Interference in the comprehension of filler-gap and filler-resumptive dependencies
Niki Koesterich, Maayan Keshev, Daria Shamai, Aya Meltzer-Asscher (Tel Aviv University)

Background. Language processing is subject to interference in various dependency types. Extensive research attributes interference effects to *Retrieval Interference* (RI)*,* namely failure to integrate the correct item, or slow integration, arising when a retrieval cue matches the features of two or more items in memory. This mechanism entails that only cues available at the retrieval site can create interference [1-3]. Recent research, however, has argued that interference effects, at least in part, must be attributed to *Encoding Interference* (EI), i.e. degradation of memory representations when features are shared by items co-activated in memory. In contrast to RI, EI can occur even when the overlap is in features not relevant for retrieval [4-8].

   In two comprehension experiments we show that, in Hebrew object relative clauses, a gender matching distractor reduces accuracy both when gender is a retrieval cue (in filler-resumptive dependencies, where gender is marked on the resumptive pronoun [RP]) and when it is not (in filler-gap dependencies). We used right branching grammatical object relatives, such that the main clause subject was the distractor, matching or mismatching the filler and the RP in gender. Participants read the sentences in rapid serial presentation and had to answer yes/no comprehension questions (with confidence ratings) directed at the correct (target) and incorrect (distractor) interpretations. A translated sample set is provided in Table 1.

   Experiment 1: obligatory RPs (64 participants, 32 sets). We used verbs that take an *Indirect Object* (IO) complement, where relativization is obligatorily realized by an RP in Hebrew. In addition to the manipulation of distractor match and question type we also manipulated dependency length by increasing the distance between the filler and the verb using a temporal adverb and an adjective phrase. We observed main effects of distractor match (p < .001), and question type (p < .001), and a significant interaction of the two such that participants were less accurate at distractor questions (i.e. answered 'yes' at a higher rate) when the distractor matched the filler (p < .001, Fig, 1A). No main effects or interaction were detected for the length manipulation. In addition, we generated ROC curves separately for Match and Mismatch conditions (see Fig. 2A). A bootstrap test comparing the two curves revealed that participants had significantly lower sensitivity when the distractor matched the filler (p < .001).

   Experiment 2: optional RPs and gaps (65 participants, 32 sets)*.* We used verbs that take a *Direct Object* (DO) complement, where relativization can be realized either by a RP or a gap. This allowed us to manipulate the retrieval site (gap vs. RP), such that only in RP conditions gender is a retrieval cue. A pre-test ensured that both the fillers and the distractors were similarly likely complements of the RC verb, and that this likelihood was not different for DO verbs and IO verbs from Exp. 1. The results revealed the same main effects and interaction as in Exp. 1 (all p < .001, Fig. 1B). Resumption did not produce significant effects apart from a two-way interaction with question type (p = .02), suggesting that RPs increased accuracy on filler questions but not on distractor questions (regardless of distractor match). A bootstrap test comparing ROC curves of Match and Mismatch conditions revealed significantly lower sensitivity for Match cases, in both RP (p < .001) and gap conditions (p < .001, Fig. 2B-C).

   Discussion. The current study provides evidence for EI effects in comprehension of relatives. As we detected interference in gap conditions, where gender is not a retrieval cue, the results cannot be attributed to RI. In addition, RI is sometimes argued not to predict interference in grammatical sentences [2], in contrast to our results. The results also cannot be attributed to simple recency of the distractor, as it precedes the target. The results are in line with previous evidence for the effect of NP type on processing of relative clauses [7-8]. We show that EI leads not only to slower RTs [4-8], but also to misinterpretation (i.e. low accuracy). Interestingly, EI is thought to arise when two NPs with overlapping features are co-activated, while in our experiments the distractor (the main clause subject) integrates with its verb before the filler (the target) is encountered. This raises questions as to the type of co-activation which leads to EI.

Exp. 1, *obligatory RP*	*distractor* *filler* The **manager{M/F}** knew the **cashier.F** that {yesterday morning} the {demanding and opinionated} customers listened **to her** during the busy shift
Exp. 2, *gap | optional RP*	The **manager{M/F}** knew the **cashier.F** that the demanding and opinionated customers interested **{ __ | her }** during the busy shift
FillerQ: **DistractorQ:**	Did the customers {listen to/interest} the cashier? (correct: Yes) Did the customers {listen to/interest} the manager? (correct: No)

Table 1. Translation of an example set from the materials of Exp. 1-2.
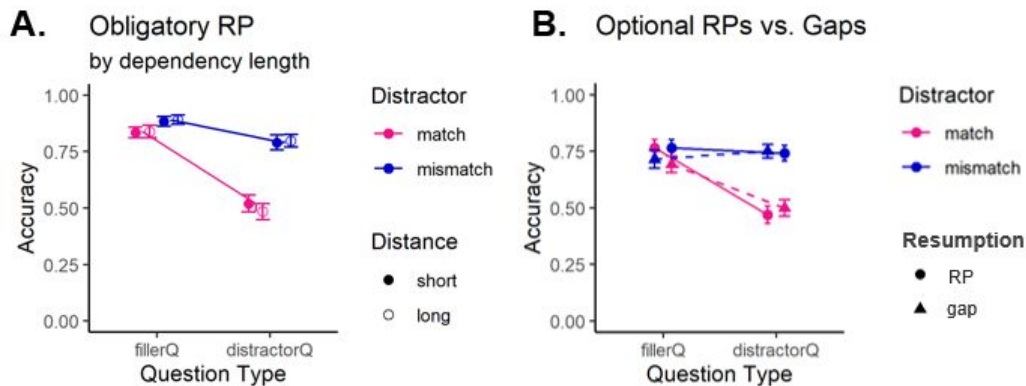
Figure 1. Percent correct responses across experimental conditions in Exp. 1 (left) and 2 (right).
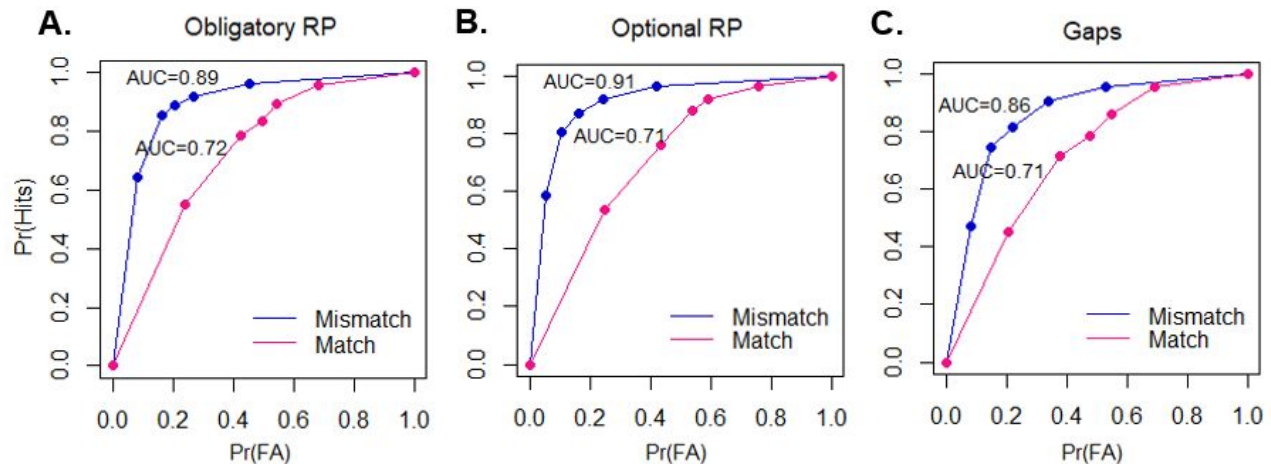
Figure 2. ROC curves for obligatory RPs (Experiment 1, collapsed across dependency length), optional RPs (Experiment 2) and gaps (Experiment 2)**.**

References: [1] Lewis & Vasishth (2005). An activation-based model of sentence processing as skilled memory retrieval. *Cog Sci*. **[2]** Wagers, Lau, & Phillips (2009). Agreement attraction in comprehension: Representations and processes. *JML.* **[3]** Jaeger, Engelmann, & Vasishth (2017). Similarity-based interference in sentence comprehension: Literature review and Bayesian meta-analysis. *JML.* **[4]** Villata, Tabor, & Frank (2018). Encoding and retrieval interference in sentence comprehension: Evidence from agreement. *Frontiers in Psych.* **[5]** Parker & Konrad (2020). Teasing apart encoding and retrieval interference in sentence comprehension: Evidence from agreement attraction. *CogSci annual meeting.* **[6]** Smith, Franck, & Tabor (2021). Encoding interference effects support self-organized sentence processing. *Cog Psy*. **[7]** Gordon, Hendrick, & Johnson (2001). Memory interference during language processing. *JEP: LMC*. **[8]** Gordon, Hendrick, & Johnson (2004). Effects of noun phrase type on sentence complexity, *JML*.