Incremental negation processing with positive questions under discussion

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Abstract

Short abstract. Previous research has shown that the processing difficulty associated with negation can be modulated by context. In the absence of a supportive context, negative sentences tend to answer a positive question under discussion (QUD) which leads to a two-step interpretation strategy. However, negation is processed incrementally when used in a context in which it addresses a negative QUD. The present study provides new evidence according to which negation can be incrementally processed when it addresses a positive polar QUD in a supportive context generated by discourse markers (*As expected, John has (not) washed the car*).

Introduction. Negative sentences are generally harder to process compared to affirmative sentences (for an overview, see Kaup & Dudschig, 2020). However, the processing difficulty can be modulated by context. When used without any contextual support, negative sentences (*John hasn't washed the car*) are processed in a two-step fashion (Kaup et al., 2006; Kaup et al., 2007): comprehenders first represent the non-factual object state (clean car) and only subsequently the factual object state (dirty car). One possible explanation is that, in the absence of any contextual information, negative sentences tend to answer a positive question under discussion (QUD) (Has John washed the car?). In contrast, negation is processed incrementally when used in a context in which it addresses a negative QUD (Tian et al., 2010, 2016; Wang et al., 2021), expressed either by means of cleft sentences (*It was John who didn't cook the spaghetti*) or wh- questions (*Which fruit isn't peeled?*).

Research question and predictions. In two behavioral experiments, we investigated whether negative sentences can be processed incrementally when addressing a positive polar QUD. To that end, in a probe recognition task (Fig. 1), affirmative and negative sentences were used in the absence (Experiment 1) or in a supportive context (Experiment 2) generated by discourse markers (*As expected, John has (not) washed the car*). These markers render the contextual expectation salient (It was expected that John would (not) wash the car), which is always congruent with the actual object state (Table 1). In both experiments, affirmative and negative sentences address a positive QUD (Has John washed the car?). For affirmative sentences, we expect faster response times (RTs) for the factual compared to the non-factual object states in both experiments. In contrast, for negative sentences we expect different patterns of responses. If negation is processed in a two-step way, we expect a crossover interaction between the factors *Polarity (aff/neg)* and *Depicted object state (factual/non-factual)*, with faster RTs for the non-factual (clean car) than for the factual object state (dirty car). If negation is processed incrementally, we expect a main effect of *Depicted object state*, with faster RTs for the factual (dirty car) compared to the non-factual object state (clean car).

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Results. RTs on correct picture-present trials were analyzed by means of a linear mixed effects model (Table 2). As predicted, participants responded faster to the factual object states in the affirmative condition in both experiments, while different patterns of responses emerged in the negative condition. *Experiment 1* (N = 104; 20 men; *M*age = 37.26; *SD* = 12.39; online, English items) revealed a crossover interaction between the factors *Polarity* and *Depicted object state* ($\chi 2(1) = 9.50$, $p = .002$, $\beta = -21.02$, $t = -3.08$), a main effect of Polarity ($\chi 2(1) = 10.36$, $p = .001$, $\beta = -21.93$, $t = -3.22$) but no main effect of Depicted object state ($\chi 2(1) = 2.47$, $p = .116$, $\beta = -10.75$, $t = -1.58$). In line with the two-step procedure, these findings suggest that participants responded faster to non-factual (clean car) than to the factual object states (Fig. 2a). By contrast, *Experiment 2* (N = 88; 27 men; *M*age = 39.82; *SD* = 13.95; online, English items) showed the reversed pattern with two main effects of Depicted object state ($\chi 2(1) = 23.77$, $p < .001$, $\beta = -41.78$, $t = -4.90$) and Polarity ($\chi 2(1) = 16.74$, $p < .001$, $\beta = -35.07$, $t = -4.11$). There was a significant ordinal interaction this time ($\chi 2(1) = 11.03$, $p = .001$, $\beta = 28.39$, $t = -3.32$), which suggests that participants responded faster to the factual (dirty car) compared to the non-factual object state in the negative condition (Fig. 2b). To receive more information about the pattern of responses in the negative conditions, a post hoc test was performed. This showed an interaction between the *Depicted object state* and *Context* (no context Exp. 1/context Exp. 2) ($\chi 2(1) = 4.51$, $p = .034$, $\beta = 16.84$, $t = 2.12$), which replicates previous findings according to which the processing of negative sentences is strongly modulated by context (Fig. 2c).

Discussion. All in all, the present paper corroborates previous results which indicate that context strongly influences the processing of negative sentences. Furthermore, it provides new evidence showing that, in a supportive context, negation can be incrementally processed when it addresses a positive polar QUD.

References

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Table 1: Example items for the probe recognition task in Experiments 1 & 2

Polarity	Depicted object state	Experiments 1 & 2: Sentence	Experiments 1 & 2: Display
Affirmative	factual	(As expected) John has washed the car.	
	non-factual	(As expected) John has washed the car.	
Negative	factual	(As expected) John hasn't washed the car.	
	non-factual	(As expected) John hasn't washed the car.	

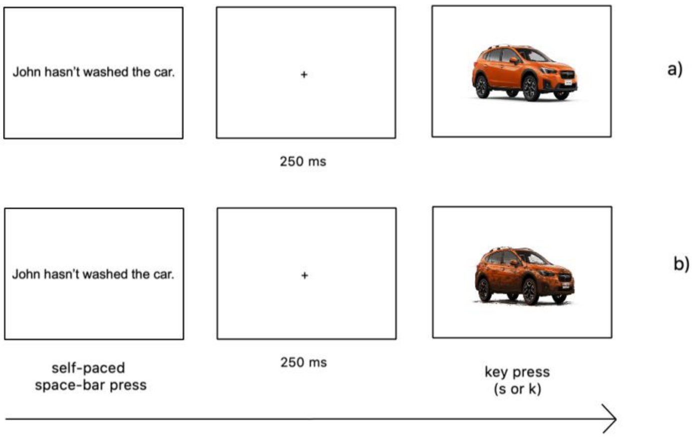

Figure 1: The time course of a typical negative trial; a) non-factual object state b) factual object state

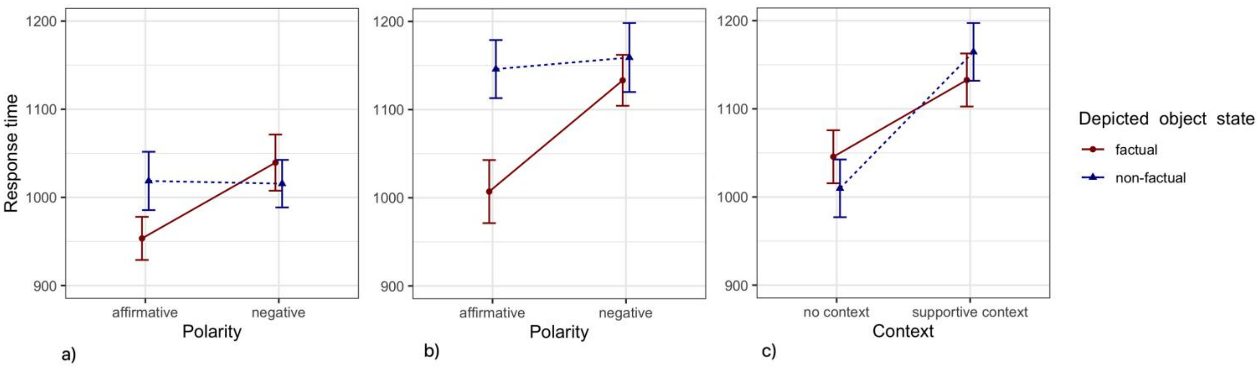

Figure 2: Response times Experiments 1 & 2, and Post hoc; error bars denote 95% confidence intervals; a) Experiment 1 b) Experiment 2 c) Post hoc

Table 2: Linear mixed effects models in Experiments 1 & 2 and Post hoc

Exp. 1 & 2	The base model: rt ~ Polarity + Depicted object state + (1| item + 1|participant)
	The best model: rt ~ Polarity* Depicted object state + (1| item + 1|participant)
Post hoc	The base model: rt ~ Context + Depicted object state + (1| item + 1|participant)
	The best model: rt ~ Context * Depicted object state + (1| item + 1|participant)