Insensitivity to truth-value in negated sentences: does linear distance matter?

Sentences are usually easier to understand when they are true vs. false, but this generalization is challenged by negated sentences. For example, picture recognition studies have shown faster comprehension of true vs. false affirmative sentences, but a reduced or absent effect of truth-value for negated sentences [1,2]. This motivated the claim that negative sentences like "The package is not wrapped" are understood in two steps: comprehenders first represent the counterfactual/alternate state-of-affairs expressed by the affirmative proposition—'The package is wrapped'—and later, in a second step, represent the actual state. However, recent findings suggest that the representation of a counterfactual state can be diminished or even avoided altogether when negative sentences are pragmatically licensed by context and/or the question-under-discussion is prominent [3,4]. We investigate whether the linear position of the negator in a sentence can similarly modulate the processing of negation. We hypothesized that an earlier negator position may facilitate comprehension by stopping the activation of a counterfactual interpretation, or by facilitating its inhibition. To date, only one study addressed this prediction but it did not find an effect of the negator position [5]. But this study differed from previous studies in that it used brain responses to a single word rather than post-sentence response times. To fill this gap and to examine whether the negator position affects the activation of counterfactual states, we conducted a conceptual replication of [5] with a picture recognition task.

Design. German-speaking adults read 40 sentences word-by-word and decided whether a subsequent picture depicted an object in the sentence. The target answer was always 'yes' for the experimental items (Table 1). Experiment 1 (n = 69) used a Polarity (affirmative/negative) × State-of-affairs (actual/alternate) design. Picture type and the adjectival predicate were used to manipulate the state of affairs, resulting in 8 Latin-square lists (collapsed to four in the analyses). Experiment 2 (n = 72) focused on negative sentences. Following [5], an earlier position of the negator was implemented as a greater linear distance between the negator and the predicate (3–4), compared to a shorter distance (1–2). A Distance (close/far) × State-of-affairs (actual/alternate) design assessed whether more distance enhanced participants' sensitivity to truth value.

Results and discussion. Experiment 1 showed longer response times in negative than affirmative sentences, consistent with more processing difficulty. Further, response times were faster for actual vs. alternate state-of-affairs in affirmative, but not in negative sentences, resulting in a significant Polarity × State-of-affairs interaction ($t = -2.4$, $p = .02$; Figure 1). Thus, sensitivity to truth value was reduced in negated sentences. Experiment 2 did not find evidence of a difference due to the negator's position (non-significant Distance×State-of-affairs interaction: $t = -0.68$, $p = .49$). This was because far distance sentences did not show a facilitation for actual (true) states—descriptively, response times were even longer than in the alternate condition. Thus, there was no evidence that the earlier negator fostered sensitivity to the truth value of negated sentences. Ongoing work is examining whether the type of negation may have influenced the results: While the negation in (1–2) simply negates a specific state of affairs, the negation in (3–4) is a metalinguistic negation, rejecting a previous assertion (e.g., 'The package is wrapped').

Table 1. Sample item in Experiment 2. Experiment 2 featured only negative sentences (all fillers were affirmative). Experiment 1 comprised close distance negative sentences together with their affirmative counterparts (e.g., 'The package is wrapped'). The target picture for the actual conditions is surrounded by a dotted line. The target picture for the alternate conditions is not framed. In another 4 lists, target pictures and predicates were reversed.

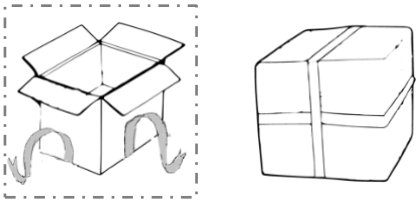
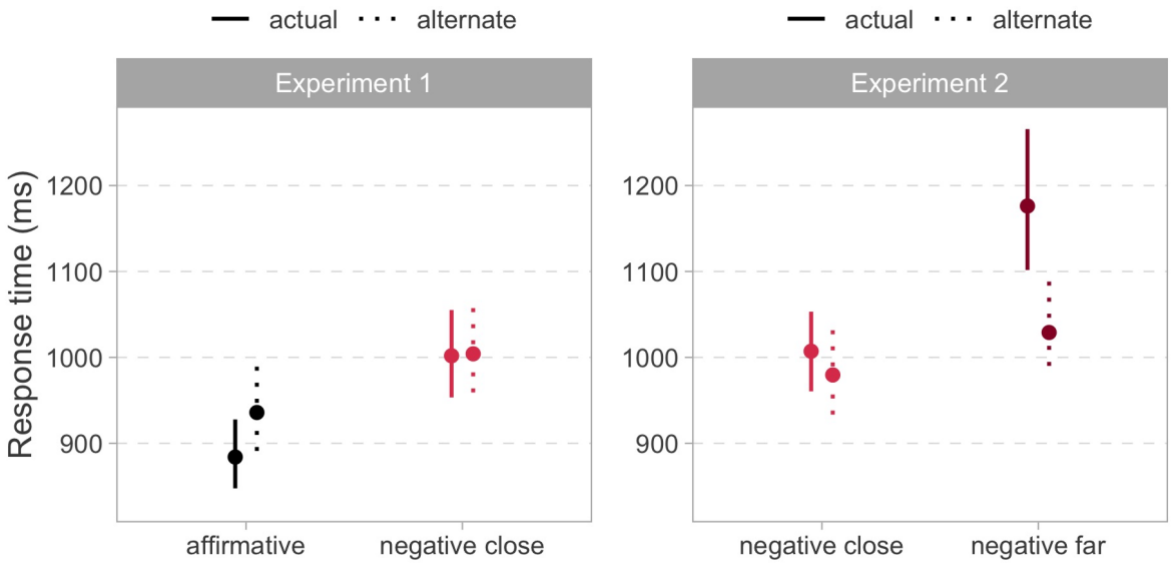
Experimental conditions	Pictures (one picture shown per trial)
1. **Close distance, actual** Das Paket ist nicht eingepackt. ‚The package is not wrapped'	
2. **Close distance, alternate** Das Paket ist nicht ausgepackt. ‚The package is not unwrapped'	
3. **Far distance, actual** Es stimmt nicht, dass das Paket eingepackt ist. ‚It is not true that the package is wrapped'	
4. **Far distance, alternate** Es stimmt nicht, dass das Paket ausgepackt ist. ‚It is not true that the packet is unwrapped'	

Figure 1. By-condition response time averages for correct responses, with error bars showing 95% confidence intervals. Response times are displayed in milliseconds for interpretability, but the statistical analyses were performed on reciprocally transformed response times using linear mixed-effects models with maximal random effects structures by participants and items.



References

[1] Clark & Chase (1982) *Cogn. Psychol*. [2] Kaup et al. (2005) *Cogsci.* [3] Tian et al. (2010) *Q. J. Exp. Psychol.* [4] Darley et al. (2020) *Cognition* [5] Dudschig et al. (2019) *Lang. Cogn. Neurosci.*