Neural activity linked with visual awareness and task-relevance in a novel 2x2 design

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Background and Rationale

- Current experiment expands upon Dehaene et al.’s (2001) study [1], which used visual masking to render physically identical stimuli “seen” vs. “unseen”.
- Dehaene et al. (2001) found that the P3b event-related potential (ERP) was uniquely elicited by “seen” stimuli, and is thus a neural marker of visual awareness.
- **BUT**, the critical stimuli were always task-relevant

So, we asked...

Does the neural contrast between seen and unseen stimuli that suggests the P3b as a marker of visual awareness also extend to task-irrelevant stimuli?

Methods

**Mask-Stimulus-Mask Streams:**

- **Seen**
  - OR
  - 250ms
  - 200ms
  - 100ms

- **Unseen**
  - OR
  - 200ms
  - 50ms

**Procedure for (n=14) naive subjects:**

1. 4x task-irrelevant blocks (232 trials each)
2. Incidental Memory Test (IMT) “94% accuracy”
   Did you see this exact image during the previous condition?
   (8 lightly masked, 8 heavily masked, 8 foils)
3. 4x task-relevant blocks (232 trials each)
   Task: respond with animal/object/nothing button press

**EEG Methods**

- 64 equidistant channels
- 500Hz sampling rate
- 0.1-150Hz hardware filter
- 30Hz low-pass offline filter
- average mastoid reference
- baseline correction: -200-0ms
- 0.1-150Hz hardware filter
- 500Hz sampling rate
- 25% heavily masked blanks
- 25% lightly masked blanks
- 25% lightly masked critical stimuli
- 25% heavily masked critical stimuli
- baseline correction: -200-0ms

ERP Results & Mass Univariate Analysis

**Task-Relevant Condition (seen vs. unseen)**

**Task-Irrelevant Condition (seen vs. unseen)**

**Theoretical Implications**

The (well-supported) empirical theory of consciousness, Global Neuronal Workspace Theory (GNWT) [2-3], describes a functional view of conscious processing...

- Sophisticated nonconscious processing
- Widespread information sharing = conscious perception

**Empirically,**

- P3b ERP = neural marker of Global Neuronal Workspace activity

In prediction,

- The P3b should be evident whenever stimuli are seen and NOT when stimuli are unseen, regardless of task-relevance

Summary and Conclusions

- P3b results from task-relevant condition replicate Dehaene et al.’s (2001) findings
- MUCH (8x) larger P3b for task-relevant compared to task-irrelevant stimuli
- P3b-like component also observed for task-relevant unseen stimuli
- Thus, P3b is mostly related to task relevance
- Frontal “no-go” N2 (inhibition) when seeing but not responding to irrelevant animal and object stimuli
- Future studies need to eliminate these “no-go” decisions to more clearly investigate the P3b
- GNWT may be correct; however, the current study demonstrates the importance of isolating perceptual differences from task-based differences

References