ERP Response in Visual Recognition

Kesha Amin, Carlos Storck-Martinez, Mengxue Kang, Kevin Ezema,
Dr. Margaret Ingate, Dr. Richard J. Contrada

RUTGERS
THE STATE UNIVERSITY OF NEW JERSEY

Abstract

Reaction times (RT) and event-related potentials (ERPs) provide insight into memory's two retrieval processes, recollection and familiarity. Nineteen participants saw 450 images in three encoding conditions that manipulated level of processing. We presented 750 images in an old/new recognition task, measuring accuracy and RT, for all subjects, and ERPs for thirteen. Deep processing instructions produced significantly higher recognition accuracy and faster RT. These findings have implications for cognitive remediation in various populations.

Background

- **Recognition memory**, the ability to identify a previously experienced stimulus, is supported by two distinct retrieval processes known as familiarity and recollection.
- **Familiarity-based recognition** describes a situation in which an individual has a sense of having experienced an event previously but does not remember the details, whereas **recollection-based recognition** occurs when the person can clearly remember stimulus details.
- **Event-related potential (ERP)** data, obtained by recording changes in electrical potentials from the surface of the scalp, provide valuable information about how recognition memory corresponds to these dual processes. The main advantage of using ERPs is that they provide real time information.

References

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Methods

- Subjects included 19 undergraduate students at Rutgers University in Piscataway, New Jersey
  - Thirteen students had both electrophysiological and behavioral data recorded
  - Six students only provided behavioral data
  - Two subjects failed to follow instructions, leaving 17 for analysis
- ERPs from the Fz, FCz, Cz, Pz, T4, T3, M1, M2, and VEOG sites were measured during both the encoding and recognition trials.
- Level of processing was manipulated within subjects. Order of conditions was counter-balanced with 150 trials in each condition.
  - In the 'deep' condition, subjects answered "yes" or "no" to the question: "Is the object safe for children to play with?"
  - In the 'shallow' condition, subjects answered "yes" or "no" to the question: "Does the picture contain the color red?"
  - The non-specific condition instructed subjects: "Try to remember the image".
- 450 targets and 300 foils were presented in an 'old/new' recognition task
- Recognition trials consisted of a central fixation point for a duration randomly varied around 1250 ms, 250 ms presentation of an image, then a blank screen for 1000 ms. Subjects used the triggers of a game controller to make their responses.

Results

Reaction Time Data during recognition trials of targets

- 3 x 2 x 3 (level of processing, outcome, order) mixed model ANOVA
- The main effect of the level of processing manipulation was significant [$F(2,28)=3.8$, $p < .05$, partial Eta squared=0.21]. No other factors or interactions were significant.
- The deep and non-specific conditions produced faster responses to target stimuli than did the shallow processing condition.

ERP Amplitude Data during recognition trials

- Amplitudes were averaged for the periods 200 msec to 799 msec after stimulus presentation, separately for hits and misses.
- Useable signal data for 5 subjects was analyzed with a 6 x 2 (channel x outcome) ANOVA, which found no differences between channels or outcomes.

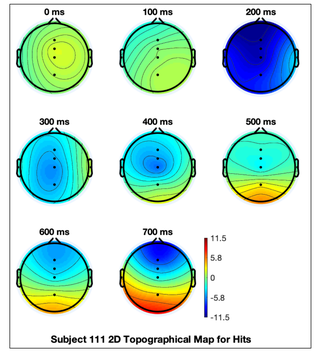
Recognition Accuracy Data

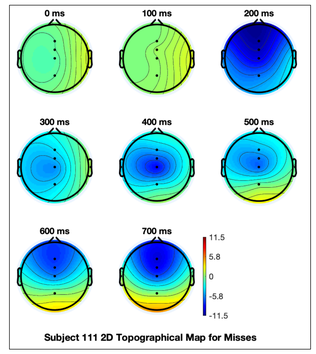
- The level of processing manipulation produced higher recognition accuracy, assessed by d' for the deep processing condition (data presented elsewhere).

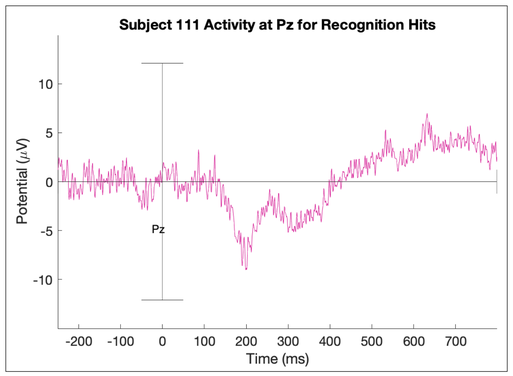
Discussion

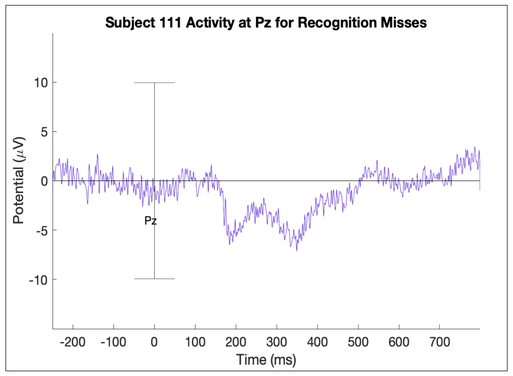
Because of the very small sample size (n = 5) for ERP data, we did not have the statistical power to detect differences.

Recognition signals may have been obscured by a response to the offset of the stimulus image at 250 msec. In future research, we will present the images during recognition trials until the subject responds.









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