Maintain to pre-activate: Is subject-verb dependency proactive?

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Syntactic prediction has been defined as expectation of a certain syntactic structure or relation, by means of maintaining it or anticipating its conclusion (Ilkin & Sturt, 2011; Staub & Clifton, 2006; DeLong et al., 2014). In this study, we investigate whether long distance dependencies are also maintained, with the aim of information pre-activation. Long-distance dependencies have mostly been investigated through filler-gap dependencies, showing that fillers are actively maintained over clause boundaries, together with some of their content (Wagers & Phillips, 2014; Ness & Meltzer-Asscher, 2017) and that this maintenance of open dependencies is costly (Chen et al., 2005; Fiebach et al., 2002). Here we investigate whether there is also a processing cost generated by maintenance of the syntactic dependency between subject and verb. Using the eyetracking technique, we expected this maintenance cost to be reflected in longer reading times on early eyetracking measures, namely on first pass and go-past reading times. We performed two eyetracking experiments in two languages of different morphological complexity - Spanish (Experiment 1), and English (Experiment 2).

In Experiment 1, the Spanish sentences contained the matrix subject (la chica, see Table 1) which was immediately followed by an embedded adverbial clause. In the control condition, the same adverbial clause followed a prepositional phrase (Para la chica) so that it does not intervene in an open subject-verb dependency. Slower reading of the embedded adverbial clause in the experimental, but not control condition would indicate maintenance cost. Fifty six native Spanish speakers read 112 items while their eye movements were recorded. We analyzed first pass and go-past reading times for the region over which the subject-verb dependency is maintained, i.e. the entire embedded clause region. We fitted LMEMs with the Condition (Experimental, Control) as fixed effect and random by-subject and by-item intercepts and slopes. A significant effect of Condition in go-past reading times appeared, such that the reading times were increased in the experimental condition (Intercept= 1622.16, Estimate=60.99, SE=16.92, t=3.61, p<.001). However, we did not find an effect in first pass reading times. This might suggest that the effect in go-past may be due to occasional difficulty that surfaced in regressive eye movements, but not in general slowing.

English sentences with a similar design were created in Experiment 2, such that the matrix clause subject and verb were separated by an embedded clause in the experimental condition (Table 1). Again, in the control condition, there was no subject-verb dependency to be maintained over the embedded clause. Also, in Experiment 2 the matrix verb is encountered even before the embedded clause. We tested 56 native English speakers while they read 80 sentences. The procedure and the analysis followed those in Experiment 1. We found a significant effect of Condition, such that experimental condition generated longer reading times on the embedded clause, both in first pass (Intercept=733.94, Estimate=38.62, SE=12.95, t=2.99, p=.003) and go-past reading times (Intercept=983.31, Estimate=61.08, SE=13.29, t=4.60, p<.001).
These experiments suggest that subject-verb dependency is maintained, which induces a processing cost in the form of increased reading times on the elements over which it is being maintained. This adds to the body of research showing maintenance cost for long distance filler-gap dependencies (e.g. Wagers & Phillips, 2014; Ness & Meltzer-Asscher, 2017; Chen et al., 2005). We propose that the subject-verb agreement is maintained in order to keep the relevant information pre-activated, with the ultimate goal of facilitating the conclusion of this syntactic relation later in the sentence. Maintenance seems to be taking place, irrespective of the morphological complexity of the language, and thus irrespective of the complexity of the information involved in agreement operation. In future, we will focus more on the potential morphosyntactic content of the maintained representation, which might explain the differences in time-course of the effects across experiments. Additionally, these results oppose theoretical accounts (e.g. McElree et al., 2003) that describe long-distance subject-verb dependency formation essentially as a retrieval process.

References:


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<tr>
<th>Condition</th>
<th>Experiment 1</th>
<th>Experiment 2</th>
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<tbody>
<tr>
<td>Experimental</td>
<td><em>La chica, cada vez que una amiga viene, prepara la cena.</em>&lt;br&gt;“The girl, whenever a friend comes over, prepares a dinner.”</td>
<td><em>That girl, whenever a boy passes by, starts laughing.</em></td>
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<td>Control</td>
<td><em>Para la chica, cada vez que una amiga viene, preparar la cena es un placer.</em>&lt;br&gt;“For the girl, whenever a friend comes over, preparing a dinner is a pleasure.”</td>
<td><em>I met that girl, and whenever a boy passes by, she starts laughing.</em></td>
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Table 1. Example of an item in Experiment 1 and 2