ERP studies of visual and auditory processing of negated sentences

Farshchi, Sara; Andersson, Annika; van de Weijer, Joost; Paradis, Carita

2019

Document Version:
Publisher's PDF, also known as Version of record

Link to publication

Citation for published version (APA):

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

• Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
• You may not further distribute the material or use it for any profit-making activity or commercial gain
• You may freely distribute the URL identifying the publication in the public portal

Take down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.
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. unauthorised, 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 negated meaning not fully present in memory either
- **Prefixal negation:** sustained anterior negativity: negated meaning needed 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.

**Results**

- **Visual:**
  - 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.

- **Auditory:**
  - The White House announced that the new Obama biography was 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.

**Method**

**Material**

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

**Visual**

- Participants: 26 English native speakers (18 F, mean age=29.9)

**Auditory**

- Participants: 32 English native speakers (21 F, mean age=24.8)

**Procedure**

- Offline reference to average of both mastoids
- 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

**Open questions**

- Prefixal negation more difficult than sentential negation. Why? Unnatural use?
- Early positivity for prefixal negation in auditory study?
- ERP effects in auditory studies later than those in visual study, unlike previous research?
- Pre-N400 negativity in auditory study (affirmatives), an N250 [1,4]?

**References**


Presented at the XV International Symposium of Psycholinguistics in Tarragona, Spain, on 11, April 2019.