

Objectives

Use the **flexible word order of Hungarian** to tease apart **Expectation-** vs. **Memory-** vs. **Thematic role-based** accounts of relative clause (RC) processing.

Background

- Important case study in the processing of syntactic complexity: RCs.
- Asymmetry between the English subject-extracted RC (1a) and object-extracted RC (1b): **ORC is harder to process than SRC**.

- (1) a. The player [RC who _ berated the coach] surprised the team. (SRC)
b. The player [RC who the coach berated _] surprised the team. (ORC)

Competing classes of accounts, with converging predictions for English:

Memory: predict general locality preference—**shorter filler-gap (or verb-argument) dependencies are preferred** (Gibson, 1998; Lewis & Vasishth, 2005).

- SRCs instantiate a shorter filler-gap dependency than ORCs.

Expectation: attribute **greater processing cost to less expected structures** (e.g. surprisal, Hale, 2001; Levy, 2008).

- SRCs are more frequent than ORCs.

Thematic: attribute cost to switching between the sentential subject's thematic role in the RC vs. main clause (Staub et al., 2017; cf. MacWhinney & Pléh, 1988).

- In a subject-modifying ORC (1-b) "player" is first assigned a subject role in the main clause, but then an object role in the RC, whereas SRCs require no switch.

Experiment: RC type × locality × modification

In Hungarian, **extraction site** (SRC vs. ORC) and **locality** (i.e. the distance between the verb and the extracted argument) can be **varied independently**.

Self-paced reading: RC TYPE × LOCALITY × MODIFICATION

- RC TYPE: SRC (2),(4) vs. ORC (3),(5)
- LOCALITY: **local** (VO, VS) vs. **non-local** (OV, SV), indicated by {}
- MODIFICATION: subject- (2),(3) vs. object-modifying (4),(5)

- (2) A játékos, aki {lehordta az edzőt} / {az edzőt lehordta}...
the player.N who.N {berated the coach.A} / {the coach.A berated }...
...a mérkőzést követően, meglepte a csapatot.
...the match following surprised the team.A
Both: 'The player who berated the coach following the match surprised the team.'

- (3) A játékos, akit {lehordott az edző} / {az edző lehordott}...
the player.N who.A {berated the coach.N} / {the coach.N berated }...
Both: 'The player who the coach berated (following the match surprised the team.)'

- (4) A csapat meglepte a játékost, aki {lehordta az edzőt}...
the team.N surprised the player.A who.N {berated the coach.A}...
.../ {az edzőt lehordta} a mérkőzést követően.
.../ {the coach.A berated } the match following
Both: 'The team surprised the player who berated the coach following the match.'

- (5) ...a játékost, akit {lehordott az edző} / {az edző lehordott}...
...the player.A who.A {berated the coach.N} / {the coach.N berated }...
Both: '(The team surprised) the player who the coach berated (following the match).'

- 60 monolingual speakers of Hungarian (aged 18-35).
- Item N=32. Filler N=38. Latin Square.
- A comprehension question of the form of the form "Who V-ed whom?" or "Whom V-ed who?" (counterbalanced) followed each sentence.

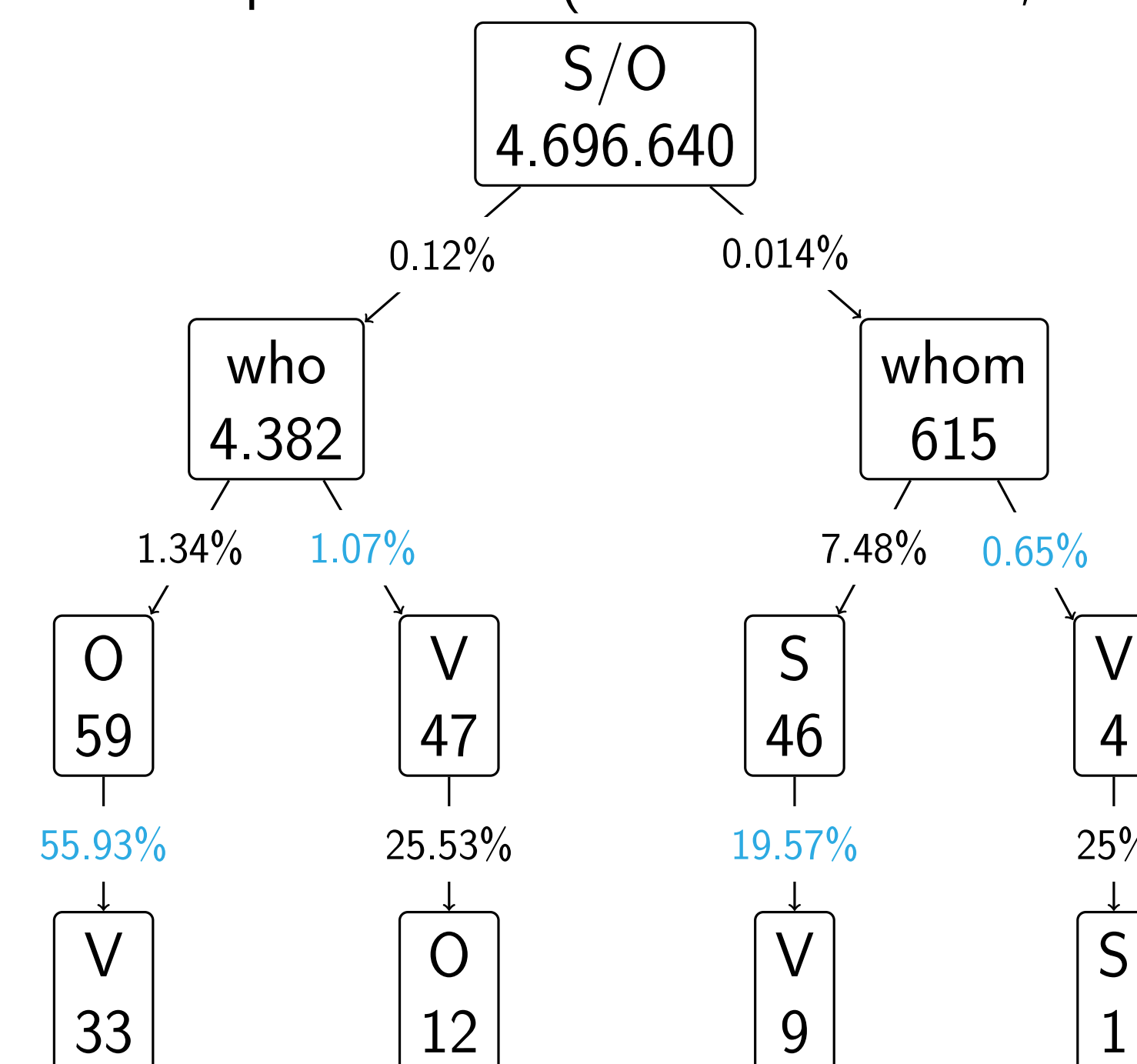
Predictions

Predicted locations of effects indicated by "→"; RT = reaction time:

- **Memory:** Structures with **local** verb-argument dependencies are **less costly** than non-local ones, irrespective of RC TYPE. → shorter RT for local RC verb
- **Expectation:** Different predictions, based on probability estimates.
 - **Local structures more costly** to process. → longer RT for local RC verb
 - General advantage for SRCs. → shorter RT for SRC relative pronoun
- ① Overall frequency: from Hungarian National Corpus (Oravecz, et al. 2014).

Structure	Count	Searches
SRC, local	44	(Det) N.nom (,) Rel.Pronoun.nom V.3sg (Det) N.acc
SRC, non-local	466	(Det) N.nom (,) Rel.Pronoun.nom (Det) N.acc V.3sg
ORC, local	26	(Det) N.nom (,) Rel.Pronoun.acc V.3sg (Det) N.nom
ORC, non-local	50	(Det) N.nom (,) Rel.Pronoun.acc (Det) N.nom V.3sg

- ② RCs=syntactically constrained context; additional pre-V material helps sharpen expectations about the location and identity of V → facilitate processing of V.
- ③ Incremental counts and probabilities (based on Oravecz, et al. 2014).



- **Thematic:** in subject-modifying RCs, ORCs should incur cost → longer RT for ORC main clause verb; in object-modifying RCs, difficulty is predicted for SRCs.

SPR results

- Trials with incorrectly answered comprehension questions were excluded.
- RC NP appears pre- and post-verbally on the plot, depending on condition.
- RTs: log-transformed and residualized (to word position + preceding RT).

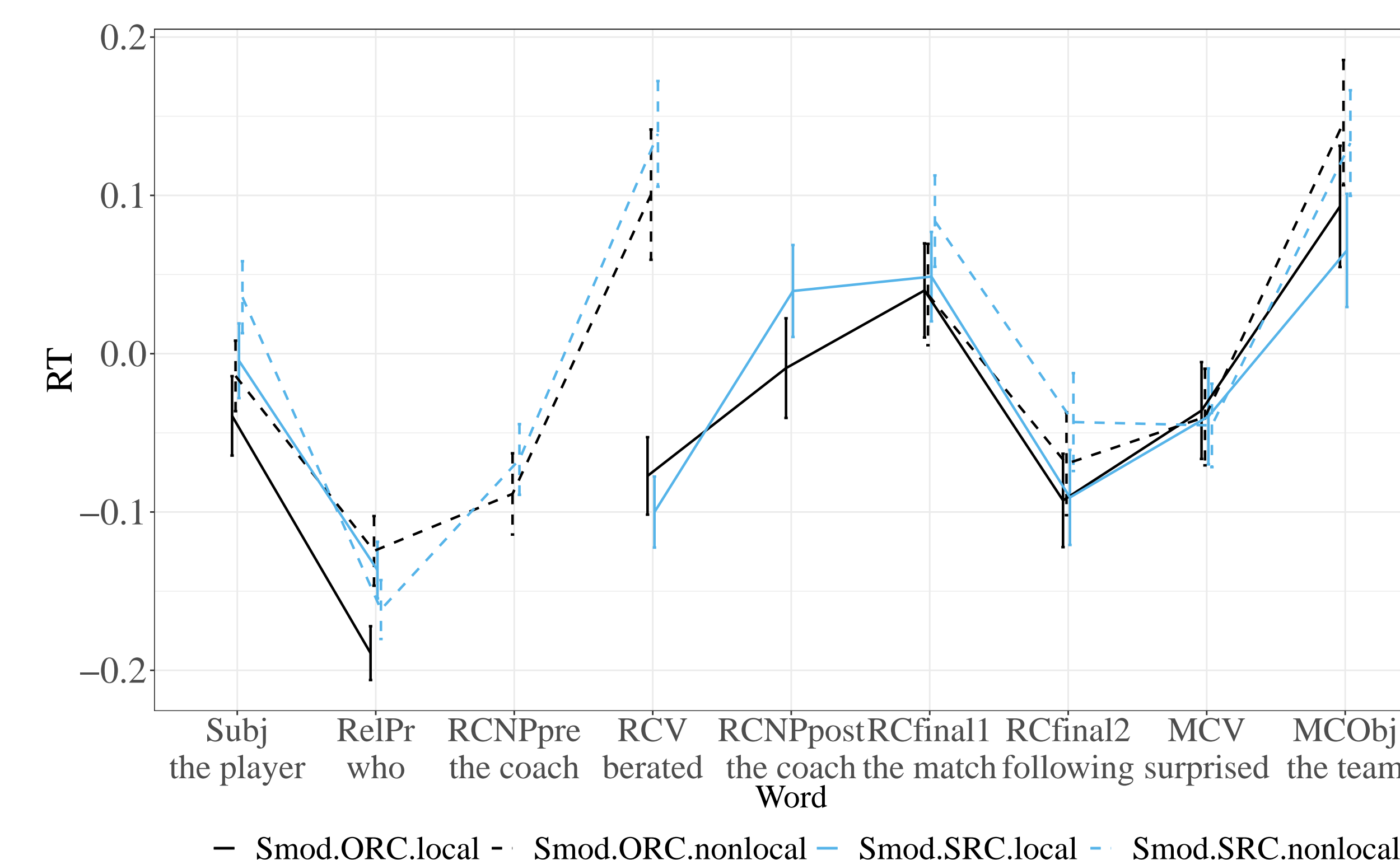


Figure: RTs by region for subject-modifying RCs. Solid = local; dashed = non-local.

Main findings:

- 1) **Main clause verb** ("surprised"): ORCs don't have longer RT than SRCs in subject-modifying RCs (RC TYPE, $p=.88$), despite the predictions of the **Thematic-account**.

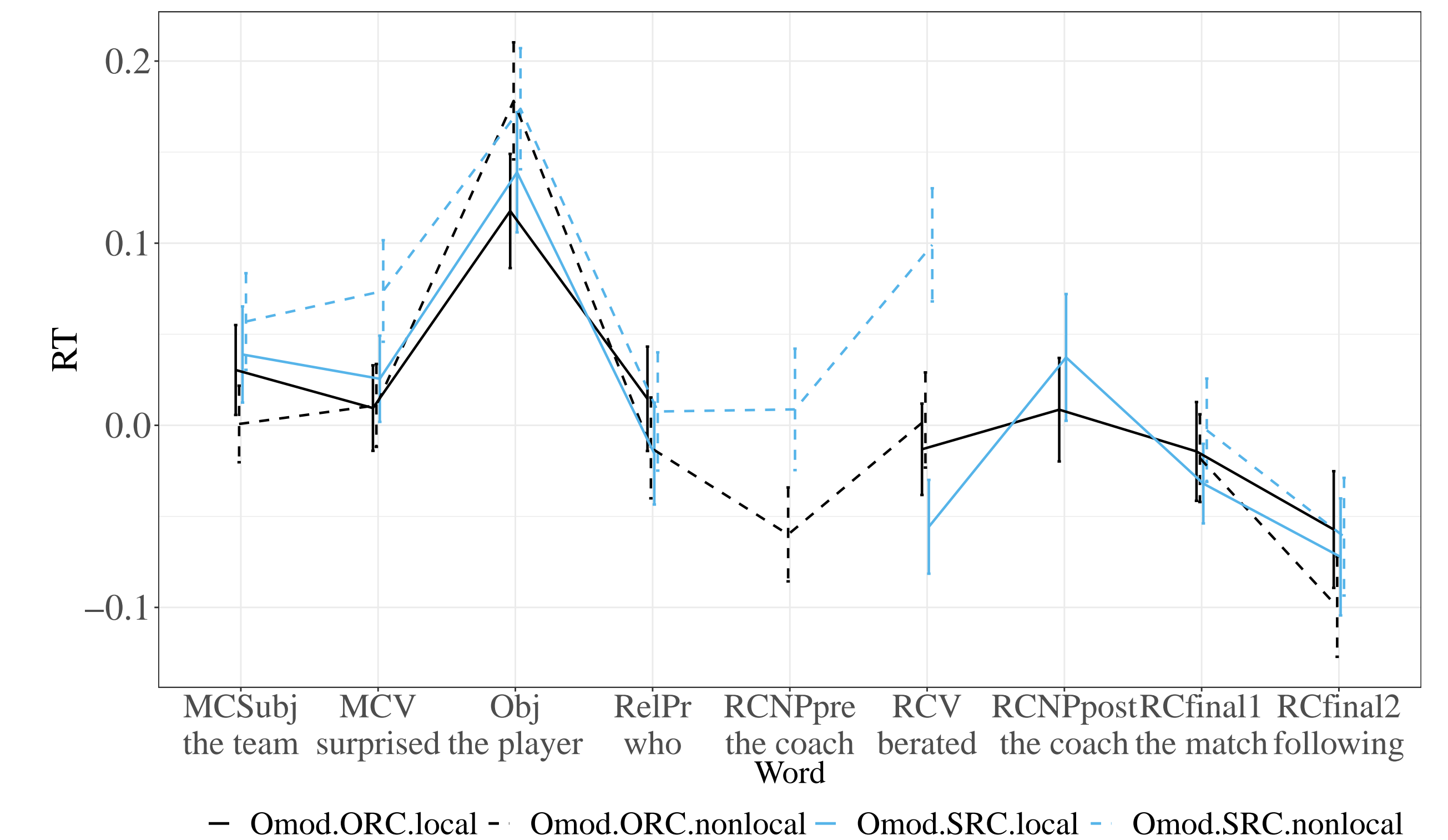


Figure: RTs by region for object-modifying RCs. Solid = local; dashed = non-local.

- 2) **RC verb** ("berated"): **shorter RT for local sentences** (LOCALITY, $p<.01$).

- 3) **RelPr** ("who"): SRCs don't have shorter RT than ORCs (RC TYPE, $p=.35$).

→ The above (2-3) replicate Ronai & Xiang (2019)¹ for subject-modifying RCs, and are in line with the Russian data of Levy et al. (2013); Price & Witzel (2017), and...

Support predictions of Memory, but not Expectation or Thematic accounts.

Comprehension results

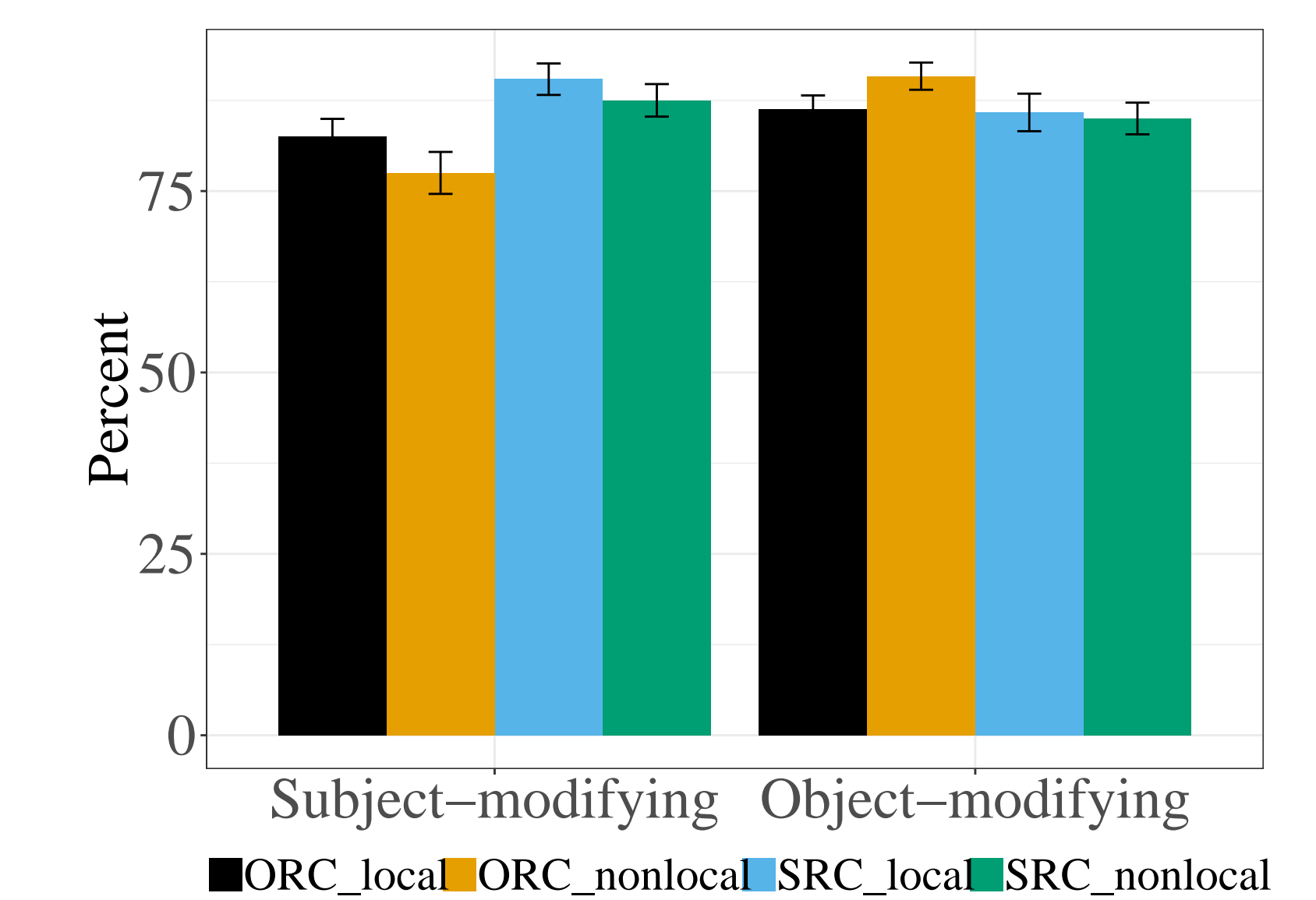


Figure: Percentage of correctly answered comprehension questions

Effect of subject- vs. object-modification: **SRCs have higher accuracy than ORCs only in subject-modifying RCs** (RC TYPE-MODIFICATION interaction, $p<.001$).

Supports the prediction of Thematic role-based accounts.

Conclusions

- **RT evidence for Memory-account at the RC verb:** advantage for structures that have shorter verb-argument distances, irrespective of frequency.
- **No evidence for Expectation** (at RelPr or RC verb).
- **Evidence for Thematic-account in offline data**, reflecting later stage processing: SRC advantage only in subject-modifying RCs.

¹There was a mistake in data analysis for Experiment 1 in that poster. The two reported experiments in fact yielded identical results (processing cost at the verb for non-local structures), and the current study replicates that finding.

References

Gibson, 1998. Linguistic complexity: locality of syntactic dependencies. *Cognition*. // Hale, 2001. A probabilistic early parser as a psycholinguistic model. // Levy, 2008. Expectation-based syntactic comprehension. *Cognition*. // Levy, et al. 2013. The syntactic complexity of Russian relative clauses. *JML*. // MacWhinney & Pléh, 1988. The processing of restrictive relative clauses in Hungarian. *Cognition*. // Lewis & Vasishth, 2005. An activation-based model of sentence processing as skilled memory retrieval. *Cognitive Science*. // Oravecz, et al. 2014. The Hungarian Gigaword Corpus. // Ronai & Xiang, 2019. Relative clause processing in a flexible word order language: Evidence from Hungarian. CUNY. // Price & Witzel, 2017. Sources of relative clause processing difficulty: Evidence from Russian. *JML*. // Staub, et al. 2017. The matrix verb as a source of comprehension difficulty in object relative sentences. *Cognitive Science*.