

## Degrees of prediction: Syntactic pressures generate stronger predictions than pragmatic considerations

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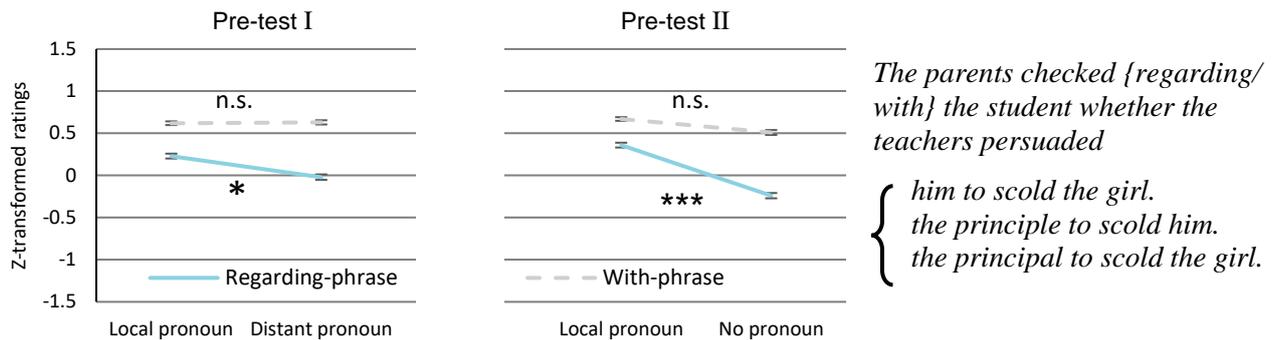
During sentence processing, comprehenders may actively form structural dependencies, not only as a tool for parsing the current input, but also as a reflection of predictions regarding upcoming material. Such predictions can be motivated by syntactic licensing of sentence structure, rapid semantic integration, or alignment with pragmatic considerations. Perhaps the most studied case of predictive dependency formation is the incremental processing of filler-gap dependencies. It is well-known that in the processing of such sentences the parser actively predicts the resolution of the dependency (see Phillips & Wagers, 2007, for review). It has also been established that the parser commits to this preference, to the extent that when the actual input contradicts the prediction, processing is disrupted, as evidenced by the "filled-gap" effect (e.g. Stowe, 1986). In the current study, we compare this (syntactically motivated) prediction with predictions motivated by pragmatic considerations. Specifically, we investigate NPs embedded in a Hebrew *regarding*-phrase (1), which constitute a discourse-prominent antecedent requiring future reference for pragmatic felicity (see Figure 1a for pre-tests which exhibit that).

(1) We checked **regarding the student** whether the teachers persuaded him to leave.

We test whether in these cases the parser predictively builds a co-referential dependency (with a pronoun), as in filler-gap dependencies. To do this, we utilize the two experimental paradigms most commonly used for detecting active dependency formation: the plausibility mismatch (e.g. Traxler & Pickering, 1996) and the filled-gap effect. In a 2 x 2 (plausibility x filler/*regarding*-phrase) self-paced reading (SPR) experiment (N=48, 32 sets) we observed a main effect of plausibility of the antecedent as complement to the verb ( $p = .017$ ) with no interaction between the two factors (Figure 1b). This indicates the NP embedded in the *regarding*-phrase is considered as an object for the verb, reflecting some anticipation for a co-referential pronoun at this position. However, in another SPR experiment (N=48, 20 sets), using the "filled-gap" design, in which the predicted-gap/pronoun position was occupied by a lexical NP, we found the "filled-gap effect" (disrupted processing at this NP), in filler-gap dependencies ( $p = .037$ ), but not following *regarding*-phrases (Figure 1c). Namely, only in the former case, costs for a failed prediction are observed. This suggests that in *regarding*-sentences, the comprehender does not commit to the prediction to the same extent as in filler-gap dependencies.

**Discussion:** In lexical prediction a distinction has been made between ease of integration due to partial overlapping activation, and predictive pre-activation of a specific word (which is also associated with costs in cases of prediction failure; Van Petten & Luka, 2012; Kuperberg & Jaeger, 2016). We take the results of the current study to suggest that a similar distinction arises in the syntactic level. Thus, a comprehender can engage in different degrees of structure prediction but would seldom go through all stages (predicting a co-referring element, projecting structure, and integrating the element semantically). As each processing stage takes resources and puts the parser at greater risk for a costly reanalysis, it seems likely that such processes would be saved for cases in which either predictability is exceptionally high or maintaining the structure in its incomplete form is very costly. We suggest that the choice of the degree of prediction is determined by linguistic licensing pressures. Therefore, while various motivations may give rise to a preference for co-reference, only syntactically-motivated dependencies are predictively formed, while dependencies predicted based on pragmatic felicity do not propel predictive structure building. In addition, the study provides evidence for a functional distinction between different measures of active dependency formation, previously taken to be mostly interchangeable.

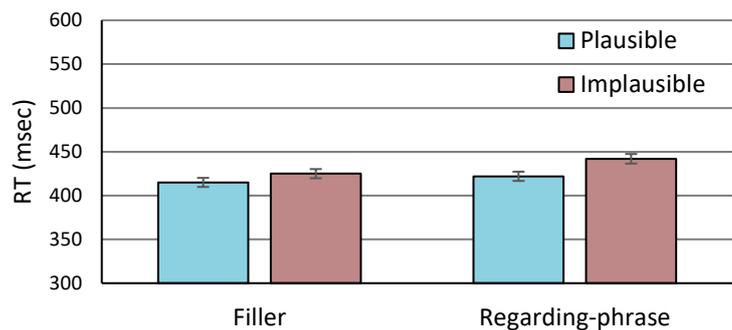
**A: Acceptability pretest exhibiting that *regarding*-NPs require subsequent coreference**



**B: Plausibility mismatch**

The clients checked

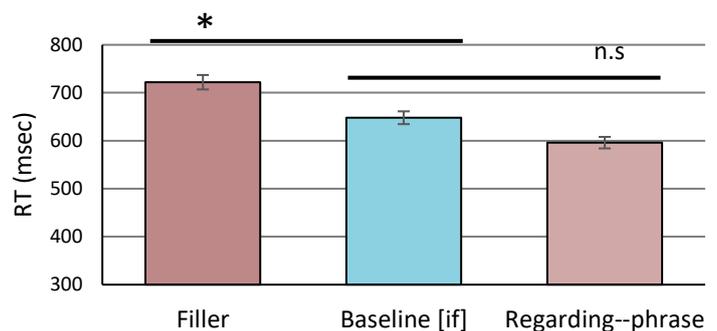
{ regarding the {diamond/solution} whether  
the {diamond/solution} which  
the jeweller polished gemstones with.



**C: Filled-gap effect**

The parents checked

{ regarding the student if  
which student  
if  
the teachers persuaded the principal  
to scold him.



**Figure 1.** Results of the reported experiments. **A:** Mean acceptability ratings in two pretests that test the preference for coreference following *regarding*-phrases. **B:** Mean RTs at the verb in the plausibility experiment. **C:** Mean RTs at the "filled-gap" NP in the "filled-gap" experiment.

\* marks  $p < .05$ ; \*\*\* marks  $p < .001$ ; All error bars mark  $\pm$ -SE.

All statistical comparisons were conducted with a linear mixed-model regression.

**References.** Kuperberg, G. & Jaeger, F. (2016). What do we mean by prediction in language comprehension? *Language, Cognition & Neuroscience*, 31(1).  
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