

Negation cancels discourse-level processing differences: Evidence from reading times in concession and result relations

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Negative sentences are difficult to process since they require an extra mental step (e.g. Wason, 1959; Kaup, Lüdtke, & Zwaan, 2006), although the prior context can reduce this difficulty in some conditions (e.g. Tian, Ferguson, & Breheny, 2016). The present study takes a novel approach to negation by switching the focus from “what makes negation easier to process” to “what is made easier thanks to negation.” Negation can act as a predictive cue at sentence level (Staab, 2007), but its role beyond the sentence remains to be uncovered. The study reports four self-paced reading experiments that investigated the effect of negative vs. positive polarity on the processing of two discourse relations, namely result and concession. In result relations, the link between the two clauses is logical and expected (e.g. *My sister is an excellent cook so she made a delicious cake for dessert*), while in concession, the second clause is unexpected (e.g. *My sister is an excellent cook but she made a disgusting cake for dessert*). Both relations thus involve a causal inference, except that, in concession, the inference is denied. This denial of expectation leads to a higher processing cost for concession compared to other relations (e.g. Townsend, 1983). By making this denial explicit, negative polarity is expected to be preferred in concession than in result, as reflected in corpus data. In processing, however, the affinity between concession and negation has so far only been demonstrated in materials where negation occurs in the second clause of the relation (e.g. Lyu, Tu, & Lin, 2019). The present study instead manipulated the polarity of the first clause, following the hypothesis that negation facilitates the processing of an upcoming concession and reduces the baseline difference between concession and result.

To test this hypothesis, 40 experimental items were created where the overt verb polarity of the first clause was manipulated (e.g. *knew* vs. *didn't know*). In addition, the type of discourse relation (result vs. concession) was controlled by changing one disambiguating word from the second clause (cf. Table 1, in bold). All relations were connected by *and* in order to avoid implausible conditions, and were preceded by a neutral sentence setting up the context. In addition, 60 filler items were created following the same structure (30 nonsensical, 30 neutral), half of those expressing negative polarity. Using the self-paced reading paradigm, 80 English-speaking participants were recruited on Prolific.co and performed a sense rating task after each trial. The data was analyzed with linear mixed effect models. The results support the central hypothesis that negation cancels the processing difference between result and concession, with a significant interaction between relation and polarity ($\beta = -15.999$, $SE = 6.024$, $t = -2.656$, $p < .01$), as shown in Figure 1. This facilitation is reflected in the offline ratings, which show a preference for negation in concession and for affirmation in result ($\beta = 0.12154$, $SE = 0.02626$, $t = 4.628$, $p < .001$).

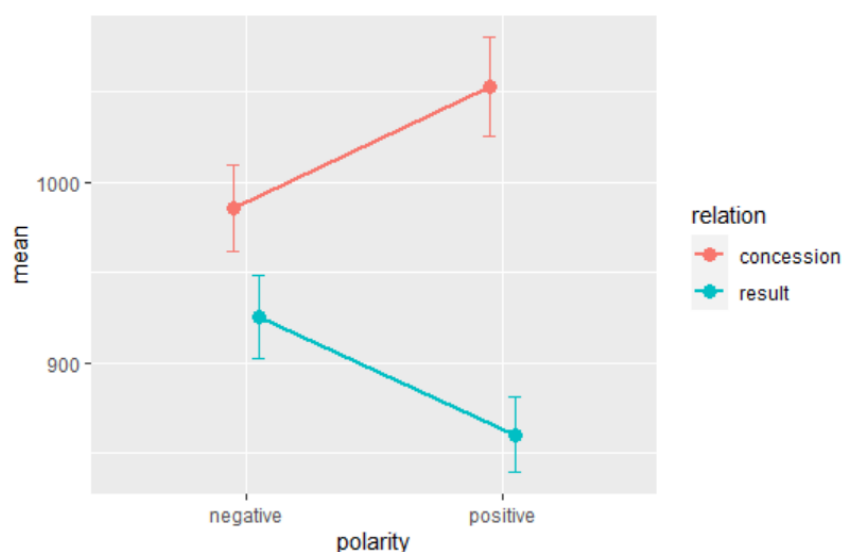
Experiments 2 and 3 further investigated the time-course of the effect of negation on concession by adding a 1,500ms delay (as in Kaup et al., 2006) and by adding a second spill-over region (as in Lyu et al., 2019), respectively. These manipulations did not remove the interaction between relation and polarity and confirmed in particular that positive concession is significantly more difficult to process than positive result, while the slow-down effect of negation in result disappeared over time. Finally, Experiment 4 replicated the findings by replacing *and* with *but* and so in order to address a potential ceiling effect in concession. Despite these more explicit connectives, concession remained more difficult than result overall, and the same interaction was once more observed on the critical region, thus confirming the robust facilitation effect of negation on concession. We can therefore conclude that the interaction between polarity and discourse relations is mutual and bi-directional: not only do some relations facilitate the processing of negation, but initial (i.e. first-clause) negation itself modulates the processing of an upcoming relation and acts as a concessive facilitator.

Table 1. Example materials (context sentence: “The students had an upcoming exam.”)

positive-result	They all knew their coursework well // and they // were confident // about their performance.
negative-result	They didn't know their coursework // and they // were anxious // about their performance.
positive-concession	They all knew their coursework well // and they // were anxious // about their performance.
negative-concession	They didn't know their coursework // and they // were confident // about their performance.

Double forward slashes “//” represent the segmented regions. In Experiment 2, the delay was added before the connective region. In Experiment 3, the second spill-over region contained neutral commentaries.

Figure 1. Mean reading times by condition on the spill-over region (Experiment 1)



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