contrast, a 'since' adverbial is fine with the perfect, just like in English.[4]

(15) **Kua** fano a Tom ki Hawaii tali mai he hau a ia ki Niu Silani
PRF go ABS Tom to Hawaii since DIR1 at come ABS 3SG to New Zealand
'Tom has been to Hawaii since he moved to New Zealand.'

5 Present relevance and experiential readings

As briefly suggested by Seiter, and as is common for perfects cross-linguistically, the Niuean perfect has present relevance effects. These are illustrated in (16-18). (16a) is a current relevance situation; the perfect is offered and the past tense *ne* is rejected. In (16b), the opposite is true.

(16) a. *Context: Breaking up with someone.*
Kua oti **tei** e kapitiga ha taua
PRF finish **PRF** ABS friend POSS 1DU.INCL
'Our relationship is/has finished!'

b. *Context: Telling a story about the past.*
Ne oti e kapitiga ha taua ti fano au ki Sydney
PAST finish ABS friend POSS 1DU.INCL so go 1SG to Sydney
'Our relationship ended and I went to Sydney.'

In (17a), the perfect marking leads the hearer to expect that the little brother is still there. If the brother came and went while the husband was out, the non-perfect version in (17b) is more appropriate.[5]

(17) a. *Context: I see a man coming up the front driveway and I call out to my husband who's inside the house:*
Kua hau (**tei**) e tehina haau!
PRF come (**PRF**) ABS younger.sibling your
'Your little brother has come!'

[4] (15) is rejected with *tei;* see section 9 below.
[5] Bauer (1997:87-88) similarly notes for Māori that if one says 'The visitors have arrived' using *kua,* it implies you should get ready to welcome them.

b.	Hau	e	tehina	haau	i	nī nei
	come	ABS	younger.sibling	your	on	earlier.on

‘Your little brother came earlier.’

Finally, (18) with perfect marking is only acceptable if the speaker is ready at the utterance time; this cannot be a report about having been ready earlier.[6]

(18)	{**Kua**}	mau	{**tei**}	au	ke	fano	ke	hī	ika
	{**PRF**}	ready	{**PRF**}	1SG	to	go	to	catch.fish	fish

‘I’m ready to go fishing.’

The Niuean perfect also allows experiential readings, as observed by Bauer (1997:118) for Māori. This is shown in (19).

(19)	A:	**Kua**	hī	nakai	a	koe	tali	mai	he	moui	a	koe?
		PRF	catch.fish	Q	ABS	2SG	since	DIR1	at	live	ABS	2SG

‘Have you fished since you were born/since you’ve become alive?’

B:	**Kua**	hī	**tei**	au
	PRF	catch.fish	**PRF**	1SG

‘I have fished.’

Without the *tali mai he moui a koe* ‘since you were born’, (19A) can be a question about whether B has fished yet on a particular day. (19B) is similarly ambiguous between an experiential ‘ever’ reading, and being about a particular occasion.[7]

So far, the Niuean *kua …tei* construction is looking like a garden-variety perfect (if there is such a thing). In the next sections we will see that there is more to the story.

6 Result state readings

As noted above, Seiter observes that *kua* allows present-state readings (as in (6)). Further examples from our own fieldwork are given in (20-24).

(20)	**Kua**	malona	e	gutuhala
	PRF	broken	ABS	door

‘The door is broken.’

(21)	**Kua**	galo	e	talo
	PRF	lost	ABS	taro

‘The taro is lost.’

(22)	{**Kua**}	lolelole	{**tei**}	a	Tom
	{**PRF**}	tired	{**PRF**}	ABS	Tom

‘Tom is tired.’

[6] If a sentence has been tested and accepted with *kua,* with *tei,* or with both (but is bad if neither is present), we mark this using curly brackets { }.
[7] (19B) also has a present in-progress reading, which we discuss in section 8.

(23)

{**Kua**}	ita	{**tei**}	a	Malia
{**PRF**}	angry	{**PRF**}	ABS	Mary

'Mary is angry.'

(24)

(**Kua**)	meo	**tei**	a	ia	i	mua	he	tau	tagata
(**PRF**)	bashful	**PRF**	ABS	3SG	at	front	POSS	PL	person

'He is bashful/embarrassed in front of the audience.'
Comment: 'It's happening right now.' (adapted from Sperlich 1997:222)

Seiter expresses the intuition that in these cases, 'the state [is] viewed as the ongoing effect of some completed event' (1980:8). This idea is supported by data such as (25), where the predicate is eventive and the perfect gives a result state reading.

(25)

Kua	moho	**tei**	e	talo
PRF	cook	**PRF**	ABS	taro

'The taro is cooked.'

If (20-24) involve result state readings, they would be more accurately translated into English as perfects of changes-of-state. (20), for example, would correspond to 'The door has broken,' and (22) to 'Tom has got tired.' Our third author agrees with, and sometimes spontaneously produces, translations of this type.

How do these change-of-state readings arise? One possibility is that all the relevant predicates are inherently eventive, already denoting a change of state: 'break' rather than 'broken', and 'get angry' rather than 'angry'. This analysis would enable a simple and unified analysis of *kua ... tei* as a perfect. It would also make Niuean similar to at least some Salish languages, in which stage-level states like 'hungry' and 'tired' have been argued to be inherently inchoative (Bar-el 2005, Kiyota 2008).

An alternative possibility is that it is the perfect itself which is inducing the change-of-state semantics. This idea is suggested by Bauer (1997), who explicitly states that similar cases with Māori *kua* involve inchoative/ingressive aspect.

Teasing these two ideas apart – that the result-state readings arise due to inherently change-of-state predicates, or to the semantics of the perfect – is difficult to do on the basis of stage-level states and result states of eventive verbs, since for example 'Mary is angry' and 'Mary has got angry' are true and appropriate utterances in very similar types of context. Individual-level states are a more fertile testing ground for the hypothesis that the perfect introduces a change-of-state semantics; we turn to these in the next section.

7 Inchoative readings with individual-level predicates

According to Seiter (1980:8), '*kua* and *tuai* are used only with states which are potentially transitory, not inherent.' In our fieldwork we have found a slightly different result, namely that perfect marking actively coerces an individual-level predicate into having an inchoative, change-of-state interpretation. An initial example of this is given in (26). *Kua* is rejected in the non-inchoative situation in (26a), but offered in the inchoative situation in (26b).

(26) a. *Context: A woman has just given birth to twins. The doctor says:*
(#**Kua**) lalahi (#**tei**) e tau tama haau
(#**PRF**) big (#**PRF**) ABS PL child your
'Your children are big.'
Comment: 'Kua *and* tei *might only be possible if the babies were somehow measured in the womb before they were born, and they've come out bigger.'*

b. *Context: You haven't seen a friend's twins for a while, and when you see them again, you notice that they have got big.*
{**Kua**} lalahi {**tei**} e tau tama haau
{**PRF**} big.PL {**PRF**} ABS PL child your
'Your kids have grown / they're bigger.'
Comment: 'Without kua *or* tei *this would be 'Your children are big'.'*

Similarly in (27), *kua* and *tei* are infelicitous in the non-inchoative (a) context, and their presence causes the third author to picture the inchoative situation in (b). The same happens in (28) for the predicate *kula* 'red', and in (29) for *malolo* 'strong'.

(27) a. *Context: Complimenting a friend on her daughter's intelligence.*
(#**Kua**) iloilo (#**tei**) e tama fifine haau
(#**PRF**) intelligent (#**PRF**) ABS child female your
'Your daughter is intelligent.'

b. *Context: Something has just happened; the daughter has become intelligent.*
Kua iloilo **tei** e tama fifine haau
PRF intelligent **PRF** ABS child female your
'Your daughter is <u>now</u> intelligent; she has become intelligent.'

(28) a. Kula e tau lau akau
red ABS PL leaf tree
'The leaves are red.'

b. {**Kua**} kula {**tei**} e tau lau akau
{**PRF**} red {**PRF**} ABS PL leaf tree
'The leaves have turned red.'
Comment: 'It's autumn. Or it could be you're dyeing them.'

(29) *Context: Tom wasn't fishing yesterday, and you were wondering about his health. But today you see him fishing.*
Hī ika a Tom he aho nei …
catch.fish fish ABS Tom on day this
'Tom is fishing today …'

a. Liga malolo a ia
EPISTEMIC strong ABS 3SG
'He's probably well.'

b. Liga {**kua**} malolo {**tei**} a ia
EPISTEMIC {**PRF**} strong {**PRF**} ABS 3SG
'He's probably better.'

The data in (26-29) reveal a clear difference between Niuean and languages like English when the perfect is applied to individual-level states. In English, 'Your daughter has been intelligent' does not have an inchoative reading (in fact, rather the reverse: it implicates that she is losing her intelligence).

In the next section we turn to a final interpretation allowed by the Niuean perfect: an in-progress one. This reading may initially appear surprising, but it has parallels in other languages, and may be able to be unified with the other readings seen so far.

8 In-progress readings with eventive predicates

The final reading of the Niuean perfect is a present-in-progress reading with eventive predicates. This interpretation is not mentioned by Seiter (1980), although his grammar contains some examples of it, as shown in (30-31).[8]

(30) **Kua** kumi a taha i a koe
PRF search ABS INDF at PERS you
'Somebody is looking for you.' (Seiter 1980:41)

(31) **Kua** kai ika mo e talo a mautolu he mogo nei
PRF eat fish with ABS taro ABS 1PL.EXCL at time this
'We are eating fish and taro right now.' (Seiter 1980:70)

Examples of in-progress readings from our own fieldwork are given in (32-34). In addition, (19B), which above received a present perfect translation, can also be uttered while the speaker is fishing.

(32) **Kua** teitei mate **tei** au
PRF almost die **PRF** 1SG
'I'm nearly dying.'
Comment: 'You can say this while you're running' (feels like you're nearly dying).
Comment: 'Teitei mate au *is more like saying it afterwards; 'I nearly died'.'*

(33) Mate **tei** au[9]
die **PRF** 1SG
'I'm dying.' *or* 'I'm dead' (e.g. if playing paintball, and having received too many hits, being out of the game).

(34) (**Kua**) kai **tei** au
(**PRF**) eat **PRF** 1SG
'I am eating.' *or* 'I've already eaten.'

In-progress readings are freely accepted by our third author with perfect-marked activity predicates, but dispreferred with accomplishments, as shown in (35). An in-

[8] For Māori, Bauer (1997:118) writes that it is not clear whether *kua* can be used for a situation which began in the past and is still continuing.

[9] This is one of a very small number of contexts where we have a judgment distinguishing *kua* from *tei*. Our third author finds *Kua mate au* fully acceptable only in the paintball context (with a gloss 'I'm dead'), and judges it 'not quite right' in a situation where one is running (with a gloss 'I'm dying'). See section 9 for further discussion.

progress reading with an accomplishment requires an alternate construction, as in (36).

(35)

Kua	faka-meā	**tei**	e	au	e	motokā	haau
PRF	CAUS-clean	**PRF**	ERG	1SG	ABS	car	your

'I've cleaned your car.' / # 'I'm cleaning your car.'
Comment: 'Sounds like you've completed it.'

(36)

Ko e	faka-meā	(a)	au	he	motokā	haau
PRESENT	CAUS-clean	(ABS)	1SG	at	car	your

'I'm cleaning your car.'

The in-progress readings in (30-34) can be assimilated to the data in the previous two sections, under the assumption that in both cases, ingression is signaled, whether into a state or an event. We expect that our eventual formal analysis of the Niuean perfect will involve the placing of the reference time within a post-transition interval. This will allow both completed and in-progress/current state readings.

This sketch of an idea bears similarity to various other proposals in the literature, including Kiyota's (2008) analysis of the perfect marker in Sənčáθən, the Saanich dialect of Northern Straits Salish (see also Turner 2012). And Davis (2006: chapter 18) proposes that the St'át'imcets (Lillooet Salish) aspectual auxiliary *plan* foregrounds the state following a final transition. The final transition can be either a telic culmination, or an initial change-of-state. *Plan* therefore gives rise to stative readings with stage-level states, post-inchoation readings with individual-level states, in-progress readings with activities, and completed readings with achievements and accomplishments. The parallels with Niuean are striking.

The readings of the Niuean perfect are also reminiscent of the Japanese *teiru* construction. As discussed by Ogihara (1998), Nishiyama (2006), Kiyota (2008), among others, *teiru* predications typically receive ongoing process interpretations with durative verbs (activities and accomplishments, (37a-b)), and resultant state interpretations with instantaneous verbs (achievements and inchoative states, (37c-d)).

(37) a.

Jiroo-ga	odot-**teiru**
Jiroo-NOM	dance-**TEIRU**

'Jiroo is dancing (now).' (Kiyota 2008:16)

b.

Taroo-ga	kuruma-o	naosi-**teiru**
Taroo-NOM	car-ACC	fix-**TEIRU**

'Taro is fixing a/the car (now).' (Kiyota 2008:16)

c.

Ano-tegami-ga	todoi-**teiru**
that-letter-NOM	arrive-**TEIRU**

'That letter has arrived (and is here now). (Kiyota 2008:16)

d.

Taroo-wa	tukare-**teiru**
Taroo-TOP	get.tired-**TEIRU**

'Taro is tired.' (Kiyota 2008:17)

Niuean *kua … tei* differs from Japanese *teiru* in some respects; for example, the former freely allows completed readings for activities,[10] and disprefers in-progress

[10] *Teiru* does allow experiential readings with all verb types, facilitated by certain adverbs.

readings for accomplishments. However, it is notable that three such unrelated language families as Polynesian, Salish and Japonic all have aspectual morphemes which encode both perfect and in-progress interpretations. Our future research on Niuean will draw on the insights of work on similar elements in these other languages.

9 Summary and questions for future research

We have shown in this preliminary study that the Niuean perfect shares some core properties with perfects cross-linguistically. It displays present relevance effects, allows experiential readings, and disallows a similar range of past-time adverbials as the perfect does in languages like English. We have also shown that the Niuean perfect differs from the English one in important ways; it allows present stative readings with stage-level states, present in-progress readings with activity predicates, and coerces a change-of-state reading with individual-level states. We have speculated that all the interpretations of the Niuean perfect can be viewed as involving a reference time which follows some transition (including the initial transition into a state, or an event).

Many issues remain for future research. Most obviously, a formal analysis must be produced which accounts for the generalizations established here. The interaction of the perfect with tense marking also requires investigation: why can the perfect not co-occur with the past tense marker *ne?* Under what circumstances are past and future perfect readings licensed?

Another issue for future research concerns a possible additional interpretation of the Niuean perfect (not mentioned by previous researchers), namely an 'about to' usage. A sentence like (38) can be uttered right before one starts to sing. Similarly, (34) above can be uttered immediately before one begins eating.

(38) **Kua** lologo **tei** au
PRF sing PRF 1SG
'I'm singing.'
Comment: 'You say it and then you start singing straight away.'

Whether this is an additional reading, or whether it is merely an extension of the in-progress reading (parallel to how an English present progressive can be used right before an event begins), is a topic for future research.[11]

Another issue which deserves further attention is the interaction of *kua … tei* with accomplishment predicates. As noted in section 8, perfect-marked accomplishments seem to lack the in-progress reading allowed for activities. The discussion in Bauer (1997) also suggests a difference between activities and accomplishments with the Māori perfect. Bauer gives examples of perfect activities which receive 'start to' interpretations (1997:89), but an example of an accomplishment ('wash the house') which cannot (1997:128). And again there is a parallel with Salish, where accomplishments are the only predicates which resist inchoative readings, either without the perfect (as in Sḵwx̱wú7mesh; Bar-el 2005), or with it (as in Sənćáθən; Kiyota 2008).

Finally, an important question concerns the relationship between the two elements *kua* and *tei.* Do these contribute different meanings which can be teased apart, and combined compositionally? In the majority of contexts which allow a perfect, *kua* and *tei* may either or both be present without affecting acceptability. However, there are some

[11] The 'about to' usage is impossible for St'át'imcets *plan,* which is otherwise very similar to the Niuean perfect (Henry Davis, p.c.).

hints that there may be differences between the two elements. We have found that *tei* alone is preferred when the event is ongoing at the utterance time, whereas *kua* tends towards a completed action interpretation. One instance of this was noted in footnote 9 with respect to example (33), and the judgment that example (15) is bad with *tei* may be another instance of the same generalization. Furthermore, there are preliminary hints that something to do with certainty or evidentiality may be going on. Our third author judges that (39) is bad with *tei* in the context given, where there is no certainty or direct witness of the event.

(39) *Context*: *You just assume Tom's gone to Mary's house, because he usually does.*

Kua	fano	(#**tei**)	a	Tom	ke he	fale	ha	Mary
PRF	go	(#**PRF**)	ABS	Tom	to	house	poss	Mary

'Tom's gone to Mary's house.'

Comment: 'Probably would leave tei *out here, because that's more like a sure thing rather than an assumption; more when you know for a fact.'*

Comment: 'Maybe not with tei *if you can't actually see him go (even if you know for sure that he is going).'*

Tei has interesting syntactic properties which also deserve further investigation. We have noticed that it is in complementary distribution with the adverbial *lā* 'just'. (40a,b) are accepted with either *lā* or *tei,* but rejected with both (in either order). There is an additional difference between (40a) and (40b), which is the presence of the particle *ia* – obligatory with *lā* (cf. Seiter 1980:16) but impossible with *tei*. Whether these distributional facts will eventually provide clues to the meaning of *tei* is a question for future research.

(40) a.

Kua	oti	*lā*	ia	e	vahega
PRF	finish	*just*	PARTICLE	ABS	class

'The class has just finished.'

b.

Kua	oti	**tei**	e	vahega
PRF	finish	**PRF**	ABS	class

'The class is/has finished.'

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Affiliation

Lisa Matthewson
Department of Linguistics
University of British Columbia
lisa.matthewson@ubc.ca

Heidi Quinn
Department of Linguistics
University of Canterbury
heidi.quinn@canterbury.ac.nz

Lynsey Talagi
University of Canterbury /
Christchurch Niue Community
lynsey.talagi@canterbury.ac.nz

On a Quirky Russian Idiom

(*užas kakoj* + ADJ lit. 'horror what.a + ADJ' ≈ 'incredibly ADJ')

Igor Mel'čuk

*Èd Kinen? On **užas kakoj** tolkovyj!*
'Ed Keenan? He is incredibly intelligent!'

[A remark I overheard in a corridor of Leningrad University about fifty years ago, during a short visit of Professor Keenan to the ex-USSR; all these years it has been patiently waiting to be used. Today is the day!]

1 The Russian Expression *užas kakoj* + ADJ

1.1 Introductory Remarks

Russian has highly colloquial sentences of type (1), which are quite common:

(1) On byl *užas kakoj* umnyj.
'He was incredibly smart.'

It is the expression UŽAS KAKOJ [+ ADJ] lit. 'horror what.a [+ ADJ]' = 'very-very' that will be examined in this paper: its status as a lexical unit, its syntactic structure, and its lexicographic description. As far as I know, Russian has another three expressions of the same form and meaning: ŽUT' KAKOJ [+ ADJ] lit. 'horror what.a [+ ADJ]', as well as the popular STRAX KAKOJ [+ ADJ] lit. 'fear$_{(N)}$ what.a [+ ADJ]' and STRAST' KAKOJ [+ ADJ] lit. 'fear$_{(N)}$ what.a [+ ADJ]'. These three expressions are mutually substitutable with UŽAS KAKOJ in all contexts, so that whatever is said about UŽAS KAKOJ covers them too.

The main linguistic interest of the expression UŽAS KAKOJ [+ ADJ] lies in its unusual syntax, which is still a source of much controversy. Let me emphasize that the present discussion is conducted in terms of dependency syntax (rather than phrase structure, or constituency, syntax).[1]

Russian actually has an open set of expressions similar to UŽAS KAKOJ [+ ADJ]. I mean expressions each of which consists of two components:

- The syntactically central component is an interrogative-relative adjectival pronoun KAKOJ 'what kind, which, what.a'; it will be referred to as **K-word** (***k**to* 'who', ***k**ogda* 'when', ***k**ak* 'how', ***k**uda* 'where to', but also ***č**to* 'what', ***sk**ol'ko* 'how many/much', etc.; in English, similar lexical units are called WH-words).

[1] For details about dependency approach in syntax see, e.g., Mel'čuk (2009).

- The second component varies from one lexeme (like UŽAS) to an incomplete clause of the type 'even your smart mother wouldn't guess [what.a]': *daže tvoja umnaja mat' ne dogadalas' by kakoj*. These quasi-relative clauses are constrained, but theoretically infinite in number.

The expressions of this type can be called **K-expressions**.

K-expressions in Russian have been studied rather extensively: Mel'čuk (2013), Iomdin (2010a), Iomdin (2010b), Testelec and Bylinina (2005a), Testelec and Bylinina (2005b), to name only the latest publications known to me (they contain a rich bibliography). Traditionally, these expressions are subsumed under the rubric of "indefinite pronouns" of a special type. However, the expression UŽAS KAKOJ [+ ADJ] was not examined, and it is worth a discussion: being a K-expression, UŽAS KAKOJ and its three close relatives are by no means pronominal, but rather are obvious intensifiers.

Given the character of this paper,

- I will not systematically introduce all necessary notions and will have to rely upon endnotes and references;
- I will limit myself to the analysis of the expression UŽAS KAKOJ [+ ADJ].

1.2 The Lexical Status of UŽAS KAKOJ *[+ ADJ]*

The expression UŽAS KAKOJ [+ ADJ] means 'very-very [ADJ]' and is used to modify an evaluative noun or a long-form qualificative adjective: it is a strong intensifier. Its main semantic property is as follows: *užas kakoj* intensifies "positive", "negative" and "neutral" nouns/adjectives alike:

(2) a. On byl užas kakoj umnica ⟨čudak, bogač, merzavec, babnik⟩
'He was an incredible/incredibly intelligent man ⟨excentric, wealthy man, scoundrel, womanizer⟩.'

b. On byl užas kakoj umnyj ⟨strannyj, bogatyj, merzkij, meločnyj, dlinnyj, korotkij⟩
'He was incredibly intelligent ⟨nice, wealthy, disgusting, petty, long, short⟩.'

In other words, UŽAS KAKOJ [+ ADJ] does not retain in its meaning the negative nuances that could be due to its etymology: 'horror'. (In this UŽAS KAKOJ is similar to the English adjective *terrific*). From this I conclude that UŽAS KAKOJ is a noncompositional phraseme — an **idiom**; from now on, it will be put into semi-brackets, which mark idioms: ⌜UŽAS KAKOJ⌝.[2]

1.3 The Syntactic Structure of the Idiom ⌜UŽAS KAKOJ⌝

As seen in (1) und (2), the idiom ⌜UŽAS KAKOJ⌝ is clearly an adjectival, yet it can also function as an adverb, modifying a short-form adjective, an adverb or a verb; in this usage it has the form ⌜UŽAS KAK⌝:

(3) a. On byl užas kak xoroš ⟨bezobrazen, umën, bolen⟩.
'He was incredibly handsome ⟨ugly, smart, sick⟩.'

[2] About idioms see Mel'čuk (2011, 2012).

b. Bylo užas kak smešno ⟨veselo, vkusno, blizko, daleko⟩.
'It was very funny ⟨hilarious, tasty, close by, far away⟩.'

c. Ja užas kak ustal ⟨ljublju, nenavižu, xoču⟩.
'I am incredibly tired ⟨I like/hate/want very-very much⟩.'

Both variants are identical in their meaning and use; they are allolexes of the lexical unit ⌜UŽAS KAKOJ⌝.[3]

As a whole, the idiom ⌜UŽAS KAKOJ⌝ syntactically depends on the modified lexeme; and since the pronoun KAK(OJ) determines the distribution of this expression in the sentence, its morphological behavior (being its morphological contact point) and its meaning (the idiom is a qualifier, just as KAK(OJ)), it is its **syntactic head**: *užas* ← **pron-junctive**-*kakoj*[← **modif**-*umnyj*] lit. 'horror ← **pron-junctive**-*how*[← **modif**-intelligent]'.[4]

The Surface-Syntactic Relation **pronominal-junctive** plays an important role in the present study: it is proposed to represent the internal syntactic structure of all Russian Kexpressions — by subordinating the remaining component via its top node to the K-word.

1.4 The Lexicographic Description of the Idiom ⌜UŽAS KAKOJ⌝

The lexicographic description of the idiom ⌜UŽAS KAKOJ⌝ is straightforward:[5]

⌜UŽAS KAKOJ⌝, idiom, adjectival.

Definition

⌜*užas kakoj*⌝ [X]: 'very-very [X]'

SSynt-trees

⌜UŽAS ← **pron-junctive**–KAKOJ⌝ | ← N/ADJ$_{\text{LONG}}$
⌜UŽAS ← **pron-junctive**——KAK⌝ | ← ADJ$_{\text{SHORT}}$/V/ADV

Lexical Functions

Syn : ⌜žut' kakoj⌝ 'very-very', **popular** ⌜strax kakoj⌝ 'very-very'; čudoviščno 'monstruously', neverojatno 'incredibly', potrjasajušče 'tremendously', užasno 'horribly', zverski 'beastly', žutko 'horribly', . . . ; očen' 'very'

1.5 Other Russian Idioms of the Form ⌜UŽAS . . . ⌝

Russian has other idioms consisting of UŽAS and a K-word different from KAK(OJ):

(4) a. K nam *užas kto* xodil.
'Some horrible people were visiting us.'

b. i. S nim *užas čto* stalo.
'A horrible thing happened to him.'

[3] The description of ⌜UŽAS KAKOJ⌝ and ⌜UŽAS KAK⌝ as allolexes can be questioned; however, this problem is irrelevant to our discussion.

[4] On criteria for syntactic heads see Mel'čuk (2009:25–40).

[5] The lexicographic description of ⌜UŽAS KAKOJ⌝ is carried out in the framework of the Explanatory Combinatorial Dictionary [= ECD]; see Mel'čuk (2006).

ii. On *užas čto* vytvorjal.
'He was doing some horrible things.'

c. Mir *užas kuda* katitsja.
'The world is going in a horrible direction.'

d. On *užas skol'ko* stixov znaet.
'He knows so many poems.'

In spite of their material similarity, these expressions are different idioms:

⌜UŽAS ←**pron-junct**–KTO⌝ 'horrible person/people'
⌜UŽAS ←**pron-junct**–ČTO⌝ 'horrible thing/things'
⌜UŽAS ←**pron-junct**–KUDA⌝ 'in a horrible direction'
⌜UŽAS ←**pron-junct**–SKOL'KO⌝ 'very much/very many'[6]

Each one needs its own lexical entry.

2 The Russian Expression UŽAS [, *kakoj...*]

2.1 *Some Basic Facts About* UŽAS *[,* kakoj... *]*

One could stop here, were it not for the existence of another Russian expression: UŽAS [, *kakoj...*], superficially very similar to the idiom ⌜UŽAS KAKOJ⌝, but in reality very different from it:

(5) Užas, kakoj on byl glupyj.
lit. 'Horror how he was stupid.'

The differences are semantic and syntactic.

Semantic differences

- UŽAS in (5) does not combine with 'positive' lexemes:

  (6) a. # Užas, kakoj on byl umnyj.
  lit. 'Horror how he was intelligent.'
  b. # Užas, kak on xorošo vygljadel.
  lit. 'Horror how he good looked.'

  In other words, this UŽAS means '... is horrible'.

- The idiom ⌜UŽAS KAKOJ⌝ in (1)–(3) is a normal descriptive LU: it can be used in a subordinate clause (e.g. in reported speech), while the lexeme UŽAS in (5) is a signalative, which expresses the attitude/the belief of the Speaker and therefore cannot be used in a subordinate clause:[7]

  (7) a. Marina govorila, čto on byl užas kak umen.
  lit. 'Marina used to say that he was horror how intelligent.'

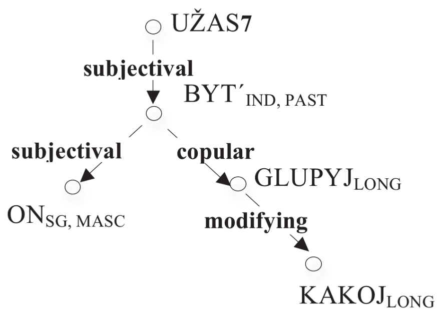
[6] However, not all K-words are capable of forming idioms with UŽAS: *⌜UŽAS KOGDA 'when'/ZAČEM 'what for'/POČEMU 'why'⌝.

b. * Marina govorila, čto užas, kak on byl umen.
lit. ‘Marina used to say that horror how he was intelligent.’

More specifically, UŽAS [, *kakoj* . . .] means ‘I signal that I believe that . . . is horrible’.

Syntactic differences

- ⌜UŽAS KAKOJ⌝ is an adjectival/adverbial idiom, while UŽAS is a single lexeme, whose part of speech is clausative:[8] UŽAS7 (MAS 1984 lists six senses of the word UŽAS, but misses the present one).
- UŽAS7 can be used alone as an interjection, constituting a complete sentence: *Užas!* ‘Horror!’
- In the idiom ⌜UŽAS KAKOJ⌝ the pronoun is the syntactic Governor, while the lexeme UŽAS7 syntactically governs the clause that contains the interrogative-relative pronoun (in this case, KAKOJ):

(8) 

- The idiom ⌜UŽAS KAKOJ⌝ does not take modifiers; the lexeme UŽAS7 can be modified by intensifiers PROSTO ‘simply’, TIXIJ ‘quiet’, ÈTO lit. ≈ ‘it’ (an intensifying particle):

(9) a. Prosto užas, s kem on vstrečaetsja.
lit. ‘Simply horror with whom he meets.’
b. Tixij užas, naskol’ko on obsčitalsja.
lit. ‘Quiet horror by how much he miscalculated.’
c. Èto užas, gde ego našli.
lit. ‘It horror where he was found.’

[7] On the distinction “descriptive ≈ non-descriptive” and, in particular, on signalatives see Iordanskaja and Mel’čuk (1995, 2011) and Mel’čuk (2001:242–251). ⌜UŽAS KAKOJ⌝ passes also two other tests for descriptive units: it can be negated and questioned; cf.:

(i) a. On vovse ne užas kakoj umnyj.
‘He is by no means very-very intelligent.’
b. On dejstvitel’no užas kakoj umnyj?
‘Is he really very-very intelligent?’

[8] Clausatives (from *clause*) are expressions that can stand alone constituting a complete clause, such as *Yes/No*, *Thanks!*, Yuk!, *Down* [*with* N]!, etc.

The three intensifiers can combine:

(9) d. Èto prosto tixij užas, č'ju odeždu on dolžen nosit'.
lit. 'It simply quiet horror whose cloths he has to wear.'

UŽAS7 can also be intensified by KAKOJ 'which', but not with all possible complements:

(10) a. *Kakoj* užas, čto on uexal!
'What a horror that he has left!'

b. * *Kakoj* užas, s kem on vstrečaetsja!
'What a horror with whom he is going out!'

The lexeme UŽAS7 belongs to a small, but noticeable series of nouns-clausatives: BEZOBRAZIE 'outrage', ČUDO 'miracle', KOŠMAR 'nightmare', POZOR 'shame', SKANDAL 'scandal', ŽUT' 'horror', etc.:

(11) a. Bezobrazie, čto on sebe pozvoljaet.
lit. 'Outrage what he himself allows.'

b. Prosto čudo, kak on risuet.
lit. 'Simply miracle how he draws.'

c. Èto košmar, radi kogo on takoe sdelal.
lit. 'It nightmare for whom he did such a thing.'

d. Pozor, kuda on otpravilsja.
lit. 'Shame where he went.'

None of these lexemes (except for ŽUT') can be used as the first component in an idiom with a K-word. But all of them have a corresponding noun that is usable as a complement of a copula (and accepts, in this role, adjectival modifiers):

(12) a. To, čto on sebe pozvoljaet, — čistoe bezobrazie.
'What he allows himself is sheer outrage.'

b. To, kak on risuet, — nevidannoe čudo.
'How he deaws is a miracle never seen.'

However, numerous nouns that can be used as a complement of the copula, do not have corresponding clausatives:

(13) a. To, čto on sebe pozvoljaet, — neslyxannaja naglost'.
'What he allows himself is unheard-of insolence.'

b. * Naglost', čto on sebe pozvoljaet.
'Inslolence what he allows himself.'

The inverse is not true: any noun usable as a clausative can be also used as a complement of the copula.

2.2 The Lexicographic Description of the Lexeme UŽAS7*[, kakoj. . .]*

⌜UŽAS7⌝, clausative (nominal); signalative.

Definition

Užas, čto X: 'I signal that I believe that X is horrible.'

Government Pattern

	X ⇔ I
1.	*čto* CLAUSE
2.	$\text{CLAUSE}_{\text{(K-word)}}$

Užas, čto my ne možem okazat' ljudjam pomošč'
'It is horrible that we cannot give these people some help.'
Užas, skol'ko derev'ev povalilo! 'It is horrible how many trees got uprooted.'
Užas! 'Horrible!'

Lexical Functions

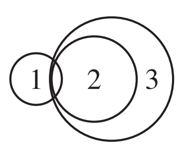
Syn	:	žut' [, *čto* CLAUSE] 'horror'; užasno[, *čto* CLAUSE] 'it is horrible'
Anti	:	čudo [, *čto* CLAUSE] 'miracle'
Magn	:	tixij 'quiet'; prosto 'simply'; èto ≈ 'it'; kakoj 'what a' | **not** $C_{I.2}$[9]

2.3 Summing Up

Russian has three subsets of the set of evaluative nouns:

1. four nouns that enter in combination with K-words to form idioms of the type ⌜UŽAS KAKOJ⌝;
2. nouns that can be used as clausatives and accept subjectival subordinate clauses;
3. nouns that can be used as the complement of the copula BYT' 'be' having as the subject a subordinate clause.

These subsets have an intersection: UŽAS 'horror'. The first and the third subsets are distinct: thus, STRAX 'fear' belongs only to the first subset, and POTRJASENIE 'shock' — only to the third one; the second subset is strictly included into the third one:



3 Four Conclusions

First, the idiom ⌜UŽAS KAKOJ⌝ and the lexeme UŽAS7[, *kakoj. . .*] are beyond doubt **two different lexical units**, which require different lexical entries.

Second, the internal **syntactic structure of the idiom** is as follows:

[9] That is, KAKOJ as a modifier of UŽAS7 is incompatible with a clause containing a K-word and depending on UŽAS7.

UŽAS ← **pron-junct**–KAKOJ

It is just the same structure as that of all K-expressions: a K-word and the rest, depending on it by the **pronominal-junctive** Surface-Syntactic Relation. Recall that syntactic dependency does not necessarily reflect semantic links: it specifies only word order and prosody. Especially so inside an idiom, which is semantically "unanalyzable," in the sense that its own meaning cannot be distributed beween its lexical components. In an idiom, the syntactic structure is laid bare: it cannot be correlated with meaningful relations between lexemes. Because of their syntactic structure, the idiom ⌜UŽAS KAKOJ⌝ and all the similar ones should not be called amalgams, which is sometimes done, following Lakoff (1974): an amalgam is an indivisible unit, like the English wordform *am* IND.PRES.1SG or the French wordform *au* /o/ (= the result of amalgamation of the preposition *à* and the article *le*); but our idioms show clearly an internal syntactic structure.

Third, while the crushing majority of Russian K-expression are indefinite pronouns, the idiom ⌜UŽAS KAKOJ⌝ and all its relatives **are not indefinite and not pronouns**.[10] Again, "Superficial similarity can be so deceiving!," as said a hedgehog getting down from a boot brush.

Fourth, a similar type of idiom and a similar correlation with the corresponding clausative exists in Serbian (Mel'čuk and Milićević 2011:107): three Serbian expressions — *užas jedan* 'horror one', *strava jedna* 'scare one' and *čudo jedno* 'miracle one' — are used both as clausatives and adjectival intensifiers:

(14) a. *Užas jedan, kako je dosadan.* lit. 'Horror one how [he] is boring.' ≈
On je dosadan užas jedan. lit. 'He is boring horror one.' =
'… horribly boring.'

b. *Strava jedna, kako su ukusne.* lit. 'Scare one how [they] are tasty.' ≈
One su ukusne strava jedna. lit. 'They are tasty scare one.' =
'… very-very tasty.'

c. *Čudo jedno, kako je nemiran.* lit. 'Miracle one how [he] is unruly.' ≈
On je nemiran čudo jedno. lit. 'He is unruly miracle one.' =
'… very-very unruly.'

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Affiliation

Igor Mel'čuk
Observatoire de linguistique Sens-Texte
Université de Montréal, Canada
igor.melcuk@umontreal.ca

The Structural and the Semantic
Subject-Object and Referential-Predicative Asymmetries

Adèle Mercier

Introduction

Kripke's *Puzzle about Belief* shows how difficult it can be to state what others believe. We can only do so in our language, but our language imposes presuppositions on others that they may not share. Kripke concludes that "the reason lies in the nature of the realm being entered"; that "our normal practices of attributing belief are questionable"; that "the situation of the puzzle seems to lead to a breakdown of our normal practices of attributing belief and even of indirect quotation."

Kaplan concurs, cautioning us about always accepting as legitimate the demand for reports in indirect discourse: since certain expressions have non-translational semantics, we should expect difficulties in making indirect reports of speech and thought involving indexicals, expressives, and other translation-resistant expressions.

There are good and obvious reasons why reporting others' states of mind should be difficult. After all, we don't read minds. I offer here some reflections that suggest, *pace* Kripke and Kaplan, that language may contain more available means for indirect reporting of beliefs than customarily appreciated. What makes our normal practice of attributing beliefs questionable or not always legitimate may pertain, not to a difference of realm being entered, but to our insufficient sensitivity to existing semantic subtleties already at play in our language.

1 Subject-Object Asymmetries in Syntax and Semantics

Subject-object asymmetries are legion in syntax, and have been well-studied. We find subject-object asymmetries in multiple questions:

I don't remember who$_{\text{SUBJ}}$ found what$_{\text{OBJ}}$.
* I don't remember what$_{\text{OBJ}}$ who$_{\text{SUBJ}}$ found [t_{OBJ}].

Relativizations out of objects, but not subjects, require DO-support:

What$_{\text{OBJ}}$ did John$_{\text{SUBJ}}$ find [t_{OBJ}]?
* What$_{\text{OBJ}}$ John$_{\text{SUBJ}}$ found [t_{OBJ}]?
* Who$_{\text{SUBJ}}$ did find a hat$_{\text{OBJ}}$?
Who$_{\text{SUBJ}}$ found a hat$_{\text{OBJ}}$?

That-trace effects occur with subjects but not objects:

* Who$_{\text{SUBJ}}$ do you think that [t_{SUBJ}] found a hat$_{\text{OBJ}}$?
What$_{\text{OBJ}}$ do you think that John$_{\text{SUBJ}}$ found [t_{OBJ}]?

Parasitic gaps are sanctioned with object, but not with subject, relativization:

Which article$_{OBJ}$ did John$_{SUBJ}$ file [t_{OB}] without reading [t_{OBJ}]?
* Who$_{SUBJ}$ filed which article$_{OBJ}$ without reading [t_{OBJ}]?

Such subject-object asymmetries are given structural explanations. In GB theory, the distinctions are expressed in sentence structure, the subject being an external argument, the object an internal argument of the VP, and the above effects are attributed to various violations: subjacency, case filters, *theta*-theory, the Empty Category Principle.

Subject-object asymmetries are also legion in semantics, where they have also been well studied. Klima (1964) remarks on the ambiguity of (1.a) versus the unambiguity of (1.b):

(1.a) He required that she marry [no one$_{OBJ}$].
(1.b) He required that [no one$_{SUBJ}$] marry her.

Kayne (1981) questions the intelligibility of (2.a) versus the unproblematic (2.b):

(2.a) * In all these years he suggested that [not a single term paper$_{SUBJ}$] be written.
(2.b) In all these years he suggested that they write [not a single term paper$_{OBJ}$].

May (1985) notes the distributive readings of (3.a) and (4.a) and their lack in (3.b) and (4.b):

(3.a) What$_{OBJ}$ did everyone bring [t_{OBJ}]?
(3.b) Who$_{SUBJ}$ brought everything?

(4.a) Who(m)$_{OBJ}$ did everyone talk to [t_{OBJ}]?
(4.b) Who$_{SUBJ}$ talked to everyone?

Whether well or incompletely understood, these are well-attested phenomena.

2 Subject-Object Metalinguistic Asymmetries

It is a simple rule of logic that from knowledge of P, and knowledge of Q, we can infer knowledge of P&Q. Beliefs, as we know, are more complicated.

As Kripke's *Puzzle* shows, Pierre can assent to, and thus be reported disquotationally as believing that P:

P Londres$_{SUBJ}$ est jolie. [*translation*: London is pretty.]

and that Q:

Q London$_{SUBJ}$ is not pretty.

while not as believing that P & Q, at least as a belief reported in English:

P&Q London$_{SUBJ}$ is pretty and London$_{SUBJ}$ is not pretty.

(Pierre might assent to a report of his belief as that London is not pretty but Londres is. But as Kripke points out, we are hard pressed to identify how this belief would differ in content from the previous, disavowed. We might say that Pierre believes:

$\exists! x$ (x est jolie et x = Londres)
and $\exists! y$ (y is not pretty and y = London)

but it is wholly unclear how these beliefs differ.)

The phenomenon extends to definite descriptions, not just proper names. Thus Pierre can be reported as believing that P:

P [La ville de Londres]$_{\text{SUBJ}}$ est jolie. [*translation*: The city of London is pretty.]

and as believing that Q:

Q [The city of London]$_{\text{SUBJ}}$ is not pretty.

while not as believing that P & Q:

P&Q [The city of London]$_{\text{SUBJ}}$ is pretty and [the city of London]$_{\text{SUBJ}}$ is not pretty.

This well-known puzzle, about how distinct co-designative names, ‘London’ and ‘Londres’, feature in belief, really is a puzzle, and I shall not purport to solve it. A different, complementary, puzzle involves identical differently-designative names. Certain features of this one have not, to my knowledge, been noticed.

I know two people named ‘Edward L. Keenan, so I can truthfully say:

(5.a) I believe that ELK$_{\text{SUBJ}}$ is a linguist at UCLA.
(5.b) I believe that ELK$_{\text{SUBJ}}$ is a historian at Harvard.

It would be syntactically awkward –some sort of binding violation?—to report my belief as:

(6.a) * Adèle believes that ELK$_{\text{SUBJ}}$ is a linguist at UCLA and ELK$_{\text{SUBJ}}$ is a historian at Harvard.

It would be false and/or semantically anomalous to report my beliefs as:

(6.b) ✗ Adèle believes that ELK$_{\text{SUBJ}}$ is a linguist at UCLA and a historian at Harvard.

It’s hardly better to report my belief as:

(6.c) * Adèle believes that ELK$_{\text{SUBJ}}$ **are** a linguist at UCLA and a historian at Harvard.

But note the improvement with:

(7.a) ✓ Adèle believes that a linguist at UCLA and a historian at Harvard are ELK$_{\text{OBJ}}$.

or even better:

(7.b) ✓ Adèle believes that a linguist at UCLA and a historian at Harvard are {each/both} ELK_{OBJ}.

Now, (7.a) may be ambiguous, between one reading where a single ELK is both a linguist at UCLA and a historian at Harvard –a reading better instantiated by:

(7.c) Adèle believes that **the** linguist at UCLA and **the** historian at Harvard are {each/both} ELK_{OBJ},

and another where there are two ELKs.

But interestingly, (7.a) and (7.b) both have a metalinguistic reading that works, where the name 'ELK' stands for a name-type, rather than a referential name token. The metalinguistic reading is *predicative*: the copula is understood as the 'is' of predication—is *an* ELK, or ELK_x, in the sense that we can say that there are many Edward*s* in the world; it is not *referential*: the copula is not understood as the 'is' of identity (= ELK).

This metalinguistic effect is predictably missing from (6.b) and (6.c), where 'ELK' appears in a canonically referential position, and, for the same reason, no more available in (6.d):

(6.d) ✗ Adèle believes that ELK {each/both} **are** a linguist at UCLA and a historian at Harvard.

The metalinguistic reading from subject position can only be induced with considerable lexical specification:

(6.e) Adèle believes that **two** ELK**s** {each/both} **are** {respectively} a linguist at UCLA and a historian at Harvard.

or even with outright metalinguistic intention:

(6.f) Adèle believes that two persons named 'ELK' {each/both} are {respectively} a linguist at UCLA and a historian at Harvard.

The metalinguistic reading from subject position is induced by clearly transforming a referential name token (ELK) into a predicative name-type (ELKs), or an outright predicate (persons named 'ELK').

These judgments are fully generalizable.

(8.a) ✗ Pierre believes that $Paderewski_{SUBJ}$ is a pianist and a politician.
(9.a) ✗ Pierre believes that $London_{SUBJ}$ is both the pretty city and the ugly city.

are false (or unattributable to Pierre); but

(8.b) ✓ Pierre believes that a pianist and a politician are {both, each} $Paderewski_{OBJ}$.

is true, on the available metalinguistic reading.

The case of 'London/Londres' confirms, negatively, the availability of the metalinguistic reading (only) in object position. For it is not true to say:

(9.b) ✗ Pierre believes that the pretty city and the ugly city are {both, each} $London_{OBJ}$.

but it is not true is precisely for metalinguistic reasons: since he thinks of the pretty city under the French name ‘Londres’ and of the ugly city under the English name ‘London,’ Pierre lacks (at least for the purpose of this example) the required metalinguistic predicate ‘is *a* London’ or ‘London*s*’.

This feature is not essential to the puzzle however. The same puzzle arises even without different languages. Monolingual Peter could think London is pretty because he saw pictures of it in a book, and that (another) London is ugly as he wanders through it, in which case, on its metalinguistic reading, the belief attribution would be true:

(9.c) ✓ Peter believes that the pretty city and the ugly city are {both, each} London$_{\mathrm{OBJ}}$.

Note that the verb ‘to be’ is essential to the metalinguistic reading. It is unavailable under the semantically related ‘ressembles’ or ‘is similar to’, which induce a referential interpretation:

(10.a) ✓ Adèle believes that a linguist at UCLA and a historian at Harvard **are** {each/both} ELK.
.b ✗ {both, each} **resemble** ELK.
.c ✗ **are** {each/both} **similar to** ELK.
(11.a) ✓ Pierre believes that a pianist and a politician **are** Paderewski.
.b ✗ **resemble** Paderewski.
.c ✗ **are similar to** Paderewski.
(12.a) ✓ Peter believes that the pretty city and the ugly city **are** London.
.b ✗ **resemble** London.
.c ✗ **are similar to** London.

Note that ‘is identical to’ renders the sentence false, for the same reason, while the ‘is’ of predication yields true (metalinguistic) belief attributions:

(10.d) ✗ Adèle believes that a ling. at UCLA and a historian at H **are** {each/both} **identical to** ELK.
.e ✓ **are** {each/both} ***an*** ELK.
(11.d) ✗ Pierre believes that a pianist and a politician **are identical to** Paderewski.
.e ✓ **are *a*** Paderewski.
(12.d) ✗ Peter believes that the pretty city and the ugly city **are identical to** London.
.e ✓ **are *a*** London.

The difference between the ‘is’ of predication and the ‘is’ of identity is, of course, the ontological categories that flank the ‘is’:

‘is’ of identity: “is *the*” or “is *NP*”	$= x$,	for x denoting an *object*
‘is’ of predication: “is *a*”	Fx,	for F denoting a *property*

The reason the ‘is’ of predication is required to yield true belief attributions in the above cases is because only metalinguistic attributions can be true, and these involve beliefs about properties (being an ELK), not objects (ELK).

Kripke’s puzzle is not a puzzle only when it relates a believer to a property (being a Paderewski), rather than an object (Paderewski). The puzzle occurs because Pierre harbours a confusion about the reference of ‘Paderewski’, and Peter of ‘London’ (in particular, that there are not two such objects but one). And the difficulty in stating Adèle’s belief is the complementary one, precisely that she knows that ‘ELK’ does have dual reference. Belief attributions succeed in such cases only when they are about *predication* (‘are {both} ELKs’), not *reference* (ELK).

Puzzling belief attributions find an outlet in reports from the object, rather than subject, position, as the above subject-object asymmetries reveal. But these subject-object asymmetries are not amenable to structural explanations. The difference between ‘is the’ and ‘is a’ is not cashed out in structural or syntactic terms (structurally they are both derived from VP $\rightarrow$ V + NP), but in semantic (or functional or logical or ontological) terms: the first denotes an object, the second a property.

We tentatively conclude then that, despite appearances, the above facts are not truly subject-object asymmetries after all. The distinction between a subject and an object are expressed in sentence structure, the subject being an external argument, the object an internal argument of the VP. The effective distinction here is not structural but semantic: it is that between a referential and a predicative interpretation of structural positions. It is true that the subject position canonically –in first-order language—receives a referential interpretation, and the object in a VP whose head is the ‘is’ of predication receives a predicative interpretation. But these are canonical regularities, not explanations, as we show below.

3 Referential-Predicative Expressive Asymmetries

Interestingly (although predictably, given the present analysis), the metalinguistic referential-predicative effects displayed above also appear in derogation inheritance.

Imagine, as per Kaplan (1999), cretinous UC Regents saying:

(13) “That bastard Kaplan was promoted.”

Clearly, (13) carries a presupposition about K, namely that he is a bastard (in the expressive, not the literal, sense).

It is clear that whoever reports the Regents’ belief thusly:

(14) 💣 The UC Regents believe [*that bastard* Kaplan]$_{\text{SUBJ}}$ was promoted.

inherits the derogatory presupposition.

The only way to report the Regent’s belief without inheriting the derogation is by saying:

(15) ✓ The UC Regents believe Kaplan *is a bastard*$_{\text{OBJ}}$ who was promoted.

This effect is strikingly robust. While the speaker inherits the derogation (big time!) in the referential:

(16) 💣 The UC Regents believe *the*$_{\text{REF}}$ g-d-d-mned f-ing bastard Kaplan was promoted.

the inheritance is cancelled in the predicational:

(17) ✓ The UC Regents believe that Kaplan is *a*$_{\text{PRED}}$ g-d-d-mned f-ing bastard who was promoted.

which acquires a metalinguistic reading.

(17.a) ✓ UCR stupidly believe that K is *a*$_{\text{PRED}}$ g-d-d-mned f-ing bastard who was promoted.

.b ✓ UCR just believe, for no reason at all, that K is a g-d-d-mned f-ing bastard who was promoted.

.c ✓ Those cretin UCR believe that K is a g-d-d-mned f-ing bastard who was promoted.

The referential-predicative distinction explains judgments of presupposition inheritance in belief reports better than a subject-object asymmetry. The speaker inherits the derogation with a referential NP in both subject and object position:

(18.a) 💣 The UC Regents believe [*that*$_{\text{REF}}$ *bastard* Kaplan]$_{\text{SUBJ}}$ should not have been promoted.

.b 💣 The UC Regents believe the Phil Dept should not have promoted [*that*$_{\text{REF}}$ *bastard* Kaplan]$_{\text{OBJ}}$.

The speaker does not inherit the derogation with a predicative NP in object position:

(19.a) ✓ The UC Regents believe that Kaplan should not have been promoted for [*being a*$_{\text{PRED}}$ *bastard*],

although derogation-inheritance can be induced by discourse-perspective changing elements such as ‘basically’ and ‘such’:

(19.b) 💣 The UC Regents believe that Kaplan should not have been promoted for *being basically a bastard*.

.c 💣 The UC Regents believe that Kaplan should not have been promoted for *being such a bastard*.

The speaker does inherit the derogation of a predicative-*like* NP in subject position:

(19.d) 💣 The UC Regents believe that [*a bastard named* Kaplan] should not have been promoted.

.e 💣 The UC Regents believe that [*a bastard like* Kaplan] should not have been promoted.

But ‘*a bastard named Kaplan*’ and ‘*a bastard like Kaplan*’ are not truly predicative, but referential NPs, witness:

(20.a) 💣 [A bastard named Kaplan]$_{\text{REF}}$ showed up at the Regents’ office this morning.

.b 💣 [A bastard like Kaplan]$_{\text{REF}}$ showed up at the Regents’ office this morning.

The speaker does not inherit the derogation of a truly predicative NP in subject position:

(19.f) ✓ The UC Regents believe that [*a/any bastard named* Kaplan]$_{\text{PRED}}$ should never be promoted.

The facts here too are robust. The speaker inherits the derogation with referential NPs in:

(21.a) 💣 John wonders *which*$_{\text{REF}}$ nigger/redneck/floozie was it who was not promoted .
.b 💣 John thinks it was *the*$_{\text{REF}}$ tall nigger/redneck/floozie who was not promoted.
.c 💣 Mary believes that *that*$_{\text{REF}}$ floozie who bewitched her husband should never be promoted.

The speaker does not inherit the derogation with predicative NPs:

(22.a) ✓ John wonders whether it was *a*$_{\text{PRED}}$ nigger[1]/redneck/floozie who was not promoted.
.b ✓ Mary believes that it was *a*$_{\text{PRED}}$ floozie who bewitched her husband.

4 Referential-Predicative Presuppositional Asymmetries

The “projection problem,” so-called by Kartunen and Peters, is the problem of how to compute the presuppositions of a complex sentence. K & P propose a cumulative model, where the presuppositions of each clause add up to constitute the presuppositions of the whole sentence. This model is defective, as shown briefly below.

The standard presupposition in the sentence:

(23) Keenan will come to the conference too.

is that:

23-**PRSP** Someone other than Keenan will come to the conference.

But if we embed (23) into a logically complex sentence, the presupposition of the whole sentence changes. The presupposition of the sentence:

(24) If Keenan$_{\text{REF}}$ will come to the conference, Kaplan will come too.

is that:

24-**PRSP** Kaplan is not Keenan.[2]

Here, ‘too’ is anaphoric on the previous clause. The presupposition differs depending on whether the anaphoric clause contains a referential or a predicative expression. The sentence:

(25) If *the*$_{\text{REF}}$ semanticist from UCLA comes to the conference, Kaplan will come too.

presupposes:

---

1 Some (David Kaplan, Jennifer Hornsby) think words like ‘nigger’ are “useless” because they can never be used without derogation. Supporters of this view will of course find the speaker derogatory in (22.a) –but this will not be a case of presupposition inheritance of the sort discussed here, but a direct case of using a derogatory word. I disagree with the view of “essentially useless” words, even as it refers to ‘nigger’, witness John Lennon’s moving and non-derogatory: “Woman is the nigger of the world.”

2 This insight is due to Saul Kripke (Kripke Conference, Barcelona Dec 2005).

25-**PRSP** Kaplan is not the semanticist from UCLA.

whereas the sentence:

(26) If a_{PRED} semanticist from UCLA comes to the conference, Kaplan will come too.

does not carry that presupposition.

The referential-predicative distinction accounts also for the following presuppositions or lack thereof. The sentence:

(27) If Kaplan comes to the conference, the_{REF} semanticist from UCLA will come too.

presupposes:

27-**PRSP** Kaplan is not the semanticist from UCLA.

whereas the sentence:

(28) If Keenan comes to the conference, a_{PRED} semanticist from UCLA will come too.

does not carry that presupposition.

Conclusion

A semantic picture, attributable to Aristotle, Mill, and direct reference theorists, conceives of the logical structure of sentences in terms of reference –the subject of the sentence functioning to denote an object—and predication –the predicate functioning to ascribe a property to that object. Frege brought attention to puzzling dimensions of that view, concluding that proper names themselves had not only a reference, but a predicative sense (while Russell did away with reference altogether). (Correcting Russell,) Donnellan showed that not just proper names but definite descriptions had both a referential use and a predicative (attributive) use.

The understanding of logical structure in terms of semantic function has by and large been ejected from linguistic theorizing, replaced in GB by structural, syntactic, analyses (although categorial grammars retain some of this understanding through rules of functional application.)

The foregoing facts suggest that the referential-predicative distinction is psychologically real. A closer look at how this distinction operates deeply in our linguistic judgments may shed some light on subtleties affecting belief attributions.

All of which is respectfully and lovingly submitted in honour of a true teacher and friend.

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Affiliation

Adèle Mercier
Department of Philosophy, Queen's University
& LOGOS, University of Barcelona
adele.mercier@gmail.com

Categories, types, symmetries

Michael Moortgat

Introduction

In this squib, we study some symmetry patterns that arise from introducing a notion of duality in categorial grammar. We first look at residuated and dually residuated families of operations, in syntax and semantics. Inspecting the monotonicity properties of these operations, we then identify a further set of (dually) Galois connected binary operations, hitherto uninvestigated in the linguistic setting. We close with a little puzzle, inspired by a visit to Dublin's Broom Bridge.

1 V

Klein's *Vierergruppe* V, with the multiplication table below, characterizes a simple but pervasive form of symmetry, showing up in many areas of natural language syntax and semantics. In the generalized quantifier framework, as observed in (Van Benthem 1986: 110), we can read Q^aAB as external negation $not\,QAB$, Q^bAB as inner negation $QA(A-B)$, and Q^cAB as their composition $not\,Q^bAB$, which for $Q = all$ then yields the traditional square of opposition.

$$V: \quad \begin{array}{c|cccc} & 1 & a & b & c \\ \hline 1 & 1 & a & b & c \\ a & a & 1 & c & b \\ b & b & c & 1 & a \\ c & c & b & a & 1 \end{array}$$

Klein's *Vierergruppe* also turns up in **LG**, a 'bilinear' generalization of Lambek's Syntactic Calculus originally proposed in Grishin (1983). In the traditional categorial systems, one has a multiplicative product $\otimes$ expressing Merge, together with left and right division operations $\backslash$ and $/$ expressing selection, i.e. incompleteness with respect to Merge. These three operations form a family, related by the residuation principles (*rp*). Grishin adds a dual family: a multiplicative sum, together with right and left *difference* operations $\oslash$ and $\obslash$, expressing subtraction with respect to $\oplus$. The operations $\obslash, \oplus, \oslash$ form a dual residuated triple in the sense of (*drp*).

$$\begin{array}{llcccc} (rp) & A \leq C/B & \Leftrightarrow & A \otimes B \leq C & \Leftrightarrow & B \leq A\backslash C \\ (drp) & B \obslash C \leq A & \Leftrightarrow & C \leq B \oplus A & \Leftrightarrow & C \oslash A \leq B \end{array}$$

In this bilinear setting, we find two symmetries: the order-preserving left-right symmetry given by the translation tables[1] ($\bowtie$) and (∞) below. One easily verifies that the operations $\bowtie, \infty$ and their composition give rise to the Klein 4-group.

$$
\bowtie \quad \begin{array}{cccc} C/D & A\otimes B & B\oplus A & D\obslash C \\ \hline\hline D\backslash C & B\otimes A & A\oplus B & C\oslash D \end{array}
\qquad\qquad
\infty \quad \begin{array}{ccc} C/B & A\otimes B & A\backslash C \\ \hline\hline B\obslash C & B\oplus A & C\oslash A \end{array}
$$

Now, writing $f : A \longrightarrow B$ for a proof of the inequality $A \leq B$, we have the biconditionals below.

$$
A^{\bowtie} \xrightarrow{f^{\bowtie}} B^{\bowtie} \quad \Leftrightarrow \quad A \xrightarrow{f} B \quad \Leftrightarrow \quad B^{\infty} \xrightarrow{f^{\infty}} A^{\infty}
$$

Starting from this simple core, one can then unfold a landscape of categorial type logics by attributing associativity and/or commutativity properties to the Merge operation and its dual. Or, more interestingly, one can keep these operations in their pure non-associative/non-commutative form, and introduce *mixed* principles of associativity/commutativity for the interaction between the $\otimes$ and the $\oplus$ families. For example

$$
\text{(mixed ass)} \quad (A\obslash B)\otimes C \leq A\obslash(B\otimes C) \qquad A\otimes(B\obslash C) \leq C\obslash(A\otimes C) \quad \text{(mixed comm)}
$$

and left/right symmetric cases. The resulting type logic respects word order and phrase structure, but it gains expressivity beyond that of the original Syntactic Calculus. A nice illustration is Moot (2007), who shows how one can model the adjunction operation of (lexicalized) Tree Adjoining Grammar with the interaction principles above, and Lowering $(B\oslash A)\obslash B \leq A$, a principle that is available already in the core residuation logic. For an overview of the linguistic exploration of **LG**, see (Moortgat 2009).

2 Monotonicity

To gain a better understanding of the meaning of these type-forming operations, it is instructive to inspect their monotonicity properties a bit closer. Deriving these properties from the preorder laws (reflexivity, transitivity of $\leq$) and the (dual) residuation principles is straightforward. As an example, below on the left the demonstration that $A\backslash B$ is antitone (order reversing) in its A argument, isotone (order preserving) in B; on the right, the image under $\cdot^{\infty}$.

$$
\dfrac{\dfrac{A' \leq \boxed{A} \quad \dfrac{\dfrac{A\backslash B \leq A\backslash B}{A\otimes(A\backslash B)\leq B}}{A \leq B/(A\backslash B)}}{\dfrac{A' \leq B/(A\backslash B)}{A'\otimes(A\backslash B)\leq B}} \quad \boxed{B}\leq B'}{\dfrac{A'\otimes(A\backslash B)\leq B'}{\boxed{A\backslash B}\leq A'\backslash B'}}
\qquad
\dfrac{B' \leq \boxed{B} \quad \dfrac{\dfrac{\dfrac{\dfrac{B\oslash A \leq B\oslash A}{B \leq (B\oslash A)\oplus A}}{(B\oslash A)\obslash B \leq A}}{(B\oslash A)\obslash B \leq A'} \quad \boxed{A} \leq A'}{B \leq (B\oslash A)\oplus A'}}{\dfrac{B' \leq (B\oslash A)\oplus A'}{B'\oslash A' \leq \boxed{B\oslash A}}}
$$

[1] Abbreviating $(A\otimes B)^{\bowtie} = B^{\bowtie}\otimes A^{\bowtie}$, etc. and with $p^{\bowtie} = p = p^{\infty}$ for atoms.

The table below gives the full picture for the six type-forming operations considered so far.

tonicity	$(-,+)$	$(+,+)$	$(+,-)$
	$A \obslash B$	$A \otimes B$	$A \oslash B$
	$A \backslash B$	$A \oplus B$	A/B

Note that the $\otimes$ and $\oplus$ families have the same tonicity behavior. To see how they differ, let $\star$ be some type-forming operation and consider which side of the inequality the subtypes A and B occupy when you put together $A \star B$ by means of a monotonicity inference. In the example of $A\backslash B$ and $B \oslash A$, we used highlighting to explicitly mark these positions.

$$\frac{\cdots \leq A \qquad B \leq \cdots}{A\backslash B \leq \cdots} \qquad\qquad \frac{\cdots \leq B \qquad A \leq \cdots}{\cdots \leq B \oslash A}$$

The possible patterns can be characterized by associating each type-forming operation with a 'trace' $(\pm_1, \pm_2) \mapsto \pm_3$. Goré (1997: §6.2) gives a clear exposition of the concept, which was originally introduced by Dunn in his study of Kripke frame semantics of substructural logics. For our purposes, we simply read these traces as follows: $\pm_1, \pm_2$ and $\pm_3$ refer to the first and second subtype and the complex formula respectively; the sign is $+$ ($-$) for an occurrence left (right) of $\leq$.

For the families $\otimes, \backslash, /$ and $\oplus, \obslash, \oslash$, we then have the following traces. Notice that from a trace $(\pm_1, \pm_2) \mapsto \pm_3$, one obtains the tonicity properties of the relevant operation by multiplying $\pm_1$ and $\pm_2$ by $\pm_3$; for example, in the case of $\oslash$, $(--, +-) = (+,-)$. Also notice that the columns for $\otimes, \backslash, /$ and $\oplus, \obslash, \oslash$ are related by the $\bowtie \infty$ symmetry, which means inversion of the signs for the traces.

	trace	tonicity
$\otimes$	$(-,-) \mapsto -$	$(+,+)$
$\backslash$	$(-,+) \mapsto +$	$(-,+)$
$/$	$(+,-) \mapsto +$	$(+,-)$

	trace	tonicity
$\oplus$	$(+,+) \mapsto +$	$(+,+)$
$\obslash$	$(+,-) \mapsto -$	$(-,+)$
$\oslash$	$(-,+) \mapsto -$	$(+,-)$

3 Interpretation

For the traditional categorial systems, the syntax-semantics mapping takes the form of a homomorphism sending types and derivations of a syntactic source calculus to their counterparts in **LP**, the semantic target calculus for resource-conscious meaning assembly. The mapping associates syntactic atoms with semantic types and maps the two directional slashes to a single function type constructor. Compositional interpretation is obtained in Curry's 'proofs as programs' style: the image of a syntactic derivation becomes a linear logic judgement $x_1 : A_1, \ldots, x_n : A :_n \vdash t : B$, assembling a program t of type B out of the input parameters x_i of type A_i.

For the bilinear type logic **LG**, the target for semantic interpretation remains **LP**. But judgements now can take the form $A_1, \ldots, A_n \vdash B_1, \ldots, B_m$, relating multiple inputs to multiple outputs. To extract a meaning assembly program out of such a judgement, we will have to *focus* on a particular input A_i or output B_j. This is exactly what a *continuation* semantics allows us to do: inputs are associated with semantic *values*, outputs with continuations, i.e. *evaluation contexts* for these values with respect to the overall result of the computation. Focusing on an input creates a function consuming a value to produce this overall result; focusing on an output creates a function that operates on a continuation to produce the overall result.

Here is how Bernardi and Moortgat (2007) work out this style of interpretation. The target logic has a distinguished atom $\perp$ representing the overall result of computations (the response type). For complex types, we have linear products $\otimes$, and a *restricted* form of linear implication: all function types result in $\perp$. We write $A \multimap \perp$ as a 'negation' $A^{\perp}$. For slash types and their duals, the syntax-semantics mapping then becomes[2]

$$\lceil A\backslash B \rceil = (\lceil A \rceil \otimes \lceil B \rceil^{\perp})^{\perp} \qquad \lceil A \oslash B \rceil = \lceil A \rceil \otimes \lceil B \rceil^{\perp}$$

The interpretation for $A\backslash B$, rather than being a function mapping an A value to a B value, here is a function taking an A value and a B *continuation* to produce a $\perp$ result. You could say that $\lceil \cdot \rceil$ reads a functor $A\backslash B$ as a classical tautology 'A implies B = 'not (A and not B)'. The interpretation of the mysterious dual operation $A \oslash B$ then simply is a pair of an A value and a B continuation: drop the outer negation.

Below we illustrate with a simple intransitive and transitive verb, 'smiles' vs 'likes'. For the lexical translation $\cdot^{\ell}$ of the constants, we interpret simple noun phrases as individuals $np^{\ell} = e$ and set the type for the overall result to t, so that we can identify $s^{\ell} = \perp^{\ell} = t$. In the translation for 'likes', the parameter v is of type $(e(tt)t)t$ (a verb phrase continuation).

SOURCE TYPE	IMAGE UNDER $\lceil \cdot \rceil$	$\cdot^{\ell}$
$np\backslash s$	$(\lceil np \rceil \otimes \lceil s \rceil^{\perp})^{\perp}$	$\lambda \langle x^{e}, c^{tt} \rangle.(c\ (\mathrm{SMILE}^{et}\ x))$
$(np\backslash s)/np$	$(((\lceil np \rceil \otimes \lceil s \rceil^{\perp})^{\perp})^{\perp} \otimes \lceil np \rceil)^{\perp}$	$\lambda \langle v, y^{e} \rangle.(v\ \lambda \langle x^{e}, c^{tt} \rangle.(c\ (\mathrm{LIKE}^{eet}\ y\ x)))$

Notice that $\lceil \cdot \rceil$, working itself recursively through $(np\backslash s)/np$, introduces a continuation for every numerator subtype, leading to a 'double negation' for the verb phrase interpretation, only to be simplified away in the lexical translation.

Bastenhof (2012) proposes a 'polarized' semantics which adapts Girard's (1991) constructive interpretation of classical logic to **LG**. Polarization simplifies the syntax-semantics mapping by preemptively compiling away double negations of the type we saw above. The key idea is to distinguish positively and negatively polar formulas, and to make the syntax-semantics map $\llbracket \cdot \rrbracket$ for complex formulas sensitive to the polarity of the subformulas. For the polarity distinction, we can go back to the *trace* we associated with formulas in the previous section. The trace output value groups together the operations $\otimes, \oslash, \obslash$ (output: $-$) and $\oplus, /, \backslash$ (output: $+$). The former we call positively polar, the latter negatively polar.

polarity					
A	B	$\llbracket A \otimes B \rrbracket$	$\llbracket A\backslash B \rrbracket = \llbracket B/A \rrbracket$	$\llbracket A \oplus B \rrbracket$	$\llbracket A \oslash B \rrbracket = \llbracket B \obslash A \rrbracket$
$-$	$-$	$\llbracket A \rrbracket^{\perp} \otimes \llbracket B \rrbracket^{\perp}$	$\llbracket A \rrbracket^{\perp} \otimes \llbracket B \rrbracket$	$\llbracket A \rrbracket \otimes \llbracket B \rrbracket$	$\llbracket A \rrbracket^{\perp} \otimes \llbracket B \rrbracket$
$-$	$+$	$\llbracket A \rrbracket^{\perp} \otimes \llbracket B \rrbracket$	$\llbracket A \rrbracket^{\perp} \otimes \llbracket B \rrbracket^{\perp}$	$\llbracket A \rrbracket \otimes \llbracket B \rrbracket^{\perp}$	$\llbracket A \rrbracket^{\perp} \otimes \llbracket B \rrbracket^{\perp}$
$+$	$-$	$\llbracket A \rrbracket \otimes \llbracket B \rrbracket^{\perp}$	$\llbracket A \rrbracket \otimes \llbracket B \rrbracket$	$\llbracket A \rrbracket^{\perp} \otimes \llbracket B \rrbracket$	$\llbracket A \rrbracket \otimes \llbracket B \rrbracket$
$+$	$+$	$\llbracket A \rrbracket \otimes \llbracket B \rrbracket$	$\llbracket A \rrbracket \otimes \llbracket B \rrbracket^{\perp}$	$\llbracket A \rrbracket^{\perp} \otimes \llbracket B \rrbracket^{\perp}$	$\llbracket A \rrbracket \otimes \llbracket B \rrbracket^{\perp}$

[2] With $\lceil p \rceil = p$ for atoms, and identifying $\lceil A\backslash B \rceil = \lceil B/A \rceil$, etc. In the examples, we have rearranged product components to keep them aligned with the corresponding subtypes in the syntactic source types, relying on the commutativity of the semantic target logic **LP**.

The table above now gives the polarized version of $\lceil\cdot\rceil$. For input (output) formulas with negative (positive) polariy, add an extra outermost negation; for atoms, assign some arbitrary polarity bias (in the example below: positive). Comparing $\lceil\cdot\rceil$ and $[\![\cdot]\!]$, we see that they agree on $np\backslash s$. But $[\![\cdot]\!]$ avoids the double negation on the verb phrase translation for $(np\backslash s)/np$, the numerator $np\backslash s$ in this case being of negative polarity.

SOURCE TYPE	IMAGE UNDER $[\![\cdot]\!]$	$\cdot^{\ell}$
$np\backslash s$	$(\lceil np\rceil \otimes \lceil s\rceil^{\perp})^{\perp}$	$\lambda\langle x^e, c^{tt}\rangle.(c\ (\text{SMILE}^{et}\ x))$
$(np\backslash s)/np$	$((\lceil np\rceil \otimes \lceil s\rceil^{\perp}) \otimes \lceil np\rceil)^{\perp}$	$\lambda\langle\langle x^e, c^{tt}\rangle, y^e\rangle.(c\ (\text{LIKE}^{eet}\ y\ x)))$

4 Galois connections

The careful reader at this point will have noticed that our ‘periodic table’ of traces is incomplete: the patterns $(+,+)\mapsto -$ and $(-,-)\mapsto +$ are missing. And indeed, there are two further type-forming operations corresponding to them.

	trace	tonicity
$\boxplus$	$(+,+)\mapsto -$	$(-,-)$
$\boxtimes$	$(-,-)\mapsto +$	$(-,-)$

Goré (1997: §8) discusses these ‘unusual connectives’, tracing them back to Allwein and Dunn (1993: 543). Algebraically, they obey the (dual) Galois connection laws below.

$$\begin{array}{lccccc} (gc) & A \leq B\boxtimes C & \Leftrightarrow & C \leq B\boxtimes A & \Leftrightarrow & B \leq C\boxtimes A \\ (dgc) & C\boxplus B \leq A & \Leftrightarrow & A\boxplus B \leq C & \Leftrightarrow & A\boxplus C \leq B \end{array}$$

The (dual) Galois connection entails that $\boxtimes,\boxplus$ are order reversing in *both* arguments. The derivation below shows this for $\boxplus$; the $\boxtimes$ case is obtained by ∞ duality.

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{A\boxplus B \leq A\boxplus B}{(A\boxplus B)\boxplus B \leq A} \quad \boxed{A} \leq A'}{(A\boxplus B)\boxplus B \leq A'}}{A'\boxplus(A\boxplus B)\leq B} \quad \boxed{B}\leq B'}{A'\boxplus(A\boxplus B)\leq B'}}{A'\boxplus B' \leq \boxed{A\boxplus B}}$$

Semantically, $A\boxtimes B$ and $A\boxplus B$ are the resource-sensitive versions of logical NAND and NOR respectively: ‘not (A and B)’ vs ‘(not A) and (not B)’. The operations $\boxtimes,\boxplus$ so far have not appeared in categorial analyses. To see whether they have sensible uses, one might look at the *unary* (dual) Galois connected type-forming operations of (Areces, Bernardi, and Moortgat 2001) for inspiration.

$$(gc) \quad B \leq A^{\mathbf{0}} \Leftrightarrow A \leq {}^{\mathbf{0}}B \quad ; \quad (dgc) \quad {}^{\mathbf{1}}B \leq A \Leftrightarrow A^{\mathbf{1}} \leq B$$

In combination with a residuated pair $\Diamond,\Box$, the downward entailing operations have been employed in (Bernardi 2002; Bernardi and Szabolcsi 2008) to control intricate patterns of polarity licensing.

5 Q

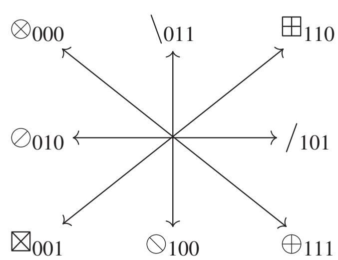
Our closing section falls in the 'mathematical games' category. In 2007, the European Summer School in Logic, Language and Information was held at Trinity College, Dublin. Many participants crossed the Liffey to visit the Old Jameson Distillery. But lovers of structure and symmetry also had a chance to head further north to the bridge over the Royal Canal where Sir William Rowan Hamilton in 1843 carved the fundamental equation for quaternion multiplication in the stone. In the previous section, we ended up with a set of eight type-forming operations. Let us see whether Hamilton's order-eight quaternion group $Q = \{\pm 1, \pm i, \pm j, \pm k\}$ can throw some light on the relations between them. Recall that Q has generators $-1, i, j, k$ with defining equations

$$(-1)^2 = 1, \qquad i^2 = j^2 = k^2 = ijk = -1$$

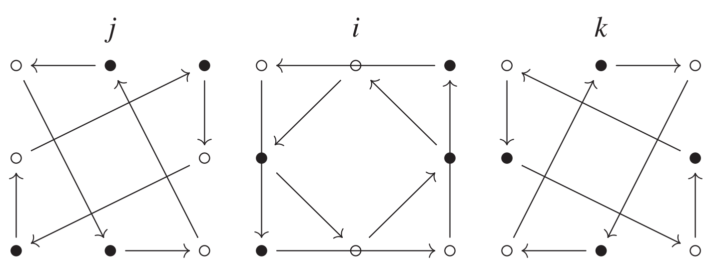
and note that Q is non-abelian: $ij = -ji = k$, $jk = -kj = i$, $ki = -ik = j$.

In the compass rose below, we have arranged the eight type-forming operations with their traces in a circle. It is convenient to write the trace in binary code, with 0 for $-$ and 1 for $+$. The arrangementis such that every triple $a_2a_1a_0$ appears diametrically opposite to its complement $\overline{a}_2\overline{a}_1\overline{a}_0$. This of course is the interpretation of -1.

$-1:$



But what about i, j, k and their negatives? There is a pleasant way of visualizing these operations as in the picture below (invert the arrows for $-i, -j, -k$).



Inspecting the effect of i, j, k on $\otimes$ (trace: 000), one would be tempted to say that the operations are interpreted as bitwise xor with 001, 100 and 010, respectively. And indeed, this is correct for the arrows leaving the white nodes. But to ensure that the square of i, j, k equals -1 (rather than 1), we have to alternate these steps with taking the *complement* of this bitwise xor at the black nodes. For example: i takes $\boxtimes$ (trace: 001) to $\oplus$ (trace: 111), i.e. the complement of (001 xor 001). For the black/white partitioning: 000 (hence also 111) is white always. For the others: 100 is white for i, 010 for j, and 001 for k.

6 Conclusion

I first met Ed Keenan when I was 25, at the 1979 LSA Linguistic Institute in Salzburg. I vividly recall the sense of excitement caused by the UCLA Occasional Working Paper that was circulating there, *Logical Types for Natural Language*, the later (Keenan and Faltz 1985), and ever since I have found his explorations of structure and symmetry in natural language a great source of inspiration. It's good to know that the pursuit of these themes can become a full-time occupation now that he is retiring from regular teaching!

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Affiliation

Michael Moortgat
Utrecht Institute of Linguistics/OTS
Utrecht University
M.J.Moortgat@uu.nl

Inference in a Boolean Fragment

Lawrence S. Moss

This paper is a contribution to *natural logic*, the study of logical systems for linguistic reasoning. We construct a system with the following properties: its syntax is closer to that of a natural language than is first-order logic; it can faithfully represent simple sentences with standard quantifiers, intransitive and transitive verbs, converses (for passive sentences), subject relative clauses (a recursive construct), and conjunction and negation on nouns and verbs. We also give a proof system which is complete and is decidable due to the the finite model property. The fragment itself was inspired by Ivanov and Vakarelov [2]. Our logical system differs from theirs in several respects and is an extension of our system in [6]. At the time of this writing, I know of no strictly larger system than the one in this paper and in [2] which is complete and decidable and which is capable of representing interesting in natural language.

Introduction

I was a student at UCLA from 1976 to 1984, mainly studying logic, mathematics, and linguistics. After taking a few undergraduate linguistics courses, I wandered into a class or seminar on *Boolean Semantics for Natural Language*. Way before computers, the class would have read a draft version of what was published some years later as [3]. I was immediately attracted to formal semantics; it seemed to have so much of what I sought in life. This kind of attraction has stuck with me, even though I never pursued the subject full force. Getting back to to my days as an undergraduate and later a graduate student at UCLA, I occasionally attended the seminars that Ed ran on topics like generalized quantifiers. I later worked with him on two papers on GQ theory. And in recent years we've been working on a textbook for his course on Mathematical Structures in Language. I always appreciate Ed's wide-ranging knowledge of linguistics, languages, and Language, and also his visionary applications of mathematical ideas. On top of all that, he's a real mensch. It's a pleasure to dedicate this paper to you, Ed.

Page 2 of *Boolean Semantics for Natural Language* proclaims "The fundamental relation we, and others, endeavor to represent is the *entailment (=logical implication, logical consequence)* relation." Semanticists usually *are* interested in facts of entailment, and they frequently study small fragments of language. But for the most part, they have not done what we aim to do in this paper: to present a small fragment of language with both syntax and semantics, and then to completely characterize the semantic entailment relation in terms of a deductive system of the sort one finds in logic.

We shall present a logical system in which one can carry out inferences in natural language, such as the following

$$(1) \qquad \frac{\textit{Some dog sees some cat}}{\textit{Some cat is seen by some dog}}$$

$$(2) \qquad \frac{\textit{Bao is seen and heard by every student} \quad \textit{Amina is a student}}{\textit{Amina sees Bao}}$$

$$(3) \qquad \frac{\textit{All skunks are mammals}}{\textit{All who fear all who respect all skunks fear all who respect all mammals}}$$

I take all of these to be valid inferences in the sense that a competent speaker who accepts the premisses (above the line) will accept the conclusion. (1) involves the passive, as does (2). The latter also has conjunction in the VP. (3) is a complicated example of iterated subject relative clauses. In my experience with this example during talks, most people cannot see that (3) is a valid inference. I mention this to point out that fragments which are syntactically very simple might still host non-trivial inferences.

This paper provides a logical system in which one may formally derive inferences corresponding to these examples, and many others. One might think that the simplest way to achieve this goal would be to simply use first-order logic (FOL). However, FOL is *undecidable*. We aim for a decidable system; indeed, we aim for a system of low computational complexity. It is currently open to devise logical systems which are decidable but at the same time are as expressive in the sense of being able to represent as much natural language inference as possible. This paper represents work in this direction.

Previous work The language introduced in this paper was based on the language in Ivanov and Vakarelov [2]. That paper goes beyond systems of natural logic in having relational inverses and the boolean operators on sentences. Specifically, the language in our paper [6] does not have these features because it lacks boolean connectives on one-place and two-place relations. The connectives are present in Ivanov and Vakarelov [2]; that paper also has full boolean connectives on sentences. However, the proof system in [2] is a Hilbert-style system, and so most people would find it more difficult to use. In addition, we believe that our completeness proof is substantially easier than the proof in [2]. However, this paper presents only a sketch and so it will not be persuasive on this point.

To summarize: the main technical contribution in this paper is a natural deduction-style logical system related to that of [2] and with an easier completeness proof.

1 The Language $\mathcal{L}$

There is only one language in this paper, called $\mathcal{L}$. $\mathcal{L}$ is based on three pairwise disjoint sets called **P**, **R**, and **K**. These are called *unary atoms*, *binary atoms*, and *constant symbols*.

The unary atoms correspond *predicate symbols*, and the binary atoms *relation symbols*, and this is the reason for our notations **P** and **R**. However, there is a significant difference having to do with variables, as we shall see shortly.

We speak of $\mathcal{L}$ as a language, but actually it is a family of languages parameterized by sets of basic symbols.

1.1 Syntax and semantics

The syntax of $\mathcal{L}$ is in Figure 1. Relational terms are built from unary and binary atoms using a negation, conjunction, and inverse on binary relations. Set terms (that is, terms whose denotations are subsets of the universe) are defined from relational terms using and quantification turning binary relational terms and a form of quantification; the semantics of that form of quantification is given below. Sentences are formed from set terms using either quantification or else by plugging the constants into relational terms. The second column in Figure 1 indicates the variables that we shall use in order to refer to the objects of the various syntactic categories. Because the syntax is not standard, it will be worthwhile to go through it slowly and to provide glosses in English for expressions of various types.

Constant symbols correspond to proper names, unary atoms to one-place predicates which we gloss as plural nouns or intransitive verbs, and relation symbols to transitive verbs.

Unary atoms *appear to be* one-place relation symbols, especially because we shall form sentences of the form $p(j)$. However, we do not have sentences $p(x)$, since we have no variables at this point in the first place. Similar remarks apply to binary atoms and two-place relation symbols. So we chose to change the terminology from *relation symbols* to *atoms*.

We form unary and binary *literals* using the bar notation. We think of this as expressing classical negation. We do not take it to be involutive, so that $\overline{\overline{p}}$ and p are technically different symbols. Of course, the negation operation is semantically involutive, and it will turn out that in the proof theory two involutively related expressions will be provably equivalent.

The set terms in this language are the one and only recursive construct in the language. If b is read as boys and s as sees, then one should read $\forall(b,s)$ as sees all boys, and $\exists(b,s)$ as sees some boys. Hence these set terms correspond to simple verb phrases. We also allow negation on the atoms, so we have $\forall(b,\overline{s})$; this can be read as fails to see all boys, or (better) sees no boys or doesn't see any boys. We also have $\exists(b,\overline{s})$, fails to see some boys. But the recursion allows us to embed set terms, and so we have set terms like

$$\exists(\forall(\forall(b,\overline{s}),h),a)$$

which may be taken to symbolize a verb phrase such as admires someone who hates everyone who does not see any boy.

Sentences allow quantification as in $\forall(b,c)$ and $\exists(b,c)$; the semantics renders these in the obvious way, using inclusion and disjointness of the extensions of the set terms. We also have sentences using the constants, such as $\forall(g,s)(m)$, corresponding to Mary sees all girls. Using relational inverses, we can also say $\forall(g,s^{-1})(m)$, corresponding to Mary is seen by all girls. We should note that the relative clauses which can be obtained in this way are all "missing the subject", never "missing the object". The language is too poor to express predicates like $\lambda x.$all boys see x.

Expression	Variables	Syntax
unary atom	p, q	
binary atom	b	
constant	j, k	
unary relational term	l, m	$p \mid \bar{l} \mid l \wedge m$
binary relational term	r, s	$b \mid r^{-1} \mid \bar{r} \mid r \wedge s$
set term	b, c, d	$l \mid \exists(c,r) \mid \forall(c,r)$
sentence	φ, ψ	$\forall(c,d) \mid \exists(c,d) \mid c(j) \mid r(j,k)$

Figure 1: Syntax of terms and sentences of $\mathcal{L}$.

Some decisions We chose to keep the language small for this paper. So we did not include disjunction on the terms, and we also did not include boolean connectives on the level of sentences. It would not be hard to add those and still obtain a complete and decidable system.

Semantics A *structure* (for this language $\mathcal{L}$) is a pair $\mathcal{M} = \langle \mathcal{M}, [\![\ ]\!] \rangle$, where M is a non-empty set, $[\![p]\!] \subseteq M$ for all $p \in \mathbf{P}$, $[\![r]\!] \subseteq M^2$ for all $r \in \mathbf{R}$, and $[\![j]\!] \in M$ for all $j \in \mathbf{K}$.

Given a model $\mathcal{M}$, we extend the interpretation function $[\![\ ]\!]$ to the rest of the language by setting

$$\begin{array}{lcl} [\![\bar{l}]\!] & = & M \setminus [\![l]\!] \\ [\![l \wedge m]\!] & = & [\![l]\!] \cap [\![m]\!] \\ [\![\bar{r}]\!] & = & M^2 \setminus [\![r]\!] \\ [\![r^{-1}]\!] & = & [\![r]\!]^{-1} \\ [\![r \wedge s]\!] & = & [\![r]\!] \cap [\![s]\!] \\ [\![\exists(l,t)]\!] & = & \{x \in M : \text{ for some } y \in [\![l]\!],\ [\![t]\!](x,y)\} \\ [\![\forall(l,t)]\!] & = & \{x \in M : \text{ for all } y \in [\![l]\!],\ [\![t]\!](x,y)\} \end{array}$$

We define the truth relation $\models$ between models and sentences by:

$$\begin{array}{lcl} \mathcal{M} \models \forall(c,d) & \text{iff} & [\![c]\!] \subseteq [\![d]\!] \\ \mathcal{M} \models \exists(c,d) & \text{iff} & [\![c]\!] \cap [\![d]\!] \neq \emptyset \\ \mathcal{M} \models c(j) & \text{iff} & [\![c]\!]([\![j]\!]) \\ \mathcal{M} \models r(j,k) & \text{iff} & [\![r]\!]([\![j]\!],[\![k]\!]) \end{array}$$

If Γ is a set of formulas, we write $\mathcal{M} \models \Gamma$ if for all $\varphi \in \Gamma$, $\mathcal{M} \models \varphi$.

Satisfiability A sentence φ is *satisfiable* if there exists $\mathcal{M}$ such that $\mathcal{M} \models \varphi$; satisfiability of a set of formulas Γ is defined similarly. We write $\Gamma \models \varphi$ to mean that every model of every sentence in Γ is also a model of φ.

Since $\mathcal{L}$ translates into the *two-variable fragment* FO^2 of first-order logic, the satisfiability problem for $\mathcal{L}$ is decidable. $\mathcal{L}$ also has the finite model property (Mortimer [5]): every sentence with a model has a finite model.

The bar notation on all syntactic items Note that every syntactic item has a negation: for relational terms, this is immediate from the definition of the syntax (no abbreviations are needed). For set terms and sentences: $\overline{\exists(l,r)} = \forall(l,\bar{r})$, $\overline{\forall(l,r)} = \exists(l,\bar{r})$, $\overline{\forall(c,d)} = \exists(c,\bar{d})$, $\overline{\exists(c,d)} = \forall(c,\bar{d})$, $\overline{c(j)} = \bar{c}(j)$, and $\overline{r(j,k)} = \bar{r}(j,k)$.

Rendering our examples in $\mathcal{L}$ Returning to (1), (2), and (3), we translate them into our language as follows:

$$\frac{\exists(\mathsf{dog},\exists(\mathsf{cat},\mathsf{see}))}{\exists(\mathsf{cat},\exists(\mathsf{dog},\mathsf{see}^{-1}))} \tag{4}$$

$$\frac{\forall(\mathsf{student},\mathsf{see}^{-1}\wedge\mathsf{hear}^{-1})(\mathsf{Bao}) \quad \mathsf{student}(\mathsf{Amina})}{\mathsf{see}(\mathsf{Amina},\mathsf{Bao})} \tag{5}$$

$$\frac{\forall(\mathsf{skunk},\mathsf{mammal})}{\forall(\forall(\forall(\mathsf{skunk},\mathsf{respect}),\mathsf{fear}),\forall(\forall(\mathsf{mammal},\mathsf{respect}),\mathsf{fear}))} \tag{6}$$

We shall see a proof system for these inferences in the next section.

We also translate $\mathcal{L}$ to FO^2, the fragment of first order logic using only the variables x and y. We do this by mapping the set terms two ways, called $c \mapsto \varphi_{c,x}$ and $c \mapsto \varphi_{c,y}$. Here are the recursion equations for $c \mapsto \varphi_{c,x}$:

$$\begin{array}{rcrcrcl} p & \mapsto & P(x) & \qquad & \forall(c,r) & \mapsto & (\forall y)(\varphi_{c,y}(y) \to r(x,y)) \\ \overline{p} & \mapsto & \neg P(x) & \qquad & \exists(c,r) & \mapsto & (\exists y)(\varphi_{c,y}(y) \wedge r(x,y)) \end{array}$$

The equations for $c \mapsto \varphi_{c,y}$ are similar. Then the translation of the sentences into FO^2 follows easily.

1.2 Proof system

We present our system in natural-deduction style in Figure 3. It makes use of *introduction* and *elimination* rules, and more critically of *variables*.

General sentences in this fragment are what usually are called *formulas*. We prefer to change the standard terminology to make the point that here, sentences are not built from formulas by quantification. In fact, sentences in our sense do not have variable occurrences. But general sentences do include *variables*. They are only used in our proof theory.

The syntax of general sentences is given in Figure 2. What we are calling *individual terms* are just variables and constant symbols. (There are no function symbols here.) Using terms allows us to shorten the statements of our rules, but this is the only reason to have terms.

An additional note: we don't need general sentences of the form $r(j,x)$ or $r(x,j)$. In larger fragments, we would expect to see general sentences of these forms, but our proof theory will not need these.

Expression	Variables	Syntax
individual variable	x, y	
individual term	t, u	$x \mid j$
general sentence	α	$\varphi \mid c(x) \mid r(x,y) \mid \perp$

Figure 2: Syntax of general sentences of $\mathcal{L}$, with φ ranging over sentences, c over set terms, and r over relational terms.

The bar notation, again We have already seen the bar notation $\overline{c}$ for set terms c, and $\overline{\varphi}$ for sentences φ. We extend this to formulas $\overline{b(x)} = \overline{b}(x)$, $\overline{r(x,y)} = \overline{r}(x,y)$. We technically have a general sentence $\overline{\perp}$, but this plays no role in the proof theory.

We write $\Gamma \vdash \varphi$ if there is a proof tree conforming to the rules of the system with root labeled φ and whose axioms are labeled by elements of Γ. (Frequently we shall be sloppy about the labeling and just speak, e.g, of the root as if it *were* a sentence instead of being *labeled by* one.) Instead of giving a precise definition here, we shall content ourselves with a series of examples in Section 1.3 just below.

The system has two rules called $(\forall E)$, one for deriving general sentences of the form $c(x)$ or $c(j)$, and one for deriving general sentences $r(x,y)$ or $r(j,k)$. (Other rules are doubled as well, of course.) It surely looks like these should be unified, and the system would of course be more elegant if they were. But given the way we are presenting the syntax, there is no way to do this. That is, we do not have a concept of *substitution*, and so rules like $(\forall E)$ cannot be formulated in the usual way. Returning to the two rules with the same name, we could have chosen to use different names, say $(\forall E1)$ and $(\forall E2)$. But the result would have been a more cluttered notation, and it is always clear from context which rule is being used.

Although we are speaking of trees, we don't distinguish left from right. This is especially the case with the $(\exists E)$ rules, where the canceled hypotheses may occur in either order.

Two-way rules The rules $\wedge$ and inv are two-way rules, going up and down. For example: from $(r \wedge s)(j,k)$, we may derive $r(j,k)$ and also $s(j,k)$. From both $r(j,k)$ and $s(j,k)$, we derive $(r \wedge s)(j,k)$.

Side Conditions As with every natural deduction system using variables, there are some side conditions which are needed in order to have a *sound* system.

In $(\forall I)$, x must not occur free in any uncanceled hypothesis. For example, in the version whose root is $\forall(c,d)$, one must cancel all occurrences of $c(x)$ in the leaves, and x must not appear free in any other leaf.

In $(\exists E)$, the variable x must not occur free in the conclusion α or in any uncanceled hypothesis in the subderivation of α.

In contrast to usual first-order natural deduction systems, there are *no side conditions* on the rules $(\forall E)$ and $(\exists I)$. The usual side conditions are phrased in terms of concepts such as *free substitution*, and the syntax here has no substitution to begin with.

Formal proofs in the Fitch style Textbook presentations of logic overwhelmingly use natural deduction instead of Hilbert-style systems because the latter approach requires one to use complicated propositional tautologies at every step, and it also lacks the facility to use sub-proofs with temporary assumptions. I have chosen to present the system of this paper in

$$\frac{c(t) \quad \forall(c,d)}{d(t)}\ \forall E \qquad\qquad \frac{c(u) \quad \forall(c,r)(t)}{r(t,u)}\ \forall E$$

$$\frac{c(t) \quad d(t)}{\exists(c,d)}\ \exists I \qquad\qquad \frac{r(t,u) \quad c(u)}{\exists(c,r)(t)}\ \exists I$$

$$\frac{\begin{array}{c}[c(x)]\\ \vdots\\ d(x)\end{array}}{\forall(c,d)}\ \forall I \qquad\qquad \frac{\begin{array}{c}[c(x)]\\ \vdots\\ r(t,x)\end{array}}{\forall(c,r)(t)}\ \forall I$$

$$\frac{\exists(c,d) \quad \begin{array}{c}[c(x)] \quad [d(x)]\\ \vdots\\ \alpha\end{array}}{\alpha}\ \exists E \qquad\qquad \frac{\exists(c,r)(t) \quad \begin{array}{c}[c(x)] \quad [r(t,x)]\\ \vdots\\ \alpha\end{array}}{\alpha}\ \exists E$$

$$\begin{array}{c} r(j,k) \quad s(j,k)\\ \hline\hline (r\wedge s)(j,k)\end{array}\ \wedge \qquad\qquad \begin{array}{c} r^{-1}(k,j)\\ \hline\hline r(j,k)\end{array}\ \mathrm{inv}$$

$$\frac{\alpha \quad \overline{\alpha}}{\perp}\ \perp I \qquad\qquad \frac{\begin{array}{c}[\overline{\varphi}]\\ \vdots\\ \perp\end{array}}{\varphi}\ RAA$$

Figure 3: Proof rules. See the text for the side conditions in the ($\forall I$) and ($\exists E$) rules.

a "classical" Gentzen-style format. But the system may easily be re-formatted to look more like a Fitch system. For more on this, see [6].

1.3 Examples

We present a few examples of the proof system at work, along with comments pertaining to the side conditions. Some of these are taken from the proof system $\mathbf{R}^*$ for the language $\mathcal{R}^*$ of [7]. That system $\mathbf{R}^*$ is among the strongest of the known syllogistic systems, and so it is of interest to check the current proof system is at least as strong.

Example 1. Here is a formal derivation of (4):

$$\dfrac{\exists(\mathsf{dog},\exists(\mathsf{cat},\mathsf{see})) \quad \dfrac{[\exists(\mathsf{cat},\mathsf{see})(x)]^2 \quad \dfrac{[\mathsf{cat}(y)]^1 \quad \dfrac{[\mathsf{dog}(x)]^2 \quad \dfrac{[\mathsf{see}(x,y)]^1}{\mathsf{see}^{-1}(y,x)}}{\exists(\mathsf{dog},\mathsf{see}^{-1})(y)}\ \exists I}{\exists(\mathsf{cat},\exists(\mathsf{dog},\mathsf{see}^{-1}))}\ \exists I}{\exists(\mathsf{cat},\exists(\mathsf{dog},\mathsf{see}^{-1}))}\ \exists E^1}{\exists(\mathsf{cat},\exists(\mathsf{dog},\mathsf{see}^{-1}))}\ \exists E^2$$

Example 2. Here is a formal derivation of (5):

$$\cfrac{\cfrac{\cfrac{\forall(\mathsf{student},\mathsf{see}^{-1}\wedge\mathsf{hear}^{-1})(\mathsf{Bao}) \quad \mathsf{student}(\mathsf{Amina})}{(\mathsf{see}\wedge\mathsf{hear})^{-1}(\mathsf{Bao},\mathsf{Amina})}\ \forall E}{(\mathsf{see}\wedge\mathsf{hear})(\mathsf{Amina},\mathsf{Bao})}\ \mathrm{inv}}{\mathsf{see}(\mathsf{Amina},\mathsf{Bao})}\ \wedge$$

Example 3. Here is a a formal derivation that $\forall(c,d) \vdash \forall(\forall(d,r),\forall(c,r))$:

$$\cfrac{\cfrac{\cfrac{\cfrac{[c(x)]^1 \quad \forall(c,d)}{d(x)}\ \forall E \qquad [\forall(d,r)(y)]^2}{r(x,y)}\ \forall E}{\forall(c,r)(y)}\ \forall I^1}{\forall(\forall(d,r),\forall(c,r))}\ \forall I^2$$

In the first application of $(\forall I)$, x is not free in any uncanceled hypothesis. (That is, it is free in $c(x)$, but this is canceled in the application.) The other variable y is free at that point, and it is quantified away by the second application of $(\forall I)$.

Example 4. We use the previous example to give a derivation (in shortened form) for (6):

$$\cfrac{\cfrac{\forall(\mathsf{skunk},\mathsf{mammal})}{\forall(\forall(\mathsf{mammal},\mathsf{respect}),\forall(\mathsf{skunk},\mathsf{respect}))}}{\forall(\forall(\forall(\mathsf{skunk},\mathsf{respect}),\mathsf{fear}),\forall(\forall(\mathsf{mammal},\mathsf{respect}),\mathsf{fear}))}$$

Note that we used Example 3 twice and that the inference is *antitone* each time: skunk and mammal have switched positions.

Example 5. Here is an example of a derivation using (RAA). It shows $\forall(c,\overline{c}) \vdash \forall(d,\forall(c,r))$.

$$\cfrac{[d(x)]^2 \qquad \cfrac{\cfrac{\cfrac{\cfrac{\cfrac{[c(y)]^1 \quad \forall(c,\overline{c})}{\overline{c}(y)}\ \forall E \qquad [c(y)]^1}{\bot}\ \bot I}{r(x,y)}\ RAA}{\forall(c,r)(x)}\ \forall I^1}{\forall(d,\forall(c,r))}\ \forall I^2$$

Example 6. Here is a statement of the *rule of proof by cases*: If $\Gamma+\varphi \vdash \psi$ and $\Gamma+\overline{\varphi} \vdash \psi$, then $\Gamma \vdash \psi$. (Here and below, $\Gamma+\varphi$ denotes $\Gamma \cup \{\varphi\}$.) Instead of giving a derivation, we only indicate the ideas. Since $\Gamma+\varphi \vdash \psi$, we have $\Gamma+\varphi+\overline{\psi} \vdash \bot$ using $(\bot I)$. From this and (RAA), $\Gamma,\overline{\psi} \vdash \overline{\varphi}$. Take a derivation showing $\Gamma+\overline{\varphi} \vdash \psi$, and replace the labeled $\overline{\varphi}$ with derivations from $\Gamma+\overline{\psi}$. We thus see that $\Gamma+\overline{\psi} \vdash \psi$. Using $(\bot I)$, $\Gamma+\overline{\psi} \vdash \bot$. And then using (RAA) again, $\Gamma \vdash \psi$. (This point is from [7].)

Example 7. *RAA* gives the rule of double negation:

$$\cfrac{\cfrac{\overline{\overline{\varphi}} \quad [\overline{\varphi}]}{\bot}}{\varphi}$$

Example 8. For binary relations, inverse and complement commute: $(\overline{R})^{-1} = \overline{R^{-1}}$. Here are the reflections of this fact in the proof system:

$$\dfrac{\dfrac{\dfrac{\overline{r}^{-1}(j,k)}{\overline{r}(k,j)} \qquad \dfrac{[r^{-1}(j,k)]}{r(k,j)}}{\bot}}{\overline{\overline{r^{-1}}}(j,k)} \qquad\qquad \dfrac{\dfrac{\dfrac{\overline{r^{-1}}(j,k) \qquad \dfrac{[r(k,j)]}{r^{-1}(j,k)}}{\bot}}{\overline{r}(k,j)}}{\overline{r}^{-1}(j,k)}$$

1.4 Soundness

Before presenting a soundness result, it might be good to see an improper derivation. Here is one, purporting to infer some men see some men from some men see some women:

$$\dfrac{\exists(m,\exists(w,s)) \qquad \dfrac{[\exists(w,s)(x)]^2 \qquad \dfrac{\dfrac{[s(x,x)]^1 \quad [m(x)]^2}{\exists(s,m)(x)}\,\exists I \qquad [m(x)]^2}{\exists(m,\exists(m,s))}\,\exists I}{\exists(m,\exists(m,s))}\,\exists E^1}{\exists(m,\exists(m,s))}\,\exists E^2$$

The specific problem here is that when $[s(x,x)]$ is withdrawn in the application of $\exists I^1$, the variable x is free in the as-yet-uncanceled leaves labeled $m(x)$.

Lemma 1. *The proof system is sound: if* $\Gamma \vdash \varphi$, *then* $\Gamma \models \varphi$.

See [6] for the proof in a smaller fragment. The argument there easily extends to the current language; the point is that the side conditions on the quantifier rules insure that the proof system is sound.

1.5 The Henkin property

The completeness of the logic parallels the Henkin-style completeness result for first-order logic. Given a consistent theory Γ, we get a model of Γ in the following way: (1) take the underlying language $\mathcal{L}$, add constant symbols to the language to witness existential sentences; (2) extend Γ to a maximal consistent set in the larger language; and then (3) use the set of constant symbols as the carrier of a model in a canonical way. In the setting of this paper, the work is in some ways easier than in the standard setting, and in some ways harder. There are more details to check, since the language has more basic constructs. But one doesn't need to take a quotient by equivalence classes, and in other ways the work here is easier.

Given two languages $\mathcal{L}$ and $\mathcal{L}'$, we say that $\mathcal{L}' \supseteq \mathcal{L}$ if every symbol (of any type) in $\mathcal{L}$ is also a symbol (of the same type) in $\mathcal{L}'$. In this paper, the main case is when $\mathbf{P}(\mathcal{L}) = \mathbf{P}(\mathcal{L}')$, $\mathbf{R}(\mathcal{L}) = \mathbf{R}(\mathcal{L}')$, and $\mathbf{K}(\mathcal{L}) \subseteq \mathbf{K}(\mathcal{L}')$; that is, $\mathcal{L}'$ arises by adding constants to $\mathcal{L}$.

A *theory* in a language is just a set of sentences in it. Given a theory Γ in a language $\mathcal{L}$, and a theory Γ^* in an extension $\mathcal{L}' \supseteq \mathcal{L}$, we say that Γ^* is a *conservative extension* of Γ if for every $\varphi \in \mathcal{L}$, if $\Gamma^* \vdash \varphi$, then $\Gamma \vdash \varphi$. (Notice that if Γ is consistent and $\Gamma^* \supseteq \Gamma$ is a conservative extension, then Γ^* is also consistent.)

Lemma 2. *Let Γ be a consistent $\mathcal{L}$-theory, and let $j,k \notin \mathbf{K}(\mathcal{L})$.*

1. *If $\exists(c,d) \in \Gamma$, then $\Gamma + c(j) + d(j)$ is a conservative extension of Γ.*
2. *If $\exists(c,r)(j) \in \Gamma$, then $\Gamma + r(j,k) + c(k)$ is a conservative extension of Γ.*

Proof. For (1), suppose that Γ contains $\exists(c,d)$ and that $\Gamma + c(j) + d(j) \vdash \varphi$. Let Π be a derivation tree. Replace the constant j by an individual variable x which does not occur in Π. The result is still a derivation tree, except that the leaves are not labeled by *sentences*. (The reason is that our proof system has no rules specifically for constants, only for terms which might be constants and also might be individual variables.) Call the resulting tree Π'. Now the following proof tree shows that $\Gamma \vdash \varphi$:

$$\dfrac{\exists(c,d) \qquad \begin{array}{c}[c(x)] \quad [d(x)] \\ \vdots \\ \varphi\end{array}}{\varphi}\ \exists E$$

The subtree on the right is Π'. The point is that the occurrences of $c(x)$ and $d(x)$ have been canceled by the use of $\exists E$ at the root.

This completes the proof of the first assertion, and the proof of the second is similar. $\square$

Definition 3. An $\mathcal{L}$-*theory* Γ has the *Henkin property* if the following hold:

1. If $\exists(c,d) \in \Gamma$, then for some constant j, $c(j)$ and $d(j)$ belong to Γ.
2. If r is a literal of $\mathcal{L}$ and $\exists(c,r)(j) \in \Gamma$, then for some constant k, $r(j,k)$ and $c(k)$ belong to Γ.

Lemma 4. *Let Γ be a consistent $\mathcal{L}$-theory. Then there is some $\mathcal{L}^* \supset \mathcal{L}$ and some $\mathcal{L}^*$-theory Γ^* such that Γ^* is a maximal consistent Henkin theory.*

Proof. This is a routine argument, using Lemma 2. One dovetails the addition of constants which is needed for the Henkin property together with the addition of sentences needed to insure maximal consistency. The formal details would use Lemma 2 for steps of the first kind, and for the second kind we need to know that if Γ is consistent, then for all φ, either $\Gamma + \varphi$ or $\Gamma + \overline{\varphi}$ is consistent. This follows from the derivable rule of proof by cases; see Example 6 in Section 1.3. $\square$

It might be worthwhile noting that the extensions produced by Lemma 4 add *infinitely many constants* to the language.

1.6 Completeness via canonical models

In this section, fix a language $\mathcal{L}$ and a maximal consistent Henkin $\mathcal{L}$-theory Γ. We construct a *canonical model* $\mathcal{M} = \mathcal{M}(\Gamma)$ as follows: $M = \mathbf{K}(\mathcal{L})$; $[\![p]\!](j)$ iff $p(j) \in \Gamma$; $[\![s]\!](j,k)$ iff $s(j,k) \in \Gamma$; and $[\![j]\!] = j$. That is, we take the constant symbols of the language to be the points of the model, and the interpretations of the atoms are the natural ones. Each constant symbol is interpreted by itself: there is no need of taking quotients as in the parallel argument for FOL completeness.

Lemma 5. *For all binary relation terms r, and all constants j and k,*

$$[\![r]\!](j,k) \textit{ in } \mathcal{M} \quad \textit{iff} \quad r(j,k) \in \Gamma \tag{7}$$

Proof. By induction on r. For r atomic, (7) is the definition of the semantics in our canonical model.

Assume that (7) holds for r; we show it for r^{-1}:

$$\Gamma \vdash r^{-1}(j,k) \quad \text{iff} \quad \Gamma \vdash r(k,j) \quad \text{iff} \quad r(k,j) \in \Gamma \quad \text{iff} \quad r^{-1}(j,k) \in \Gamma$$

The middle step uses the induction hypothesis.

Assume that (7) holds for r; then (7) holds for $\overline{r}$ using maximal consistency of Γ.

Assume that (7) holds for r and s. Then due to the $\wedge$ rules of the system we see that

$$[\![r \wedge s]\!](j,k) \quad \text{implies} \quad r(j,k) \text{ and } s(j,k) \text{ belong to } \Gamma$$

Conversely, if both $r(j,k)$ and $s(j,k)$ belong to Γ, then by the last rule above, $[\![r \wedge s]\!](j,k)$ belongs. $\square$

Lemma 6. *For all set terms c, $[\![c]\!] = \{j : c(j) \in \Gamma\}$.*

Proof. By induction on c, using the Henkin property in the step for set terms of the form $\exists(c,s)(j)$. $\square$

Lemma 7. $\mathcal{M} \models \Gamma$.

Proof. We check the sentence types in turn. Throughout the proof, we shall use Lemma 6 without mention.

First, let Γ contain the sentence $\forall(c,d)$. Let $j \in [\![c]\!]$, so that $c(j) \in \Gamma$. We have $d(j) \in \Gamma$ using $(\forall E)$. This for all j shows that $\mathcal{M} \models \forall(c,d)$.

Second, let $\exists(c,d) \in \Gamma$. By the Henkin condition, let j be such that both $c(j)$ and $d(j)$ belong to Γ. This element j shows that $[\![c]\!] \cap [\![d]\!] \neq \emptyset$. That is, $\mathcal{M} \models \exists(c,d)$.

Continuing, consider a sentence $c(j) \in \Gamma$. Then $j \in [\![c]\!]$, so that $\mathcal{M} \models c(j)$.

Finally, the case of sentences $r(j,k) \in \Gamma$ is immediate from the structure of the model. $\square$

Theorem 8. *If $\Gamma \models \varphi$, then $\Gamma \vdash \varphi$.*

Proof. We rehearse the standard argument. Due to the classical negation, we need only show that consistent sets Γ are satisfiable. Let $\mathcal{L}$ be the language of Γ, Let $\mathcal{L}' \supseteq \mathcal{L}$ be an extension of $\mathcal{L}$, and let $\Gamma^* \supseteq \Gamma$ be a maximal consistent theory in $\mathcal{L}'$ with the Henkin property (see Lemma 4). Consider the canonical model $\mathcal{M}(\Gamma^*)$ as defined in this section. By Lemma 7, $\mathcal{M}(\Gamma^*) \models \Gamma^*$. Thus Γ^* is satisfiable, and hence so is Γ. $\square$

1.7 The finite model property

Let Γ be a consistent finite theory in some language $\mathcal{L}$. As we now know, Γ has a model. Specifically, we have seen that there is some $\Gamma^* \supseteq \Gamma$ which is a maximal consistent theory with the Henkin property in an extended language $\mathcal{L}^* \supseteq \mathcal{L}$. Then we may take the set of constant symbols of $\mathcal{L}^*$ to be the carrier of a model of Γ^*, hence of Γ. The model obtained in this way is infinite. It is of interest to build a finite model, so in this section Γ must be finite. The easiest way to see that Γ has a finite model is to recall that our overall language is a sub-language of the two variable fragment FO^2 of first-order logic. And FO^2 has the finite model property by Mortimer's Theorem [5].

However, it is possible to give a direct argument for the finite model property, along the lines of filtration in modal logic (but with some differences). We shall not go into the details on this, since they are essentially the same as in [6].

Theorem 9 (Finite Model Property)**.** *If Γ is consistent, then Γ has a model of size at most 2^{2n}, where n is the number of set terms in Γ.*

Conclusion

This paper has provided a logical system, defined in terms of a semantics, and then presented a proof system in the format of natural deduction, and finally proved the completeness theorem and the finite model property. The semantics of the language allows us to translate some natural language sentences into the languages faithfully. This particular fragment goes beyond other work in the area of natural logic in the sense of being complete and decidable, and also having the capability to represent inference. It is possible to go even further, and future papers will take this up.

Here is a bit more on this history of this topic. Set terms originate in McAllester and Givan [4], where they are called *class terms*. That paper was probably the first to present an infinite fragment relevant to natural language and to study its logical complexity. The language of [4] did not have negation, and the paper shows that satisfiability problem is NP-complete. The language of [4] is included in the language $\mathcal{R}^*$ of Pratt-Hartmann and Moss [7]; the difference is that $\mathcal{R}^*$ has "a small amount" of negation. Yet more negation is found in the language $\mathcal{R}^{*\dagger}$ of [7]. This fragment has binary and unary atoms and negation. It is fairly close to being a sublanguage of the language $\mathcal{L}$ of this paper, but there are two small differences. First, here we have added constant symbols. In addition to making the system more expressive, the reason for adding constants is in order to present the Henkin-style completeness proof in Sections 1.5. A second difference is that $\mathcal{R}^{*\dagger}$ does not allow recursively defined set terms, only "flat" terms. However, from the point of view of decidability and complexity, this change is really minor: one may add new symbols to flatten a sentence, at the small cost of adding new sentences. Finally, $\mathcal{R}^{*\dagger}$ lacks the conjunction and negation operations that this paper has. The first paper to tackle the fragment in this paper was Ivanov and Vakarelov [2].

The proof systems in [7] are syllogistic; there are no variables or what we have in this paper called general sentences. The proof systems in [2] also do not have variables, but there is a sense in which the syntax of that fragment is farther from natural language than ours. For example, the subject wide-scope reading of *Every man likes some animal* in their system is rendered as

$$\forall\exists(\mathsf{man},\mathsf{animal})[\mathsf{likes}]$$

in their system and

$$\forall(\mathsf{man},\exists(\mathsf{animal},\mathsf{likes}))$$

in ours.

The use of natural deduction proofs in connection with natural language is very old, going back to Fitch [1]. Fitch's paper does not deal with a formalized fragment, and so it is not possible to even ask about questions like completeness and decidability. Also, the phenomena of interest in the paper went beyond what we covered here. We would like to think that the methods of this paper could eventually revive interest in Fitch's proposal by giving it a foundation. For that matter, one could look open a classic like *Boolean Semantics for Natural Language* and aim for a perspicuous proof theory to match its sophisticated semantics.

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Affliation

Lawrence S. Moss
Department of Mathematics
Indiana University
lsm@cs.indiana.edu

Interrogative Verbs in Takic[1]

Pamela Munro

Introduction

A Google Scholar search for "interrogative verbs" brings up mostly references to verbs of asking, verbs with interrogative affixes, or verbs used in questions. A number of languages, however, have special verbs that include a semantic *wh* element in addition to their more typical question words. Verbs like this have not been extensively described, although Hagège (2003, 2008) suggests they are more common than most linguists realize: "Interrogative verbs," he writes, "can teach us many interesting things about certain relatively hidden, or unheeded, properties of language" (2008: 38). Hagège's broad survey turned up 28 languages with verbs of this type, including four from different North American indigenous language families. In this paper I'll consider interrogative verbs in four languages from the Takic subfamily of Uto-Aztecan (all from Southern California), which is unrelated to the languages surveyed by Hagège.

I begin by explaining (in section 1) what interrogative verbs are (and are not), using non-Takic examples, and then I'll describe the interrogative verbs in the Cupan and Gabrielino/Tongva/Fernandeño branches of Takic (in section 2). In section 3 I consider briefly some of the typological and theoretical implications of such verbs .

1 What is an interrogative verb?

An interrogative verb is a verb that includes a semantic *wh* element and is used in *wh* questions. Thus, a verb of asking (1), an ordinary verb used in a *wh* question (2), or a verb with an interrogative affix such as the Chickasaw *-taa* suffix that appears in (3) is not an interrogative verb (as I will use the term).[2] (Chickasaw, a Muskogean language of Oklahoma,[3] is related to Creek, one of Hagège's example languages.)

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[1] I am grateful to audiences at the UCLA American Indian Seminar, the Friends of Uto-Aztecan conference, and LASSO for input on earlier versions of this paper. Heidi Harley and Marcus Smith made especially helpful comments.

This paper is dedicated to Edward Keenan in celebration of 38 years of typological solidarity and fun.

[2] Abbreviations used in the examples include abs : absolutive, acc : accusative, cl : verb class, conj : conjuntion, cop : copula, def : definite, dur : durative, fut : future, inc : incomplete, ind : indefinite, int : interrogative, mod : modal, neg : negative, nom : nominative, nzr : nominalizer, obj : object, pist : present imperfective singular, poss : possessive, pro : pronoun, prs : present singular, pssd : possessed, pt : past/perfective, Q : question, subj : subject, wh : wh interrogative element. 1, 2, 3, s, and p indicate person and number features; I, II, and III are pronominal agreement classes in Chickasaw. Many examples illustrate various phonological alternations that I cannot comment on here. I use approximately the same glosses as in the sources cited (a few very small changed were made for consistency), except as indicated.

[3] As always, of course, I am extremely grateful to my Chickasaw teacher Catherine Willmond and to the

(1) I asked him who he was.

(2) Who saw him?

(3) Malli-taa-m?
jump-Q-pt 'Did he jump?' (Chickasaw)

Rather, an interrogative verb is one like Chickasaw *katihmi* 'to do what', as in (4), vs. the corresponding non-interrogative verb *yahmi* 'to do' (5). (In the remainder of this paper I box the interrogative verbs.)

(4) a. Ish-$\boxed{\text{katihm}}$-a'chi?
2sI-do.what-inc 'What are you going to do?' (Chickasaw)

b. Hattak-at $\boxed{\text{katihm}}$-a'chi?
person-nom do.what-inc 'What is the man going to do?'

(5) a. Ish-yahm-a'chi.
2sI-do-inc 'You're going to do it' (Chickasaw)

b. Hattak-at yahm-a'chi.
person-nom do-inc 'The man is going to do it'

As I show below, interrogative verbs often have indefinite uses, or are closely related to verbs with indefinite uses, just as in many languages *wh* words of other categories may be used as indefinites, or are closely related to indefinites.

2 Uto-Aztecan (Takic): Cupan and Tongva

Within the Takic sub-branch of Uto-Aztecan, the Cupan languages (Luiseño, Cahuilla, and Cupeño) and Gabrielino/Tongva/Fernandeño (henceforth Tongva) have interrogative verbs.[4] All these languages, which are or were formerly spoken in Southern California, either have no current speakers or are very critically endangered.[5]

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other speakers who have taught me so much about their language.

[4] Subclassification within Takic is controversial. Conservatively speaking, there are three subbranches of Takic — Cupan, Serrano-Kitanemuk, and Gabrielino/Tongva/Fernandeño — but proposals have been make to group Tongva with each of the other two.

[5] I thank the late Katherine Siva Sauvel for the Cahuilla examples cited without other attribution.

My principal source of information on Tongva is the field notes of J. P. Harrington, reporting his work (unfortunately not extensive enough!) with several speakers in the early decades of the last century. Many people have assisted me in gaining access to and understanding this material, including especially Geraldine Anderson, the late William Bright, Kenneth Hill, and Martha Macri. My colleagues on the Gabrielino/Tongva language committee, especially Jacob Gutierrez, Virginia Carmelo, and the late Carol Ramirez, have provided continued encouragement and inspiration.

Other sources are cited in the text. Unfortunately I have no data on interrogative verbs in the fourth Cupan language, Juaneño/Acjachemem (which is very similar to Luiseño).

2.1 Cupan interrogative verbs

Cupan interrogative verbs were first noted (I believe) by Jacobs (1975: 121f), who presents a succinct description of verbs meaning variously 'be how'/'have what happen'/'for what to happen'/'do what', as illustrated by Cupeño (6):

(6) nə'ə=n m-iya-qa ?
1s.pro=1s ind-cop-dur.prs
'What happened to me?' (Cupeño)
(Jacobs 1975: 121 (2) and 160 (40), slightly adapted)

Jacobs analyzes the verb in (6) as including an indefinite prefix *m-* on a copular verb *iya*, which can mean 'say', 'do', or 'be', as well as 'happen'. Note that there is no word for 'what' in this sentence: the verb alone conveys the interrogative meaning.

As Jacobs notes, verbs like Cupeño *miyax* also have indefinite uses, as in (7):[6]

(7) Ne'=en tum mi-ya-qa pe-ya-qa.
1s.pro=1s.abs truly ind-do-prs def-do-prs
'I'm doing everything [i.e., truly something] as best I can' (Cupeño)
(Hill 2005: 285)

The second verb I'll illustrate here is *hiyax* 'say (what/something/...)', which has a different prefix (most likely connected with the independent question word 'what') on the *yax* root. My examples below are from Cahuilla. (8) contrasts an interrogative with prefixed *hi-yax* (a) with a non-interrogative sentence with an unprefixed verb (b):

(8) a. 'e-hí-ya-qa-'?
2s-wh-say-dur-past 'What did you say?' (Mountain Cahuilla)

b. "Míyaxwe," ya-qa-'.
hello say-dur-past 'He said, "Hello."'

The same Cahuilla verb as in (8) is used interrogatively in the first part of (9) and indefinitely in the second part (which also contains another indefinite use of the *míyax* 'be' verb).

(9) pen ne-hí-ya-ne kil~ ne-h-éx-ap mí-yax-we.
conj 1s-ind-say-fut neg 1s-ind-say-mod ind-be-dur
'Well, then, what shall I say? There's nothing for me to say' (Desert Cahuilla)
(Seiler and Hioki 1979: 58)[7]

[6] Jacobs also suggests that such verbs may also have apparent non-interrogative, non-indefinite uses (1975: 122), as in

Me ne' aya awelve ne-miyax-wen.[6]
and 1s.pro then grown 1s-be-pist
'And I was grown up then' (Hill 2005: 284) (Cupeño)

(It seems likely that this actually means something like 'And I was somehow, namely grown up, then'.)

Jacobs and Hill disagree somewhat about the analysis of the Cupeño verb *miyax*, but I think both would agree that this disagreement is primarily related to their differing historical viewpoints: Jacobs always glosses the root *yax* as 'cop', while Hill's glosses relate more to the form's uses in the sentences at hand.

As far as I know, however, the 'say' verb *hiyax* has no non-indefinite, non-interrogative uses in Cupan (Jacobs does not discuss this verb) — I have seen none in Cahuilla, and while Hill (2005: 286) and Elliot (1999: 337) both suggest there may be such uses in Cupeño and Luiseño, in fact all the examples they cite are susceptible of an indefinite 'say something' interpretation (the evidence against this would be an explicit object, like the 'hello' in (8)(b)).

One apparent difference between Luiseño and the other two Cupan languages is that it appears that in Cahuilla and Cupeño the indefinite use of *hiyax* is only negative, as illustrated for Cahuilla in the second half of (9) and noted explicitly by Seiler and Hioki (1979: 57). Hill does not mention any such Cupeño restriction, but her three non-interrogative examples are all negative (2005: 286). However, Elliot gives many non-negative non-interrogative examples of the Luiseño verb he cites as *híx*, such as

(10)	Pá'$upku	wám'	pó'	hísh	más	'ayá'yich-i	hí-yx-uk.
	and.so	already	3s.pro	what.acc	more	funny-acc	ind-say-dur

'And so then someone would say something funny' (Luiseño)
(Elliot 1999: 338, adapted)

A full list of Cupan indefinite/interrogative verbs and related cognate elements is given in Table 1. Cupeño words in the table are from Hill (2005), who presents by far the most careful discussion of these words; most Cahuilla words are from Seiler and Hioki (1979), and most Luiseño words are from Elliot (1999).

• The group of words before the first heavy line in the table are basic verbs, all of which are documented as interrogative verbs except the last set, whose meaning seems similar enough that they should be considered along with the other verbs.[8]

• The group of verbs before the second heavy line includes causatives of verbs in the first group.

• The third group of words are lexicalized same-subject subordinate derivatives of verbs in the second group, meaning variously 'how', 'thus', and 'that way'.

• The fourth and final set of cognates are words meaning 'hello' (as in (8)(b)), all presumably derived from 'how are (you)', 'how is (it)', or perhaps 'what's happening?'.

Some of the definitions of verbs in the table may appear not to support my claimed indefinite/interrogative use; I base this classification on the cited examples in each source. I have not exemplified here the third and fourth basic verbs in the table. The third verb, *'iyax*, is explicitly discussed in as a member of this group by Jacobs and Hill. The fourth, *'ayax*, seems to be comparable in its indefinite meaning, but appears to have no interrogative uses. However, it is clearly the source of some of the later Luiseño words in the table.

[7] I replace Seiler and Hioki's l-tilde with a sequence. The gloss here is mine.

[8] I have conflated verbs containing *–y-* with those that don't, despite Hill's discussion of the paradigmatic differences between these groups; I acknowledge that this may be a mistake.

Cupeño (Hill 2005)	Cahuilla (Seiler and Hioki 1979)	Luiseño (Elliot 1999)
miyax 'be, happen' (283); *mix* 'do to', 'be like', 'happen' (288) [9]	*-míyax-* 'act, happen', 'exist' (111), *-méx-* 'do something, behave', happen' (108)	*miyx / miy* 'be', 'exist', happen' (etc.) (531-33) [10]
hiyax 'say a certain way' (283); *hix* 'say' (289)	*-híyax-* 'say what', 'say nothing' (57-58)	*hix / hiy* 'say something', 'be how' (337-39)
iyax 'be a certain way' (283); *ix* 'do like' (290)	*-ʔíyax-* 'be that way' (67-68), *-ʔéx-* 'behave in that way' (43)	*'íyx / 'íy* 'be', 'be also', 'happen', 'be what' (198-200)
	-ʔáyax- 'be alike', 'seem like' (19-20)	*'áax* 'be like, seem like' (101-02)
mix-a(a)n 'do', do to' (291)	*-méx-an-* 'do', 'do to' (108)	*míyxan* 'make somehow, make how', 'do something' (533)
ix-an 'do to', 'do like' (292)	*-ʔéx-an-* 'do like that', 'do to' (43)	*'ixáni* 'do this way' (archaic song word) (196)
		'áxani 'do likewise' / *'áxana* 'be likewise' (152-53)
mixanuk 'how' (289), *ixanuk* 'thus' (290)	*méxanuk* '[not] by any means', 'how'	*michaxáninuk* 'somehow, how' (Bright 1968: 23)
		'axáninik 'like, that way' (153-55)
miyaxwe 'hello' (372)	*míyaxwe* 'hello' (Sauvel and Munro 1980: 296)	*míiyu* 'hello' (521-22)

Table 1: Cupan Interrogative Verbs

There's a final syntactic point to demonstrate about the Cupan '... what' verbs, which actually have two separate uses. As (11) shows, these verbs may apparently be used either intransitively, with no object (a), or transitively, with an explicit 'what/something' object (b):

(11) a. Hem-hí-yax-we?
3p-ind-say-dur 'What are they saying?' (Mountain Cahuilla)

b. Hich'a-y hem-hí-yax-we?
what-acc 3p-ind-say-dur 'What are they saying?'

[9] Hill notes: "A curious fact about the *mix, hix, ix* series is that, while they are stressed stems, they exhibit vocalic augments before ablauting suffixes. Thus they are in a intermediate category between the fully stressed stems, which do not have vocalic augments in ablauting contexts, and the stressless roots, which shift stress to prefixes and suffixes in contexts" (288); "The answer here probably lies in the fact that the prefixes *mi-, hi-, i-* fix the stress; unprefixed *yax*, the probable root, is stressless when it is not prefixed." (293) (Cupan stressless roots are discussed by Hill and Hill 1968.)

[10] Elliot gives a number of additional non-question, non-indefinite translations (most unusually perhaps 'carry on', presumably in the sense of 'make a fuss'), but his examples suggest there is probably always an indefinite present semantically in non-questions.

Each language has examples of both of these uses of the basic verbs in the table.

(However, does (11)(b) actually represent a transitive use of *híyax* ? Cahuilla verbs with a third-person singular object and a third-person plural subject, like (11)(b), normally have a *pe-m-* prefix rather than the *hem-* prefix in (11)(b), with the *pe-* morpheme showing agreement with the third-person singular object (Sauvel and Munro 1981). So possibly the 'what' here is a non-argument complement (cf. Munro 1982 for ideas along this line concerning complements of 'say').)

2.2 *Tongva interrogative verbs*

Available documentation of the Takic language Gabrielino/Tongva/Fernandeño (Tongva), which has had no native speakers for over 50 years, reveals a question verb *miyii* 'say what?'[11] that can be used with or without a complement 'what?'.

(12) Miyii=ha'?
say.what=Q 'What does he say?' (Tongva)

(13) Hitaa='a miyii 'ooma'?
what=2s say.what you 'What do you say?'

The verbal status of this word is confirmed by its use in (14) with the future suffix *-ro*, which occurs only on verbs:

(14) Miyii-ro='a maay-ro?
say.what-fut=2s do-fut
'What are you going to do?'
(i.e. 'What do you say you are going to do?') (Tongva)

Unlike the 'say (what)?' verbs in Cupan, however, Tongva *miyii* does not seem to be analyzable: the usual verb for 'say' is *chwee'-* . (The language also has a 'thus' quotative construction.)

The simple question words 'who?', 'what?', and 'how much?' are also (more or less) unanalyzable in Tongva, but various forms of 'where?' as well as 'when?' and one 'how?'/'why?' word all share the same root (*hamii-*), which probably is composed of *=ha'*, the question clitic seen in (12) (Munro 2000), plus the same root in *miyii*. In addition to what appears to be its basic 'say what?' meaning, *miyii* also is used to mean 'say how?' and, apparently, 'be how?'. While example (14) shows that *miyii* clearly has verbal status, examples like (15) suggest that *miyii*, with or without the question clitic *=ha'*, is also used to mean simply 'how?', as in

(15) Miyii=ha' xaa 'a-maa-n?
how/say.what=Q be 3s.poss-hand-pssd
'How is his hand?' (Tongva)

[11] Most Tongva verbs have one of four class endings, *-k, -ax, -nok,* or *–nax*. *Miyii* does not, but there are other groups of irregular Tongva verbs that work similarly (including 'be', 'go', 'come', and other cognates to the Cupeño stressless roots (Hill and Hill 1968)).

(16) Miyii=h=ra' mokáa-nax?
how/say.what=Q=2s.subj>3s.obj kill-cl
'How did you kill him?' (Tongva)

By itself, the word *miyii=ha'* was also used as a greeting, just like the cognate 'hello' words in Cupan (Table 1, last line). So a sentence like (12) could also mean 'Hi!' (or 'Say what?').

However, the Tongva verb *miyii* means (according to the documentation) only 'say what'. There is no evidence that this verb can have the wider meanings of the apparently cognate verbs in Cupan (Table 1) that mean 'be what', 'do what', or 'happen'.

I also have no evidence of indefinite uses of Tongva *miyii*, but I would guess this may just be a gap in the data. Indefinite uses are documented for other Tongva *wh* words, such as *hitaa* 'what'.

2.3 Interrogative verbs elsewhere in Uto-Aztecan

There seems to be no evidence of interrogative verbs in the third subgroup of Takic, Serrano-Kitanemuk (Marcus Smith, p.c.),[12] nor have I seen any elsewhere in Uto-Aztecan.[13]

Perhaps, then, this Cupan-Tongva feature may be a syntactic borrowing from the neighboring Yuman family (all languages of which have interrogative and indefinite verbs), which have influenced Takic in other ways as well.[14]

3 The typology of interrogative verbs

3.1 Hagège's survey

Hagège (2008) presents the results of a survey of 217 languages, 28 of which, he finds, have interrogative verbs. (One of these, Creek, is a Muskogean language related to Chickasaw; another, Jamul Tiipay, is a Yuman language (cf. section 2.3); Hagège does not consider any Uto-Aztecan languages.) A number of his general observations are borne out by the data we have seen here.

We have seen examples of most of the frequent meanings Hagège cites, including especially 'do what', 'say what', and 'do how', as well as 'be what'.

Hagège reports that interrogative verbs are often used in "serial structures" or, alternatively, as "secondary predicates" (10ff). None of the languages considered here uses prototypical serialization (though possibly structures like Tongva (14) come close), but the Cupan examples show interrogative verbs in subordinate or coordinate structures. Oddly, though, all the examples of such constructions Hagège presents express the non-argument interrogatives 'how' and 'why' rather than 'what'.

Hagège also mentions that, just as non-verbal interrogatives may have a syntactic or morphological relationship with indefinites, this may be true of verbs as well, and this too

[12] Smith suggests that some complex expressions that look similar to the interrogative verbs in Cupan and Tongva have indefinite uses.

[13] I mentioned this in my presentation to the Friends of Uto-Aztecan meeting in 2008 and was not contradicted.

[14] As one example, the Cupan languages Cupeño and Cahuilla are believed to have developed their palatal *l* phoneme under the influence of Yuman.

is true of the Cupan interrogative verbs at least (I don't have specific evidence of this in Tongva, but since it's true of Cupan this is probably just a gap in the data).

I've extensively studied two other languages with interrogative verbs , the Muskogean language Chickasaw (exemplified in section 1) and the Yuman language Tolkapaya Yavapai.[15] Table 2 below presents a comparison of various features Hagège notes in the interrogative verbs of Takic and these two additional languages, showing that the features of the Takic verbs are quite similar to those of other interrogative verbs.

	Takic	*Chickasaw*	*Tolkapaya*
behave both as verbs and as question words	√	√	√
occur in sentences which normally do not contain a polar question marker	√ (may co-occur)	√	√
should not be confused with verbs inflected for interrogative mood	√	√	√
are distinct from predicatively used interrogative words	√	√	√
are morphologically and semantically related to indefinites	√	√	√
in general are synchronically unanalyzable	partly	partly	no
have core meanings that form part of the most fundamental contents in linguistic communication	√	√	√

Table 2: Some Features of Interrogative Verbs (after Hagège 2008)

3.2 *Interrogative verbs and syntactic theory*[16]

As Hagège (2008: 2) observes, theoreticians such as Donegan and Stampe (1983: 339) have denied that it's possible to for a verb to include an interrogative feature: "for any operator there exists an interrogative word, so that it can be questioned vis-à-vis the operand, but there are no operand-interrogatives".[17]

3.2.1 *Are interrogative verbs really just indefinite verbs?*

One approach to the problem of analyzing interrogative verbs was suggested by Heidi Harley (p.c.): perhaps a question like 'What did John do?' (or 'What did John eat?') should be seen as a yes-no question containing an indefinite, like 'Did John do something? ('Did John eat something?), so that we could view fuller responses than just 'Yes' and 'No' as Gricean cooperation ('(Yes), he sang'; '(Yes), beans').

I'll consider arguments against this interesting proposal for Chickasaw (since I have most data on this language).

If *wh* questions clearly contrasted intonationally with yes-no questions, that would be a powerful argument. Unfortunately, for Chickasaw, there seems to be no difference in intonation (Matthew Gordon 1999, 2005, p.c.). So potential intonational differences

[15] I thank the late Molly Star Fasthorse for my understanding of the Tolkapaya data.
[16] Thanks to Marcus Smith for discussion of some of the issues in this section.
[17] Donegan and Stampe explicitly deny the possibility of questions like "*WH-Verb he a book?' (339), noting "This seems to be a novel observation, but Aristotle anticipated it in using interrogative phrases to define his categories, which were to figure centrally in medieval syntactic theory" (351).

provide no argument here.

But consider question pairs like the following:

(17)	John-at	(nanta-hta̲)	kati̲h-tok?	(Chickasaw)
	John-nom	(what-int.acc)	do.what-pt	
	'What did John do?'			

(18)	John-at	nanna-hma̲	kani̲h-taa-m?
	John-nom	something-ind.acc	do.ind-Q-pt
	'Did John do something?'		

Crucially, the questions are different in a number of ways. In Chickasaw, indefinites like *nanna* 'something' include a medial *–n-*, while interrogatives like *nanta* 'what?' include *–t-*. (Although other languages considered here don't make a similar distinction, many require a special the presence of a special indefinite morpheme, such as Tolkapaya *'móo*, to give the indefinite meaning. Alternatively there may be an interrogative morpheme, like Luiseño *$u*, whose presence or absence differentiates minimal sentence pairs comparable to (17)-(18).)

Another difference involves the "polar question marker" *–taa* (seen in (18)). Usually Chickasaw *wh* interrogatives use normal tense/aspect marking, like the past/perfective *-tok* in (17).

The object 'something' apparently can't be omitted in (18), although as seen above the object 'what' can be omitted in (17).

Finally, responses to these questions are different. In Chickasaw, *i̲i̲* 'yes' and *ki'yo* 'no' are always among the acceptable responses to yes-no questions like (18). In contrast, these are never acceptable responses to *wh* questions like (17).

(This argument is language-specific, but quite suggestive. Unfortunately the demographic state of the Takic languages makes it unlikely that we will ever know exactly how Harley's suggestion would play out for them.)

3.2.2 Do interrogative verbs derive their meaning via synchronic incorporation?

Another approach might be to view interrogative verbs as having incorporated a nominal *wh* word (an "operator") onto a pro-verb. In the case of the Cupan verbs for 'say what' (e.g., *híyax*, with *yáx* 'say' and a standard Takic 'what' like *hí-sh*), this seems highly plausible, but it's harder to argue in other cases without resorting to abstraction.

The other Takic interrogative verbs, including Tongva 'say what', don't seem connected with words for 'what'.

In the Chickasaw and Tolkapaya interrogative verbs I've documented, only Chickasaw 'say what' seems easily susceptible of such a componential analysis. The most basic Chickasaw interrogative verb, *katihmi* ((4), (17)), could be connected with *yahmi* 'do' (as in (5)) (in which *ya-* is most likely a demonstrative element) — but the *kat(i)* element at the beginning of *katihmi* looks more like *kata* 'who' than like *nanta* 'what', and the same element occurs in all the other Chickasaw *wh* verbs, even, for example, *kattohmi* 'be how many'.

3.2.3 Interrogative verbs and wh *movement*

Chickasaw and Tolkapaya are SOV languages that do not have obligatory overt *wh* movement: examples like (17) illustrate *wh* words in situ. In contrast, non-verbal question words in the Takic languages normally appear initially, as in other Uto-Aztecan languages, which generally have very flexible word order. But this does not seem to be true of the Takic interrogative verbs. The only Takic interrogative verb question clause with more than one word cited here, Cupeño example (6), does not begin with its interrogative verb, suggesting that *wh* movement may work differently with interrogative verbs than with non-verbal question words.

Again, we may not be able to develop rigorous arguments about the interrogative verbs and *wh* movement with regard to Takic because of the demographics of these languages, but the data considered here reinforce the idea that interrogative verbs are clearly of great interest typologically.

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Affiliation

Pamela Munro
Department of Linguistics
UCLA
munro@ucla.edu

Notes on class operators: *And the like, or the like, etc.*

Seungho Nam

1 Class constructions and class operators

Natural language has various ways of denoting plural entities – sets, sums, and groups. A simple plural morphology like English *-s* (as in *cat-s*) is a stereotype of plural marking, and some languages employ a bit more extended morphology like reduplicative plurals in Samoan and Salish. But many do not have a special morpheme for plurality, so common nouns in Korean and Japanese may denote either a singular or a plural reading depending on the context. Overt quantifiers or determiners often render the whole DP as denoting a plural entity, whereas some common nouns are inherently plural, i.e., *committee*, *team*, and *family* denote a group of people. Another way to denote a plural entity is to coordinate NPs/DPs, so *Marge and Homer* may denote a couple or a set of two individuals. Plural entities are sometimes denoted by a bare plural as in English. So *birds fly* means 'generically, normal birds fly' even though there might well be many exceptions.

The above plural constructions have all been treated as denoting a closed set, sum, or group, whose membership is determinate. But this article is concerned with some constructions which do not denote a determinate set or group but denote an open, non-determinate "class" of entities. For instance, the following sentences contain a sequence of words followed by *and/or the like*. These constructions do not determine a closed set or group with the enumerated exemplars, but they denote a plural entity like an 'open sum' of entities which covers the exemplars "and/or the like."

(1) a. We're also making ourselves available to the media for [*interviews and talk shows and the like*]. (AP)
b. … the popular science fantasy films such as [*Star Wars, Superman, and the like*]. (BNC)
c. Some plays may live on – in [*York or Wakefield or the like*]. (BNC)

Let us call such expressions "class/c-constructions," and they are claimed to denote a "class" – an open non-determinate plural entity. Thus a c-construction contains a sequence of exemplars and a special expression – *and/or the like* – which we dub "a class operator" or c-operator.

(2) Class constructions: [exemplars + C-operator]
Ex_1, Ex_2, … Ex_n, O_{CL}
Soccer, *basketball*, *baseball*, *and the like*

We will illustrate some other c-constructions in English, and we will focus on Korean counterparts of c-constructions. Korean has a special particle of class operator *tung* ('the like'), which corresponds to *and/or the like*, *and/or the others*; *etcetera*, *and so on/forth* in English. Thus for instance,

(3) Selnal-ey-nun *ttek.kwuk, songphen, yakkwa*
NewYearDay-on-Top rice cake.soup, stuffed rice cake, honey cookies
tung-ul mek-nun-ta
TUNG-Acc eat-Pres-Decl
'On the New Year's Day, We eat rice cake soup, stuffed rice cake, honey cookies and the like.'

This particle *tung* is not an independent noun, so it cannot stand in a subject or object position by itself. It can also take a sequence of verbal exemplars as well as nominals, thus we have:

(4) na-nun hywuil-ey *yenghwa-lul po-kena tungsan-ul ha-nun*
I-Top holiday-on movie-Acc see-or tracking-Acc do-Adn
tung yeka.hwaltong-ul culkinta
TUNG leisure.activity-Acc enjoy
'I enjoy leisure activities like going to see a movie or go tracking or the like on holidays.'

The following illustrates some more c-constructions in Korean, whose c-operator is either *ilen ke/ttawi* ('things like these') or *kulen ke/ttawi* ('things like those').

(5) Hankuk.salam.tul-un *chwukkwu-hako/-na yakwu, kuliko nongkwu*
Koreans-Top soccer-and/-or baseball, and basketball
ilen ke-lul cohaha-n-ta
these thing-Acc like-Decl
'Koreans like soccer, baseball, basketball and/or the like.'

2 Distribution of C-construction

2.1 C-constructions may have one or more exemplars, so a class operator can take a single exemplar to yield a class denotation. On the other hand, the list of exemplars can be extended as many as needed.

(6) i.wel imsi kwukhoy-eyse *kwukka.poan.pep tung*-ul
February temporary Assembly-at NSL TUNG-Acc
cheliha-l.yeceng.ita
process-schedule.BE
'The National Assembly meeting in Feb is scheduled to deal with *National Security Law and the like*.'

2.2 Exemplars can be given by simple enumeration, or conjunction, or disjunction. Thus, the class operators ignore the Boolean combinations of exemplars, so the following c-constructions denote the same 'class.'

(7) a. hankukin-un *chwukkwu, nongkwu, yakwu* tung-ul culkinta
Koreans-Top soccer basketball baseball TUNG-Acc enjoy
'Koreans enjoy soccer, basketball, baseball and the like.'
b. *chwukkwu-na, nongkwu-na, yakwu* tung-ul culkinta
soccer-or basketball-or baseball TUNG-Acc enjoy
c. *chwukkwu-wa, nongkwu-wa, yakwu* tung-ul culkinta
soccer-and basketball-and baseball TUNG-Acc enjoy
'Koreans enjoy soccer, basketball, baseball or/and the like.'

English c-operators exhibit the same behavior, thus we have *and the like*, and *or the like* interchangeable in the following c-constructions.

(8) a. the popular science fantasy films such as *Star Wars, Superman*, *and the like*. (BNC)
b. This is surprising in view of the time which people spend in *committees, task forces and the like*. (BNC)
c. Very few people could say when it is without consulting *a diary or the like*. (BNC)
d. Some plays may live on — in *York or Wakefield or the like*. (BNC)
e. There are no prohibitions against the formation of associations or societies for any lawful object — *religious, social, political, philanthropic*, *or the like*. (BNC)

2.3 C-constructions can take various types of exemplars, thus they might be entities, properties, or events as illustrated below:

(9) a. There are no prohibitions against the formation of associations or societies for any lawful object – *religious, social, political, philanthropic*, *or the like*. (BNC)
b. We're also doing radio and TV ads and making ourselves available to the media for *interviews and talk shows and the like*. (AP)
c. *Yuli.chang-ul kkay-kena mun-ul puswu-nun tung*-uy
glass.window-Acc break-or door-Acc destroy-Adnom TUNG-Gen
pangpep-ulo …
method-with
'by breaking a glass window or destroying a door, …'

3 Semantics of "class"

As mentioned earlier, a class denotes a plural entity, which can be determined by exemplars in the c-construction. Then we say the c-construction implies a characteristic property of the class, "class property" in short.

3.1 Unlike other plural entities – set, sum, group, kind – classes do not denote a total function but a partial function. Thus a 'class' is not a categorically closed but an open entity, and it might be extended by more exemplars. So the more exemplars there appear, the more deterministic the class property is. Thus (10a) below gives more restricted class property than (10b) does.

(10) a. *basketball*, *volleyball*, *soccer*, *baseball*, *beach volleyball*, *and the like.*
b. *basketball*, *volleyball*, *and the like.*

Further, the more homogeneous exemplars there are given, the more restricted the class property is. Thus (11a) denotes 'Eastern European countries' while (11b) 'European countries in general.' But the class property is heavily dependent on the utterance context.

(11) a. *Poland*, *Hungary*, *Slovakia*, *Romania*, *etc*.
b. *Poland*, *Romania*, *France*, *Germany*, *Spain*, etc.

3.2 Scope behaviors: C-constructions can be interpreted as a 'sorting key' of a distributive reading. So in (12) below the class of Asian cities may scope over the 'many K-pop stars'.

(12) manhun K-pop star.tul-i *Tokyo, Beijing, Taipei* tung-eyse kongyenha-ess-ta
many K-pop stars-Nom TUNG-Loc performed
'Many K-pop stars performed at Tokyo, Beijing, Taipei and so on.'

Thus the above sentence is ambiguous in scope readings. The following sentence is also ambiguous between the distributive and the collective reading.

(13) *England, France, Germany* tung (Europe sencin.kwuk.tul)-un
TUNG (Europe developed.countries)-Top
may-nyen IMF-ey 100-ek euro isang chulyenha-n-ta
each-year IMF-to more.than donate
'(Such developed countries as) England, France, and Germany donate to IMF more than 10 billion euros each year.'

A class denotation in a question should scope under the question operator, so the following sentence does not allow distributive/pair-list reading.

(14) Nwuka *Tokyo, Beijing, Taipei tung*-eyse kongyenha-ess-ni?
who TUNG-Loc performed?
'Who performed at Tokyo, Beijing, Taipei and so on?'

Without the c-operator *tung*, however, the sentence allows a distributive reading as well.

(15) *Tokyo-hako Beijing, kuliko Taipei*-eyse nwuka kongyenha-ess-ni?
T-and B and T -Loc who performed?
'Who performed at Tokyo, Beijing, Taipei?'

3.3 Scope relation between 'class' and negation: When the scope construction shows up in a negative sentence, class operator should take a wide scope over negation. Thus the following sentence only yields a distributive reading, and it does not derive a collective reading.

(16) *England-na*/*-wa, France, kuliko Germany tung*-un nam.kuk-ey yenkwuso-lul
-or/-and and TUNG-Top South.Pole-at institute-Acc

yel-kay isang sellipha-ci.anh-ass.ta
ten-CL more.than set.up-not-Past
'(Countries like) England, France, and Germany did not establish more than ten institutes at the South Pole.'

4 Concluding remarks

A class construction denotes a plural entity like an unorganized sum of individuals. The individual entities of a class do not form a nice lattice but a poorly organized plural. A class is highly unrestricted partial function, and its denotation is heavily dependent on the context. This fuzziness might be due to the speaker's intention or the lack of full information. We have introduced some features of 'class', but the fuzzy nature of its identity calls for further study.

Affiliation

Seungho Nam
Department of Linguistics
Seoul National University
nam@snu.ac.kr

Malagasy Phrasal Compounds*

A Syntactic Account

Dimitrios Ntelitheos

Introduction

In Malagasy, a linking particle *-n-* prototypically marks the possessee-possessor configuration, as in example (1), and also links postverbal external arguments to the verb in non-active voices, as well as most prepositions to their complements (Keenan and Polinsky 1998)[1].

1. lehibe [ny trano.n-dRabe]
   big DET house.LNK-Rabe
   'Rabe's house is big.'

The structure in (1) resembles a type of productive compounds in the language:

2. a. ambi.m-bava
   excess.LNK-mouth
   'a surplus of food'

   b. lamba.m-baravarana
   cloth.LNK-window/door
   'curtain'

   c. feo.n-kira
   sound.LNK-song
   'melody'

   d. trano.n-kala
   house.LNK-spider
   'spider-web'

The bracketed string in (1) and the strings in (2) exhibit the same prosodic properties in that they both carry a single main stress and are subject to the same type of morphophonological processes of consonant mutation and prenasalization (Keenan and Razafimamonjy 1996).

However, the two structures present a number of differences in their internal structure

* I would like to dedicate this paper to Ed Keenan. I will always be grateful to him for sharing with me his enthusiasm about Malagasy and for never tiring of explaining to me the finer points of the language (including teaching me a reading course based on a first grade reader!). Sometimes when pursuing different working hypotheses, one can get distracted and lose sight of what the data actual shows. Ed's numerous insightful comments during my dissertation work and my broader research on Malagasy morphosyntax helped me keep a constant eye on the data. This skill, I hope, will always stay with me. Misaotra betsaka anao!

A special thank you goes to Mamy Rasolofondrainibe for providing some of the data used in this paper.

[1] Abbreviations follow the Leipzig rules. The following conventions in abbreviating Malagasy-specific labels in the examples will be used: LNK linking particle –n-; V, verbalizing prefix; CT, circumstantial topic.

and semantic interpretation. While possessive structures are mostly interpreted compositionally, compounds often carry idiomatic readings. In addition, the strings in 2 exhibit lexical integrity effects in that they contain non-referential atoms and are islands for extraction. In addition, while the rightmost element can be modified by its own modifiers in a possessed DP, direct modification is not available for the corresponding element in a compound.

These properties of Malagasy linked compounds match compound properties crosslinguistically in their idiomatic semantics and lexical integrity effects. This seems to indicate that while possessive structures are formed in the syntax, compounds are derived through a morphological process. However, I argue here that both possessive structures and compounds in Malagasy are formed in the syntactic component and that their differences are the result of merging the linker at different heights in the syntactic structure. The proposed analysis relies on the assumption that referential properties are acquired in specified projections outside the domain of first merge (Sportiche 2005). Thus, in both possessive structures and compounds the derivation starts with the two nominals merging in bare form and with no referential properties. In possessive structures the possessor moves to a higher (in)definiteness projection where referential properties are fixed. No such movement occurs in compounds.

The proposed analysis limits the role morphology as a distinct combinatorial grammatical component. It assumes a unified analysis for the derivation of all compounds in the syntactic component via independently motivated syntactic processes. In addition it provides a straightforward analysis of gradient morphosyntactic properties: the degree of "lexicality" of a structure is directly related to the height of merger of specific functional morphology in the language.

The paper is organized as follows: In Section 2, I discuss briefly a number of structures in Malagasy that exhibit compound-like properties and lay down the properties of linking as a generalized mechanism of establishing a relation between two elements in the language. In Section 3, I provide a number of tests that distinguish between possessive structures and linking compounds in Malagasy. The discussion here relies heavily on Borer's (1988, 2009) tests for Hebrew construct state compounds. In Section 4, I provide a syntactic analysis that captures these differences in a principled manner, relying only on independently motivated syntactic mechanisms. The proposal explains the morphosyntactic as well as the phonological and semantic properties of the structures involved. Finally, in the last section I present my concluding remarks.

1 Generalized Incorporation and Compounds in Malagasy

Malagasy exhibits rich morphological structures that are often the output of synthetic processes, what Keenan and Polinsky (1998:617) term generalized incorporation. Thus, very often direct objects of transitive verbs incorporate into the verb (3.a), while less often adjectival modifiers incorporate into the nouns they modify (3.b):

3. a. [Manana vola] izy → manam-bola
   PRS.V.have money 3SG.NOM
   'He/She has money.'

   b. Tsy tia ity [satroka fotsy] ity aho → satro-potsy
   NEG like DEM hat white DEM 1SG.NOM

‘I don’t like this white hat.’

It is not clear whether these are cases of real ‘incorporation’ in the sense of Baker (1988) or a “looser” connection, although accumulated evidence seems to support the latter analysis (see Massam 2001; Paul 2004; Ntelitheos 2012). Better cases of real incorporation in the language involve “possessor-raising” constructions, discussed in detail in Keenan and Ralalaoherivony (2000), and synthetic compounds (Ntelitheos 2012).

In possessor-raising structures the possessor raises to the sentence-rightmost privileged position (the subject position in traditional accounts), while the sentence predicate forms a tight unit with the possessee (see Keenan & Ralalaoherivony 2000; Paul 2004).

4. Maty ny vadi.n-dRabe → Maty vady Rabe
died DET spouse.LNK-Rabe died spouse Rabe
‘Rabe's spouse died/is dead.’ ‘Rabe was widowed.’

A similar type of compound is formed in synthetic compounds composed by an incorporated verbal argument and the verbal base (see Ntelitheos 2007, 2012):

5. n.a.hita [f.an.ala.hidy] aho
PST.V.see NMLZ.V.remove.lock 1SG.NOM
‘I found a key. (Lit. instrument used to remove lock with)’

Less attention has been paid to more straightforward cases of compounding in the language. These include cases of N-N, N-Adj and Adj-N compounds (examples from Malzac, 1960:26):

6. a. rano.mainty
water.black
‘ink’

b. rano.maso
water.eye
‘tears’

c. tani.ravo
earth.happy
‘white earth’ (used for whitewash)

Malagasy compounds are left-headed and so N-Adj compounds (6.a-6.c) are nouns, while N-N compounds’ meaning (as in (6.b)), is determined by the leftmost nominal:

7. a. loha trano
head house
‘rafters in the roof of a house’

c. afo.kasika
fire.rubbing
‘matches’

b. ady hevitra

d. ar.omby

fight thought	protection.ox
‘discussion, dispute’	‘fence’

The meaning of N-N compounds is not always compositional, as the examples in (7) illustrate. Thus, in (7.a), *loha trano* does not mean ‘the head of the house’ but rather the series of timbers or bamboo with pronounced slope, supporting the sheathing and covering of the roof of the house. Similarly, in (7.d), *aromby* does not mean ‘protection from ox’ but rather ‘fence’.

Compound formation in Malagasy is subject to the same set of morphophonological properties that govern other word-level processes such as affixation and reduplication (Keenan and Razafimamonjy 1996; Paul 1996; Keenan 1995; Keenan and Polinsky 1998). That is, compounding involves concatenation of roots with stress reduction on the leftmost root and additional phonological changes such as consonant mutation and prenasalization, affecting the initial consonantal segments of the rightmost root.

Apart from these types of N-N compounds, Malagasy allows for an additional type of N-N compounds that are connected with the generalized linking mechanisms that involves the linker/ligature *-n-* (see Keenan and Razafimamonjy 1996; Paul 1996; Keenan and Polinsky 1998; Ntelitheos 2006, 2012). In Malagasy, the linker *-n-* marks environments that include possessors (8.a), objects of most prepositions (8.b), internal agents of non-active verbs (8.c)[2], and arguments of some adjectives and nouns:

8.	a.	lehibe	ny	trano.n-dRabe		
		big	DET	house.LNK-Rabe		
		‘Rabe’s house is big.’				
	b.	n.an.apaka	mofo	t.ami.n’ ny	antsy	Rabe
		PST.V.cut	bread	PST.with.LNK’DET	knife	Rabe
		‘Rabe cut bread with the knife.’				
	c.	n.an.orat.an-dRabe	ilay	penisily	vaovao	
		PST.V.write.CT/LNK-Rabe	DEM	pencil	new	
		‘This new pencil, Rabe wrote (with it).’				

I will focus here on the properties of the possessive structure in 8.a, but given that linking in Malagasy is a general mechanism of marking predicate-argument relations, the discussion extends to all other cases of linking with only minimal exceptions (see Ntelitheos 2006, 2012 for discussion). The word order of the linked string is fixed (c.f. (9)), and the string forms a tight morphosyntactic unit in that nothing can intervene between the possessee and the possessor (10.b):

9.	*	lehibe	ny	Rabe.n’trano
		big	DET	Rabe.LNK-house

[2] I have chosen to gloss the nasal in the Circumstantial Trigger (CT) form of the verb in (8.c) as the linker, although it is arguably part of the CT affix *an-*. Geminate consonants are not possible in Malagasy and thus one of the two nasals in the sequence CT.LNK is deleted. I chose to gloss the remaining nasal as the linker to facilitate the discussion.

‘Rabe’s house is big.’

10.	a.	ny	sakaiza.n-dRabe	faly …
		DET	companion.LNK- Rabe	happy …
		‘Rabe’s happy companion…’		

	b. *	ny	sakaiza	fali.n-dRabe
		DET	companion	happy.LNK-Rabe
		‘Rabe’s happy companion…’		

In (10.a), a modifying adjective follows the string possessee-possessor. Adjectival modification by one or more adjectives of a possessed nominal is somewhat unnatural in Malagasy but speakers do accept them as possible in the language and they are attested in Malagasy texts. However, in most cases the adjective is not allowed to appear between the possessor and the possessee (10.b). There are a few exceptions to this empirical generalization. As Keenan (1995) notes, a number of adjectival modifiers, that Keenan (1995: 97) terms ‘inherent property denoting adjectives’, are able to appear between the noun and the possessor in linking structures:

11.	a.	trano.n-dRabe	vaovao
		house.LNK-Rabe	new
		‘Rabe’s new house’	

	b.	trano	vaovao.n-dRabe
		house	new.LNK-Rabe
		‘Rabe’s new house.’	

In terms of morphophonological properties the nominal possessee seems to be functioning like a bound morpheme and the linked possessor as a host forming a single prosodic unit. The “sub-lexical” properties of the string include phonological alterations at the boundary between predicate and subject. These processes are also attested in prefixation, reduplication and other morphological processes that are traditionally viewed as word-bound. A second property involves reduction of primary stress to secondary on the possessee, i.e. the string defines a single prosodic unit for purposes of stress assignment (12.a-12.b) (for a detailed discussion of these properties see Keenan and Razafimamonjy 1996; Paul 1996; Keenan 1995; Keenan and Polinsky 1998):

12.	a.	trano	Rabé	→	tràno.n’dRabé
		house	Rabe		house. LNK-Rabe
		‘Rabe’s house …’			

	b.	vóla	i	Vóa	→	vòla.n’i	Vóa
		money	DET	Voa		house.LNK’DET	Voa
		‘Voa’s money…’					

In (12.a) the initial [r] of the rightmost element, the possessor, changes to the affricate [dr]. This change is characteristic of word-level processes such as prefixation and reduplication and seems to indicate that the resulting string is a word. This is further supported by the stress pattern in (12.a-12.b). The primary stress of the possessee reduces to secondary stress allowing for a single main stress for the whole string, again indicating that the string forms a single prosodic domain behaving like a (phonological) word. Obviously, any analysis that deals with the mechanism deriving linking in Malagasy will have to account for these properties in an adequate way (see Ntelitheos (2006) for a phase-based analysis). In the following section we will examine a number of strings which at first glance seem to resemble possessive linking structures, but under closer scrutiny exhibit properties predominately associated with morphological derivations.

2 Linking Compounds

There are a number of strings formed with the use of the linking mechanism which we discussed in the previous section that exhibit compound-like properties. Some examples are provided in (13):

13. a. ambi.m-bava
excess.LNK-mouth
'a surplus of food'

b. doka.m-barotra
praise.LNK-trade
'advertising'

c. horohoro.n-tany
trembling.LNK-earth
'earthquake'

d. feo.n-kira
sound.LNK-song
'melody'

e. trano.n-kala
house.LNK-spider
'spider web'

f. amboa.keli.n.tenda
dog.small.LNK.throat
'tonsil'

g. antsi.m.panafody
knife.LNK.medicine
'scalpel'

h. atodi.n.tany
egg.LNK.earth
'edible root, tough mushroom'

i. ombalahi.n.tongotra
bull.LNK.foot
'heel'

j. maso.n.drano
eye.LNK.water
'the channel of a river'

In many ways the compounds of (13.a-13.j) look identical to the possessive structures of (8). Compare (14) and (15) below:

14. lehibe ny trano.n-dRabe
big DET house.LNK -Rabe
'Rabe's house is big.'

15. lehibe ny trano.n-kala
big DET house.LNK-spider
'The spider-web is big'

The two structures behave in exactly the same way for purposes of stress assignment.

There is only one main stress carried by the head of the rightmost element in the construction, as discussed in the previous section. In addition, the leftmost element of both the possessive and compound structures cannot be directly modified:

16. * ny trano.lehibe.n'd Rabe
det house.big.LNK' Rabe
'Rabe's big house.'

17. * ny trano.n-lehibe-kala
DET house. LNK-big-spider
'The big spider's web'

An exception seems to be cases of the type in (13.f), where an adjective appears inside the compound, modifying its leftmost head. However, these cases are extremely rare and must be listed (I have only managed to find one example in Richardson (1885)). In all cases no free modification with an adjective of choice is permitted.

Careful examination shows that even though the morphophonological shape of the two structures is the same, their morphosyntactic and semantic properties are different. Some extra-linguistic evidence from this comes from the choice of orthographic representation for these compounds: while many of them are written with a hyphen separating the possessee-linker form and the possessor (c.f.13.a-13.e), others are written as single words with no spaces or other spelling conventions, which seems to indicate that speakers conceive them as single units of some sort (i.e. *words* in traditional accounts). In addition to speakers' intuitions, the main body of evidence supporting the treatment of these strings as compounds comes from a number of morphosyntactic tests that have been proposed in the relevant literature on "genitive" or "construct state" compounds (Borer 1988, 2009).

In terms of semantics and in contrast to possessive structures, most of these compounds are not fully compositional and present idiomatic readings. In (13.e) for example, *tranon-kala* does not simply mean 'spider's house' but rather '(spider-)web'. Similarly, in (13.a) the meaning of the compound *ambim-bava* is not 'excess of mouth' but rather 'surplus of food or surplus of things in general' which can only be considered an idiomatic reading. And of course, there is no obvious straightforward connection between a foot's bull and a heel (13.i) or the small dog of a throat and a tonsil (13.f). On the other hand in most cases, possessed DPs are interpreted compositionally.

More support for treating the cases in (13) as compounds comes from a number of syntactic tests (the discussion here relies heavily on Borer's (1988, 2009) discussion of Modern Hebrew compounds). For example, the possessor can be modified by its own modifiers in a possessed DP (18.a). On the other hand, direct modification is not available for the rightmost element in a compound (18.b):

18. a. trano.n'olona mainty
house.LNK'person black
'black person' house'
'person's black house'

b. trano.n-kala mainty
house. LNK-spider black

‘black spider-web’
‘*[black spider]-web[3]’

Furthermore, as illustrated in (19.a) nested possessors are available with linking. Nesting is extremely marginal with compounds however:

19. a. trano.n’ ny rai.n-dRabe
house.LNK’ DET father.LNK-Rabe
‘Rabe’s father’s house’

b. *trano.n-kala.n-jazalahy[4]
house.LNK -spider.LNK-boy
‘[(a) boy’s spider]web’

Iteration of compounding is possible (Keenan and Polinsky 1998:620). An example of a compound formed by linking three roots is:

20. a. volo + vody → volom-body
‘hair, feather’ ‘rump’ ‘tail of bird’

b. volom-body + trano → volom-bodin-trano
house ‘eaves or thatch projecting over the walls of a house’

What the facts in (20) show is that attachment of a possessive structure as the leftmost member of a compound is not possible in Malagasy. On the other hand, if the leftmost member is a possessive structure (or a compound), additional right-attaching possessors are available in both possessive structures and in compounding. This shows that the structure of compounds must be different than that of possessive DPs. Expanding on this fact, it is also predicted that determiners or demonstratives should not be able to precede the rightmost element in compounds. If a determiner is used then the idiomatic reading is lost, and the string is interpreted as possessive.

21. trano.n’ ity/ny kala
house.LNK-DEM/DET spider
‘the/this spiders house’

This indicates that the DET-layer of the possessee nominal is not available in these structures, contrary to possessive structures where the possessee can, and in most cases is definite/specific (c.f. 19). Furthermore, while Malagasy possessors are referential, the rightmost elements in compounds are not. For example, they cannot antecede pronouns:

22. * Fongotra ny trano.n-kala$_1$ fa lasa izy$_1$
destroyed DET house.LNK-spider because gone 3NOM

[3] The possessive reading “house of black spider” is possible here. What is excluded in the compound interpretation “web of black spider”.
[4] The structure is OK with a different bracketing resulting in a phrase meaning ‘a boy’s spider web’.

'The spider$_1$-web is destroyed because it$_1$ left.'

Similarly, the entire possessive phrase may be coordinated with the identical possessor realized as a pronoun on the second conjunct, as illustrated in (23):

23. ny trano.n-dRabe$_1$ sy ny zaridai.ny$_1$
DET house.LNK Rabe and DET garden.3GEN
'Rabe's house and his garden.'

24. * ny trano.n-kala$_1$ sy ny toha.ny$_1$
DET house.LNK-spider and DET prey.3GEN
'The spider$_1$-web and its$_1$ prey.'

As (24) shows, such coordination is not possible for compounds, nor is any pronominal reference to the non-head allowed without a loss of non-compositional meaning.

Keenan and Ralalaoherivony (1998) discuss cases where a DP-internal possessor raises to subject position while the remnant possessee NP incorporates onto the predicate:

25. a. Maty ny vadi.n-dRabe
died DET spouse.LNK-Rabe
'Rabe's spouse died/is dead.'

b. Maty vady Rabe
died spouse Rabe
'Rabe was widowed.'

26. a. Róvitra ny void.n'ny hárona
torn DET bottom.LNK'DET basket
'The bottom of the basket is torn.'

b. Ròvi-bódy ny hárona
torn bottom DET basket
"The basket has a torn bottom."

The possessor subject has to be marked as definite following the general requirement that the rightmost discourse prominent element be marked as definite in Malagasy. This predicts that since the possessor element in linked compounds is always indefinite (in fact non-referential), it cannot participate in possessor-raising structures of this type:

27. a. fongotra ny trano.n-kala
destroyed DET spider.LNK-web
'The spider-web is destroyed.'

b. * fongo-drano kala
destroyed-house spider
'The spider is web-destroyed.'

In other words, the rightmost element in a compound cannot participate in NP-raising structures due to the definiteness requirement on the Malagasy subject. If the rightmost element appears with a definite determiner, the idiomatic reading is lost and the structure is interpreted as possessive again:

28. fongo-drano ny kala
destroyed-house DET spider
'The spider is house-destroyed.'

Given the absence of a definiteness projection in Malagasy phrasal compounds the next question addresses the depth of nominal functional layers that the compound structure allows. As we have seen, a specific class of adjectives which Keenan (1995: 97) calls 'inherent property denoting adjectives' are able to appear between the noun and the possessor in linking structures, i.e. the leftmost element of a possessive structure can be directly modified by an adjective:

29. trano.n-dRabe vaovao
house.LNK-Rabe new
'Rabe's new house'

30. trano vaovao.n-dRabe
house new.LNK-Rabe
'Rabe's new house.'

No such modification with this type of adjectives is possible with compounds:

31. * trano vaovao.n-kala
house new.LNK-spider
'new spider-web'

Thus, adjectival layers, or more precisely the functional projections where attributive adjectives merge, cannot be contained inside these compound structures.

In the following section I provide a syntactic derivation for these compounds, based on recent developments in syntactic theory, which allow for a fresh look on the properties of these compounds and provide explanations supported by independently motivated syntactic mechanisms.

3 A Syntactic Analysis

The properties of Malagasy linked compounds match compound properties crosslinguistically in their idiomatic semantics and in that they exhibit lexical integrity effects: no reference, no modification, and no extraction. This initially seems to point towards a morphological derivation for these compounds as opposed to a syntactic derivation which would be the default analysis for the corresponding possessive strings. On the other hand, the presence of functional morphology in the form of the linker adds Malagasy phrasal compounds to an increasing body of data which contains expressions exhibiting "mixed" morphosyntactic properties. For example, since Siegel (1979) it is generally assumed that the appearance of inflectional morphology is usually strictly forbidden within the word domain. However, even English provides a number of examples where possessive phrases appear to have compound-like properties, as in expressions like “women’s magazine” (see for example Taylor 1996). Booij (2008) discusses such strings and proposes the following:

> “*We therefore assume an idiomatic pattern or constructional idiom N’s N for English that serves to create new lexical expressions. A constructional idiom is a fixed syntactic pattern in which some positions may be filled by all kinds of words of the right category, whereas other positions are filled by specific morphemes or words. In this case, there is only one morpheme lexically specified, the morpheme -s. The two N positions are variable, and can be filled by all sorts of noun*”. Booij, 2005:83

In other words these constructional idioms are assumed to be phrases with possibly idiosyncratic phonology (i.e. stress patterns) and semantics. But if this is the case, the default analysis should be a syntactic one. How is the combination of “all sorts of noun” with “specific morphemes” different than the combination of all sorts of nouns with specific functional heads which host adjectives? A number of earlier and recent accounts (Baker 1988, Lieber 1992, Marantz 1997, Julien 2003, Ntelitheos 2012) place traditional structure-building morphological processes (including category-changing operations such as nominalization) in the syntactic component and show that these derivations can be accounted for by independently motivated syntactic operations, simplifying thus the computational mechanisms of language.

Following this line of thought, I propose here that despite their word-like properties linking compounds in Malagasy are derived in the syntactic component. The starting point for the discussion is the existence of functional material within what is traditionally assumed to be a “word domain”.

At the phonological level, as we have seen, both possessive and compound structures define a single prosodic domain for purposes of stress-assignment. So the differences between the two structures have to do with different syntactic behavior, the fact that compounds exhibit so-called “lexical-integrity” effects and the semantic distinction of compositionality for possessive structures vs. idiomatic readings for compounds. The latter two can be combined into one if we assume that idiosyncratic readings are associated with the domain of syntax where incorporation, and therefore compound-like properties and lexical-integrity are associated with. Borer (2009) assumes that incorporation takes place at the low level within the noun phrase, and more specifically above N or N+CL the clitic projection in the noun phrase, but crucially not above #P the number associated phrase or DP the referential projection, as the last two projections are of the wrong type <e>. By confining the encyclopedic search to this domain Borer succeeds in deriving semantic opacity for Hebrew construct compounds. In addition the fact that these compounds are derived through incorporation accounts for the set of other properties that they carry (see Borer (2009)) for a detailed discussion of these properties.

I will follow the same general lines here trying to make more precise the process of linking compound formation, but assuming that the linking compounds derive via phrasal movement rather than head-movement. The reason for this choice is directly related to the presence of the linker in the derived string, as the linker is a functional element that seems to facilitate predicate-inversion type of structures (see Ntelitheos 2012).

The proposal assumed here builds heavily on work by Sportiche (2005), which proposes that referential properties are licensed in projections outside the domain of first merge (Sportiche 2005). This means that predicates select for bare NPs and that subsequent nominal layers (case, number, quantification) project outside the thematic domain and trigger movement of the argument NP to VP-external positions. A VP-internal argument is selected by the verb as an NP. It subsequently moves to number, case and definiteness projections outside the VP shell. The evidence supporting this claim is drawn from reconstruction effects (see Sportiche 2005, for discussion). The direct result of this claim is that any derivation starts by merging a predicate to a bare NP. Assuming (following DenDikken 2005) that the possessive construction is a merger of a nominal possessee argument with a possessive predicate (possibly headed by a null preposition), then this merge happens at the pre-functional level in Sportiche's analysis. Thus, in both Malagasy possessive structures and compounds the derivation starts with the two nominals merging in bare form and with no referential properties:

32. [trano] [olona]
house person

In possessive structures the possessor moves to the higher number projection (#P) while an (in)definiteness projection (DP) also merges outside this domain and referential properties are fixed by moving the possessor to this projection:

33. [$_{\text{DP}}$ ny [olona [$_{\text{\#P}}$ ~~olona~~ [trano] [~~olona~~]]

Given that number and/or the determiner are category-determining functional projections, at this level meaning is compositionally derived[5]. This is based on the hypothesis that compositional semantics is the normal way of interpreting strings derived by merging category-determining functional material in the extended projection. This has been promoted in Marantz (2001, 2007, 2012) and Arad (2003, 2005) and assumes that idiosyncratic meaning derives from locality conditions on the interpretation of roots. Roots obtain semantic interpretation when the first category assigning head (or phase head) merges in their projection and this interpretation is then fixed for the remainder of the derivation. Idiosyncratic meanings arise when functional elements merge directly with a root. However, when affixes attach outside category defining heads (such as NUMBER and DET), the result is a meaning predictable from the meaning of the stem, i.e. compositional. In the example of (33), the linker attaches outside the domain defined by the category-determining affixes for number and definiteness and thus the meaning of the derived string is determined compositionally. After the linker has merged, the possessee moves and gets licensed in its specifier resulting in the final word order. Additional number and definiteness projections can merge now, quantizing the possessee:

34. [$_{\text{LNKP}}$ trano [$_{\text{LNK}}$ n [$_{\text{DP}}$ ny [olona [$_{\text{\#P}}$ ~~olona~~ [trano] [~~olona~~]]

However, if a functional element such as the linker merges directly with the root domain, before category-determining heads, the semantic interpretation can be idiomatic.

[5] In the original discussion (Marantz 2001, 2007) category-determining heads are phasal heads like little *v* for the verbal domain (e.g. *n* for nominals and *a* for adjectives). However, this is not crucial; for the discussion here, one can assume a little *n* merging below number and definiteness projections or take these projections to be category-determining. Once these heads have merged, compositionality ensues.

This is possible because as we have discussed above, an “encyclopedic” interpretation, which is connected to the phonological spellout of a specific morphosyntactic domain, confines its searches to this “inner” or lower domain while larger syntactic domains which contain functional projections are interpreted compositionally.

We assume here that the linker merges directly above the root domain in the cases of compound formation, attracting the possessee to its specifier:

35. [$_{\text{LNKP}}$ trano [$_{\text{LNK}}$ n [~~trano~~] [kalo]

The linker acts as a marker of the relation between possessee-possessor in both structures (in the sense of den Dikken 2006). In phonological terms, the projection headed by the linker defines a single prosodic domain for purposes of stress assignment, i.e. only a single main stress is associated with this domain, whatever the internal structure of the domain may be.

If this structure is on the right track then a number of properties exemplified in the previous section follow straightforwardly. The possessor, now embedded in the domain defined by the linker (a phase), has not been quantized, in the sense of Sportiche (2005). Since referentiality is associated with specific projections and since these projections are not available within the compound, it is natural to exclude D-elements like determiners and demonstratives with the possessor:

36. * trano.n’ ity/ny kala
house.LNK’this/the spider
‘the/this spiders house’

Non-referentiality of the compound-internal constituents also prohibits their anteceding pronominals (examples (22-24) repeated here):

37. * Fongotra ny trano.n-kala$_1$ fa lasa izy$_1$
destroyed DET house.LNK-spider because gone 3NOM
‘The spider$_1$-web is destroyed because it$_1$ left.’

38. * ny trano.n-kala$_1$ sy ny toha.ny$_1$
det house.lnk-spider and det prey.3gen
‘The spider$_1$-web and its$_1$ prey.’

The discussion here is also relevant to modification. If modification is related to specifiers of functional projections above the root or lexical domain (as in Cinque 1999), then these projections are also not available within the domain of compound formation. Thus, adjectives are not expected to be able to modify either the possessor or the possessee. The only possibility is for adjectives to merge above the linking domain, in which case they modify the full possessee-linker-possessor structure:

39. trano.n-kala mainty
house. LNK-spider black
‘black spider-web’

As we have already seen, the unavailability of extraction is explained independently by the requirement that Malagasy subjects are preceded by a definite determiner:

40. a. fongotra ny trano.n-kala
destroyed DET spider.LNK-web
'The spider-web is destroyed.'

b. * fongo-drano kala
destroyed-house spider
'The spider is house-destroyed.'

Finally, the problem of iteration can also be somewhat explained. As we have seen iteration of compounding is possible, although very marginal in Malagasy (Keenan and Polinsky 1998:620). This is expected as the linker defines the domain of compounding. A linked compound is a domain where functional material has already been introduced, in the form of the linker. In most cases the derived string will merge with a category-determining head creating an "outer" domain where merging of subsequent linkers will be interpreted compositionally. However, sometimes the language allows for linkers to merge again creating a larger "inner" domain, i.e. a recursive compound with three roots. Speaker dispreference for these compounds then may be attributed to a more general dispreference of iteration in the inner domain, in other words there is a requirement that the category-determining morpheme attaches as early as possible in the derivation.

Conclusion

I have shown that a class of phrasal compounds in Malagasy has properties which point towards a syntactic source. I have derived their compound-like properties from the independently motivated syntactic properties of the domain in which their derivation takes place. This 'phasal' domain is responsible not only for their idiosyncratic semantic properties and lexical integrity effects but also for their single prosodic domain for purposes of stress assignment. The discussion indicates that the term "compound" in this context is in fact misleading and what we are actually dealing with is different syntactic phrasal domains whose properties are determined by the height of attachment of certain functional and category-determining heads.

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Affiliation

Dimitrios Ntelitheos
Department of Linguistics
United Arab Emirates University
dimitrios_n@uaeu.ac.ae

Duality

Richard T. Oehrle

One of the key ideas of modern mathematics and linguistics is the notion of invariance under permutation. On the mathematical side, Kaplansky writes:

> We take this opportunity to mention Klein's *Erlangen* program. In a famous lecture, Felix Klein enunciated the thesis that the goal of geometry is the study of properties invariant under a particular group of transformations, the group being selected appropriately for the geometry in question.
>
> Klein's program is widely quoted, and of considerable historical significance. But it might be a good idea to point out that geometry is not unique in possessing an *Erlangen* program. In the study of any mathematical system, the group of automorphisms is certain to be important.... (Kaplansky 2003:p. 86)

Keenan and Stabler (2003) explore extensively the linguistic applicability of the insight Kaplansky expresses in the last sentence of the quotation above.

Another key idea of mathematics is the notion of duality. In what follows, I attempt to show, through some initial examples, that duality yields linguistic insights as well. I hope to pursue further examples subsequently.

1 Mathematics

In mathematics, duality arises naturally in a variety of contexts.

Set Theory. Halmos (1960) points out:

> ...the theorems of set theory usually come in pairs. If an inclusion or equation involving unions, intersections, and complements of subsets of E we replace each set by its complement, interchange unions and intersections, and reverse all inclusions, the result is another theorem. This fact is sometimes referred to as the *principle of duality* for sets. [p. 18]

Lattice Theory. Birkhoff (1967):

> ...It is obvious from inspection of conditions P1-P3 [the reflexivity, transitivity, and anti-symmetry conditions defining posets] that

THEOREM 2 (DUALITY PRINCIPLE). *The converse of any partial ordering is itself a partial ordering.*

DEFINITION. The *dual* of a poset X is that poset $\check{X}$ defined by the converse partial ordering relation on the same elements.[p. 3]

Lattice Theory again. Davey and Priestley (1990) elaborate:

> **1.17 The dual of an ordered set.** Given any ordered set P we can form a new ordered set P^∂ (the **dual** of P) by defining $x \leq y$ to hold in P^∂ if and only if $y \leq x$ holds in P. For P finite, we obtain a diagram for P^∂ simply by 'turning upside down' a diagram for P. ...
>
> To each statement about P there corresponds a statement about P^∂. ... In general, given any statement Φ about ordered sets, we obtain the **dual statement** Φ^∂ by replacing each occurrence of $\leq$ by $\geq$ and vice versa. Thus ordered set concepts and results hunt in pairs. This fact can often be used to give two theorems for the price of one or to reduce work .... The formal basis for this observation is the Duality Principle below; its proof is a triviality.
>
> **1.18 The Duality Principle.** *Given a statement Φ about ordered sets which is true in all ordered sets, then the dual statement Φ^∂ is true in all ordered sets.*[pp. 12f.]

Category Theory. Mac Lane (1971) develops the concept of duality in Category Theory as follows:

> The *dual* of any statement Σ of [the elementary theory of an abstract category] is formed by making the following replacements throughout in Σ: "domain" by "codomain", "codomain" by "domain" and "h is the composite of g with f" by "h is the composite of f with g"; arrows and composites are reversed. Logic (and, or, ...) is unchanged. This gives the following table ....
>
> | Statement Σ | Dual statement Σ^* |
> |---|---|
> | $f : a \to b$ | $f : b \to a$ |
> | $a = \operatorname{dom} f$ | $a = \operatorname{cod} f$ |
> | $i = 1_a$ | $i = 1_a$ |
> | f is monic | f is epi |
> | u is a right inverse of h | u is a left inverse of h |
> | f is invertible | f is invertible |
> | t is a terminal object | t is an initial object |
>
> Note that the dual of the dual is the original statement ($\Sigma^{**} = \Sigma$). If a statement involves a diagram, the dual statement involves that diagram with all the arrows reversed. [pp. 31f.]

Category Theory again. Barr and Wells (1990) define the dual of a category as follows:

> **2.6.7 The dual of a category.** Given any category $\mathscr{C}$, you can construct another category denoted $\mathscr{C}^{\mathrm{op}}$ by reversing all the arrows. The **dual** or **opposite** $\mathscr{C}^{\mathrm{op}}$ of a category $\mathscr{C}$ is defined by:
>
> D-1 The objects and arrows of $\mathscr{C}^{\mathrm{op}}$ are the objects and arrows of *calC*.
> D-2 If $f : A \to B$ in $\mathscr{C}$, then $f : B \to A$ in $\mathscr{C}^{\mathrm{op}}$.
> D-3 If $h = g \circ f$ in $\mathscr{C}$, then $h = f \circ g$ in $\mathscr{C}^{\mathrm{op}}$.
>
> The meaning of D-2 is that source and target have been reversed. It is easy to see that the identity arrows have to be the same in the two categories $\mathscr{C}$ and $\mathscr{C}^{\mathrm{op}}$ and that [the statements defining a category] hold, so that $\mathscr{C}^{\mathrm{op}}$ is a category. ...
>
> ... The major use we make of the concept of dual is that many of the definitions we make have another meaning when applied to the dual of a category that is often of independent interest. [pp. 33f.]

The category-theoretic characterizations generalize the characterizations from sets and lattices: a preorder—that is, a set on which there is defined a relation that is reflexive and transitive (but not necessarily anti-symmetric)—may be regarded as a category whose objects are the elements of the set and whose arrows correspond to the partial ordering relation. In particular, identity arrows correspond to the reflexivity requirements and transitivity corresponds to composition. Reversing these arrows gives the dual preorder. But the category-theoretic definition generalizes the set-theoretic and lattice-theoretic perspectives. The linguistic examples that follow are not formalized categorically, ... at least not yet.

2 Words $\leftrightarrow$ Worlds

2.1 Anscombe

In the mid-1950's, Elizabeth Anscombe (1957) offered an essential insight in her account of the different roles a list might play with respect to a shopping expedition:

> 32. Let us consider a man going round a town with a shopping list in his hand. Now it is clear that the relation of this list to the things he actually buys is one and the same whether his wife gave him the list or it is his own list; and that there is a different relation when a list is made by a detective following him about. If he made the list itself, it was an expression of intention; if his wife gave it him, it has the role of an order. What then is the identical relation to what happens, in the order and the intention, which is not shared by the record? It is precisely this: if the list and the things that the man actually buys do not agree, and if this and this alone constitutes a *mistake*, then the mistake is not in the list but in the man's performance (if his wife were to say: 'Look, it says butter and you have bought margarine', he would hardly reply: 'What a mistake! we must put that right' and alter the word on the list to 'margarine'); whereas if the detective's record and what the man actually buys do not agree, then the mistake is in the record.

The relation of the two lists to events contains a common core: a correspondence between the items on the list and the purchases. And this correspondence is the same. That is, whether our shopper wants to pair a particular pound of butter with the list item 'butter' or our detective wants to pair up the word 'butter' with that same pound of butter, the criteria for the match or pairing are the same. The asymmetry in the two cases that Anscombe points out stems not from the correspondence itself but from whether we go from list to object or go from object to list.

We regard this as an instance of duality: a single relation—the matching relation between list and purchases—can be viewed from two different perspectives.

2.2 Searle

Two decades later, John Searle proposed a classification of illocutionary acts in which Anscombe's insight plays a key role. The classification rests on 'twelve significant dimensions of variation'. The first of these is the point or purpose of the act.[1] The second is what Searle calls 'direction of fit':

> Some illocutions have as part of their illocutionary point to get the words (more strictly, their propositional content) to match the world, others to get the world to match the words. Assertions are in the former cateogry, promises and requests are in the latter. The best illustration of this distinction I know of is provided by Elizabeth Anscombe (1957). [see above] . . .
>
> In these examples the list provides the propositional content of the illocution and the illocutionary force determines how that context is supposed to relate to the world. I propose to call this difference a difference in *direction of fit*. The detective's list has the *word-to-world* direction of fit (as do statements, descriptions, assertions, and explanations); the shopper's list has the *world-to-words* direction of fit (as do requests, commands, vows, promises). I represent the word-to-world direction of fit with a downward arrow thus $\downarrow$ and the world-to-words direction of fit with an upward arrow thus $\uparrow$. Direction of fit is always a consequence of illocutionary point. It would be very elegant if we could build our taxonomy entirely around this distinction in direction of fit, but though it will figure largely in our taxonomy, I am unable to make it the entire basis of the distinctions.

Searle then proposes a 5-fold taxonomy of illocutionary acts (after a critical review of Austin's classification in *How to Do Things with Words* (Austin (1970))), based primarily on the parameters: illocutionary point, direction of fit, psychological state, and propositional content. He symbolizes these as follows:[2]

[1]Examples: the point or purpose of an order is to get someone to do something, the point or purpose of an assertion is to represent something, the point of puporse of a promise is to undertake an obligation. Each of these examples is an instance of a larger family.

[2]We are primarily interested in the direction of fit properties of this taxonomy, but there are a lot of extra symbols. In the illocutionary point column, '$\vdash$' is Frege's assertion sign, '!' is commonly used to indicate commands; in the psychological state column, *B* stands for a family of states related to believing, *W* stands for a

taxon	*illocutionary point*	*direction of fit*	*psychological state propositional content*
assertives	$\vdash$	$\downarrow$	*B(p)*
examples: *believing that p, asserting that p, insisting that p, suggesting that p, ...*			
directives	!	$\uparrow$	*W(H does A)*
examples: *asking H to A, ordering H to A, requesting H to A, begging H to A, ...*			
commissives	C	$\uparrow$	*I (S does A)*
examples: *promising to A, vowing to A, pledging to A, contracting to A, ...*			
expressives	E	$\emptyset$	*(P)(S/H + property)*
examples: *apologizing, thanking, congratulating, welcoming, deploring, ...*			
declarations	D	$\updownarrow$	$\emptyset$ *(p)*
examples: *nominating, appointing, ...*			
(assertive declarations)	D_a	$\downarrow\updownarrow$ *B(p)*	
examples: calls by umpires and referees, jury findings, ...			

Anyone familiar with distinctive feature theory is bound to feel that columns 2, 3, and 4 are hardly exhaustive of the primitives proposed—this is a sparse classification. Moreover, it doesn't assign any role to iterative speech acts (such as hectoring a witness) or to second order speech acts (insulting, libeling, ...). And of course it would be wonderful to know what C.S. Peirce would make of it.[3] We aren't interested here in a theory of speech acts in general (at least, not initially). But we are interested in Searle's use of the direction of fit.

For Anscombe, there are two 'directions of fit': from list to purchases and from purchases to list. Searle expands on this to include the class he calls declarations, of which he states:

> *Declarations.* It is the defining characteristic of this class that the successful performance of one of its members brings about the correspondence between the propositional content and reality, successful performance guarantees that the propositional concern [content?] corresponds to the world: if I successfully perform the act of appointing you chairman, then you are the chairman;.... [p. 149]

Talk about dynamic semantics! (*Fiat lux!* was, thank God, just the beginning.)

Searle distinguishes two subclasses of declarations—those that express a ruling or decision concerning the institutional status of independently existing states of affairs (judicial findings, referee decisions, ...) and whose successful performance brings about the existence of an institutional fact of the appropriate kind, and those that are not necessarily institutionally dependent, though they may be (naming, defining, abbreviating, ...).[4]

family of states related to wanting or wishing, *I* stands for a family of states related to intending, *P* is a variable ranging over the relevant range of psychological states, *S* is speaker, *H* is hearer, *A* is action, *p* is proposition, and C, E, D represent the illocutionary point of Commissives, Expressives, and Declarations, respectively.

[3] To explain a bit, if we think about the information carried by speech (and other signaling channels), Peirce's early *icon/index/symbol* trichotomy is still useful: speech acts typically involve properties of each.

[4] As with many other cases, the intuitive difference Searle is sensitive to here involves a distinction among acts, not necessarily a distinction among verbs.

2.3 Preliminary Assessment

Anscombe's insight is both appealing and correct—correct in the sense that the matching principle between word and world is the same in the two instances she highlights. The asymmetry between the two cases is a temporal one: either the list precedes the purchases or the purchases precede the list. This doesn't match up exactly with English usage: assertives and directives have very different aux/modal properties, for example. An additional problem involves the interaction, in Searle's notation, of the direction of fit with psychological operators: in the schema for commissives, for example, we have $C \uparrow (I(S\ does\ A)$, but this doesn't sort out (formally, at least) what the scope of the $\uparrow$ operator is. It clearly doesn't bind the psychological state (Intention), which presumably holds at the time of the speech act in question; but it does bind the argument of the psychological state operator (indeed, if it is an operator). We will revisit this after gaining more experience of duality from a different, but closely related, perspective.

3 Present Tense, Some Aspect

In English, one usually can't use the simple present form to represent a simple (non-generic) event. For example, consider an English-speaking mountaineer talking with his mother by cell-phone as he reaches the summit:

Mountaineer I'm getting there, Mom, just as I told you I would. . . . But I'm a little short of breath. Not much oxygen up here.

Mother You can do it. And I only have so many minutes left this month, so hurry up and do it!

Mountaineer I'm reaching the top! / *I reach the top! / I've reached the top!

… . . .

This is not a morphological oddity: there are some cases in which this general rule fails (so the issue is not about tense or aspect *per se*). Before we look at the cases where this generalization fails, let's try to understand why the generalization holds in the cases where it does.

3.1 The Baseline Theory

Suppose that to use the present tense in English to describe a state of affairs, the state of affairs has to hold at the time of utterance and beyond. This is true for sentences describing states. But it precludes the use of present tense sentences whose verbs describe events with a definite end point. Because: if we haven't reached the endpoint, the sentence isn't true; and if we've reached the endpoint, the event is already past. (We can't just coincide with the endpoint, because of the "beyond" clause of "at the time of utterance and beyond".) This Baseline Theory captures the judgements represented above.

Now, let's consider some potential counterexamples.

3.2 *Narrative description*

Here's a section from the diary of the mountaineer above:

> I'm very determined today. When the sun comes up, I'm already at the col. The ice-field is treacherous, but by mid-afternoon, I reach the top. (And Mom, on the phone, is completely supportive!)…

Narrative involves a temporal chain of events. Let's suppose that it can take one of two modes. In one mode (the descriptive mode), the events are taken to exist in time and the narrative attempts to describe them. In the other mode (the constructive mode), we start from scratch in some sense[5] and build up the event structure piece by piece in the narration. This is a case of duality—matching linguistic descriptions to events, whether real or imagined, is a game whose matching rules are the same, but whose interaction with time is reversed. In the descriptive mode, time and the temporal connections with other events (including the circumstances of the communicative event) are a given and these connections are respected. In the constructive mode, a temporal model is built from the description.

The Baseline Theory applies only to the descriptive mode, where it is perhaps useful to think that we measure temporal descriptions against an independently existing temporal flow of events. In the constructive mode, there is no independently existing temporal flow of events to compare against: we're construcing the temporal relations as we go.

4 Aspect in world-to-words cases

Now let us go back to Searle's classification and suppose that in the language games we play in conversation, we have some high level options, including the possibility of Searle's assertives and declarations, whose differentiation in Searle's taxonomy rests in part on the direction of fit parameter. Searle's characterization of direction of fit for declarations begins by contrasting declarations with other types:

> The illocutionary force indicating device in the sentence operates on the propositional content to indicate among other things the direction of fit between the propositional content and reality. In the case of assertives, the direction of fit is words-to-world, in the case of directives and commissives, it is world-to-words; in the case of expressives there is no direction of fit because the existence of fit is presupposed. The utterance can't get off the ground unless there is already a direction of fit. But now with the declarations we discover a very peculiar relation. The performance of a declaration brings about a fit by its very successful performance. How is such a thing possible? (p. 150)

Searle's proposed answer to this question is: "…the direction of fit is both words-to-world and world-to-words because of the peculiar character of declarations" (p. 150). He continues:

[5] We can never really start completely from scratch—it would be as if we could write before being born. But writers play with the notion of common ground in amazing ways: Kafka's great story 'The Bucketrider' is a case in point.

> The reason there has to be a relation of fit arrow here at all is that declarations do attempt to get language to match the world. But they do not attempt to do it either by describing an existing state of affairs (as do assertives) or by trying to get someone to bring about a future state of affairs (as do directives and commissives). (p. 150)

I prefer to think of the distinction as one based on dynamic model-theory: assertives are evaluated or tested against a (partial) model μ; successful declarations extend the model μ to a new (still partial) model μ'.

One reason for this preference is that it embeds the problem in a useful theoretical space.

A second (noted earlier) is that Searle's use of direction of fit indicators does not always clearly indicate how it is to be applied to the components of the linguistic object being modeled: in the classificatory schemata that Searle introduces and employs, the direction of fit indicator occupies the second position (after the symbol representing the illocutionary point), but the words relevant to the direction of fit are sometimes provided by the expression as a whole (as in many assertives), and sometimes by the complement (as in a commissive utterance of I promise to help you).

Third, the proposal that direction of fit goes both ways in declarations, while avoiding the initial dilemma posed, is less obvious than it appears at first glance. Are the two directions of fit independent? Are they temporally ordered? Do they apply equally to all components of the relevant structure? Thus, while the appeal to a two-way direction of fit for declarations is theoretically elegant, it isn't clear, to me at least, that it's correct.[6]

Finally, the model-theoretic perspective sheds light on the aspectual properties of declarations: unlike present tense sentences evaluated or tested against a given cotemporaneous model μ, the progressive form is not required. In fact, when the progressive form is used—compare *I name this ship the* U.S.S. Aliscafo and *I'm naming this ship the* U.S.S. Aliscafo—the special declarational force of the non-progressive vanishes and the sentence is understood as describing what the speaker is doing, rather than bringing about a name-entity pairing. Specifically, like the narrative constructive mode, declarations are exempt from the requirements of the Baseline Theory—because they are not evaluated against an existing, independent model. Of course, in virtue of duality, the verbs used in declarations can also be used, possibly with different tense and aspect to describe declarational events, as in the simple discourse: *I hereby name this ship the* U.S.S. Aliscafo. *There! I named the* Aliscafo *the* Aliscafo.

5 The Whiff of Generality

In fact, explicit performatives always have the aspectual properties just discussed with regard to declarations. The most direct conclusion to draw from this (in the framework adumbrated here, at least) is that explicit performatives, when succesitul, are always interpreted as model-extenders, rather than model-describers. This holds across all of Searle's classes when instances of them involve explicit performatives.

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[6] I'm reminded for some reason of Russell's aside after introducing the problem of the baldness of the present king of France: "Hegelians, who love a synthesis, will probably conclude that he wears a wig." (Russell 1905:p. 48).

assertives: *I state that I am here.*
directives: *I request that you be there.*
commissives: *I promise to be there.*
expressives: *I thank you.*
declarations: *I name this dog* Lola.

From the present point of view, this means that at the top level, all of these sentences have a uniform characterization: as explicit performatives, they are all to be interpreted as model-extenders. How then do we characterize the distinctions among them? And what does this mean for Searle's taxonomy? We can't address these questions in full here. But a few comments are in order.

First, the parametric criteria proposed by Searle certainly remain relevant (especially the role of the direction of fit with regard to the complement clauses of the examples above). But notions like direction of fit need to be associated with the correct corresponding component of the expression in question. (That is, we would like a more compositional account.)

Second, the classification seems skewed: compare the narrowness and specificity of the commissives class (promises) to the almost open-ended character of the expressives class.

A natural question to ask, then, is whether (even given Searle's extensive set of parameters) the space of possibilities is appropriately chosen. For example, a promise involves not only an obligation on the part of the promiser but also a benefit to the promisee. Moreover, the promisee can act to unwind the promiser's obligation, for example by saying *I release you from your promise to X* or *You needn't worry about X-ing* or *Don't feel that you have to X... At least not on my behalf*. This type of act doesn't fit comfortably in any of Searle's classes. But such acts would be expected in a setting where speaker/hearer interactional negotiations of power/permission/obligation are a central and basic focus of communication.

Such a setting would also naturally accommodate the performative aspects of deontic uses of *may*. If we compare questions of the form *May I ... ?* with questions of the form *Am I allowed to* ..., we find that the former favor interpretations as requests for permission, not simply as requests for information, while the latter are more neutral. For example, if my brother Atreus is imprisoned for some reason and I wish to ascertain the boundaries of his freedom under these limited conditions, I might ask him "*Are you allowed to spend time outside your cell on weekdays?*", but the similar question "*May you spend time outside your cell on weekdays?*" is deontically odd, to say the least. If we assume that the first is a question about objective rules and regulations, while the second is a request for permission addressed to a person not in a position to grant permission, this oddity is immediately explained.

Third, many of the examples that Searle includes in his expressives category involve the interaction of the relation between speaker and hearer and events that affect the interests of speaker or hearer (congratulations, apologies, thanks, condolences, ...). Situating these speaker/hearer actions in an appropriate space should be useful.

But these questions, however interesting, go far beyond the bounds of duality. And addressing them must therefore be postponed to a more appropriate occasion.

6 Conclusion

Present tense sentences in English whose main verb is non-stative are subject to restrictions which are attributed above to a basic distinction: assertive uses of the sentence (where the sentence describes an independently given model) and several different (narrative, performative) uses in which the sentence serves to create, in some way, the state-of-affairs which it describes. The Baseline Theory, described above in section §3.1 shows how this interesting range of grammatical behaviors can be characterized for basic cases. Duality provides the connection across these distinct uses. And we see that apparent counterexamples to the Baseline Theory—at least both the narrative and performative cases considered here—fall outside its domain of definition, for the same reason.

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Affiliation

Richard T. Oehrle
502 Lobos Avenue
Pacific Grove, CA 93950
rto@redshift.com

Passive Morphemes in a Passive-less Language?

Yuko Otsuka

Introduction

In his comprehensive and succinct overview of passives in the world's languages, Edward Keenan (1985) makes the following typological observations. First, not all languages have passives; and second, such passive-less languages commonly use one of the following grammaticized means to express functional equivalents of passive: (a) to use the "impersonal" third person plural subject; or (b) to eliminate the subject of an active construction. Tongan is cited as an example of the latter, but with a disclaimer that "[i]t is not clear whether we want to consider such cases [as (1b)] … as a 'truncated' active, with perhaps a third person plural or indefinite pronoun understood or as some kind of morphologically degenerate passive in which the verb form is not distinctively marked" (Keenan and Dryer 2006: 330).[1]

(1) a. Na'e tāmate'i 'e Tevita 'a Koliate
PST killed ERG David ABS Goliath
'David killed Goliath.'
b. Na'e tāmate'i 'a Koliate
PST killed ABS Goliath
'Goliath was killed.'

This question arises because case marking in Tongan shows an ergative-absolutive pattern. In a language with a nominative-accusative case system, whether the relevant construction is a truncated active or morphologically degenerate passive can be determined based on the Case of the theme NP, which should be marked as accusative in active transitive constructions, but as nominative in passive (intransitive) constructions. This is illustrated in the Supyire (Gur) example below (Carlson 1994 cited in Keenan and Dryer 2006: 330).

(2) a. nàŋa à sikàŋi bò
man.DEF PERF goat.DEF kill
'The man killed the goat'
b. sikāŋa a bò
goat.DEF PERF kill
'The goat has been killed'

[1] Abbreviations used in this paper are as follows: ABS = absolutive, AGT = agent, DEF = definite, DO= direct object, ERG = ergative, EXCL = exclusive, INC= inceptive, PERF = perfective, PL = plural, POSS = possessive, PRS = present, PST = past, PTCPL = participle, REF = referential, S = singular, SBJV = subjunctive, SUBJ = subject, 1 = first person, 3 = third person.

In Supyire, subjects and direct objects occur in fixed positions, the sentence-initial position and between the aspect marker and the main verb, respectively. Thus, given the position of the 'goat', we can safely assume that (2b) is intransitive, hence an instance of morphologically degenerate passive. In contrast, the difference between the two Tongan sentences in (1) is simply the presence or absence of the ERG-marked NP. Since the subject of the intransitive verb and the direct object receive identical case morphology (the ABS marker, *ʻa*), one cannot tell if the theme *Koliate* in (1b) is the subject of a passive verb or the direct object of an active verb.

In this squib, I demonstrate that (1b) is a transitive construction, and not a passive without morphological marking. I will also discuss two affixes, *ma*- and -C*ia*, that appear to be passive morphemes in Tongan. I will show that despite the passive meaning associated with them, these affixes cannonot be regarded as a morphological marker of passivization.

1 Evidence against Morphologically Degenerate Passive

While intransitive subjects and direct objects in Tongan are indistinguishable in terms of case morphology, the two are nonetheless treated differently in some syntactic operations such as (a) pronominalization, (b) coordination reduction, and (c) control. Using these as diagnostic tests, I will show below that the theme NP of the agentless construction (1b) is the direct object, not the subject.

1.1 Pronominalization

Tongan has a set of clitic pronouns, which occur in the position between the tense marker and the verb. The use of clitic pronouns is restricted to subjects, ERG or ABS, as shown in (3a-b). Pronominal objects may not take a clitic form, but must occur as an independent pronoun, as shown in (3c-d). In other words, the distribution of clitic pronouns is governed by the grammatical relation of the relevant NP rather than Case.

(3) a. Naʻa ku ʻalu ki ai.
PST 1.S go to there
'I went there.'
b. Naʻa ku ʻave ʻa e tamasiʻi ki ai.
PST 1. S take ABS REF boy to there
'I took a boy there.'
c. *Naʻa ku ʻave ʻe he faiakó ki ai.
PST 1. S take ERG REF teacher.DEF to there
Intended: 'The teacher took me there.'
d. Naʻe ʻave au ʻe he faiakó ki ai
PST take 1.S ERG REF teacher.DEF to there
'The teacher took me there.'

If the construction in (1b) is passive, the ABS-marked theme is a subject and therefore, should be able to occur as a clitic pronoun. As shown in (4), however, this prediction is not borne out. The sentence is grammatical only if the clitic pronoun is understood as the agent of *ʻave* 'take' and the theme, as a phonetically null third person singular pronoun. (The latter is permitted in Tongan when the referent is identifiable in context.) Thus the pronominalization test suggests that the relevant construction is transitive, not passive.

(4) Na‘a ne ‘ave ki he fale mahaki.
PST 3.S take to DEF house sick
*‘He was taken to the hospital.’ (OK ‘He took (him/her) to the hospital.’)

1.2 Coordination Reduction

The second test involves a type of coordination reduction. One of the coordinating conjunctions in Tongan, *mo* ‘and also’, requires the subject of the first conjunct and that of the second conjunct to be coreferential (5).[2] This condition is useful in determining the syntactic status of the ABS-marked NP in (1b) above. If (1b) is passive, then, the relevant NP should be able to participate in *mo*-coordination. This prediction is not supported, as shown in (6). This suggests that the ABS-NP in (1b) is the direct object, not the subject.

(5) a. *Na‘e tangi ‘a Hina$_i$ mo taa‘i ‘e Mele Ø$_i$.
PST cry ABS Hina and hit ERG Mary
‘Hina was crying and Mary was hitting (her).’
b. Na‘e tangi ‘a Hina$_i$ mo taa‘i Ø$_i$ ‘a Mele.
PST cry ABS Hina and hit ABS Mary
‘Hina was crying and (she) was hitting Mary.’
c. Na‘e taa‘i ‘e Hina$_i$ ‘a Mele$_j$ mo kata Ø$_{i/*j}$.
PST hit ERG Hina ABS Mary and laugh
‘Hina was hitting Mary and (Hina/*Mary) was laughing.’

(6) a. Na‘e taa‘i ‘a Mele$_i$ mo tangi Ø$_{*i/j}$.
PST hit ABS Mary and cry
‘Mary was being hit and (she$_{*i/j}$) was crying.’
b. *Na‘e tangi ‘a Mele mo taa‘i Ø.
PST cry ABS Mary and hit
Intended meaning: ‘Mary was crying and was being hit.’

1.3 Control

The third test concerns the distribution of PRO. What I call PRO here is the empty category that occurs, among other things, in clausal complements of verbs of volition or effort such as *feinga* ‘to try’ and *loto* ‘to want’. This element exhibits syntactic behaviors that are distinct from those of other types of empty categories found in Tongan (Otsuka 2011a). Its distribution does not exactly match what is generally expected of PRO, however. First, it can apparently occur in a Case-marked position, or at least can alternate with an overt NP, as shown in (7). Second, it can only occur in the subject position of transitive clauses. When the embedded verb is intransitive, an overt pronoun must occur instead of a PRO (8).[3] Despite these anomalies, and although the notion of PRO has been

[2] The other conjunction *pea* ‘and (then)’ requires the gap and the antecedent to bear the same Case.
(i) Na’e tangi ‘a Hina$_i$ pea taa‘i ‘e Mele Ø$_i$.
PST cry ABS Hina and hit ERG Mary
‘Hina was crying and Mary hit (her).’

[3] There are two exceptions to this generalization. One is PROarb in the complement of one place predicates. The other is purpose clauses containing a stative verb. I do not discuss these exceptions

questioned and/or disputed in the literature (Hornstein 1999, 2000; Manzini and Roussou 2000 among others), I refer to this empty category as PRO for the lack of better term. As expected of PRO in general, it cannot occur as direct objects (9).

(7) a. ‘Oku loto ‘a Sione$_i$ [ke fili PRO$_i$ ‘a Mele].
PST want ABS John SBJV choose ABS Mary
‘John wants to choose Mary.’
b. ‘Oku loto ‘a Sione [ke fili ‘e Mele ‘a Pila]
PST want ABS John SBJV choose ERG Mary ABS Peter
‘John wants Mary to choose Peter.’
(8) ‘Oku loto ‘a e tamaikí$_i$ [ke nau$_i$/*PRO$_i$ nofo].
PRS want ABS REF children.DEF SBJV 3.PL stay
‘The children want to stay.’
(9) *‘Oku loto ‘a Sione$_i$ [ke fili ‘e Mele PRO$_i$].
PST want ABS John SBJV choose ERG Mary
Intended: ‘John$_i$ wants Mary to choose (him$_i$).’

Based on the distribution described above, PRO should be banned in agentless constructions such as (1b) no matter whether it is transitive (because PRO cannot occur as the direct object) or passive (because PRO cannot occur in intransitive clauses). If (1b) is passive, however, we would expect a clitic pronoun, as in the examples in (8) above. This latter prediction is not borne out. The ungrammaticality of (10) suggests that the ABS-marked NP is not the subject of an intransitive (passive) construction, but the direct object of a transitive construction.[4]

(10) *‘Oku ou$_i$ loto [ke PRO/u$_i$ ‘ave ki ai].
PRS 1.S want SBJV 1.S take to there
Intended: ‘I want to be taken there.’

2 The Status of the Unexpressed Agent

The preceding discussion has shown that the agentless construction in Tongan should be treated as an instance of active transitive rather than morphologically degenerate passive. Let us now turn to the second part of the question: is the unexpressed agent in (1b) an instance of “a third person plural or indefinite pronoun understood”?

2.1 Evidence against the Null Pronoun Analysis

Should (1b) be understood as an instance of *pro*-drop of the impersonal third person plural pronoun? The answer seems to be negative. In Tongan, third person plural *nau* is never used as impersonal/non-referential, nor is it omissible. Third person singular pronouns, *ne* (clitic) and *ia* (independent), can be dropped, but only if the prior context provides the referent. That is, the omission of a third person singular pronoun is an instance of topic variable in the sense of Huang (1984) and therefore, referential by definition. This argues against the possibility of (1b) involving a *pro*-drop of a non-

further, as it is irrelevant to the present discussion on passive.

[4] The sentence is grammatical if the intended meaning is ‘I want to take (him/her) there’, with PRO being the subject and the direct object being a null third person singular pronoun.

referential/indefinite third person singular pronoun. It should be noted, however, that (1b) could be analyzed as a construction with a null (understood) subject, if the intended meaning is '(He/she) killed Goliath.' This construction, however, does not give rise to a passive interpretation.

The other possibility, *pro*-drop of an indefinite pronoun, is not viable either, as Tongan does not have any indefinite pronoun as such. Although there is an expression *ha taha* 'indefinite one', the indefinite article *ha* is usually used only in interrogative or negative contexts in a way analogous to English *any*. Moreover, such an indefinite expression generally cannot be dropped.

2.2 Pragmatically Controlled PRO

The unexpressed agent in constructions like (1b) differs from a discourse topic variable in two more important respects. First, unlike discourse topic variables, when the context makes it possible to identify the referent of the unexpressed agent in agentless transitive constructions, it is not restricted to third person. For example, the unexpressed agent is interpreted as coreferential with the possessor *'eku* 'my' in (11a) and the subject of the second clause *mau* 'we' in (11b) (Dukes 1996: 152).

(11) a. ‘oku ou mahalo pē kuo ilo ‘e he‘eku
PRS 1.S maybe just PERF know ERG POSS.1.S
fa‘ē [na‘e ‘ikai paasi ‘eku sivi].
mother PST NEG pass POSS.1.S exam
‘I think my mother knows that I didn’t pass my exam.’
b. [Na‘e tāmate‘i ‘a e misini´] ka mau folau lā pē.
PST kill ABS REF engine.DEF and 1.PL.EXCL travel sail only
‘(we) turned off the engine and we traveled by sail alone.’

Second, unlike topic variables, which are not subject to any Case-related constraints, unexpressed agents must be ERG. In his corpus study, Dukes (1996) observes that null arguments in Tongan can be coreferential with first and second person arguments only when they are taken to be ERG arguments.

Based on these observations, Otsuka (2010) proposed that agentless constructions such as (1b) in Tongan results from the incorporation of a phonetically null pronominal agent with unspecified phi-features. The incorporated agent is interpreted as coreferential with a particular DP if the context provides a potential antecedent (or “postcedent”, as in (11b) above). If not, its unvalued phi-features yield an indefinite interpretation, “someone”.

Agent incorporation in passive constructions is attested in languages like Quechua, as the following example from Keenan and Dryer (2007: 345) illustrate.

(12) a. Kuru-Ø manzana-ta miku-rqa-n
bug-SUBJ apple-DO eat-PST-3
‘The bug ate the apple.’
b. Kuru miku-sqa-mi manzana-Ø ka-rqa-n
bug eat-PTCPL-comment apple-SUBJ be-PST-3
‘The apple was bug eaten.’

Agent incorporation in Quechua is productive and the subject marking on the theme NP suggests that the relevant operation is passivization. The agentless transitive construction in Tongan is also productive, but it differs from the agent incorporation in Quechua in two respects. First, the construction is not intransitive in that the theme NP is not the grammatical subject, as shown in Section 1. Second, the incorporated agent must be a phonetically null pronoun. These facts cast doubt on the agent incorporation analysis.

I therefore propose an alternative analysis of (1b) that does not require agent incorporation: the unexpressed agent is an instance of PRO.[5] Recall that the distribution of PRO is also restricted to ERG-marked subjects in Tongan. One may question how PRO could be permitted in the subject position of a tensed clause at all, but as noted above, PRO in Tongan apparently can occur in Case positions, specifically, in ERG positions. The unexpressed agent in constructions like (1b) is then an instance of pragmatically controlled PRO, whose reference may be arbitrary. When PRO is assigned arbitrary reference, the relevant construction serves as a functional equivalent of passive.

3 Passive Morphemes?

Thus, agent suppression is a productive means to achieve the main function of passive, namely, backgrounding of the agent, but it is not the only functional equivalent of passive in Tongan. There is also a handful of verbs that are inherently passive in that they take a theme subject: *ʻosi* 'to be finished', *ngalo* 'to be forgotten', *ʻohovale* 'to be surprised', *lavea* 'to be injured' to list a few. These are monovalent, state-denoting predicates, and the agent cannot be implied. In order to express the agent, these forms must be causativized (e.g., *faka-ʻosi* 'to finish') or causativized and transitivized (e.g., *faka-ʻohovale-'i* 'to surprise (someone)', *faka-lavea-ʻi* 'to injure (someone)'). Thus, what we find in Tongan is a number of intransitive-causative pairs rather than active-passive pairs. Inherently passive verbs of this sort are commonly found across Polynesian languages and are treated as a subclass of stative verbs (e.g., *loa'a* stative verbs in Hawaiian).

Many Tongan words that are translated as passive in English contain either a prefix *ma-* or a suffix -C*ia* (where C represents a variable thematic consonant). The prefix *ma-* derives a lexeme denoting a resultative state: e.g., *ma-fao* 'stretched', *ma-fola* 'widespread', *ma-fuli* 'flipped', *ma-hae* 'torn', *ma-hino* 'clear, understood', *ma-hua* 'spilt', *ma-puni* 'closed', *ma-vau* 'scraped'. These *ma*-verbs are monovalent and accordingly, the agent cannot be expressed. This prefix, however, cannot be analyzed as passive morpheme as such for two reasons. First, the base to which *ma-* attaches is not always a transitive verb. In some cases, it is not even a lexeme: *ma-hino* vs. **hino*, but *faka-hinohino* 'to explain', *ma-puni* vs. **puni*, but *tā-puni-'i* 'to close (something)', *ma-hua* vs. **hua*, but *huaʻi* 'to spill (something)' and so on. Second, not all *ma*-forms have a passive meaning: e.g., *puna* 'to jump' vs. *ma-puna* 'to gush', *lingi* 'to pour out' vs. *ma-lingi* 'to gush', *lava* 'possible' vs. *ma-lava* 'possible'.

The other affix -C*ia* occurs in a number of Polynesian languages and in fact, is commonly accepted as a passive morpheme in Eastern Polynesian languages such as Hawaiian and Māori.[6] In Eastern Polynesian, -C*ia* suffixation is highly productive. The unmarked form and the C*ia* form of a transitive verb correspond to active and passive in English translation, respectively. Consider the Māori examples in (13). Note that case

[5] Or more accurately, what I refer to as PRO in Section 1.3. The basic nature of this empty category remains the same as formulated in Otsuka 2010: a phonetically null pronoun with unspecified phi-features. It could well be postulated as a type of *pro*, especially if all occurrences of controlled PRO can be shown to be an instance of pragmatic control. I defer further discussion to future work.

[6] But see Otsuka 2012 for an alternative view.

alignment shows a nominative-accusative pattern in Māori, in which the subject is unmarked and the direct object is marked by *i*.

(13) a. Ka patu te tangata i te kurī.
INC kill the man DO the dog
'the man killed the dog.'
b. Ka patu-a te kurī e te tangata.
INC kill-PASS the dog AGT the man
'The dog was killed by the man.'

In Tongan, however, the relationship between the unmarked form and the C*ia* form is not a syntactic one. Affixation of -C*ia* is not productive (cf. Chung 1978); nor does it always involve a transitive base. Churchward (1953) aptly observed that a subclass of C*ia* forms consists of "intransitive verbs that may appear to be passive", noting that in other instances -C*ia* suffixation yields either durative or polite form of the base. Verbs derived by -C*ia* suffixation are typically intransitive (but not always) and the base may be a transitive verb, intransitive verb, adjectival (or stative) verb, or noun. Furthermore, not all C*ia* forms have passive meaning. When they do have passive meaning, the relationship between the base and the C*ia* form is not always the same as that between active and passive. In some cases, the base has passive meaning to begin with: e.g., *malu* 'to be sheltered' vs. *malungia* 'to be shaded, overshadowed'. In other words, -*Cia* does not necessarily de-transitivize a verb. In fact, there are some instances in which the derived form is a transitive verb, including those in which -C*ia* actually transitivizes an intransitive base.[7] Thus, clearly, -C*ia* cannot be regarded as a passive morpheme in Tongan, whether we take passive to be a productive syntactic operation or a semantic feature (as in the case of inherent passive verbs discussed above).

If -*Cia* is not a passive morpheme, then, why is it that so many of *Cia* verbs correspond to passive forms in English? I argue that it is due to the semantic feature [+affected], which nearly all of the C*ia* forms seem to share: C*ia* forms differ from their base in that their argument is affected in some way. The affected entity is the subject if it is an intransitive verb or adjectival verb, and the object, if it is a transitive verb. Consider the examples in Table 1 below.[8] Due to this feature [+affected], C*ia* verbs are interpreted as passive when translated into English (or any other language that has passive), as the affectedness of the patient is one of the semantic correlates of passive.

[7] Including "passive transitive", which refers to a class of C*ia* verbs that have passive meaning, but permit an ERG-marked agent, as exemplified in (i) below (from Chung 1978: 274).
(i) 'Oku manakoa 'a e hiva ko eni 'e he kakai Tonga.
PRS to.be.liked ABS DEF song PRED this ERG DEF people Tonga
'This song is popular among the Tongan people.'

[8] Forms such as *ifo-'ia* 'to find (something) tasty, pleasant' and *sai'ia* 'to like (something)' are intransitive in Tongan although the corresponding English verbs are transitive. These verbs take an experiencer subject and the theme is expressed as an oblique NP.
(i) 'oku ou sai'ia 'i he ika.
PRS 1.S like in REF fish
'I like fish' (Lit. 'I am affected by the niceness in the fish')

BASE		-CIA FORM	
malūlū	'moist, soft'	*malūlū-ngia*	'moistened, softened'
'ata'atā	'free, not busy'	*'ata'atā-ina*	'to be freed, cleared'
ifo	'tasty'	*ifo-'ia*	'to find (something) tasty, pleasant'
sai	'good, nice'	*sai-'ia*	'to like (something)'
'uha	'to rain'	*'uhe-ina*	'to be caught in the rain'
'anuhi	'to spit'	*'anu-hia*	'to mess up (smt) by spitting on'

Table 1. Comparison of the base and C*ia* forms

Conclusion

The present study has shown that Tongan mainly has two means to express functional equivalents of passives: (a) agent suppression and (b) inherently passive lexical items. I have shown above that the agentless suppression in Tongan does not alter the transitivity of the relevant construction, and that agent backgrounding is achieved by means of the use of arbitrary PRO. As for inherently passive verbs, I have shown that this class of verbs includes root forms such as *'osi* 'to be finished' as well as forms affixed with *ma-* and -C*ia*. I have argued that the apparent passive meaning of these derived forms arises because their semantic effects happen to coincide with the semantic correlates of passivization: resultative (necessarily backgrounding or removing the agent) for *ma-* and affectedness of the patient (necessarily foregrounding the patient) for -C*ia*.

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Affiliation

Yuko Otsuka
Department of Linguistics
University of Hawai‘i
yotsuka@hawaii.edu

A note on invariance of grammatical categories

Denis Paperno

This squib aims to further our understanding of the relation between invariants of grammar and grammatical categories. Keenan and Stabler (2003) propose to formalize of the notion of 'structural/ grammatical' in terms of automorphism invariance, based on a very general notion of formal grammars (Bare Grammars). It is natural to think that category labels (more precisely: sets of language expressions that bear a given category label) are flesh and blood of grammatical structure and should be invariant. Indeed, categories are invariant (under stable automorphisms) in all of Keenan and Stabler's example grammars. But in fact it is possible to construe several types of counterexamples where grammatical categories fail to be invariant. I conjecture that automorphism invariance characterizes only categories whose content is properly syntactic, excluding e.g. morphological properties, which are traditionally also considered grammatical.

Keywords Bare Grammar, invariants, grammatical categories

Background

Keenan and Stabler (2003) propose a neat formalization of the linguistic notion of *structural* in terms of automorphism invariance. They rely on the a simple grammar format, whereby a grammar G is a quadruple

$$\langle \mathrm{V_G}, \mathrm{Cat_G}, \mathrm{Lex_G}, \mathrm{Rule_G} \rangle$$

where $\mathrm{V_G}$ and $\mathrm{Cat_G}$ are sets of vocabulary items and category symbols, respectively. Possible expressions have the form (s,C) where s$\in \mathrm{V_G^*}$ and C$\in \mathrm{Cat_G}$. The set of lexical items $\mathrm{Lex_G}$ is a subset of $\mathrm{V_G} \times \mathrm{Cat_G}$, and each rule $R \in \mathrm{Rule_G}$ is a partial function from sets of expressions to expressions (from $(\mathrm{V_G^*} \times \mathrm{Cat_G})^+$ into $\mathrm{V_G^*} \times \mathrm{Cat_G}$).

The language $\mathrm{L_G}$ generated by grammar G is defined as the closure of $\mathrm{Lex_G}$ under $\mathrm{Rule_G}$:

$$\mathrm{Lex}_0 = \mathrm{Lex_G};$$

$$\mathrm{Lex}_{n+1} = \mathrm{Lex}_n \cup \{R(e_1, \ldots, e_k) \mid R \in \mathrm{Rule_G}, e_i \in \mathrm{Lex}_n\};$$

$$\mathrm{L_G} = \bigcup_{n \in \mathbb{N}} \mathrm{Lex}_n$$

A map h from $\mathrm{L_G}$ to $\mathrm{L_G}$ can be extended to a map h^* on relations on $\mathrm{L_G}$ so that $h^*(R) = \{h(e_1), \ldots, h(e_k) \mid e_1 \ldots e_k \in R\}$. In particular, h^* applies to functions on $\mathrm{L_G^*}$ and to the subsets of L_G, which can be seen, standardly, as special cases of relations. An *automorphism* on L_G is a map h that fixes Rule_G, i.e. for each $R \in \text{Rule}_G$, $h^*(R) = R$ (recall that rules are functions on L_G^*). Using this notion of automorphism (a map from language onto itself that fixes rules of grammar), (Keenan and Stabler 2003:21) conjecture:

> The *syntactic invariants* of a grammar G are the fixed points of the automorphisms of G.

So syntactic invariants are expressions, sets of expressions or relations on expressions that any automorphism on the language maps to themselves. Provably, the relations CON 'be constituent of', CC 'c-command' are invariant in all grammars; the grammatical formatives are "lexical items that are always mapped to themselves by the structure preserving transformations [= automorphisms – D.P.] on L_G." Keenan and Stabler argue that the anaphor-antecedent relation, theta role equivalence, grammatical case, and other syntactically relevant properties of and relations on natural language are invariant (fixed by all automorphisms of grammar). Most of the suggested invariance universals are quite plausible; but one, I claim, requires closer scrutiny.

Following the idea that structural equals invariant, Keenan and Stabler hypothesize that in all natural languages, syntactic categories are invariant (p. 23):

> For all C$\in \text{Cat}_G$, PH(C) [the set of expressions of category C – D.P.] is invariant (that is, the property of being a C is structural).

Later in the same work, Keenan and Stabler weaken this conjecture, requiring invariance only under *stable* automorphisms – those which can be extended properly under any extension of Lex_G (all the automorphisms considered below are stable). So (Keenan and Stabler 2010:13) hypothesize that

> for a given lexical item *d*, the other lexical items of the same category as *d* are just those $\langle \ldots \rangle$ that a stable automorphism can map *d* to.

A related idea that (Keenan and Stabler 2010:9) entertain (and reject) equates syntactic categories with equivalence classes of the coarsest congruence, where a *congruence* is an equivalence relation $\simeq$ such that if $s_i \simeq t_i$ for all $\mathbb{N}$, then for any $R \in \text{Rule}$ and any $k \in \mathbb{N}$ either $R(s_1,\ldots,s_k)$ and $R(t_1,\ldots,t_k)$ are both undefined or $R(s_1,\ldots,s_k) \simeq R(t_1,\ldots,t_k)$. The grammars in the next section illustrate three types of counterexamples to both the original hypothesis (with or without the restriction to stable automorphisms) and the congruence-based hypothesis.

Example grammars

In fact, without additional assumptions the invariance of syntactic categories is not guaranteed (even just under stable automorphisms). A trivial case is category distinctions that play no role in the grammar. So for example one could assign distinct categories to animate and inanimate proper nouns of English:

$$\text{Lex}_{\text{Eng}} = \{(\text{Susan}, N_a), (\text{Leslie}, N_a), (\text{Martha}, N_a), (\text{Titanic}, N_i), (\text{Britain}, N_i), (\text{sank}, V)\}$$

$$\text{Rule}_{\text{Eng}} = \{\text{Merge}\}$$

where y=Merge((s,C),(t,C′)) iff C is N_a or N_i and C′=V and y=(s^t,S)

Given this grammar (which marks nouns for animacy but incorporates the idea that animacy plays no role in English) a map substituting an animate and an inanimate noun in all expressions would be an automorphism (a stable one):

$$h(\text{Susan}, N_a) = (\text{Britain}, N_i); h(\text{Britain}, N_i) = (\text{Susan}, N_a)$$

$$\text{and for all other } e \in \text{Lex}_\text{G}, h(e) = e.$$

Clearly, one of the categories N_a, N_i is redundant (in the following technical sense: one can replace all lexical items of category N_a with ones of N_i – and vice versa –without changing the string image of the language – $\{s \mid (s, C) \in \text{L}_\text{G} \text{ for some } C \in \text{Cat}_\text{G}\}$). Theoretical linguistics tends to avoid such redundancy of grammatical description, so the last example is hardly realistic for a grammar of natural language to be constructed by linguists. But redundant syntactic categories are merely a trivial special case of non-invariant ones – and more realistic examples are to follow.

So how can a category matter (i.e. be non-redundant in the grammar) without being structurally invariant? The short answer is that non-invariant category distinctions can encode the string operations on expressions but not their combinatory capabilities. Note that automorphisms have to fix rules, construed set-theoretically as relations on expressions: that $e_1, \ldots, e_k$ combine into e via rule R is, in Bare Grammar, formalized as $\langle e_1, \ldots, e_k, e\rangle \in R$ where R includes as a subset a k+1-ary relation (equivalently, in function notation, $R(e_1, \ldots, e_k) = e$). So combinatory properties encoded in categories have to be structural. E.g. in the English example above nouns can combine only with verbs and not with other nouns to produce a sentence; so any automorphism has to preserve the noun-verb distinction, otherwise the automorphism fails to fix the domain of Merge — and by implication Merge itself — and so is not an isomorphism, leading to a contradiction.

So a non-redundant category can be non-invariant if it matters only for the string component of what a rule does to the input expressions; domains and ranges of rules have to stay fixed. Linear order is one of the simplest examples of how the operation on strings can vary depending on the syntactic category of constituents combined. The category of an expression can indicate whether it is preposed or postposed when combining with another expression (this is standardly encoded in categorial grammar slash notation), and a single rule can serve both the preposed and the postposed case. Then if linear position is the only difference between two categories, expressions of these categories can be interchanged by automorphisms, so the categories are not invariant. Take the example of a language that has both prepositions and postpositions, assuming that both produce the same kind of adpositional phrases (PP), Ger with Rule_{Ger}={Merge}:

$$\text{Merge}((s,C),(t,C')) = \begin{cases} (s^\wedge t, PP) & \text{if } C = PP/N \text{ and } C' = N; \\ (t^\wedge s, PP) & \text{if } C = N\backslash PP \text{ and } C' = N; \\ \text{undefined} & \text{otherwise.} \end{cases}$$

$$\text{Lex}_{\text{Ger}} = \{(\text{Max}, N), (\text{Karl}, N), (\text{trotz}, PP/N), (\text{gemäß}, PP/N), (\text{zufolge}, N\backslash PP)\}$$

The example grammar above uses German words for illustration since German has both numerous prepositions (*trotz* 'despite', *gemäß* 'according to' etc.) and a few postpositions such as *zufolge* 'according to'. Take the map h that interchanges (gemäß, PP/N) and (zufolge, $N\backslash PP$), and also interchanges (gemäß Karl, PP) with (Karl zufolge, PP) and (gemäß Max, PP) with (Max zufolge, PP) but maps all other expressions to themselves. This map is an automorphism since it preserves Merge as can be easily seen on a case-by-case basis since the language is finite. The only non-trivial cases are expressions containing *zufolge* or *gemäß*, for instance

$$h(\text{Merge}((\text{gemäß}, PP/N)(\text{Karl}, N))) = h(\text{gemäß Karl}, PP) = (\text{Karl zufolge}, PP) =$$

$$= \text{Merge}((\text{zufolge}, N\backslash PP), (\text{Karl}, N)) = \text{Merge}(h(\text{gemäß}, PP/N), h(\text{Karl}, N))$$

So in this case, h commutes with Merge, our only rule here; other cases are analogous. This means that h fixes Rule_G and is by definition an automorphism, indeed a stable one (it naturally extends to new expressions of the language should we add new lexical items). But h fails to preserve categories PP/N and $N\backslash PP$, so these are not invariant (they are also non-redundant!). Therefore, prepositional and postpositional phrases turn out to be structurally isomorphic.

There is some linguistic evidence that in actual German, as opposed to our simplified example, prepositional and postpositional phrases are not isomorphic, but it has no bearing on the theoretical point made here: category distinctions that encode only the linear position of the expression with respect to others may fail to be invariant. Other than adpositions, some reasonable candidates for such category distinctions are preposed and postposed adjectives in French, phrase-initial vs. second-position elements in Indo-European languages (Latin *et* 'and' vs. second-position *-que* 'and'), and the preposed definite vs. postposed indefinite article of Classical Arabic.

Categories can affect not just linear order of constituents but also string operations applied to them by the same rule. A poster child could be inflection classes, as observed in numerous languages, compare the conjugation of Ancient Greek verbs in present indicative:

person	'say'	'release'
1sg	phē-mi	lu-ō
2sg	phē-s	lu-eis
3sg	phē-si	lu-ei

Inflection classes can be formalized as distinct categories in a grammar like the following:

$$\text{Rule}_{Gr} = \{\text{Form}_{1s}, \text{Form}_{2s}, \text{Form}_{3s}\}$$

$$\text{where } \text{Form}_{1s}(s, C) = \begin{cases} (s^\wedge\text{mi}, V) & \text{if } C = V_{mi} \\ (s^\wedge\text{ō}, V) & \text{if } C = V_o \\ \text{undefined} & \text{otherwise.} \end{cases}$$

$$\text{Form}_{2s}(s, C) = \begin{cases} (s^\wedge\text{s}, V) & \text{if } C = V_{mi} \\ (s^\wedge\text{eis}, V) & \text{if } C = V_o \\ \text{undefined} & \text{otherwise.} \end{cases}$$

$$\text{Form}_{3s}(s,C) = \begin{cases} (s^\wedge\text{si}, V) & \text{if } C = V_{mi} \\ (s^\wedge\text{ei}, V) & \text{if } C = V_o \\ \text{undefined} & \text{otherwise.} \end{cases}$$

$$\text{Lex}_{\text{Gr}} = \{(\text{lu}, V_o), (\text{pher}, V_o), (\text{leg}, V_o), (\text{phē}, V_{mi}), (\text{histē}, V_{mi})\}$$

Given this grammar, the map h that exchanges the stems and all forms of the verb (lu, V_o) and $(\text{phē}, V_{mi})$ and maps all other expressions to themselves is a stable automorphism (as can be easily shown on a case-by-case basis). So inflection classes, even though they play an important role in Greek grammar (and are clearly not redundant), are not structural.

Conclusion

We identified two linguistic phenomena — positional classes and inflection classes — which are an indispensable part of the grammar of respective natural languages and can be encoded as grammatical categories, but may fail to be invariant under (stable) automorphisms. So positional and inflection classes are not syntactic invariants — and indeed, this makes informal sense. Inflection classes are traditionally treated in morphology rather than syntax, and it is a common assumption in modern generative grammar that linear order (as opposed to the phrase structure underlying it) plays no role in the syntax. Many linguists would agree that the counterexamples to invariance of categories should be formalized in different components of grammar than syntax proper: inflection classes within a dedicated morpho(phono)logical component, and the alternations in linear position "in a special component devoted to cliticization and readjustment" (Zwicky and Pullum 1983:385). To summarize, I conclude that categories of Bare Grammars are invariant to the extent that the content of those categories pertains to (narrow) syntax. Category distinctions that are purely morphological (the Greek conjugation example), linear (the German adposition case), or semantic (the English animacy distinction), do not need to be syntactic invariants.

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Affiliation

Denis Paperno
Center for Mind/Brain Sciences
University of Trento
paperno@ucla.edu

Appreciating Functions: Ed Keenan in the Early History of Formal Semantics

Barbara H. Partee

As I work on a book project on the history of formal semantics, I come to appreciate how everyone involved has a unique story, and Ed Keenan certainly does. To me, one of the many things that make him special is the degree of his devotion to *functions* and their role in semantics. So for this short squib I want to pick out a few pieces of Ed Keenan's story that illustrate his love of functions.

Keenan is not a functionalist in the usual "formalists vs. functionalists" sense, and it's a pity that the term is now attached to that sense. Otherwise he could be a proud functionalist in at least two other senses. On the one hand, he has found it very fruitful to think about how various syntactic constructions in different languages contribute to the expressive power of those languages — to think about the semantic function of having certain things in the syntax. I'll illustrate that with a Malagasy story. And on the other hand, Ed really likes to think of semantics in terms of the functions that are denoted by various expressions. When I interviewed him, this came up many times in different contexts, and I mostly want to write about that, because it probably sets him apart from many linguists who think of semantics in terms of some sort of "logical forms" or in terms of expressions in some logical language or some other semantic representation language, treating the model-theoretic interpretation as secondary or of no great interest.

Ed went to Madagascar in 1969–70 to do fieldwork on Malagasy as an NSF Postdoctoral Fellow. He had just finished his Ph.D. in Linguistics at Penn in 1969, with a program that included a lot of logic and recursive function theory, a minor in the school of Information and Computer Science, and a dissertation offering a three-valued logic for treating presuppositions, including a completeness proof. His dissertation supervisor was John Corcoran, an Assistant Professor of Linguistics at Penn whose own Ph.D. was in mathematics at Berkeley (supervised by Robert McNaughton, himself a student of Quine). Corcoran was a young Assistant Professor then, and although Ed was in principle doing his dissertation with Zellig Harris, Harris was away in Israel much of the time and Corcoran was his real advisor, and Ed and Harris both agreed Corcoran should get the recognition as his advisor. Corcoran later went on to become Professor of Philosophy at Buffalo, and he's known as a logician, philosopher, mathematician, and historian of logic. Penn at that time was a very heterogeneous department — Henry Hiż was also not a linguist by training but part of a group of Polish logicians. No one was teaching natural language semantics; when I asked Ed whether he agreed with something I had read that said that Zellig Harris was extremely skeptical about semantics and didn't consider it an empirical subject, Ed said that that was at least consistent with what he knew of him — that Harris's concern was entirely with distributional patterns on the surface, with defining transformations via substitution classes based on patterns of co-occurrence restrictions. What Ed knew of semantics was mainly from logic; he knew considerably more logic than most linguists of our generation, and when he eventually encountered Montague's work, he found it not so surprising as it was to many of us.

But I want to report a nice episode from his year in Madagascar, about passives. Ed says that the year he spent in Madagascar was "a real learning experience", "one of the things that in a sense partly kept me in the field". "The only thing that was easy about it was that it was obvious you had a lot to learn, and in that sense it's rather different from, say, going to [. . .] England where you think you think you sort of know everything except the accent, and you realize too late that you don't. [. . .] But when I'm in this little rice growing village, it was totally obvious that I had to adapt, and I didn't have much of an idea how to start." But quite remarkably, a young fellow from the next village showed up on his doorstep who had heard that Ed knew English, and he wanted to learn English, and Ed agreed to do it as a trade: " 'You teach me Malagasy and I'll teach you English.' And we did that for the whole year. And this guy wasn't like some super-genius in the rough; but [. . .] he was careful, and assiduous. So after about six months, we didn't even speak any French any more except every once in a while [. . .]."

Ed reports on an 'aha' moment from his learning about Malagasy with the kid from the next village. He had been finding out that only subjects are "extractible" to form relative clauses, wh-questions, cleft sentences, etc., and that there was a rich system of morphology that went on the verb to mark the theta-role of the subject as instrument, agent, benefactive, etc. And he reports on how he came to see that as a rich 'voice' system and to see what it was "for".

> And I mean I'm sitting there working with this kid from the next village, sitting there watching the cows with him, and we're going through my sheets, and checking things off, or putting x's , [chuckling] and finally at one point, this kid just loses patience, he takes my sheet and he just starts going through and filling in — we're still saying it orally, but —, and then I finally saw the pattern, and I'm thinking, Why does the language have six kinds of passives? This is crazy! What do you need them for? And then I realized, what it's there for is to feed the extraction rules. Only we weren't calling them extraction then, but to feed movement rules, to feed things like question formation, cleft formation, relative clauses. And at the time it never occurred to me to think that there was any voice other than passive. I didn't think much of English passive actually — you know, if you lost it, I don't think anybody but a few linguists would notice. Whereas if you lost the voice systems in these Philippine languages, you'd have to change how you do relative clauses, imperatives, reflexives, questions, you know, the core grammar rides on the voice system in a very essential way.
>
> [. . .] But this was like a discovery. You know, I realized what the function of this voicing system was in the language, and I'm thinking: This is like the real linguistic pattern. It's independent of my theories, and it's not something I'm getting from English. And that was exciting, like that was the first linguistic regularity I ever really noticed. Something that you might call a 'law of nature'

> or something, a pattern in nature. That was exciting.
>
> And that made all of my careful work with this guy worthwhile. You know, there's still 10% of the cases that were fuzzy and didn't quite fit, but the overwhelming pattern was clear. And I could see why little kids learn that voice system, you know, if they want to talk about the clothes that John is washing, it's got to be the clothes that are being washed by John. And so on. You know, the axe that John killed the chicken with *has* to be 'the axe that was killed-with by John the chicken'.[1]

That illustrates one kind of interest that Ed has in functions: why did Malagasy need six kinds of "passives"? Because the rules for the formation of relative clauses, wh-questions, etc., all targeted only subjects.

But even more striking to me is his interest in functions as the denotations of linguistic expressions. As Lewis (1970) had put it, "I promised simplicity; I deliver functions from functions from functions to functions to functions from functions to functions. And worse is in store if we consider the sort of adverb that modifies ordinary adverbs: the category $((S/N)/(S/N))/((S/N)/(S/N))$. Yet I think no apology is called for. Intensions are complicated constructs, but the principles of their construction are extremely simple." (p. 12 in the reprint in Partee 1976).

Keenan reports that he first encountered Montague's work in the early 1970's via colleagues in Germany, mainly Christian Rohrer and his group at Stuttgart. "Conceptually, I didn't find his work all that startling, because it's like it was in logic [. . .] — you have your syntax, compositionally interpreted — that's what I thought semantics was! What I thought was totally great was the first article [Montague (1970a)], that you can treat English as one of these languages." Ed goes on to say that he liked the later work [Montague (1970b, 1973)] less, because of Montague's decision in those papers not to do direct model-theoretic semantics as in Montague (1970a) but to proceed indirectly via translation into intensional logic:

> We could as in (Montague 1970a) introduce the semantics of our fragment directly; but it is probably more perspicuous to proceed indirectly, by (1) setting up a certain simple artificial language, that of tensed intensional logic, (2) giving the semantics of that language, and (3) interpreting English indirectly by showing in a rigorous way how to translate it into the artificial language.
>
> Montague (1973), page 256 in the 1974 collection

Linguists in general embraced that "indirect" method. Keenan: "What it meant was that people who thought they were doing semantics in my judgment weren't so much studying meaning any more, they were studying translation from one language to another. So they were doing syntax. Admittedly your target language was one that was semantically interpreted, so you can say, yes, yes, you take the composition of the interpreting function with the translation function and you've got an interpretation."

Keenan was glad that there were people who kept their eye on the real semantics, and didn't just pay attention to translation into their favorite logical language. I have the sense

[1] Later on, expressing his negative reaction to the idea that the main recursion in grammar is recursion on sentences, Ed talks about seeing this all in terms of predicate-formation, rather than as extraction from a sentence.

that Ed thinks, probably wisely, that if you want to stay attuned to possible differences in the way the semantics of different languages works, you should try to think as directly as possible about the functions denoted by various expressions or involved in various constructions. Working by translation into a given logical language could have some of the same kind of prejudicial effects as trying to treat every language through the lens of English. One could counter by saying that linguists have often sensed the inadequacy of a given logical language for capturing some phenomenon in some language and have accordingly proposed extensions or revisions of the logical language and its semantics, as was done in Link (1983), in Kamp and Heim's work in the early 1980's, and others. The reply might be that those proposals were made by people who thought first and foremost about how the denotations needed to work, and the languages they designed were undoubtedly guided by their "real semantic" sense.

Drawing a contrast with those who did 'semantics' by translating into some logical language, Keenan says, approvingly:

> But a lot of the later people didn't do that, so there were things that we found out later of a semantic nature that I think Montague would have been delighted with, had he lived. I think he would have been fully supportive of the kind of work done in generalized quantifier theory. And the regularities that people have found there, properties like conservativity and others. But none of that was discovered working through this PTQ-style translation semantics.
>
> And I have to say more – I really didn't like all these sub-stars and super-stars and caps and cups, you know, it just kept getting in the way. And it's still true: I much prefer to define the functions I'm interested in and study the functions, rather than write down an appropriate definition with a lot of lambda expressions with typed variables, which in theory can say the same thing. And some people seem to do extremely well that way. Van Benthem thinks he looks at the world through lambda lenses, as he puts it. But I like to look at the functions, you know, that's what I sort of see as real.

Ed considers type theory useful just insofar as it helps clarify what the domains and codomains of the various functions are that interpret expressions of various categories. But even there he sees some danger of straitjacketing our semantic analyses by type theories that make it hard to express certain generalizations. So for example, in the domain of quantification, he believes that

> the field has failed to make a kind of basic generalization. In Heim and Kratzer (1998) for example, even in van Benthem's writings, they look at the object of a transitive verb and they say 'you've got a type mismatch' — because with, say, *every student* in, say, *Bill knows and likes every student*, they want to think that the transitive verbs are of type $\langle e, \langle e,t \rangle \rangle$, which they are, just binary relations — the extensional ones — but the noun phrases are type $\langle \langle e,t \rangle ,t \rangle$ — they just take properties to truth values. So Heim and Kratzer say there's a mismatch. [...] It won't cancel to what it should cancel to, namely $\langle e,t \rangle$ — the whole thing's a verb phrase. And so people have provided lots of solutions to that [...]. And it seems to me intuitively that the right generalization should be the following: Noun phrases, by which I'm including *every student* and *John* and

all the complicated things, are not simply functions that map unary predicates to 0-ary ones, which are truth values, they in general just map $n+1$-ary relations to n-ary relations. And the type notation has misled us — it's given us a fixed type, $\langle\langle e,t\rangle,t\rangle$, because you started looking at subject-predicate sentences, and then you had in that sense the same problem that Frege faced, how do you get two quantified arguments on the same predicate?

And if you think of it just at a lower level, suppose I tell you I've got, say, some kind of string function — where you've got a vocabulary V with at least two elements $\{a,b\}$, and I define a function f let's say from $\{a,b\}^+$, it takes the set of finite non-empty strings and it maps each string to the string you get by deleting the last symbol from the string. OK? Seems like a both straightforward and uninteresting function. It wouldn't occur to you tell me, "No, no, Keenan, you've got your head messed up, what you've really defined there is an infinite set of functions. One of them maps strings of length 1 to strings of length 0; a second maps strings of length 2 to strings of length 1; and so on." And I'm saying "No, no, it's just one function, all it does is gobble up the last thing." And that's what the NPs do, only instead of looking at sequences of length n, you're looking at sets of sequences of length n, and what the NP does is gobble up the last argument and reduce it. So I find it much happier thinking that way.

Ed acknowledges a debt to Lewis (1970). "Montague (1970a) was *hard* to read; Lewis was very clear. And he assigned a type to the quantifier words like *every*; PTQ didn't." For Keenan, one of the important advances in Lewis's and Montague's work was the categorial grammar notation, which gave a way to think about what the denotations could be. As a graduate student, Ed had had frustrations, because he had only a small set of Boolean things in his semantic toolbox, and had for instance no way at all to think about what the denotation of a preposition might be. As both Keenan and Bach quickly observed, categorial grammar had been dismissed by the generative syntacticians too quickly as soon as it was shown to be equivalent in generative capacity to context-free phrase structure grammar. Only after semantics came into the picture was it reappreciated as showing how to think semantically about function-argument structure associated with syntactic categories.

One of Keenan's papers that had a great influence on me in my early work was his paper, "The functional principle" (Keenan 1974). The Functional Principle that gives the paper its name is stated as follows:

The Functional Principle (FP)

(i) The reference of the argument expression must be determinable *independently* of the meaning or reference of the function symbol.

(ii) Functions which apply to the argument however may vary with the choice of argument (and so need not be independent of it). (Keenan 1974:298)

Keenan gives examples from mathematics, but his main concern is to show the far-reaching usefulness of the principle in explaining various properties of *subjects* of simplex sentences, *heads* of restrictive relative clauses, and *possessor phrases* of possessive constructions. Later on, Bach and Partee (1980) drew on this work in arguing for the usefulness of a more semantic analog of the "c-command" relation in accounting for constraints on antecedent-anaphor relations, invoking a relation to which David Dowty (1980) gave the apt name *f-command*, for "function-argument command". The idea was to replace the constraint "A pronoun may not c-command its antecedent" with a constraint "A pronoun may not be the argument of a function containing its antecedent" (Bach and Partee 1980, p.127 in Partee 2004). The idea that it's the argument that f-commands the function, rather than vice versa, would have seemed counter-intuitive to us if not for what Keenan had already demonstrated in Keenan (1974).

Keenan has been thinking about functions for decades since that early work, with fruitful and original results of many kinds. For me it's interesting to see how far back we can find him focusing on what sorts of things denotations really might be, rather than on finding some logical notation for writing down representations of meaning. His work constitutes a good argument for pursuing direct rather than indirect semantic interpretation.

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Affiliation

Barbara H. Partee
University of Massachusetts Amherst
partee@linguist.umass.edu

Aspect and Voice Selection in Malagasy

Initial Observations

Matt Pearson

Introduction

In Malagasy, a head-initial Austronesian language of Madagascar, basic clauses consist of a *predicate phrase* combined with a DP constituent which I will refer to here as the *trigger* (also known as the *subject*). When the predicate phrase is headed by a verb, that verb inflects for *voice* to indicate the grammatical function of the trigger. The examples in (1) below illustrate the various voice forms for the verb 'kill' (root *vono*), with the trigger of each clause shown in italics. If the verb's external argument or *actor* (roughly, the highest argument on some participant hierarchy) functions as the trigger of the clause, then the verb appears in the *actor-trigger* (AT) voice (1a). If the trigger is the internal argument of a transitive verb, the verb appears instead in the *theme-trigger* (TT) voice (1b). Finally, the *circumstantial-trigger* (CT) form is used when the trigger bears a peripheral grammatical function such as instrument, beneficiary, location, or goal (1c).[1,2]

(1) a. Namono ny akoho tamin' ny antsy *ny mpamboly*
Pst.AT.kill Det chicken with Det knife Det farmer
'The farmer killed the chicken with the knife'

b. Novonoin' ny mpamboly tamin' ny antsy *ny akoho*
Pst.TT.kill Det farmer with Det knife Det chicken
'The farmer killed the chicken with the knife'

c. Namonoan' ny mpamboly ny akoho *ny antsy*
Pst.CT.kill Det farmer Det chicken Det knife
'The farmer killed the chicken with the knife'

As these examples show, the trigger has an invariant morphological form (the default form for DPs, traditionally labeled the *nominative*), and occurs at the end of the clause, following the predicate phrase. In non-AT clauses, the external argument appears immediately after the verb, and the two form a single phonological unit. Notice also that peri-

[1] Note that the three-way voice contrast illustrated in (1) is something of an oversimplification. As discussed in Pearson (2001, 2005b), there are actually three different TT forms, where certain verbs can appear in more than one form. This is true especially of ditransitives, which tend to take one TT form when the primary object is the trigger and a different TT form when the secondary object is the trigger. For purposes of this paper, I set such complication aside.

[2] The following abbreviations are used in the examples: Acc: accusative, AT: actor-trigger, CT: circumstantial-trigger, Det: determiner, Foc: focus particle, Gen: genitive (clitic), Nom: nominative, Obl: oblique marker, Pst: past.

pheral participants are encoded as DPs when functioning as the trigger, but as obliques (headed by a preposition such as *tamin'* 'with') when they appear in other positions.

The AT and TT forms are commonly referred to as the *active* and *passive*, respectively (Rajemisa-Raolison 1971, Keenan 1976). However, the form and distribution of TT clauses is quite distinct from that of passive clauses in English and other familiar languages. There is little or no evidence that the external argument in TT clauses (e.g., *ny mpamboly* in (1b)) has been demoted to oblique status. Moreover, the TT voice is less morphologically marked than the AT voice: for verbs such as *vono*, AT and TT voice are both expressed by affixes; but for other verbs only the AT voice is marked by affixation while the TT voice is expressed by the bare root. Finally, Keenan and Manorohanta (2001) report that the AT and TT forms of transitive verbs occur with roughly equal frequency in texts.

What conditions voice selection in Malagasy—that is, what determines which of the verb's arguments will be selected as the trigger? In certain situations voice selection is clearly syntactically determined. As numerous authors have discussed, beginning with Keenan (1976), voice is restricted in contexts involving A′-extraction of a nominal dependent. An example of such a context is the cleft construction, used both to express constituent focus and to form wh-questions (see Paul 2001, Potsdam 2006 for discussion). The cleft construction is illustrated in (2)-(3) below, where the *remnant* (the non-focused material, introduced by the particle *no*) is bracketed, and the gap within the remnant (corresponding to the clefted constituent) is notated as [e]. As (2) shows, AT voice is required when the external argument is clefted, while TT voice is ungrammatical. Likewise, when the internal argument is clefted, TT voice is required while AT voice is ungrammatical, as shown in (3). In other words, the gap corresponding to the clefted constituent necessarily functions as the trigger of the clause.[3]

(2) a. Ny mpamboly [no namono ny akoho [*e*]]
Det farmer Foc Pst.AT.kill Det chicken
'It's the farmer who killed the chicken'

b. * Ny mpamboly [no novonoina [e] *ny akoho*]
Det farmer Foc Pst.TT.kill Det chicken
'It's the farmer who killed the chicken'

(3) a. * Ny akoho [no namono [e] *ny mpamboly*]
Det chicken Foc Pst.AT.kill Det farmer
'The chicken is what the farmer killed'

b. Ny akoho [no novonoin' ny mpamboly [*e*]]
Det chicken Foc Pst.TT.kill Det farmer
'The chicken is what the farmer killed'

Outside of A′-extraction contexts, semantic and pragmatic factors play a role in voice selection. Consider again the sentences in (1) above. When presented with sets of sentences such as these, which differ only in the choice of trigger, native speakers generally report that they mean the same thing—in the sense of being truth-conditionally equivalent—but differ with regard to 'aboutness', or focus of attention: (1a) is interpreted as predicating a property of the farmer, namely that s/he killed the chicken; likewise, (1b)

[3] Clefting of PPs and adverbials presents further complications, which I set aside here. Cf. Paul (1999) and Pearson (2001) for some discussion.

predicates a property of the chicken, while (1c) predicates a property of the knife. This suggests that the choice of trigger depends on the information structure of the clause, with the trigger mapping to the *theme* (or *topic*) of the clause, and the predicate phrase mapping to the *rheme* (or *comment*).

The topic-like properties of the trigger account for an important constraint on trigger selection, namely that the trigger must be a formally definite expression—i.e., a pronoun, a proper name, or a DP headed by an overt determiner and interpreted as specific/referential, generic, or strongly quantificational (in the sense of Milsark 1977). Non-specific indefinites, which take the form of bare NPs, cannot function as triggers. Compare the following examples with an indefinite patient, where only the AT variant is possible:

(4)	a.		Namono	akoho	*ny*	*mpamboly*
			Pst.AT.kill	chicken	Det	farmer
			'The farmer killed {a chicken/some chickens}'			
	b.	*	Novonoin'	ny	mpamboly	*akoho*
			Pst.TT.kill	Det	farmer	chicken
			'The farmer killed {a chicken/some chickens}'			

To account for the topic-like behavior of the trigger, along with various binding facts, I argue in Pearson (2001, 2005a) that the trigger is merged in a clause-peripheral A′-position (the specifier of TopP) and binds an operator within the predicate phrase. The verb agrees in Case features with the operator, as schematized in (5) below, and the voice morphology on the verb is an (indirect) spell-out of this agreement relationship (see Pearson 2005b for details). To account for the extraction restriction illustrated in (2)–(3), I argue that the gap [e] is a null operator coindexed with the clefted constituent, and that this null operator competes for the same landing site with the null operator that licenses a trigger. This accounts for why the gap determines the voice of the verb within the remnant, and why the remnant cannot contain a trigger.

(5) $[_{\text{PredP}}\ \underbrace{Op_i \quad \text{V}}_{[\text{Case}]}\ \ldots\ t_i\ \ldots\ ]\ \text{Trigger}_i$

However, the theory presented in Pearson (2005a) does not provide a complete account of the Malagasy voice system. In certain cases that I have observed, voice selection in non-extraction contexts is not determined (solely) by which of the verb's arguments is most topical, but also reflects—or affects—the event-structure interpretation of the clause. In particular, the choice between AT and TT voice in transitive clauses often correlates with aktionsart or aspectual viewpoint. In some instances, AT voice is used when the focus is on the beginning point (or activity portion) of the event, while TT voice is prefered if the focus is on the endpoint of the event, or the event as a whole. In other instances, AT voice favors a durative and atelic interpretation of the predicate, while TT voice favors a punctual and telic interpretation. I provide some examples of this in the next section. Then in section 2 I present some initial speculations regarding the connection between voice and aspect.

1 Observations Regarding Voice and Aspect

Consider the sentences in (6) below, where the verb *tosek* 'push' (citation form *tosi-*

ka) selects the DP *ny vehivavy* 'the woman' as its external argument (agent), and the DP *ny sarety* 'the cart' as its internal argument (theme). Since both arguments are definite, either can function as the trigger of the clause. In (6a) the verb appears in the AT voice, marking the external argument as the trigger, while in (6b) the internal argument functions the trigger and the verb appears in the TT voice.

(6) a. Nanosika ny sarety ny vehivavy
Pst.AT.push Det cart Det woman
'The woman {pushed/was pushing} the cart' [*activity*]

b. Natosiky ny vehivavy ny sarety
Pst.TT.push Det woman Det cart
'The woman gave the cart a push' [*achievement*]
or 'The woman {pushed/was pushing} the cart' [*activity*]

Speakers I have consulted report that the AT clause and its TT counterpart differ not merely in the choice of trigger, but in the type of event they can refer to. Like its English counterpart, *tosek* 'push' can denote either a durative, atelic event (an *activity*, in the typology of Vendler 1967) or a punctual, telic event (what Vendler calls an *achievement*). Under the activity reading, the woman applies continuous force to the cart to move it forward; while under the achievement reading, the woman applies force to the cart to set it in motion, and it continues to move forward under its own momentum. According to my consultants, (6b) is ambiguous between the two interpretations, though most speakers showed a clear preference for the achievement reading. For (6a), however, only the activity reading was available. In other words, voice selection is conditioned in part by *aktionsart*: in cases where a predicate can be construed as denoting either a durative/atelic event or a punctual/telic event, AT voice forces the former interpretation while TT voice favors the latter.

In other cases, the aktionsart remains constant, and voice selection seems to reflect something like viewpoint aspect. Consider the examples in (7), where the clause denotes an event involving an incremental activity which culminates in an endpoint (what Vendler calls an *accomplishment*): Rakoto engages in the act of writing, which incrementally affects the letter and terminates when the letter is complete.

(7) a. Nanoratra ny taratasy Rakoto
Pst.AT.write Det letter Rakoto
'Rakoto wrote the letter'

b. Nosoratan-dRakoto ny taratasy
Pst.TT.write=Rakoto Det letter
'Rakoto wrote the letter'

With predicates of this sort, the choice of AT voice (7a) seems to focus attention on the inception or activity component of the event, while TT inflection (7b) places focus on the endpoint or result. This can be seen when a temporal measure phrase like *nandritra ny adiny roa* (lit. 'lasted two hours') is added to the clause, as in (8) below. Speakers consistently report that the interpretation of this measure phrase crucially depends on the voice of the main verb. The AT clause in (8a) receives an *imperfective* construal, such that the measure phrase specifies some subinterval of the letter-writing event, which need not include the inception or the endpoint: Rakoto spent two hours working on the letter, but did not necessarily finish it during that time (and may not have finished it at all). By contrast, the TT clause in (8b) receives a *perfective* construal: here, the measure phrase specifies the duration of the letter-writing event from its inception to its culmination point—meaning that it took Rakoto two hours to finish the letter. Notice how this difference is reflected in the translation of the measure phrase: 'for two hours' in the former case, versus 'in two hours' in the latter.

(8) a. Nanoratra ny taratasy nandritra ny adiny roa Rakoto
Pst.AT.write Det letter Pst.AT.last Det hour two Rakoto
'Rakoto was writing the letter for two hours'

b. Nosoratan-dRakoto nandritra ny adiny roa ny taratasy
Pst.TT.write=Rakoto Pst.AT.last Det hour two Det letter
'Rakoto wrote the letter in two hours'

If AT voice is associated with imperfectivity while TT voice is associated with perfectivity interpretation, this suggests an alternative way to conceptualize the contrast in (6) above: perhaps (6a) receives an imperfective interpretation while (6b) receives a perfective interpretation, and only the former is compatible with a punctual construal of the predicate 'push the cart' (punctual events cannot be ongoing).

Another way of expressing temporal measurement is illustrated in (9). Here the temporal measure phrase (*telo andro* 'three days') appears as the main predicate of the sentence, while an embedded clause introduced by the subordinator *vao* 'before' expresses the event being measured. As in (8) above, the interpretation of the measure phrase is determined by the voice of the embedded verb: when *vao* selects an AT clause (9a), the sentence means 'It took him three days to start writing the letter'; but when *vao* selects a TT clause (9b), the sentence means 'It took him three days to finish writing the letter'.

(9) a. Telo andro vao nanoratra ny taratasy Rakoto
three day before Pst.AT.write Det letter Rakoto
'(It was) three days before Rakoto was writing the letter'

b. Telo andro vao nosoratan=dRakoto ny taratasy
three day before Pst.TT.write=Rakoto Det letter
'(It was) three days before Rakoto {wrote/had written} the letter'

The construction in (9) may express either the amount of time required to accomplish the event, or the amount of time which elapses before the event is initiated.[4] When 'write' is in the TT form (9b), *telo andro* 'three days' specifies the duration of the letter-writing event—in other words, the end of the three days is associated to the endpoint of the event. By contrast, when the TT form is used, as in (9a), *telo andro* specifies the length of time between some contextually-determined reference point and the point at which the event of writing the letter begins—that is, the end of the three days is associated to the beginning point of the event. This appears to be consistent with the contrast in (8) above, where TT voice favors a perfective reading while AT voice favors an imperfective reading. It seems that in (9b), the 'before' clause refers to the event as a whole, including the endpoint; while in (9a) the 'before' clause refers to a sub-part of the event, excluding the endpoint. (The fact that that *telo andro* in (9a) is interpreted as measuring the time to the

[4] English exhibits a similar ambiguity with *in* phrases in future tense contexts. E.g., *We will climb the mountain in three days* may mean either 'It will take us three days to climb the mountain' or 'Three days will elapse before we [begin to] climb the mountain'.

beginning point of the event might follow from an implicature: by asserting that three days separate some contextually-relevant time *t* from a point at which Rakoto is engaged in the letter-writing event, the speaker implies that Rakoto was not engaged in this event at any earlier point following time *t*.)

Consider also the contrast between AT and TT voice in sentences containing clauses headed by the subordinator *rehefa* 'when'. In the examples in (10) below, the event denoted by the 'when' clause in (10a) sets up a temporal context for the event denoted by the main clause (10b,c). When (10a) is followed by the AT clause in (10b), it is understood that Rasoa was in the process of opening the window at the time when the speaker entered—in other words, the temporal point associated with the entering event is contained within the interval of the opening event. On the other hand, when (10a) is followed by the TT clause in (10c), there is no overlap between the events: it is understood that the opening event either properly precedes or properly follows the entering event.

(10) a. Rehefa niditra ao an-trano aho…
when Pst.AT.enter in:there Obl-house 1sNom
'When I came into the house…'

b. … namoha ny varavarankely Rasoa
Pst.AT.open Det window Rasoa
'… Rasoa was opening the window'

c. … novohain-dRasoa ny varavarankely
Pst.TT.open=Rasoa Det window
'… Rasoa (had) opened the window'

Note that the use of TT voice in (10c) merely indicates that the time of the entering event is not contained within the time of the opening event, without specifying the temporal order of the two events. According to my speakers, this is normally disambiguated by adding a preverbal particle to the main clause: *dia* 'then' specifies that the entering event precedes the opening event (11a), while *efa* 'already' can be used to indicate that the entering event follows opening event (11b):

(11) a. … dia novohain-dRasoa ny varavarankely
then Pst.TT.open=Rasoa Det window
'(When/once I came into the house,) Rasoa opened the window'

b. … efa novohain-dRasoa ny varavarankely
already Pst.TT.open=Rasoa Det window
'(When I came into the house,) Rasoa had already opened the window'

In (10), the event denoted by the 'when' clause establishes a reference time *t* for the event denoted by the matrix clause. Here we see the same relationship between voice selection and aspect as in earlier examples, where use of the AT voice yields an imperfective reading while TT voice yields a perfective reading. In the former case, *t* is understood to be internal to the matrix clause event time, while in the latter case *t* is external to the matrix clause event time.

Consider finally the construction in (12)–(15) below. Here again, the event denoted by an embedded clause (introduced in this case by the particle *no*) identifies a reference time for the event denoted by the matrix clause. When the main clause is in the AT voice, as in (12a), the reference time is located within the matrix event time: the harvesting event is ongoing at the point when the raining event begins (the rain interrupts the harvesting event, and may actually prevent the harvesting event from reaching completion). However, when the main clause is in the TT voice, as in (12b), the reference time follows the matrix event time: it is understood that the farmer has already completed harvesting the rice (i.e., the harvesting event has reached its culmination point) at the time when the raining event begins. As the glosses indicate, a similar contrast obtains in (13a,b).

(12)	a.	Nijinja	vary	ilay	mpamboly	no	avy	ny	orana
		Pst.AT.harvest	rice	that	farmer	when	come	Det	rain

‘That farmer was harvesting rice when it began to rain’

b.	Nojinjain’	ilay	mpamboly	ny	vary	no	avy	ny	orana
	Pst.TT.harvest	that	farmer	Det	rice	when	come	Det	rain

‘That farmer had (already) harvested the rice when it began to rain’

(13)	a.	Nanasa	ny	lobaka	izy	no	niditra	aho
		Pst.AT.wash	Det	shirt	3sNom	when	Pst.AT.enter	1sNom

‘She was washing the shirt when I came in’

b.	Nosasany	ny	lobaka	no	niditra	aho
	Pst.TT.wash=3sGen	Det	shirt	when	Pst.AT.enter	1sNom

‘She had finished washing the shirt when I came in’

Notice that in (12)–(13) the matrix clause denotes an accomplishment. When the matrix clause instead denotes an activity, the speakers I consulted generally reported a difference in acceptability or naturalness between the AT and TT variants. Consider the examples in (14) below. Speakers uniformly accepted (14a), with the matrix clause in the AT voice, and interpreted the sentence to mean that the ringing of the phone interrupted the event of Rakoto watching television. However, speakers hesitated to accept the TT variant in (14b). One speaker reported that the sentence was acceptable, but only if it was understood that Rakoto watched television only for a brief period, and that the television-watching event ended some time before the moment at which the phone rang.

(14)	a.	Nijery	fahitalavitra	Rakoto	no	naneno	ny	telefaonina
		Pst.AT.look:at	television	Rakoto	when	Pst.AT.ring	Det	telephone

‘Rakoto was watching television when the phone rang’

b. ?	Nojeren-dRakoto	ny	fahitalavitra	no	naneno	ny	telefaonina
	Pst.TT.look:at=Rakoto	Det	television	when	Pst.AT.ring	Det	telephone

‘Rakoto had (already) watched television when the phone rang’

The contrast between AT and TT voice is even starker for (14) below. The AT variant in (14a) was judged fully acceptable, and interpreted to mean that Rabe was interrupted in his search for the shoes by the phone ringing. However, its TT counterpart in (14b)—and other sentences of the same form—sounded very strange to my consultants. This might be for pragmatic reasons. From what I have been able to determine, (14b) seems to imply that Rabe had set aside a designated period of time to search for his shoes, but without necessarily intending to find them, and that he had carried out this task at the moment when the phone rang.

(15) a.

Nitady	ny	kirarony	Rabe	no	naneno	ny telefaonina
Pst.AT.look:for	Det	shoe=3sGen	Rabe	when	Pst.AT.ring	Det telephone

‘Rabe was looking for his shoes when the phone rang’

b. ??

Notadiavin-dRabe	ny	kirarony	no	naneno	ny telefaonina
Pst.TT.look:for=Rabe	Det	shoe=3sGen	when	Pst.AT.ring	Det telephone

(‘Rabe had [already] looked for his shoes when the phone rang’ ?)

For the *no* construction in (12)–(15), then, we find the following pattern: Speakers find such sentences uniformly acceptable when the matrix clause is in the AT voice, and interpret them to mean that the matrix event is ongoing at the time when the event denoted by the *no* clause occurs. When the matrix clause is instead in the TT voice, the construction is sometimes judged unacceptable; but when speakers accept the TT variant, they interpret it such that the matrix event is completed by the time the event denoted by the *no* clause occurs.

2 Speculations Regarding Voice and Aspect

The principal goal in this short paper has been to draw attention to certain situations in Malagasy where voice selection appears to have consequences for the aspectual interpretation of the clause. It remains an object of future research to account for the correlations between voice and aspect noted in the previous section. Here I confine myself to making some initial suggestions for the direction this research might take.

As noted above, I argue in Pearson (2001, 2005a/b) that Malagasy voice morphology expresses a kind of agreement relation, whereby the abstract Case feature of an A′-operator is realized on the verb (see (5) above; cf. Chung 1998 on wh-agreement in Chamorro, and Rackowski and Richards 2005 on voice as Case agreement in Tagalog). If the operator raises from the position where the external argument checks its Case feature, then the verb carries AT inflection; if it raises from the position where the internal argument checks its Case, then the verb carries TT inflection. I further argue that these Case positions are associated with the event structure of the clause. The internal argument checks its Case in the specifier of an aspectual projection AspP, located within the *v*P and associated with *inner aspect* (here I follow Travis 2010). The features of the inner aspect head distinguish telic from atelic events, accounting for the often-observed connection between telicity and object selection (e.g., the strong tendency for quantized objects of accomplishment predicates to be interpreted as incremental themes). The external argument checks its Case feature in a position above *v*P—the specifier of an *event* phrase, EP, associated with the event argument of the predicate.[5] This is schematized in (16). AT morphology spells out the head of EP, while TT morphology spells out the head of AspP, just in case their specifiers contain a trace of the operator bound by the trigger (see Pearson 2005b for details).

(16) $[_{TP}\ T\ [_{EP}\ \mathit{Ext.Arg}_i\ E\ [_{vP}\ t_i\ v\ [_{AspP}\ \mathit{Int.Arg}_j\ Asp\ [_{VP}\ t_j\ V\ \ldots\ ]]]]]$

It is possible that the correlations between voice and aspect noted above can be explained in terms of the relationship between argument structure and event licensing. Since

[5] Alternatively, the external argument might have its Case checked in the specifier of an *outer aspect* phrase (Travis 2010), whose head expresses a relationship between the event time and a reference time.

internal arguments are licensed in SpecAspP, promoting the internal argument to trigger function (TT voice) somehow places focus on the endpoint of the event, favoring a telic/perfective reading of the clause. Likewise, inasmuch as external arguments are licensed in SpecEP, promoting the external argument to trigger function (AT voice) places focus on the initiation point or activity component of the event, favoring an atelic/imperfective reading (at least for activity and accomplishment predicates). We might enshrine this connection in the form a specifier-head agreement requirement: suppose that the operator bound by the trigger (*Op* in (5)) has a [+topic] feature, and that the head in which it checks its Case must have a matching feature—i.e., the E head is [+topic] in AT clauses, while the Asp head is [+topic] in TT clauses.

At this point, however, this approach remains purely stipulative—and potentially problematic. The analysis outlined above implies a rather tight connection between voice selection and aspectual viewpoint. However, it is far from clear that AT clauses consistently receive an atelic/imperfective interpretation or that TT clauses consistently receive a telic/perfective interpretation. In fact, the aspectual contrast between these two forms is generally noticeable only in constructions where the event denoted by the AT/TT-alternating verb is anchored with respect to a *reference time*—e.g., in constructions containing a temporal measure phrase or a 'when' clause. Outside of these constructions, speakers do not generally report an aspectual contrast between AT clauses and their TT counterparts (the minimal pair in (6) is a rare exception). This suggestions that the aspectual contrasts discussed here should receive a more construction-specific account.

As a final observation, it is worth noting that the apparent association of AT voice with imperfectivity and TT voice with perfectivity is reminiscent of the pattern found in languages which exhibit ergativity splits based on aspect. In such languages, imperfective clauses show a nominative-accusative case alignment while perfective clauses show an ergative-absolutive alignment. While Malagasy is normally analyzed as nominative-accusative, the AT/TT alternation shows at least superficial parallels to a split-ergative pattern when we compare transitive AT clauses and their TT counterparts to intransitive clauses (which lack a TT form). This is especially apparent when we consider pronominal arguments, which exhibit morphological case distinctions. In transitive AT clauses, the external argument patterns with the core argument of an intransitive clause, while the internal argument is marked differently: the former function as the trigger of the clause and take the default nominative form (cf. (18) and (19a)), while the latter appears inside the predicate phrase and takes the accusative form (19b). In transitive TT clauses, by contrast, it is the internal argument which patterns with the core argument of an intransitive, while the external argument patterns differently: again, the former appear in trigger function and take the nominative (cf. (18) and (20b)), while the latter appears inside the predicate and takes the 'genitive' form (20a).

(18)		Natory	*aho*		
		Pst.AT.sleep	1sNom		
		'I slept / was sleeping'			
(19)	a.	Namangy	ny	ankizy	*aho*
		Pst.AT.visit	Det	children	1sNom
		'I visited the children'			
	b.	Namangy	*ahy*	ny	ankizy
		Pst.AT.visit	1sAcc	Det	children
		'The children visited me'			

(20) a. Novangia*ko* ny ankizy
Pst.TT.visit=1sGen Det children
'I visited the children'

b. Novangian' ny ankizy *aho*
Pst.AT.visit Det children 1sNom
'The children visited me'

While I am not suggesting that Malagasy should be analyzed as an aspect-based split-ergative language, it is interesting to note the parallels between them. It is possible that whatever analysis we propose for explaining the interaction between aspect and case alignment can be extended (perhaps with modifications) to account for the interaction between aspect and trigger selection found in languages of the Malagasy type.

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Affiliation

Matt Pearson
Department of Linguistics
Reed College
3203 SE Woodstock Blvd
Portland, OR 97202 USA
pearsonm@reed.edu

Headedness, again

Maria Polinsky

Introduction*

Headedness is an intriguing feature of language design. On the one hand, headedness manifests itself very clearly; preposed relative clauses are visibly different from postposed ones, and postpositions are easily distinguished from prepositions. More generally, structural heads (the constituents which determine the category of their phrase) either precede or follow their dependents. On the other hand, there is room for disagreement and variation. For instance, the ordering of determiners or nouns can be assessed differently depending on what counts as the head, causing disagreements over the headedness of nominal constituents. Furthermore, even if all linguists agree on what counts as the head and what counts as a dependent, there is no required consistency within the same language in the way dependents and heads are ordered across different phrases. An otherwise dependably head-final or head-initial language may exhibit exceptions; the results are messy, and linguists get discouraged.

There is, as of yet, no good explanation for headedness. It is visible; it is rather robust; it seems easy to learn (Lupyan and Christiansen 2002; van Everbroeck 2006), but what is it? This question has puzzled many researchers and we still do not know its answer. When dealing with something that is unfamiliar it is often tempting to just toss it out as unnecessary or superficial. Researchers now and again have suggested that headedness is no more than a a trivial pattern-recognition device without much deep meaning and with no value in linguistic theory, yet it is hard to dismiss a device that is so pervasive. This squib presents a new argument as to why theoreticians should still give headedness a chance. I am not prepared to explain headedness, but I will bring in a new dimension in which its effects are apparent: the proportions among lexical categories. If my results are on the right track they add further evidence in support of the conception that headedness is still important.

1 Starting point

The new dimension of language structure where headedness manifests its effects has to do with the number of verbs vs. number of nouns in a language. To begin with a casual

* I dedicate this work to Ed Keenan, a dear friend, a wonderful colleague, and an inspiration to us all. Ed has always enjoyed asking questions—even when the answer is far from obvious, so it is only appropriate to present him with a puzzle. I am looking forward to seeing his explanation for this puzzle in the years to come.

For helpful comments on this paper, I am grateful to Katryna Cadle, Keith Plaster, Kevin Ryan, and Barbara Stiebels. All errors are my responsibility.

observation, many L2 learners of languages such as Japanese know from experience that being unfamiliar with a verb may not be the end of the world. When at a loss, the learner takes a noun, combines it with the verb *suru* 'do' and can be understood, even though the result may not be authentic Japanese. These days *suru* mostly combines with English words, as in *beesu appu suru* 'increase salary (from *base up*), *emayru suru* 'email', *guuguru suru* 'Google', and many others. There is the usual hand wringing about the Japanese vocabulary being destroyed by English, but the modern-day mourners of Japanese forget that before it was being destroyed by English, *suru* used to combine with Chinese words, yielding such compounds as *kenkyuu suru* 'study' or *gensyoo suru* 'decrease.' This initial observation suggests that Japanese has a rather small number of inflecting verbs and a large open class of complex predicates. Such complex predicates are created from non-verbal constituents combined with light verbs.

Turning to less-known languages, Pawley (2006) discusses the northern Australian language Djamindjung (djd) and the PNG language Kalam (kmh), which both have a real paucity of verb roots–just over a hundred. These small, closed classes of verb roots occur as independent verbs, and all other verb meanings are expressed by complex predicates, as in Japanese. Pawley suggests that these languages are not unique, and that related Australian and PNG languages also have small, closed verb classes.

What do other languages do? English's response to the need for new verbs is to make a verb out of pretty much anything using zero morphology (conversion), yielding *to ftp, to R the data, to KCCO a friend,* or, from the days of the Clinton White House, *to Linda-Tripp someone.* Languages encumbered by more morphology than English build new inflected verbs using verbal morphology; for instance, modern Russian, which has experienced a true Anschluss of English words has been creating verbs like *piarit'* 'to PR', *parkovat'/parkirovat'* 'park', *postít'* 'post on a blog', or *kopipejstit'* 'copy and paste' in droves.

So the difference between English and Russian, on the one hand, and Japanese, Djamindjung, and Kalam, on the other, is that while English and Russian freely create new verb roots or stems to add new verbal concepts to the language, the latter three do not; instead, they rely on light verbs to produce new complex verbs. The three languages that utilize light verbs happen to be head-final and SOV. Is this an accident, or does that paucity of inflecting verbs have anything to do with headedness? This is the essence of the question that I will explore in this paper:

(1) Does the noun-verb ratio differ across headedness types?

In order to investigate (1) I first need to go over the main headedness types, and also clarify, even if only partially, what counts as a noun or a verb. The next two sections will address these issues.

1 Headedness types

As far as headedness goes, the main contrast is between head-final and head-initial languages. Within the head-final type, languages such as Japanese and Korean represent the "rigid head-final" type (cf. Kayne 1994; Siewierska 1997; Herring and Paolillo 1995 and references therein). In a way, they are dream languages because their heads consistently follow dependents in all types of phrases. Languages such as German or Persian can be considered exemplars of the non-rigid head-final type; their head-final property seems to be a violable constraint in an optimality design.

Rigidly head-final languages do not allow verb-medial or verb-initial orders, but at the other end of the headedness scale, head-initial languages (VSO, VOS) always seem to allow verb-medial orders. In fact, verb-initial languages that do not allow verb-medial SVO are either impossible or rare (Siewierska 1997).

Once we allow optionality, it can become confusing as to how to classify a given language. For instance, is Yucatec Mayan VOS or SVO? Its most frequent word order is SVO; all its genetic relatives are verb-initial, and it still uses a number of verb-initial orders. Understandably, researchers cannot agree; Briceño (2002) and Gutierrez-Bravo and Montforte (2008, 2009) classify it as SVO; Hofling (1984) and Durbin and Ojeda (1979) argue that it has two basic word orders, SVO and VOS, but with a secondary statistical preference for SVO, and finally, Gutierrez-Bravo and Montforte (2010) suggest that it is SVO with two-place predicates and VS in objectless clauses. This confirms that headedness is frequently inconsistent.

In establishing the subtypes for my query, I would like to balance the need to recognize different headedness subtypes and the desire to have as few types as possible. So the types I will be using are as follows:

(2) Basic headedness types and their examples

Rigid head-final	**Non-rigid head-final**	**Clearly head-initial**	**SVO/head-initial**	**SVO, sundry**
Japanese, Korean, Tamil	German, Persian, Latin, Tsez, Avar, Basque	Malagasy, Tongan, most Mayan languages, Irish	Indonesian, Yucatec Mayan	English, Russian, Romance languages, Bantu languages

With this very broad-based typology, I would like to examine the ratio of nouns vs. verbs in languages illustrating each type. This investigation is naturally limited by the available data; languages such as English and some other Indo-European languages are catalogued in WordNet (Miller et al. 1990) or CELEX Lexical Databases.[1] For other languages, the data are much more limited and surprisingly hard to come by (see also below).

In order to get a set of comparable data, I have limited my query to the ratio of nouns to verbs. This is a reasonable measure; if we added the two other lexical categories that are often included in the counts, adverbs and adjectives, we would start losing the strength of cross-linguistic comparison. While noun-verb distinctions may sometimes be subtler than we usually assume (an issue to which I will return in the next section), all languages have nouns and verbs. However, not all languages have easily *identifiable* adjectives and adverbs, another reason to exclude them.

Before discussing the absolute numbers, however, let me address the issue of noun-verb distinctions.

[1] For details on CELEX, see links and references at: http://www.ldc.upenn.edu/Catalog/readme_files/celex.readme.html#sources.

2 Nouns and verbs: Can we always tell?

Most linguists have historically agreed that all languages have some universal structural building blocks, among which are the lexical categories of nouns and verbs. However, “a persistent thread of research that maintains that there are languages that do not have … familiar … categories” (Chung 2012) has created serious doubts about this universality. While the division of the lexicon into nouns and verbs is likely universal, the diagnostics for lexical classes are language-specific, and may even be highly obscure or subtle. In general, the identification of nouns vs. verbs relies on formal patterns of inflection, morphological derivation, and syntactic distribution (Schachter 1985, Sasse 1993, Baker 2003, Kaufman 2009, Chung 2012).

The languages for which a stringent lexical division between nouns and verbs has been most doubted are characterized by a large class of roots that can be used either nominally or verbally, as in Tongan (Broschart 1997), Chinese (Chao 1968), Riau Indonesian (Gil 2005) or Mapuzungun (Malvestitti 2006). Such languages often have polysynthetic features (see Lois and Vapnarsky 2006 for Amerindian, Aranovich 2010 for Austronesian, Arkadiev et al. 2009 for Adyghe) or templatic morphology (Arad 2003), and include many multifunctional content words. A careful analysis of the categorially ambiguous content words usually shows fine-grained distinctions and thus leads to the desired differentiation of lexical categories. To cite a few examples, Chung’s (2012) meticulous study argued that the Chamorro language has noun, verb, and adjective categories. In Adyghe, only nouns proper but not derived nouns (e.g, nouns derived from verbs) can appear without overt case marking (Arkadiev et al. 2009: 51-56). Other studies that identify fine-grained distinctions between nominal and verbal roots include Arad’s (2003) semantic analysis of the relations between nominal and verbal roots in Hebrew (showing principled rules underlying root polyvalence), and Haviland’s (1994) analysis of roots in Tzotzil. This is not the place to defend the universality of the noun-verb distinction; much work in that direction will rely on better understanding the lexical semantics of complex word formation and category conversion.

For my purposes, the best I can do is to assume that the lexicon of a given language is divided into nouns and verbs based on language-particular criteria, including inflectional morphology, semantic correspondences (Arad 2003, Chung 2012), and syntactic distribution. In some of the languages cited below, most notably Zinacantec Tzotzil (Haviland 1994), the noun-verb division is established at the level of roots rather than lexical items.

All in all, the seemingly simple question of counting nouns and verbs is a quite difficult one; even obtaining data about the overall number of nouns and verbs proves to be an immense challenge. The ultimate consequence is that linguists lack reasonable tools to compare languages with respect to their lexical category size. Cooperation between theoreticians and lexicographers is of critical importance: just as comparative syntax received a big boost from the micro-comparative work on closely related languages (Romance; Germanic; Semitic), so micro-comparative WordNet building may lead to important breakthroughs that will benefit the field as a whole.

3 Results

Table (3) shows the calculation of the noun-to-verb ratio for some representative languages.[2]

(3) Nouns and verbs across languages: Numerical comparison of lemmas[3]

	Nouns	**Verbs**	**Noun-to-verb ratio**
Japanese	86028	15346	5.6
Korean	89125	17956	4.96
Tamil	2403	423	5.6
Telugu	3489	521	6.69
Archi* (Kibrik et al. 1977)	2419	362	6.68
Tsez* (Xalilov 1999)	3508	506	6.93
Hungarian	31600	3300	9.57
Basque	23069	3496	6.59
Latin* (Aronoff 1994; Minozzi 2009)	4777	700	6.82
German* (Barbara Stiebels, p.c.)	72785	11201	6.49
Dutch (average of WordNet and CELEX)	59182	8549	6.9
English	82115	13767	5.9
Chinese* (Xu et al. 2008)	78764	13430	5.86
Polish	14131	3497	4.04
Czech	31029	5158	6.02
Greek	29782	7839	3.7
Romanian	56594	16122	3.5
Spanish	48323	12910	3.74
Swahili*	685	226	3.03
Hebrew	11961	4804	2.49
Vietnamese	6000	2500	2.4
Bahasa (Indonesian/Malay)	12429	5805	2.14
Zinacantec Tzotzil* (Haviland 1994)	1629	850	1.91
Halkomelem* (Galloway 2009)	967	916	1.05
Zapotec* (Long and Cruz 1999)	542	439	1.23
Irish (Modern, from 1800)	1850	890	2.07
Malagasy* (Diksionera 1973)	5436	3643	1.49
Maori* (Williams 1957)	2920	1656	1.76

The chart below shows the distribution of noun-verb ratios across these languages. The languages can be broken into three bins that show a strong correlation with headedness.

[2] For languages marked with an asterisk the data come from dictionaries or published sources indicated in parentheses; all other numbers are from WordNet, CELEX and/or corpora. I am very grateful to Eneko Agirre, Francis Bond, Verena Hinrichs, Katia Kravtchenko, Sun-Hee Lee, Dan Tufis, Shuly Wintner for help with the counts.

[3] Where it is relevant, the counts exclude compound verbs formed using a light verb as in the Japanese examples above.

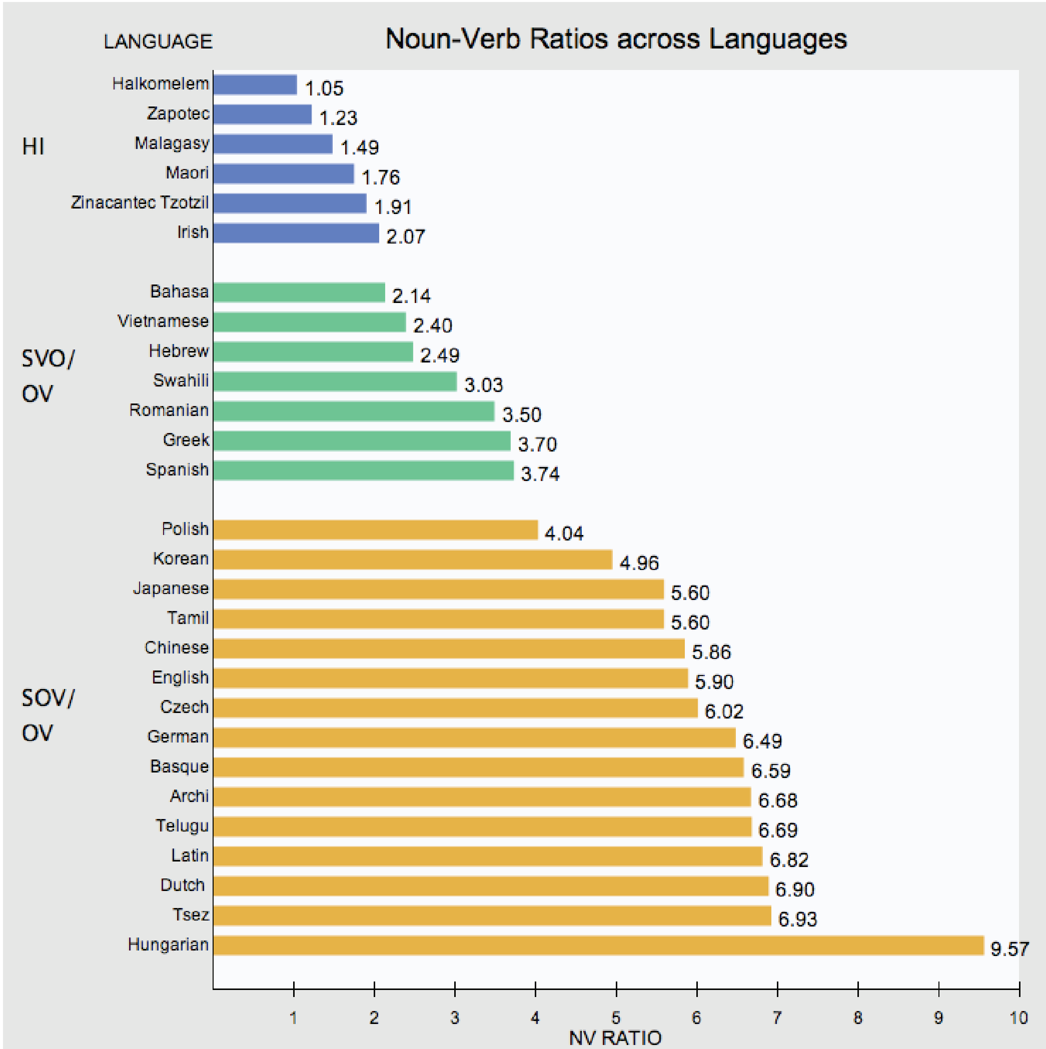

Figure 1. Noun-to-verb ratios in the sample languages

The group with the lowest noun-verb ratio includes Maori, Malagasy, Irish, Zapotec, Halkomelem, and Tzotzil, languages that are all head- and verb-initial (HI in the chart stands for 'head-initial'). The intermediate group includes Greek, Romanian, Spanish, Swahili, Hebrew, Vietnamese, and Bahasa, languages that are all SVO with verb-initial characteristics. The third group, with the highest noun-verb ration includes the majority of the surveyed languages, which are rigidly verb-final and SVO/SOV. Wilcoxon tests show that the three bins identified here and shown in different colors in the chart (head-initial, SVO/VO, and SOV/OV types) are real; the differences between the bins are highly significant ($p \leqq 0.001$).

4 What this means

The results show a clear correlation between headedness and the proportion of verbs in the lexicon. Head-initial languages (Irish, Malagasy, Maori, Tzotzil) have a particularly high proportion of verbs. In contrast, languages of the rigidly head-final type are verb poor. Hungarian seems almost an outlier, with the highest noun-verb ratio (9.57 as compared to the 5-6 ratio found for other head-final languages), but that could be an artifact of the incomplete corpus of Hungarian WordNet (Miháltz et al. 2008). This introduces an additional concern: we must question the adequacy of language corpora and dictionaries, whether they accurately identify nouns and verbs, and whether they accurately reflect the everyday life of a given language. Even if we accommodate for the variation in the sample we still see a significant clustering of verb-poor languages in the head-final type and of verb-rich languages, in the head-initial type.

The intermediate group includes the SVO languages, which much be probed more thoroughly to see what additional patterns may emerge. For now, I would like to offer two considerations. The first one takes into account the canonic idea that SVO languages are not uniform, comprising of OV and VO languages. Many researchers agree that OV and VO are simply representations of head-final and head-initial structures respectively (see Lehmann 1973, 1978, Venemann 1974, 1976, for the initial idea). Each subtype has significant structural corollaries; for instance, OV in an otherwise SVO language entails object shift, scrambling, final question particles, and head-final embedded structures—none of which is found in a VO subtype of SVO languages (Dryer 1991, Vikner 1994, Biberauer and Roberts 2005, 2009, a.o.). The noun-verb ratios reflect the division of SVO languages into OV and VO types quite well: Greek, Romanian, Spanish, Swahili, Hebrew, Vietnamese, and Indonesian/Malay all have independently documented VO characteristics and their noun-verb ratios are very close to the ones found in the bona fide head-initial languages such as Irish or Zapotec. At the other extreme, Chinese, a source of never-ending sorrow for advocates of well-behaved SVO languages, shows OV properties; its ratio is very close to the one observed in head-final languages in our sample. Indeed, Chinese has prenominal relatives, which is very unusual for SVO languages, as well as object shift and scrambling; as a result, researchers are often at a loss as to how to characterize it (see Dryer 1991: 447, 476 for different, often conflicting approaches). To take another example, Latin conforms to the OV stereotype with a high noun-verb ratio, even though its Romance offspring show VO properties. All these results add a novel argument to the general notion that SVO is no more than a shibboleth, and that the real distinction is between OV and VO language types.

A few languages do not fit into their expected slots, namely the Germanic and Slavic languages from my sample. Let us start with the three Germanic languages: German, Dutch, and English. According to the data in the table, German and Dutch seem more OV than even rigid OV languages. From all we know about its structure, English patterns with VO languages, but its ratio is like that of Chinese. As with the languages discussed in the preceding paragraph, such a pattern may be a side effect of the way English WordNet was built. For instance, if we count particle verbs as separate verbs that would inflate the verbal lexicon; counting obsolete or occasional nouns would inflate the nominal part of the English WordNet. For comparison, let's set the WordNet numbers aside and consider the ratio of nouns to verbs in child directed speech in CHILDES. In the corpus of parental speech addressed to Sarah we find 1403 nouns and 390 verbs, with the resulting ratio of 3.5, which is much closer to the ratios in other VO languages.[4] Assuming that the parental speech is a better representative of the actual language than the semantic web at WordNet, this is a welcome result.

Turning now to the two Slavic languages, Czech and Polish, one would expect them to be more similar to each other. The differences may be due to the Slavic-specific issues that arise in the construction of dictionaries, WordNet, or other databases. In their discussion of the Czech Wordnet, Pala et al. (2008: 371) explicitly address the

[4] I am grateful to Robyn Orfitelli for help with the CHILDES statistics.

outstanding issues that Slavic lexicographers need to address: verb aspect; reflexive verbs; verb prefixation (single, double, triple); diminutives (noun derivation by suffixation), and noun derivation by suffixation. For instance the number of verbs could go up or down depending on how the lexicographer approaches Slavic aspectual pairs: does one count verbs in the perfective and imperfective as separate lemmas or as members of the same lemma? Counting all verbs twice of course inflates the size of the verbal lexicon. Similarly, counting nouns in the diminutive as separate lemmas or as part of the same lemma as the corresponding non-diminutive would affect the size of the nominal lexicon. These two factors alone are more than sufficient to force an even greater discrepancy than the one we observe.

Conclusion

Initially, I asked whether the noun-verb ratio differs across headedness types. I collected simple numerical data on the noun-verb ratio across a sample of languages, chosen more or less opportunistically as a "convenience" sample, focusing on languages for which I was able to find or recover numerical data on the number of nouns and verbs.

The results may be surprising: there is a robust correlation between headedness and the proportion of verbs in the lexicon. Head-final, OV languages have a relatively small percentage of *simple* verbs, whereas head-initial languages have a considerably larger percentage of simple verbs. The OV/VO difference with respect to noun-verb ratios also reveals itself in SVO languages; some languages, Chinese and Latin among them, show a strongly OV ratio, whereas others, such as Romance or Swahili, are VO-like in their noun-verb ratios.

Another way of looking at these results is to tie them to the possible and/or preferred derivational methods used by a given language. In that case, the correlation is between headedness and choice of derivational method. Looking back at the examples used in this paper, English happily zero-derives verbs, Russian adopts new verbal roots with or without a derivational suffix, but head-final languages prefers to use light verbs.

On either approach, the proportion among lexical classes emerges as a new linguistic characteristic that is correlated with headedness. Further verification is needed, and assuming that further studies confirm this new generalization, the next step is to explain why this pattern exists. But that would be a topic for another Keenan celebration.

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Affiliation

Maria Polinsky
Department of Linguistics
Harvard University
Polinsky@fas.harvard.edu

Which Questions in Malagasy

Eric Potsdam

Introduction

This squib discusses the analysis of certain wh-questions in Malagasy, an Austronesian language spoken by approximately 18 million people on the island of Madagascar. It investigates wh-questions that are translated in English with the wh-determiner *which*. The results contribute to current work that analyzes Malagasy wh-questions as clefts (Keenan 1976, Paul 2001, Pearson 2001, Potsdam 2006, Law 2007, Kalin 2009, and others).[1]

1 Malagasy Basics

Malagasy is a predicate-initial, subject-final language for both verbal and non-verbal clauses:

(1) a. [nanoroka an-dRasoa]$_{VP}$ ny mpahandro
kiss.PAST ACC-Rasoa the cook
'The cook kissed Rasoa.'
b. [faly amin' ny zanany]$_{AP}$ Rasoa
happy PREP the child.3SG Rasoa
'Rasoa is proud of her children.'
c. [vorona ratsy feo]$_{NP}$ ny goaika
bird bad voice the crow
'The crow is a bird with an ugly voice.'

For concreteness, I will assume that such clauses have the following structure (see also Paul 2008). There is an underlying predication relationship between the VP/AP/NP predicate and the DP subject of predication mediated by a Pred(ication)° projection in which the subject of predication occupies spec,Pred and the predicate itself is the complement of Pred. Surface word order is derived by raising some element, typically the subject of predication, into a righthand specifier of TP, which is part of the functional structure dominating PredP:

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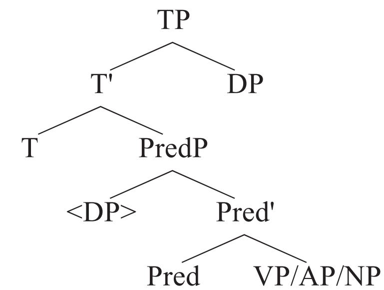
[1] Syntactic work on Malagasy would not be at its current level of sophistication without the groundbreaking work that Ed Keenan has done and continues to do on his "perfect" language. It is an honor to follow in his footsteps. I thank my consultants Charlotte Abel-Ratovo, Voara Randrianasolo, and Bodo Randrianasolo for help with the data.

(2)

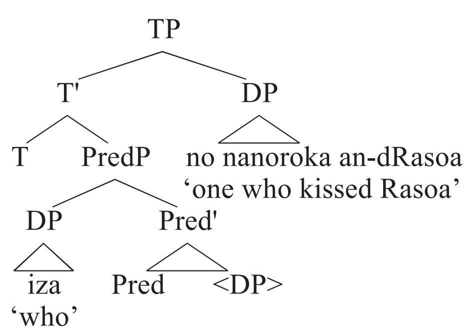


Wh-questions in Malagasy can be formed using WH-IN-SITU or WH-FIRST strategies. In the latter, the wh-phrase is initial followed by an obligatory particle *no* (glossed FOC(US) because it is also used in a focus construction (Paul 2001)) and the rest of the clause, (3). Only subjects and some adjuncts can be questioned with the wh-first strategy (see Keenan 1976, Potsdam 2006, and references therein).

(3) a. iza no nanoroka an-dRasoa?
who FOC kiss.PAST ACC-Rasoa
'Who kissed Rasoa?'
b. oviana no nanoroka an-dRasoa ny mpahandro?
when FOC kiss.PAST ACC-Rasoa the cook
'When did the cook kiss Rasoa?'
c. *iza no nanoroka __ ny mpahandro?
what FOC kiss.PAST the cook
(ungrammatical with the meaning 'Who did the cook kiss?')

There is some consensus that the structure of these wh-questions is a specificational pseudocleft (Paul 2001, Potsdam 2007, Travis 2008, Kalin 2009, but see Sabel 2002, 2003 and Law 2007 for alternatives). *No* and the following material (the *no*-phrase) constitute a free relative and the underlying predicate. The wh-phrase is the underlying subject of predication. The free relative then moves to spec,TP, (4). Thus, on the surface, the wh-phrase appears to be the predicate, contained in PredP, while the *no*-phrase is the subject. Consequently, Malagasy is a fully wh-in-situ language: the wh-phrase is either in place as an argument/adjunct or in place inside PredP.

(4)



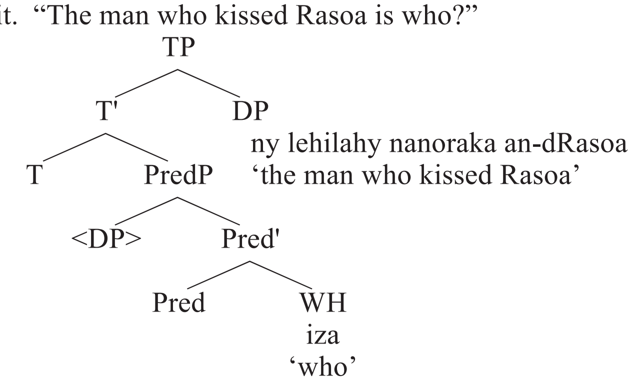
Consultants' translations of English *which*-questions into Malagasy typically take the forms in (5) and (6). Those in (a) involve *no* but those in (b) do not.

(5) a. lehilahy iza no nanoroka an-dRasoa
man who FOC kiss ACC-Rasoa
b. iza ny lehilahy nanoroka an-dRasoa?
who the man kiss ACC-Rasoa
'Which man kissed Rasoa?'

(6) a. trano inona no no-vidi-nao?
house what FOC PAST-buy.PASS-2SG
b. inona ny trano no-vidi-nao?
what the house PAST-buy.PASS-2SG
'Which house did you buy?'

I will assume that the (a) sentences with *no* are derived as described above. The initial wh-phrase is contained in PredP. It consists of a head noun (*lehilahy* 'man' or *trano* 'house') and a post-nominal wh-modifier (*iza* 'who' or *inona* 'what').[2] This wh-phrase is followed by a *no*-phrase in subject position.

The concern of this squib is the analysis of the (b) sentences. Because they lack *no*, it is less clear what the structure of such examples is. I will argue that the examples have the structure in (7). They are copular clauses. The initial wh-phrase is the predicate in keeping with the predicate-initial nature of the language. The remaining material is a headed relative clause in subject position, *ny lehilahy nanoroka an-dRasoa* 'the man who kissed Rasoa' in (5) and *ny trano novidinao* 'the house you bought' in (6). More literal translations of the *which*-questions would be 'The man who kissed Rasoa is who?' or 'The house that you bought is what?' The definiteness of the subject nominal conveys the d-linking associated with English *which*.

(7) a. [iza]$_{PredP}$ [ny lehilahy nanoroka an-dRasoa]$_{DP}$
who the man kiss Rasoa
lit. "The man who kissed Rasoa is who?"
b.


2 Syntactic Evidence

The analysis makes the following claims about such *which*-questions, which are

[2] To first approximation *iza* 'who' is used with animate head nouns and *inona* 'what' with inaninmate nouns. Speakers do allow *iza* with inanimates as well, however: *lakana iza* 'which boat'. Further investigation is required but it is possible that *iza* is used when a specific instance is requested such as the title of book or the name of a particular boat.

defended in the subsections below.

(8) a. WH is the predicate
b. [ny ...] is a constituent and a headed relative clause

2.1 *The predicate*

Evidence from predicate-related particles and sluicing show that the wh-phrase is the predicate. A number of particles immediately follow the predicate in Malagasy, including *daholo* 'all', *anie* 'EXCL', *hono* 'they say', and *avy* 'each', (9). These particles are generally ungrammatical in other positions. For concreteness, one can assume that they are right-adjoined to PredP in (2), (4), and (7). See Potsdam 2006 for details.

(9)	a.	nihinana	vary	(daholo)	ny	vahiny	(*daholo)
		ate	rice	all	the	guest	all
		'The guests all ate rice.'					
	b.	manapaka	bozaka	(anie)	Rasoa	(*anie)	
		cut	grass	indeed	Rasoa	indeed	
		'Rasoa is really cutting the grass!'					

In ordinary wh-questions with *no*, these particles immediately follow the wh-phrase because it is the predicate, (10a) and (11a). In *which*-questions, they also immediately follow the wh-phrase because it is still the predicate, as claimed above, (10b) and (11b).

(10)	a.	iza	(daholo)	no	nihinana	vary?			
		who	all	FOC	ate	rice			
		'Who all ate rice?'							
	b.	iza	(daholo)	ny	(*daholo)	lehilahy	(*daholo)	nanoroka	an-dRasoa?
		who	all	the	all	man	all	kissed	ACC-Rasoa
		'Who are all the men who kissed Rasoa?'							

(11)	a.	inona	(anie)	no	ho-vaki-nao?			
		what	EXCL	FOC	FUT-read.PASS-2SG			
		'What are you really going to read?'						
	b.	inona	(anie)	ny	(*anie)	boky	(*anie)	hovakinao?
		what	EXCL	the	EXCL	book	EXCL	FUT.read.2SG
		'What are you really going to read?'						

Supporting evidence comes from sluicing. Sluicing is a construction that reduces an embedded question to just a wh-phrase by deleting all non-wh-material (Ross 1969, Merchant 2001): *The student read something but I don't know what (he read)*. Malagasy has a sluicing construction, which strands the wh-phrase predicate (see Potsdam 2007 and Paul and Potsdam 2012 for analytical details). Sluicing affects the *which*-questions as predicted. In ordinary wh-questions, only the wh-phrase remains, (12). In *which*-questions, the wh-phrase again remains when the headed relative clause is deleted, (13).

(12) nividy zavatra ny mpianatra fa tsy fantatro hoe
bought thing the student but NEG know.1SG COMP
inona (no no-vidi-ny)
what FOC PAST-buy.PASS-3SG
'The student bought something but I don't know what (he bought).'

(13) nividy boky ny mpianatra fa tsy fantatro hoe
bought book the student but NEG know.1SG COMP
inona (ny boky no-vidi-ny)
what the book PAST-buy.PASS-3SG
'The student bought a book but I don't know which (is the book he bought).'

2.2 The subject

The second claim about *which*-questions is that those lacking *no* are copular clauses linking a headed relative clause subject and a wh-phrase predicate:

(14) [iza]$_{\text{PredP}}$ [ny lehilahy nanoroka an-dRasoa]$_{\text{DP}}$
who the man kiss ACC-Rasoa
lit. "The man who kissed Rasoa is who?"

That the subject here is a noun phrase modified by a relative clause is supported by the fact that the relativizer *izay* can appear between the head noun and the relative clause:

(15) [iza]$_{\text{PredP}}$ [ny lehilahy izay nanoroka an-dRasoa]$_{\text{DP}}$
who the man REL kiss ACC-Rasoa
'Which man kissed Rasoa?'

In addition, the default determiner *ny* can be replaced by so-called framing demonstratives, which are a clear diagnostic for noun phrases. Framing demonstratives are matching demonstratives that circumscribe a noun phrase, appearing initially and finally:

(16) tsy tsara [io boky no-vidi-ko io]
NEG good DEM book PAST-buy.PASS-1SG DEM
'This book that I bought is not good.'

The framing demonstrative appears around both the noun phrase and the relative clause, confirming its constituent status, (17). Other positions of the two demonstratives are ungrammatical.

(17) iza ity lehilahy nanoroka an-dRasoa ity?
who DEM man kissed ACC-Rasoa DEM
'Who is this man who kissed Rasoa?'

2.3 *Combined strategies*

Finally, both strategies for forming *which*-questions can be combined. A complex wh-phrase predicate of the form noun plus post-nominal wh-modifier can be related to a headed relative clause in subject position, (18) as a copular clause. Speakers find such examples acceptable, though somewhat repetitious. I claim that these sentences have the predicate-subject structure in (7b).

(18) a. [lehilahy iza] [ny lehilahy nanoroka an-dRasoa]?
man who the man kissed ACC-Rasoa
'Which man is the man who kissed Rasoa?'

b. [trano inona] [ny trano novidi-nao]?
house what the house PAST.buy.PASS-2SG
'Which house is the house you bought?'

Conclusion

This paper has argued that certain Malagasy clauses offered as translations for English *which*-questions are copular clauses in which the d-linked interpretation of English *which* is encoded using a definite noun phrase with a modifying relative clause as the subject. It replaces the free relative headed by *no* found in Malagasy wh-questions previously analyzed in the literature. The initial wh-phrase is still the predicate of the clause. Such questions instantiate the basic predicate-subject word order in Malagasy and are support the analysis of Malagasy wh-questions as clefts generally.

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Affiliation

Eric Potsdam
Linguistics Department
University of Florida
potsdam@ufl.edu

Toward a Derivational Typology

Craig Sailor · Anoop Mahajan

Greenbergian surface word order typology is not an accurate reflection of underlying syntactic diversity and similarity. Languages of the same type often exhibit significant syntactic differences, which we illustrate in a pair of case studies of the OVS and VSO types. Since this system of classification is misleading to syntactic analysis, we advocate that it be replaced by a "derivational typology", whereby languages are classified by major derivational properties. As an initial attempt, we show how existing tools of syntactic theory can be combined to capture a known correlation between the relative ordering of, and within, VP and PP. Using a limited set of independently-motivated assumptions, we claim that these correlations arise from two factors: a sort of "Generalized Holmberg's Generalization", the effect whereby movement of a syntactic object can trigger re-ordering within the clause to preserve linear precedence relations established earlier in the derivation (Cyclic Linearization: Fox and Pesetsky 2005), alongside lexical variation of a single head, namely P (projected on the clausal spine in all clauses, following Kayne 1999). Order preservation and basic selection interact to yield the major generalizations relating the order of VP and PP, as well as the order of the elements they contain.

Keywords Word order typology, cyclic linearization, typological opacity

Introduction

Recent high-profile publications (Evans and Levinson 2009a, Dunn, Greenhill, Levinson, and Gray 2011, a.o.) take aim at the theory of Universal Grammar (UG), arguing that it cannot be reconciled with the profound diversity of linguistic structures known to descriptive linguists. This is a common but misguided criticism of UG, which has never been a theory of surface representations. A more apt target, perhaps, is generative linguistics as a discipline: although much of it strives for descriptive adequacy,[1] its main focus has not been on accounting for important generalizations from e.g. word order typology (but see Cinque 2005, a.o.). Many of these generalizations do not directly lend themselves to a theoretical treatment: they are extrapolated strictly from linear orders, rather than underlying syntactic derivations, which could vary wildly across languages of the same superficial linear order ("type").

Therefore, our goals in this paper are twofold. First, we argue that surface word order typology in the tradition of Greenberg (1963) is not adequate as a window into the proper

[1] This is certainly not true of all generative work: see e.g. Chomsky (2004) for discussion.

understanding of syntactic diversity. In its place, we advocate the pursuit of a "derivational typology", in which languages are classified by their major derivational properties. Under this approach, the various derivational types yield the known surface patterns, as well as many (and possibly all) exceptions to these patterns. Then, we offer a specific example of how the existing tools of syntactic theory can be used within this framework in order to capture a known correlation between the relative order of elements within VP and PP, and the relative order of VP and PP themselves.

1 The Misleading Nature of Surface Word Order Typology

Advances in linguistic typology have produced a number of significant surface word order generalizations since Greenberg's (1963) seminal work, much of which is synthesized by WALS Online (Dryer and Haspelmath 2011). The empirical foundation is a typology built on the strict but arbitraily-defined notion of *dominant word order*: among all relative orderings of S(ubject), O(bject), and V(erb) within a language corpus, the dominant word order for that language is the one that is "more than twice as common as the next most frequent order" in the corpus (Dryer and Haspelmath 2011: supplement 6).[2] The word order types themselves (SVO, OV, etc.) have no linguistic status beyond their descriptive import; they are treated as grammatical primitives, and the syntactic sources of these orders are not factored into their classification.[3]

Of course, syntactic theory has changed significantly since Greenberg's findings were first published. We now know that syntax is capable of generating a single surface word order in numerous ways. Distinct derivations can produce equally distinct surface constituencies, despite converging on a single superficial word order. If even just the basic tenets of the generative enterprise are valid, then the familiar word order types are not primitives: they are by-products of independently-motivated derivational operations (under strict Minimalist assumptions, (Re-)Merge).[4]

Inherently, each word order type (the "order of meaningful elements" in Greenberg 1963) often comprises a syntactically-heterogeneous set of languages as a result. That is, languages belonging to the same type often exhibit diverging syntactic properties. We conclude that a language's dominant word order type (if it has one) in fact reveals very little of value about the actual structure of that language, meaning that these classifications can be, syntactically speaking, misleading and inaccurate.

We provide concrete examples illustrating this conclusion below, in the form of a pair of case studies involving the VSO and OVS word order types.

1.1 Case Studies: the VSO and OVS Types

First, consider Potsdam's (2009) discussion of wh-question formation in VSO (and VOS) languages. Although these languages tend toward the same major syntactic prop-

[2] If no such order can be found, then the language is described as "lacking a dominant word order" (*ibid*.).

[3] "Subject", "object", and "verb" also have primitive status, perhaps problematically; we leave this aside.

[4] These criticisms of surface word order generalizations are not new: they echo those raised in e.g. many of the cogent replies to Evans and Levinson (2009a). See *Behavioral and Brain Sciences* 32:5 and *Lingua* 120:12 for a few dozen such replies.

erties, Potsdam notes that they differ in their strategies for achieving wh-initial order in questions. Depending on the language, wh-initial order arises from either canonical wh-movement, focus fronting, or (pseudo)clefting. On the surface, it is not at all clear what dictates a language's preference for one strategy over the other, so this property seems to vary arbitrarily among members of this word order type.

Potsdam claims (following others) that suggestive patterns emerge when one compares these languages' strategies for achieving wh-initial order with their strategies for achieving V-initial order. Summarizing a sizable literature on V-initial languages, he notes that V-initial order has at least four distinct derivational sources: V movement, (remnant) VP movement, subject lowering, and rightward specifiers (for VOS order). He argues that the derivation involved in each of these V-initial strategies has the effect of limiting the set of wh-initial strategies available to a language, perhaps to the extent that a true implicational relationship exists between the two sets (e.g. "if VP movement, then clefting"). Note that this proposed implicational universal relates syntactic derivational steps. Progress of this sort can only be made through careful syntactic analysis; surface classification is not sensitive to patterns (including patterned exceptions) originating in the syntax.

Now consider a more detailed case study involving the major syntactic properties of OVS languages. Although Dryer and Haspelmath (2011: 81A) list only 11 languages with "dominant OVS order" (seven of which are spoken in South America), it is nevertheless a discrete word order type by their definition. One of these languages, Hixkaryana (Carib), is broadly similar to the other OVS languages in the region in terms of its major syntactic properties (Derbyshire and Pullum 1981). In particular, these languages are postpositional (1), and also allow SOV word order (2):

(1) *Hixkaryana: OVS order, postpositions* (Derbyshire 1985: p. 60)

bɨryekomo	komo	yonyetxkonɨ	kamara	**txetxa**	**wawo**	amnyehra
child	COLL	he.was.eating.them	jaguar	forest	in	long.ago

'The jaguar used to eat children in the forest long ago.'

(2) *Hixkaryana: SOV order possible* (Derbyshire 1985: p. 74)

okomkurusu	**bɨryekomo**	heno	yoskeko
bushmaster	child	dead	it.bit.him

'It was a bushmaster (snake) that bit the child.'

Derbyshire (1985: p. 74) notes that clause-initial subjects in Hixkaryana are "emphatic", and only licensed under certain discourse conditions (cf. *ibid.* §13.1). Adjuncts can also be fronted for emphasis, but only if the subject has not been; and, emphatic fronting is only available in matrix clauses. This cluster of properties strongly implicates a single, clause-initial A′ position, very likely related to information structure.

If this is correct, and only a single constituent can be fronted for emphasis, then (2) indicates that OV order in Hixkaryana is not derived by emphatic fronting of O (see also Kalin 2011), which we return to shortly. It is also worth noting that many other properties of Hixkaryana (and neighboring OVS languages) are consistent with traditional head-final properties (e.g. their genitives, relative clauses, etc.: see Derbyshire 1985: §11.2). So far, then, our expectations have not been met: there is no sign of diverging syntactic properties among OVS-type languages. Instead, they seem to be well-behaved OV languages.

However, outside of South America, the OVS typology quickly breaks down. Consider Tuvaluan (Polynesian), whose dominant word order is also reported to be OVS (Dryer and Haspelmath 2011). First, Besnier (2000: p. 144) notes that postpositions are unattested in Tuvaluan, and that it is strictly prepositional (3). Second, SOV order is also unattested (4b):

(3) *Tuvaluan: OVS order, prepositions* (Besnier 2000: p. 338)
tamaliki ne afuli nee au **mai te lulu puaka**
child PAST chase ERG I from the pen pig
'I chased the children from the pig pen.'

(4) *Tuvaluan: SOV order impossible* (Besnier 2000: p. 131)
a. te atu teelaa ne ffuti nee Niu
the bonito DEM PAST pull ERG Niu
'Niu landed that bonito (fish).'
b. ***nee Niu te atu teelaa** ne ffuti
ERG Niu the bonito DEM PAST pull

These Tuvaluan examples contrast sharply with their equivalents in Hixkaryana, (1)-(2). Moreover, in addition to its head-initial PPs, Tuvaluan exhibits many other canonical head-initial properties as well (Besnier 2000: p. 131).[5] This sets it even further apart from Hixkaryana, despite that the two share OVS dominant word order.

In terms of their major structural properties, then, these two languages are quite dissimilar. They do, however, seem to share at least one major syntactic property – one that relates to a lingering question about Tuvaluan. That is, given Tuvaluan's strong tendency toward head-initial configurations, how do we make sense of its OV surface order?

We argue that OVS arises in Tuvaluan when O has undergone A′-movement to a unique clause-initial position.[6] This is precisely what we claimed for Hixkaryana's subject-initial order (which we return to shortly), and we apply the same argumentation to support the claim for Tuvaluan, below, following a series of observations by Besnier (2000: p. 131-6).

First, Tuvaluan exhibits all possible surface word orders except SOV and OSV, the only orders in which both arguments are preverbal. Assume that the basic syntax of Tuvaluan, like its VSO relatives, involves movement of V(P) to a position higher than the subject (see Potsdam 2009 for references). If there is only one clause-initial position for fronted arguments (and adjuncts, which we leave aside), then it follows that SOV and OSV should be impossible in Tuvaluan: there is only room for one preverbal argument in the structure.

Second, preverbal arguments in Tuvaluan must be definite. This arises straightforwardly if preverbal arguments in the language have undergone topicalization, an A′ operation that non-definite DPs cannot undergo. [7]

Third, embedded clauses in Tuvaluan are obligatorily V-initial. Again, this is strongly reminiscent of an A′ operation: in many languages, such operations are prohibited in embedded contexts (e.g. embedded topicalization in English: Emonds 1976).

Finally, preverbal subjects (in SVO clauses) never bear ergative case, whereas they can

[5] In fact, apart from its curious preference for OVS order, Tuvaluan is effectively identical, typologically speaking, to its close Polynesian relatives (e.g. Samoan), which are overwhelmingly VSO.

[6] See Besnier (2000: §1.12 & 1.2.1) for the pragmatic effects of fronting arguments in Tuvaluan.

[7] If correct, it must be true of Tuvaluan that only one constituent can be topicalized per clause (see above).

(and typically do) elsewhere. Instead, when the subject is preverbal, an ergative-marked resumptive pronoun obligatorily appears postverbally. This is consistent with known constraints on A′-extraction in ergative languages: that is, ergative arguments are known to resist A′ operations in many languages (see Manning 1996), but resumptive pronouns (in languages that have them) often provide a means around this constraint. Crucially, operations such as relativization, which are uncontroversially A′ operations, also trigger resumption in Tuvaluan when targeting ergative-marked arguments (Besnier 2000: p. 66). Additionally, under the reasonable assumption that the resumptive pronoun occupies canonical subject position, its appearance postverbally lends further support to the claim that the Tuvaluan V ends up higher than non-A′-moved subjects.

Summing up, we claim that Tuvaluan's dominant O-initial order is derived by A′-movement of O from within an otherwise prototypical Polynesian VSO structure (which, of course, has its own complex derivation). Looking back at Hixkaryana, we claimed that it also had a unique, clause-initial A′ position responsible for subject-initial (SOV) order. This implies that Hixkaryana OV order does <u>not</u> require A′-movement, unlike Tuvaluan; this explains why the former, but not the latter, allows two arguments to appear preverbally. Tuvaluan's head-initial properties are consistent with its VO configuration (before A′ operations), while Hixkaryana's head-final properties are consistent with its OV configuration. If we could factor out Tuvaluan's O-fronting, then it could be properly re-classified.

1.2 Typological Opacity

Looking back at Hixkaryana and Tuvaluan, we see that the two share almost no structural similarities, and yet, under the going methodology, they belong to the same word order type. Because of its frequent but superficial O-fronting operation, Tuvaluan is improperly categorized as an OVS language, and thus, even more misleadingly, as an OV language. We refer to this state of affairs – whereby a syntactic process generates a surface word order pattern in a language that is inconsistent with its other major typological properties – as an instance of *typological opacity*. Specifically, a typologically opaque process is one that causes a deviation from what Cinque (to appear) calls the "abstract harmonic orders", a definition which characterizes many, perhaps all, of the information-structural (A′) movement operations. Of course, the existence of typologically opaque processes raises an important question: what are the processes that are typologically *transparent*? We take this up in §2.

Other well-known examples of typological opacity arise due to the verb-second (V2) phenomenon, e.g. in German, Dutch, etc. These languages are classified as "lacking dominant order among S, O, and V" by Dryer and Haspelmath (2011: 81A),[8] putting most of Germanic on par with e.g. Warlpiri, typologically speaking. This is not a desirable outcome, given that German, Dutch, etc. are, for the most part, typical head-final languages. In traditional typology, they stand out as anomalous, even though the processes responsible for these "anomalies" are known to syntax, and not at all exotic. What we must do, then, is work to identify the sources of typological opacity, so that they may be factored out of our system of classification. The result would no longer be a typology of "surface word order".

[8]Dryer and Haspelmath (2011: 81): "A third subtype of language lacking a dominant order consists of languages in which different word orders occur but the choice is syntactically determined." We contend, of course, that syntax *always* determines word order.

1.3 *An Alternative: Toward a Derivational Typology*

Given that surface word orders are epiphenomena of syntax, and on their own tell us very little about structure, the abundance of weak typological correlations and tendencies might simply reflect corresponding statistical noise. This noise could perhaps be greatly reduced if systems of linguistic classification were informed by linguistic theory (cf. Polinsky and Kluender 2007, Hermon 2009, Polinsky 2010, and particularly Koopman 2012), but the onus lies with generative linguistics to construct such systems, as Evans and Levinson (2009b: R2.3) and others point out. [9]

In place of word order typology, we propose a classification of the derivations that converge on these orders. This move toward what we call *derivational typology* should be concerned not just with capturing the surface generalizations, but also the patterned exceptions to those generalizations. We join a chorus of recent generative work expressing this sentiment (see fn. 9).

We sketch out a syntactic analysis consistent with these themes below.

2 Deriving Harmony

We have emphasized throughout that surface word order generalizations are often misleading. Still, the Greenbergian tradition has yielded a small number of such generalizations whose statistical correlations are extremely strong. These are also epiphenomenal, only they happen to reflect the final output of the core syntactic derivation.

We concern ourselves here with two such generalizations involving correlations between and within VPs and PPs.[10] Specifically:

(5) *Relative order of VP and PP*
With overwhelming frequency, PPs appear on the same side of the verb as objects. Dryer (1992) notes VO-PP order in ≈98% of VO languages (59 of 60), and PP-OV order in ≈88% of OV languages (63 of 72).[11]

(6) *Harmonious order across VP and PP*
With overwhelming frequency, VPs exhibit the same head-complement order as PPs. Dryer and Haspelmath (2011: 95A) observe PrepP in ≈92% of VO languages (456 of 498), and PostP in ≈92% of OV languages (472 of 514).

We aim to develop a theory of syntax that produces these correlations.[12]

[9] A handful of recent work has taken up this charge, including Kayne (2000), Biberauer, Holmberg, and Roberts (2007, and subsequent work), Potsdam (2009), and Biberauer and Sheehan (to appear). We offer our own attempt in §2.

[10] Throughout, we use the term "P(P)" to refer to adpositions (and their "objects") generally. When the order of P and its "object" is relevant, we indicate this using the terms Prep(osition)P and Post(position)P.

[11] In Dryer's (1992) sample, 4 of the 9 languages exhibiting exceptional OV-PP order are in South America. Hixkaryana, a South American language, exhibits this exceptional pattern. See §2.4.

[12] See Kayne (2005: ch. 9) for similar goals, although our analyses differ in fundamental ways.

2.1 Proposal

Assuming a small set of initial assumptions in (8), our claim is that the generalizations in (5)-(6) can be fully reduced to simple lexical variation of P. That is, feature-checking on P yields the headedness of PP, which in turn dictates the order in VP. Along the way, the relative order of PP and VP also falls out as a consequence. This is a significant departure from the traditional assumption that the headedness of VP is privileged in the grammar.[13]

Formally, we encode the relevant lexical variation of P as a pair of strong (EPP) features (indicated with '*'), although this could be accomplished other ways (cf. Richards 2011). The going distinction between head-initial and head-final languages is stated below:[14]

(7) *The lexical variation of P*

a. Head-initial languages: P bears [*u*V*], attracts VP to [Spec, PP].

b. Head-final languages: P bears [*u*D*], attracts the "object" of P to [Spec, PP].[15]

Once we adopt the following proposals from the literature as our initial assumptions, the remaining surface correlations arise "for free" from syntax.

(8) *Initial assumptions*

a. **Cyclic Linearization**: When a Spell-Out domain X is *linearized*, a set of *precedence relations* is created among each of the elements within X (e.g. *Y* > *Z*, "Y precedes Z": Fox and Pesetsky 2005).

(i) Linearization of a Spell-Out domain X is triggered by merger of the head that selects X (signaling completion of that domain).

(ii) Extraction of an element from within a linearized domain creates precedence violations. The previously-established orders must be restored by additional movement before the next cycle (*Order Preservation*).

(iii) The Spell-Out domains are at least PP (see below) and CP, but *not* VP.

b. **T-V adjacency**: T and V must be adjacent at some stage of the derivation (Holmberg 2000, Richards 2011, a.o.; see below).

c. **P on the spine**: P is present in all clauses (overtly or non-overtly), merged on the clausal spine above VP (Kayne 1999 *et seq.*, Schweikert 2005).

d. **OV in VP**: VPs can be head-final in first-merged base structure (Haider 2000).[16]

Following (Kayne 2005: ch. 7 & 9), prepositions select K, a head whose specifier licenses the "object" of P.[17] K, in turn, selects VP, yielding the simplified clause structure in (9):

[13] Thus, we make a prediction for first language acquisition in languages with overt adpositions: children should acquire the order of heads and complements on the basis of data from PP, not VP. This question remains to be investigated.

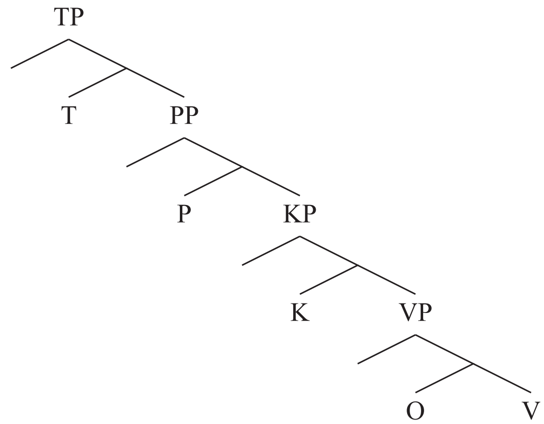
[14] This implies that prepositions and postpositions are somehow distinct (sub)categories with different selectional properties. What we suggest here implies that prepositions have "verbal" selectional properties, while postpositions have "nominal" ones (but Hixkaryana P has both: see §2.4).

[15] We assume in (8c) that P is present in all clauses. If P is non-overt, then it attracts a silent DP.

[16] If we adopt the Antisymmetric view that all XPs are head-initial upon first merge, more would need to be said about the interaction of Cyclic Linearization and the T-V adjacency requirement. See fn. 20.

[17] See Kayne (2005: §7.1.2) for detailed discussion of KP. Strictly for reasons of derivational simplicity, we differ with *ibid.* §9.4.4, which states that the "object" of P never occupies [Spec, PP].

(9) *Simplified clause structure*



For concerns of space, we do not discuss the derivation of clauses containing more than one P; see Schweikert (2005). Likewise, we leave aside the position of subjects throughout our discussion, focusing only on the core derivation of VP and PP.

As stated in (8b), we follow previous work assuming that certain selectionally-related heads must be adjacent during the derivation. This has consequences for the linearization of syntactic objects that would otherwise disrupt adjacency at some stage of the derivation. For example, given a first-merge structure [X [ZP Y]], if X and Y must become adjacent, then ZP is an intervener. Various movement possibilities present themselves for achieving X-Y adjacency in this structure (e.g. ZP movement, Y-to-X movement, etc.). In the absence of independent evidence for such movements, we follow Richards (2011) in assuming that minimal structural changes are preferred, and that a linearization-based solution is plausible. That is, if the linear order of ZP and Y were simply reversed, then Y would be adjacent to X. (Likewise, starting from the initial structure above, X-Y adjacency could also be achieved if the linear order of X and YP were reversed). Richards refers to this linear reversal operation as *Rotate*, motivating it on prosodic grounds.[18] For simplicity, we take this to be the operation responsible for deriving (some of) the adjacency effects seen in our system, perhaps ultimately owing to independent prosodic properties if Richards' approach is on the right track (though nothing crucially relies on this).

With these assumptions in place, we turn now to the derivation of VO-PrepP order.

[18]In brief, Richards argues that various theory-internal formal features, e.g. "strong" and EPP features, can be done away with, as they simply reflect re-ordering for predictable prosodic reasons (i.e., to satisfy the requirement that two selectionally-related elements be adjacent within the same level of phonological phrasing). *Rotate* achieves this re-ordering without movement: "you can tag a node X with a diacritic which is interpreted by phonology as meaning 'If X c-commands Y, then X follows Y'" (Richards 2011: p. 18).

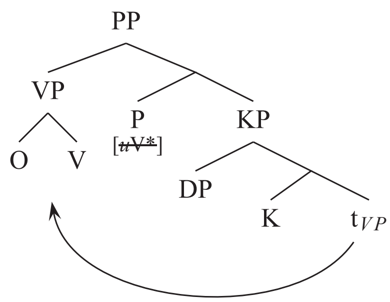
The same result could be achieved using e.g. Biberauer, Holmberg, and Roberts's (to appear) 'L(inearization)-movement' (movement of a head's complement to its specifier for linearization purposes), though more would need to be said about the timing of such movement within a Cyclic Linearization approach.

2.2 *The Derivation of VO-PrepP Order*

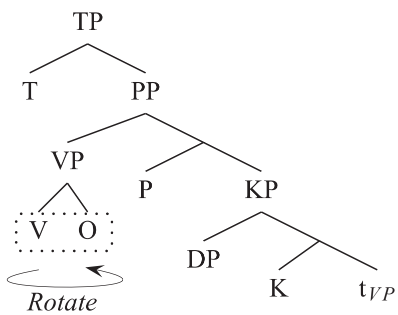
Languages exhibiting this order have P [*u*V*], triggering movement of VP to [Spec, PP]. Upon merger of T, the object is an intervener for T-V adjacency, necessitating a VP-internal reordering (i.e., Rotate). This applies simultaneously with Spell-Out of PP, and Order Preservation is respected.

(10) *Deriving VO-PrepP*

a. Merge P [*u*V*]: attract VP



b. Merge T: triggers Rotate of VP (T-V adjacency) and Spell-Out of PP



This derivation yields head-initial surface order for VP and PP (recognizing that the latter is not a simplex constituent), as well as VP-PrepP order, in accordance with the generalizations in (5) and (6).

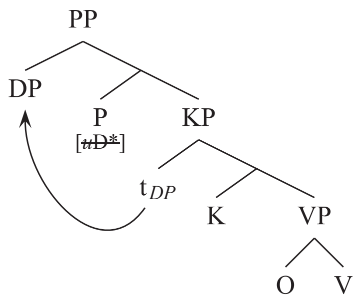
We turn now to the derivation of PostP-OV order.

2.3 *The Derivation of PostP-OV Order*

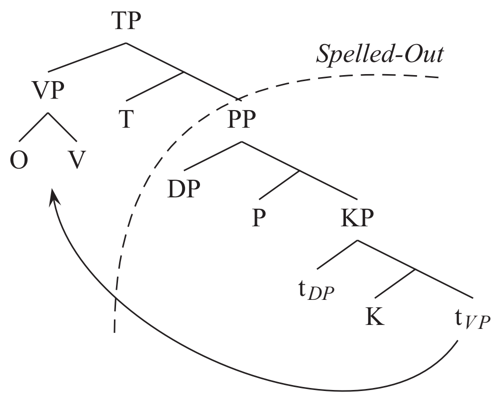
Languages exhibiting this order have P [*u*D*], triggering movement of the DP "object" of P to [Spec, PP]. The remainder of the derivation – which involves movement of VP followed by remnant-movement of PP – arises from satisfaction of the T-V adjacency requirement and Cyclic Linearization.

(11) *Deriving PostP-OV*

a. Merge P [*u*D*]: attract DP (PostP order)



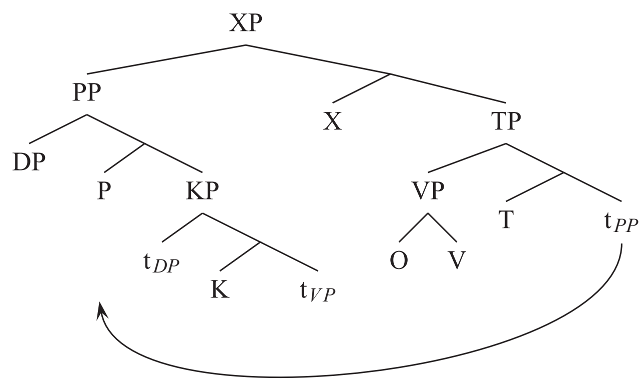
b. Merge T: triggers Spell-Out of PP, fixing the relative order of the elements inside PP; however, T-V adjacency forces VP to move, creating precedence violations (e.g. P < VP).[20]



[20]If we take the Antisymmetric view that all XPs start out head-initial, then the derivation of PostP-OV order (11b) becomes problematic: VP movement would fail to yield T-V adjacency by itself (O would intervene), and precedence within VP would presumably be fixed at Spell-Out of PP, meaning Rotate could not apply. (Rotating VP prior to Spell-Out of PP would require "lookahead", which is to be avoided.)

Fox and Pesetsky's (2005) discussion of ellipsis offers a potential solution. They argue that deleting a linearized constituent also deletes all precedence relations established among elements within that constituent (correctly allowing "repair by deletion"). If Move is actually Re-Merge, and lower copies of a displaced XP are deleted, then, by analogy to ellipsis, this ought to entail deletion of all precedence relations within any moved XP. If correct, then moving a linearized VP would "feed" Rotate, allowing T-V adjacency to be established. This approach makes a number of testable predictions, but we must leave them for future work.

c. The P < VP precedence established in the prior cycle must be restored before the end of the next cycle, requiring remnant movement of PP across VP.[21]



Following this movement of PP, Order Preservation is satisfied: P precedes VP. Thus, given our initial assumptions in (8), simple feature-checking on P leads directly to the generalizations in (5) and (6). It also yields a head-final configuration for T, consistent with the facts for many languages with PostP-OV order.

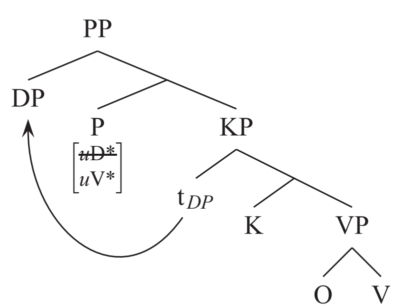
2.4 Deriving an Exception: OV-PostP Order (Hixkaryana)

Hixkaryana (and neighboring languages) exhibits OV-PostP order (see fn. 11), which stands in exception to (5). Exceptional patterns such as this can also be made to follow from minor lexical variation of P, consistent with our proposal in §2.1.

Specifically, we suggest that OV-PostP languages have a P with nominal and verbal selectional properties (see fn. 14). That is, it bears [*u*D*, *u*V*], meaning it attracts both the DP "object" of P to its specifier (deriving postpositional order) as well as the VP:[22]

(12) *Deriving exceptional OV-PostP*

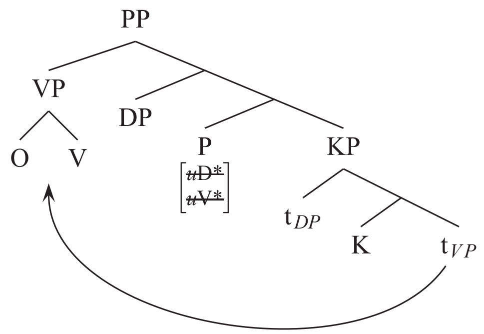
a. Merge P [*u*D*, *u*V*]: attract DP (PostP order)...



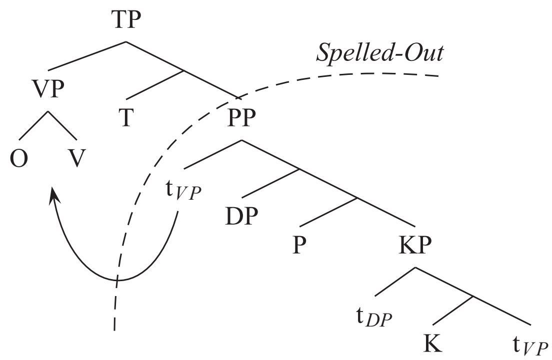
[21] We do not commit ourselves to a label for XP, although several options present themselves. For our purposes, all that matters is that this XP is lower than CP, the highest Spell-Out domain in the clause.

[22] This requires multiple specifiers, unlinearizable by the LCA (or by its mirror image, Rotate). However, this conflict is resolved before Spell-Out: see (12c). Note that the relative order of these specifiers is irrelevant for our purposes (although we assume that DP occupies the lower specifier).

b. ...and attract VP



c. Merge T: triggers Spell-Out of PP, fixing the relative order of the elements inside PP; however, T-V adjacency forces VP movement.[23]



This yields exceptional OV-PostP order. Unlike canonical head-final languages, those of the Hixkaryana type do not involve movement of PP: this is a direct consequence of the features on P. Thus, the rarity of this OV-PostP type reduces to the rarity of P bearing [*u*D*, *u*V*]. Exactly why this feature should be rare, though, remains an open question.

3 Closing Remarks

In essence, we claim that the typological generalizations in (5) and (6) arise as the result of a sort of "Generalized Holmberg's Generalization" – the idea that precedence relations established for major constituents early in a derivation must persist through later stages.[24] This is the major contribution of Fox and Pesetsky (2005), and if it is correct, then we expect to see such effects arising in many other places in grammar. We believe that this is a promising route toward capturing important typological generalizations (and their exceptions) from basic properties of syntax.

[23] We are left to explain why VP moves, instead of simply undergoing Rotate in [Spec, PP]. We conjecture that this is due to the position of the Subject in the derivation (which we have left aside for concerns of space): given Hixkaryana's OVS order, we suggest that the Subject occupies a position between TP and PP, making it an intervener for V-T adjacency, even if Rotate were to apply.

[24] Cf. Richards' (2011: p. 13) notion of *Mitigated Ruthlessness*.

Abbreviations

COLL = collective; DEM = demonstrative; ERG = ergative; EXCL = exclusive; PAST = past tense; PostP = postpositional order; PrepP = prepositional order.

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This work is inspired by a tradition of careful work in syntactic typology – a tradition in which Ed Keenan is a central figure. We would like to thank the audience of NELS 42 for helpful feedback on this project.

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Affiliation

Craig Sailor	Anoop Mahajan
Department of Linguistics	Department of Linguistics
UCLA	UCLA
cwsailor@ucla.edu	amahajan@ucla.edu

Generalized Quantification and Anaphora Across Ontological Domains: Evidence from ASL*

Philippe Schlenker

Introduction

It was shown in Schlenker (to appear) that in ASL one and the same anaphoric element has nominal, temporal, and modal uses, and that in all three domains generalized quantifiers can introduce loci (= positions in signing space) that denote what is often called the 'maximal set', i.e. the maximal set of objects that satisfy both the restrictor and the nuclear scope. But the anaphoric status of restrictors proper was only mentioned in passing, with no convincing examples. Here we summarize our earlier results about maximal set anaphora, and we suggest that in all three ontological domains (i) sign language restrictors can introduce discourse referents, which can also be overtly realized by loci, and that (ii) these loci can be made available for further anaphoric uptake. As a result, 'restrictor set' and 'maximal set' anaphora are sometimes overtly distinguished in ASL in the nominal, temporal and modal domains alike.[1]

1 Maximal Set, Restrictor Set and Complement Set Anaphora in ASL: Nominal Case (summary of previous work)

In Schlenker 2012, Schlenker and Lamberton to appear, and Schlenker et al. 2012, two findings were reported concerning the interaction between anaphora and generalized quantification in ASL, depending on whether the quantifier introduces one or several loci. This section borrows from these earlier works in both form and content.

***Main ASL consultant for this article: Jonathan Lamberton.**
Special thanks to Jonathan Lamberton, who has provided exceptionally fine-grained data throughout this research, and has checked and corrected the transcriptions of the ASL videos; his contribution as a consultant has been considerable. The present work was supported by an NSF grant (BCS 0902671 - Schlenker) and by a Euryi grant from the European Science Foundation ('Presupposition: A Formal Pragmatic Approach' - Schlenker). Neither foundation is responsible for the claims made here. The research reported in this piece also contributes to the COST Action IS1006.

[1] In the following, sign language sentences are glossed in capital letters. Non-manual markings are omitted. Subscripts correspond to the establishment of loci in signing space – thus *[POSSIBLE IX-1 LOSE]$_b$* transcribes the sequence of words 'POSSIBLE IX-1 LOSE' signed in or near locus *b*. Letters encoding loci are assigned from right to left from the signer's perspective – and in some examples we give a rough representation of the loci's positions using a diagram. Pronouns, glossed as *IX* (for 'index'), can point back to previously established loci. In such cases, the locus is suffixed to the pronoun, so that *IX-a* is a pronoun that points towards (or 'indexes') locus *a*; the numbers *1* and *2* correspond to the position of the signer and addressee respectively. Importantly, indexes can also be used to *establish* a locus.

(i) When a quantificational antecedent just introduces a single (default) locus, standard data from spoken language, illustrated in (1), are replicated in ASL, as in (2).[2]

(1) **Maximal Set Anaphora**

a. Few of my students came to class, but they asked good questions.

a'. Most of my students came to class, and they asked good questions.

Restrictor Set Anaphora

b. Few students came to class. They aren't a serious group.

b'. Most students came to class. They are a serious group.

Complement Set Anaphora

c. ?Few students came to class. They stayed home instead.

c'. #Most students came to class. They stayed home instead.

(2) a. 6.7 POSS-1 STUDENT FEW a-CAME CLASS.
'Few of my students came to class.'
IX-arc-a a-ASK-1 GOOD QUESTION
'They asked me good questions.'

a'. 6 POSS-1 STUDENT MOST a-CAME CLASS.
'Most of my students came to class.'
IX-arc-a a-ASK-1 GOOD QUESTION
'They asked me good questions.'

b. 6 POSS-1 STUDENT FEW a-CAME.
'Few of my students came.'
IX-arc-a NOT SERIOUS CLASS.
'They are not a serious class.'

b'. 6.7 POSS-1 STUDENT IX-arc-a MOST a-CAME CLASS.
'Most of my students came to class.'
IX-arc-a SERIOUS CLASS.
'They are a serious class.'

c. POSS-1 STUDENT FEW a-CAME CLASS.
3.6 IX-arc-a a-STAY HOME

c'. POSS-1 STUDENT MOST a-CAME CLASS.
2.8 IX-arc-a a-STAY HOME

Intended: 'Few/Most of my students came to class. They [the students that didn't come] stayed home.'

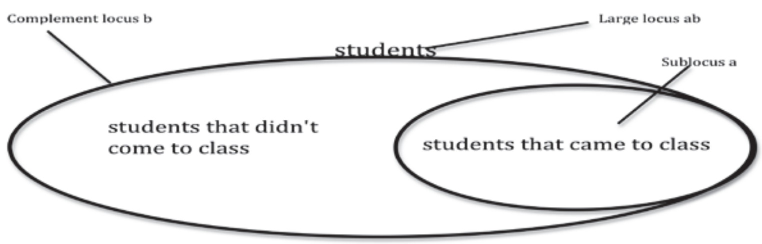
Specifically, one can obtain in ASL instances of 'maximal set anaphora', whereby a pronoun refers to the maximal set of objects that satisfy both the restrictor (= NP) and the nuclear scope (= VP), as in (1)a-a' and (2)a-a' – so that in the present case the pronoun refers to the students who came to class. Similarly, instances of 'restrictor set anaphora' can be obtained: in (1)b-b' and (2)b-b', the pronoun refers to the set of objects that satisfy the restrictor NP, hence in this case it refers to the entire set of students. But as was argued for spoken language in Nouwen 2003, 'complement set anaphora' is very degraded: in (1)c-c' and (2)c-c', it is difficult for the pronoun to refer to the students who did *not* come to class (the acceptability of (1)c(i) might be due to a collective reading 'with exceptions', whereby the students collectively, *with the exception of a few of them,* stayed home). Ratings for the sentences in (2) are (as always in this work) on a 7-point scale (7 = best), and in the present case they represent averages per trial over 3 informants.

(ii) While the examples in (3) roughly replicate spoken language data, another anaphoric strategy is possible in ASL: it consists in establishing a large plural locus *A* for the restrictor set [= the set of all students], and a sublocus *a* for the maximal set [= the set of students who came]. Remarkably, this strategy automatically makes available a locus

[2] When numerical ratings are provided at the beginning of examples, they are on a 7-point scale (7 = best). Depending on the examples, they may be averages over several informants (average per trial, often with different numbers of trials per informant), or just our main informant's ratings (which might be repeated and hence averaged over several trials).

A-a for the complement set. As a result, *all three readings become equally available*, though with different indexings (and importantly, all involve normal plural pronouns, and not the word *OTHER*). In (2), we provide our main consultant's judgments (3 iterations) based on this second anaphoric strategy ('embedded loci'). For perspicuity, we notate the large area *A* as *ab* to indicate that it comprises subloci *a* and *b* – but it is essential to keep in mind that it is just signed as a large circular area, as is schematically represented in (4).

(3) POSS-1 STUDENT IX-arc-ab MOST IX-arc-a a-CAME CLASS.
'Most of my students came to class.'
a. 7 IX-arc-b b-STAY HOME 'They stayed home.'
b. 7 IX-arc-a a-ASK-1 GOOD QUESTION 'They asked me good questions.'
c. 7 IX-arc-ab SERIOUS CLASS. 'They are a serious class.'

(4)


In the papers cited in the introduction, the emergence of the 'complement set reading' in (3) was taken to be due to a condition of 'structural iconicity' whereby the relations of inclusion and relative complementation among loci in signing space are preserved in the space of denotations. Briefly, the reasoning was as follows:
–since *a* is a proper sublocus of a large locus *ab*, we can infer by a closure condition on the space of loci that *(ab-a)* (i.e. *b*) is a locus as well;
–by the requirement that inclusion be preserved in the space of denotations, we can infer that for the initial assignment function s, $s(a) \subset s(ab)$;
–finally, by the requirement that relative complementation should be preserved as well, we can infer that $s(b) = s(ab)-s(a)$.

In this way, the complement set locus ends up denoting the set of the students who didn't come to class. Importantly, the proposal was that besides this condition of structural iconicity, the *grammar* of ASL does not differ much from that of English in the case at hand (modulo the visibility of formal indices as loci in sign language but not in spoken language): in both cases, no discourse referent is initially made available for the complement set, though one does become available through other means in ASL (namely through structural iconicity).

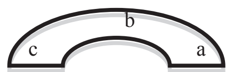
(iii) In the case of embedded loci considered in (ii), the maximal set locus was signed as a subpart of the restrictor set locus. By contrast, in the case of default loci considered in (i) above, the two loci appeared to be collocated. We now turn to a third strategy: in (5), the two loci are disjoint – despite the fact that their *denotations* are in a subset-superset relation.

(5) POSS-1 STUDENT [SOME AMERICAN]$_a$. BUT [HAVE FOREIGN]$_c$. IX-arc-a LAZY. IX-arc-c WORK-WORK. UNDERSTAND-UNDERSTAND, **IX-arc-c [SOME SHORT]$_b$. IX-arc-b GENIUS.**
'[Some of my students]$_a$ are American. But I also have [foreign students]$_c$. They$_a$ [= my

American students] are lazy, while they$_c$ [= my foreign students] are hard-working. See, among them$_c$, some$_b$ are short. They$_b$ [= the short foreign students] are geniuses.' (14, 162; 163)

Inferences:
(i) The speaker's students who are geniuses are those that are foreigners and are short.
(ii) The speaker's students who are hard-working are those who are foreigners (whether short or not).

(6) Approximate areas associated with the loci in (5) (from the signer's perspective)



(5) involves three loci, whose positions are represented in (6): locus *a* refers to the speaker's American students, and locus *c* to the speaker's foreign students. Both are introduced by way of existential constructions, and retrieved by the plural pronouns *IX-arc-a* and *IX-arc-c* respectively. In addition, *IX-arc-c* serves as the restrictor of the existential construction *[SOME SHORT]$_b$*, which ends up meaning 'some of my foreign students are short' (since *c* denotes the set of the speaker's foreign students), and introduces a maximal set locus *b* denoting the speaker's short foreign students. Inferential data were obtained by way of a multiple choice question as in (7):

(7) Which of the speaker's students are geniuses?
(i) those that are Americans (whether short or not)
(ii) those that are foreigners (whether short or not)
(iii) those that are Americans and are short
(iv) those that are foreigners and are short

As is clear in the part of (5) which appears in bold, restrictor set and maximal set loci are clearly distinguished and are not embedded within each other, despite the fact that their denotations are in a subset-superset relation. It is this anaphoric strategy that we now going to investigate in the temporal and modal domains.

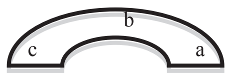
2 Maximal Set and Restrictor Set Loci in ASL: Temporal and Modal Case

It is a traditional idea that *when-* and *if-*clauses can function as restrictors of temporal and modal generalized quantifiers respectively (e.g. Lewis 1979, Kratzer 1986, de Swart 1995). We show that besides the maximal set loci described in Schlenker, to appear, temporal and modal restrictors – specifically: *when-* and *if-*clauses – can establish loci of their own in ASL.[3] The examples we consider rely on the last of the three mechanisms we saw in the previous section: the maximal set locus and the restrictor locus are signed as disjoint. (We have not been able to create felicitous examples in which the maximal set locus is a subpart of the restrictor set locus with *when-* and *if-*clauses; more work is needed to determine whether the relevant examples are impossible or just harder to construct).

Let us start with the temporal case, illustrated in (8), with the loci as shown.

[3] A preliminary example is discussed in Schlenker to appear (example (21b)). Inferential data were discussed, but the acceptability of the sentence was left unclear.

(8) *Context:* I often compete with you or with others.



6.3 [SOMETIMES IX-1 PLAY WITH OTHER PEOPLE]$_a$. BUT [WHEN THE-TWO-1,2 PLAY TOGETHER]$_c$ [SOMETIMES IX-1 LOSE]$_b$. IX-b IX-1 NOT HAPPY BUT IX-c GET-PILE MUCH MONEY, IX-a LITTLE MONEY.
'Sometimes$_a$ I play with other people. But [when you and I play together]$_c$, sometimes$_b$ I lose. Then$_b$ [= when you and I play together and I lose] I am not happy, but then$_c$ [= whenever you and I play together] I make a lot of money; then$_a$ [= when I play with other people] I just make a little money.' (12, 161; 12, 162; 12, 167; 14, 15)

Inferences:
(i) The speaker gets lots of money under the following condition: the speaker and addressee play together.
(ii) The speaker is unhappy under the following condition: the speaker and addressee play together and the speaker loses.

Three temporal loci are introduced in (8), with an opposition between times at which the speaker plays with other people – denoted by locus *a* – and times at which he plays with the addressee – denoted by locus *c*, which is explicitly introduced by a *when*-clause. A third locus, *b*, is introduced by a main clause with the temporal adverb *SOMETIMES*. An inferential task shows that the pronoun indexing *c* yields a 'restrictor set' reading, and ends up denoting the times at which the speaker and addressee play together; while the locus indexing *b* yields a 'maximal set' reading, and denote the times at which it is both the case that the speaker and addressee play together, and the speaker loses.

A structurally analogous modal example appears in (9). While the quantifiers and restrictors are modal rather than temporal, the main facts are as in (8): *IX-b* yields a 'maximal set' reading, and ends up referring to *those accessible worlds in which the speaker and addressee play together and the speaker loses*; while *IX-c* yields a 'restrictor set' reading, and refers to the set of *all accessible worlds in which the speaker and the addressee play together*.

(9) 6.5 [TOMORROW POSSIBLE IX-1 PLAY WITH OTHER PEOPLE]$_a$. BUT [IF THE-TWO-1,2 PLAY TOGETHER TOMORROW]$_c$ [POSSIBLE IX-1 LOSE]$_b$. IX-b IX-1 NOT HAPPY BUT IX-c MUCH MONEY, IX-a LITTLE MONEY.
'Tomorrow I might$_a$ play with other people. But [if you and I play together tomorrow]$_c$, I might$_b$ lose. Then$_b$ [= if you and I play together and I lose] I won't be happy, but then$_c$ [= if you and I play together] I will make a lot of money; then$_a$ [= if I play with other people] I will just make a little money.' (12, 150; 12, 151; 12, 152; 12, 166; 14, 14)
Inferences:
(i) The speaker gets lots of money under the following condition: the speaker and addressee play together.
(ii) The speaker is unhappy under the following condition: the speaker and addressee play together and the speaker loses.[4]

[4] The multiple choice question for the second inference was the following:

(i) Under what condition am I unhappy? In case: (i) I play with other people; (ii) we play together; (iii) I play with other people and I lose; (iv) we play together and I lose?

Conclusion

We conclude that in the nominal, temporal and modal domains alike, (i) loci can be the overt manifestation of discourse referents denoting the 'maximal set' of objects satisfying both the restrictor and the nuclear scope of a general quantifier; and that in addition (ii) loci can be established by restrictors in general, and by *if*- and *when*-clauses in particular – and indexing these loci gives rise to truth conditions that are clearly distinct from 'maximal set' readings.

In the study of spoken language, it took a relatively complex semantic analysis to come to the conclusion that (a) distinct discourse referents are introduced for maximal set readings and restrictor set readings, and that (b) *when*- and *if*-clauses behave like restrictors of generalized temporal and modal quantifers. In ASL, we see that both facts are made a bit more transparent by the existence of loci, which are the overt manifestation of discourse referents.

Finally, the fact that the same quantificational and anaphoric resources are available in the nominal, temporal and modal domains further strengthens the case for a uniform grammatical approach to individual, temporal and modal reference, as suggested in Schlenker 2006 and Bittner 2001, among others.

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Our informant picked (iv) twice, but the second time also added: *(iii also possible but iv is the more precise reading)*. We have no explanation for this fact.

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Affiliation

Philippe Schlenker
Institut Jean-Nicod, CNRS;
New York University
philippe.schlenker@gmail.com

Quantification of Expressions of Duration in Bole and Other Chadic Languages

Russell G. Schuh · Alhaji Maina Gimba

This paper discusses the quantification of the duration of events in Bole, a Chadic language of northeastern Nigeria. Durational quantity of an event can be viewed from two perspectives: the beginning and/or end points of the event (*I have been reading since 3:00*, *I read from 3:00 to 6:00*, *I read until 6:00*) and the overall duration of the event (*I read for three hours*). In this paper, we consider only the latter perspective.

In English and other European languages, durative time periods are expressed by nouns, e.g. 'time', 'year', 'day', 'hour'. In order to quantify duration, one therefore quantifies nouns, e.g. 'the vistors stayed a *long time*', 'Ed Keenan has taught at UCLA for *many years*', 'we traveled for *two days*', 'the food was gone in *less than an hour*'. In Bole, expressions of duration are predicates. Thus, in an English expression like *I spent three years in Paris*, the noun *year* has a quantificational modifier, whereas Bole expresses *spend-a-year* as a verb, with the quantifier as a sort of adverbial modifier:[1]

(1) **ǹ sonū kunùm gà Pārìs**
I spent-year three in Paris
'I spent three years in Paris.'

In order to quantify the duration of an event, one must use a biclausal structure, one clause expressing the duration, the other the event that is coextensive with that duration.

(2) **ǹ sonū kunùm ǹ jì̄ rùta gà Pārìs**
I spent-year three I PROG working in Paris
'I spent three years working in Paris.'

(3) **mu nossan (rànkatà) mu jì̄ sùmmàna**
we spent-time very we PROG chatting
'We chatted for a (very) long time.'

(4) **ngorwa sùnan monòu màte ɗòwasù gà bòn-ko?**
guests spent-day how many they staying at house-your
'How many days did the guests stay at your house?'

[1] Bole is a tone language with two tones and has distinctive vowel length. Low tone is marked with a grave accent (**à**), high tone is unmarked. Long vowels are marked with a macron (**ā**). The transcription is standard Bole orthography, in which **sh** = IPA [ʃ], **'y** = IPA [ʔ^j]. Most other symbols are as in IPA.

The durational predicates in these examples are all expressed by verbs:[2] **sonu** ‘spend a year’, **nòssu** ‘spend (a long) time, last’, **sunu** ‘spend a 24-hour period’. These may be the only monomorphemic durational verbs in Bole. However, durational predicates can be productively created with the “light” verb **ī** ‘do’ (→ **an** with a plural subject in the perfective, → **ài** in the subjunctive) followed by a noun expressing a unit of time.[3]

(5) **ǹ ī tère suram ǹ jī̀ ngàɗa lo sa**
I did month entire I PROG eat meat not
‘I spent the entire month without eating meat.’

(6) **mu an awà kunùm mu jī̀ sùmmàna**
we did hour three we PROG chatting
‘We chatted for three hours.’

(7) **ka ī sātì monòu zā̀ ka teke ruta yê?**
you did week how many before you finished work the
‘How many weeks did it take you to finish the work?’

(8) **an sòmbòɗì bòlou à jī̀ pempelì wā̀rì ’yorno**
one-did 24 hours two one PROG wind without stopping
‘The wind blew for two days without stopping.’

English does have predicates of duration, most notably the verbs ‘spend (time)’ and ‘last (for a time)’. It may be instructive to compare the structures of clauses containing such predicates with their translation equivalents in Bole. ‘Spend’ clauses in English require an agentive subject + ‘spend’ + quantified durational expression + gerundive phrase, e.g. *I spent three hours working, my dog spent 15 minutes burying a bone*. ‘Last’ clauses require a durative event as subject + ‘last’ + quantified durational expression, e.g. *the drought lasted two years*, *the lecture lasted too long*. The fact that the two predicates have different types of subjects results in distinct clause structures in English. In Bole, on the other hand, the translation equivalents of both “spend” sentences and “last” sentences are structurally identical, *viz.* a clause with a durational predicate paired with an event clause over which the durational clause scopes:

(9) **ǹ ī awà kunùm ǹ jī̀ rùta**
I did hour three I PROG working
‘I spent three hours working.’

(10) **sònan bòlou à jī̀ poishi**
one-spent-year two “it” PROG drought
‘The drought lasted two years.’

An alternative structure to that seen in the durational clauses above is the following:

[2]Verbs are inflected for tense/aspect, subject agreement, and certain “extensions”. The exact morphological analysis of verbs is not relevant to the topic of this short paper, so we write verbs as unit words, glossed with the most appropriate English tense. See Lukas (1970-72) and Gimba (2000) for descriptions of Bole verb morphology.

[3] **Sòmbòɗì** in (8), which means ‘day’ in the sense of a period of 24 hours, is the nominal counterpart of **sunu** in (4), which means either ‘spend the night’ or ‘spend a period of 24 hours’.

(11) **sòni-no kunùm ǹ jǐ rùta gà Pārìs**
year-my three I PROG working in Paris
'I spent three years working in Paris.'

(12) **sòmbòɗì ngorwa monòu màte ɗòwasù gà bòn-ko?**
days-of guests how many they staying at house-your
'How many days did the guests stay at your house?'

That is, a genitive construction consisting of a time period plus an agent forms the subject of a clause with a quantifier predicate. In effect, these are nominalized versions of the clauses seen above with the quantifier separated out as a predicate. In clauses such as **ǹ sonū kunùm...** 'I spent three years...' (more literally, 'I yeared three..."), the quantifier, here a number, directly quantifies a verb. This type of construction and the nominalized versions illustrated just above suggest that, in constructions such as **mu an awà kunùm...** 'we spent three hours...' (more literally "we did three hours..."), the quantifier is actually "higher" than the noun and scopes over the predicate "do hour", even though it appears from the English translation and the linear syntax that the quantifier is modifying a noun.

The Bole expressions match two clauses, one a quantified durational construction and the other an event whose duration is coextensive with the time expressed in the durational clause. This predicts that an English construction like 'I couldn't sleep for five nights' cannot be directly expressed in Bole. The problem here is that the sleeping events (actually the successive failures of sleeping events) are interrupted. That is, one cannot express a succession of five nights in a clause that expresses a singular period of duration. This prediction is borne out. The example here must be expressed in Bole in one of the following ways:

(13) **ǹ sunū bàɗì ǹ njȅlè sa gà bòɗì**
I spent-day five I sleeping not at night
'I couldn't/didn't sleep for five nights.'
Literally: 'I spent five 24-hour periods (during which) I didn't sleep at night.'

or, using the nominalized version with quantifier predicate to express duration,

(14) **sòmbòɗì-no bàɗì ǹ njȅlè sa gà bòɗì**
day-my five I sleeping not at night
Literally: 'my 24-hour periods [were] five (during which) I didn't sleep at night.'

That is, the durational expression in Bole covers the entire period that encompasses the sleepless nights, *viz.* five 24-hour periods, within which each night was sleepless.

Since duration is expressed in Bole using a clause separate from the event over which the duration scopes, the nature of the quantificational expression of the duration results in variations in the structures of the durational clauses. For purposes of this brief description we consider only expressions translatable as "less than..." and "more than...".

(15) **dȁjin ài sòmboɗì bòlou ngorwa tan-tùn shìnkāba yê**
before one-did day two guests ate-up rice the
'The guests had eaten up the rice in less than two days.'
Literally: 'Before one had spent two days the guests had eaten up the rice.'

(16) **’yātū̀ awà bòlou à jī̀ pito**
exceeded hour two it PROG rain
‘It rained more than two hours.’
Literally: ‘It exceeded two hours it was raining.’

(17) **màkānikè ’yàtū̀ sòmbòɗì bòlou à jī̀ rā̀mà mōtà-no**
mechanic exceeded day two he PROG repairing car-my
‘The mechanic spent more than two days fixing my car.’
Literally: ‘The mechanic exceeded two days he was fixing my car.’

The translation equivalent of English “less than” in Bole uses a ‘before’ clause, i.e. “before the time period in question was complete”, the paired durational event WAS complete. The translation equivalent of English “more than” uses the Bole verb **’yā** ‘exceed’, i.e. the expression of duration exceeded the matched event.

In summary, unlike European languages, which express duration using adjunct expressions involving quantified nouns of duration (‘hour’, ‘day’, ‘year’, etc.), Bole expresses duration by predications in clauses that are paired with clauses expressing durative events. One would like to know, from a typological point of view, how widespread durative expressions of this type are. It turns out not to be easy to determine this, at least from descriptive grammars. The types of constructions exemplified here are probably typical of Chadic languages, yet descriptive statements regarding these constructions are hard to come by. All the examples above could be calqued, almost morpheme-by-morpheme in Hausa, one of the best documented languages in Africa. Yet, Newman (2000), the most comprehensive published descriptive grammar of Hausa, does not mention these types of constructions, and Abraham’s (1962) dictionary, which includes an almost bewildering array of contextual examples for lexical items, has no examples like those presented in this paper.[4]

Durational expressions are a rather small corner of grammar, but we hope to have shown that investigation of such constructions, and in particular expression of quantification of duration, is worth further cross-linguistic investigation.

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[4] Under **kwāna** ‘spend a 24-hour period’ (equivalent to Bole **sunu**), Abraham (1962:582) has a couple of examples in which he translates **kwāna** as ‘since’: **nā kwāna bìyar, bàn gan shì ba** ‘it’s been five days *since* I saw him’ (literally: ‘I “dayed” five I haven’t seen him’), an interpretation that clearly misses the nature of the Hausa construction.

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Affiliation

Russell G. Schuh	Alhaji Maina Gimba
UCLA	University of Maiduguri
schuh@humnet.ucla.edu	gimbaa2000@gmail.com

Learnability and the autonomy of syntactic categories

Edward P. Stabler

Linguistics might be easier if there were a fixed, finite number of string substitution tests that could distinguish any pair of categories, or if the categories were fixed and finite across grammars of all possible human languages. But the evidence does not support these simple ideas (at least, as we can understand them now), and so linguistics is more of a challenge, and language acquisition is more of a mystery, than might otherwise have been expected. The familiar and persuasive evidence for this assessment is reviewed here, but with particular attention to how these facts are compatible with the existence of significant linguistic universals, and with the fact that languages are learned easily by normal human infants.

Keywords language, grammar, automorphism, learnability

0 Introduction

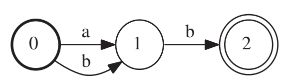
Some linguists have remarked that the conception of linguistic categories and structure in Keenan and Stabler (2003) is very 'intensional' in the sense that structure depends entirely on grammar, and of course grammars vary with speaker and language. This leaves us with the problem of getting from the 'extension' of a language (its spoken expressions), possibly with other relevant evidence, to the right structure. But no oracle has provided us with secure, easily applicable criteria, extensional or otherwise, for telling whether we have the right grammar for any language; we have found no 'royal road' to linguistic truth. But a royal road is essentially what the facts of language learnability seem to require. Learnability considerations are sometimes thought to require that linguistic categories must be pinned down distributionally by finite tests on their pronounced extensions, or else categories given once and for all in the one and only universal grammar. But familiar arguments show that those ideas cannot be right (at least, as we can understand them now). If they were, language would not be the amazing human creation we know it to be. In fact, every reasonable characterization of human language must be 'intensional' in something like the way it is in Keenan and Stabler (2003). But this does not spell doom for significant, restrictive universals, or for language acquisition that depends on them. On the contrary, it draws attention to some basic facts about how language acquisition must work. This paper reviews some advances in learnability, and then some linguistic perspectives, to argue that in spite of apparent differences a coherent perspective is emerging.

1 Learning some simple languages

The Nerode-Myhill theorem shows that the states of a minimal deterministic finite automaton can be regarded as sets of expressions.[1] Given any alphabet Σ, any language $L \subseteq \Sigma^*$ and any sentences $u, v \in \Sigma^*$, let's say $u \equiv_L v$ iff for all $w \in \Sigma^*$, $uw \in L$ iff $vw \in L$. That is, u and v are equivalent iff they can appear in all the same 'good contexts', w. For regular languages, the relevant contexts are the 'good finals', the suffixes of the well formed expressions. If L is regular, the states of minimal deterministic finite automaton for L can be regarded as the sets of 'good finals' $\{\{v\colon\ uv \in L\}\colon\ u \in \Sigma^*\}$. With this perspective, every suffix of every sentence in the language is a member of one or more of these categories. Learnability results for subsets of the regular languages often quite explicitly depend on some such identification, since then it is completely clear how, in any finite sample of the language, the learner is seeing finite approximations to the categories of the minimal automaton that generates the language.

Angluin (1982) provides a learnability result for the infinite subset of the regular languages, the zero-reversible languages, in which finding one good final, v, shared by two different prefixes u_1 and u_2, guarantees that u_1 and u_2 have all their good finals in common. That is, the state reached by accepting u_1 in a minimal deterministic automaton must be the same state reached by accepting u_2. So the minimal automata for these languages are distinguished by being 'deterministic in reverse' too, with exactly one final state, and where every state has at most one entering transition for each $a \in \Sigma$. This property provides a finite basis for category identification, so that learning is possible (and even efficient in a certain sense) from positive data.

When a language is defined with a context free grammar, the situation is more complicated. Each category of a context free grammar derives a set of strings which might occur only in the middle of an expression, and the boundaries of these 'middles' u in their 'good contexts' $\langle v, w\rangle$, where vuw is derivable, may not be indicated in any way. But Clark and Eyraud (2007) show how Angluin's result for zero-reversible regular languages can be generalized to context free languages in which finding one good context, $\langle v, w\rangle$, shared by two different substrings u_1 and u_2, guarantees that u_1 and u_2 have all their contexts in common. These languages are learnable from positive evidence.[2] Clark and Eyraud (2007) point out that the artificial language $\{ab, bb\}$ is zero-reversible but not substitutable, as we can see from the fact that its minimal deterministic automaton is also reverse deterministic:



and from the fact that a, b share some but not all their contexts:

<u>'middles'</u>	<u>contexts</u>
a	$\langle \varepsilon, a\rangle$, $*\langle a, \varepsilon\rangle$
b	$\langle \varepsilon, a\rangle$, $\langle a, \varepsilon\rangle$.

[1] See for example Hopcroft and Ullman (1979:§3.4) or Moll, Arbib, and Kfoury (1988:§8.2).

[2] Clark and Eyraud (2007) first propose a learning function that finds very large and redundant grammars, and then consider the problem of how to get a more compact representation. This is closely related to the natural ideas (discussed below) that the categories should not draw syntactically irrelevant distinctions (Keenan and Stabler 2003:141).

The languages Σ^* and $\{wcw^r : w \in \{a,b\}^*\}$, on the other hand, are substitutable, where w^r is the reverse of w.

Context free grammars (CFGs) are not appropriate for the definition of human languages, even for ones that may have context free string languages (Chomsky 1956; Stabler 2012). Mildly context sensitive grammars are more expressive than CFGs. For example, multiple context free grammars (MCFGs) which generalize CFGs by allowing a category to derive a pair (or in general a k-tuple) of strings instead of just a single string. The previous learning results can be extended into this class with learners that consider contexts $\langle v,w,z\rangle$ for possibly discontinuous pairs of strings $\langle s,t\rangle$, such that $vswtz$ is well-formed. Let's say that a language is k-substitutable iff whenever two k-tuples share a context, they share all contexts. When $k = 1$, we have substitutable context free languages, but with $k > 1$, larger classes of languages become learnable (Yoshinaka 2011). These ideas also extend to languages defined by certain 'parallel' MCFGs (PMCFGs), k-dimensional grammars with rules that allow copying (Clark and Yoshinaka 2012).

These recent learnability results – coming from first results on regular languages, then extended to large subsets of context free and context sensitive languages – are exciting partly because they suggest that the some of the evidence linguists use for determining structure might also be used reflexively by language learners. And even if this turns out not to be the whole story, it is still valuable to explore precisely and systematically some of the kinds of substitution tests we find in the linguistics literature – standard fare in introductory linguistics texts. But we can see that the learnability results mentioned here are established with fundamental assumptions that may be troubling:

(Cong) Categories are blocks of a coarsest congruence of L(G) and invariant

(Conc) Complexes are formed by concatenation (or similar functions on tuples[3])

(Subst) If two pronounced (tuples of) sequences have one context in common, they are the same category and have all contexts in common.

First, let's briefly introduce these properties and show how they hold in the classes of artificial languages mentioned above, classes for which we have learnability results.[4]

2 Fundamental properties of some artificial languages

For comparing grammars, it is useful to have a very expressive formalism like 'bare grammars' $G = \langle \Sigma, Cat, Lex, \mathscr{F}\rangle$, where V, Cat are nonempty sets, $Lex \subseteq (\Sigma^* \times Cat)$, and $\mathscr{F} \subseteq [(\Sigma^* \times Cat)^* \to (\Sigma^* \times Cat)]$. The language L(G) of the grammar is the closure of Lex with respect to the functions in $\mathscr{F}$. For any category C, the phrases of category C

$$Ph(C) = \{\langle s,C\rangle : \langle s,C\rangle \in L(G)\}.$$

[3]Extensions of the standard string function, concatenation, to tuples of strings are defined by Seki, Matsumura, Fujii, and Kasami (1991). For an analogous logical perspective see Morrill and Valentin (2010).

[4]A careful reader might notice, even before the properties Cong, Conc and Subst are carefully explained, that all of them refer to grammars. This might seem odd since standard measures of learning success depend on the learner's language, not the learner's grammar. But the learnable language classes are defined by grammars with these standard properties, and the learner's hypotheses are grammars with these properties too. As we will see in §3 below, linguists might worry that, with these properties, we have excluded appropriate grammars for human languages.

For the 'start' category (or any category) S, the strings of category S,

$$Str(S) = \{s\colon\ \langle s, S\rangle \in Ph(S)\}.$$

An interpretation maps expressions in $L(G)$, or their derivations, to semantic values. An automorphism of $\langle L(G), \mathscr{F}\rangle$ is a bijection on $L(G)$ that, when applied pointwise to each rule in $\mathscr{F}$, leaves each rule unchanged. We will call a property or relation on expressions that is fixed by the automorphisms structurally invariant, or structural. And two expressions are said to have the same structure iff some automorphism maps one to the other.

Keenan and Stabler (2003:§3.1) point out that CFGs have a straightforward translation into this framework. The CFG on the left below, for example, is represented by the bare grammar on the right:

$S \to ASA$	$\Sigma = \{a, b, c\}$
$S \to BSB$	$Cat = \{A, B, S\}$
$S \to c$	$Lex = \{\langle a, A\rangle, \langle b, B\rangle, \langle c, S\rangle\}$
$A \to a$	$\mathscr{F} = \{f, g\}$
$B \to b$	

where f is defined as follows:

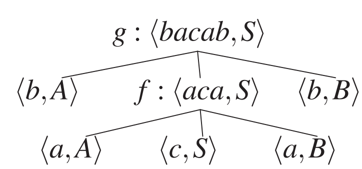
$$\begin{array}{ccc} \text{Domain} & f & \text{Value} \\ \begin{array}{ccc} s & t & u \\ A & S & A \end{array} & \longmapsto & \begin{array}{c} stu \\ S \end{array} \end{array}$$

This notation from Keenan and Stabler (2003) indicates that for any $s, t, u \in \Sigma^*$, f applies to $\langle s, A\rangle$, $\langle t, S\rangle$, and $\langle u, A\rangle$ to produce $\langle stu, S\rangle$. And g is defined similarly:

$$\begin{array}{ccc} \text{Domain} & g & \text{Value} \\ \begin{array}{ccc} s & t & u \\ B & S & B \end{array} & \longmapsto & \begin{array}{c} stu \\ S \end{array} \end{array}$$

Clearly $L(G) = Lex \cup \{\langle wcw^r, S\rangle\colon\ w \in \{a, b\}^*\}$, and as mentioned above, the string language $Str(S) = \{wcw^r\colon\ w \in \{a, b\}^*\}$ is a substitutable context free language. We can represent derivations with trees (i.e. terms) with lexical items at their leaves and generating functions (and possibly, redundantly, their values) at internal nodes. So with the previous grammar, $\langle aabb, S\rangle$ has the derivation represented by the term on the left or the corresponding tree on the right:

$$g(\langle b, B\rangle, f(\langle a, A\rangle, \langle c, S\rangle, \langle a, A\rangle), \langle b, B\rangle)$$



Multiple context free grammars (MCFGs) generalize CFGs by allowing categories to have more than one string component, and a straightforward extension of bare grammars can represent MCFGs (Keenan and Stabler 2003:§3.3), allowing $\mathscr{F} \subseteq [((\Sigma^*)^* \times Cat)^* \to$

$((\Sigma^*)^* \times Cat)]$. For example, consider the following grammar where T categorizes pairs of strings:

$$\begin{aligned}
&V = \{a,b,c,d,e\}\\
&Cat = \{A,C,E,T,S\}\\
&Lex = \{\langle a,A\rangle,\langle b,d,T\rangle,\langle c,C\rangle,\langle e,E\rangle\}\\
&\mathscr{F} = \{h,i\}
\end{aligned}$$

where h is defined as follows:

$$\begin{array}{ccc}
\text{Domain} & h & \text{Value}\\
\begin{array}{cccc} s & t & u & v,w\\ A & C & E & T\end{array} & \longmapsto & \begin{array}{c} svt,wu\\ T\end{array}
\end{array}$$

and i is

$$\begin{array}{ccc}
\text{Domain} & i & \text{Value}\\
\begin{array}{c} s,t\\ T\end{array} & \longmapsto & \begin{array}{c} st\\ S\end{array}
\end{array}$$

With this grammar, $Str(S) = \{a^n bc^n de^n |\ n \geq 0\}$, a non-context-free language. The string *aabccdee* has the derivation

$$\begin{array}{l}
i : \langle aabccdee, S\rangle\\
\quad h : \langle aabcc, dee, T\rangle\\
\qquad \langle a,A\rangle \quad \langle c,C\rangle \quad \langle e,E\rangle \quad h : \langle abc, de, T\rangle\\
\qquad\qquad \langle a,A\rangle \quad \langle c,C\rangle \quad \langle e,E\rangle \quad \langle b,d,T\rangle
\end{array}$$

Notice that, in the definition of the rules in this example, each string component in the arguments appears at most once (in this case, exactly once) in the value on the right, as MCFGs require.

We can easily relax the string copying requirement to allow multiple copies of argument strings, as in parallel multiple context free grammars (PMCFGs). For example, the following bare grammar represents a PMCFG with a single copying rule, extending our first example with just one rule j:

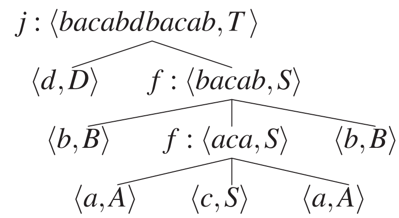
$$\begin{aligned}
&V = \{a,b,c,d\}\\
&Cat = \{S,T\}\\
&Lex = \{\langle a,A\rangle,\langle b,B\rangle,\langle c,S\rangle,\langle d,D\rangle\}\\
&\mathscr{F} = \{f,g,j\}
\end{aligned}$$

where rules f,g are unchanged from the first example and j is the rule:

$$\begin{array}{ccc}
\text{Domain} & j & \text{Value}\\
\begin{array}{cc} s & t,u\\ D & T\end{array} & \longmapsto & \begin{array}{c} tsu\\ T\end{array}
\end{array}$$

With this grammar, $Str(T) = \{wcw^r dwcw^r |\ n \geq 0, w \in \{a,b\}^*\}$. The string *bacabdbacab* has the derivation:

$$j(g(\langle a,A\rangle, f(\langle a,A\rangle, \langle \varepsilon,S\rangle, \langle b,B\rangle), \langle b,B\rangle))$$



It is significant that, as we see in this derivation tree, the copying never needs to compare two independently generated strings, but simply copies one derived string to more than one position.

We have now shown how to represent as bare grammars all of the kinds of grammars mentioned in §1, grammars defining learnable classes of languages: certain regular grammars (i.e. certain CFGs), MCFGs, and PMCFGs. It is easy to see that these formal grammars have the fundamental properties Cong and Conc. With all of them expressed in the bare grammar framework, the following properties are immediate:

Cong: Categorization is a coarsest congruence and invariant. For any bare grammar, the set $\{Ph(C) \colon C \in Cat\}$ is a partition of $L(G)$. Let's call that partition the **categorization**. For all the artificial grammars mentioned, the categorization is invariant, that is, every $Ph(C)$ is invariant, because the categories define the domains of the rules, and the rules are fixed by every automorphism. For any sequence u of expressions of $L(G)$, let $|u|$ be the length of u. Then it is easy to see that, for each of our grammars above, the categorization is also a **congruence** with respect to $\mathscr{F}$ in the sense that

$$\forall F \in \mathscr{F},\ \forall u \in \text{Domain}(F),\ \text{if } |u| = |v| \text{ and } \forall 1 \le i \le |u|,\ u_i, v_i \text{ have the same category,}$$
$$\text{then } v \in \text{Domain}(F) \text{ and } F(u), F(v) \text{ have the same category.}$$

In general there can be many congruences. For example the trivial partition of singleton sets of elements of $L(G)$ is of course a congruence too. But for all the formal grammars of this section, the categorizations are coarsest congruences. That is, no union of any two distinct $Ph(C)$ and $Ph(D)$ yields a partition of $L(G)$ that is also a congruence.

Conc: Complexes are formed by concatenation. In each of the previous grammars G, each rule simply concatenates string components (possibly with repetitions, as in the last example).

Now we are ready to consider why some linguists will be uncomfortable with the fundamental assumptions Cong, Conc, and Subst, and whether their worries are well founded.

3 Linguistic perspectives

3.1 Against Cong: categories may have distinguished subsets

Various of the example grammars in Keenan and Stabler (2003) have categorizations that violate Cong. The example that gets the most attention there is Little Spanish = $\langle \Sigma, Cat, Lex, Rule\rangle$ where

Σ: man, woman, obstetrician, doctor, -a, -o, gentle, intelligent, every, some, very, moderately

Cat: Nm, Nf, A, Am, Af, Amod, NPm, NPf, Agrm, Agrf D, Dm, Df

Lex:

Nm	man, doctor
Nf	woman, obstetrician
A	gentle, intelligent
D	every, some
Agrm	-o
Agrf	-a
Amod	very, moderately

$\mathscr{F}$: GM, Merge, where

Domain	GM	Value	Conditions
$\overset{s}{\text{C}}\ \overset{t}{\text{Agrm}}$	$\longmapsto$	$\overset{st}{\text{Cm}}$	$\text{C} \in \{\text{D}, \text{A}\}$
$\overset{s}{\text{C}}\ \overset{t}{\text{Agrf}}$	$\longmapsto$	$\overset{st}{\text{Cf}}$	$\text{C} \in \{\text{D}, \text{A}\}$

Domain	Merge	Value	Conditions
$\overset{s}{\text{Ax}}\ \overset{t}{\text{Nx}}$	$\longmapsto$	$\overset{st}{\text{Nx}}$	$\text{x} \in \{\text{m}, \text{f}\}$
$\overset{s}{\text{Dx}}\ \overset{t}{\text{Nx}}$	$\longmapsto$	$\overset{st}{\text{NPx}}$	$\text{x} \in \{\text{m}, \text{f}\}$
$\overset{s}{\text{Amod}}\ \overset{t}{\text{Ax}}$	$\longmapsto$	$\overset{st}{\text{Ax}}$	$\text{x} \in \{\text{m}, \text{f}\}$

With this grammar, we have derivations like this:

- Merge:⟨some -a very intelligent -a obstetrician, NP⟩
  - GM:⟨some -a, Df⟩
    - ⟨some, D⟩
    - ⟨-a, Agrf⟩
  - Merge:⟨very intelligent -a obstetrician,Nf⟩
    - Merge:⟨very intelligent -a,Af⟩
      - ⟨very, Amod⟩
      - GM:⟨intelligent -a, Af⟩
        - ⟨intelligent, Af⟩
        - ⟨-a, Agrf⟩
    - ⟨obstetrician, Af⟩

This grammar has automorphisms that exchange masculine and feminine nouns (Nm and Nf), and the masculine and feminine agreement markings (Agrm and Agrf) in the lexicon, projecting these changes through the language to exchange all masculine and feminine expressions. So apparently agreement and other similar dependencies can produce symmetric subcategories, subcategories that we would like to relate, but doing so with an automorphism yields non-invariant categorizations. A similar problem for congruences arises if sometimes a pair of constituents must be identical or in some other very close correspondence at some point in a derivation (ellipsis, X-or-no-X, verbal clefts in Kru languages, X-bu-X questions in certain Chinese dialects, etc.) In such cases, we cannot generally replace one member of the pair by something else of the same category without replacing the other member of the pair, and so the categorization cannot be a congruence.

3.2 Against Conc: Expressions not formed by concatenation

For the description of human languages, assumption Conc is potentially problematic too. When two strings s, t are concatenated to produce st, obviously their edges do not overlap or change each other. But it might seem that human languages are not like that. There are various kinds of string mergers, reversals, and fusions across brackets. For example, traditional grammars tell us that when P combines with [D NP], we do not always get [P [D NP]] or [[D NP] P], the possibilities that concatenation allows. Sometimes, for example, we get [P+D NP], where P+D is a single, fused element.[5] In Chomskian syntax, we find many similar types of complexes. [T [V DP]] can becomes [V+T [_ DP]], and so on. Changes at the edges of constituents are also produced by morphophonological processes: fusion (Halle and Marantz 1993; Embick 2010), m-merger (Matushansky 2006), span instantiation (Svenonius 2012; Williams 2003), and other similar schemes have been proposed to form portmanteau morphemes for agreement and tense, for case and number, or other elements.

3.3 Against Subst: no simple substitutability

The learnability results mentioned above were for languages with the property that if two sequences (or tuples of sequences) of pronounced elements share a common context, they share all contexts. Obviously, English is not substitutable in this sense, as shown for example by the following observations of strings that share some contexts but not others, from Keenan and Stabler (2003:135ff):

	'middles'	contexts
(1)	Sue laughed	$\langle\varepsilon,\varepsilon\rangle$, $\langle$the boy who kissed,$\varepsilon\rangle$
(2)	it rains in Spain	$\langle\varepsilon,\varepsilon\rangle$, *$\langle$the boy who kissed,$\varepsilon\rangle$
(3)	and	$\langle$I saw John,Bill$\rangle$, $\langle$I saw both John,Bill$\rangle$
(4)	or	$\langle$I saw John,Bill$\rangle$, *$\langle$I saw both John,Bill$\rangle$

In the former pair of cases (1,2), we fail to respect the traditional constituency; many substrings are non-constituents. The latter pair of cases (3,4) raises a different issue, failing to respect the dependency between *both* and *and*.

4 A reconciliation

There are various ways to reconcile recent directions in learnability theory with mainstream linguistic proposals. I outline one perspective which I think looks most promising, and then conclude by proposing a new candidate axiom for the theory of human language, a fundamental grammatical principle that this perspective assumes. Anticipating: (i) we must of course generalize Subst, (ii) Conc is not as restrictive as it seems, and it could be rejected over morphemes but still preserved over phonological features, and (iii) I propose Cong as a law of language.

[5] Various kinds of P+D contraction and fusion are found in French (Zwicky 1987), Italian (Napoli and Nevis 1987), German (Waldmüller 2008), and other languages (Svenonius 2012; Williams 2003).

4.1 Categories are not fixed and universal across languages

The situation with categorizations would perhaps be easier to assess if there were a finite, universal, fixed set of syntactic categories, but this claim is difficult to understand when the categories are never defined in cross-linguistically applicable ways (Keenan and Stabler 1994; Stabler and Keenan 2007). For example, the claim that there are $\pm N$ and $\pm V$ categories is not a substantial claim that can be assessed without a theory of the properties of those categories. When 'subcategorizing' features, agreement, phrase level, and so on are factored in, of course we expect to have more than four distinctions among syntactic elements, and it is not unclear what those distinctions will need to be, or why we should assume, in advance, that there is a linguistically principled finite bound on the set of distinctions. One could adopt the methodology of beginning with some basic, 'core' distinctions (Chomsky 1981:§1), but then it is a mistake to confuse that very reasonable methodological strategy with strong empirical claims about what is really needed to get an adequate theory.

Some 'cartographic' approaches to syntax have aimed to identify particular structural positions which have similar roles across languages – a clausal template, or partial order of projections along the spine, or something similar (Cinque 1999; Rizzi 2004; Cinque and Rizzi 2008: among many others). Even on these accounts, languages vary in what can move into these positions (overtly or covertly), how these positions interact or not with agreement and other phenomena, and so the syntactic properties of the phrases in these positions vary significantly even though they may have some common semantic and syntactic features. What kind of arguments could support the claim that there are finitely many fixed positions with significant universal semantic and syntactic features? Various different kinds of arguments could in principle be relevant. It could be that by exploring one language after another, we will find a finite system of positions, perhaps with some finite range of syntactic variation in each position, that is descriptively and explanatorily adequate for all well-studied human languages, or successful enough to suggest that any remaining difficulties are bound to be managed without fundamental changes in our assumptions. But we will not be in that situation anytime soon. Some researchers seem to think that another kind of support for the hypothesis of a fixed, finite clause structure for all languages comes from learnability. But, on the one hand, a very large but finite number of options does not necessarily support a feasible learning theory, and on the other hand, many infinite classes of artificial languages are known to be rather easily learnable (with appropriate senses of 'learnable'). Consequently, it is hard to imagine a persuasive argument coming from considerations of this sort. Keenan and Stabler (2003) point out that studies of artificial languages show that languages can be similar in important respects, and learnable, without being limited to a finite number in principle, and without having the same grammatical structure, and without having any substantial parts of their grammars in common. It is difficult to find any reason to assume that human languages would have to be more similar than these sorts of examples, especially when, by 'language' we include the identification of properties of lexical items and other aspects of language that may be 'peripheral' to the interests of some linguists.

4.2 *Syntax is not sensitive to phonology, but invariants are*

One other idea in the informal linguistics literature is that syntactic rules cannot refer to phonological properties (Pullum and Zwicky 1988; Zwicky and Pullum 1986; Katz and Bever 1976). One sense in which this may be right is that our rules of syntax could be category functional (Keenan and Stabler 2003:p.153, Axiom 4). But it might also seem that the question of how many different expressions there are, how many different nouns, for example, is not a structural or syntactic matter. Similarly non-structural, it seems, is the question of whether any expressions of one category are pronounced the same way as expressions of another category. But the notion of structure in Keenan and Stabler (2003) leads to a different perspective on these matters. For example, we have, almost immediately from our definitions:

Theorem 1. *If no lexical item is also derived, the lexicon is a structural invariant (Keenan and Stabler 2003:23), and so the number of lexical items is too.*

Theorem 2. *For any invariant categories C,D, the number of elements with the same pronunciation, $|\{s\colon (s,C),(s,D) \in L(G)\}|$, is a structural invariant. So, in particular, if any structural category has just one expression, that expression is a structural invariant.*

The point here is unlike the previous debates; we are not concerned with whether these properties should be regarded as 'syntactic' in the sense of any earlier authors. The point here is that pronunciation matters for what we are calling structural invariants. Keenan and Stabler (2003:4) point out that, with invariants defined as the fixed points of the grammatical automorphisms, morphological forms themselves, that is, particular categorized, pronounced expressions, can be structural invariants.

Invariants depending on pronunciation and ambiguity (structural and lexical) are directly relevant to central linguistic interests, as we see for example from learnability results like those mentioned earlier; pronunciation obviously matters for the definition of learnable classes of languages. For example, it is easy to see that while the regular grammar,

$$S \to aB \quad B \to bB \quad B \to \varepsilon$$

is zero-reversible, the grammar that results from replacing b by a in the second rule,

$$S \to aB \quad B \to aB \quad B \to \varepsilon$$

is not. The derivations have the same shape, differing only in the lexical item in one rule, but that is significant. And similarly, as noted above, the context free grammar

$$S \to ab$$

defines a substitutable language, but

$$S \to ab \quad S \to bb$$

does not. (Trivial existence proofs like this are important because they signal the possibility of the infinitely many more difficult but fundamentally similar cases.) Differences like this, differences in how things are pronounced, can and do affect whether a language is learnable.

4.3 *Cong: Categorization is a coarsest congruence and invariant*

The arguments against Cong in §3.1 are not persuasive. What we see there is that it is possible to define Little Spanish in such a way that a match is required between different categories, matching the gender implicit in {Nf, Af, Df}, or in {Nm, Am, Dm}. But grammars that require repeated matching operations like this are missing generalizations, separating things that are really unified. Similarly for X-or-no-X constructions and the other examples mentioned. The grammars are improved when brought into accord with Cong, and so we will propose that Cong should always be respected.

4.3.1 *Little Spanish′*

The simple language for Spanish-like NPs in §3.1 above has these properties:

- It has 12 categories, with masculine and feminine varieties of the categories N, A, Agr, D, and NP.
- There is no category N, but instead a (lexically-sensitive) automorphism exchanging Nm and Nf.
- For $C \in$ {Agrm,Agrf,Nm,Nf,Dm,Df}, the phrases $Ph(C)$ are not invariant
- A rule of gender marking combines Nm with Agrm, Nf with Agrf.
- A rule called merge combines Af with Nf, Am with Nm, Df with Nf, Dm with Dm.

But it is possible to capture these agreement relations more simply.[6] Instead of assigning nouns to different categories depending on their gender, and then matching those categories with agreement categories of the same gender, we can formulate an essentially similar grammar with these nicer properties:

- It has not 12 but 5 simple categories: N, A, Amod, D, and NP.
- Masculine and feminine nouns both have category N. They have the same structure, in the sense that they are interchanged by our automorphisms (without the lexical sensitivity of the earlier grammar).
- For all $C \in Cat$, the set of phrases of category C is invariant.
- No separate gender marking rule is required. Instead, lower agreement affixes are attached to selecting heads.
- The rules of the grammar do not need special cases and conditions for masculine and feminine instances.

One way to achieve this is with the following alternative Little Spanish′=$\langle \Sigma, Cat, Lex, \mathscr{F} \rangle$:

[6] The idea for this reformulation came from Hilda Koopman's suggestion to me (p.c.) that grammars like the one in §3.1 are more complex than necessary because they ignore the evidence that surface-discontinuous agreement is often (perhaps always) underlyingly local.

Σ:	man, woman, obstetrician, doctor, -a, -o, gentle, intelligent, every, some, very, moderately	
Cat:	N, A, Amod, NP, D	
Lex:	N	⟨man,-o⟩, ⟨doctor,-o⟩, ⟨woman,-a⟩, ⟨obstetrician,-a⟩
	A	gentle, intelligent
	D	every, some
	Amod	very, moderately
$\mathscr{F}$:	f,g,h	

where rules f,g,h are the following mappings, respectively:

$$\begin{array}{cc} s & t \\ \text{Amod} & \text{A} \end{array} \longmapsto \begin{array}{c} st \\ \text{A} \end{array}$$

$$\begin{array}{cc} s & t,u \\ \text{A} & \text{N} \end{array} \longmapsto \begin{array}{c} sut,u \\ \text{N} \end{array}$$

$$\begin{array}{cc} s & t,u \\ \text{D} & \text{N} \end{array} \longmapsto \begin{array}{c} sut \\ \text{NP} \end{array}$$

With this grammar, we have derivations like this:

h:⟨some -a very intelligent -a obstetrician, NP⟩
- ⟨some, D⟩
- g:⟨very intelligent -a obstetrician,-a,N⟩
  - f:⟨very intelligent,A⟩
    - ⟨very,Amod⟩
    - ⟨intelligent,A⟩
  - ⟨obstetrician,-a,N⟩

This grammar captures the agreement regularities more simply and elegantly than the one in §3.1. Gender is marked just once, by the lexical entries. Parsimony weighs in favor of this alternative too, if fleshed out versions of these agreement marking rules have a form that is similar to other rules needed in Spanish and other languages. And here, the rules are category functional and string functional, the lexicon is invariant, the sets Ph(C) are invariant, and the sets Ph(C) are a congruence:

Theorem 3. *In Little Spanish′, $\forall C \in Cat$, $Ph(C)$ is invariant.*

Proof. This follows immediately from the fact that the $Ph(C)$ are domains and ranges of the generating functions, which must be fixed by the automorphisms. □

Theorem 4. *In Little Spanish′, $\{Ph(C) \colon C \in Cat\}$ is a coarsest congruence.*

Proof. Since each rule is total on the respective domain of pairs $Ph(C) \times Ph(D)$ (where C,D differ in each rule), and since each rule is category functional, we see immediately that the categorization is a congruence.

That the congruence is coarsest follows from the fact that taking the union of any pair of distinct $Ph(C), Ph(D)$ will produce a strict superset of the domain of at least one of the rules, so substitution within this larger set will not preserve grammaticality. □

For language learners, this last result immediately gives us the nice consequence:

Corollary 5. *For any $a, b, c \in L(\textit{Little Spanish}')$, if a occurs in b and c has the same category as a, then substituting c for any (i.e. one or more) occurrences of a in b produces a well-formed expression that has the same category as b.*

4.3.2 Little X-or-no-X

The English X-or-no-X and other apparent copying constructions have received some attention in the literature (Manaster-Ramer 1986; Pullum and Rawlins 2007). We construct a little grammar that gets the X-or-no-X phrases in examples like,

Linguistics test or no linguistics test, I will enjoy myself
Long day trip or no long day trip, they should be home by now

Let Little X-or-no-X = $\langle \Sigma, Cat, Lex, \mathscr{F} \rangle$ where,

Σ:	long,short,dull,exciting,day,trip,linguistics,test	
Cat:	N, A, NP, X	
Lex:	N	day,trip,linguistics,test
	A	long,dull,short,exciting
$\mathscr{F}$:	f, g, h, i	

where f, g, h, i are defined as the following mappings, respectively:

$$\begin{array}{ccc}
\begin{array}{cc} s & t \\ \mathrm{N} & \mathrm{N} \end{array} & \longmapsto & \begin{array}{c} st \\ \mathrm{N} \end{array} \\[1em]
\begin{array}{c} s \\ \mathrm{N} \end{array} & \longmapsto & \begin{array}{c} s \\ \mathrm{NP} \end{array} \\[1em]
\begin{array}{cc} s & t \\ \mathrm{A} & \mathrm{NP} \end{array} & \longmapsto & \begin{array}{c} st \\ \mathrm{NP} \end{array} \\[1em]
\begin{array}{c} s \\ \mathrm{NP} \end{array} & \longmapsto & \begin{array}{c} s \text{ or no } s \\ \mathrm{X} \end{array}
\end{array}$$

So then we have derivations like this:

i:⟨long linguistics test or no long linguistics test, X⟩
h:⟨long linguistics test,NP⟩
⟨long,A⟩ g:⟨linguistics test,NP⟩
f:⟨linguistics test,N⟩
⟨linguistics,N⟩ ⟨test,N⟩

The important thing here is that there are no two distinct constituents NP that are copies of each other, and so the simple substitution required by the congruence can work.[7] When a string is repeated, but not a copy, then of course any repeated instance can be replaced, independent of the others, preserving grammaticality. We can have copying even when the

[7]Pullum and Rawlins (2007) note that at least some English speakers allow expletives to be inserted, as in *linguistics test or no damn linguistics test*, or even *long linguistics test or no long bloody linguistics test*. This could plausibly be done by a late adjunction step, after the copy is produced. As in the simpler example displayed here, this would not require two constituents corresponding to the two pronounced copies.

categorization is invariant, and a coarsest congruence. As we saw in the previous example, here again these nice properties are trivially established. The form of the grammar guarantees a simple correspondence between categories and rules.

4.4 Conc: fusion is concatenation (if you choose the right basic elements)

It is not difficult to model head-movement-like relations in a Conc-respecting grammar, even ones that 'fuse' the head complexes (Michaelis 1998; Stabler 2001; Kobele 2002). In fact, since most or all morphology and phonology is finite state, mildly context sensitive formalisms are powerful enough to swallow them entirely, as has been noted before (Kobele 2011; Graf 2011). This would mean that the phonological features of instantiated lexical forms would become the alphabet, replacing the morphemes or words that are used in simple examples like the ones in this paper. The possibility of doing this, in principle, does not mean that it is the best thing to do, but it provides tools for studying how an integration could be achieved without losing the generalizations captured by either the syntax or the morphophonology.

4.5 Beyond substitutability

In human languages, it is a fact that the simple substitutability criteria mentioned earlier – sharing a single context – is not enough to show that two subsequences are (the pronounced parts of) constituents of the same category, or that they are constituents at all. Linguists use other sorts of evidence, and language learners certainly do too. Significant developments in learnability theory for human language are likely to come from better ways of assessing constituency and similarity, especially now that we have positive results reaching into parts of the Chomsky hierarchy where human languages seem to be. We see this trend already in the research briefly reviewed in §1. We see there that when constituents can have discontinuous parts, or copies, an inference from substitutability is still possible in certain settings. Ongoing research aims to find ways of relaxing the strong substitutability requirements on which those preliminary results are based.

5 Laws of language

Keenan and Stabler (2003:§4) propose a number of restrictions on categories and generating functions, but stop short of requiring:

(Cong) Categories are blocks of a coarsest congruence of L(G) and invariant.

On closer examination, though, it seems the reasons for rejecting Cong were unsound. Cong requires a simple, desirable correspondence between the categorization and the generating functions, and it licenses a simple and powerful substitution principle defined over the constituents of the language. The language learner does not hear or see the constituents directly, of course, but can hear or see their pronounced parts, and plausibly gets evidence of constituency from other sources too (fragments, prosody, etc.). With any hypothesized constituency, categorization must be identified using some kind of substitution-based reasoning, assessing the similarity of contexts of pronounced parts of constituents.

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Affiliation

Edward P. Stabler
UCLA
stabler@ucla.edu

Quantifiers in object position and transitive verb ellipsis: anaphora *vs.* binding

Anna Szabolcsi

1 The type-mismatch problem

Expressions like *some man* and *every book* serve as subjects and objects of verbs like *read*, much like *Mary* and *The New York Times* do, but they do not denote individuals. How is that possible? One might imagine that verbs directly take generalized quantifiers as arguments. and the resulting sentences are reduced to talking about individuals via meaning postulates, in the spirit of Montague (1974), minus intensionality. This is not the standard solution adopted in the semantics literature. Instead, verbs like *read* are given individual-denoting arguments, variables where necessary, and quantificational expressions are linked to those variables by rules such as Quantifying-In, Quantifier Raising (QR), Argument Raising, or equivalent type-logical moves. Heim & Kratzer (1998) present the QR of non-subject quantifiers to the closest available node of type *t* as being forced by type-mismatch. That endows the local QR of non-subject quantifiers with a privileged status in theories that adopt some form of Fox's (1998) Scope Economy: whatever additional syntactic or semantic benefits such QR has can be freely enjoyed.

Keenan (1987, 1989) proposed a different way to combine quantifiers and verbs. The idea was that quantifier phrases are arity-reducers. They apply to an n-place function and return an (n-1)-place function, and they do so in all their grammatical occurrences, not only when they apply to a one-place function and return a sentence. Keenan called the approach Semantic Case Theory, because the pertinent versions of quantifiers can be seen as nominative, accusative, etc. extensions of their basic generalized quantifier denotations. For example, one of the types of the phrase *every book* enables it to apply to a transitive verb and return an intransitive verb phrase. With a simple example:

(1) *every*, accusative:	$\lambda P\lambda R\lambda z\forall y[P(y) \rightarrow R(y)(z)]$
every book:	$\lambda R\lambda z\forall y[\mathbf{book}(y) \rightarrow R(y)(z)]$
read every book:	$\lambda z\forall y[\mathbf{book}(y) \rightarrow \mathbf{read}(y)(z)]$
Some man read every book:	$\lambda P\exists x[\mathbf{man}(x)\wedge P(x)](\lambda z\forall y[\mathbf{book}(y)\rightarrow\mathbf{read}(y)(z)])$
	$= \exists x[\mathbf{man}(x) \wedge \forall y[\mathbf{book}(y) \rightarrow \mathbf{read}(y)(x)]]$

Keenan (2005) came back to this idea, stated it in a more general form, and made the point that the solution eliminates the type-mismatch problem. That observation raises an interesting question. What can we say about the cases where QR to the closest available node of type *t* (the vP node) has been claimed to have beneficial effects, in contrast to QR to a higher node, or no QR in the presence of an individual expression? Assuming that *ex nihilo nihil fit*, there are two logical possibilities. One is that the beneficial effects are illusory. The other is that the effects are real, but QR is not their true source, or at least not their sole source.

2 A processing argument in favor of QR

Hackl, Koster-Hale, & Varvoutis (2012) present a new and interesting argument to bolster the case for QR, and contrast it with the predictions of Keenan's proposal, which they dub the type-shifting theory. The argument comes from experimental evidence obtained from the processing of sentences with so-called Antecedent Contained Deletion (ACD), such as (2) and (3). The name reflects the view that such sentences involve an elided verb phrase that is anteceded by the matrix verb phrase that it is contained in.

(2) John talked to {every / the} student that Mary did.
(3) John was willing to talk to {every / the} student that Mary was.

Hackl and colleagues adopt a particular account of ACD that is well-established in the literature and makes the following central assumptions:

(4) Assumptions of the type-mismatch/infinite regress theory
  (i) ACD runs into infinite regress, unless *{every/the} student that Mary did/was* is removed from its antecedent verb phrase by QR;
  (ii) Quantifier phrases such as *every student*, but not definite descriptions, such as *the student*, give rise to a type-mismatch when they occur in non-subject position;
  (iii) Type-mismatch is resolved by Quantifier Raising (QR);
  (iv) Economy (Shortest move) requires QR to adjoin the quantifier phrase to the closest suitable landing site, here, the vP of the same clause.

Hackl and colleagues observe that these assumptions have the following consequences:

(5) Consequences of (4)
  (a) When a sentence is of the form (2) and the direct object with ACD is a quantifier phrase, then this direct object will automatically undergo QR in view of (ii)-(iv). This pre-empts infinite regress in view of (i), and so ACD imposes no new requirement on the derivation;
  (b) When the direct object is not a quantifier phrase, nothing forces QR, and so only ACD mandates it;
  (c) If the material that ACD needs to pick up spans two clauses, as in (3), then quantificational and non-quantificational direct objects are on equal footing. This is because ACD-related QR needs to adjoin the direct object to a higher vP than the instance of QR mandated by a type-mismatch does, cf. (i).

Hackl and colleagues point out processing predictions made by (5a-c). In view of (5a), the occurrence of *every* in (2) should facilitate the processing of downstream ACD in *Mary did*. In view of (5b), the occurrence of *the* in (2) should not facilitate the processing of downstream ACD in *Mary did*. In view of (5c), neither *every*, nor *the* in (3) should facilitate the processing of downstream ACD in *Mary was* (the bi-clausal example). They report that self-paced reading time experiments bear out the predictions, thus allowing them to draw a **positive conclusion** in connection with the theoretical assumptions in (4i-iv), with specific reference to QR as the main player.

Hackl and colleagues also consider another account of quantification and ACD, which they dub the Type Shifting + Functional Composition (TSh/FC) account, based on theories in Keenan (2005) and Jacobson (1992). Jacobson (1992) proposes that "Antecedent Contained Deletion" is a misnomer. Examples like (2) and (3) do not have a missing verb phrase; they only have a missing transitive verb: the lexical verb *read* in (2), and a result of functional composition, *willing to read*, in (3). *Did* and *was* for their part function-compose with subject *Mary*; the result still has a direct object argument slot unfilled and will be bound by the relative pronoun. The relative pronoun is null in (2) and (3) and, for reasons that are not well-understood, ACD examples are a bit better with the complementizer *that* than with an overt relative pronoun such as *who* (compare *John talked to every student who Mary did* and *John was willing to talk to every student who Mary was*). In either case the claim is that the clause does contain the direct object. Hackl and colleagues call this the Functional Composition account.

Keenan's theory handles quantified direct objects without a type-mismatch, and Jacobson's theory handles ACD without the threat of infinite regress. This should be reason to celebrate. But, as Hackl and colleagues point out, a combination of these two theories lacks the critical ingredients that lead to the consequences in (5a-c). They draw the **negative conclusion** that TSh/FC theories cannot predict the processing effects they observed, and so the experimental results speak against TSh/FC.

3 Have all things been considered? How is ACD resolved?

I am happy to accept that the type-mismatch/infinite regress theory, involving QR and Economy, makes predictions that are fully consistent with Hackl and colleagues' experimental findings. I also agree that the exact shape of the TSh/FC theory that Hackl and colleagues consider fails to make those predictions. But this particular theory is not the only way to implement a combination of Keenan's and Jacobson's critical assumptions. I will point out that a modification of Hackl and colleagues' version of the TSh/FC theory has the potential to make very similar predictions as their own type mismatch/infinite regress theory. If so, then the processing effects are probably not specific for the theoretical devices that Hackl and colleagues take the experimental results to support.[1]

Before going into concrete details, let me give the gist of my argument. Observe that the way Hackl and colleagues derive their predictions makes no reference to how ACD is resolved. This should give us pause. Whether or not ACD faces the threat of infinite regress, the name of the game is to ensure that the elided material gets linked to the desired antecedent. To assume that the way in which ACD is resolved might be significant does not require a big stretch of imagination. Now, theories like Keenan's and Jacobson's fall within the rubric of "variable-free" or "combinatory" grammar. That kind of grammar may indeed involve type shifting and functional composition, but its main distinctive feature is how it deals with constructions that other theories interpret using variable-binding of some sort. Let us not ignore this distinctive feature. Below I review a particular way of resolving anaphora, ACD included, within variable-free, or combinatory, grammar, and show how it leads to similar conclusions as the theory that Hackl and colleagues support. I am relying on published literature, and so the summary below will be brief. I will not attempt to motivate and lay out the details.

Jacobson's theory of verbal ellipsis has two pertinent components. One is the above-mentioned view that ACD is transitive verb ellipsis. The other is the view that the pro-verb *do*, whether it stands for a full verb phrase or just a transitive verb, is much like a free pronoun: it picks up a salient antecedent (here: a salient function) from discourse.

[1] I am not aware of experimental work that correlates categorial grammar derivations with behavioral measures, so the prediction is hypothetical. Also, I am not addressing any aspect of the processing assumptions that Hackl and colleagues make.

Pro-verbs are special in that they typically demand a linguistic antecedent; pure deixis is not enough. But that antecedent may come from another sentence, as in (6):

(6) Bagels I like. Donuts I don't.

Jacobson's position can be summarized by saying that pro-verbs are anaphoric to, but are not bound by, their antecedents. This analysis has no special consequences for types.

The view that the resolution of verbal ellipsis is always a matter of anaphora is not tenable; Charlow (2008) shows that some cases, such as (12) below, require binding. We have two questions now. One, how would binding work here? Two, what processing predictions would we make if ACD were resolved by binding, and not by anaphora?

As regards prototypical cases of binding, Keenan (1987, 1989) subsumed the reflexive pronoun *himself* under his arity-reducer proposal. At the same Sixth Amsterdam Colloquium, Szabolcsi (1987, 1989) presented a consonant but more elaborate theory of reflexives and bound pronouns in combinatory categorial grammar. Both Keenan and Szabolcsi treated accusative *himself* as a function whose type is the same as that of accusative *every book*; it is just a different function of that same arity-reducing type. The parallel between accusative *every book* and accusative *himself* is not a mere fact about these theories: both Keenan and Szabolcsi present their proposals in those terms.

(7)	*himself*, accusative:	$\lambda R\lambda x[Rxx]$
	saw himself:	$\lambda R\lambda x[Rxx](\mathbf{saw}) = \lambda x[\mathbf{saw}(x)(x)]$
	John saw himself:	$\lambda P[P\mathbf{j}](\lambda x[\mathbf{saw}(x)(x)]) = \mathbf{saw}(\mathbf{j})(\mathbf{j})$

The important feature of (7) is that *himself* is not a free variable that needs to get bound and ends up ungrammatical if it fails to get bound. *Himself* grabs the verb it is an argument of, and ensures that the next argument of that verb will bind it. Its semantic type entails that if it can be integrated into a syntactic derivation at all, it will never fail to be bound. In particular, *himself* as defined in (7) is the duplicator combinator (**W**) of Curry and Feys (1958). **W** is the bare-bones duplicator. Curry and Feys point out the usefulness of other combinators that likewise duplicate but in more complex ways, such as **S**, **Φ**, and **Ψ**.[2] Szabolcsi (1992) extended the duplicator account of reflexives and bound pronouns to VP-ellipsis, for example as in (8)-(9).

(8) John left before Mary did [leave].
(9) Which man did you mention before Mary did [mention that man]?

Details of implementation aside, the relevant segments of (8) are interpreted as follows.

(10)	*before Mary did*:	$\lambda P\lambda x[\mathbf{before}(P\mathbf{m})(Px)]$
	left before Mary did:	$\lambda P\lambda x[\mathbf{before}(P\mathbf{m})(Px)](\mathbf{left}) =$
		$= \lambda x[\mathbf{before}(\mathbf{left}(\mathbf{m}))(\mathbf{left}(x))]$
	John left before Mary did:	$\lambda x[\mathbf{before}(\mathbf{left}(\mathbf{m}))(\mathbf{left}(x))](\mathbf{j}) =$
		$= \mathbf{before}(\mathbf{left}(\mathbf{m}))(\mathbf{left}(\mathbf{j}))$

[2] These combinators do not have speaking names in Curry and Feys (1958); only the compositor **B**, the permutator **C**, the duplicator **W**, the identificator **I**, and the cancellator **K** do, being intuitively and technically basic. The **S** combinator, which Steedman (1987) shows derives parasitic gap structures, is defined as **B(B(BW)C)(BB)**. Jacobson's **z** that enables sentence-internal pronoun binding is **B(BW)B**.

Before Mary did is a duplicator like *himself*: its *P* argument appears twice in the description of the function value. Schematically: *λPλx[...P... Px]*. Unlike *himself*, it duplicates a function, not an entity. Due to the presence of wh-extraction, the derivation of (9) involves further composition steps. We need not illustrate them here, but it is useful to be aware that such more complex examples fit in seamlessly; they were in fact of central concern in Szabolcsi (1992). The abstract in (9) that must be derived before question-magic comes in is as below:

(11) $\lambda x[\mathbf{before}(\mathbf{mentioned}(x)(\mathbf{m}))(\mathbf{mentioned}(x)(\mathbf{you}))]$

Charlow (2008) develops a theory of pro-verbs that relies on two different ways of resolving ellipsis. One is Jacobson's (anaphora) and the other is Szabolcsi's (binding). In particular, Charlow argues that binding is needed for (12), from Kratzer (1991):

(12) I only went to TANGLEWOOD after you did.
`Tanglewood is the only place such that I went there after you went there'

It will be clear, even without technical details, that (12) is analogous to (9), with focus in the place of the question-word, cf.

(13) $\lambda x[\mathbf{after}(\mathbf{went\text{-}to}(x)(\mathbf{you}))(\mathbf{went\text{-}to}(x)(\mathbf{i}))]$

Charlow (2008) offers an empirically detailed and formally explicit theory of ellipsis that comprises both anaphoric and bound readings, and both verb phrase ellipsis and transitive verb ellipsis.

Charlow implements binding with Jacobson's **z** combinator. In the derivation of the transitive verb ellipsis example *read every book that Rori does* he applies **z** to *every.*[3] It is a design feature of **z** that it applies to the function one of whose arguments contains the element to be bound and thus, in linear terms, it "anticipates" the bound element. But there is no inherent need for the combinator that produces the bound ellipsis reading to apply as high as *every*. From our perspective it is relevant that the bound reading can be ensured in the derivation of the relative clause that contains the ellipsis site. To this end one may employ, instead of **z**, the duplicator **W** aided by a few applications of the compositor **B**, in the spirit of Szabolcsi (1992: 259-265); the gory details can be skipped. The result is equivalent to Charlow's. Below I use the linguistic example from Hackl et al. (2012).

(14) *every*, accusative: $\lambda P\lambda R\lambda z\forall y[P(y) \rightarrow R(y)(z)]$
that Mary did, bound ellipsis: $\lambda N\lambda D\lambda R'\lambda v[D(\lambda x[N(x) \wedge R'(x)(\mathbf{m})])(R')(v)]$
student that Mary did: $\lambda D\lambda R'\lambda v[D(\lambda x[\mathbf{student}(x) \wedge R'(x)(\mathbf{m})])(R')(v)]$
every student that Mary did:
$\lambda R'\lambda v\forall y[(\mathbf{student}(y) \wedge R'(y)(\mathbf{m})) \rightarrow R'(y)(v)]$
talk to every student that Mary did:
$\lambda v\forall y[(\mathbf{student}(y) \wedge \mathbf{talk\text{-}to}(y)(\mathbf{m})) \rightarrow \mathbf{talk\text{-}to}(y)(v)]$

[3] Charlow (2008: 205) uses the exact same version of *every* as (14). My derivation only differs from his in where and by what combinators binding is established. Charlow's **z**(*every*)(*book that Rori does*) yields $\lambda R\lambda y[\mathbf{every}(\lambda z[\mathbf{book}(z) \wedge R(z)(\mathbf{r})])(\lambda x[Rxy])]$. Applied to *read*, this produces the predicate meaning $\lambda y[\mathbf{every}(\lambda z[\mathbf{book}(z) \wedge \mathbf{read}(z)(\mathbf{r})])(\lambda x[\mathbf{read}(x)(y)])]$.

What if the example had *the*? Because of ACD (bound ellipsis), *the student that Mary did* would have a parallel interpretation to that of *every student that Mary did* in (14), which then would have to be built using a version of *the* that parallels *every* in (14):

(15) *the*, accusative: $\lambda P \lambda R \lambda z[R(\iota y[Py])(z)]$
that Mary did, bound ellipsis: $\lambda N \lambda D \lambda R' \lambda v[D(\lambda x[N(x) \wedge R'(x)(\mathbf{m})])(R')(v)]$
student that Mary did: $\lambda D \lambda R' \lambda v[D(\lambda x[\mathbf{student}(x) \wedge R'(x)(\mathbf{m})])(R')(v)]$
the student that Mary did: $\lambda R' \lambda v[R'(\iota y[\mathbf{student}(y) \wedge R'(y)(\mathbf{m})])(v)]$
talk to the student that Mary did:
$\lambda v[\mathbf{talk\text{-}to}(\iota y[\mathbf{student}(y) \wedge \mathbf{talk\text{-}to}(y)(\mathbf{m})])(v)]$

But there is one crucial difference. The version of *every* in (14) is identical to Keenan's accusative *every*, see (1). This is the version of *every* that enables the quantifier *every book* to serve as the direct object of a transitive verb without QR or any of its relatives. Does the version of *the* used, and needed, in (15) have the same status? What is the type of a direct object definite description, e.g. *the book*, without ACD? The definite description is capable of having the same type as quantifiers, afforded by the logic and empirically supported by the fact that it can coordinate with quantifiers, see (16), and coordination requires like categories. But it does not have to be of the same type as quantifiers as per logical necessity, precisely because it can denote an individual, and probably is not always of the same type, in view of non-c-command anaphora facts, see (17).

(16) the book and every magazine
(17) I bought the book, and Mary stole it from me.
*I bought every book, and Mary stole it from me.

The default interpretation of *the book* is $\iota y[\mathbf{book}(y)]$, of type e. This is precisely the reason why, in terms of Heim & Kratzer, it does not produce a type-mismatch in non-subject position and does not have to undergo QR.

The generalization is this:

(18) On the Jacobson—Szabolcsi—Charlow theory of ACD, a direct object *DET student that Mary did* on the bound ellipsis reading has the format $\lambda R \lambda y[\dots R \dots \lambda x[Rxy]]$, i.e. it is of type $\langle\langle e,\langle e,t\rangle\rangle,\langle e,t\rangle\rangle$.
If *DET* is *every*, it uses its usual VP-internal type, as per Keenan.
If *DET* is individual-forming *the*, its usual type and its ACD-supporting type diverge.

4 Bound vs. anaphoric transitive verb ellipsis, and processing predictions

We may now return to (2),

(2) John talked to {every / the} student that Mary did.

What we saw in section 3 is that, as long as ellipsis is resolved by binding, not just anaphora to a contextually salient function as in Jacobson (1992), our theory reproduces the same contrasts for (2) as the theory espoused by Hackl and colleagues does. With *every*, (2) uses the usual interpretation of the determiner, and the job of creating a bound reading for transitive verb ellipsis is performed close to the ellipsis site. With *the*, the usual individual-forming interpretation will not work and the processor is in for a surprise when it encounters the ellipsis site. It has to reprocess the preceding material using the arity-reducer version of *the*. This predicts the same effect that Hackl and colleagues observed: a significant slow-down at the ACD site in the case of *the*, but not in the case of *every*. This prediction is made straightforwardly, without a type-mismatch, without the threat of infinite regress, without the operation QR, and without the assumptions of Scope Economy. The essential component of the prediction is the manner in which ACD is resolved, namely, the assumption that here, *that Mary did* has the same duplicator kind of semantics as reflexives.

Rather than moving on directly to (3), let us examine the bound vs. anaphoric readings of transitive verb ellipsis in more detail. Previous literature has investigated bagels/donuts-style anaphoric readings; but it is also possible for the elided transitive verb to pick up its antecedent from the linguistic context in examples that are string-identical to the classical ACD ones. Consider the following text, as spoken by a single speaker.

(19) Helmut admired Greta, and John admired Mary.
Helmut saw every film that Greta recommended.
John read every book that Mary did [recommend].

Here the resolution of *did* to *recommended* can only be Jacobsonian, via anaphora to a salient antecedent and not via binding. Therefore, it has no type consequences. What happens if the determiner is *the*, not *every*?

(20) Helmut followed Greta's lead, and John followed Mary's.
Helmut saw the film that Greta recommended.
John read the book that Mary did [recommend].

Not having performed any experiments, I cannot say if there is a measurable processing difference between these non-binding contexts of transitive verb ellipsis resolution and the binding ("ACD") versions that Hackl and colleagues studied. We know however that speakers impressionistically prefer *every* to *the* in ACD examples like (2). More precisely, many speakers of English report that, unless the ACD sentence with the definite contains *the same* in the place of plain *the*, it is degraded as compared to the ACD sentence with *every*.[4] But several speakers I have consulted also report that in the anaphoric ellipsis examples (19) and (20), they are equally happy with *every* and with plain *the*.

These judgments do not distinguish my proposal from that of Hackl and colleagues; on their account, (19)-(20) involve VP-ellipsis but no antecedent containment. But they indicate that my proposal potentially makes further correct, and convergent, predictions.

One might even elicit two different ways of resolving ellipsis to *read* in *John read {every / the } book that Mary did*, by presenting it out of the blue, as in (21), versus presenting it in an extended linguistic context, as in (22).

(21) **Out of the blue**: John read {every / the} book that Mary did [read].

(22) The editor wanted to double-check Greta's and Mary's judgments about books. Following his instructions,
Helmut read {every / the} book that Greta read, and
John read {every / the} book that Mary did [read].

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[4] The addition of *same* would make a difference for interpretation and type, as compared with plain *the*; see Barker (2007).

If, as Jacobson (1992) assumes, verbal ellipsis is invariably resolved by picking up a salient function from context, then there should be no acceptability or processing difference between these presentations. My assumption is that purely sentence-internal ellipsis resolution in (21) involves binding, as outlined in section 3, but ellipsis resolution in (22) involves anaphora. If so, then *the* is predicted to be degraded or more difficult in (21) than it is in (22). If indeed significant differences are found in acceptability and/or in processing time along these lines, that would support the assumption that these two ways of resolving ellipsis in *John read DET book that Mary did* must be distinguished. It would also confirm the significance of binding in the behavioral results.

Hackl and colleagues conducted a second experiment that pertains to bi-clausal ACD, cf. example (3) and the relevant consequence (5c). Their observation is that in (3), *every* vs. *the* does not make a difference. Both incur a slow-down at the ACD site:

(3) John was willing to talk to {every / the} student that Mary was.

What does the variable-free theory have to say here? Fairly theory-neutral reasoning will suffice. Consider *John was willing to talk to every student that Mary ...* . Up to this point the sentence is ambiguous: the next word could be *invited*, and then *every student that Mary invited* could scope either in the complement or in the matrix. In fact, native speakers report a preference for the complement scope. As soon as *was* comes up, this reading has to be abandoned, and the sentence has to be re-computed with *every student that Mary was* scoping into the matrix, i.e. taking *willing to talk to* as its argument. This is much the same thing that happens if the sentence contains *the student that Mary was*. So an increased processing cost at the ACD site is predicted, irrespective of the determiner.

To be more precise, in the combinatory grammar it is not the direct object whose interpretation and type is affected in (3). The difference concerns whether *willing to talk to* is composed into one big function, as is needed when ACD has to be resolved to this function, or *willing* simply braces to apply to the control complement *to talk to ...* as its argument. Functional composition by itself is not dispreferred or costly, but the unexpected necessity to compose probably is.

Again, a very similar prediction is made as by the theory Hackl and colleagues support, without reference to Economy as a regulator of QR. Probably, many other theories will make the same prediction, irrespective of how they fare in connection with the *every* vs. *the* contrast in the first experiment.

To summarize, I have argued that the theory that Hackl and colleagues constructed and dismissed, based on Keenan's approach to quantification and Jacobson's construal of ACD as transitive verb ellipsis, can make very similar predictions as their own, if we add the assumption that the purely sentence-internal resolution of transitive verb ellipsis proceeds via binding.[5]

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[5] I thank the semanticists in my department, especially Jeremy Kuhn, for discussion.

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Affiliation

Anna Szabolcsi
Department of Linguistics
New York University
as109@nyu.edu

The mysterious specific indefinite

Mark de Vries

Introduction[*]

When an indefinite newly introduces or reintroduces an accessible referent into the discourse, it is called *specific*. Thus, in (1a), *it* can be coreferential with *a lion* in the previous sentence, which indicates a *particular* lion in the relevant situation. By contrast, a *non*specific indefinite has no specific referent at all, as is illustrated in (1b), where *a lion* can be *any* lion. In that case, the problem of reference can be solved by means of modal subordination (where the speaker takes the point of view of a possible world).

(1) a. Marian speared *a lion*$_i$ last week. *It*$_i$ was a fierce creature.
    b. You'd better run if you see *a lion*$_i$. # *It*$_i$ is dangerous. / *It*$_i$ may be dangerous.

Normally, the referent of a specific indefinite is known to the speaker but not yet to the hearer. A prototypical context for a specific indefinite is a presentational construction, as in (2), but this is not a requirement.

(2) Once upon a time, there was *a lion* who lived in a cave.

See further Farkas (2006) and Geurts (2010), among others, for discussion and opposing views.

Here, I will show that restrictors on indefinite variables are often construed cataphorically, which forces the hearer to accommodate. I argue that the speaker facilitates this process by extending the intonational domain beyond its regular measures. Section 2 discusses various kinds of relative clauses and especially *quasi-relatives* from this perspective. In the final part, I claim that specific indefinites can be silent as well, dependent on the syntactic context – particularly, in the case of appositive relative clauses.

1 Scope, restrictors, and intonation

The interpretation of an indefinite noun phrase is determined by the context. For instance, the phrase *a lion* can be specific, nonspecific, generic, or a predicate; see the illustrations in (3a) through (3d):

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[*] In my studies of relative constructions, I inevitably ran into Ed Keenan's pioneering typological endeavors. More generally, he has set a great example in combining cross-linguistic research with formal grammar. The present squib is a small tribute to his work. Although much less ambitious, it discusses an interface phenomenon that might interest the *reader of honor*.

(3) a. Yesterday, I saw *a lion* in the zoo. (specific)
b. I'd like to see *a lion* some day. (nonspecific)
c. *A lion* can roar. (generic)
d. If only I were *a lion*... (predicate)

In some cases, sentences in isolation are ambiguous. In (4), *a lion* can be either specific or nonspecific. The specific reading is normally associated with high scope of the indefinite, the nonspecific with low scope:

(4) Every girl saw *a lion* in the zoo.
(i) There was a particular lion in the zoo that every girl saw. $(\exists > \forall)$
(ii) Every girl saw some lion in the zoo. $(\forall > \exists)$

The indefinite can be seen as a (generalized) quantifier with a restrictor and a nuclear scope. In formulaic speech: there is some x, x having property <restrictor>, for which it is the case that proposition <nucleus containing x>. Example (5) shows that a restrictor (underlined) can be quite complex:

(5) A man in white tie that must be very rich wore a big diamond ring at the party.

This paper focuses on restrictors of specific indefinites. Interestingly, a restrictor, or part thereof, can be separated from the indefinite by means of extraposition across the nucleus. In (6), the nuclear scope of the indefinite corresponds to 'I met x at the party'.

(6) I met a nice man at the party that was very rich.

Such a situation involves a crossing dependency, and therefore implies a potential parsing problem for the hearer. However, we can only do this if the sentence accent shifts to the right periphery. Consider (7), where prosodic accentuation is indicated by capitals.

(7) a. I met a nice man that was very RICH at the party.
b. I met a nice man at the party that was very RICH.
c. # I met a nice MAN at the party that was very rich.

In intonational languages, including English and other Germanic languages, there is one main accent per sentence, which is right-aligned with the focus. (Potentially interfering contrastive pitch accents are disregarded here, as this is an independent issue.) If a focused constituent is shifted further to the right, it obligatorily drags the sentence accent along. Note that (7c) is only acceptable under a different, contrastive interpretation, which is irrelevant for our purposes. Clearly then, shifting a restrictor correlates with an extension or reorganization of the intonational phrase.

Nonrestrictive material has no such effect. In (8), addition of an appositive relative clause does not influence the intonational contour of the host clause, similarly to the situation with subsequent sentences. Instead, the additional material constitutes an independent intonational domain.

(8) a. I met a nice MAN at the party.
b. I met a nice MAN at the party, who was very RICH (by the way).
c. I met a nice MAN at the party. He was very RICH.

There is a subtle meaning difference between (7a/b) and (8b/c). In the first examples, the restriction *being rich* implies that there is a potential set of people that is not rich. In (8), this is not the case. So if everyone present at the relevant party happened to be rich, it would be infelicitous to express (7), as opposed to (8). The difference between restrictive and appositive meanings comes out more dramatically in (9).

(9) a. I invited only nice people that are rich to the party.
b. I invited only nice people, who are rich, to the party.
c. I invited only nice people to the party. They are rich.

Example (9b) implies that all nice people in the domain of discourse are rich, because *being rich* is a property parenthetically attributed to this full set of referents; consequently, all nice people are said to be invited to the party. This is equivalent to the situation in (9c). In (9a) there is no such implication: the set of nice people is restrictively intersected with the set of rich people, and only those are invited; thus there may well be nice people who are poor and consequently not invited.

2 Relative clauses and quasi-relatives

Quasi-relatives or 'V2-relatives', are found in Dutch and German. An example from Dutch is (10a). What is striking here is that the apparent relative clause displays verb second, whereas normally embedded clauses are verb final. For comparison, the corresponding regular relative clause is given in (10b).

(10) a. Ik ken een man [die <u>is</u> erg rijk].
I know a man DEM is very rich
'I know a (particular) man who is very rich.'
b. Ik ken een man die erg rijk <u>is</u>.

Previous research has shown that quasi-relatives are actually juxtaposed or coordinated main clauses containing a preposed demonstrative rather than a relative pronoun (Gärtner 2001, Zwart 2005, Endriss & Gärtner 2005, Huber 2006, and De Vries 2012; see also Den Dikken 2005 for a somewhat different take on the matter). Since the most frequent relative pronouns are homophonous with demonstratives in the relevant languages, confusion easily arises. Where the paradigms diverge, the difference is clearly detectable; see (11), for instance.

(11) a. Ik ging naar een feest **daar/*waar** <u>kwamen</u> rijke mensen.
I went to a party there/*where came rich people.
'I went to a party where rich people came.'
b. Ik ging naar een feest **waar/*daar** rijke mensen <u>kwamen</u>.

Furthermore, quasi-relatives are necessarily sentence-final, contrary to regular relatives, as is shown by the minimal pair in (12), compared to (11):

(12) a. * Ik ben naar een feest [**daar** <u>kwamen</u> rijke mensen] geweest.
I am to a party there came rich people been
'I have been to a party where rich people came.'
b. Ik ben naar een feest **waar** rijke mensen <u>kwamen</u> geweest.

In Dutch (but not in German, according to Gärtner 2001), it is possible to optionally spell out the coordinator *en* 'and' between the host clause and a quasi-relative:

(13) Ik ben naar een feest geweest (en) daar kwamen rijke mensen.

Thus, it seems reasonable to assume the following approximate structure, where CoP is some kind of coordination phrase (in fact, specifying coordination, as discussed in Koster 2000, De Vries 2007):

(14) $[_{\text{CoP}}\ [_{\text{host\_clause}} \ldots \text{DP}_i \ldots]\ [\ (\text{Co})\ [_{\text{quasi-RC}}\ \text{DEM}_i \ldots]]]$

Crucially, quasi-relatives come with a particular intonation (15a) that corresponds to the pattern for extraposed restrictive relatives (15b) already mentioned in section 1. There is a single prosodic contour, and the sentence accent is shifted to the right. In (15), the approximate rise and fall of the intonation is indicated by / and \. Note that the rise of pitch near the beginning of the focus creates a secondary accent on *feest* 'party' (thus producing the familiar 'hat' pattern, cf. Keijsper 1984).

(15) a. Ik ben naar een /FEEST geweest (en) daar kwamen rijke MENSEN\.
b. Ik ben naar een /FEEST geweest (*en) waar rijke MENSEN\ kwamen.

The situation for subsequent main clauses and appositive relatives is quite different; here we obtain two prosodic contours, of which the main rise and fall are indicated in (16):

(16) a. Ik ben naar een /FEEST\ geweest. (En) daar kwamen rijke /MENSEN\.
b. Ik ben naar een /FEEST\ geweest, waar overigens rijke /MENSEN\ kwamen.
I am to a party been where by.the.way rich people came

It is the extension of the intonational domain to the second clause in (15) which facilitates the restrictive reading that is absent in (16). Since (15a) involves two main clauses, this possibility is somewhat unexpected, since normally main clauses cannot be prosodically integrated; compare (17a) to (17b), for instance.

(17) a. Ik ben naar een /FEEST\ geweest. Er waren rijke /MENSEN\.
I am to a party been. There were rich people.
'I have been to a party. There were rich people.'
b. * Ik ben naar een /FEEST geweest. Er waren rijke MENSEN\.

Apparently then, the specific indefinite in (15a) and other quasi-relatives is responsible for cross-main clausal dependencies. A specific indefinite's search for restrictors is powerful enough to extend the regular intonational domain beyond its regular measures in certain configurations, but as soon as the prosodic contour containing the indefinite is closed off, newly added material can no longer function as a restrictor of it.

Interestingly, definite expressions do not have the power to extend an intonational domain, which implies that quasi-relatives cannot be related to a definite noun phrase at all. Compare the minimal pair in (18a), the corresponding regular relative construction in (18b), which is fine with a definite antecedent, and the regular subsequent sentences in (18c), which are also fine but have a slightly different meaning, as discussed.

(18) a. Ik ken {een, *de} /KAPITEIN die is erg RIJK\.
I know a, the captain DEM is very rich
'I know {a, [*]the} captain who is very rich.'

b. Ik ken {een, de} /KAPITEIN die erg RIJK\ is.
c. Ik ken {een, de} /KAPITEIN\. Die is erg /RIJK\.

Returning to indefinites, we can now explain the funny contrast in (19). Like a regular restrictive relative (19b), the quasi-relative in (19a) acts as a restrictor on the indefinite variable. In (19c) and (19d) the second clause is outside the scope of the indefinite, which leads to an odd interpretation in which the house has only one wall in total.

(19) a. Dit huis heeft /ÉÉN MUUR die is ROOD\. (quasi)
this house has one wall DEM is red
'This house has one wall which is red.'
b. Dit huis heeft /ÉÉN MUUR die ROOD\ is. (restrictive)
c. (#) Dit huis heeft /ÉÉN MUUR\. Die is /ROOD\. (subsequent)
'This house has one wall. It is red.'
d. (#) Dit huis heeft /ÉÉN MUUR\, die /ROOD\ is. (appositive)

Similarly, (20a/b) have an interpretation very different from (20c/d). The first two examples state that relatively many rich people live in Haren. The last two that many people live in Haren and that they are all rich: in accordance with the intonational pattern, the reference of the indefinite needs to be established in the first clause, and hence the second cannot be interpreted as a restrictor.

(20) a. In Haren wonen veel mensen die zijn rijk.
In Haren live many people DEM are rich
'Many people live in Haren who are rich.'
b. In Haren wonen veel mensen die rijk zijn.
c. In Haren wonen veel mensen. Die zijn rijk.
'Many people live in Haren. They are rich.'
d. In Haren wonen veel mensen, die rijk zijn.

Thus, there is an essential similarity between quasi-relatives and restrictive relative clauses related to scope. There is also a crucial difference, which I believe is related to the difference between relative pronouns and demonstratives. Consider (21). Due to the negative context, the indefinite *een vriend* 'a friend' cannot be interpreted as specific. Therefore, the demonstrative in the quasi-relative (21a) cannot find a referent, which leads to unacceptability. In (21b), *die* is a relative operator, which is not referential; hence the problem disappears.

(21) a. * Niemand van ons heeft een vriend die is miljonair.
nobody of us has a friend DEM is millionaire
'[*] None of us has a friend who is a millionaire.'
b. Niemand van ons heeft een vriend die miljonair is.

What this example proves is that a quasi-relative necessarily relates to a *specific* indefinite. From this we can predict that a quasi-relative resolves potential ambiguities. This is indeed the case. In (22a), *een vriend* 'a friend' can be understood as specific or nonspecific. If we add a quasi-relative, the only interpretation involves a particular friend. Thus, some kind of accommodation takes place. By contrast, a regular restrictive relative as in (22c) does not curtail the possibilities in this way.

(22) a. Ik heb een vriend. (specific or nonspecific)
b. Ik heb een vriend die is miljonair. (only specific)
I have a friend DEM is millionaire.
'I have a friend who is a millionaire.'
c. Ik heb een vriend die miljonair is. (specific or nonspecific)

Not very surprisingly then, subsequent sentences containing an independent demonstrative or a personal pronoun pattern with quasi-relatives.

(23) a. Ik heb een vriend. Die/hij is miljonair. (only specific)
b. * Niemand van ons heeft een vriend. Die/hij is miljonair. (cf. (21a))
'[*] None of us has a friend. He is a millionaire.'

Appositive relative clauses behave in the same way. As is well-known, they cannot take a non-specific antecedent. In previous research, it has been claimed that appositives involve E-type pronominal reference (see Del Gobbo 2007, for instance). This is compatible with the facts in (24), but it shifts the burden of explanation: why is the relative pronoun in an appositive different from a relative pronoun in a restrictive?

(24) a. Ik heb een vriend, die miljonair is. (only specific)
b. * Niemand van ons heeft een vriend, die overigens miljonair is.
'[*] None of us has a friend, who is a millionaire, by the way.'

In the coordination account of appositives I proposed earlier (De Vries 2006, 2012), these facts fall out naturally. This requires some elaboration. The structure is sketched in (25). Here, ParP is a functional projection indicating parenthetical specifying coordination, which generalizes over – at least – appositions (as in *my neighbor, John*) and nonrestrictive relative clauses. The relative clause proper is embedded in a DP, which turns it into a semi-free relative. The abstract D head corresponds to a specific indefinite pronoun that is coreferential with the antecedent. A paraphrase of the analysis would be roughly *a friend, namely someone (a particular person) who is a millionaire.*

(25) $[_{\text{host clause}}$ ... $[_{\text{ParP}}$ $[_{\text{DP}}$ antecedent] [Par $[_{\text{DP}}$ D $[_{\text{CP}}$ relative clause]]]] ...]

The relative clause is in fact restrictive with respect to its immediate head (D), i.e., it acts as a restrictor on the indefinite variable. The internal relative pronoun therefore behaves equivalently to relative pronouns in restrictive relative constructions, i.e. as an operator. This is a big advantage: relative constructions are always the same, and it is the syntactic context (here, ParP) that can establish a nonrestrictive meaning. Since many other construction types besides relative clauses can be assigned a parenthetical status, it must be an independent mechanism that takes care of this.

To repeat, the D head necessarily acts as a referential pronoun. From this, it follows that its antecedent must also be specific, whence the facts in (24). Secondly, since the relative clause is already a restrictor of D, it cannot be a restrictor of the antecedent itself. The relationship between the relative clause and the visible antecedent is therefore indirect, mediated by anaphoric linking through discourse, but separated by intervening structure. I believe this is an important insight, which explains the fact that appositive relatives behave on a par with subsequent clauses involving run-of-the-mill pronominal coreference in various respects.

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Affiliation

Mark de Vries
Dept. of Linguistics
University of Groningen
mark.de.vries@rug.nl

Midpoints

Dag Westerståhl

Introduction

A *midpoint* is a quantifier identical to its own postcomplement, i.e. a fixed point of the postcomplement operation. I'm borrowing the term from Ed Keenan, who noticed that such fixed points lead to curious logical equivalences, like the one between (1-a) and (1-b):

(1) a. Between one-third and two-thirds of the students passed the exam.
    b. Between one-third and two-thirds of the students didn't pass the exam.

Keenan, however, did not use "midpoint" in this way, but rather for a feature of a certain class of proportional fixed points (section 2 below). But there are many other examples, and for lack of a natural descriptive name, I shall here appropriate the label *midpoint* for any such fixed point.

Keenan discovered that, far from being an anomaly, midpoints exist in great numbers. He proved theorems about them and gave numerous English examples; see Keenan (2005, 2008). In this note I take a new look at these results and their proofs.

A secondary aim is to illustrate the difference between two approaches to semantics: *global* and *local*. Like most linguists, Keenan usually prefers a local perspective: fix a universe M of individuals and consider predicates, relations, functions, quantifiers, and other higher-type objects over M. He then observes facts like the following: if Q and Q' are midpoints, so is $Q \vee Q'$. Literally, this result quantifies over *all sets of subsets of* M (all type $\langle 1 \rangle$ quantifiers on M). However, in this case, the same proof works *for every universe* M, so in effect, you are quantifying over M too. This is the logician's global perspective.

A global result implies the corresponding local version, but the converse can fail, although it didn't in the example just mentioned. *Definability* results provide the clearest examples. Keenan and Stavi (1986) proved that all type $\langle 1 \rangle$ quantifiers on a finite universe M are definable as Boolean combinations of Montagovian individuals (and hence—in a liberal sense—denotable by English DPs). But the defining sentence depends on $|M|$ ($|X|$ is the cardinality of X), and there is no global version of this theorem. A global definability result requires the same defining formula for every universe.[1]

[1] An example: the type $\langle 1,1,1 \rangle$ quantifier *more than*, defined, for all M and all $A,B,C \subseteq M$, by

(i) $\textit{more than}_M(A,B,C) \Leftrightarrow |A \cap C| > |B \cap C|$,

as in "More men than women smoke", turns out to also be definable in terms of the two type $\langle 1,1 \rangle$ quantifiers *most* and *infinitely many*; see e.g. Peters and Westerståhl (2006), ch. 13.2.

My point about midpoints will be that the global perspective gives a better view of the issues involved and simplifies proofs. But this doesn't mean that it is always preferable. An interesting contrast is provided by a question dual to the one about midpoints: the existence of *self-dual* quantifiers. I point out that here the global approach is barren, but the local perspective provides some linguistic insights.

1 Preliminaries

1.1 Quantifiers

A (global) *type* $\langle 1,1\rangle$ (generalized) *quantifier* Q associates with each non-empty set M a (local) *type* $\langle 1,1\rangle$ *quantifier* Q_M *on* M, i.e. a binary relation between subsets of M.[2] Similarly for a type $\langle 1\rangle$ quantifier, associating with each M a set of subsets of M. When a type $\langle 1,1\rangle$ quantifier interprets an English Det, we use that Det to name it:

(2) a. $\mathit{all}_M(A,B) \Leftrightarrow A \subseteq B$
b. $\mathit{exactly\ five}_M(A,B) \Leftrightarrow |A\cap B| = 5$
c. $\mathit{most}_M(A,B) \Leftrightarrow |A\cap B| > |A-B|$
d. $\mathit{infinitely\ many}_M(A,B) \Leftrightarrow A\cap B|$ is infinite
e. $\mathit{between\ one\text{-}third\ and\ two\text{-}thirds\ of\ the}_M(A,B) \Leftrightarrow 1/3 \leq |A\cap B|/|A| \leq 2/3$ [3]

Recall that Det denotations have the properties of *conservativity* and *extension*:

(CONSERV) $Q_M(A,B) \Leftrightarrow Q_M(A,A\cap B)$ (all M, all $A,B \subseteq M$)

(EXT) If $A,B \subseteq M \subseteq M'$, then $Q_M(A,B) \Leftrightarrow Q_{M'}(A,B)$

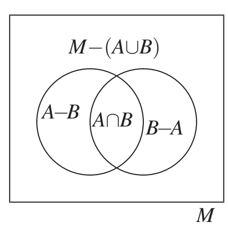

Figure 1: The four sets relevant to a type $\langle 1,1\rangle$ quantifier on M

CONSERV says that $B-A$ doesn't matter for the truth value of $Q_M(A,B)$, EXT says that $M-(A\cup B)$ doesn't matter; together they restrict the domain of quantification to A. Many

[2] I give only the bare essentials of the generalized quantifier framework used in this note; for more details, examples, and explanations, see any overview of GQ theory, such as Peters and Westerståhl (2006), Keenan and Westerståhl (2011), Westerståhl (2011). Keenan treats quantifiers as *functions* rather than relations; then a type $\langle 1\rangle$ (or, if you will, type $\langle\langle e,t\rangle,t\rangle$) quantifier is, on each M, a function from subsets of M to truth values, and a type $\langle 1,1\rangle$ (or $\langle\langle e,t\rangle,\langle\langle e,t\rangle,t\rangle\rangle$) quantifier is a function from subsets of M to type $\langle 1\rangle$ quantifiers on M. For present purposes, this is just a notational variant of the relational approach.

[3] Keenan adds the condition $A \neq \emptyset$ on the right-hand side, which seems right in view of the obligatory presence of the definite article in the corresponding Det. For simplicity, I leave out that condition here.

Det denotations (e.g. all those in (2)) also satisfy ISOM, which says that only the *cardinalities* of the relevant sets matter (in general, all four partition sets in Fig. 1; under CONSERV and EXT, just $|A-B|$ and $|A\cap B|$ matter).

EXT also entails that we often can drop the subscript $_M$. In a way this hides the global/local distinction, but note that quantifiers are essentially global objects, with a local version on each universe—the condition EXT cannot even be formulated from a strictly local perspective. From now on, unless otherwise noted, type $\langle 1,1\rangle$ quantifiers are assumed to be CONSERV and EXT.

1.2 Boolean operations

Standard Boolean operations apply directly to quantifiers:

(3) Definition:

a. $\neg Q(A,B) \Leftrightarrow$ not $Q(A,B)$
b. $(Q\wedge Q')(A,B) \Leftrightarrow Q(A,B)$ and $Q'(A,B)$
c. $(Q\vee Q')(A,B) \Leftrightarrow Q(A,B)$ or $Q'(A,B)$

$\neg Q$ is the *outer negation* of Q. But quantifiers have two other kinds of negation: an *inner negation* $Q\neg$, that Keenan calls the *postcomplement* of Q, and a double, inner-outer (or vice versa), negation Q^d, called the *dual* of Q:

(4) Definition:

a. $Q\neg(A,B) \Leftrightarrow Q(A,A-B)$
b. $Q^d = (\neg Q)\neg = \neg(Q\neg)$

Then

$$square(Q) = \{Q, Q\neg, \neg Q, Q^d\}$$

is a modern version of the Aristotelian *square of opposition*, generalized to any quantifier Q.[4] That it makes sense to say that any Q spans a unique square follows from:

(5) If $Q' \in square(Q)$, then $square(Q') = square(Q)$.

The following facts are easy to establish:

(6) a. The three negations are idempotent, i.e. $Q = \neg\neg Q = Q\neg\neg = Q^{dd}$.
b. $\neg(Q\wedge Q') = \neg Q\vee\neg Q'$ and $\neg(Q\vee Q') = \neg Q\wedge\neg Q'$ (de Morgan laws)
c. $(Q\wedge Q')\neg = Q\neg\wedge Q'\neg$ and $(Q\vee Q')\neg = Q\neg\vee Q'\neg$
d. $(Q\wedge Q')^d = Q^d\vee Q'^d$ and $(Q\vee Q')^d = Q^d\wedge Q'^d$

Since a quantifier is always distinct from its outer negation, if follows that $square(Q)$ has either 4 or 2 members. So in principle there are just two ways for a $square(Q)$ to be 'degenerate': it contains either a midpoint or a self-dual quantifier:

[4]For an account of the (considerable) differences between the traditional and the modern square, and a study of *square*(Q) for various Q, see Westerståhl (2012).

(7) Definition:

a. Q is a *midpoint* if $Q = Q\neg$
b. Q is *self-dual* if $Q = Q^d$

I mentioned a midpoint in the Introduction: the equivalence of (1-a) and (1-b) shows that *between one-third and two-thirds of the* = (*between one-third and two-thirds of the*)¬. I gave no example of a self-dual quantifier; we will see why presently.

1.3 The number triangle

We often restrict attention (as Keenan usually does) to *finite universes*; this is marked FIN. It then follows from the definitions above that under FIN, a type $\langle 1,1\rangle$ CONSERV, EXT, and ISOM quantifier Q can be identified with a *binary relation between natural numbers*. More precisely, using the same name for this relation, define

(8) $Q(k,m) \Leftrightarrow$ for some A,B with $|A-B| = k$ and $|A \cap B| = m$, $Q(A,B)$ [5]

For example,

(9) a. $all(k,m) \Leftrightarrow k = 0$
b. $exactly\ five(k,m) \Leftrightarrow m = 5$
c. $most(k,m) \Leftrightarrow m > k$
d. $between\ one\text{-}third\ and\ two\text{-}thirds\ of\ the(k,m) \Leftrightarrow 1/3 \leq m/(k+m) \leq 2/3$

The *number triangle* is just $\mathbb{N}^2$ turned 45 degrees; see Fig. 2. So a quantifier Q is simply

(0,0)
(1,0) (0,1)
(2,0) (1,1) (0,2)
(3,0) (2,1) (1,2) (0,3)
(4,0) (3,1) (2,2) (1,3) (0,4)
. . . .

Figure 2: The number triangle

an area in the number triangle; Fig. 3 gives examples. Johan van Benthem realized early on that this visual representation of (CONSERV, EXT, and ISOM) quantifiers is an enormously useful tool for finding properties of and proving facts about them (under FIN); see (van Benthem 1984). I will make essential use of it below.

[5] Note that the *first* argument of the relation is $|A-B|$ and the *second* is $|A \cap B|$. This is purely conventional.

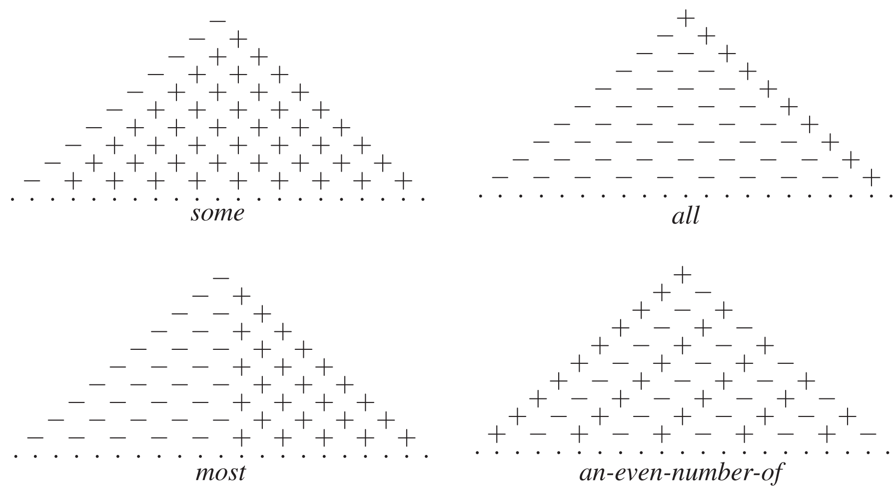

Figure 3: Some quantifiers in the number triangle

2 Keenan on midpoints

The perspective in Keenan (2005, 2008) is local: a finite universe M, say $|M| = n$, is fixed, and a midpoint is a local quantifier Q_M on M such that $Q_M = (Q_M)\neg$. Keenan (2005) considers type $\langle 1 \rangle$ quantifiers: the three kinds of negation, and thus the notion of a midpoint, transfer in an obvious way to such quantifiers. One result counts the number of type $\langle 1 \rangle$ midpoints on M: without ISOM it is

$$2^{2^{n-1}}$$

and restricted to ISOM quantifiers it is

$2^{(n+1)/2}$ if n is odd, and $2^{(n+2)/2}$ if n is even.[6]

Thus, on a 5 element universe there are $2^{16} = 65536$ midpoint quantifiers (out of 2^{32} type $\langle 1 \rangle$ quantifiers in total), 8 of which are ISOM (out of 64 in total). This shows that in some sense there are *many* midpoints, which seems surprising if you think of them as 'degenerate'. These results are local and have no immediate global versions. Nevertheless, we will see that, in a related sense, there are also *many* global midpoints.

In Keenan (2008) the focus is on type $\langle 1, 1 \rangle$ midpoints; as I said, the label comes from certain proportional quantifiers. Following Keenan, Q is *proportional* if the truth value of $Q(A,B)$ depends only on the proportion of Bs among the As (assuming FIN):

(10) For $A, A' \neq \emptyset$, if $|A \cap B|/|A| = |A' \cap B'|/|A'|$ then $Q(A,B) \Leftrightarrow Q(A',B')$.[7]

[6]Keenan's proof uses facts about complete atomic Boolean algebras, but we will see a simpler calculation in section 3 (Corollary 8). Note that in a local approach, the condition corresponding to ISOM is PERM_M; *closure under permutations* of M. One can show that under EXT, ISOM is equivalent to PERM_M holding for all M.

[7]Keenan doesn't mention the requirement $A, A' \neq \emptyset$ (and neither does the definition of proportionality in Keenan and Westerståhl (2011)), but it is needed: if we were to drop it and rewrite the antecedent as $|A \cap B| \cdot |A'| = |A' \cap B'| \cdot |A|$, we would get the consequence that if $Q(\emptyset,\emptyset)$ then $Q(A',B')$ for all A', B', and if not $Q(\emptyset,\emptyset)$ then $Q(A',B')$ holds for no A', B', rendering the notion of proportionality useless.

We note that a (CONSERV and EXT) proportional quantifier is automatically ISOM, since for $A, A' \neq \emptyset$, if $|A \cap B| = |A' \cap B'|$ and $|A - B| = |A' - B'|$ then $|A \cap B|/|A| = |A' \cap B'|/|A'|$, and for $A = \emptyset$ ($A' = \emptyset$), if $|A \cap B| = |A' \cap B'|$ and $|A - B| = |A' - B'|$ then $A' = \emptyset$ ($A = \emptyset$), and thus trivially $Q(A,B) \Leftrightarrow Q(A'B')$.

Let us define the following *basic* proportional quantifiers:[8]

(11) For $0 \leq p \leq q$ (and $q \neq 0$),
a. $(p/q)(A,B) \Leftrightarrow |A \cap B| > p/q \cdot |A|$
b. $[p/q](A,B) \Leftrightarrow |A \cap B| \geq p/q \cdot |A|$

So (p/q) is *more than p/q'ths of the*, and $[p/q]$ is *at least p/q'ths of the*. These are proportional, but many other quantifiers are too; indeed Keenan observes that the class of proportional quantifiers is closed under Boolean operations, including inner negation. For example,

$$\textit{between one-third and two-thirds of the} \;=\; [1/3] \wedge \neg(2/3)$$

is proportional. That it is also a midpoint follows from

Theorem 1 (Keenan's First Midpoint Theorem)**.** *If $p/q + p'/q' = 1$, then the quantifier* between p/q and p'/q' of the *is a midpoint.*

Thinking of 1/2 as the midpoint, the requirement $p/q + p'/q' = 1$ means that p/q and p'/q' have equal distance to the midpoint,[9] which explains the terminology.

The next step is to generalize this further, noting two things. First, an easy calculation shows

(12) a. $[p/q]\neg \;=\; \neg((q-p)/q)$
b. $(p/q)\neg \;=\; \neg[(q-p)/q]$

Second, we have (collecting some of Keenan's results in one theorem):

Theorem 2 (Keenan's Second Midpoint Theorem)**.**

(a) *For any Q, the quantifiers $Q \wedge Q\neg$ and $Q \vee Q\neg$ are midpoints.*

(b) *The class of midpoints is closed under Boolean operations, including inner negation.*

(a) is an immediate corollary of (6-c) and (6-a): $(Q \wedge Q\neg)\neg = Q\neg \wedge Q\neg\neg = Q\neg \wedge Q = Q \wedge Q\neg$, and similarly for $Q \vee Q\neg$. Then we note that if the assumption of Theorem 1 is satisfied we have $p'/q' = (q-p)/q$, and hence, using (12-a), that

$$\textit{between } p/q \textit{ and } p'/q' \textit{ of the} \;=\; [p/q] \wedge \neg((q-p)/q) \;=\; [p/q] \wedge [p/q]\neg\,,$$

so Theorem 1 follows. Theorem 2(b) also follows by applications of (6).

The midpoint theorems are formulated locally, but the theorems and their proofs extend immediately to a global context. So a global approach adds nothing new to *these* results. But

[8] Elsewhere, e.g. in Keenan and Westerståhl (2011), it is required that $0 < p < q$. Allowing $p = 0$ or $p = q$ makes for greater generality, which turns out to be useful; see the discussion of (16) below.

[9] Note that since $0 \leq p/q \leq p'/q' \leq 1$, we have $p/q \leq 1/2$ and $p'/q' \geq 1/2$, and so $1/2 - p/q = p'/q' - 1/2$, since $p/q + p'/q' = 1$.

Keenan also raises the natural question of a useful *characterization* of the property of being a midpoint, and conjectures that the answer has something to do with proportionality. Here is where I think a global perspective helps.

Keenan (2005, 2008) also presents a number of striking examples, such as the following equivalent pairs:

(13) a. More than three out of ten and less than seven out of ten teachers are married.
b. More than three out of ten and less than seven out of ten teachers are not married.

(14) a. Between 40 and 60 per cent of the students passed.
b. Between 40 and 60 per cent of the students didn't pass.

(15) a. Either all or none of the students will pass that exam.
b. Either all or none of the students will not pass that exam.

(16) a. Some but not all of the professors are on leave.
b. Some but not all of the professors are not on leave.

(17) a. Either exactly five or else all but five students came to the party.
b. Either exactly five or else all but five students didn't come to the party.

(18) a. Exactly three of the six students passed the exam.
b. Exactly three of the six students didn't pass the exam.

As Keenan points out, (13)–(16) are proportional instances of Theorem 2(a). For example, we see that *some* = $(0/1)$, so *some but not all* = $(0/1) \wedge (0/1)\neg$. (Here is where allowing $p = 0$ in (11) is useful!) But he also shows that (17) and (18) do *not* involve proportional quantifiers, thus severing the tie between proportionality and midpoints. As we will see, there seems to be no hope of maintaining that tie.

3 Midpoints in the number triangle

The number triangle provides a thoroughly global view of quantifiers, but it presupposes CONSERV, EXT, ISOM, and FIN. Let us see what proportionality and midpoints look like from this perspective. I'm not sure there is a useful visual way to think of proportionality in general, as defined by (10), i.e. the condition that

(19) if $k+m, k'+m' > 0$ and $m/(k+m) = m'/(k'+m')$, then $Q(k,m) \Leftrightarrow Q(k',m')$.

But the basic proportionals $[p/q]$ and (p/q) from (11) are easy to 'see' in the number triangle, for example, *most* = $(1/2)$ was drawn in Fig. 3. And the midpoint property is beautifully represented in the triangle. First, note that the inner negation of Q becomes the *converse* of Q as a relation between numbers:

(20) $Q\neg(k,m) \Leftrightarrow Q(m,k)$

Thus,

(21) Q is a midpoint iff for all k and m, $Q(k,m) \Leftrightarrow Q(m,k)$.

So the midpoint property says something about how Q must behave *on each diagonal*, where the *diagonal at level n* is $(n,0),(n-1,1),\ldots,(1,n-1),(0,n)$. For example, here are some 'midpoint patterns':

$$+ - + - + - + - +$$

$$+ - - - - - - - +$$

$$+ + - - - - - + +$$

$$- - - - + - - - -$$

Figure 4: Some midpoint patterns (at level 8)

Imagine a vertical line drawn from (0,0) in the number triangle, thus passing through (1,1), (2,2), (3,3), ..., and between (1,0) and (0,1), between (2,1) and (1,2), between (3,2) and (2,3), etc. Let the *left part* of the number triangle consist of all the points to the left of that line, *including* the points on the line itself. (So, for example, (2,2) and (3,2) are in the left part, but (2,3) is not.) Then, essentially by just 'looking' in the number triangle, we have the following result.

Theorem 3. (CONSERV, EXT, ISOM, FIN) *The following are equivalent:*

(a) *Q is a midpoint.*

(b) *For some Q', $Q = Q' \vee Q'\neg$.*

(c) *For some subset Q' of the left part of the number triangle, Q is the union of Q' and its* mirror image*, i.e. $Q'\neg$.*

That (b) implies (a) is the first part of Keenan's Second Midpoint Theorem,[10] and the converse implication is trivial (with $Q' = Q$). And (c) essentially just restates this in a more pictorial way, noting that Q' can always be taken as a subset of the left part. So there is really nothing new in this theorem, except for the visual aid. But that aid, it seems to me, brings some insight.

First, I think we must abandon all hope of connecting midpoints in general to proportionality. *Any* subset of the left part yields a midpoint, regardless of requirements like (19).

Second, we see that also from a global perspective there are *many* midpoints. There are $2^{\aleph_0}$ subsets of the left part of the number triangle. Hence:

Corollary 4. *There are $2^{\aleph_0}$ midpoints, even if only finite universes are considered, and even if* CONSERV, EXT*, and* ISOM *are imposed.*

Third, we can sharpen the First Midpoint Theorem to an equivalence:

Corollary 5. *The quantifier* between p/q and p'/q' of the *is a midpoint iff $p/q + p'/q' = 1$.*

[10] The second part is also easily 'seen' to be true in the triangle. For Q is a midpoint iff it is symmetric as a relation between numbers, and symmetry is obviously preserved by the Boolean operations.

This doesn't really require the number triangle, but using the triangle makes it fairly obvious (I won't give details here) that if $p/q + p'/q' \neq 1$, one can find a counter-example to the midpoint property by looking at the diagonal at level n, for a large enough n.

Fourth, we can see why some common quantifiers *cannot* be midpoints. Keenan (2008) proves that no non-trivial *intersective* quantifier can be a midpoint.

Definitions:

a. Q is *intersective* if $A \cap B = A' \cap B'$ entails $Q(A,B) \Leftrightarrow Q(A',B')$
b. $\mathbf{1}_M(A,B)$ holds for all $A,B \subseteq M$ ($\mathbf{1}_M$ is the *trivially true* quantifier on M)
c. $\mathbf{0}_M(A,B)$ holds for no $A,B \subseteq M$; ($\mathbf{0}_M$ is the *trivially false* quantifier on M)

Corollary 6 (Keenan)**.** *If Q is an intersective midpoint, then on each M, Q_M is either $\mathbf{1}_M$ or $\mathbf{0}_M$.*

The result is easily provable in the number triangle, but in this case, Keenan's proof of the more general fact is just as simple: Note first that if Q is intersective then $Q\neg$ is *co-intersective*, i.e. the truth value of $Q(A,B)$ depends only on $A-B$. Now suppose Q is an intersective midpoint. Then, for any M and any $A,B \subseteq M$, $Q_M(A,B) \Leftrightarrow Q_M(A \cap B, M)$ (since Q is intersective) $\Leftrightarrow Q_M(\emptyset, M)$ (since $Q = Q\neg$ is co-intersective), so Q_M is either $\mathbf{1}_M$ or $\mathbf{0}_M$.

Other similar results are evident by looking in the number triangle; I give one more example. First, a definition:

Q is *right monotone* if $Q(A,B)$ and $B \subseteq B'$ implies $Q(A,B')$.

Most common English Dets denote right monotone quantifiers, or Boolean combinations of such quantifiers (see Peters and Westerståhl (2006), ch. 5, for a fuller statement). However:

Corollary 7. *If Q is a right monotone midpoint, then on each M, Q_M is either $\mathbf{1}_M$ or $\mathbf{0}_M$.*

This fact is obvious in the number triangle, but again there is a very simple proof without any extra conditions on Q or on the size of universes: Suppose $Q_M(A,B)$ holds. By right monotonicity, $Q_M(A,M)$. Since $Q = Q\neg$, we get $Q_M(A,\emptyset)$. Thus, by right monotonicity again, $Q_M(A,C)$ holds for any $C \subseteq M$.[11]

Finally, let us get back to counting quantifiers on a given universe. I said that the number triangle embodies a global perspective, but it can be used locally too. For CONSERV, EXT, and ISOM type $\langle 1,1 \rangle$ quantifiers on an n-element universe M, just look at the finite triangle up to and including the n'th diagonal. There are $(n+1)(n+2)/2$ pairs in this triangle, so the total number of such quantifiers on M is

$$2^{(n+1)(n+2)/2}$$

And a simple calculation shows that if n is odd, the number of pairs in the left part of the triangle is $(n+1)(n+3)/4$, whereas if n is even it is $n(n+4)/4+1$.[12]

[11] It often happens that a result obtained by looking at the number triangle turns out to hold under more general conditions. (That's how I came to Corollary 7.) The above results answer natural questions, but in other cases one would hardly ever have thought of the more general result, had it not been suggested by the number triangle; see Peters and Westerståhl (2006), ch. 5, for a few examples.

[12] These calculations use essentially nothing more than the fact that $1+2+3+\ldots+k = k(k+1)/2$.

We can also do this for ISOM type $\langle 1\rangle$ quantifiers on M. Then only the diagonal at level $|M|$ is relevant.[13] It has $n+1$ pairs, of which $(n+1)/2$ belong to the left part if n is odd, and $(n+2)/2$ belong to the left part if n is even. Thus:

Corollary 8. *Let M be a universe with n elements. If n is odd, there are $2^{(n+1)(n+3)/4}$ CONSERV, EXT, and ISOM type $\langle 1,1\rangle$ midpoint quantifiers on M, and $2^{(n+1)/2}$ ISOM type $\langle 1\rangle$ midpoint quantifiers on M. If n is even, the corresponding numbers are $2^{n(n+4)/4+1}$ and $2^{(n+2)/2}$, respectively.*

4 Self-duality

Let me spell out definition (7-b) in some more generality:

(22) a. A type $\langle 1,1\rangle$ Q is self-dual iff $\forall M \forall A,B \subseteq M\,(Q_M(A,B) \Leftrightarrow \neg Q_M(A,M-B))$.
b. A type $\langle 1\rangle$ Q is self-dual iff $\forall M \forall B \subseteq M\,(Q_M(B) \Leftrightarrow \neg Q_M(M-B))$.

The problem with self-dual quantifiers is that they almost never exist.

Theorem 9.

(a) *No* CONSERV *type $\langle 1,1\rangle$ quantifier is self-dual.*

(b) *No* ISOM *type $\langle 1,1\rangle$ or type $\langle 1\rangle$ quantifier is self-dual.*

(c) *Montagovian individuals, i.e. type $\langle 1\rangle$ quantifiers of the form $(I_a)_M(B) \Leftrightarrow a \in B$, are not self-dual.*

(d) *Type $\langle 1\rangle$ quantifiers interpreting quantified DPs, i.e. of the form Q^A for some* CONSERV *and* EXT *type $\langle 1,1\rangle$ Q, are not self-dual.*

(a): If Q is CONSERV, then (22-a) requires

$$Q_M(A,B) \Leftrightarrow \neg Q_M(A,A-B)$$

to hold, which is impossible for $A = B = \emptyset$. (b): If Q is ISOM, choosing A,B,M such that $|A-B| = |A\cap B| = |B-A| = |M-(A\cup B)|$ will yield a counter-example to (22-a), and similarly in the type $\langle 1\rangle$ case. (c): As to I_a, choose M such that $a \notin M$: then, for any $B \subseteq M$, $(I_a)_M(B)$ and $(I_a)_M(M-B)$ are both false, contrary to what (22-b) requires. (d): Finally, the quantifiers Q^A are defined by

$$Q^A_M(B) \Leftrightarrow Q_{A\cup M}(A,B)$$ [14]

Choose A disjoint from M. Then, using the conservativity of Q, one easily sees that $Q^A_M = Q^A_M\neg$ (so Q^A_M is a midpoint), contradicting self-duality.

As a bonus, we obtain from Theorem 9(a) a final characterization of midpoints.

[13] Now the binary relation corresponding to Q is

(i) $Q(k,m) \Leftrightarrow$ for some M and some $B \subseteq M$ with $|M-B| = k$ and $|B| = m$, $Q_M(B)$

[14] See Peters and Westerståhl (2006), ch. 4.5.5, for arguments why this is the correct definition, rather than, say, $(Q^A)_M(B) \Leftrightarrow A \subseteq M \;\&\; Q_M(A,B)$. However, also with the latter definition, Q^A cannot be self-dual.

Corollary 10. (CONSERV) *Q is a midpoint iff square(Q) has 2 elements.*

However, Theorem 9 may seem very surprising, in view of the fact that self-dual quantifiers are often discussed in the linguistic literature. For example, Barwise and Cooper (1981) point out that since self-duality means that $\neg Q = Q\neg$, we have an immediate semantic explanation of why negation always has wide scope over self-dual quantifiers, such as I_a. But there is no contradiction here, since Barwise and Cooper are talking about *local* quantifiers, and if $a \in M$, then $(I_a)_M$ is indeed self-dual, in the sense that *on such an M*,

$$\forall B \subseteq M\,((I_a)_M(B) \Leftrightarrow \neg(I_a)_M(M - B))$$

Keenan (2005) also discusses local self-dual type $\langle 1 \rangle$ quantifiers, noting, however, that the ISOM ones rarely exist (he establishes a local version of Theorem 9(b)). Only when $|M| = n$ is odd can you get some self-dual ISOM local quantifiers, like *at least* $(n+1)/2$ *things*, or *at least* $n-1$ *or between 2 and* $(n+1)/2$ *things* (as is seen by looking at the diagonal at level n in the number triangle, and recalling that the condition to satisfy is $(n-k,k) \in Q \Leftrightarrow (k,n-k) \notin Q$).

But at least for proper names interpreted as Montagovian individuals, local self-duality seems like a significant property, which goes to show that sometimes a local view of quantifiers can be rewarding even when there is no reasonable global alternative.

Conclusion

Midpoint quantifiers, discovered (though not named in this way) by Keenan, are a curious and interesting phenomenon, on the borderline between linguistics and logic. I do believe that a global perspective, with the help of the number triangle, offers insights into their properties and distribution. But perhaps this is partly a matter of taste; Keenan is probably so used to working with Boolean algebras that he thinks that framework is easier to visualize. In any case, I have claimed here that for at least one question, concerning a possible connection between midpoints and proportionality, the global view is preferable and in fact suggests a (negative) answer. But I also noted the contrast with respect to a seemingly very similar issue (similar from the point of view of the square of opposition), that of self-dual quantifiers, where the local perspective is essentially the only one in which they even exist. My aim has not been to say that one perspective is preferable to the other, but rather to note the difference between them, and that both have their uses, with certain facts about quantification and negation as paradigmatic examples.

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Affiliation

Dag Westerståhl
Department of Philosophy
Stockholm University
dag.westerstahl@philosophy.su.se

Reflexives and non-Fregean quantifiers

Richard Zuber

It is shown that depending on the subject noun phrase sequences of noun phrases and reflexive expressions give rise to three formally different type $\langle 2 \rangle$ quantifiers. If the noun phrase is a proper name, the quantifier is reducible, if the noun phrase denotes a filter, the quantifier is weakly reducible and if the noun phrase denotes an atom, the corresponding quantifier is strongly irreducible

Introduction

Natural languages display a great variety of constructions which denote non-Freagean quantifiers that is complex quantifiers which are not iterations of simpler quantifiers. Such quantifiers have been extensively studied by Ed (Clark and Keenan (1986), Keenan (1987b), Keenan (1992)). Usually expressions denoting non-Fregean quantifiers are not lexically simple and often they are not syntactic constituents. They are sequences composed of an NP (DP) and of an expression which can be called a generalised NP (GNP). GNPs are linguistic objects that can play the role of syntactic arguments of transitive VPs. So "ordinary" NPs or DPs are GNPs. However there are *genuine* GNPs which differ from "ordinary" NPs in that they cannot play the role of all verbal arguments; in particular they cannot occur in subject position. For instance the reflexive pronoun *himself/herself* or the reciprocal *each other* are such genuine GNPs.

A sequence NP...GNP can be considered as applying to a transitive VP to give a sentence S. In this case such sequence denotes a type $\langle 2 \rangle$ quantifier. If the GNP is a genuine GNP then often the sequence NP...GNP denotes a non-Fregean type $\langle 2 \rangle$ quantifier. In this note I present some general results concerning non-Fregean quantifiers denoted by the sequence NP...GNP in case when GNP is the reflexive pronoun or a Boolean compound of the reflexive pronoun and another expression. Thus, roughly speaking, I will show that the type $\langle 2 \rangle$ quantifiers involved in the interpretation of the following examples have different properties:

(1) Leo washed himself/himself and Lea.

(2) Leo and Lea/every student washed themselves

(3) Only Leo washed himself.

The GNPs that I will consider are those which denote specific type $\langle 2:1 \rangle$ functions (functions from binary relations to sets). An ordinary NP occurring in (direct) object position in a sentence can also be considered as denoting a type $\langle 2:1 \rangle$ function. When occurring in subject position in a simple '"intransitive" sentence, an NP denotes a type $\langle 1\rangle$ quantifier, that is a function from sets to truth values. When occurring in direct object position this NP denotes the *accusative extension* of the quantifier denoted by this NP on subject position. The accusative extension Q_{acc} (which is a function from binary relations to sets) of the quantifier Q is defined as follows (Keenan (1987a):

Definition 1. $Q_{acc}(R) = \{x : (QxR) = 1\}$, where $xR = \{y : \langle x,y\rangle \in R\}$

Type $\langle 2:1\rangle$ functions which are accusative extensions of some type $\langle 1\rangle$ quantifier satisfy so-called *case extension condition* EC:

Definition 2. A type $\langle 2:1\rangle$ function F satisfies EC iff for an y $a,b \in E$ and any binary relation R and S , if $aR = bS$ then $a \in F(R)$ iff $b \in F(S)$.

Here basically functions which satisfy a weaker condition, so-called *predicate invariance* (Keenan and Westerståhl (1997)) are considered:

Definition 3. A type $\langle 2:1\rangle$ function F is *predicate invariant* iff for any $a \in E$ and any binary relations R,S, if $aR = aS$ then $a \in F(R)$ iff $a \in F(S)$, where R,S are binary relations, E is the universe and $aR = \{x : \langle a,x\rangle \in R\}$.

Obviously functions satisfying EC are predicate invariant. It is important to observe, however (cf. Keenan (2007)), that functions denoted by genuine GNPs (like reflexive pronouns or by many expressions which are Boolean compounds of them), do not satisfy EC, even if they are predicate invariant. Similarly, functions denoted by GNPs formed from anaphoric determiners such as *Every...except himself, Most...,including herself* or specific possessive anaphoric determiners found in Slavic languages for instance, do not satisfy EC (Zuber 2010) . Thus $SELF$ does not satisfy EC and, moreover, for any type $\langle 1\rangle$ quantifier Q the type $\langle 2:1\rangle$ function $F = SELF \oplus Q_{acc}$, where $\oplus$ is a binary Boolean operator, is a predicate invariant function which does not satisfy EC. Similarly the function $NO(A)\text{-}BUT\text{-}SELF$, as specified in (4), does not satisfy the EC for any $A \neq \emptyset$ (Zuber 2010):

(4) $NO(A)\text{-}BUT\text{-}SELF(R) = \{x : A \cap xR = \{x\}\}$

Thus the difference between genuine GNPs (considered here) and NPs is that the former denote predicate invariant functions which do not satisfy EC.

1 Reflexives and Fregean quantifiers

A set of binary relations is a type $\langle 2\rangle$ quantifier; among them one can distinguish the following sub-class (cf. Keenan (1992)):

Definition 4. A type $\langle 2\rangle$ quantifier F is Fregean, or Frege reducible iff there exist two type $\langle 1\rangle$ quantifiers Q and Q_1 such that $F(R) = Q_1(Q_{acc}(R))$.

A type $\langle 2\rangle$ quantifier is non-Fregean iff it is not Frege reducible.

Various tests showing that a type $\langle 2\rangle$ quantifier is Fregean have been established and various type $\langle 2\rangle$ quantifiers have been shown to be non-Fregean (Keenan (1992), Ben Shalom (1994), (van Eijck 2005)) with their help. In these tests essential role play cross-product binary *relations*, that is binary relations of the form $A \times B$. Thus Keenan (1992) proved the following theorem which can be used to show that some functions are not Fregean (see also van Eijck (2005)):

Proposition 1. *(Keenan) If F_1 and F_2 are Fregean (type $\langle 2\rangle$) quantifiers then $F_1 = F_2$ iff for all $A, B \subseteq E$ it holds that $F_1(A \times B) = F_2(A \times B)$*

I am interested in the reducibility type $\langle 2\rangle$ quantifiers induced in some way by subject NPs and by expressions "containing" reflexives. The following definition makes this more precise:

Definition 5. Let $\langle NP, GNP\rangle$ be a sequence such that NP denotes the type $\langle 1\rangle$ quantifier Q and GNP denotes the type $\langle 2:1\rangle$ function F. Then the sequence $\langle NP, GNP\rangle$ induces a type $\langle 2\rangle$ quantifier G iff $G(R) = Q(F(R))$.

I will also say, somewhat ambiguously, that in this case the sequence $\langle Q, F\rangle$ induces the quantifier G or that the GNP (or its denotation, the function F) induces the type $\langle 2\rangle$ quantifier.

Let me consider now some correlations between the properties of NP and GNP (or of their denotations) and the reducibility of the quantifier they induce. Obviously, if the GNP is an NP then the sequence $\langle NP, GNP\rangle$ induces a Fregean quantifier. Interestingly not only GNPs which are NPs can induce Fregean quantifiers. This is the case when the NP in the sequence $\langle NP, GNP\rangle$ is a proper name and the GNP is, roughly speaking, a simple or complex reflexive expression. Proper names denote individuals, that is ultrafilters generated by the element of the universe E which is the referent of the proper name. More precisely if the PrN refers to a ($a \in E$), then PrN denotes the individual I_a defined as follows:

Definition 6. $I_a = \{X : X \subseteq E \wedge a \in X\}$.

The following proposition shows that the sequence $\langle PrN, GNP\rangle$, where GNP denotes a predicate invariant function, always induces a Fregean quantifier:

Proposition 2. *Let F be a type $\langle 2:1\rangle$ predicate invariant function. Define a type $\langle 2\rangle$ quantifier G_{F,I_a} as follows: $G_{F,I_a}(R) = 1$ iff $I_a(F(R)) = 1$. Then G_{F,I_a} is Fregean for any $a \in E$.*

Proof. Define the function h_F which maps every $a \in E$ to a type $\langle 1\rangle$ quantifier in the following way: $h_F(a)(Y) = 1$ iff $a \in F(\{a\} \times Y)$. Since F is predicate invariant we have $y \in F(R)$ iff $y \in F(\{y\} \times yR)$ (because $yR = y(\{y\} \times yR)$). From this it follows that $G_{F,I_a}(R) = I_a((h_F(a))_{acc}(R)))$ for any $a \in E$. Thus G_{F,I_a} is equivalent to $Q_1(Q_{acc})$ where $Q_1 = I_a$ and $Q = h_F(a)$. □

Thus a proper name and a GNP which denotes a predicate invariant function always induce Fregean quantifiers. This means that the type $\langle 2\rangle$ quantifiers involved in the interpretation (1) above are Fregean. Similarly with the quantifier involved in (5):

(5) Al shaved nobody but himself and Leo.

Using proposition 1 it is easy to show that type $\langle 2\rangle$ quantifiers involved in the interpretation of (2) above are not Fregean (Keenan (1992)). I present now a general result from which this fact follows. Consider:

Definition 7. The set of sets $Ft(C)$ called *filter generated by the set C* is defined as follows: $Ft(C) = \{X : X \subseteq E \wedge C \subseteq X\}$

Thus an ultrafilter is a filter generated by a singleton. However, not only proper names denote filters. For instance a conjunction of proper names denotes a filter (generated by the union of their referents). Similarly universally quantified NPs like *Every (student)* denote filters.

The following proposition is easy to prove:

Proposition 3. *Let $Q = Ft(C)$ for some $C \subseteq E$, $|C| \geq 2$. Then:*
(i) $Q(SELF(X \times Y) = Q(Q_{acc}(X \times Y)$, for any $X, Y \subseteq E$
(ii) $Q(SELF((C \times C) \cap Id)) \neq Q(Q_{acc}((C \times C) \cap Id))$, where $Id = \{\langle x, x\rangle : x \in E\}$

Observe that the relation $(C \times C) \cap Id$ is not a cross-product relation. Thus it follows from proposition 3 that the quantifier in (2) above is not Fregean.

In fact more can be shown. The following proposition is a consequence of proposition 3 and of the properties relating Boolean operations on sets to Boolean propositional connectives:

Proposition 4. *Let $Q = Ft(C)$ and $F = SELF \oplus (Q_1)_{acc}$, where $|C| \geq 2$, $\oplus$ is a Boolean connector and Q_1 a type $\langle 1\rangle$ quantifier. Then the following holds:*
(i) $Q(F(X \times Y)) = Q((Q \oplus Q_1)_{acc}(X \times Y))$, for any $X, Y \subseteq E$
(ii) $Q(F((C \times C) \cap Id)) \neq Q((Q \oplus Q_1)_{acc}((C \times C) \cap Id))$

As an example consider (6):

(6) Leo, Lea and every philosopher hate themselves and most logicians.

It follows from proposition 4, given that the meet of two filters is a filter, that the quantifier induced by the NP *Leo, Lea and every philosopher* and by the GNP *themselves and most logicians* (as they occur in (6) below) is not Fregean.

2 Strongly irreducible quantifiers

The proof of irreducibility of quantifiers induced by a type $\langle 1\rangle$ quantifier and the function *SELF* discussed in the previous section essentially involves proposition 1. In order to decide whether quantifier F is (Frege) reducible two steps are necessary. First, a Fregean quantifier G which takes the same values as F on cross-product relations has to be found. Second, one has to show that both quantifiers differ on a non-cross-product relation. Neither of these steps is obvious. To construct the quantifier G when the quantifier F is induced the sequence $\langle Ft(C), SELF\rangle$ is easy: it is enough, as we have seen, to replace *SELF* by $Ft(C)_{acc}$. This move does not apply, however, to other cases, when the NP does not denote a filter, and in particular not to the case illustrated in (3) above.

Indeed, it has been observed by Ben Shalom (1994) that (7) is not equivalent on cross product-relations to (8a) but rather to (8b). Similarly (9a) is not equivalent to (9b):

(7) Two students criticised themselves.

(8) a. Two students criticised two students.

b. Two students criticised the same two students.

(9) a. Only Leo shaved himself.
b. Only Leo shaved Leo.

Ben Shalom (1994) proposes another way of solving the problem of reducibility of quantifiers in general and shows in particular that the type $\langle 2 \rangle$ quantifier involved in the interpretation of (7) is not Fregean. Still another solution to the above problem is offered by van Eijck (2005) who proves the following:

Proposition 5. *(van Eijck) : Let F be a type $\langle 2 \rangle$ quantifier such that $F(\emptyset) = 0$. The reduct F^* of F is defined as follows: $F^* = Q_1(Q_2)_{acc}$ where Q_1 and Q_2 are positive type $\langle 1 \rangle$ quantifiers such that $Q_1(X \neq \emptyset) = 1$ iff $\exists_{B \subseteq E} F(X \times B) = 1$ and $Q_2(Y \neq \emptyset) = 1$ iff $\exists_{A \subseteq E} F(A \times Y) = 1$. Then F is Fregean iff $F^* = F$.*

It is not difficult to show that if Q is positive (that is if $Q(\emptyset) = 0$) and $F(R) = Q(SELF(R))$ then $F^*(R) = Q(Q_{acc}(R))$. From this fact the Frege non-reducibility of many quantifiers follows in particular the non-reducibility of the quantifier given in the example (3) above.

In (3) the subject NP *Only Leo* denotes an atomic $\langle 1 \rangle$ quantifier (an atom of the algebra of type $\langle 1 \rangle$ quantifiers). This is a quantifier which contains just one element. More precisely, for any $A \subseteq E$ the quantifier Q_A is atomic iff $Q_A(X) = 1$ iff $X = A$. The following property holds for "most" atomic quantifiers:

Proposition 6. *Let Q_A be atomic quantifier having just A as its only element such that $\emptyset \neq A \neq E$. Then Q_A is neither a union of individuals, nor an intersection of individuals nor a finite symmetric difference of individuals (where the symmetric difference of two sets X and Y = $(X \cap Y') \cup (Y \cap X')$)*

The above proposition and the following proposition 7 proved by Westerståhl (1996) will be used to show that atomic type $\langle 1 \rangle$ quantifiers and the function *SELF* induce non-Fregean quantifiers:

Proposition 7. *Let Q be a positive type $\langle 1 \rangle$ quantifier (that is $Q(\emptyset) = 0$). Then the equality $Q(Q_{acc}(R)) = Q(Q_{acc}(R^{-1}))$ holds iff Q is either a union or intersection of individuals or a finite symmetric difference of individuals.*

Consider now a type $\langle 2 \rangle$ quantifier F defined as $F(R) = Q(SELF(R))$, where Q is an atomic type $\langle 1 \rangle$ quantifier containing A as only element and such that A is not empty and not equal to E. Observe first that F is convertible, that is $F(R) = F(R^{-1})$. Furthermore, the reduct F^* of F has the following form: $F^* = Q(Q_{acc})$. It follows from propositions 6 and 7 that $F^* \neq F$ and thus the quantifier $F = Q(SELF)$ is not Fregean.

The above discussion about the use of proposition 1 in demonstrating the irreducibility of some quantifiers shows that it might be interesting, not only for theoretical reasons, to distinguish the reducibility of quantifiers "detectable" by proposition 1 and other types of reducibility. More precisely (Zuber (2003)):

Definition 8. A type $\langle 2 \rangle$ quantifier F is *weakly reducible* iff there exists two type $\langle 1 \rangle$ quantifiers Q and Q_1 such that $F(X \times Y) = Q_1(Q_{acc}(X \times Y))$, for any $X, Y \subseteq E$, A quantifier which is not weakly reducible is strongly irreducible (strongly non-Fregean). Obviously Fregean quantifiers are weakly reducible. There are, however, non-Fregean quantifiers which are weakly reducible. In fact we have already seen such quantifiers in connection with propositions 3 and 4: quantifiers induced induced by a filter (generated by a non-singleton) and the function *SELF* are such quantifiers. As a more abstract example, consider the atomic type $\langle 2 \rangle$ quantifier $F_{A\times B}$ which is true of just the relation $A \times B$, for $A, B \neq \emptyset$ and $A \neq E$. This quantifier is not-Fregean, because, as Keenan (1992) shows, atomic quantifiers are Fregean just in case the only relation of which they are true is of the form $E \times X$. Furthermore, it is easy to see that $F_{A\times B}(X \times Y) = Q_A((Q_B)_{acc}(X \times Y))$, where Q_A and Q_B are atomic type $\langle 1 \rangle$ quantifiers.

To show that a quantifier is not weakly reducible, the following proposition can be used Zuber (2003):

Proposition 8. *A type $\langle 2 \rangle$ quantifier is strongly irreducible iff for some sets P, P_1, P_2, P_3, P_4, $S_1$and S_2, the following holds: $F(P_1 \times S_1) \neq F(P_2 \times S_1)$, $F(P_3 \times S_2) \neq F(P_4 \times S_2)$ and $F(P \times S_1) \neq F(P \times S_2)$.*

Using proposition 8 it is easy to show that any sequence $\langle Q_A, SELF \rangle$, where Q_A is an atomic quantifier, induces a strongly irreducible quantifier. Consequently the quantifier induced by $\langle$*only Leo, himself*$\rangle$ (as found in (3)) is strongly irreducible.

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Affiliation

R. Zuber
CNRS, Paris
Richard.Zuber@linguist.jussieu.fr