

Background

Processing costs due to reanalysis are mainly explored in cases of **structure reassignment**: an initial attachment of the input proves to be incorrect as more material is revealed, necessitating structural and/or semantic-thematic reanalysis, for example:

- *Garden Path* (Ferreira & Henderson, 1991; Frazier & Rayner, 1982; Trueswell et al., 1993)
- *Filled-gap Effect* (Stowe, 1986; Wagers & Phillips, 2009)

The present study Explores the processing effects of a reanalysis which does **not involve structural or semantic change**, but rather the **realization of an optionally overt element**

- Specifically, does the need to integrate a direct object resumptive pronoun (**RP**) appearing after the verb in Hebrew incur an observable processing cost?

Resumption in Hebrew

- Optional in direct object (**DO**) relative clauses (**RCs**), obligatory in indirect object (**INDO**) RCs
- DO RCs with resumptives show reduced acceptability compared to their gapped equivalents (Farbi et al., 2010; Meltzer-Asscher et al., 2015)

Hypothesis: The lower acceptability of direct object RPs as compared to gaps reflects a processing cost

Why would this be costly?

- Comprehenders resolve the dependency immediately at the verb by **positing a gap**
- When a post verbal RP is revealed, they have to **reanalyze the already-resolved dependency** (see Han et al., 2012, for a similar proposal about English)
- This shift in gap manifestation incurs a processing cost

Prediction: If the integration of a post-verbal RP incurs a processing cost due to its redundancy, post-verbal RPs will be more difficult to integrate than pre-verbal ones

- Post-verbal: The dependency can be resolved before the occurrence of the RP, by positing a gap after the verb → integration of the RP would demand reanalysis

- Pre-verbal: The RP appears before the verb, hence before the dependency can be resolved → no reanalysis is required for its integration

Experiments 1 and 2

- Contrasted reading times (RTs) of **post-verbal** and **pre-verbal** RPs
- To tease apart the **location** of the RP from its **redundancy for dependency resolution**, the **phrasal category** of the RP was manipulated between **NP** and **PP**
 - Hebrew pronouns embedded under **PPs** are **bound morphemes**
 - Given a verb with an obligatory PP argument, a dependency with INDO position **cannot be resolved before the RP is encountered**
 - Hence, if the processing cost we predict is related to a shift in gap manifestation, prolonged RTs of post-verbal RPs should be observed **only for the NP condition**

Materials

- **Embedded 2-place verbs taking an obligatory NP/PP** were chosen based on an elicitation pretest (n=200)
- **Location** (pre-/post-verbal) and **Category** (NP/PP) were **fully crossed** to create 20 sets, **matched** for embedded verb RTs (n=18) and embedded clause plausibility (n=26), presented in 4 lists
- 40 **filler** sentences included **gapped** subject and DO RCs
- **Participants**: Two different groups of **40** adults Hebrew speakers
- **Procedure**: Moving-window self-paced reading
 - Exp 1: y/n questions on third of the items
 - Exp 2: acceptability rating (1-7) for each item

Post-verbal NP	ha-saxkanim ha-yedu'im še-ha-soxen ha-menuse hišpil otam kiblu picuy na'e the-actors the-known that-the-agent the-experienced humiliated them received compensation decent
Pre-verbal NP	ha-saxkanim ha-yedu'im še-otam ha-soxen ha-menuse hišpil kiblu picuy na'e the-actors the-known that-them the-agent the-experienced humiliated received compensation decent 'The well-known actors that the experienced agent humiliated received a decent compensation'
Post-verbal PP	ha-saxkanim ha-yedu'im še-ha-soxen ha-menuse ba'at ba-hem kiblu picuy na'e the-actors the-known that-the-agent the-experienced kicked at-them received compensation decent
Pre-verbal PP	ha-saxkanim ha-yedu'im še-ba-hem ha-soxen ha-menuse ba'at kiblu picuy na'e the-actors the-known that- at-them the-agent the-experienced kicked received compensation decent 'The well-known actors that the experienced agent kicked received a decent compensation'
Base	ha-soxen ha-menuse hišpil et ha-saxkanim ha-yedu'im the-agent the-experienced humiliated the-actors the-known 'The experienced agent humiliated the well-known actors'
Task	Fill in the blank according the information provided above
Prompt	ha-saxkanim ha-yedu'im še-_____ kiblu picuy na'e the-actors the-known that-_____ received compensation decent 'the known actors that _____ received a decent compensation'

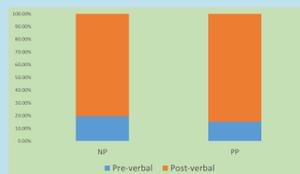
Experiment 3 (n = 37) was designed to identify if findings from Experiments 1 & 2 reflect a surprisal effect at the post-verbal RP due to frequency of occurrence, via structural preferences in production.

Materials: Main clauses corresponding to targets RCs from Experiments 1 and 2 ('base sentences')

Task: Sentence completion, relativizing base sentences

Results: Participants produced more RPs **after** the verb in **both the NP and PP** conditions

- This indicates that the observed RT pattern does not reflect surprisal

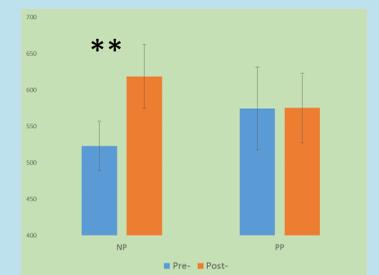


Results: Experiment 1

Model: log RT of RPs ~ Location*Category as fixed effects, log RT of the previous word and trial as predictors, and subject and item random effects

Significant Location*Category interaction ($p = .025$)

- Post-verbal RPs slowed RTs for NP RPs ($p = .006$), but not for PP ones ($p = .83$)

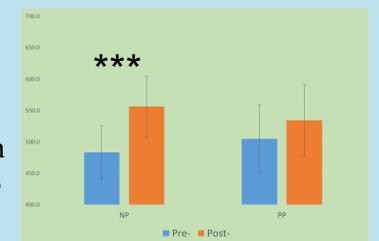


Results: Experiment 2

Reading times:

Replication of **Location*Category interaction** ($p = .01$)

- Main effect of Location: Post-verbal RPs were read slower than pre-verbal ones ($p = .003$), due to contrast in NP RPs ($p < .001$), but in not PP ones ($p = .4$)

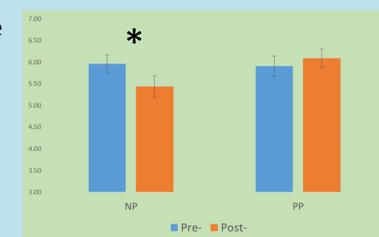


Acceptability:

Z-transformed data, mixed-model regression

Significant Location*Category interaction ($p = .036$)

- Post-verbal occurrence was more detrimental for NP RPs ($p = .02$), relative to PP RPs ($p = .4$)
- Main effect of category: NP sentences were rated lower than PP ones ($p = .024$), due to contrast in post-verbal RPs only



Discussion

- Integration of an optional post-verbal RP into the parse incurs a processing cost even though it does not involve structure reassignment, or a change in meaning
- This supports the hypothesis that the effect is due to a shift in dependency resolution, triggered by the need to integrate an RP into the parse after the dependency has already been resolved by positing a gap
- This might suggest that dependency formation mechanisms are rapidly inhibited once a potential gap is identified, such that an immediate change in its realization incurs a processing cost
- In addition, this suggests that in some cases, RPs not only do not aid processing (e.g. Hawkins, 1994) but actually hinder it.

References

- Ferreira, F., & Henderson, J. M. (1991). Recovery from misanalyses of garden-path sentences. | Frazier, L. & Rayner, K. (1982). Making and correcting errors during sentence comprehension: Eye movements in the analysis of structurally ambiguous sentences. | Han, C., et al. (2012). Processing strategies and resumptive pronouns in English. | Hawkins, J. (1994). A Performance Theory of Order and Constituency. | Stowe, L. (1986). Parsing wh-constructions: Evidence for on-line gap location. | Sturt, P. (2007). Semantic reinterpretation and garden path recovery. | Trueswell, J.C., et al. (1993). Verb-specific constraints in sentence processing: Separating effects of lexical preference from garden-paths. | Wagers, M. W., & Phillips, C. (2009) Multiple dependencies and the role of the grammar in real-time comprehension

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