

Similarity-based interference in online and offline sentence processing

Juliana Gerard (Ulster University)

j.gerard@ulster.ac.uk

Parsing a long-distance dependency involves encoding, storage, and retrieval [1-2]. However, non-target elements in the context may interfere with these processes, especially when they share some of the features of elements in the dependency [3-5].

This study tests the predictions of encoding and retrieval interference with adjunct control - a dependency between the main clause subject and silent adjunct subject [6], as in (1). Importantly, retrieval for this syntactic dependency is not triggered by morphosyntactic features which are more common retrieval cues in other contexts (e.g. subject-verb agreement) [7-8]. Therefore, if interference is observed for these features, it will occur during encoding or storage, but not at retrieval.

In Experiment 1, adult native English speakers were recruited on Prolific (N=33, plus 3 excluded for <70% accuracy on fillers). **The main clause subject MATCHED or MISMATCHED with the object in (stereotypical) gender**, as in (2). Sentences were presented in a self-paced reading paradigm, with all test sentences and fillers followed by a yes/no question, as in (3). Adjunct control questions probed for interpretation of the adjunct subject, and filler sentence questions provided feedback for incorrect answers.

Since gender is not a retrieval cue for antecedent retrieval in adjunct control, retrieval interference is not predicted. However, encoding interference is predicted in the form of (a) a slowdown in reading times for MATCHED elements (main clause subject and object) at the adjunct verb and/or spillover region, compared to MISMATCHED elements, and (b) lower accuracy/less subject control for comprehension questions after sentences with MATCHED elements.

In addition, all adjuncts included an emphatic reflexive to probe the interpretation of the adjunct subject [7]. The reflexive either matched with the main clause subject in gender, making the sentence GRAMMATICAL, or mismatched in gender, making it UNGRAMMATICAL, as in (4). If the main clause subject is retrieved as the antecedent, then slower reading times are predicted for the UNGRAMMATICAL sentences at the reflexive, compared to the GRAMMATICAL sentences.

Reading times for Experiment 1 are presented in Figure 1, and the proportion of subject control responses in Figure 2. As expected, slower reading times were observed for ungrammatical sentences at the reflexive, in the spillover region (refl+1; $p < .001$, linear mixed model with log RTs). There were no other reading time effects. However, in their offline responses, participants gave significantly less subject control answers in MATCH conditions than in MISMATCH conditions for GRAMMATICAL sentences ($p = .003$, logistic mixed model), as predicted.

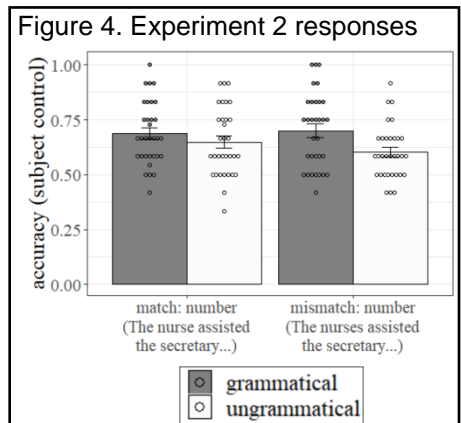
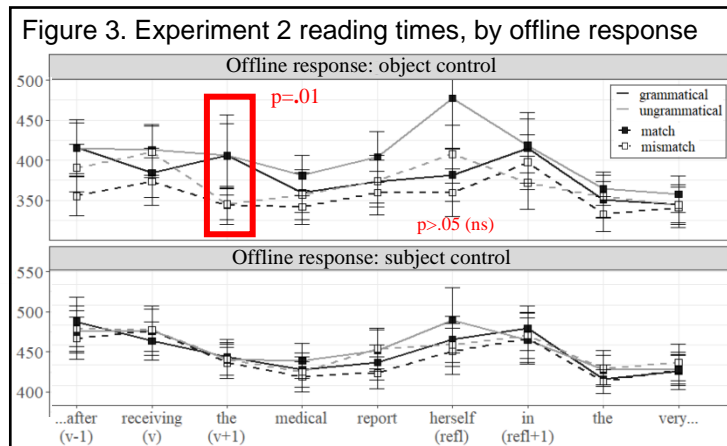
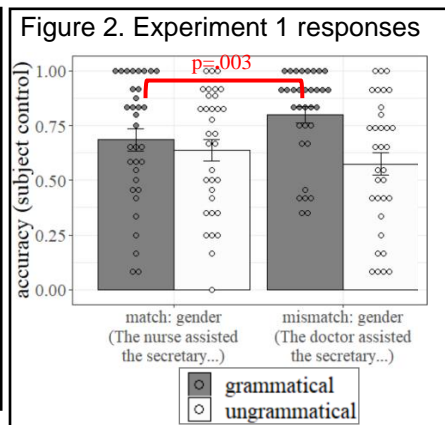
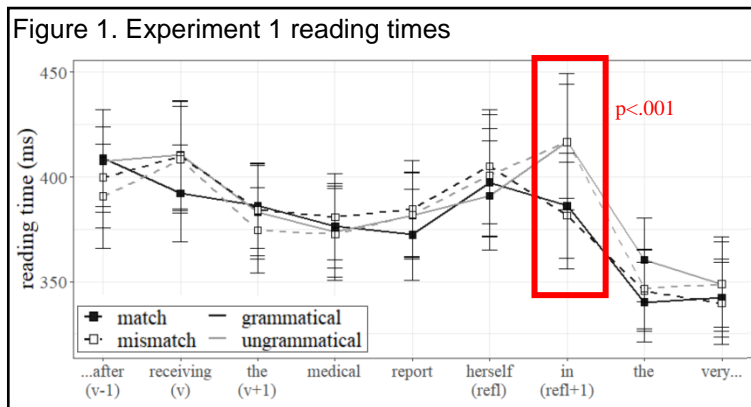
The main effect of grammaticality on reading times indicates that participants access a subject control interpretation online, without interference from semantic gender features. However, these features do cause interference for the final representation, as shown in participants' offline responses. To tease apart the role of semantic and syntactic features, **Experiment 2 repeated the same design with number**, which is explicitly marked in English (N=32, +2 excluded). The main clause subject and object either MATCHED or MISMATCHED in number, and always matched in gender. Ungrammatical sentences mismatched in the reflexive number (5).

Reading times for Experiment 2 are presented in Figure 3, and the proportion of subject control responses in Figure 4. In contrast to Experiment 1, participants did exhibit slower reading times when the subject and object MATCHED in number, but only when they gave an offline object control response ($p = .01$, linear mixed model with log RTs). There were no other reading time effects. Interference effects were not observed for number in offline responses (E1*E2 interaction $p = .02$). This further contrasts with the gender effect in Experiment 1, and suggests that **morphosyntactic features affect online dependency formation, while semantic features cause interference for a later form of the representation in memory**. Future research will increase the sample with a power analysis, and test the predictions that this makes for (a) crosslinguistic variation (e.g. languages with morphosyntactic gender) and (b) interactions between syntactic and semantic features in resolving long-distance dependencies.

- (1) The nurse₁ assisted the doctor₂ after $\emptyset_{1/2}$ receiving the report.
- (2) a. MATCH: The **nurse** assisted the **secretary** at the hospital after receiving the medical report herself in the very crowded examination room. (full test sentence)
b. MISMATCH: The **doctor** assisted the **secretary** at the hospital after receiving....
- (3) Did the secretary receive the medical report? (50% "Yes" answers, 50% "No" answers)
- (4) a. GRAMMATICAL: The doctor assisted the secretary...after receiving report **himself** ...
b. UNGRAMMATICAL: The nurse assisted the secretary...after receiving the report **himself**...
- (5) a. The nurses assisted the secretary at the hospital after receiving the report **herself** ...
b. The nurse assisted the secretaries at the hospital after receiving the report **themselves**...

		Experiment 1: gender (m=male, f=female)		Experiment 2: number (s=singular, p=plural)		
	subj/obj	GRAMMATICAL	UNGRAMMATICAL	subj/obj	GRAMMATICAL	UNGRAMMATICAL
MATCH	m/m	himself	herself	s/s	himself*	themselves
	f/f	herself	himself	p/p	themselves	himself*
MISMATCH	m/f	himself	herself	s/p	himself*	themselves
	f/m	herself	himself	p/s	themselves	himself*

*gender was also counterbalanced in Experiment 2, but always matched



References:

- [1] Frazier & Fodor (1978). *Cognition*, 6(4)
- [2] Lewis & Vasishth (2005). *Cognitive Science*, 29(3)
- [3] Jäger, Engelmann, & Vasishth (2017). *Journal of Memory and Language*, 94
- [4] Jäger, Mertzen, Van Dyke, & Vasishth, (2020). *Journal of Memory and Language*, 111
- [5] Smith, Franck, & Tabor (2021). *Cognitive Psychology*, 124
- [6] Chomsky, (1981). *Lectures on Government and Binding*.
- [7] Parker, Lago, & Phillips, (2015). *Frontiers in Psychology*, 6.
- [8] Gerard, Lidz, Zuckerman, Pinto, (2017). *Frontiers in Psychology*, 8.