

Polarity effects in negated sentences with and without truth value reversal: Evidence from N400 and theta oscillations

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Current ERP studies investigating sentence negation have primarily investigated negation in contexts where its operator renders the truth value of a proposition (Fischler et al., 1983; Dudschig et al., 2016, 2019). However, negation is not always employed to render the truth value of a sentence, but also to attenuate a concept activation into a proposition (e.g. *Elizabeth baked some bread but no cookies*, c.f. MacDonald & Just, 1989). To date, it remains an open question if these two structures are processed in a similar way, and what are the potential neural indices for these operations.

In our study, we investigate the online processing of these two types of sentence structures, with a focus on the N400 and oscillatory effects. Therefore we employed two distinct types of sentence structures, both manipulating sentence polarity (positive vs. negative). The first type (truth value) is directly adapted from Fischler et al., (1983), and describes truth value of categorical relations (true vs. false, e.g. *A robin is/not a bird/vehicle*). The second type (congruency) manipulates the verb-object congruency (congruent vs. incongruent, e.g. *The woman reads a/no newspaper/bicycle*). Unlike in the first type, verb-object congruency in the second type is not affected by the negation operator. German-speaking participants (n=21) read 720 sentences in an RSVP (rapid serial visual presentation) manner. In both types, 90 trials per condition (polarity*2/truth value or congruency *2) were presented.

For N400 effects, in the truth value sentences, our results replicated Fischler et al., (1983) by showing an interaction of truth value x polarity: false affirmative and true negative conditions elicited the most pronounced N400 effects. In the congruency items, however, we observed no interaction but only main effects of congruency and polarity: Here, the N400 amplitude was more pronounced for incongruent and negative sentences. Our results corroborated findings from previous studies showing the insensitivity of the N400 to truth value evaluation; additionally, however, we observed that the N400 is affected when negation is not used to falsify a true statement, seen in enhanced N400 amplitudes in

congruent negatives compared to congruent affirmatives.

In the time-frequency domain, across both types of sentences, we observed effects in the theta band (4-7Hz) in terms of total power and inter-trial phase coherence (ITPC): For truth value sentences, false vs. true affirmative sentences elicited increased power and ITPC in the theta band; however, false vs. true negative sentences showed no effect of theta power but reduced theta ITPC. For congruency sentences, theta power increase was only observed in the affirmative condition; as for theta ITPC, incongruent sentences elicited increased theta ITPC in both affirmative and negative conditions. Our results suggest that although both the N400 and theta oscillations might index semantic processing in general, they are differentially affected by negation during online processing.

References

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