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ERP studies of visual and auditory processing of negated sentences

Sara Farshchi1, Annika Andersson2, Joost van de Weijer1, and Carita Paradis1
1Centre for Languages and Literature, Lund University
2Department of Swedish, Linnaeus University

Introduction

Previous research shows that negation is ignored in initial processing and the event-related potential (ERP) component N400 is insensitive to negation in the presence of semantic priming effects [2-3, 5]. But other evidence has shown that negation can be readily integrated and incongruities in negated sentences can elicit an N400 [6]. Most of this research has focused on negated forms such as not, no or any while little is known about prefixally negated words (e.g. unauthorized, unintentional) despite their high frequency of occurrence in language use [7].

Aim and research questions

• Two ERP experiments in visual and auditory modalities to investigate affirmatives (authorized), prefixal negation (unauthorized) and sentential negation (not authorized) in sentential contexts such as example 1:

1) The White House announced that the new Obama biography was authorized/unauthorized/not authorized and the details in the book were correct/wrong in actual fact

• ERPs time-locked to the critical word (underlined), the congruency of which was determined by the adjective (bold) in the first part of the sentence. We asked the following questions:

Visual study:

□ Is there a delay in the integration of negated meanings?
□ Is prefixal negation processed similar to the negated form or the affirmative form?

Auditory study:

□ Is auditory presentation of sentences more natural and easier than visual processing?

Summary of findings

Visual:

• Affirmative: N400-P600: successful detection of incongruities (N400) followed by re-evaluation of content to repair meaning (P600)
• Sentential negation: no N400, but a negativity with a longer latency than the typical N400: negation not entirely ignored in processing but meaning not fully present in memory either
• Prefixal negation: sustained anterior negativity: needed meaning to be retrieved from working memory, which was taxing

Auditory:

• Affirmative: N400-P600
• Sentential negation: no N400 but a P600: re-evaluation of content
• Prefixal negation: late positivity (P600): re-evaluation of content

Conclusions

• Negated sentences were not ignored in early processing [unlike 2-3, 5], nor were they processed the same way as affirmative sentences [unlike 6].
• We found evidence for a more nuanced processing of negation suggesting that incongruities in negated sentences involved different processing mechanisms than those in affirmative sentences.
• Prefixal negation was the most difficult form to process in both studies, hence was not likely to be processed the same way as affirmative forms.
• Auditory processing of negated sentences was easier (clearer ERP effects) than word-by-word visual processing.

Material

• 3 pseudo-randomized lists each including 108 visual (100) and auditory (102) items

Method

 EEG recording and processing

• Offline referenced to average of both mastoids
• Filters of 0.01 and 40 Hz
• ICA for removing eye artifacts
• Epochs of 1000 ms (plus 100 ms baseline)
• Amplitudes for congruent and incongruent conditions analyzed for each negation type and each time-window separately
• Mixed-effects modeling, multiple models of various complexity compared, model with lowest AIC reported
• Regions of interest (anterior/central/posterior) and hemisphere (left/mid/right) added as predictors
• Subject and electrode as random factors

References


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