Contrary to expectations: Is negation more difficult than affirmation?

Elena Albu, Oksana Tsaregorodtseva, Barbara Kaup (University of Tübingen)

Research question. In comparison with affirmation, the processing of negation is said to be more difficult when presented out of context (for an overview, see Kaup & Dudschig, 2020). When embedded in a supportive context, i.e. narrative stories where the proposition denied is either explicitly stated or strongly inferred (Lüdtke & Kaup, 2006) or the relevant attribute dimension is highlighted (Glenberg et al., 1999), the difficulty associated with negation is reduced or completely eliminated. Based on the premise that the processing of negation requires a context of plausible denial (Wason, 1965), we investigated whether negation is facilitated in a minimal context provided by discourse connectives which deny contextual expectations (in the following: "denial contexts").

Experiment 1. We compared the response times (RT) of negative and affirmative sentences *([Contrary to expectations/ Surprisingly/ Unexpectedly/ Unpredictably], John has/hasn't eaten the soup*) in a sensibility-judgement task (see Table 1). 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-denial contexts and (b.) similar RTs for affirmative and negative sentences in the denial contexts.

Results. We analyzed the data of 79 participants (32 females; M_{age} = 38.13, SD_{age} = 11.32) by means of repeated measures ANOVA with the factors *Polarity* (affirmative/negative) and *Context* (non-denial/denial). There was a main effect of Polarity (F(1,78) = 22.14, p < .001), with shorter RTs in the affirmative condition, and a main effect of Context (F(1,78) = 145.1, p < .001), with shorter RTs in the non-denial contexts. The interaction was not significant (F < 1), invalidating our second prediction. However, the sentences in the two contexts differed in length, an aspect which may have confounded the findings.

Experiment 2 addressed the length confound and investigated the effect of context in denial and non-denial contexts. Expressions reporting people's beliefs with the same number of syllables were added to non-denial contexts (*Everybody is convinced that/ Everyone thinks that/ We believe that/ Based on what we know, John has/hasn't eaten the soup*). The design and predictions were identical to those in Exp. 1.

Results. The data of 62 participants were analyzed (26 females; M_{age} = 39.96, SD_{age}=11.13). As in Exp. 1, the ANOVA revealed a main effect of Polarity (F(1,61) = 21.02, p < .001) and a main effect of Context (F(1,61) = 21.41, p < .001). This time, however, there were longer RTs in the non-denial contexts, possibly reflecting the complexity of the grammatical structures employed. Similarly to Exp. 1, there was no polarity-by-context interaction (F < 1).

Experiment 3. To rule out that the previous results were an artefact of the task, as the RTs in the sensibility-judgement task included the time required for response decision and preparation, a self-paced reading paradigm was employed, where the participants read the sentences fragment by fragment (*Contrary to expectations, // John has/hasn't eaten the soup*). In the attempt to avoid the assumed complexity disparity of the expressions used, connectives with similar complexity were added to the non-denial context (*By all accounts/ Reportedly/ Apparently/ Supposedly, // John has/hasn't eaten the soup*) The predictions were identical to those in Exp. 1.

Results. The analysis of the data (59 participants, 22 females; M_{age} = 39.76, SD_{age} = 13.11) revealed the same patterns: a main effect of Polarity (F(1,58) = 56.31, p < .001), and a main effect of Context (F(1,58) = 14.27, p < .001), but no significant interaction (F < 1).

Conclusions. To sum up, this study aimed at investigating whether negation is facilitated when presented in denial contexts provided by discourse connectives. Both affirmative and negative sentences were designed similarly around the mismatch between the polarities of contextual expectations and sentence meaning. The discourse connectives were meant to provide the context of interpretation by activating and accommodating the expectations as part of the hearers' common ground. The findings in all three experiments showed that the relevant interaction was not significant, indicating that polarity and context do not influence each other. In other words, the denial context provided by discourse connectives does not facilitate the processing of negation. In contrast to previous work, our behavioral study suggests that the contextual licensing of negation is not enough to reduce the processing difficulty associated with negation. By comparison, factors like relevance and informativeness which are triggered in longer narrative stories may be responsible for the facilitation of negation.

Table 1: Conditions Experiment 1 - 3

	Context	Affirmative	Negative
Exp. 1	non-denial	*John has eaten the soup.*	*John hasn't eaten the soup.*
	denial	*Contrary to expectations, John has eaten the soup.*	*Contrary to expectations, John hasn't eaten the soup.*
Exp. 2	non-denial	*Everybody is convinced that John has eaten the soup.*	*Everybody is convinced that John hasn't eaten the soup.*
	denial	*Contrary to expectations, John has eaten the soup.*	*Contrary to expectations, John hasn't eaten the soup.*
Exp. 3	non-denial	*By all accounts, John has eaten the soup.*	*By all accounts, John hasn't eaten the soup.*
	denial	*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 - 3

	Experiment 1		Experiment 2		Experiment 3	
Context	**Affirmative**	**Negative**	**Affirmative**	**Negative**	**Affirmative**	**Negative**
non-denial	1683(65)	1827(60)	2119(95)	2270(94)	1462(60)	1621(72)
denial	2099(76)	2208(80)	2009(90)	2117(89)	1709(69)	1709(76)

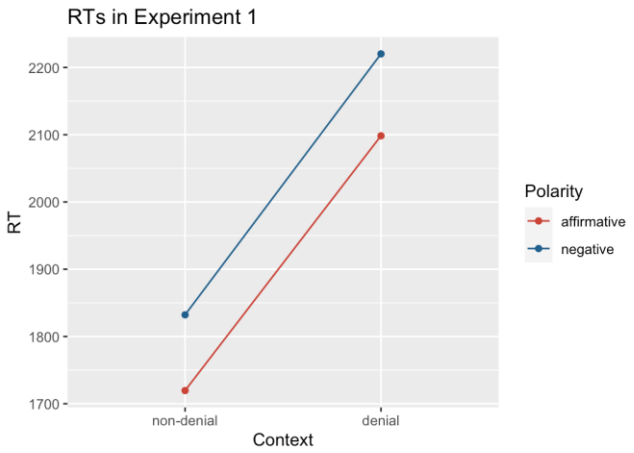

Figure 1. RTs in Experiment 1

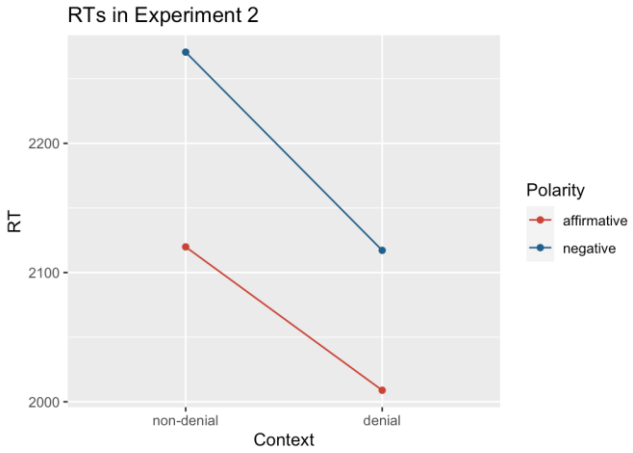

Figure 2. RTs in Experiment 2

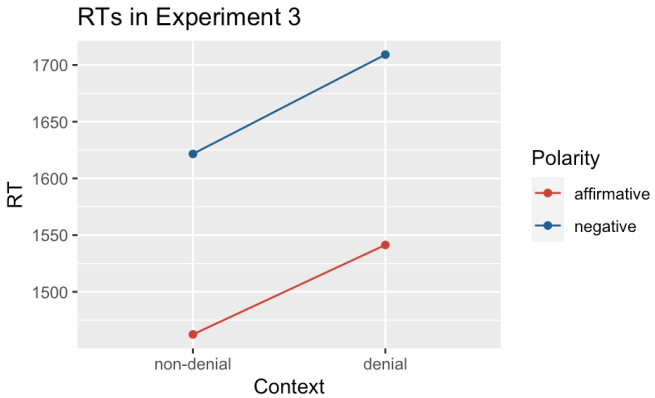

Figure 3. RTs in Experiment 3