Monotonicity as a Third Factor in Syntax and Morphology

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Take-home message

Descriptive observation: Monotonicity beyond semantics

- Monotonicity shows up **a lot** across linguistics domains.
- Monotonicity ties together seemingly unrelated phenomena.

A bigger picture

- Monotonicity as a third factor
- Applying third factors directly to data

Take-home message

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A bigger picture

- Monotonicity as a third factor
- Applying third factors directly to data

Third factors as an analytical tool

Phenomenon

A

B

C

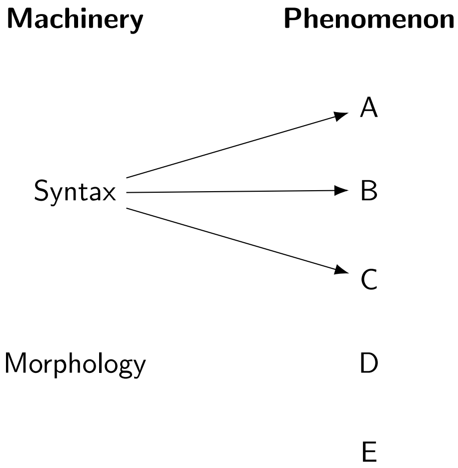
D

E

Third factors as an analytical tool

Machinery	Phenomenon
	A
Syntax	B
	C
Morphology	D
	E

Third factors as an analytical tool



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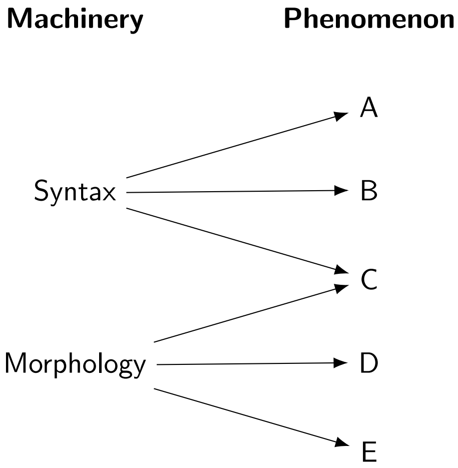

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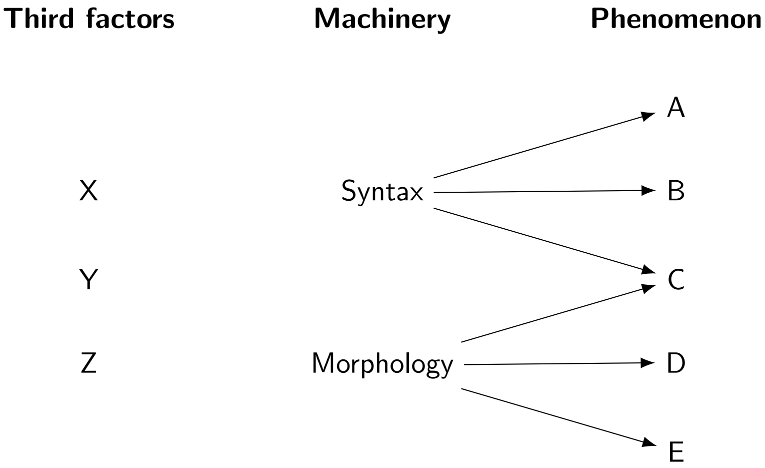

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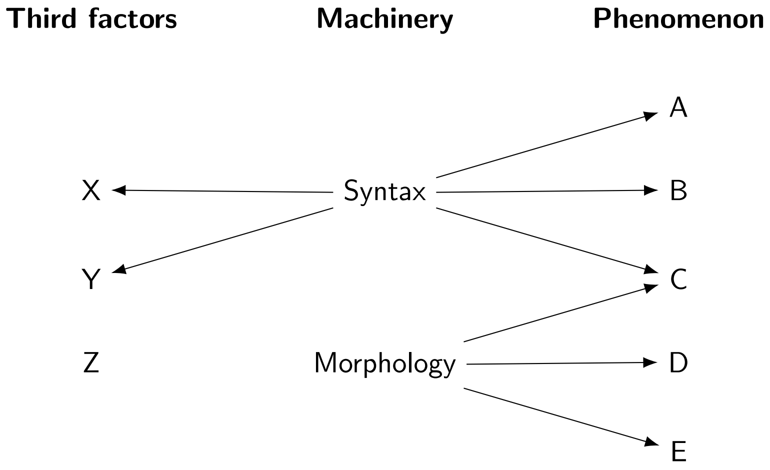

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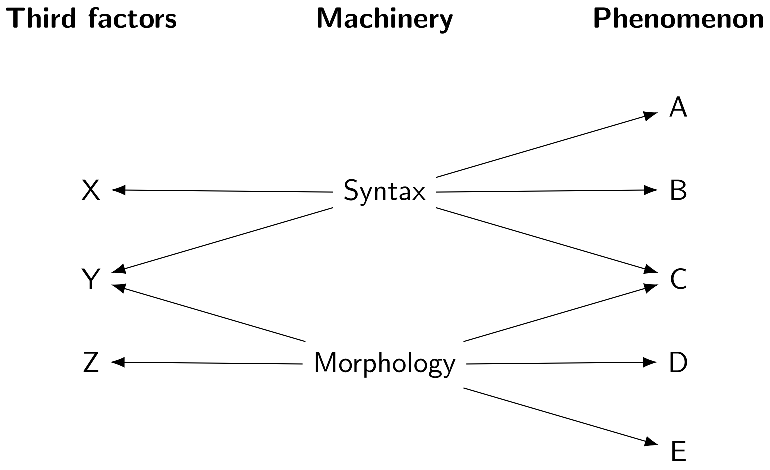

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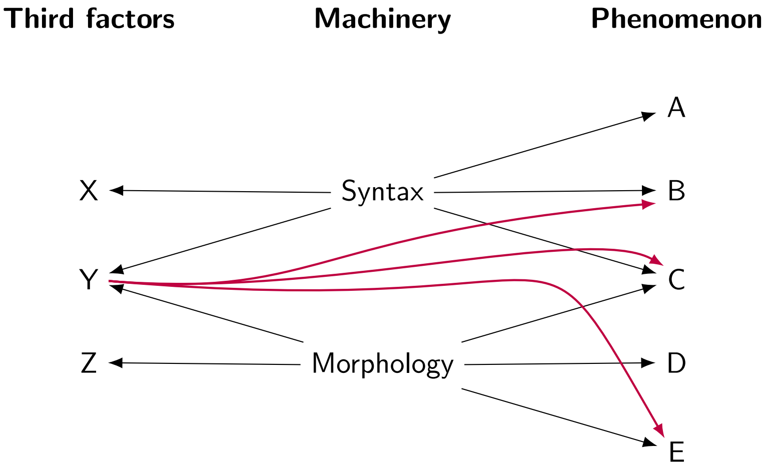

Outline

1. Monotonicity: what and why?

2. Monotonicity in morphology and morphosyntax
   - Adjectival gradation and person pronoun syncretism
   - Tense syncretism
   - Person Case Constraint & Gender Case Constraint
   - Omnivorous number

3. Monotonicity in syntax
   - Expletive negation and 3/4 splits
   - Ban against improper movement
   - Corollary: Ban against improper selection
   - Order preservation in Fox & Pesetsky (2005)
   - Freezing effects

Monotonicity

Definition (Monotonicity)

- Let $\mathbf{A}$ and $\mathbf{B}$ be two sets with orders $\leq_{\mathbf{A}}$ and $\leq_{\mathbf{B}}$, respectively.
- A function f from $\mathbf{A}$ to $\mathbf{B}$ is **monotonic**(ally increasing) iff

$$x \leq_{\mathbf{A}} y \Rightarrow \mathsf{f}(x) \leq_{\mathbf{B}} \mathsf{f}(y)$$

- Monotonicity is similar to **No Crossing Branches** constraint.

1	2	3
A	B	C

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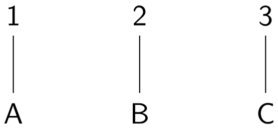

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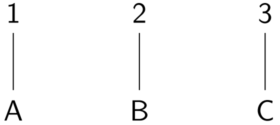

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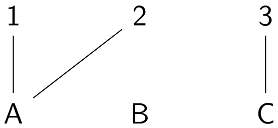

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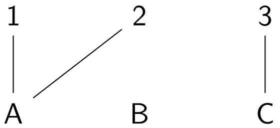

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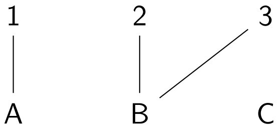

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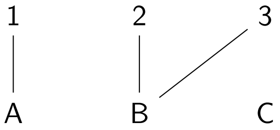

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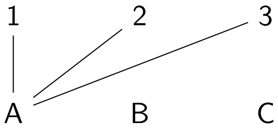

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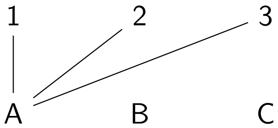

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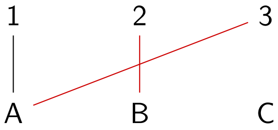


Monotonicity as a third factor

- Why should monotonicity be a third factor? **Learnability!**
- In mathematical learning theory,
  monotonicity provides safe and efficient inference.
  (cf. Jeff Heinz's MIT mini course)
- Modeling-based work shows similar trend
  (Carcassi et al. 2021)
- Cognition in general shows trend towards monotonicity
  (Gärdenfors 2000)

*ABA as a special case of monotonicity

*ABA generalization (Bobaljik 2012)

Given an underlying hierarchy $\mathbf{x} < \mathbf{y} < \mathbf{z}$,
$\mathbf{z}$ cannot pattern with $\mathbf{x}$ to the exclusion of $\mathbf{y}$.

Example

- Adjectival gradation: *good — better — goodest
- Pronoun paradigm: *I — you — I (cf. Harbour 2015)

Usually explained via

- containment (Bobaljik 2012)
- feature combinatorics (Bobaljik and Sauerland 2017)

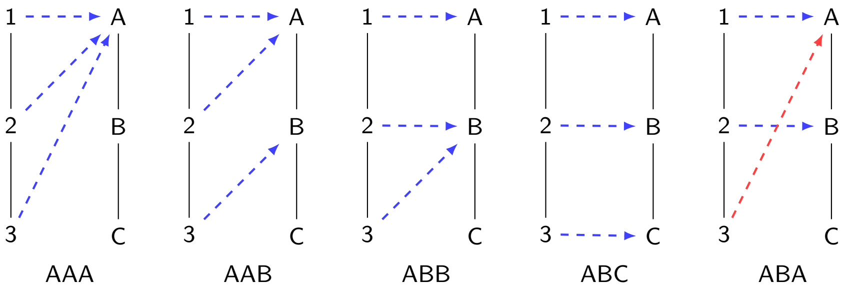
Monotonicity subsumes *ABA

- Monotonicity provides a high-level account that abstracts away from causal mechanisms.
- **General recipe**
  1. Identify a base hierarchy
     (ideally: grounded, non-arbitrary)
  2. Map from hierarchy into another structure
     (surface forms, well-/ill-formed, ...)
  3. Mapping must be monotonic

A corollary of monotonicity

- If $\mathbf{x} \leq \mathbf{y} \leq \mathbf{z}$, then it cannot hold that $f(\mathbf{x}) = f(\mathbf{z}) \neq f(\mathbf{y})$.
- Hence monotonicity enforces *ABA for linear orders.

*ABA for adjectives and pronouns

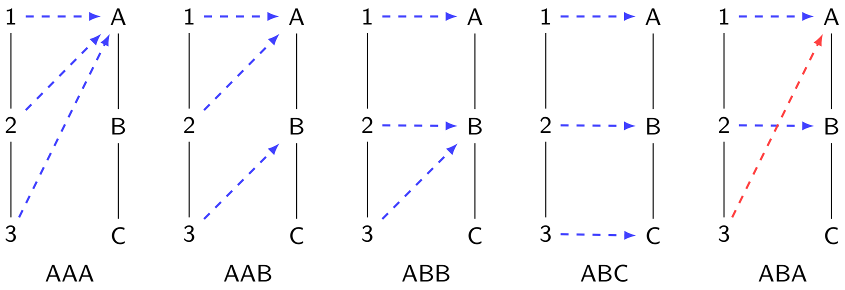


	1	2	3	
adjectives	positive	comparative	superlative	(cf. semantics)
pronouns	1p form	2p form	3p form	(cf. Zwicky 1977)

What about *AAB in adjectival gradation?

Monotonicity carves out general space of options,
grammar may not be able to realize all of them.

*ABA for adjectives and pronouns



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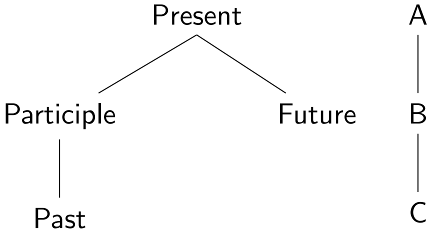
Collateral monotonicity damage in the grammar

- Suppose the mechanism's of the grammar allow us to build
  1. patterns AAA, ABB, ABC via mechanism X,
  2. patterns AAB and ABA via mechanism Y.

Mechanism X	**Mechanism Y**
AAA	AAB
ABB	ABA
ABC	

- Then monotonicity, by virtue discriminating against ABA, pushes the grammar away from mechanism Y.
- The AAB pattern is **collateral damage**.
- **Disclaimer:** Pure speculation; meant to show how monotonicity approach could integrate with grammar approach

Beyond linear orders: *ABA for tense



- **Forbids**:
  present = past ≠ participle
- **Allows**:
  present = participle ≠ future, past
  present = future ≠ participle = past
  present ≠ participle = future ≠ past
- Hierarchy derived from Reichenbach

Sophie Moradi

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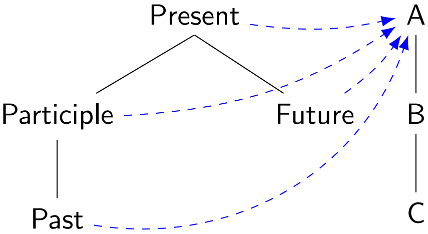

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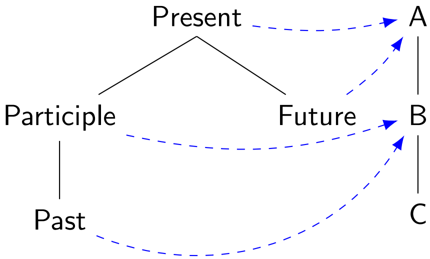

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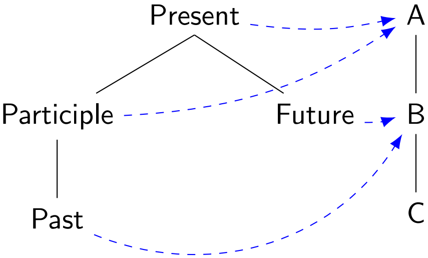

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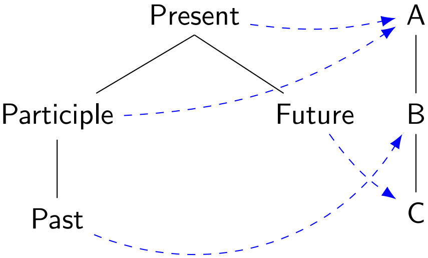

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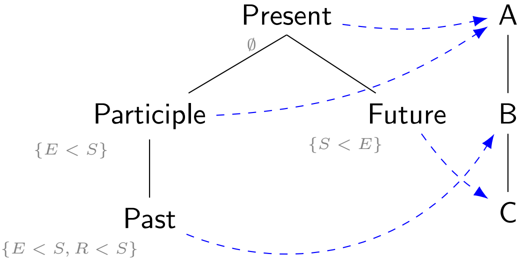

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Person Case Constraint

- Monotonicity handles the attested PCCs, too. (Graf 2019)

Example: Person Case Constraint (PCC; Bonet 1994)

The well-formedness of clitic combinations is contingent on their person specification.

(1)	Roger	*le/*me*	*leur*	a	présenté.
	Roger	3SG.ACC/1SG.ACC	3PL.DAT	has	shown

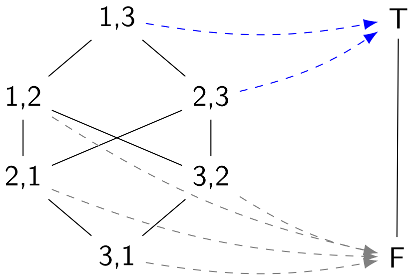
‘Roger has shown me/him to them.’

- Out of 64 conceivable PCC variants, **only 5 are attested**.
- Monotonicity explains why.

The PCC mappings

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

Strong PCC



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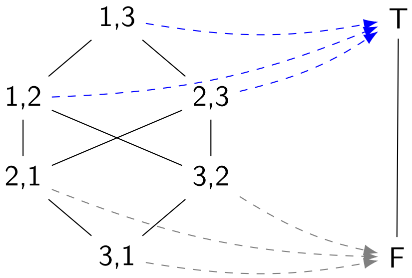
Ultrastrong PCC



The PCC mappings

IO↓/DO→	1	2	3
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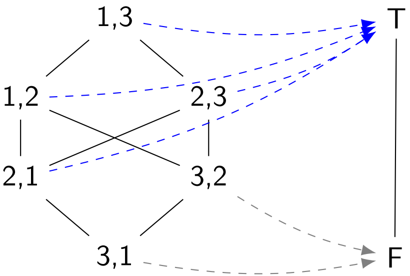
2	✓	NA	✓
3	*	*	NA

Weak PCC



The PCC mappings

IO↓/DO→	1	2	3
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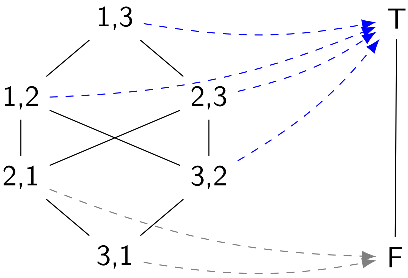
2	*	NA	✓
3	*	✓	NA

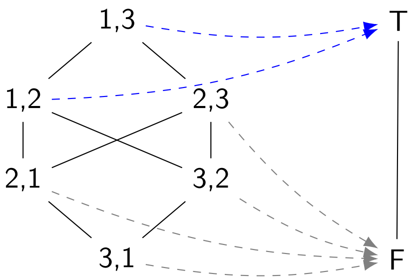
Me-first PCC



The PCC mappings

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

Choctaw PCC (Tyler 2017)



The PCC mappings

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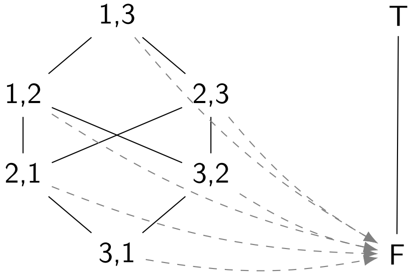
2	*	NA	*
3	*	*	NA

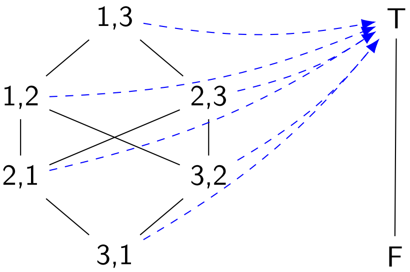
Cairene Arabic (Shlonsky 1997)



The PCC mappings

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

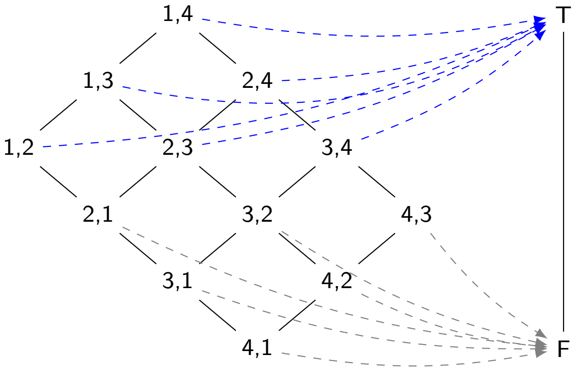
Free combination



Gender Case Constraint

IO↓/DO→	1	2	3	4
1	NA	✓	✓	✓
2	*	NA	✓	✓
3	*	*	NA	✓
4	*	*	*	NA

Zapotec GCC (Foley et al. 2017)



Interim summary

General approach

1. Pick an underlying hierarchy
2. Map to output values (surface forms, grammaticality, ...)
3. Monotonic?

- Monotonicity provides a succinct, unified description of seemingly unrelated phenomena.
- Let's look at one more case that's odd from the standard perspective.

Omnivorous number (Nevins 2011)

- In some languages, verbs agree with **subject and object**
- Some of these languages display **omnivorous number**.

Omnivorous number: $\vee$ for agreement

If subject or object is plural, verbal agreement is plural.

S	**O**	**V**
sg	sg	sg
sg	pl	pl
pl	sg	pl
pl	pl	pl

(2) g- xedav- t
2NDOBJ- saw- PL
Georgian (Nevins 2011:950)

1. I saw y'all
2. We saw you
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A curious typological gap...

Unattested: $\wedge$ for agreement

If subject or object is singular, verbal agreement is singular.

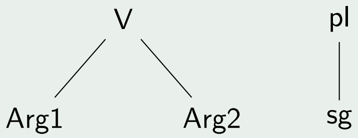
S	O	V
sg	sg	sg
sg	pl	sg
pl	sg	sg
pl	pl	pl

- Syntactic explanations of this fact exist.
- They make omnivorous number look special.

The monotonicity perspective

- both arguments must receive number before V does
- but number values of arguments are independent of each other

Monotonicity + agreement order = Omnivorous number



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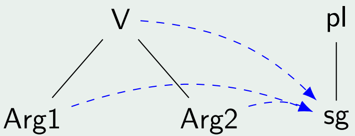

Uniform agreement

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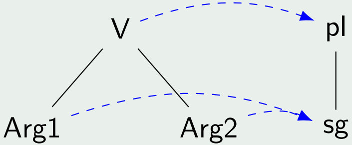

Unattested?

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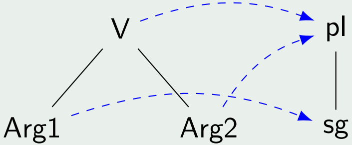

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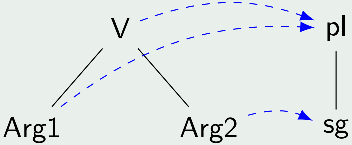
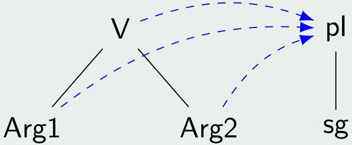


Omnivorous number

The monotonicity perspective

- both arguments must receive number before V does
- but number values of arguments are independent of each other

Monotonicity + agreement order = Omnivorous number

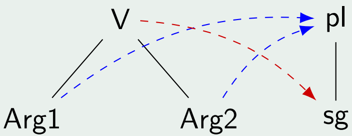


Uniform agreement

The monotonicity perspective

- both arguments must receive number before V does
- but number values of arguments are independent of each other

Monotonicity + agreement order = Omnivorous number



Impossible

But what if. . . ?

- We could have used the **dual** of one of those hierarchies.
- We could we have replaced monotonicity with **antitonicity**.
- Either one allows for $\wedge$-agreement.

What this approach is about

- Correct, we could have done things differently.
- The point is not that $\vee$-agreement is more natural than $\wedge$-agreement.
- But monotonicity predicts that it is impossible to have both.
- Since $\vee$-agreement exists, $\wedge$-agreement is ruled out.

Venturing into syntax: Expletive negation and 3/4 splits

- Typology often reveals **3/4 splits**:
  out of 4 conceivable options, only 3 are found.
- Those could all be instances of monotonicity.

Expletive negation

(3) Bevor die Lage sich **nicht** entspannt, können wir nicht reisen.
before the situation SE not improves, can we not travel
'We can't travel until the situation improves.'

Languages may allow expletive negation

1. not at all,
2. only with T[+fin],
3. with T[+fin] and T[-fin].

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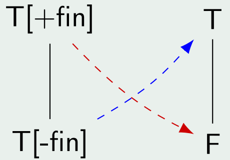

A-movement and A′-movement

- **A-movement phenomena**

(4) a. John was attacked t.
    b. John seems t to have t cut the carrot.

- **A′-movement phenomena**

(5) a. This girl, John thinks that Mary likes t.
    b. Who does John think t might t cut the carrot?

Ban Against Improper Movement

Once a phrase undergoes A′-movement,
it can no longer undergo A-movement.
(But: possible exception in Brazilian Portuguese; Kobayashi 2020)

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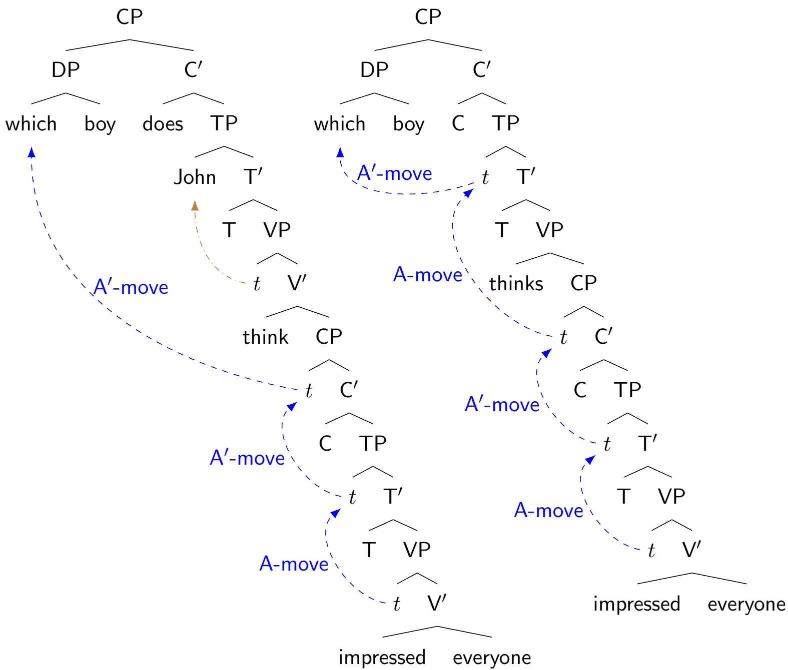
CP
DP
C′
which
boy
does
TP
John
T′
T
VP
t
V′
think
CP
t
C′
C
TP
t
T′
T
VP
t
V′
impressed
everyone
A′-move
A′-move
A-move
CP
DP
C′
which
boy
C
TP
t
T′
T
VP
thinks
CP
t
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A-move

Why should there be a ban against improper movement?

- Formalisms vary in how they derive this ban.
- They usually require extra stipulations.
- We can derive it from monotonicity.

Monotonicity + locality = Ban Against Improper Movement

Locality hierarchy: A-move $<$ A′-move

Derivation:

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Monotonicity + locality = Ban Against Improper Movement

Locality hierarchy: A-move $<$ A′-move

Derivation: Step 1 $<$ Step 2 $<$ Step 3 $<$ Step 4

A welcome corollary: Ban Against Improper Selection

- Selection combines heads with their arguments.
- Selection is even more local than A-movement:

$$\text{Select} \quad < \quad \text{A-move} \quad < \quad \text{A}'\text{-move}$$

- **Corollary:**
  Once a phrase undergoes any movement, it can no longer select an argument or be selected as an argument.
- This is widely considered to be the case.
  (But: Late Merge of arguments;Takahashi and Hulsey 2009; Stanton 2016)

Williams Cycle

General definition (paraphrasing Williams 1974)

- Assume some fixed order $<$ of heads. For example:

$$\mathsf{V} < v < \mathsf{T} < \mathsf{C}$$

- If a phrase resides in in Spec,**X**P, then it cannot move to any Spec,**Y**P such that **Y** $<$ **X**.

Monotonicity + head order = Williams Cycle

Head hierarchy: $\mathsf{V} < v < \mathsf{T} < \mathsf{C}$

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Head hierarchy: $\mathsf{V} < v < \mathsf{T} < \mathsf{C}$

Derivation: Step 1 $<$ Step 2 $<$ Step 3 $<$ Step 4

Ban Against Improper Case

A constraint on Dependent Case Theory (Poole 2018)

- Assume some fixed order $<$ of syntactic positions.
- NP in position **X** cannot license case on NP in position **Y** if there is some position **Z** such that
  1. **Z** occurs between **X** and **Y**, and
  2. **X** $<$ **Z**

Example

(6) $[_{\text{TP}}$ John $[_{v\text{P}}$ told $[_{\text{VP}}$ Mary $[_{\text{CP}}$ that $[_{\text{TP}}$ Bill had left$]]]]]$.

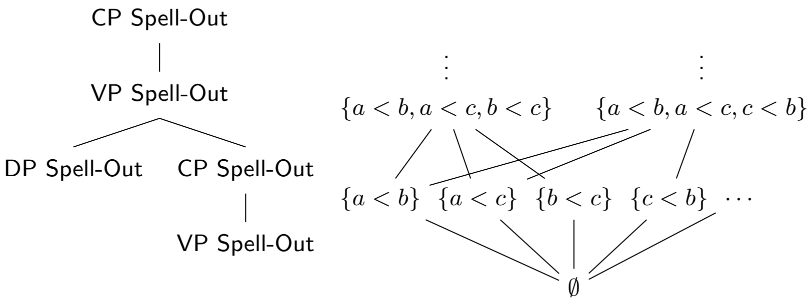
1. *Mary* licensed by *John*: V $<$ v $<$ T
2. **Bill* licensed by *Mary*: T $<$ C $<$ V

Order preservation in Fox and Pesetsky (2005)

System in a nutshell

1. When phase completed, determine ordering statements $(a < b)$ between nodes
2. New ordering statements must not contradict old ones.

Formally:
Monotonic map from Spell-Outs to sets of ordering statements



Freezing effects

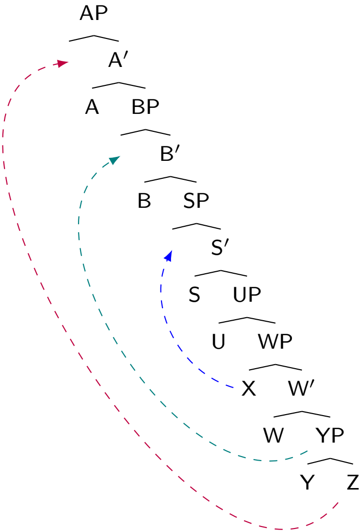
General observation

- A phrase cannot be extracted from a containing phrase that has already undergone movement.
- **But:** you can escape by moving out first.

Intuitive solution

- Two phases in "life" of a head/phrase
  1. Merge phase
  2. Move phase
- Two orderings connected via monotonicity:
  1. relative prominence established by Merge
  2. relative order in which heads transition into Move phase

An abstract freezing example



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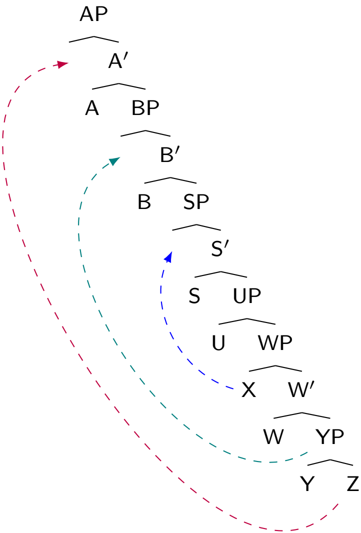

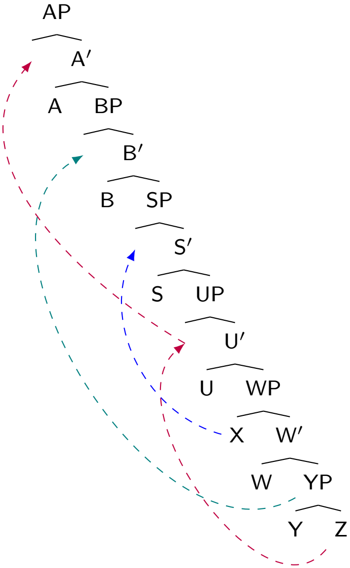

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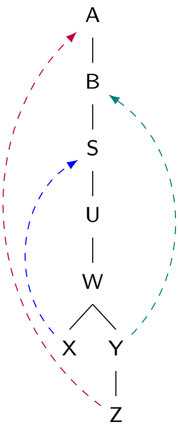

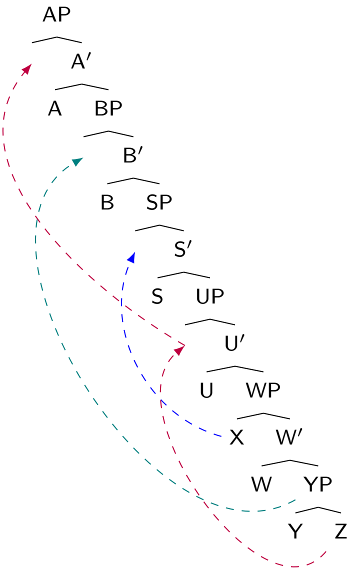

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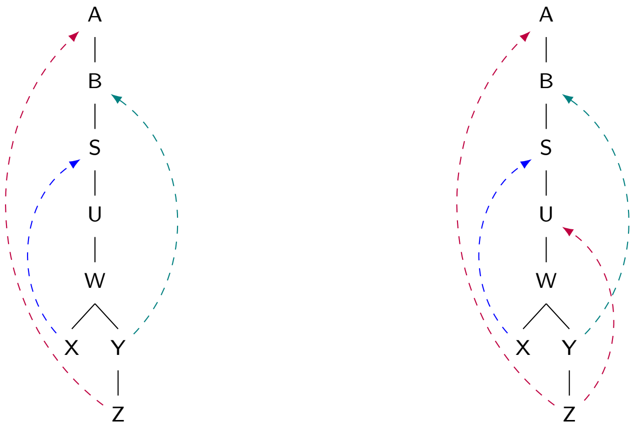

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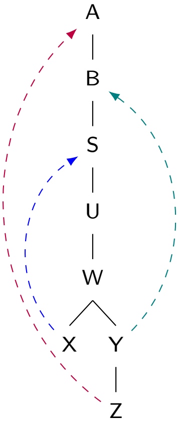

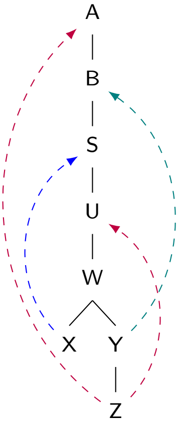

Move transition: X < Y < Z

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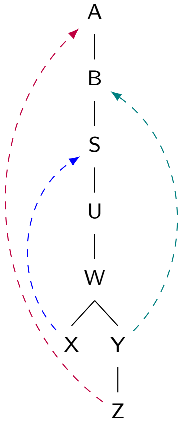

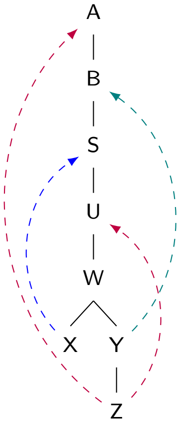

Move transition: X $<$ Y $<$ Z

Move transition: Z $<$ X $<$ Y

Monotonicity in morphology

- Adjectival gradation (Graf 2019)
- Pronoun syncretism (Graf 2019)
- Case syncretism (Graf 2019)
- Case stem syncretism (Graf 2019)
- Tense syncretism (Sophie Moradi's thesis)
- Resolved gender agreement (Sophie Moradi's thesis)
- Person-number syncretism (Sophie Moradi's thesis)
- Inverse marking (Sophie Moradi, in progress)

Monotonicity in syntax

- Ban Against Improper Movement/Selection
- Williams Cycle
- Ban Against Improper Case
- Omnivorous number
- Person Case Constraint (Graf 2019)
- Gender Case Constraint (Graf 2019)
- Adjunct Island Constraint (appendix; Graf 2013)
- Coordinate Structure Constraint (appendix)
- Keenan-Comrie hierarchy (by definition)
- Freezing effects

Conclusion

- Monotonicity goes beyond semantics
- Unified perspective on seemingly unrelated phenomena

The general approach

linguistically motivated hierarchies + monotonicity = bingo

The road ahead: From cute idea to research program

- proper theory of what is a possible hierarchy
- dealing with exceptions
- phenomena that do not care about monotonicity at all

Acknowledgments

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Appendix

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