

## Underlying clausal structure modulates lexical interference: Evidence from raising and control

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Speaking requires effectively managing the interference between words in an utterance (e.g., Dell et al. 2008). In previous studies, it has been suggested that words within the same clause interfere with each other more than the words across two different clauses because words in the same clause are more likely to be planned simultaneously (Garrett, 1975). Thus, clausal boundaries may limit interference between words. Here we examine how clausal structures that are not necessarily transparent on the surface modulate interference between words in a single utterance to better understand how structural and lexical processes interact in speaking.

We investigated the production of sentences involving Raising-To-Object (RtO) and Object Control (OC) (see Table 1). In RtO, *the donkey* starts off in the underlying subject of the verb *follow*, then raises to the object position of the matrix verb *want*. In comparison, in OC, *the donkey* is not the subject of the verb *follow*, because the subject of the verb *follow* is a null pronoun coreferential to *the donkey* (Postal 1974 a.o; see Polinsky 2013). Therefore, in the underlying structural representations, *the donkey* and *the horse* belong to the same clause in RtO but not in OC. Given the previous finding that nouns in the same clause interfere with each other (Smith & Wheeldon, 2004) more than nouns in different clauses (Garrett, 1975), it is predicted that speakers show more interference between *donkey* and *horse* in RtO sentences than in OC sentences. If this prediction is borne out, it would suggest that sentence planning involves fine-grained structure building processes that distinguish between RtO and OC, and that the non-surface structures of sentences affect the time-course of lexical planning in production, which in turn affect how much words interfere with each other.

We used a sentence-recall task, where speakers ( $n = 69$ ) memorized a sentence presented in RSVP fashion, read aloud 2-4 random verbs, and recalled the sentence upon seeing another (random) verb that was presented in red font (Fig. 1). The random verbs served to inhibit rote memorization thereby encouraging conceptual encoding. Speakers recalled 24 sentences like in Table 1. Our working assumption is that sentence recall involves the regeneration of sentences from conceptual memory (Potter & Lombardi, 1990), and thus it involves the usual processes of grammatical encoding. We measured the duration of the matrix verb of their utterance (e.g., *wanted/taught*), which we predicted to reflect the difficulty of selecting the upcoming noun (e.g., *donkey*). This choice of dependent measure was pre-registered. Because *donkey* and *horse* are semantically related and should interfere with each other (Levelt, 1999), to the extent *donkey* and *horse/man* are planned simultaneously, speakers should show longer duration in the matrix verb production in the related conditions (where the object of the embedded verb is *the horse*) than in the unrelated conditions (where the object of the embedded verb is *the man*). If clauses constitute planning domains such that elements in different clauses are not planned concurrently, then we should observe the interference effect only in the RtO condition and not the OC condition. We fit linear models, with SentenceType and Relatedness as fixed effects and maximal random effect structures that allowed model convergence, and with the number of syllables in the matrix verb as a covariate. The result shows that speakers indeed showed longer matrix verb duration in the related compared to unrelated conditions, but only in the RtO sentences (Fig. 2, interaction  $p < .05$ ; pairwise comparison in the raising condition:  $p = .01$ ), confirming the pre-registered prediction.

The current study suggests that the underlying clausal structures of sentences modulate how much words interfere with each other in a sentence. This in turn suggests that speakers construct syntactic structures detailed enough to distinguish between RtO and OC during planning and use these fine-grained structural representations to control the time-course of lexical access. We thus argue that the temporal dynamics of lexical planning are modulated by underlying syntactic structures even when these structures are not apparent on the surface.

Table 1. Example sentences used in the experiment in each condition. The underlined words are either similar (in the related condition) or dissimilar (in the unrelated condition).

MatrixVerb	Relatedness	Sentence
Raising to Object	Related	The rancher wanted <u>the donkey</u> to follow <u>the horse</u> .
Raising to Object	Unrelated	The rancher wanted <u>the donkey</u> to follow <u>the man</u> .
Object Control	Related	The rancher taught <u>the donkey</u> to follow <u>the horse</u> .
Object Control	Unrelated	The rancher taught <u>the donkey</u> to follow <u>the man</u> .

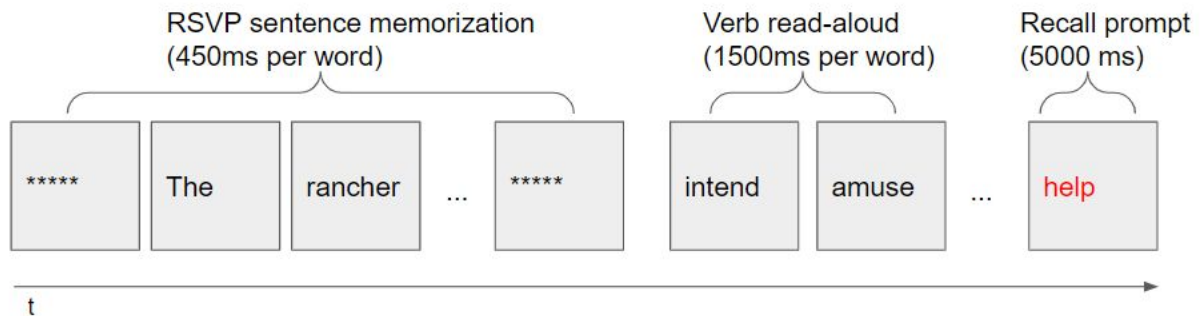


Fig 1. A schematic illustration of the sentence recall task.

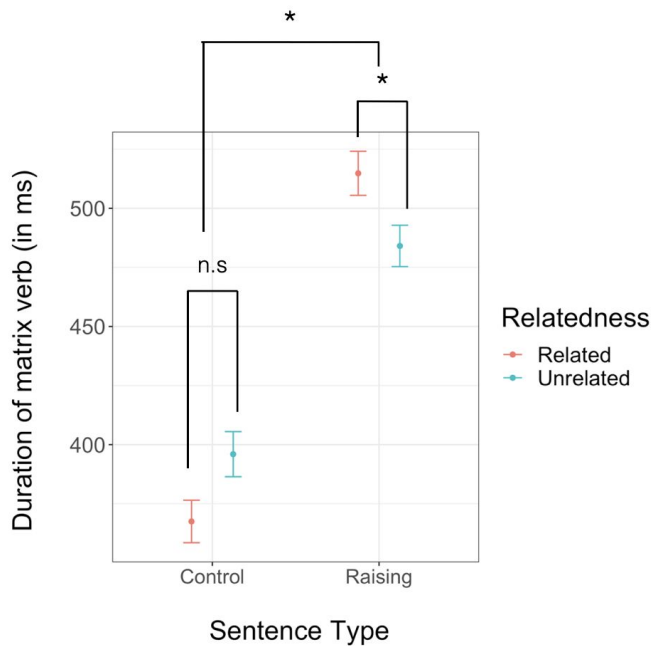


Fig 2. The mean duration of the matrix verb by condition.