ERP Response in Visual Recognition

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Abstract

Event-related potentials (ERPs) provide insight into memory's two retrieval processes: recollection and familiarity. Thirty-seven participants saw 450 images in three encoding conditions that manipulated level of processing. We then presented 750 images in an old/new recognition task, measuring accuracy and RT, for all subjects, and ERPs for nineteen. The recognition trials showed a strong negative frontal response, without a significant difference in average amplitude between hits and misses. These findings contribute to our understanding of the neural processes involved in memory retrieval.

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 FN400 and P600 ERP components correspond to familiarity and recollection, respectively.

References

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Methods

- Subjects included 37 undergraduate students at Rutgers University in Piscataway, New Jersey
  - Nineteen students had both electrophysiological and behavioral data recorded
  - Eighteen students only provided behavioral data
- 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 was as follows: "Try to remember the image".
- Encoding trials consisted of a central fixation point for a duration randomly varied around 1250 ms, 300 ms presentation of an image, then a blank screen for 1000 ms. Subjects used the triggers of a game controller to make their responses.
- 450 targets and 300 foils were then presented in an 'old/new' recognition task.

Results

Reaction Time Data during recognition trials of targets

- 3 x 2 x 3 (level of processing, outcome, order) mixed model ANOVA found no significant differences in reaction time

Recognition Accuracy Data

- Depth of processing was significant [F(2,68)=50.6, p < .05, partial Eta squared=0.60].
- The level of processing manipulation affected recognition accuracy
- Images in the 'deep' encoding condition were more likely to be recognized than those from the 'shallow' and non-specific conditions, as assessed by d'.

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 19 subjects were analyzed with a 6 x 2 (channel x outcome) ANOVA, which found channels to be significant [F(5,18)=55.6, p < .05, partial Eta squared=0.76].

Discussion

A strong negative frontal response was found, which suggests that, in this study, familiarity played a greater role in visual recognition than recollection. These findings have implications for cognitive remediation in various populations.

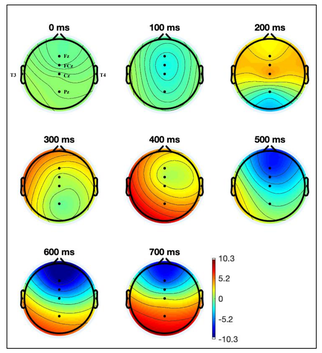

Figure 1. Subject 246 2D Topographical Map for Recognition Hits (244 events reported)

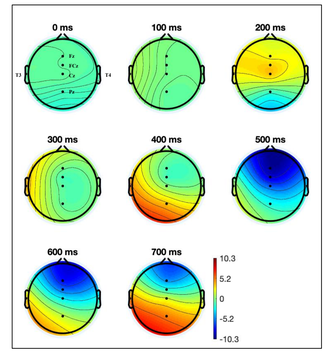

Figure 2. Subject 246 2D Topographical Map for Recognition Misses (205 events reported)

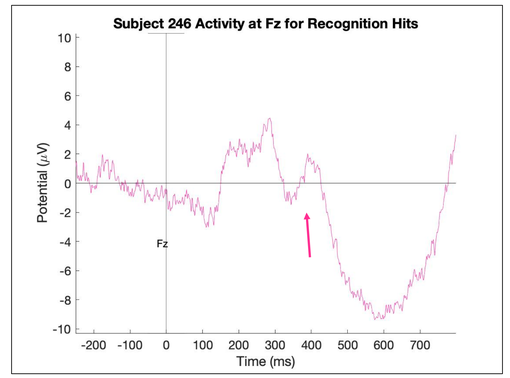

Figure 3. Changes in potential throughout the experiment at the Fz channel for hits during recognition for a single subject. The arrow shows the FN400 ERP component.

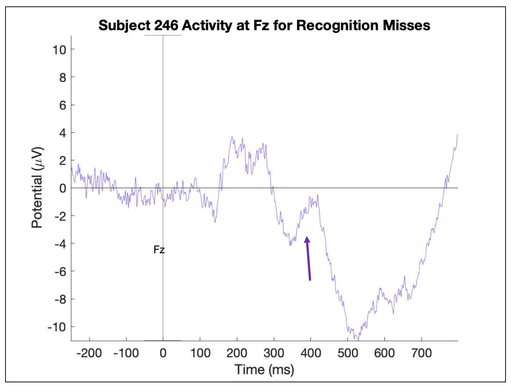

Figure 4. Changes in potential throughout the experiment at the Fz channel for misses during recognition for a single subject. The arrow shows the FN400 ERP component.

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