Speakers encode silent structures: evidence from complementizer priming in English

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Are syntactic structures with no perceptual-motor content, like the null complementizer (e.g., ∅ in *the boy believes ∅ the dog likes the cat*), relevant for modeling real-time language use (Culicover & Jackendoff, 2006, Wagers & Phillips, 2009)? Here we investigate whether speakers encode the null complementizer using *structural priming*, the tendency for speakers to reuse structures they previously encountered (Bock, 1986). We show that the null complementizer can be primed across constructions hypothesized to contain the null complementizer.

We report three sentence recall-based production experiments (Potter & Lombardi, 1990, Ferreira, 2003) with the same general procedures. Speakers first read out loud and memorized a target sentence and prime sentence, in this order. They were then presented with an array of words used in one of the two sentences, which served as a recall cue for recalling the sentence that contained them. There were 24 target sentences, shared across all experiments. They all contained VP-complement clauses with 'that' (e.g., *The director announced that the actor would be in the new movie)*. Each target was paired with a prime, the properties of which varied across experiments (Table 1). The resulting 24 pairs of sentences were randomly mixed with 32 filler sentence pairs. In filler trials, participants sometimes recalled the second sentence, so they could not reliably guess which sentence they should recall before seeing the recall cues. Priming manipulation was within-subject, and experimental lists were created according to a Latin Square design. All data were analyzed using Bayesian logistic regression with maximally structured random effects (Barr et al. 2016).

Results are summarized in Fig. 1. **In Exp. 1** (n = 72), we examined if relative clauses with the relative pronoun *who* prime the null complementizer in VP-complement clauses. According to some theories (see Bhatt, 2002 for an overview), *who* but not *that* relative clauses contain the null complementizer (see Fig. 2). Speakers were 7.8% less likely to say *that* in target production given a who relative clause prime compared to a neutral prime (b = -0.54, SE = 0.20, 95% CrI = [-0.90, -0.14]). There was no evidence for the priming of *that* in this experiment, like in Ferreira (2003). Importantly, this priming effect, unlike the one reported in Ferreira (2003), cannot be explained as the priming of phrase structure configuration (Bock & Loebell, 1990; Pickering & Ferreira, 2008) like VP → V CP vs. VP → V TP. This is because relative clauses and complement clauses do not share the relevant phrase structure configuration. **In Exp. 2** (n = 100), we replicated the null complementizer priming effect in Exp. 1 while also addressing the potential confound of prime sentence length difference between neutral and the null complementizer primes, by adding the long neutral condition. Speakers were 6.8% less likely to say *that* given the *who* relative clause primes compared to the average of other primes (b = -0.58, SE = 0.17, 95% CrI = [-0.92, -0.24]). There was no evidence for the difference between the short neutral, long neutral, or *that* conditions. **In Exp. 3** (n = 84), we tested if *whether*-clauses prime the null complementizer in declarative VP-complement clauses, compared to synonymous *if*-clauses. This prediction was derived from linguistic theories positing the null complementizer in *whether*-clauses but not *if*-clauses (e.g., Larson, 1985; Kayne, 1991, Wu, 2022; see Fig. 2). Speakers were 5.5% less likely to say *that* given whether-primes than given *if* primes or neutral primes (b = -0.45, SE = 0.18, 95% CrI = [-0.81, -0.09]), suggesting that speakers encode the null complementizer when producing whether-clauses and VP-complement clauses, but not *if*-clauses. Taken together, speakers encode the null complementizer shared across distinct constructions hypothesized to contain the null complementizer. As far as we are aware, no phonological, semantic, or pragmatic factors can capture the current results (cf. Ziegler et al. 2019). The effect also cannot be explained as the priming of phrase structure configuration, because relative clauses and VP-complement clauses do not share relevant phrase structures. Thus, the current results are difficult to explain without assuming the null complementizer. We conclude that (a) speakers encode the null complementizer as a cognitively active mental object and (b) theories of grammar that allow null elements are more, not less, psychologically adequate than the theories that ban them.

Exp #	Prime	Prime Type
1	*They appreciated the really lenient professor.*	Neutral
	They appreciated the professor that was really lenient.	That
	They appreciated the professor who was really lenient.	Who
2	*They appreciated the really lenient professor in their class.*	Long neutral
	They appreciated the really lenient professor.	Short neutral
	They appreciated the professor that was really lenient.	That
	They appreciated the professor who was really lenient.	Who
3	*The scientist is unsure about the accuracy of the theory.*	Neutral
	The scientist is unsure if the theory is accurate.	If
	The scientist is unsure whether the theory is accurate.	Whether

Table 1. Example prime sentences used in each experiment. Target sentences were constant across experiments, and they contained VP-complement clauses, like *the director announced that the actor would be in the new movie.*

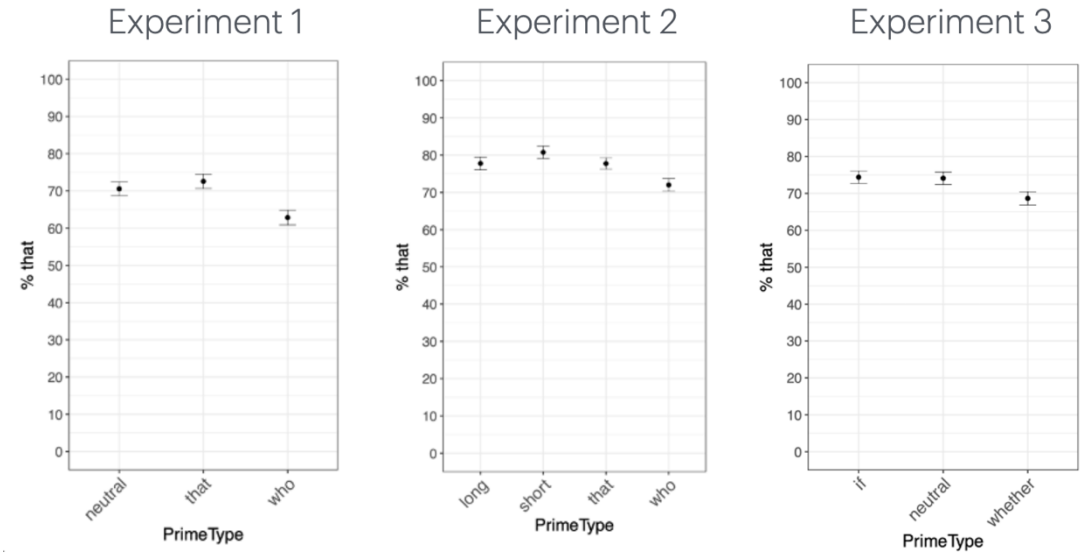

Fig. 1. The average rate of 'that' production by condition across experiments. Error bars are Standard Errors of subject means.

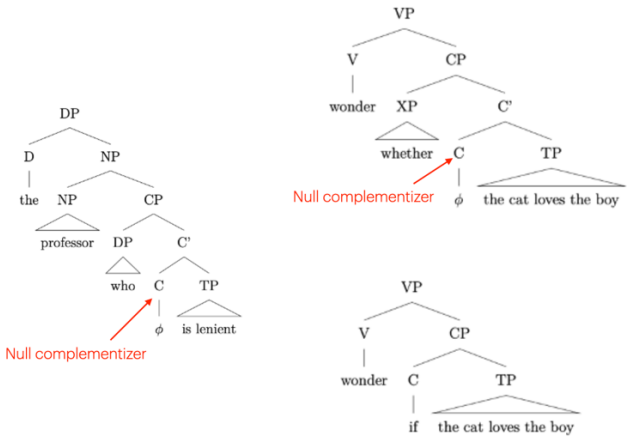

Fig. 2. Hypothesized syntactic structures of who relative clauses, whether-clauses and if-clauses.