Partial reanalysis: A large-scale replication testing plausibility and transitivity bias.

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Background. Research on object/subject garden path (GP) sentences with an optionally transitive verb (OPT) such as (1) has revealed partial reanalysis in such sentences [1-6]. Partial reanalysis occurs when participants fail to fully reanalyze the sentence, resulting in persistent misinterpretation, i.e. incorrectly answering "yes" to the question in (1) [1-3].

(1) While the man hunted the deer ran into the woods.
Question: Did the man hunt the deer?

Previous studies compared GP sentences to various baselines, including sentences with reversed clause order (e.g., "The deer ran into the woods while the man hunted") [1-3]. While these studies applied various manipulations, they did not examine how the plausibility of the initial, incorrect interpretation, and the transitivity bias of the optionally transitive verb, affect reanalysis. Moreover, previous research found no effects of clause order when GP sentences included a simple post-verbal NP like "the deer" [2], focusing instead on sentences with longer post verbal NPs (e.g., "the deer that was brown and graceful"). In this study, we investigate partial reanalysis in two large-scale single-trial experiments (n=4,560). Experiment 1 included sentences with optionally transitive verbs and a simple post-verbal NP, manipulating the plausibility of the initial interpretation and the transitivity bias of the OPT verb. Experiment 2 included sentences with reflexive (e.g., "dressed") or alternating unaccusative verbs (e.g. "changed") [1-3,5-6], which eliminate the need for an additional NP.

Method. For Experiment 1, 45 sentences sets were constructed, crossing three factors: Sentence Type (GP or non-GP, with reversed clause order), Plausibility (plausible or implausible initial parse), and Question Type (simple vs. difficult) (see Table 1). The verbs in the adjunct clause varied in their transitivity bias (the proportion in which they appear with a direct object), ranging from 0.1 to 0.8. For Experiment 2, 24 sentence sets with reflexive or unaccusative verbs were constructed, manipulating Sentence Type and Question Type (see Table 2). The experiment was web-based. Participants saw two simple practice items and then read one experimental sentence, one word at a time (400 ms presentation time), and answered the comprehension question.

Results. Simple questions showed a ceiling effect across experiments and conditions. For Experiment 1, logistic regression on difficult questions revealed a main effect of Sentence Type, with lower accuracy for GP sentences ($p = .006$), and a main effect of Plausibility ($p < .001$), with plausible sentences showing lower accuracy compared to implausible ones. The interaction between these two factors was not significant. Follow-up pairwise comparisons showed that GP sentences were less accurate than non-GP sentences in implausible conditions ($p = .02$), while plausible sentences showed a marginal effect ($p = .07$) (see Figure 1). A model which further included the transitivity bias of the embedded verb revealed an interaction between transitivity bias and Sentence Type; the accuracy advantage of non-GP over GP sentences was reduced for more transitively biased verbs (see Figure 2). In Experiment 2, there was an effect of Sentence Type, with lower accuracy for GP compared to non-GP sentences ($p < .001$, see Figure 3).

Discussion. The results replicate the existence of partial reanalysis in GP sentences with a simple post-verbal NP, and support good enough approaches for sentence processing [7-8]. The drop in accuracy for GP compared to non-GP sentences was especially evident when the embedded verb was reflexive, not requiring an object to be interpreted. Plausibility affected misinterpretation: the NP was interpreted as the object of the OPT verb at lower rates when it was implausible in this role. This effect did not interact with clause order, meaning that the semantic consideration was independent of the syntactic manipulation. The interaction between transitivity bias and Sentence Type shows that highly transitive verbs attach the NP as their object regardless of its position, while for less transitive verbs misinterpretation arises more when the NP follows the verb directly. Interestingly, our study showed overall lower accuracy in difficult questions compared to previous studies, likely due to the single-trial design, which limited participants' ability to reflect on the structures used in the study.

Table 1. An example set from the materials of Experiment 1 with optionally transitive verbs.

Conditions	Garden path	Non-Garden path
Plausible	While the man hunted the deer ran into the woods.	The deer ran into the woods while the man hunted.
Implausible	While the man hunted the child ran into the woods.	The child ran into the woods while the man hunted.
Question	**Simple**: Did the deer/child run into the woods? **Not simple**: Did the man hunt the deer/child?	

Table 2. An example set from the materials of Experiment 2 with reflexive verbs.

Garden path	Non-Garden path
While Jim bathed the child giggled with delight.	The child giggled with delight while Jim bathed.
Question	**Simple**: Did the child giggle with delight? **Not simple**: Did Jim bathe the child?

Figure 1. Accuracy rates of Experiment 1.

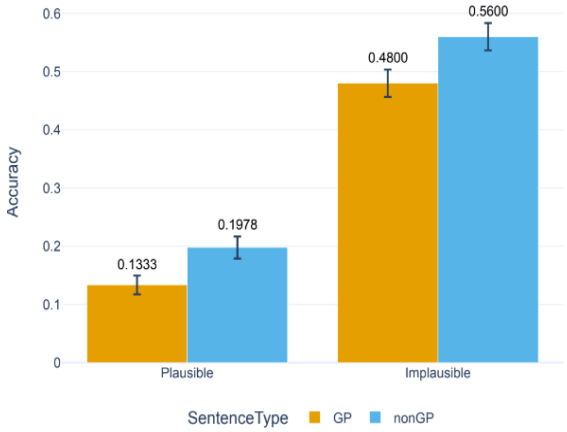


Figure 2. Accuracy rates of Experiment 1 as a function of transitivity factor.

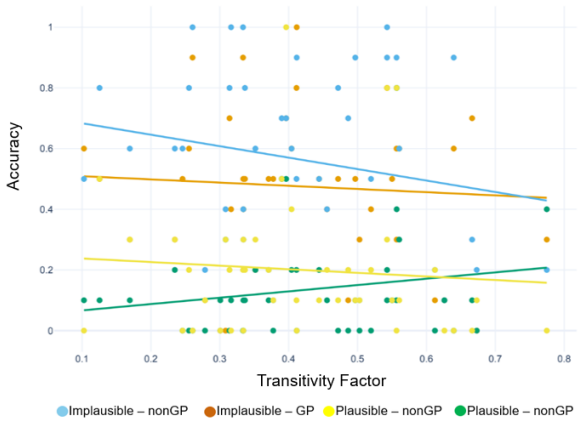
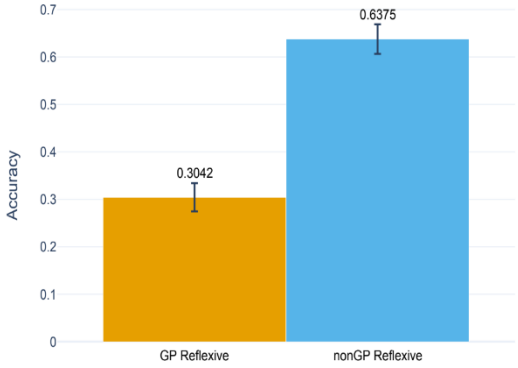


Figure 3. Accuracy rates of Experiment 2.



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