

# The size of 'it': Syntactic reactivation effects and accessibility of conceptual event representations during anaphora processing

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**Background.** When processing sentences like 'Oliver signed the contract and Jasmine did it, too,' comprehenders can rapidly recover the antecedent of the anaphor 'it'. Studies investigating anaphora processing leave unclear whether the syntactic structure of the antecedent ('sign the contract') is copied (and therefore represented) at the anaphor (Murphy, 1985; Postal, 1966), or whether antecedent information is retrieved from memory without reactivating its syntactic structure (Martin & McElree, 2008; Sag & Hankamer, 1984). Another less-studied question is whether anaphora processing affects conceptual structure, in particular when antecedents differ in their syntactic complexity. To address both of these issues, we employ a novel composite task involving a G(rammatical)-Maze followed by Sentence Picture Verification (SPV). The G-Maze task tests (i) whether antecedent syntactic information is reactivated by the anaphor and (ii) whether increasing syntactic complexity of the antecedent (NP<VP<CP) increases processing costs. We hypothesize that antecedent syntactic structure is reactivated by the anaphor, and more complex antecedents incur increased processing costs. The SPV task is included to enforce antecedent recovery and to measure conceptual structure activated by the sentence. Following Ramchand & Svenonius (2014), we expect anaphor complexity effects to also be reflected in the conceptual representation.

**Methods.** English speakers (N=208) read two-sentence sequences in English in the G-Maze task (Boyce & Levy, 2023; Freedman & Forster, 1985) in the 2×2 design in (1) manipulating ANTECEDENT TYPE (object vs. event) and NUMBER OF EVENTS in the discourse (one vs. two). For clarity, we use Noun Phrase (NP), Verb Phrase (VP), and Complementizer Phrase (CP) to refer to the conditions.

(1) **First Sentence:** Oliver signed the contract.

- |  |                     |
|--|---------------------|
| a. <b>NP<sub>same</sub>:</b> He signed it (= the contract) in the office.    | ONE EVENT   OBJECT  |
| b. <b>NP<sub>diff</sub>:</b> He left it (= the contract) in the office.      | TWO EVENTS   OBJECT |
| c. <b>VP:</b> He did it (= sign the contract) in the office.                 | ONE EVENT   EVENT   |
| d. <b>CP:</b> He announced it (= that he signed the contract) in the office. | TWO EVENTS   EVENT  |

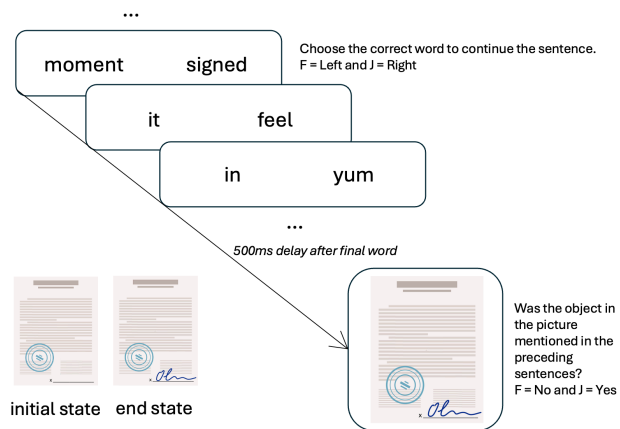
In the SPV task at the end of each trial, participants saw a picture of an object and had to determine as quickly and accurately as possible whether the object was mentioned in the preceding sentence. Target trial objects were depicted in either initial or end state (e.g., unsigned vs. signed contract) according to the event introduced by the first sentence (see Fig.1). We take these states to be a measure of the activated representations of objects and events (see Altmann & Ekves, 2019).

**Analysis.** We fit generalized linear mixed-effects models with gamma distributions to raw reaction times (RTs) in the second sentence at the verb, at 'it', and at the word following 'it' (anticipating spillover effects) to test the effects of ANTECEDENT TYPE, NUMBER OF EVENTS, and their interaction, and at the picture screen to test the effects of ANTECEDENT TYPE, NUMBER OF EVENTS, PICTURE TYPE, and their interactions. Models included random effects of *participant*, *item*, and *surprisal* (based on predictions of GPT-2 Sm for sentence 2), which estimates the likelihood of sentence continuation at each word. We take residual effects to be reflective of processing cost beyond these regressors.

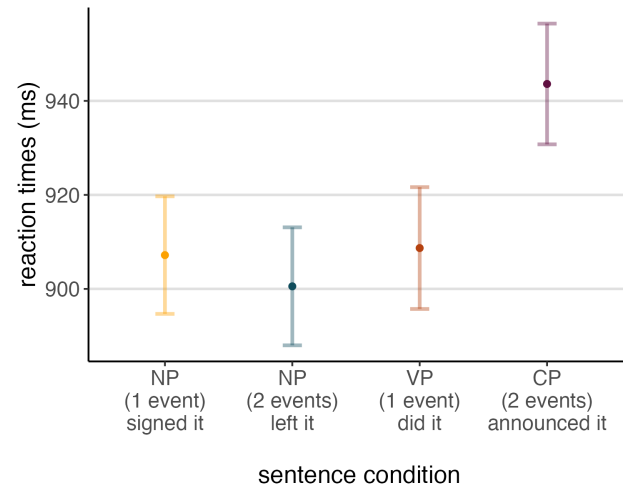
**Results & Discussion.** In the G-Maze (Fig.2), a persistent effect of NUMBER OF EVENTS ( $p < .001$ ) shows slower processing for two events versus one. Crucially, an interaction at the word following 'it' ( $p < .001$ ) reveals slower RTs in the CP condition. These results indicate that syntactic structure is reactivated by the anaphor, with greater structural complexity (CP vs. VP/NP) incurring increased processing costs. The SPV results (Fig.3) corroborate this: RTs were slowest in the CP condition ( $p = .001$ ; no interaction with PICTURE TYPE). These results further suggest that introducing CP-level

structure shifts a comprehender's conceptual state from an event-level mode to a proposition-level mode, leading to increased effort to respond to perceptual event detail (object states) at the picture.

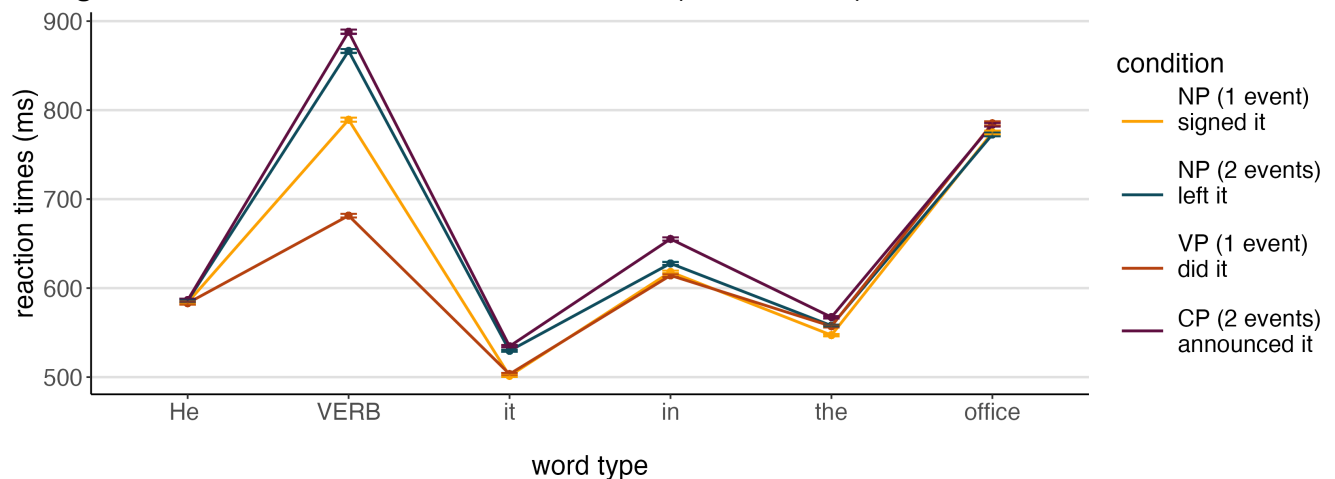
**Figure 1. Schema of the Task By Trial.**



**Figure 3. Means and SEs of Raw RTs to Pictures (SPV Task).**



**Figure 2. Means and SEs of Raw RTs to Words (G-Maze Task).**



## References

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