Interference in the processing of complement control: an eye-tracking study on lexically determined long-distance dependencies

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Background: This investigation focuses on the resolution of lexically-driven anaphoric dependencies in Spanish complement control constructions. This dependency, illustrated in Table 1, involves an interpretative relation between the null subject of the non-finite clause (PRO) and its antecedent: the subject or the object of the matrix clause, depending on certain lexico-semantic properties of the matrix clause verbs (e.g. *promise* = subject control, *order* = object control). Previous eye-tracking studies have contended that whereas control information is immediately accessed and used to retrieve an antecedent, distance effects also influence antecedent selection processes at the point of dependency formation (Betancort et al. 2006; Kwon and Sturt 2016). In these works, object control dependencies were found to be processed faster at the infinitive region, which was interpreted as evidence for a recency effect (or locality advantage). Furthermore, other studies have respectively shown that adjunct control dependencies and subject nominal (rather than verbal) control dependencies exhibit interference effects by irrelevant but feature matching antecedents (Parker et al., 2015; Sturt & Kwon 2015). Here we replicate previous works by examining whether object control dependencies are facilitated over subject control ones at the point of retrieval (the infinitive verb) due to a locality advantage. Furthermore, by fully crossing the type of control verb and the gender of the NPs in the matrix clause we are able to investigate whether the integration of the embedded adjective is subject to facilitatory and/or inhibitory interference effects in both subject and object control dependencies.

Method (n=48): The effects of the experimental factors –CONTROL, GRAMMATICALITY and DISTRACTOR– on the different eye-tracking measures are analyzed in five regions using LMEM: the NP2, infinitive verb, the adverb the adjective, and PP following the adjective. The materials consisted of 96 item sets like the one in Table 1.

Results: No differences between subject and object control dependencies were found at the infinitive verb. Significant interactions between the three experimental factors were found in first-pass times of the adjective region (Figure 1) and the PP region (Figure 2). An interaction between GRAMMATICALITY and DISTRACTOR was found in go-past times at the PP (Figure 3).

Discussion: First, in contrast with the results from previous works, in this study we found no evidence for a facilitation effect for object control dependencies. Instead, the two types of sentences were read similarly at the NP2, the infinitive and the adverb region. This discrepancy with previous works is possibly due to a confound identified in the materials by Betancort et al. (2006) and differences between control nominals (used in Kwon and Sturt 2016) and control verbs. Second, the significant interactions indicate that control-irrelevant antecedents are temporarily considered during the adjective's integration. The effect found in first-pass times of the adjective region (Figure 1) is suggestive of inhibitory interference processes in subject control sentences. The effect found in first-pass times of the PP region (Figure 2) is consistent with facilitatory interference processes in subject control sentences. Effects for facilitatory interference processes for both types of dependencies are only found in the go-past times of the PP region (Figure 3). Furthermore, the lack of grammaticality effects independently of the type of distractor (match/mismatch) appears to indicate that there is a tradeoff between grammatical sensitivity and facilitatory interference. These findings show that verbal control dependencies are also affected by interference effects and, what is more interesting, these effects emerge for both types of control structures. Nonetheless, the fact that interference effects appear earlier and more pervasively in subject control sentences seems to indicate the proximity of the NPs with respect to the adjective plays a role in the adjective's integration.

Table 1: Experimental materials*

Subject control		
Gram.	**D. Match**	María$_i$ prometió a Cristina$_j$ PRO$_i$ ser mucho más **ordenada** con los apuntes del instituto.
	D. Mismatch	María$_i$ prometió a Francisco$_j$ PRO$_i$ ser mucho más **ordenada** con los apuntes del instituto.
Ungr.	**D. Match**	Antonio$_i$ prometió a Cristina$_j$ PRO$_i$ ser mucho más **ordenada** con los apuntes del instituto.
	D. Mismatch	Antonio$_i$ prometió a Francisco$_j$ PRO$_i$ ser mucho más **ordenada** con los apuntes del instituto.
Object control		
Gram.	**D. Match**	María$_j$ ordenó a Cristina$_j$ PRO$_j$ ser mucho más **ordenada** con los apuntes del instituto.
	D. Mismatch	Antonio ordenó a Cristina$_j$ PRO$_j$ ser mucho más **ordenada** con los apuntes del instituto.
Ungr.	**D. Match**	María$_j$ ordenó a Francisco$_j$ PRO$_j$ ser mucho más **ordenada** con los apuntes del instituto.
	D. Mismatch	Antonio$_j$ ordenó a Francisco$_j$ PRO$_j$ ser mucho más **ordenada** con los apuntes del instituto.
NP1 promised/ordered NP2 PRO to be much more organized with the notes from high school.		

*Note that *María* and *Cristina* are feminine names and *Antonio* and *Francisco* are masculine names. In this example, the sentences become ungrammatical when the feminine adjective *ordenada* (*organized*) does not agree in gender with the appropriate antecedent of the null subject (PRO). The regions of interest are underlined in the English translation at the bottom of the table.

Figures: The y-axis represents the transformed RTs for the different eye-tracking measures. The power transformation was determined using the Box-Cox procedure. Asterisks indicate significant post-hoc contrasts after applying Hochberg's correction.

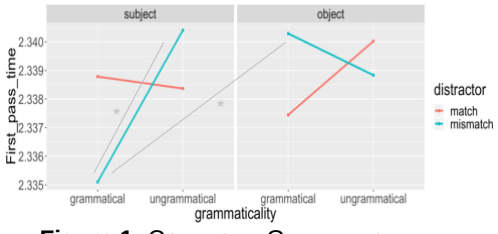

Figure 1: CONTROL X GRAMMATICALITY X DISTRACTOR interaction in the first-pass times at the adjective.

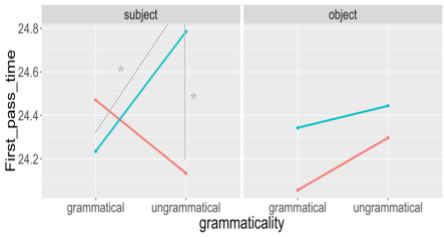

Figure 2: CONTROL X GRAMMATICALITY X DISTRACTOR interaction in first-pass times at the PP.

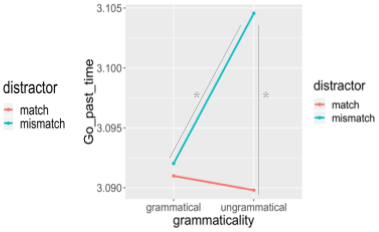

Figure 3: GRAMMATICALITY X DISTRACTOR interaction in the go-past times of the PP.

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