EEG CORRELATES OF EMOTIONAL FACE PROCESSING

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Background

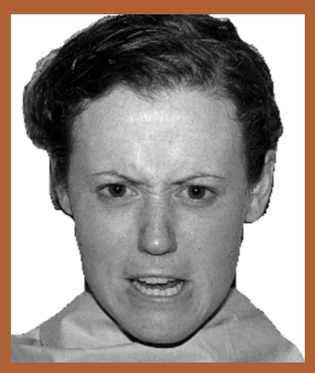
We are interested in understanding the determinants of the conscious awareness threshold. Prior research studying the threshold of consciousness utilizes the electroencephalogram (EEG) (Mathewson et al., 2009). Prior research also shows that individuals with anxiety and/or depression tend to have a *conscious* bias towards negative emotional stimuli, however there is mixed evidence on whether those with anxiety and/or depression have an *unconscious* bias towards negative emotional stimuli (Sterzer et al., 2011; Yang et al., 2011). We investigated conscious vs unconscious awareness in those with and without anxiety and/or depression to see if mental health played a role in participants' outcomes.

Experimental Design

Participants completed the Beck Depression Inventory-II (BDI-II) and the Beck Anxiety Inventory (BAI), and the raw score scale for non-clinical settings was examined for each participant. Participants were equipped with EEG caps and shown emotional face stimuli (positive, negative, or neutral faces). For each trial, subjects were shown fifteen distractors and one target stimulus, each having the same size and shape. Targets were highlighted with four dots, one in each corner of the target object. Subjects were asked to identify if the target was male, female, or neither (an unidentifiable pixelated face). Brain activity was recorded with an EEG. Trials were either Masked or Unmasked; these trials were intermixed.

Positive Facial Stimulus Example

Neutral Facial Stimulus Example



Negative Facial Stimulus Example

Masking Effect

Masking is the process of making a presented visual stimulus harder to perceive. On "Unmasked" trials, the four dots surrounding the target stimulus offset the same time as the face. Unmasked trials reflect that the participant was consciously aware of the stimuli because they were able to complete the task without perceptual hindrance. On "Masked" trials, the four dots offset 500ms after the face, reducing perceptual processing. Three different experiment outcomes were observed: Unmasked / Correct & Incorrect, Masked / Correct, and Masked / Incorrect. Masked / Correct trials indicated conscious awareness since the participants were able to overcome the perceptual hindrance from the masking and maintain awareness. Levels of electrical activity weren't statistically different in the Unmasked condition and the Masked / Correct condition. Significantly different levels of activity were found in the Masked / Incorrect condition, indicating a lack of conscious awareness in these trials.

Conscious Awareness	Lack of Conscious Awareness
Unmasked / Correct & Incorrect	Masked / Incorrect
Masked / Correct	

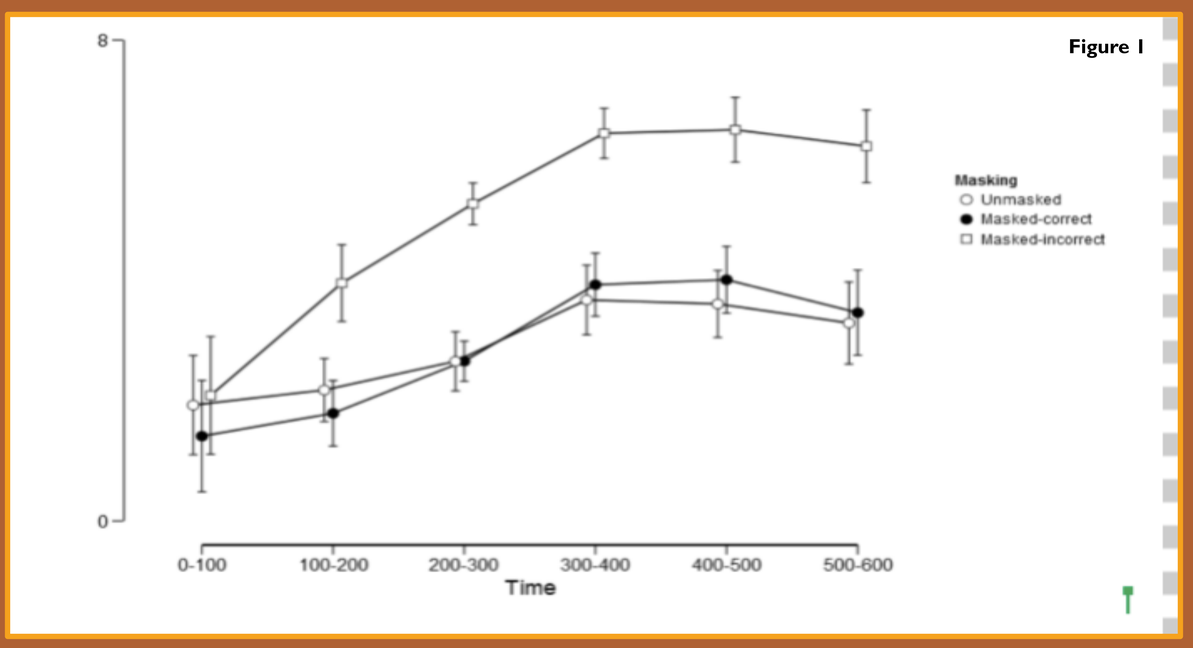


Figure 1

Results

A significant masking effect was found between the Unmasked-Correct / Masked-Correct and Masked-Incorrect trials, indicating a difference of brain activity between conscious and unconscious perception. We also found that the emotion (positive, negative, neutral) of the presented stimuli modulated brain activity. Over time, positive emotional stimuli caused a significant difference in brain activity over negative and neutral stimuli. Negative facial stimuli had a subject response most similar to the trials where the subject was consciously aware (Unmasked and Masked / Correct). There were no significant findings for subject's levels of anxiety and depression on performance.

Emotive Modulation

Figures 2, 3, and **4** are topographical maps of brain EEG recordings in response to positive, neutral, and negative emotional stimuli, respectively. The topographical maps are of Event Related Potentials (ERPs) and show the electrical activity of all thirty-two electrodes used in the study. The top rows of the figures display brain activity in response to Unmasked trials, the middle rows display brain activity for Masked / Correct, and the bottom rows display brain activity for Masked / Incorrect trials. Areas that are more aggressively red correspond to more highly electrical potential. **Figure 2** (activity for positive stimuli) is significantly more active than **Figures 3** and **4** (activity for neutral and negative stimuli, respectively).

Conclusions

- Negative emotional stimuli displayed brain activity that was statistically similar between unconscious and conscious awareness
- This reflects that even if the subject was not consciously cognizant of the negative stimulus, their brain responses were akin to trials where they *were* consciously cognizant
- This is likely due to the brain's prioritization of a negative stimulus as a threat to survival
- Future research is needed to determine if mental health affects unconscious biases of visual stimuli

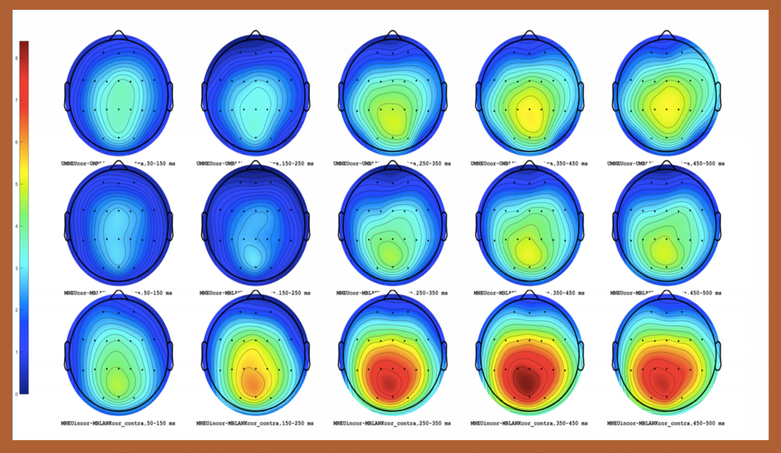


Figure 2: Neural Activity **in** Responses to *Positive* Emotional Stimuli

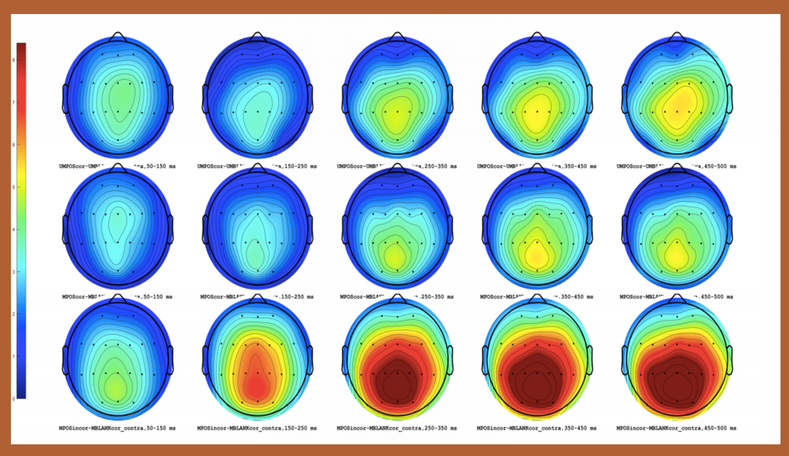


Figure 3: Neural Activity in Responses to the *Neutral* Emotional Stimuli

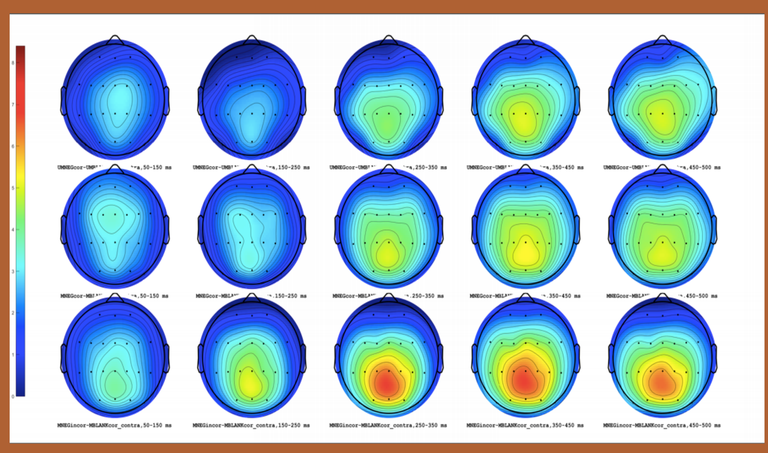


Figure 4: Neural Activity in Responses to the *Negative* Emotional Stimuli

References

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Acknowledgements: The Magellan Scholar grant was received by a member of this research project as funding for this project.