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An Algebraic Perspective on the Person Case Constraint

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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 ClauseMate(x,y) which holds iff every node labeled CP reflexively dominating x reflexively dominates y, and the other way round. In formal terms, ClauseMate$(x,y) \Leftrightarrow \forall z[\mathrm{CP}(z) \rightarrow (z \triangleleft^* x \leftrightarrow z \triangleleft^* y)]$, where $\triangleleft^*$ is the reflexive transitive closure of the immediate dominance relation $\triangleleft$. Moreover, we define two predicates DO-Clitic(x) and IO-Clitic(x) that only hold of nodes labeled with DO clitics and IO clitics, respectively. In French, this would be DO-Clitic$(x) \Leftrightarrow \mathit{me}(x) \vee \mathit{te}(x) \vee \ldots \vee \mathit{les}(x)$ and 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 $\pi := \forall x,y[\mathrm{ClauseMate}(x,y) \wedge \text{DO-Clitic}(x) \wedge \text{IO-Clitic}(y) \rightarrow \phi]$, 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 $\{2,2,3\}$.

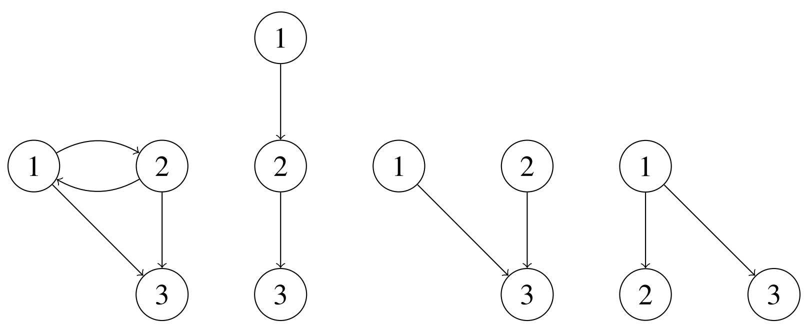

Figure 1: Graphs for the attested variants of the PCC (S-PCC, U-PCC, W-PCC, M-PCC)

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.

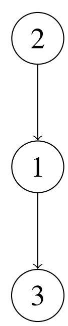

Figure 2: A variant of the U-PCC obtained by replacing *Top* with *Top*$'$

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

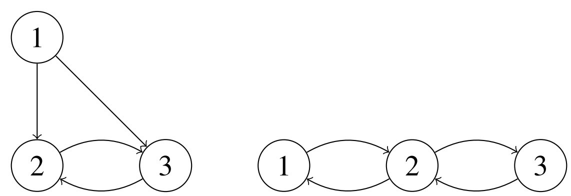

Figure 3: A variant of the M-PCC and a new one that blocks all clitic combinations

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.

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References

Béjar, Susana, and Milan Rezac. 2009. Cyclic agree. *Linguistic Inquiry* 40:35–73.

Bonet, Eulàlia. 1991. Morphology after syntax: Pronominal clitics in Romance. Doctoral Dissertation, MIT, Boston, MA.

Bonet, Eulàlia. 1994. The Person-Case Constraint: A morphological approach. In *The Morphology-Syntax Connection*, number 22 in MIT Working Papers in Linguistics, 33–52.

Graf, Thomas. 2011. Closure properties of minimalist derivation tree languages. In *LACL 2011*, ed. Sylvain Pogodalla and Jean-Philippe Prost, volume 6736 of *Lecture Notes in Artificial Intelligence*, 96–111. Heidelberg: Springer.

Kayne, Richard S. 1975. *French syntax: The transformational cycle*. Cambridge, Mass.: MIT Press.

Kobele, Gregory M. 2011. Minimalist tree languages are closed under intersection with recognizable tree languages. In *LACL 2011*, ed. Sylvain Pogodalla and Jean-Philippe Prost, volume 6736 of *Lecture Notes in Artificial Intelligence*, 129–144.

Nevins, Andrew. 2007. The representation of third person and its consequences for person-case effects. *Natural Language and Linguistic Theory* 25:273–313.

Shlonsky, Ur. 1997. *Clause structure and word order in Hebrew and Arabic*. Oxford: Oxford University Press.

Walkow, Martin. 2012. Goals, big and small. Doctoral Dissertation, University of Massachusetts Amherst.

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