Neurophysiological Signature of Stimulus Discrimination Associated with Memory & N300/P500 Activation: An Event-Related Potential Study

Diana A. Hobbs M.S. | Mejdy Jabr, B.S. | Ashley Sanders, B.S. | Andrea Tountas, B.S. | Connie Lamm, PhD. | Department of Psychology | University of New Orleans

Objective

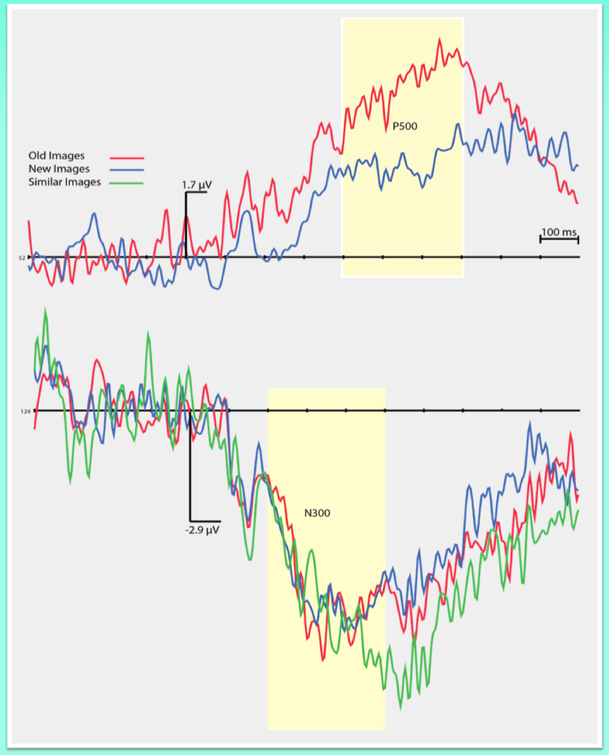
This study examines the neurophysiological signature underlying stimulus discrimination in recognition memory by looking at P800 (400-800ms) ERP activation associated with recollection and FN400 (300-500ms) ERP activation associated with familiarity in adults discriminating between old and new stimuli[1,2,3,4].

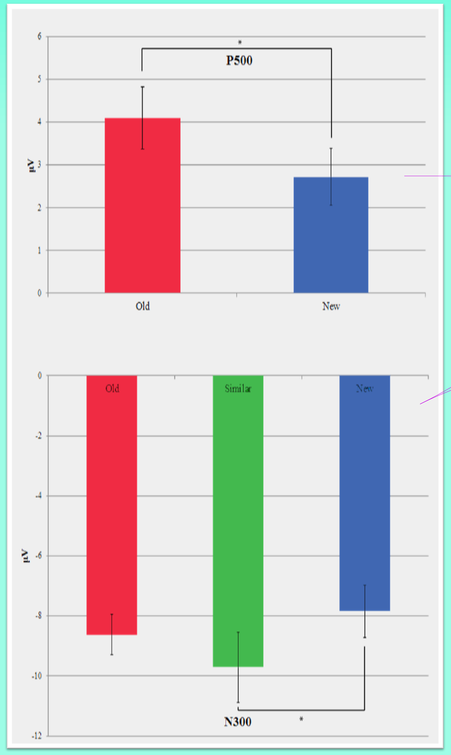
Background

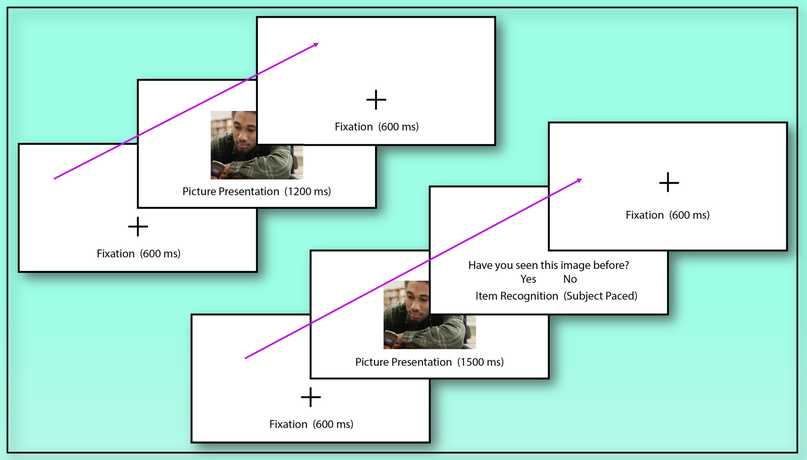
- Studying the processes underlying memory is essential for understanding the function of stimulus discrimination in discerning between past and present events encoded within particular contexts in memory networks[5,6].
- Problems in proper encoding and retrieval are factors associated with impaired memory, and studies of human pathology expressed by individuals displaying medial temporal lobe damage or exhibiting Alzheimer's disease exemplify such findings[7,8].
- Studies have explored neurophysiological signatures underlying stimulus discrimination; however, few have traversed the territory using photo representations of individual among adults[3,4].
- Examining differences in these neurophysiological signatures may elucidate early detection of problems associated with memory.

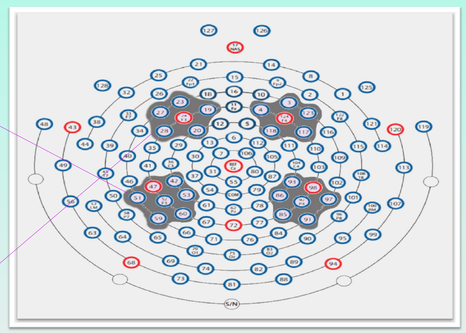
Methods

- 10 (2 male) Participants: Aged 19-32 (mean age = 24 ± 5.29)
- A recognition memory task was used to measure effortful stimulus discrimination, i.e. assessment of how much neurocognitive activation is used to discriminate between old-previously encountered images, similar-mirror images, and new-never before encountered images.
- P800 old/new effect was measured as peak activation roughly 500ms after stimulus onset[3,4].
  - The average of left and right posterior-superior clustered electrodes was statistically analyzed via repeated-measures ANOVA
- FN400 old/new effect was measured as peak activation roughly 300 ms after stimulus onset[3,4].
  - The average of left and right superior-frontal clustered electrodes was statistically analyzed via repeated-measures ANOVA.









Results and Discussion

Results for stimulus discrimination revealed that in the context of recollection memory, participants displayed greater P500 amplitudes (more positive) for presentation of old photos than new photos, $F(1, 9) = 13.998$, $p < .01$, Means (old, new): 4.10, 2.72.

In the context of familiarity, a main effect was reported for the N300 ERP, $F(2, 16) = 6.046$, $p < .05$, such that participants exhibited smaller N300 amplitudes (more positive) for presentation of new (mean: -7.84) photos compared to both old (mean: -8.63, $p = .068$) and similar (mean: -9.71, $p < .01$) photos. Results did not differ between similar and old photos ($p = .138$).

- Results showed increased (more positive) P500 activation for participants encountering old vs. new photos, suggesting effortful retrieval of previously encoded images.
  - Thus, when viewing old previously encountered images, more neural resources are required to discriminate stimuli compared to new never-before-seen images.
- Results revealed greater (more negative) N300 activation for participants encountering similar vs. new photos, suggesting effortful discrimination of mirror images similar to those previously encountered.
  - Thus, when viewing similar images, more neural resources are required to discriminate stimuli compared to new images.
- While the results of the P500 support previous studies in the literature, results from the N300 display effects opposite to what has been previously examined. The aversive and neutral conditions in our photos may have affected the degree to which images were encoded, and thus, later retrieved.
- Future studies should examine this question in different contexts with more participants.

Works Cited & Thanks

See reference sheet for citations.

Special thanks to our instructor, Dr. Connie Lamm, as well as my colleagues in science, Mejdy, Ashley, and Andrea, for their dedication and guidance throughout the duration of this project.

For additional information contact: Dahobbs1@uno.edu