Prominence scales guide incremental sentence comprehension in Georgian

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Prominence scale misalignments (e.g. inanimate subjects) often trigger **special grammatical phenomena**. SPR data from a **split-ergative** language show that **the parser makes fine-grained predictions** while navigating **incremental ambiguities** in order to avoid positing **role–animacy mismatches**.

Prominence scales are relevant for grammar & parsing

- Some grammatical categories (syntactic role, animacy, etc.) can be hierarchically arranged into **prominence scales [1,2]**.

Prominence	Role	Animacy
↑	Subject (SU)	Human (👱)
	Ind. Obj. (IO)	Animal (🐶)
↓	Dir. Obj. (DO)	Inanimate (🤖)

- Grammars often treat structures with **misaligned scales** in a special way, across many languages & phenomena.
  - Take **differential object marking** in Persian **[2]**. Low-prominence objects like 🤖**DO**s are unmarked (1); high-prominence objects like 👱**DO**s are associated with special morphology ('DOM') (2).

(1) *medâdi xarid.*
pencil bought
'He bought a pencil.'

👱	SU
🐶	IO
🤖	DO

Scales are Aligned: **No DOM**

(2) *mardi-**râ** did.*
man-**DOM** saw
'He saw a man.'

👱	SU
🐶	IO
🤖	DO

Scales are Misaligned: **DOM appears**

- Prominence scales also shed light on **syntactic processing**.
  - Parsers seem to **predict aligned scales** as much as possible, and **misaligned scales** can cause **processing difficulty [3]**.
  - And indeed, for psycholinguistic theories like **eADM [3,4]**, prominence scales feature prominently.
- However, **crosslinguistic investigation** is necessary to better understand just **how the parser uses which scales**.

Georgian split ergativity causes parsing challenges

- Georgian is a **scrambling SOV** language with **null pronouns** and (more unusually) **split-ergative** case **[5]**.
  - Arguments appear in different cases across different tenses (3), and cases differ in how many roles they are compatible with (4).

(3)

	SU	IO	DO
Future	NOM	DAT	DAT
Past	ERG	DAT	NOM
Perfect	DAT	(PP)	NOM

(4)

	ERG	NOM	DAT
SU	✓	✓	✓
IO	—	—	✓
DO	—	✓	✓

- Due to these properties, incremental ambiguities abound: e.g. is a preverbal **DAT** argument the **SU, IO, or DO**?

(5) *oršabats* ***bavšv-s**…*
Monday **child-DAT**
- *…vunaxivar.* see:PERF.3SU/1DO = 'On Monday **the child (SU)** saw me.'
- *…miveci.* give:PAST.1SU/3IO = 'On Monday I gave it **to the child (IO)**.'
- *…vnaxav.* see:FUT.1SU/3DO = 'On Monday I will see **the child (DO)**.'

- If scale alignment is prioritized during parsing, an ambiguous argument's prominence (e.g., **animacy**) will **influence its parse**.
  - Find **human** 👱 argument → assign it **highest** unclaimed role.
  - Find **inanimate** 🤖 argument → assign **lowest** unclaimed role.

Testing how arguments' animacy affects their parse

- Two SPR studies: **Exp👱** = all human arguments, **Exp🤖** = all inanimate
- **2×2 design**: word order **{SOV; OSV}** × SU/DO-case frame **{NOM/DAT; ERG/NOM}**
  - 42 paid participants in Georgia. Experiment conducted online, via Ibex Farm **[6]**.
  - One session: **28** 👱-itemsets + **28** 🤖-itemsets + **42** fillers + comprehension questions

(6) a. [**SOV** + **ERG/NOM** + 👱]
dġes sṭumar-ma kera xuro gaaxara ḳetili sačukr-it.
today guest-**ERG** blond carpenter.**NOM** gladden:PAST kind gift-INST
"Today the guest gladdened the blond carpenter with a kind gift."

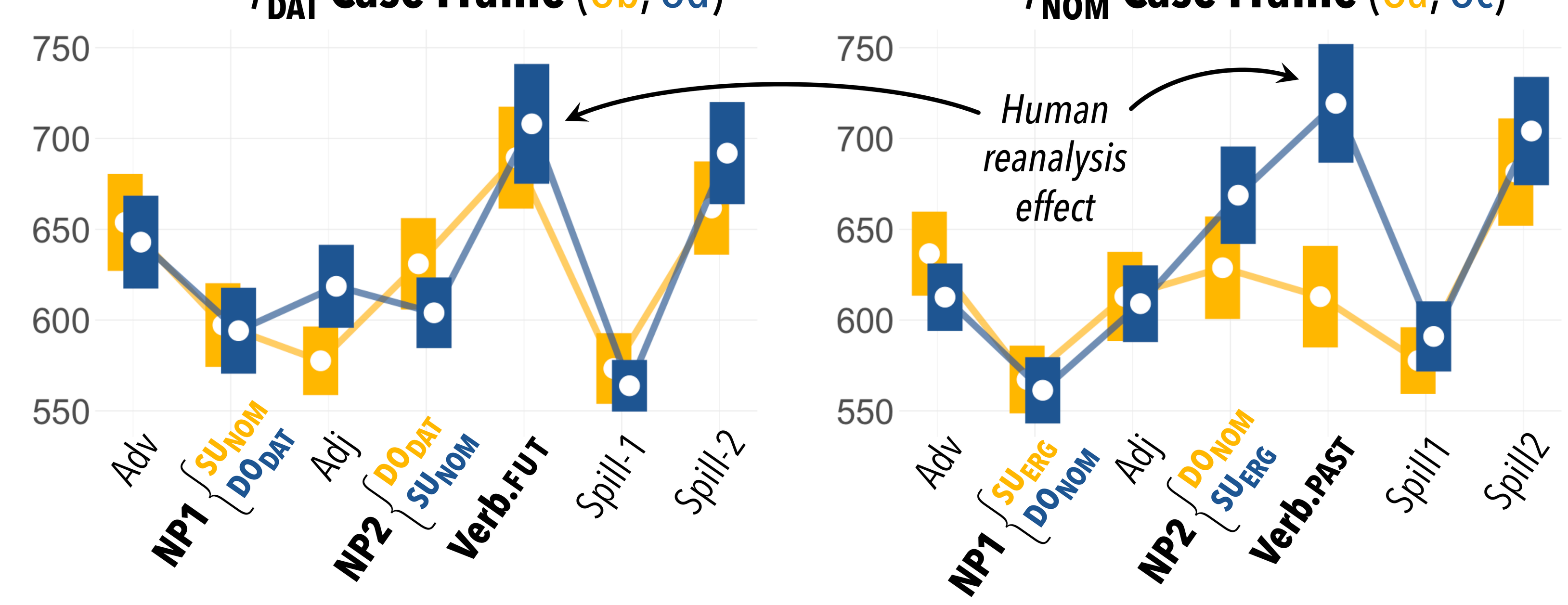
b. [**SOV** + **NOM/DAT** + 👱]
dġes sṭumar-i kera xuro-s gaaxarebs ḳetili sačukr-it.
today guest-**NOM** blond carpenter-**DAT** gladden:FUT kind gift-INST
"Today the guest will gladden the blond carpenter with a kind gift."

c. [**OSV** + **ERG/NOM** + 👱]
dġes sṭumar-i kera xuro-m gaaxara ḳetili sačukr-it.
today guest-**NOM** blond carpenter-**ERG** gladden:PAST kind gift-INST
"Today the blond carpenter gladdened the guest with a kind gift."

d. [**OSV** + **NOM/DAT** + 👱]
dġes sṭumar-s kera xuro gaaxarebs ḳetili sačukr-it.
today guest-**DAT** blond carpenter.**NOM** gladden:FUT kind gift-INST
"Today the blond carpenter will gladden the guest with a kind gift."

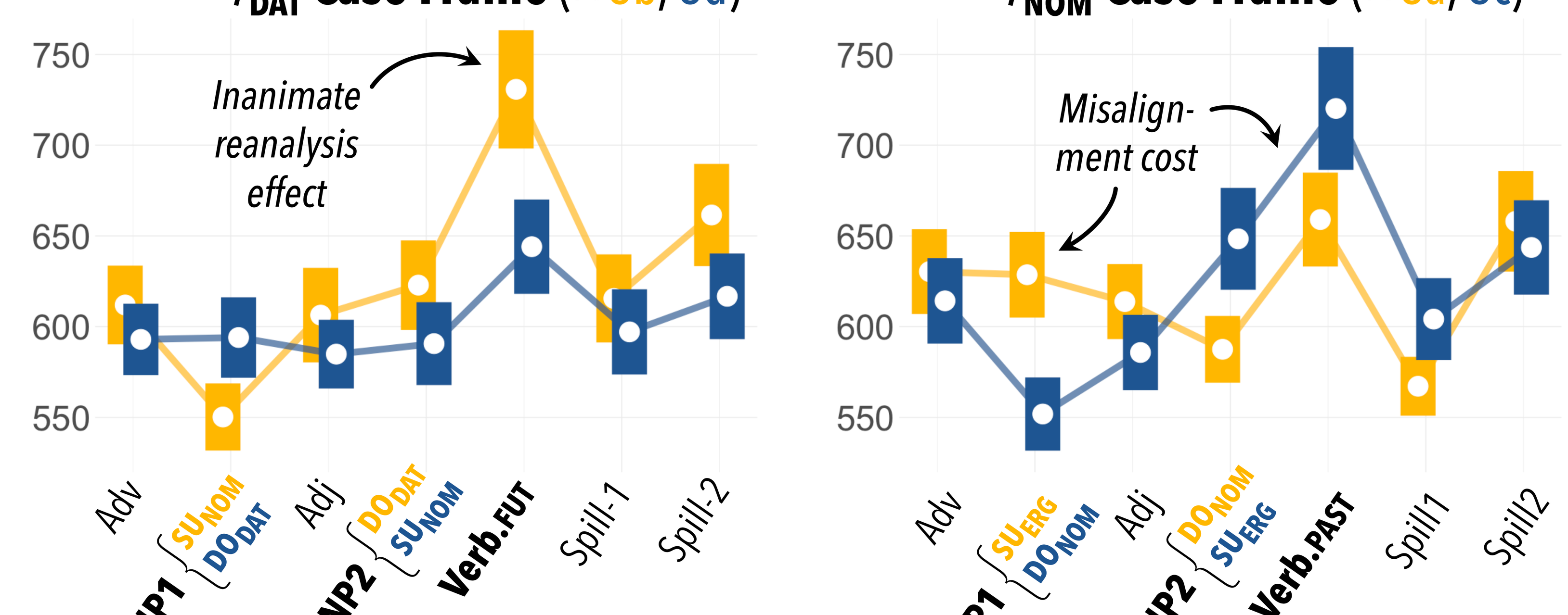
- Reading time results for **Exp👱** (SOV vs. OSV)

NOM/DAT Case Frame (6b, 6d) | **ERG/NOM Case Frame** (6a, 6c)



- Reading time results for **Exp🤖** (SOV vs. OSV)

NOM/DAT Case Frame (≈6b, 6d) | **ERG/NOM Case Frame** (≈6a, 6c)



◦ Labeled effects are significant ($p < 0.05$). No effects found for comprehension measures.

Incremental alignment of role & animacy derives RTs

- A very **simple theory** accounts for the observed patterns.
  - Parse arguments by **maximally aligning** animacy and roles.
    - 👱→**SU** if possible; else 👱→**IO** if possible; else 👱→**DO**
    - 🤖→**DO** if possible; else 🤖→**IO** if possible; else 🤖→**SU**
  - **Processing difficulty** arise when **reparses** are necessary, or when role–animacy **misalignments** (like 🤖→**SU**) are unavoidable.
- **Human reanalysis effect** *(seen at positions with thick **black** boxes below)*
  - If **NP1** is 👱, the optimal parse is always **SOV**, since any case can be **SU** (4).
  - But this parse is foiled in **OSV** conditions, by **NP2.ERG** (6c) or the **Verb** (6d).
  - In (6b), a ditransitive parse avoids positing a 👱**DO** at **NP2** — but the monotransitive verb foils this prediction.

	at NP1: Parse 👁	at NP1: Predictions 💭	at NP2: Parse 👁	at NP2: Predictions 💭	at Verb: Parse 👁
(6a)	👱ERG–SU	🤖NOM–DO; VERB [PAST, TR]	👱ERG–SU; ⁉👱NOM–DO	VERB [PAST, TR]	👱ERG–SU; 👱NOM–DO; VERB [PAST, TR]
(6b)	👱NOM–SU	🤖DAT–DO; VERB [FUT, TR]	👱NOM–SU; 👱DAT–IO	🤖DAT–DO; VERB [FUT, ⁉DITR]	👱NOM–SU; ⁉👱DAT–⁉DO; VERB [FUT, ⁉TR]
(6c)	👱NOM–SU	🤖DAT–DO; VERB [FUT, TR]	⁉👱NOM–⁉DO; 👱ERG–SU	VERB [⁉PAST, TR]	👱NOM–DO; 👱ERG–SU; VERB [PAST, TR]
(6d)	👱DAT–SU	🤖NOM–DO; VERB [PERF, TR]	👱DAT–SU; ⁉👱NOM–DO	VERB [PERF, TR]	⁉👱DAT–⁉DO; 👱NOM–⁉SU; VERB [⁉FUT, TR]

- **Misalignment cost** *(seen at positions with thick **gold** boxes below)*
  - 🤖**ERG** is surprising anywhere (6′a,c) as it entails misaligned scales (🤖**SU**).
- **Inanimate reanalysis effect** *(seen at positions with thick **blue** boxes below)*
  - In (6′b), a ditransitive parse at **NP2.DAT** avoids positing 🤖**SU**, but the monotransitive verb foils this prediction.

	at NP1: Parse 👁	at NP1: Predictions 💭	at NP2: Parse 👁	at NP2: Predictions 💭	at Verb: Parse 👁
(6′a)	⁉🤖ERG–SU	🤖NOM–DO; VERB [PAST, TR]	🤖ERG–SU; 🤖NOM–DO	VERB [PAST, TR]	🤖ERG–SU; 🤖NOM–DO; VERB [PAST, TR]
(6′b)	🤖NOM–DO	👱ERG–SU; VERB [PAST, TR]	🤖NOM–DO; 🤖DAT–IO	👱ERG–SU; VERB [PAST, ⁉DITR]	⁉🤖NOM–⁉SU; 🤖DAT–⁉DO; VERB [FUT, ⁉TR]
(6′c)	🤖NOM–DO	👱ERG–SU; VERB [PAST, TR]	🤖NOM–DO; ⁉🤖ERG–SU	VERB [PAST, TR]	🤖NOM–DO; 🤖ERG–SU; VERB [PAST, TR]
(6′d)	🤖DAT–DO	👱NOM–SU; VERB [FUT, TR]	🤖DAT–DO; ⁉🤖NOM–SU	VERB [FUT, TR]	🤖DAT–DO; 🤖NOM–SU; VERB [FUT, TR]

Nearly all cues **predicted** to cause difficulty under an alignment theory (notated with ⁉ in the above tables) correspond to **observed RT slow-downs** — strong evidence that the **parser prioritizes prominence scale alignment**. But a few questions remain open.

- Why don't 👱**DO**s and 🤖**NOM.SU**s trigger an obvious misalignment cost like 🤖**ERG.SU**s?
- Does the parser really prefer positing **ditransitive** verbs over misaligned arguments?
- No strong evidence that **DAT** in Georgian is strongly tied to **DO**, as **[7]** claim. Why not?
- Do parsers ever posit **intransitive** structures? (Georgian has **ERG**, **NOM**, and **DAT INTR.SU**s.)