Contrary to expectations:
Does context influence the processing cost associated with negation?

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Research question. In comparison with affirmation, the processing of negation is said to be more costly and more error-prone (Fischler et al. 1983), often requiring the activation and rejection of the positive correspondent (Kaup et al. 2007). However, negation serves more interactional functions in communication which may be obscured when negation is used out of context. Based on the premise that the rejection of the counterpart is not exclusive to negation, we investigated the hypothesis that negation is not more difficult to process than affirmation when both are presented in contexts where contextual expectations are denied (for different kinds of supportive contexts, see Nieuwland and Kuperberg, 2008).

Experiment 1. We compared the response times (RT) of negative and affirmative sentences in a sensibility-judgement-task in four conditions (see Table 1). We used 40 sensical experimental sentences *([Contrary to expectations/ Surprisingly/ Unexpectedly/ Unpredictably] John has/hasn't eaten the soup)* and 40 non-sensical fillers *([Contrary to expectations/ Surprisingly/ Unexpectedly/ Unpredictably] Mark has/hasn't fed the shelves)*, distributed over four counterbalanced lists. The discourse connectives activate, accommodate and trigger the denial of contextual expectations (positive in the case of negative sentences and negative in the case of affirmation). A pre-test was conducted to make sure that the negative and affirmative experimental items did not differ significantly with regard to plausibility (U = 661.5, p = 0.182). The task of the participants was to decide as quickly as possible whether the sentences made sense by pressing *f* or *j*, standing for *yes* and *no*, respectively. Response configurations were counterbalanced across participants. The experiment took place online and the procedure was controlled by *JsPsych* (de Leeuw, 2015).

Predictions. We expected an interaction between the factors *Context* and *Polarity* with (a.) significantly longer RTs for negative sentences in comparison with affirmation in the non-supportive contexts and (b.) similar RTs for affirmative and negative sentences in the supportive contexts.

Results. A threshold of 80% accuracy was set (reducing the initial set of N = 153 to a final set of N = 79, 32 females; Mean age=38.13, SD=11.32). Mean RTs in the four conditions are displayed in Figure 1 and Table 2. We analyzed the results by means of repeated measures ANOVA with the factors *Polarity* (affirmative/negative) and *Context* (non-supportive/supportive). There was a main effect of Polarity (F(1,78) = 14.31, p < .001), with shorter RTs in the affirmative condition, and a main effect of Context (F(1,78) = 135.6, p < .001), with shorter RTs in the non-supportive contexts. Numerically, the difference between the two polarity conditions was smaller in the supportive contexts but the interaction was not significant (F(1,78) = 2.32, p = .132), invalidating our second prediction.

Experiment 2. The sentences in the two contexts in Experiment 1 differed in length. The aim of Experiment 2 was to look at the effect of context without this confound. We now compared the supportive contexts from Experiment 1 with non-supportive contexts with the same number of syllables (*[Everybody is convinced that/ Everyone thinks that/ Based on what we know/ We believe that] John has/hasn't eaten the soup*). The design and predictions were identical to those in Experiment 1.

Results. Based on an accuracy threshold of 80% the initial set of N = 130 participants was reduced to a final set of N = 59 (27 females; Mean age=39.93, SD=11.47). The means in the four conditions are displayed in Figure 2 and Table 2. As in Experiment 1, the ANOVA revealed a main effect of Polarity (F(1,58) = 7.52, p = .008) and a main effect of Context (F(1,58) = 9.42, p < .003) but no interaction (F(1,58) = 0.76, p = .386), although again the difference between the two polarity conditions was smaller in the supportive than in the non-supportive context.

Conclusions. To sum up, this study aimed at investigating whether negation and affirmation behave similarly in supportive contexts. Both affirmative and negative sentences were designed around

the mismatch between contextual expectations and sentence meaning: the denial of negative expectations lead to an affirmative sentence meaning whereas the denial of affirmative expectations lead to a negative sentence meaning. The discourse connectives activate, accommodate and reject the contextual expectations, rendering the utterances relevant and informative. In comparison with previous studies (Tian et al. 2016), in our study both affirmative and negative sentences presuppose the activation and rejection of the counterpart representation and the question under discussion for both polarities is *whether p*. Although the patterns of RTs tended to validate our prediction, the relevant interaction was not significant, showing that polarity and context do not influence each other. In other words, the supportive context does not seem to facilitate the processing of negation in the current setting. However, the processing difficulty associated with negation should be further investigated, as the RTs in the sensibility-judgement task include the time required for response decision and preparation and might not be ideal to capture differences in processing times.

Table 1: Conditions Experiment 1

Context	Affirmative	Negative
non-supportive	*John has eaten the soup.*	*John hasn't eaten the soup*
supportive	*Contrary to expectations, John has eaten the soup.*	*Contrary to expectations, John hasn't eaten the soup.*

Table 2: Means per condition (standard errors in parentheses) in the four conditions of Experiment 1 and 2

	Experiment 1		Experiment 2	
Context	**Affirmative**	**Negative**	**Affirmative**	**Negative**
non-supportive	1629(30.3)	1769(29.3)	2256(52.0)	2422(55.1)
supportive	2099(38.9)	2143(36.7)	2102(45.6)	2214(47.8)

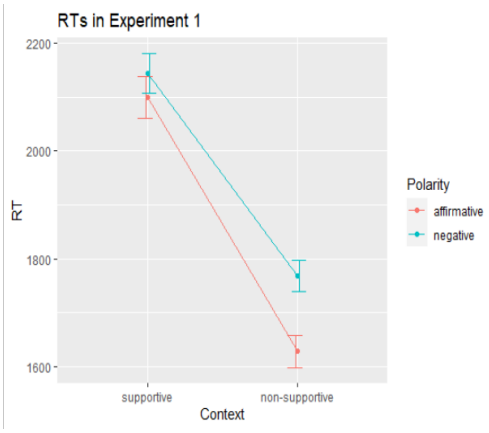

Figure 1. RTs in Experiment 1; Error bars denote standard errors.

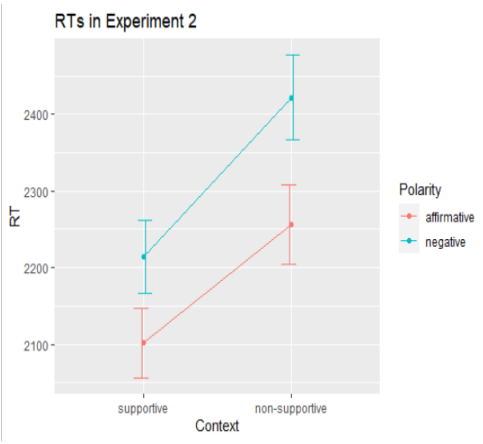

Figure 2. RTs in Experiment 2; Error bars denote standard errors.

References

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