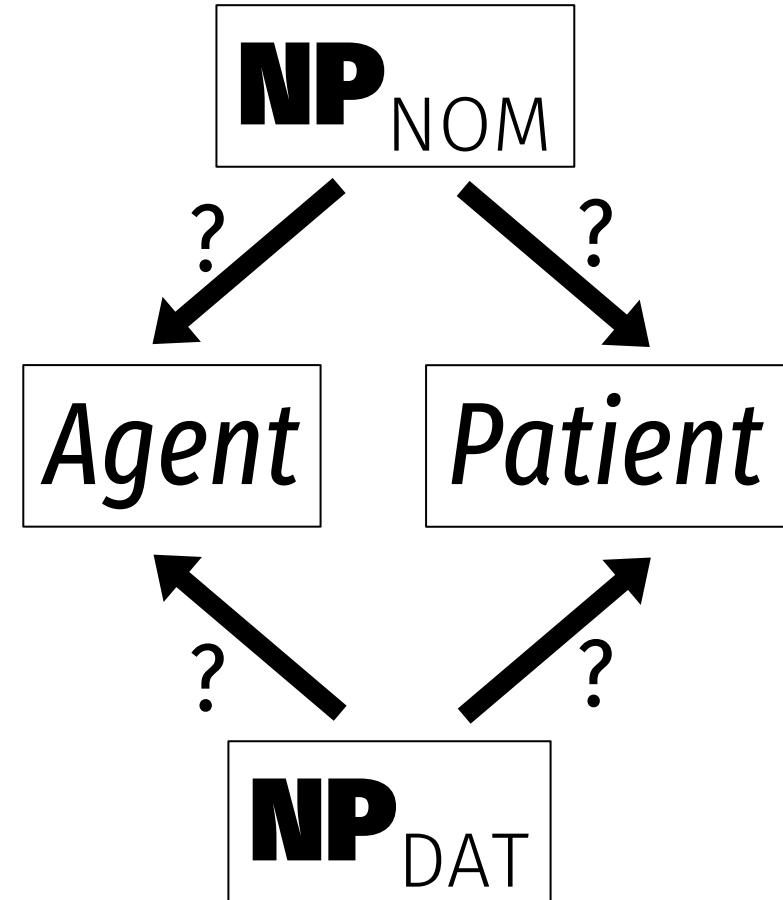


Comprehending ambiguous cues to thematic role in Georgian

Steven Foley (University of Southern California)

Johns Hopkins Linguistics Colloquium – April 2, 2024

<https://tinyurl.com/foleyJHU>



1.1 Introduction

What topics interest me?

- Nature of, origin of, and limits on grammatical complexity
- Syntax, morphology, typology, and psycholinguistics
- Georgian (Shanidze 1953, Harris 1981, Aronson 1990)

Methodological & theoretical versatility

- Formal theory, fieldwork, corpus research, experimental methods
- Experimentation–fieldwork continuum (Davidson 2020)



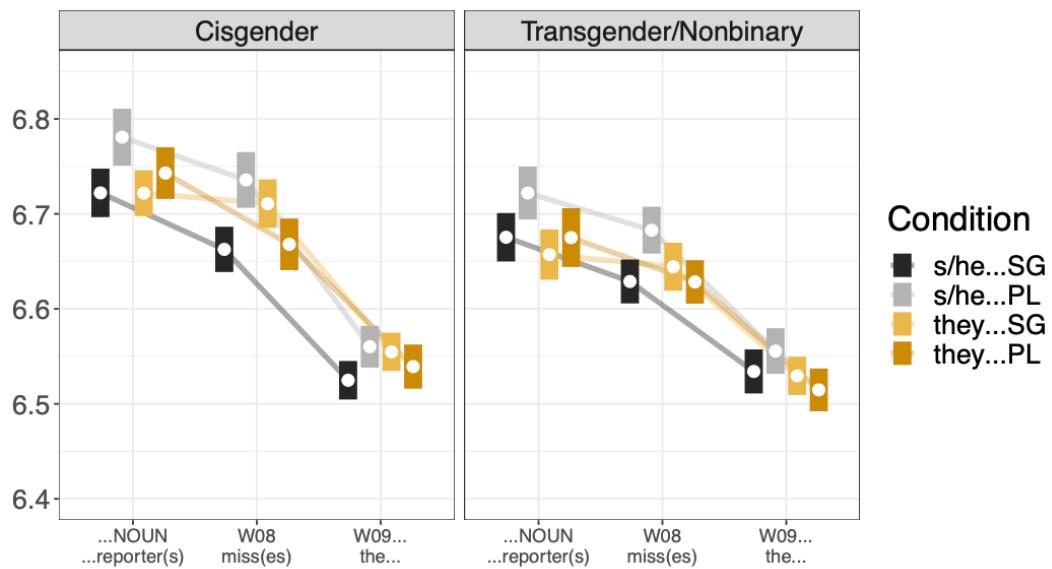
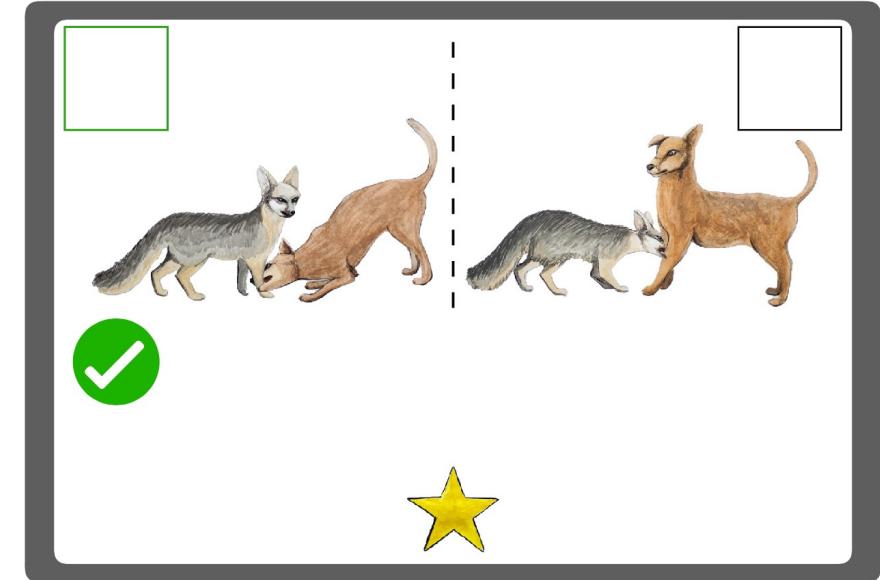
1.1 Introduction

Santiago Laxopa Zapotec (Oto-Manguean, Mexico)

- Syntax of weak-pronoun movement and animacy (Foley & Toosarvandani 2022)
- Field-psycholinguistics visual-world study on relative-clause processing (Foley et al. 2019)

Singular *they* in North American English

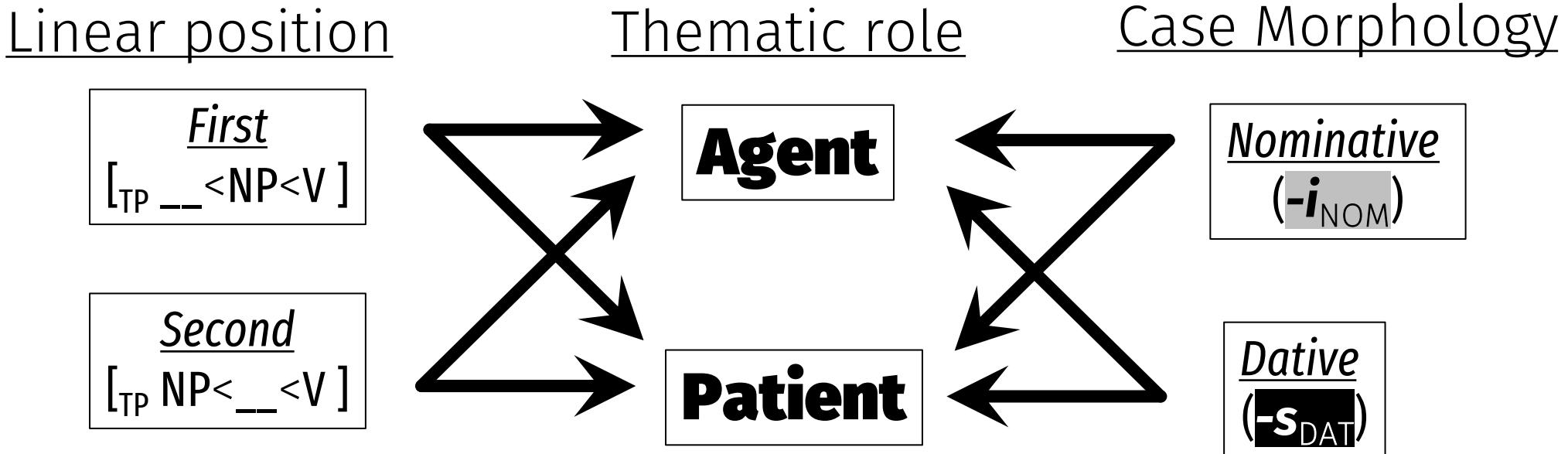
- Cataphora as a lens into socio-psycholinguistic variation (Foley & Ahn submitted)



1.2 Today's talk

Zoom into a sentence-processing puzzle in Georgian

- Free word order & complex case morphology can make θ -roles temporarily ambiguous
- What disambiguating cues (on clause-final verbs) are hard to process, and why?



1.2 Today's talk

Present novel reading-time evidence (Foley submitted)

- **Case-Order Interaction**
 - Noncanonical word order (patient first) is only hard to process given noncanonical case marking (“inverse”, with dative agent) – and vice versa (cf. Skopeteas et al. 2011)
 - Subliminal to speakers, and not straightforwardly reflected in corpus frequencies

Condition	Word order	Case Pattern	RT of Verb
$\text{NP}_{\text{NOM}} < \text{NP}_{\text{DAT}} < \text{Verb}_{\text{T.DIR}}$	$\text{AGT} < \text{PAT}$	Direct ($\text{AGT} = -i_{\text{NOM}}$)	faster 
$\text{NP}_{\text{DAT}} < \text{NP}_{\text{NOM}} < \text{Verb}_{\text{T.DIR}}$	$\text{PAT} < \text{AGT}$		faster 
$\text{NP}_{\text{DAT}} < \text{NP}_{\text{NOM}} < \text{Verb}_{\text{T.INV}}$	$\text{AGT} < \text{PAT}$	Inverse ($\text{AGT} = -s_{\text{DAT}}$)	faster 
$\text{NP}_{\text{NOM}} < \text{NP}_{\text{DAT}} < \text{Verb}_{\text{T.INV}}$	$\text{PAT} < \text{AGT}$		slower 

1.2 Today's talk

Discuss interpretations and ramifications

- Crosslinguistic AGT-first preference must be qualified. Grammar-dependent interaction of prominence scales? (eADM; Bornkessel-Schlesewsky & Schlesewsky 2014)
- Soft/subliminal costs to representations violating Relativized Minimality (Rizzi 1990)
- Insights into grammar and sentence processing only observable in a language like Georgian

Roadmap

1. Introduction

2. Processing thematic roles

3. Primer on Georgian

4. Reading-time study

5. Theoretical perspectives

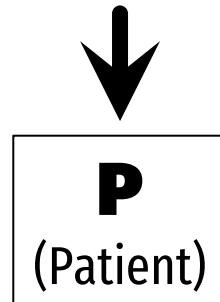
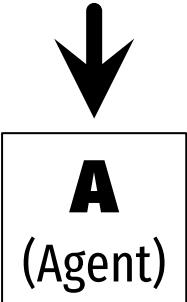
6. Conclusion

2.1 Comprehending thematic roles

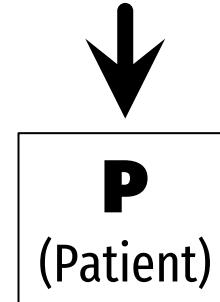
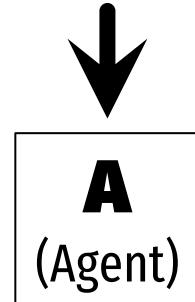
Sentences are processed quickly, incrementally, & actively (e.g. Ferreira & Qiu 2021). Key is identifying **who did what to whom**.



The fox is biting the dog



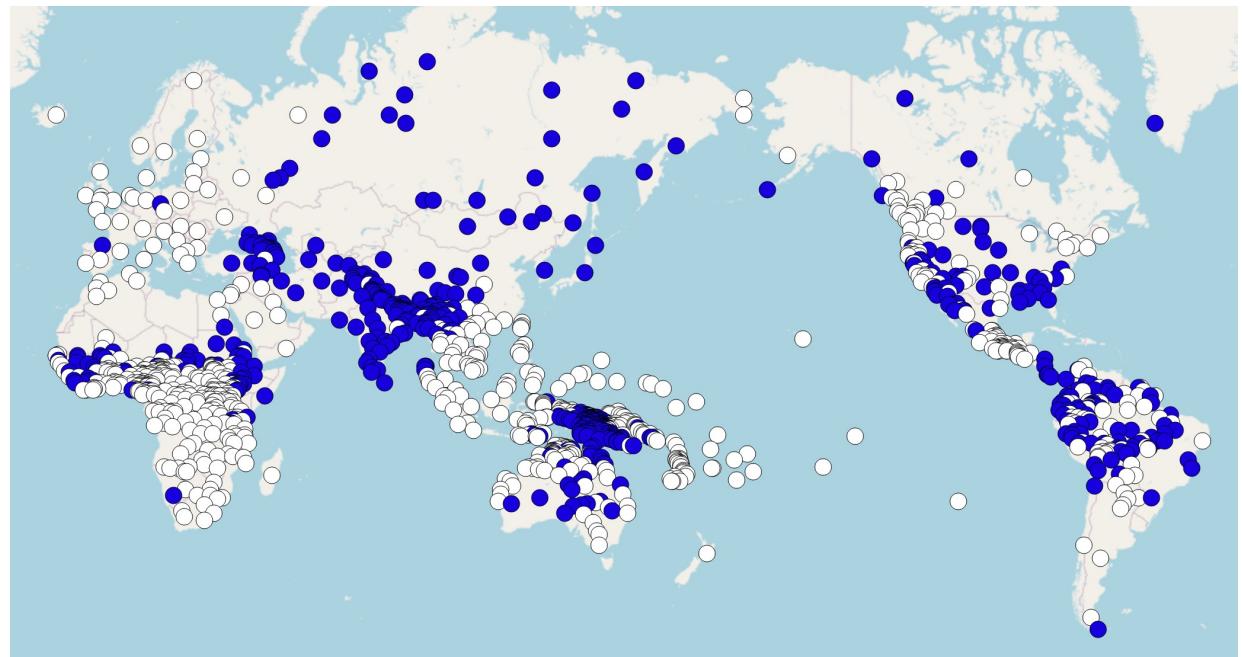
The dog is biting the fox



2.2 Cues influencing θ-processing

The verb

- Verbal lexical semantics are at the heart of the meaning of the conceptualized event.
- Yet, **verb-final word order** is ubiquitous across languages!
 - Blue dot = Verb-final
 - White dot = V-initial or V-medial

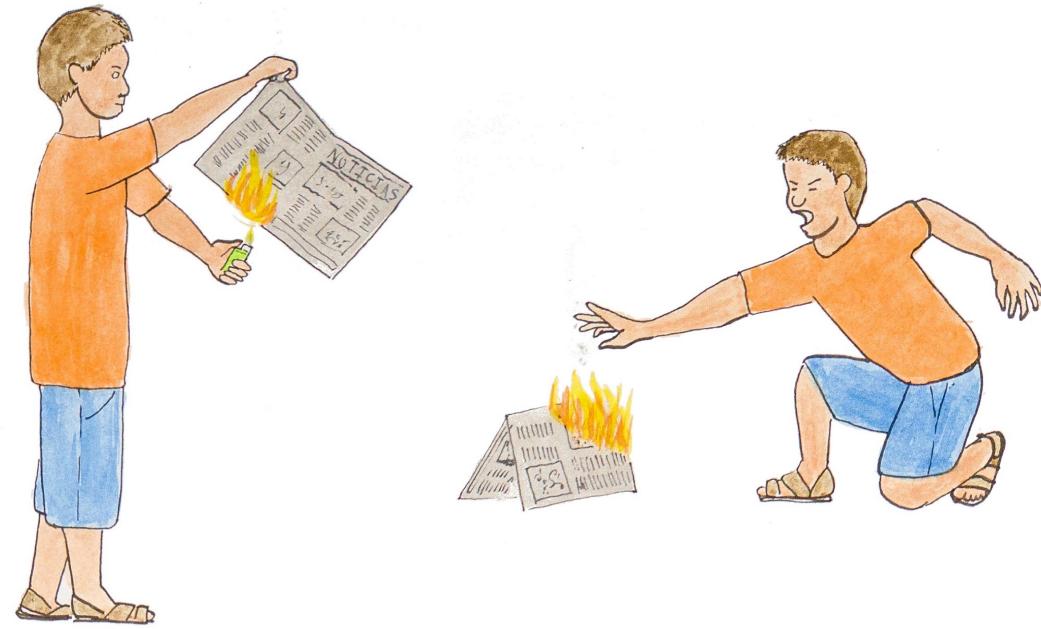


(WALS, Ch 81; Dryer & Haspelmath 2013)

2.2 Cues influencing θ-processing

Real-world knowledge

- Inanimates are noncanonical agents (e.g. Dowty 1991)
- And preverbal evidence of **A_{INAN}** impedes processing in many languages (Bornkessel-Schlesewsky & Schlesewsky 2014)



... “The boy the paper...”

2.2 Cues influencing θ -processing

Word order

- In some languages, the *only* grammatical word order is **A<P**. In others, it's flexible.
- But even in flexible languages, there's often an **A-initial preference** (e.g. German: Bader & Meng 1999; Turkish: Demiral et al. 2008; Chamorro: Wagers et al. 2015)
- Rooted deeply in cognition (Saupe 2023)? But possibly not universal (e.g. Kaqchikel Mayan: Koizumi et al. 2014)

Lg where word order is...	Odds of NP1's θ -role	Cue Utility
Strict	$p(\mathbf{A} 1\text{st}) \approx 1$ $p(\mathbf{P} 1\text{st}) \approx 0$	Great
Flexible	$p(\mathbf{A} 1\text{st}) > p(\mathbf{P} 1\text{st})$	Ok
Free	$p(\mathbf{A} 1\text{st}) \approx p(\mathbf{P} 1\text{st})$	Poor

2.2 Cues influencing θ-processing

Case

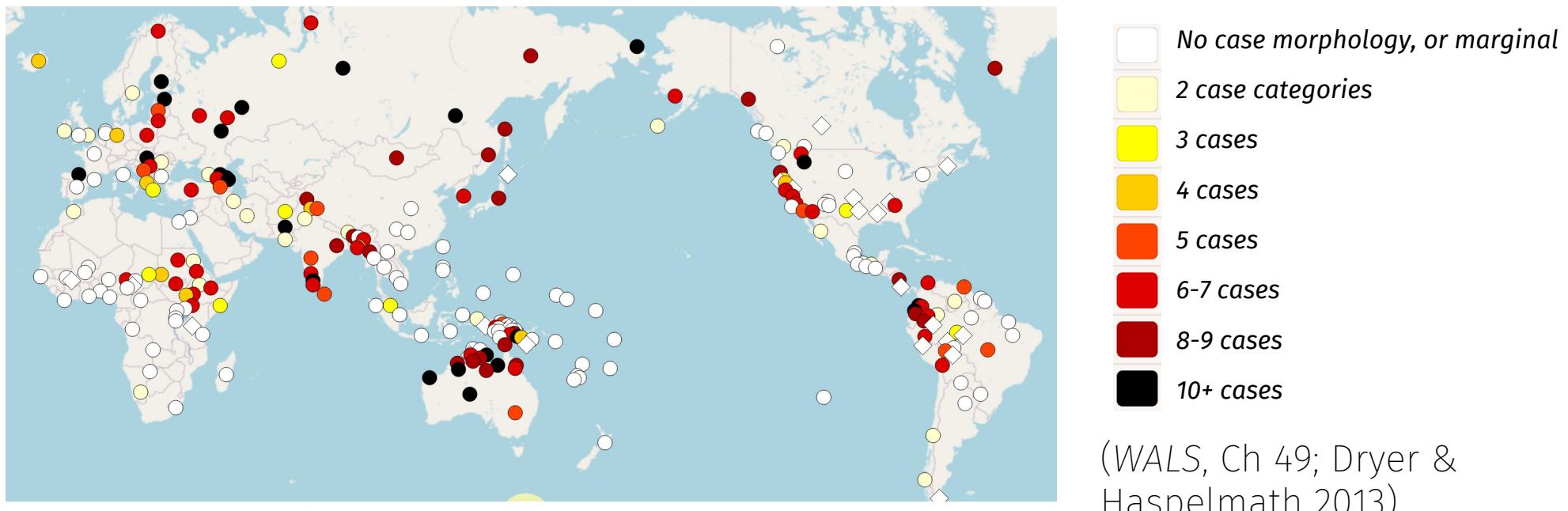
- i.e. nominal morphology determined by syntactic/grammatical factors
- In English, case is only expressed on pronouns.

- (1) **The foxes (A)** are biting **the dogs (P)**
- (2) **They (A)** are biting **them (P)**

2.2 Cues influencing θ -processing

Case

- A major locus of crosslinguistic variation — many diverse patterns, including none at all
- NB: rich case correlates with verb finality! (Greenberg 1963, Bickel et al. 2015)



2.2 Cues influencing θ -processing

Case

- An important cue for comprehension in every language investigated so far
- Affects reading times (Bader & Meng 1999), eye movements (Henry et al. 2017), and neurophysiological responses (Chow et al. 2018)
- Including in children (Arosio et al. 2012, Janssen et al. 2015), heritage speakers (Polinsky 2011), aphasics (Hanne et al. 2015), L2 learners (Frenck-Mestre et al. 2019).

Lg where case is...	Odds of θ -role given case morpheme κ	Cue Utility
Straight-forward	$p(\mathbf{A} \kappa) \approx 1$ $p(\mathbf{P} \kappa) \approx 0$	Great
Complex	$p(\mathbf{A} \kappa) > p(\mathbf{P} \kappa)$	Ok
Sadistic	$p(\mathbf{A} \kappa) \approx p(\mathbf{P} 1st)$	Poor

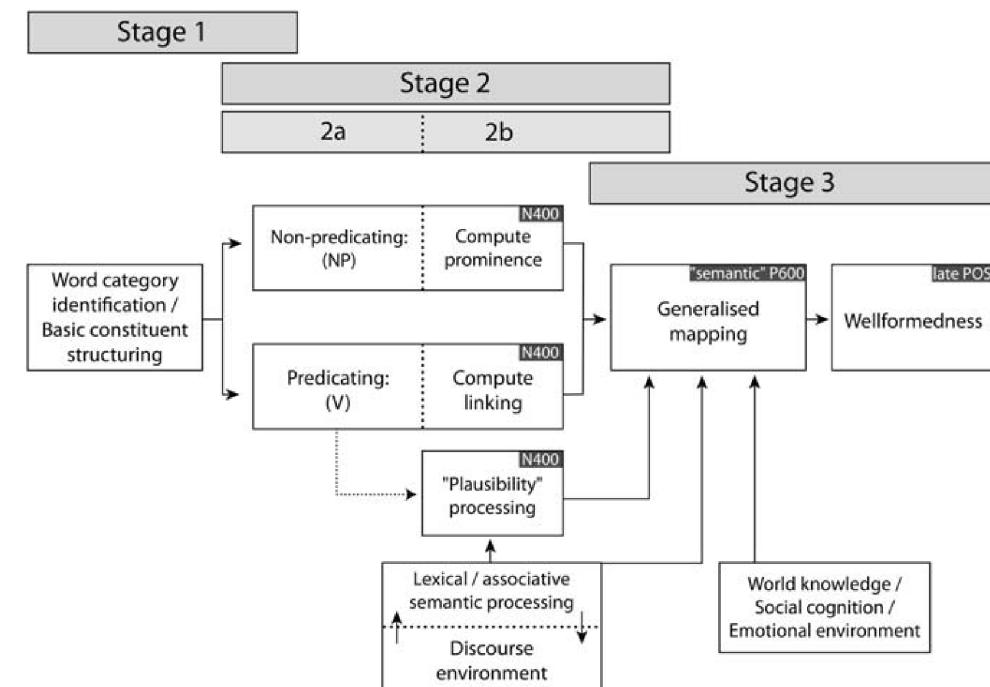
2.3 Towards a language-general theory

A promising framework: eADM

- More & more languages are being studied (Bornkessel-Schlesewsky & Schlesewsky 2009), but widening the empirical net is still imperative (Anand et al. 2011).

Georgian offers a stress test!

- A verb-final language with “sadistic” grammar
- Neither word order nor case is a reliable cue to thematic role



(Bornkessel-Schlesewsky & Schlesewsky 2009)

Roadmap

- ~~1. Introduction~~
- ~~2. Processing thematic roles~~
- 3. Primer on Georgian**
- 4. Reading-time study**
- 5. Theoretical perspectives**
- 6. Conclusion**

3.1 Why Georgian?

Grammar seems gratuitously complex – even maladaptive!

- Typologically: Morphosyntactic classification is controversial (Hewitt 1987, Harris 1990)
- Theoretically: Analysis is challenging (Harris 1981, Marantz 1991, Legate 2008, Nash 2017)
- Psycholinguistically: Comprehension is, somehow, possible (Skopeteas et al. 2011; Foley 2020, submitted; Lau et al. 2022a,b) despite high case–role entropy (Foley 2022)

Yet, speakers are plentiful, tech-literate, and fluent readers

- A goldmine for sentence processing research!

3.2 Georgian case is very complex

Split ergative system conditioned by **tense** (Harris 1985, Nash 2017)

- (Many details will be ignored here!)

(3) *mts'eral-i_{NOM}* *msaxiob-s_{DAT}* *naxavs*
writer-NOM actor-DAT see:T.DIR
“The writer will see the actor”

In the “**Direct**”
Tenses (e.g. future)

A_{NOM} / **P_{DAT}**
≈ **They** will see **them**

(4) *mts'eral-s_{DAT}* *msaxiob-i_{NOM}* *unaxavs*
writer-DAT actor-NOM see:T.INV
“The writer has seen the actor”

In the “**Inverse**”
Tenses (e.g. perfect)

A_{DAT} / **P_{NOM}**
≈ **Them** have seen **they**

3.2 Georgian case is very complex

These two case patterns aren't made equal

- Direct tenses are more frequent, and arguably the grammatical default
- Inverse tenses are fewer, rarer, morphosyntactically marked, and associated with noncanonical transitivity (Hopper & Thompson 1980)

Corpus hits in the GRC (Gippert & Tandashvili 2012):

In the “ Direct ” Tenses (e.g. future)	A _{NOM} / P _{DAT} ≈ They will see them
--	---

3,129,120 hits

In the “ Inverse ” Tenses (e.g. perfect)	A _{DAT} / P _{NOM} ≈ Them have seen they
--	--

718,055 hits

3.3 Georgian word order is flexible

NP arguments often scramble (Vogt 1971, Skopeteas et al. 2009)

- **A<P<V** is the default; **P<A<V** is pragmatically marked. This is true in all tenses.

(5)	<i>mts'eral-i</i> _{NOM}	<i>msaxiob-s</i> _{DAT}	<i>naxavs</i>	A < P < V
	writer-NOM	actor-DAT	see:T.DIR	
	“The writer will see the actor”			T.DIR

(6)	<i>msaxiob-s</i> _{DAT}	<i>mts'eral-i</i> _{NOM}	<i>naxavs</i>	P < A < V
	actor-DAT	writer-NOM	see:T.DIR	
	≈ “The actor, the writer will see”			T.DIR

3.3 Georgian word order is flexible

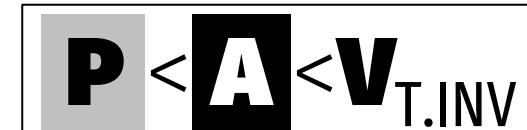
NP arguments often scramble (Vogt 1971, Skopeteas et al. 2009)

- **A<P<V** is the default; **P<A<V** is pragmatically marked. This is true in all tenses.

(7)	<i>mts'eral-s</i> _{DAT}	<i>msaxiob-i</i> _{NOM}	<i>unaxavs</i>
	writer-DAT	actor-NOM	see:T.INV
“The writer has seen the actor”			



(8)	<i>msaxiob-i</i> _{NOM}	<i>mts'eral-s</i> _{DAT}	<i>unaxavs</i>
	actor-NOM	writer-DAT	see:T.INV
≈ “The actor, the writer will see”			



3.4 Order/case frequencies

Corpus frequencies generally reflect grammatical markedness

- GNC hits for transitive verbs following two NPs:

	A<P<V	P<A<V
T.DIR (A_{NOM} / P_{DAT})	44,272	19,995
T.INV (A_{DAT} / P_{NOM})	3,393	3,434

3.5 Summary of key facts

<u>Tense</u>	<u>Marked?</u>	<u>Word Order</u>	<u>Case Pattern</u>	<u>Pseudo-English</u>
Future	Common, Unmarked	Flexible (A<P<V is default)	Direct A _{NOM} / P _{DAT}	They will stop them
Perfect	Rare, Marked		Inverse A _{DAT} / P _{NOM}	Them have stopped they

Roadmap

- ~~1. Introduction~~
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4. Reading-time study

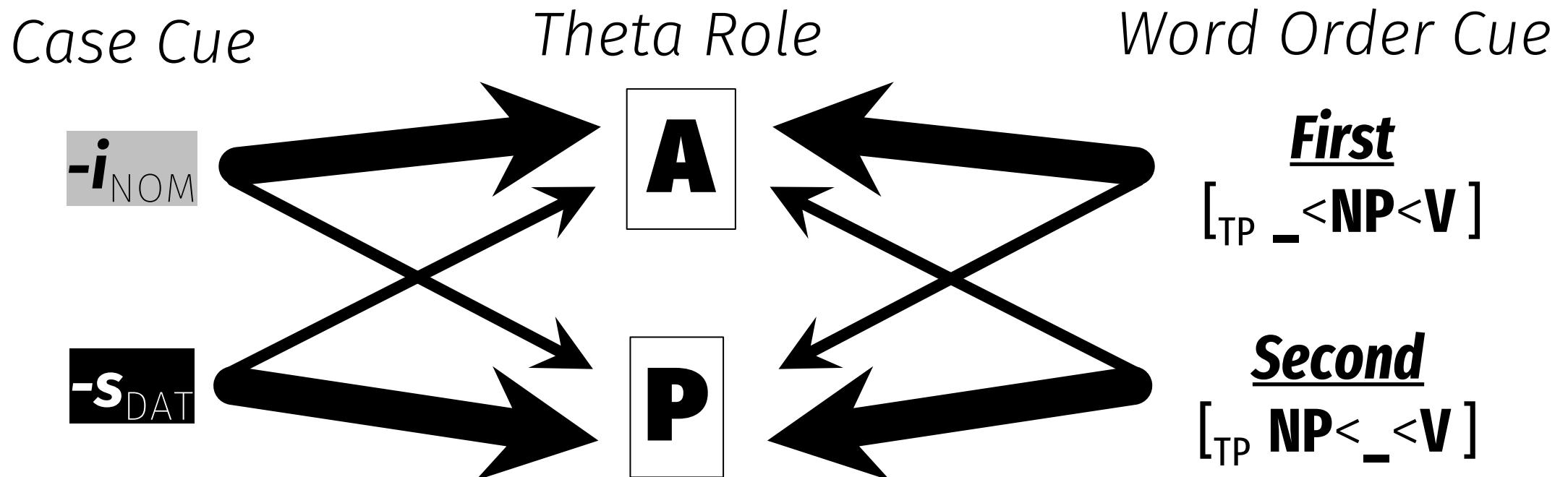
5. Theoretical perspectives

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4.1 The comprehension puzzle

Incremental θ -ambiguities are pervasive in Georgian.

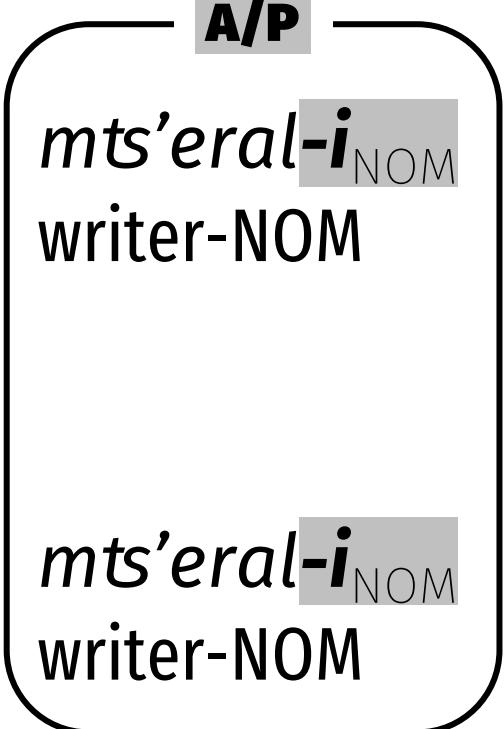
- The crucial disambiguator is verbal morphology, indicating tense.



4.2 Processing word by word

- (9) **A/P**
- mts'eral-i*_{NOM}
writer-NOM
- (10) *mts'eral-i*_{NOM}
writer-NOM

4.2 Processing word by word

- (9) 
mts'eral-i_{NOM}
writer-NOM
- (10) 
msaxiob-s_{DAT}
actor-DAT

4.2 Processing word by word



“The writer will see the actor”



“The writer, the actor has seen”

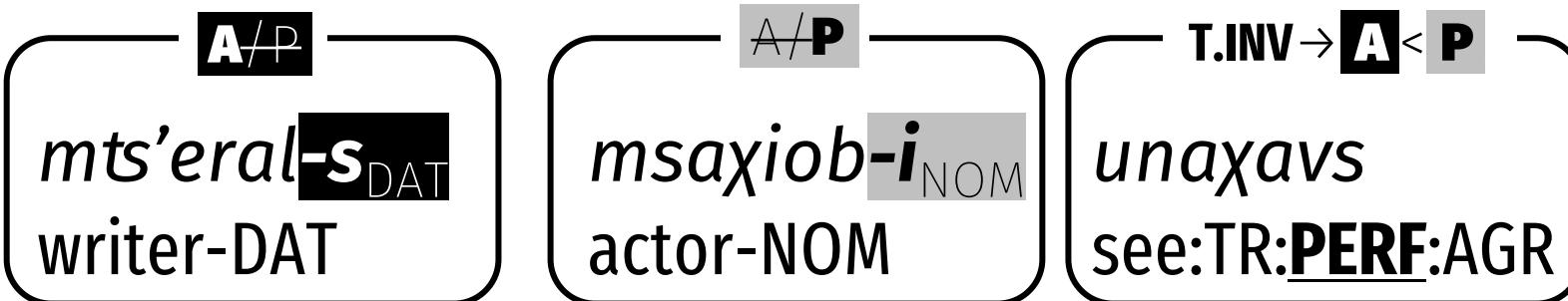
4.2 Processing word by word

- (11) **A/P**
mts'eral-s_{DAT}
writer-DAT
- (12) *mts'eral-s_{DAT}*
writer-DAT

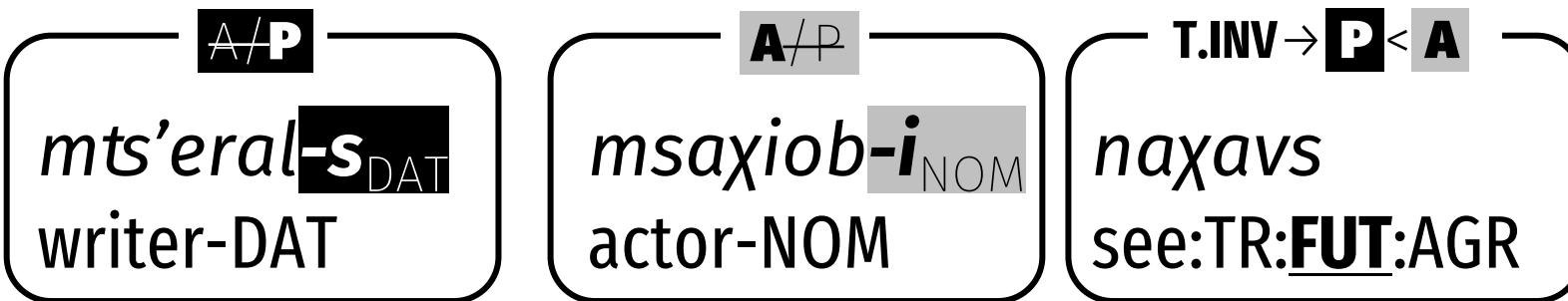
4.2 Processing word by word

- (11) **A/P** *mts'eral-s*_{DAT}
writer-DAT
- (12) **A/P** *msaxiob-i*_{NOM}
actor-NOM
- (11) **A/P** *mts'eral-s*_{DAT}
writer-DAT
- (12) **A/P** *msaxiob-i*_{NOM}
actor-NOM

4.2 Processing word by word

- (11) 
A/P *mts'eral-s*_{DAT}
writer-DAT **A/P** *msaxiob-i*_{NOM}
actor-NOM **T.INV → A < P**
unaxavs
see:TR:**PERF**:AGR

“The writer has seen the actor”

- (12) 
A/P *mts'eral-s*_{DAT}
writer-DAT **A/P** *msaxiob-i*_{NOM}
actor-NOM **T.INV → P < A**
naxavs
see:TR:**FUT**:AGR

“The writer, the actor will see”

4.3 Description of experiment

Guiding questions

- Upon observing combinations of **role-ambiguous** nouns in **-i_{NOM}** and **-s_{DAT}**...
- ...what types of **disambiguations** (i.e. verbal cues) are **easiest** to process, and **why?**

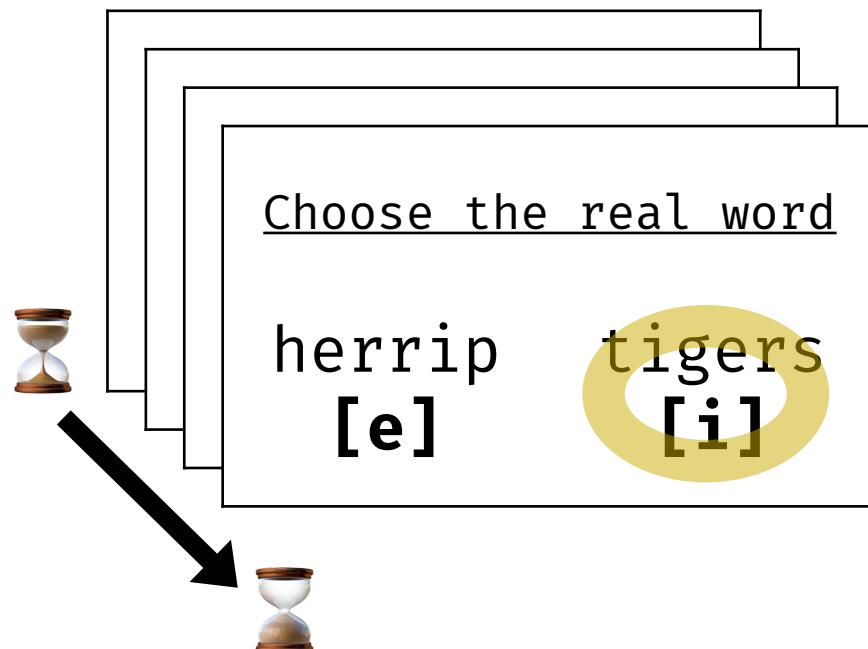
Methods, materials, participants

- **L-Maze** (Freedman & Forster 1985, Boyce et al. 2020); conducted over two sessions on the **internet** via **PClubex** (Zehr & Schwarz 2018); 56 native speakers in Georgia
- **2×2 design**: Order (**A<P<V, P<A<V**) × Case / Tense (**T.DIR, T.INV**); 16+16 itemsets
- What's presented here are subparts of a larger, more complex study (Foley submitted)

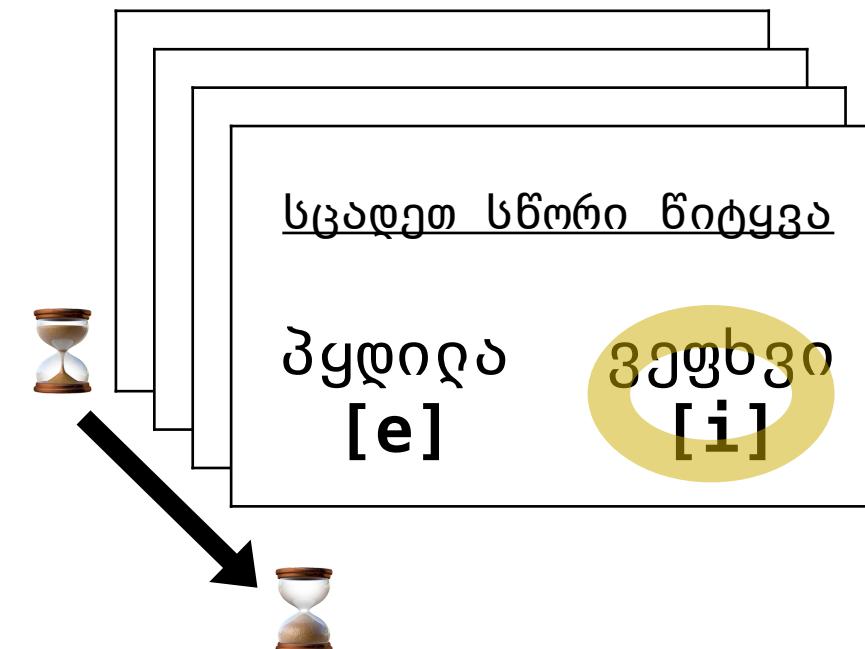
4.4 Lexicality Maze (L-Maze)

Hybrid of self-paced reading and lexical decision task

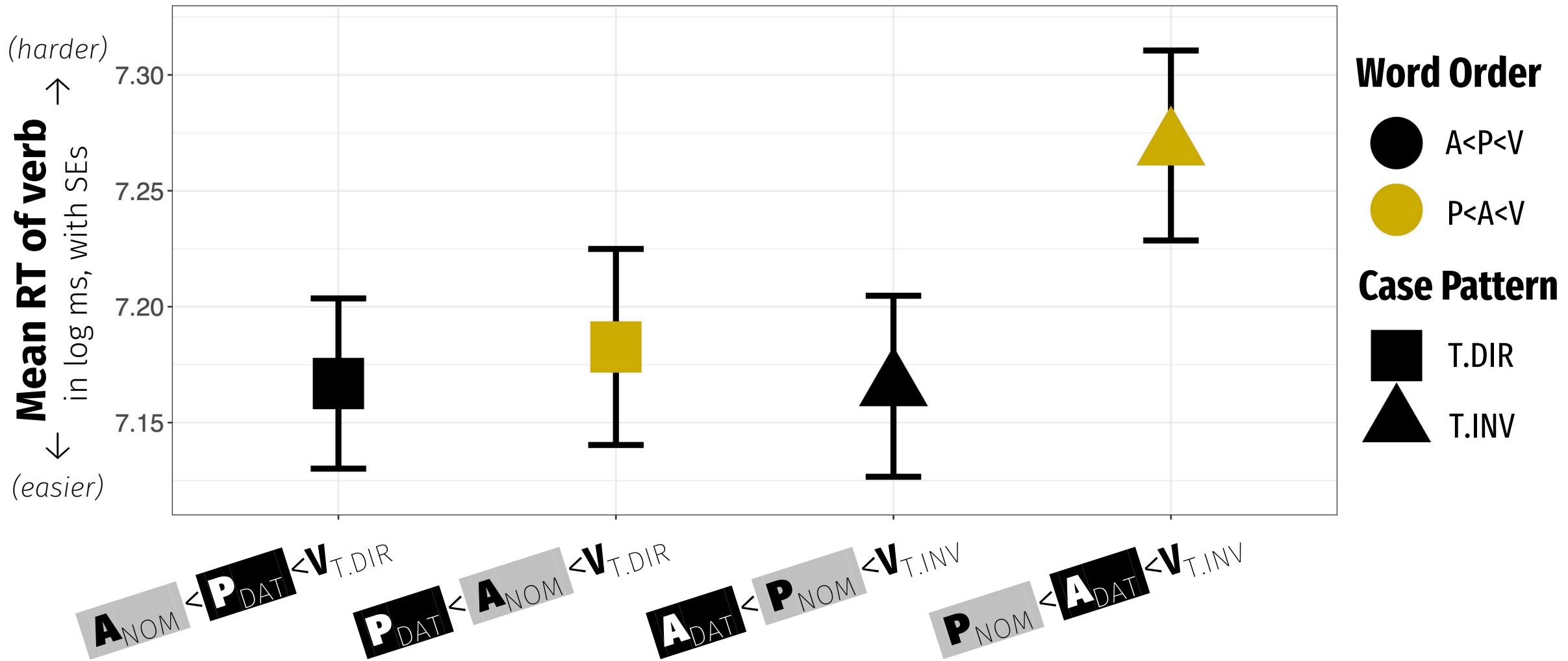
English Mock-Up



Georgian Mock-Up



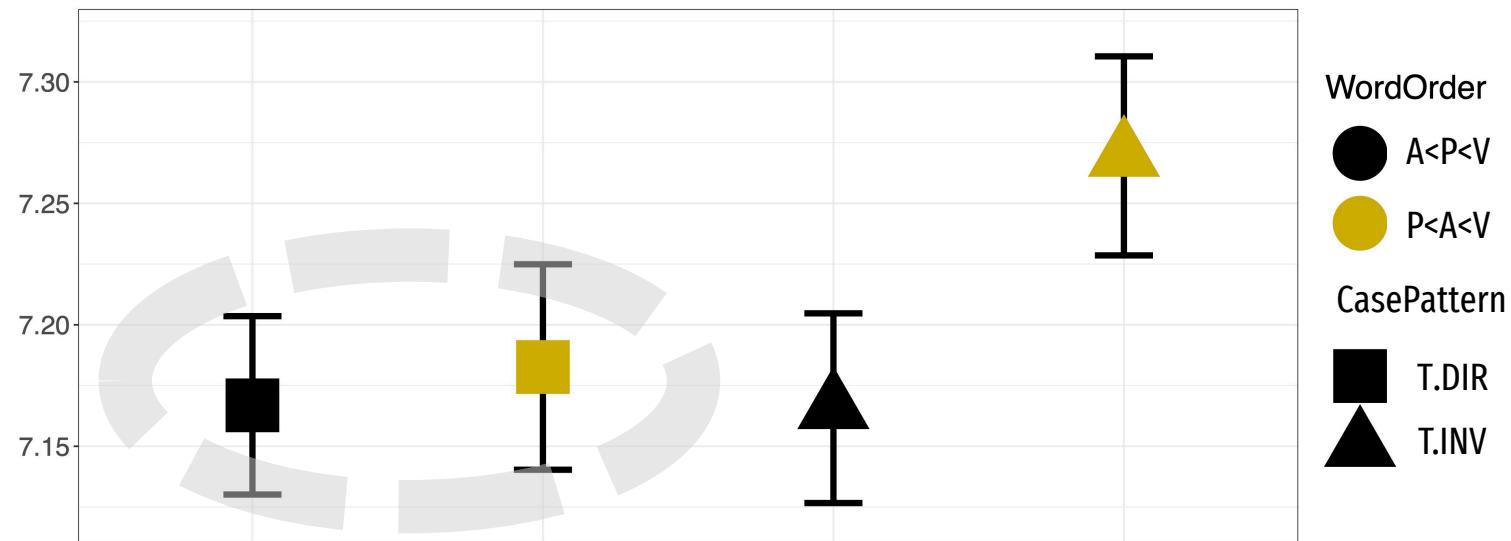
4.5 RTs of disambiguating verbs



4.6 Key finding: Case–Order Interaction

No main effects of Word Order or Case on RTs

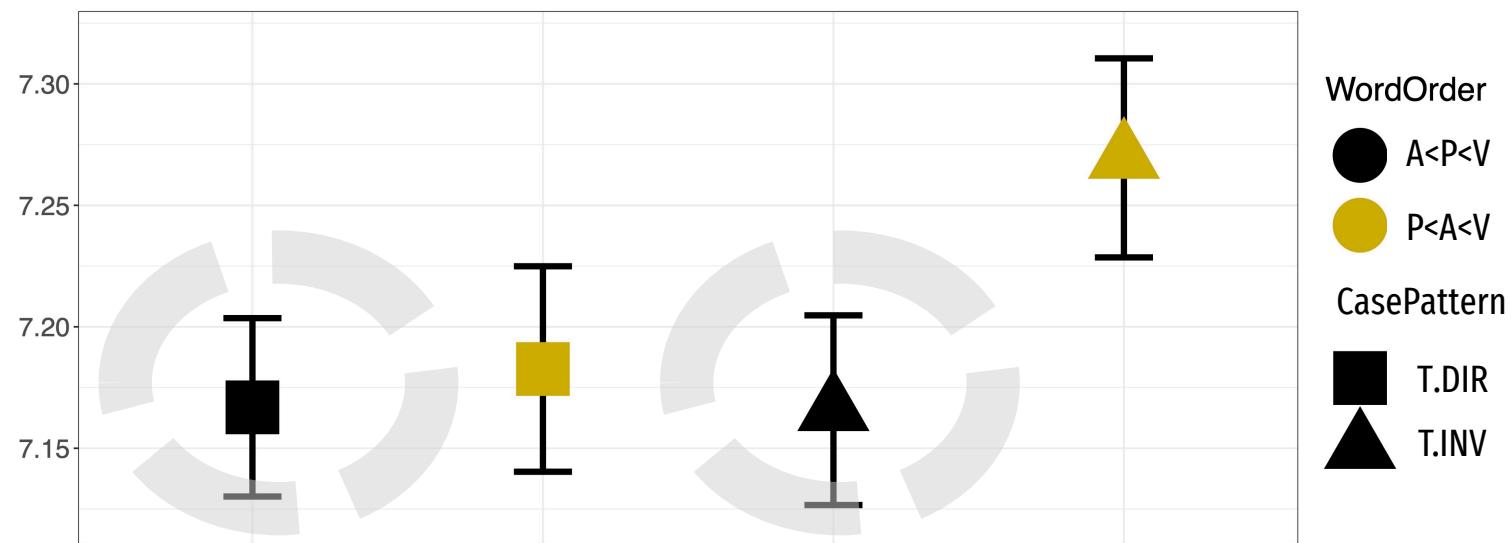
- **Patient-first** order ($P < A < V$) is not inherently difficult relative to agent-first ($A < P < V$)



4.6 Key finding: Case–Order Interaction

No main effects of Word Order or Case on RTs

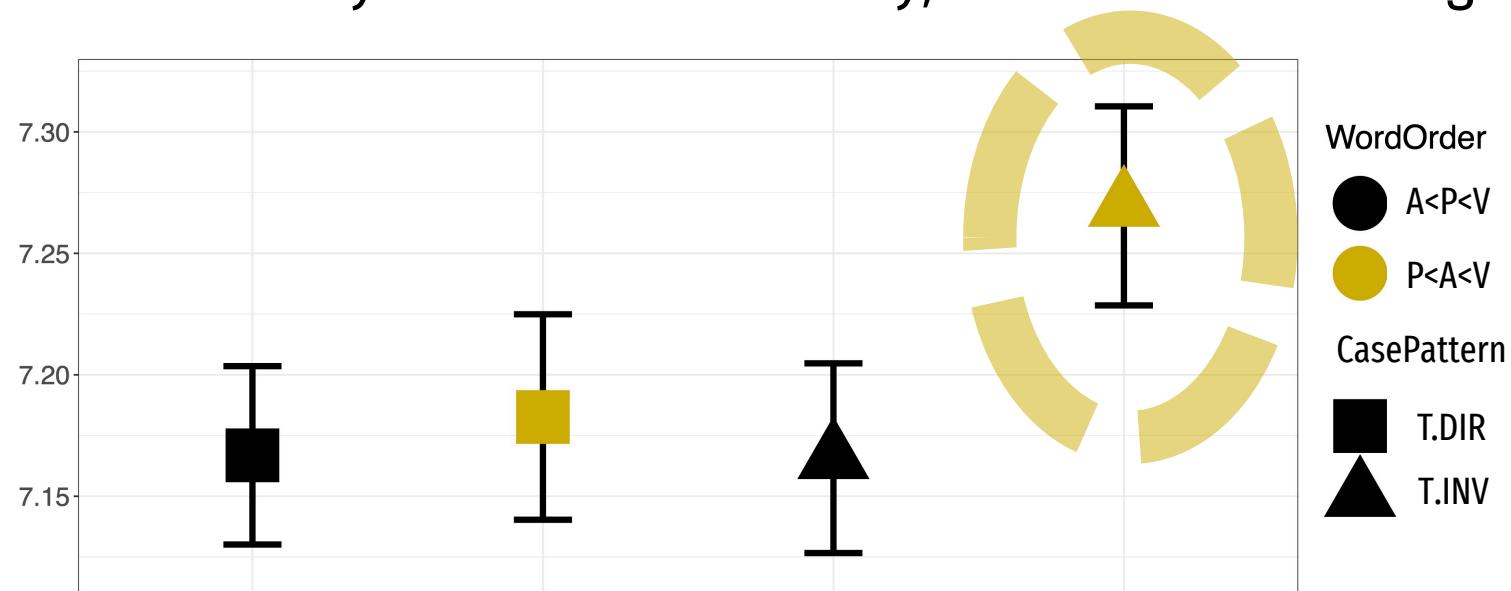
- **Patient-first** order ($P < A < V$) is not inherently difficult relative to agent-first ($A < P < V$)
- Nor is the **Inverse** case pattern (in the perfect) relative to Direct (in the future)



4.6 Key finding: Case–Order Interaction

But Word Order and Case interact¹

- Sentences are difficult if they are **patient-first and Inverse**: $P_{NOM} < A_{DAT} < V_{T.INV}$
- Speakers aren't consciously aware of the difficulty, and it doesn't affect grammaticality.



¹By post-hoc pairwise comparison: $\beta = 0.098$, $SE = 0.043$, $t(107) = 2.2$, $p < 0.05$

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5.1 Surprisal

Intuition: the $\mathbf{P}_{\text{NOM}} < \mathbf{A}_{\text{DAT}} < \mathbf{V}_{\text{T.INV}}$ sequence is esp. unexpected

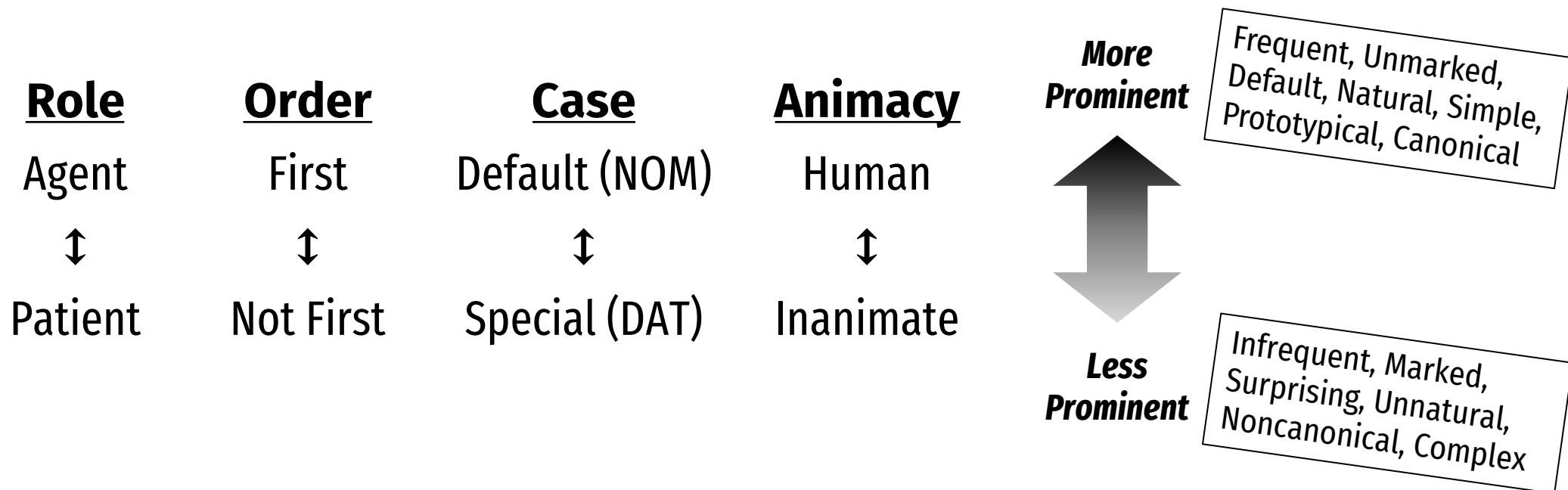
- In general, words with higher surprisal values are harder to process (Hale 2001, 2011, Levy 2008)
- Indeed $p(\mathbf{T.DIR} | \mathbf{N1} < \mathbf{N2})$ is much greater than $p(\mathbf{T.INV} | \mathbf{N1} < \mathbf{N2})$

	$\mathbf{N1}_{\text{NOM}} < \mathbf{N2}_{\text{DAT}} < \underline{\quad}$	$\mathbf{N1}_{\text{DAT}} < \mathbf{N2}_{\text{NOM}} < \underline{\quad}$
T.DIR	44,272 ($\mathbf{A} < \mathbf{P} < \mathbf{V}$)	19,995 ($\mathbf{P} < \mathbf{A} < \mathbf{V}$)
T.INV	3,434 ($\mathbf{P} < \mathbf{A} < \mathbf{V}$)	3,393 ($\mathbf{A} < \mathbf{P} < \mathbf{V}$)

5.2 Prominence scales & eADM

Intuition: Prominence scales guide real-time comprehension.

- Faced with ambiguities, parsers assign grammatical roles by aligning prominence scales (eADM; Bornkessel-Schlesewsky & Schlesewsky 2014)



5.2 Prominence scales & eADM

Perhaps **First+Human+NOM** leads to a strong prediction of **A**.

- Rhymes with previous sentence-processing generalizations about V-final Georgian (Skopeteas et al. 2011) and V-Initial Tagalog (Pizarro-Guevara & Garcia 2024).

(18) *mts'eral-i*_{NOM} *msaxiob-s*_{DAT}
writer-NOM actor-DAT

5.2 Prominence scales & eADM

Perhaps **First+Human+NOM** leads to a strong prediction of **A**.

- (18) *mts'eral-i_{NOM}* *msaxiob-s_{DAT}*
writer-NOM actor-DAT

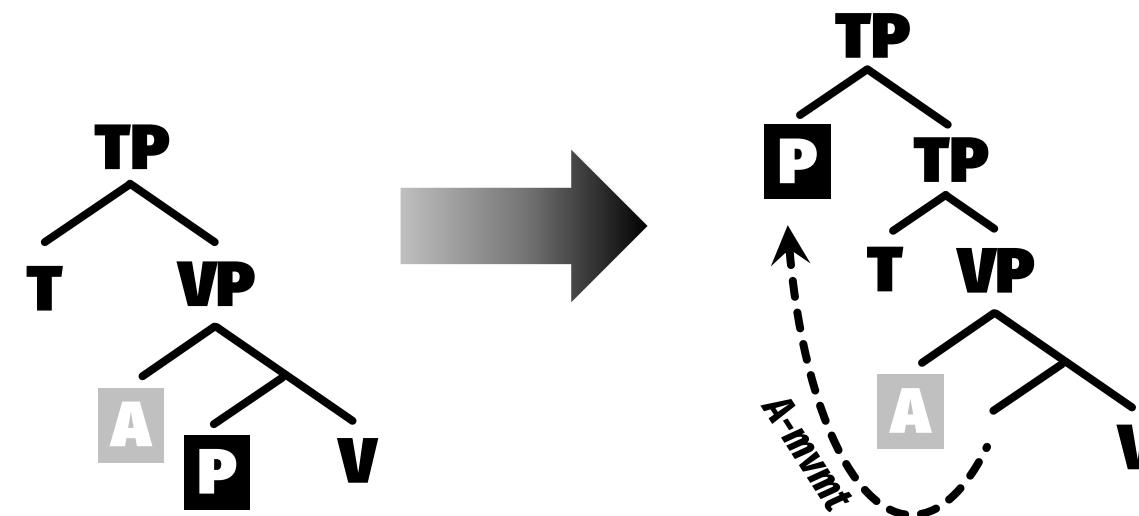
naxavs
see:TR:**FUT**:AGR
“The writer will see
the actor” [A<P<V]

unaxavs
see:TR:**PERF**:AGR
“The writer, the actor
has seen” [P<A<V]

5.3 Relativized Minimality

Intuition: Scrambling & dative-case assignment are too similar.

- Scrambling is widely taken to be A-movement (Mahajan 1990; cf. Miyagawa 1997)

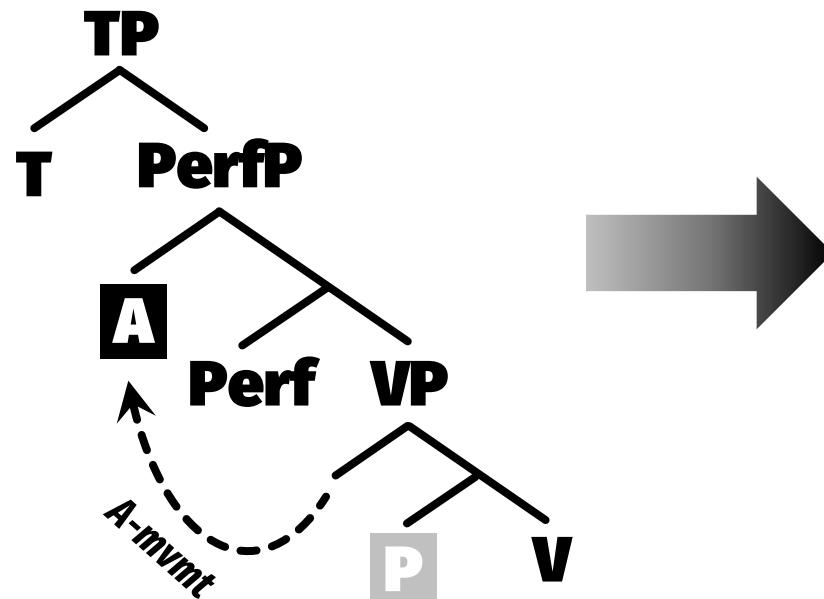


Step 1: Build normal future-tense A-P-V clause

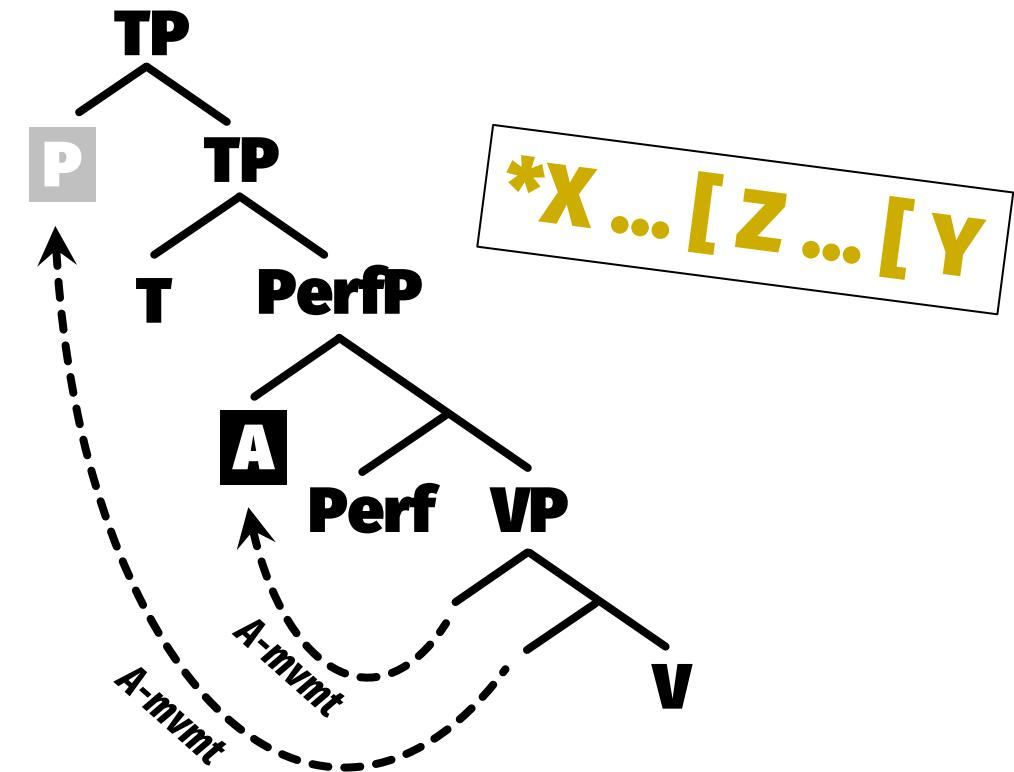
Step 2: P undergoes scrambling, adjoining to TP

5.3 Relativized Minimality

- If dative-raising is A-movement too, scrambling in Dat-A tenses will violate **Relativized Minimality** (Rizzi 1990)



Step 1: Build normal perfect-tense A•P•V clause



Step 2: P undergoes scrambling, violating RM

5.4 Teasing the theories apart

There are other operations that can target the patient, including **wh-movement** – e.g. in relative clauses (Foley 2013)

- (19) *mts'erali, [_{RC} *romel-its^h_{NOM}* *msaxiob-s_{DAT}* *naxavs*]*
writer which-NOM actor-DAT see:TR:FUT:AGR
“the writer [_{RC} who __ will see the actor]”

A undergoes wh-mvmt

- (20) *mts'erali, [_{RC} *romel-its^h_{NOM}* *msaxiob-s_{DAT}* *unaxavs*]*
writer which-NOM actor-DAT see:TR:PERF:AGR
“the writer [_{RC} who the actor has seen __]”

P undergoes wh-mvmt

5.4 Patient-relatives in Inverse tenses

Relativized Minimality predicts no special processing difficulty.

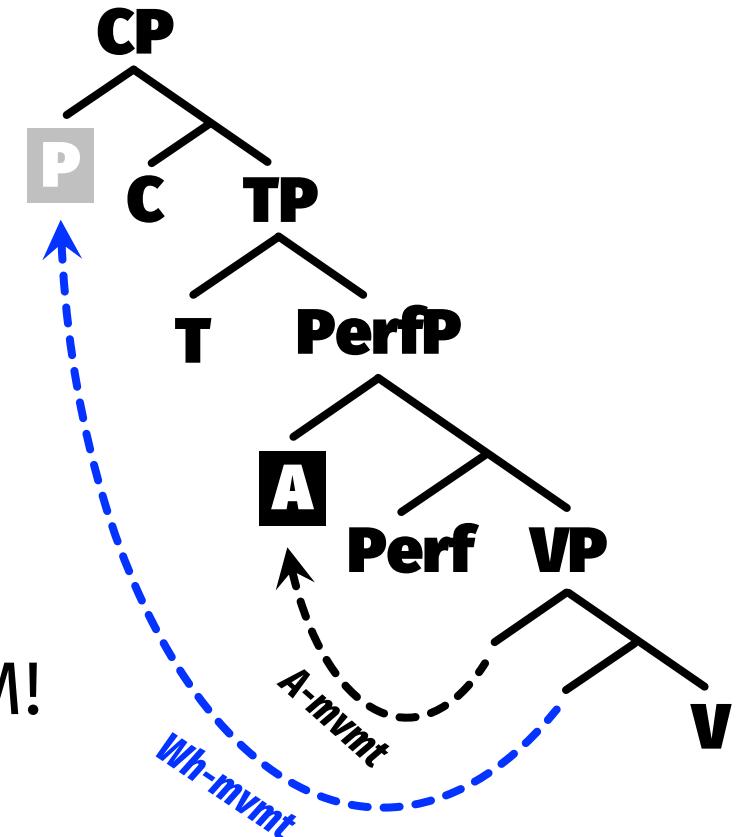
- *Wh*-movement is sufficiently distinct from dative-raising.

Prominence Scales do predict processing difficulty.

- Initial NOM should always cause a garden path.

Previous work (Foley 2020) seems to support RM!

- *Wh*-movement of P causes processing difficulty in Nom-A, but not Dat-A tenses.



5.5 Future directions

Low-hanging fruit

- Targeted experimental comparison between **scrambling and relativization**
- Targeted fieldwork on the **syntax of datives** (cf. Belletti & Rizzi 1989, Boneh & Nash 2017)
- Return to ergative case (Foley 2020), which is as effective a disambiguator as the verb.

(21)	A/S/P	ms'eral- i _{NOM}	A	msaxiob- ma _{ERG}	naxa
		writer-NOM		actor-ERG	see:TR:AOR:AGR

“The writer, the actor saw”

5.5 Future directions

Higher-hanging fruit

- Other **methods**: visual world (Foley et al. 2019), acceptability (Foley & Amiridze, in prep)
- Parallels **within the word** – How are Georgian's incrementally ambiguous agreement morphemes (Lomashvili & Harley 2011; Foley 2017, 2021) processed?

(21)	<i>ga-v-a-t^hb-ob</i>	<i>ga-m-a-t^hb-ob-s</i>	<i>ga-m-i-t^hb-i-a</i>	<i>ga-v-u-t^hb-i-var</i>
	warm:TR:FUT:1>3	~ warm:TR:FUT:3>1	~ warm:TR:PERF:1>3	~ stop:TR:PERF:3>1
	“ I ’ll warm 3rd”	“3rd’ll warm me ”	“ I ’ve warmed 3rd”	“3rd’s warmed me ”

- **Comparative experimental syntax** in other languages: large, medium, or small.

Roadmap

- ~~1. Introduction~~
- ~~2. Processing thematic roles~~
- ~~3. Primer on Georgian~~
- ~~4. Reading time study~~
- ~~5. Theoretical perspectives~~
- 6. Conclusion**

6. Zooming out

Grammatical diversity offers an important window onto cognitive science.

- With many typologically unusual properties, Georgian pushes theories of sentence processing to the limit.
- To what extent is Georgian maladaptive? Does sentence processing shape typology?
- How comprehenders process thematic roles sheds light on human event perception.

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Summary

-i _{NOM}	FUT (T.DIR)	A / P
-S _{DAT}	PERF (T.INV)	A / P

	N1 < N2 < _	N1 < N2 < _
T.DIR	44,272	19,995
T.INV	3,434	3,393

