The processing cost of negation in sentence comprehension: Evidence from eye movements

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Background. Previous research on negation strongly suggests that negated information is more difficult to process compared to non-negated information. Some even suggest any kind of negation, even words with negative semantics such as *a few*, *a small proportion* and *forget* also take longer to process. Some studies on negatively-prefixed words suggest that these negative words take longer time to process compared to their affirmative base forms (Sherman, 1973), while in other studies contrasting results were found showing that there is no difference in processing between the negatively-prefixed words and their non-prefixed forms and that the prefixed words are processed as single lexical items (Hoosain, 1973; Sherman, 1976).

Method. In order to test the previous claims made about negatively-prefixed words, this study used an eye-tracking sentence processing task where three forms of negation, namely prefixal negation (*un-*), sentential negation (*not*) and double negation (*not un-*) along with the affirmative base form were compared. 20 sets of adjectives of various frequency ranges were selected. The comprehension of these negated forms was tested in a sentence where the first clause contained the negated condition, and the second clause contained a contextual manipulation that would render the sentence congruent or incongruent. In total, 8 conditions were created for every adjective set as exemplified in the table below:

	Negation conditions		Contextual manipulations	
If the evidence shows that the fire in the school was	**intentional**, **unintentional**, **not intentional**, **not unintentional**,	the jury will find the headmaster	**guilty** **innocent**	in court.

The eye movements of 25 native speakers of English were recorded while reading 160 experimental trials. Eye-movement data were analyzed using mixed-effects models. Total reading time and probability of regressions-out were analyzed for the manipulated area and first-pass and second-pass reading times, total dwell time and probability of regressions-in were analyzed for the negated adjectives.

Results. Main effect of negation was found on the negated adjectives where an increased first-pass and second-pass reading times and higher probability of regressions back were found: *base* < *un-* < *not* < *not un-*. In addition, longer total dwell times were found for the negated adjectives with *un-*, *not* and *not un-* compared to the base form. No effect of negation or consistency was found in any of the measures for the manipulated area in the subsequent context.

Conclusion. The findings of this study are in line with the previous research suggesting a processing cost associated with negation where the combination of prefixal and sentential negation proved to be the most problematic case for participants. Moreover, this study provides new evidence for an increased processing time associated with *un-*prefixed adjectives compared to the affirmative base forms. Whether this processing difference is driven by the negative semantics of the prefixed words or is caused by morphology remains to be further investigated. The insignificant differences between the congruent and incongruent conditions could suggest that a good-enough approach was adopted by participants while reading the sentences. However, this result is inconclusive as behavioral data was not available to support this claim.