Mechanisms Underlying Memory Distortion for Emotional Orthographic Associates with EEG

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Introduction

- Individuals with major depressive disorder (MDD) have shown greater memory for negative stimuli than positive and neutral stimuli[1,2].
- Semantic DRM paradigm studies show greater recall for negative critical lures in MDD participants than controls[3].
- The use of orthographic DRM-like lists allow for control of valence and isolate false alarms to emotive critical lures[4] (Fig 2).
- Our previous behavioral findings supported that individuals with depressive symptoms showed greater calibration for negative items than controls.
- Revisions in the current study aim to address the following points:
  - Whether outcomes were state-dependent (mood driven) or trait-dependent (depressive symptom driven).
  - Whether true and false orthographic associates memory outcomes are informed by familiarity or post-retrieval monitoring processes, which can be examined using confidence ratings and gamma scores.

Experiment 1 - Methods

Participants

- 60 adults, fluent English speakers. 34 females, 26 males (mean age = 19.5, SD = 1.0).
- Participants completed Center for Epidemiologic Studies Depression scale (CESD)[5]. Scores ≥ 16 = High CESD group (max = 60). Low CESD: n = 30. High: n = 30.

Encoding

- Each block: 4 lists assoc. with neutral, 4 lists assoc. with negative lures.
- **LIST WORDS ONLY** (64 words per block; 32 assoc. with each valence).

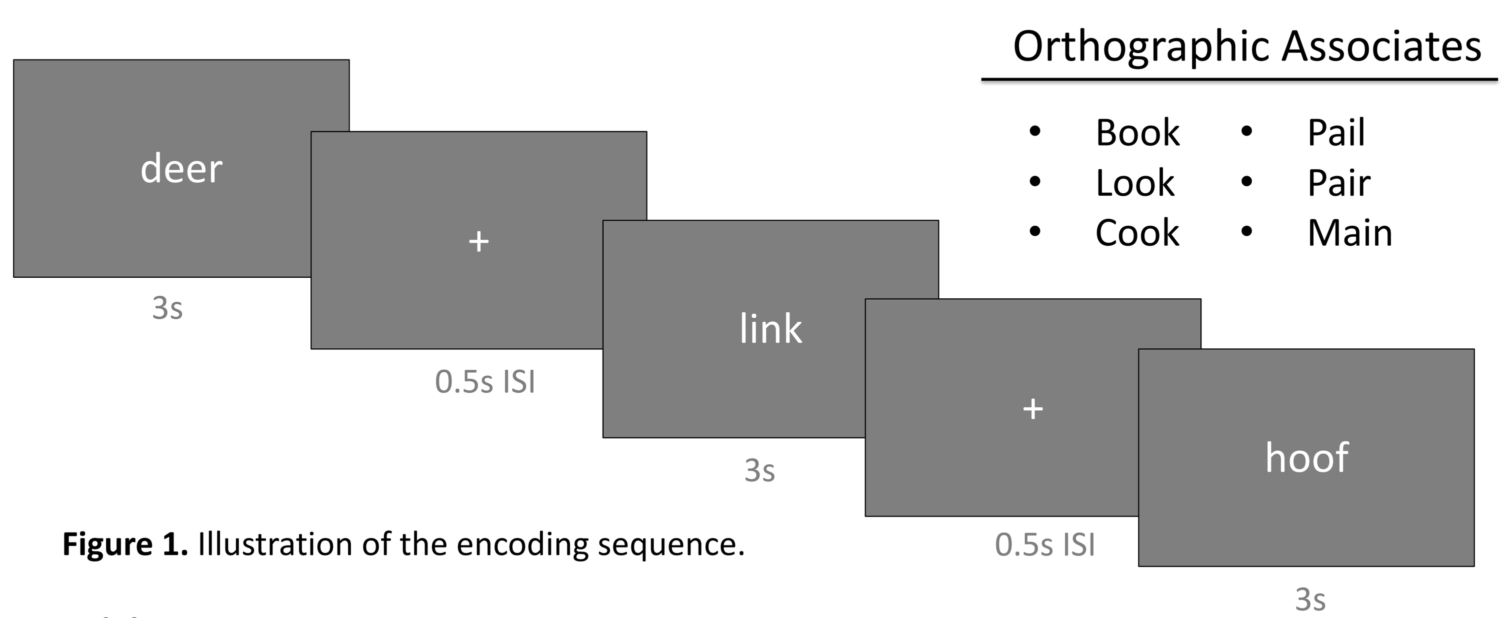

Figure 1. Illustration of the encoding sequence.

Recognition Test

	Orthographic Associates	
Critical Lures:	Hook (neutral)	Pain (negative)
Repeated Words	Book	Pail
	Look	Pair
Novel:	Paint (neutral)	Malice (negative)

Figure 2. Examples of orthographic associates with associated critical lures (shown at test).

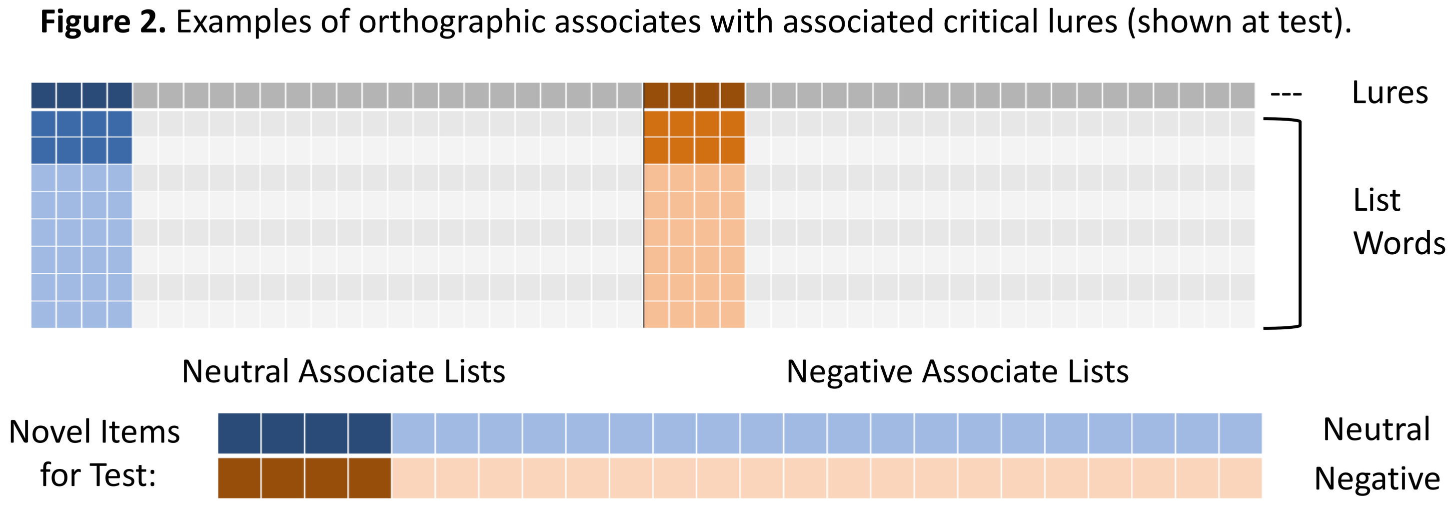

Figure 3. Representation of test design, with blocking example.

- 16 List Words: 2 randomly selected from each encoding block.
- 16 Novel Items: 8 Associated Critical Lures + 8 Novel Words.
- Confidence ratings following each trial (4-Point scale).

Experiment 1 - Results

Behavioral Results

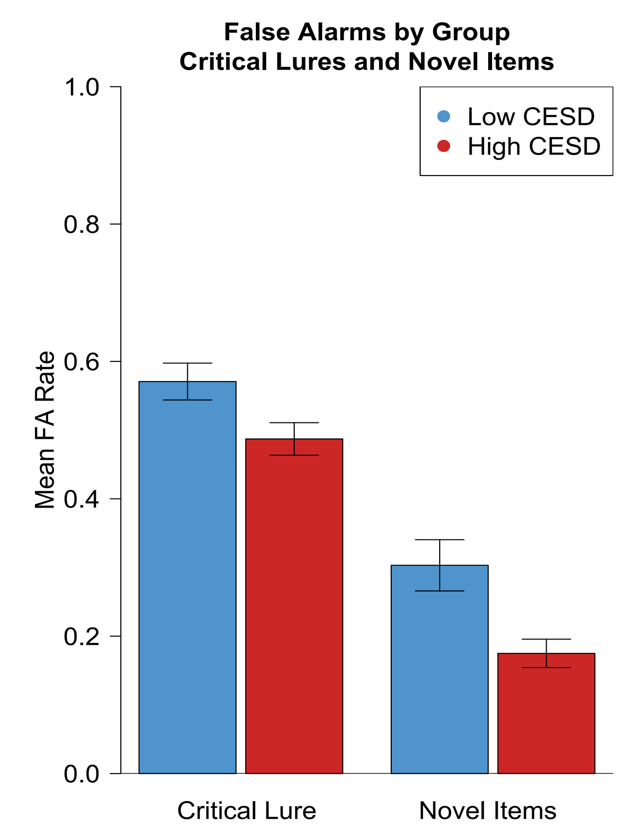

Figure 4. False Alarms by item type and valence.

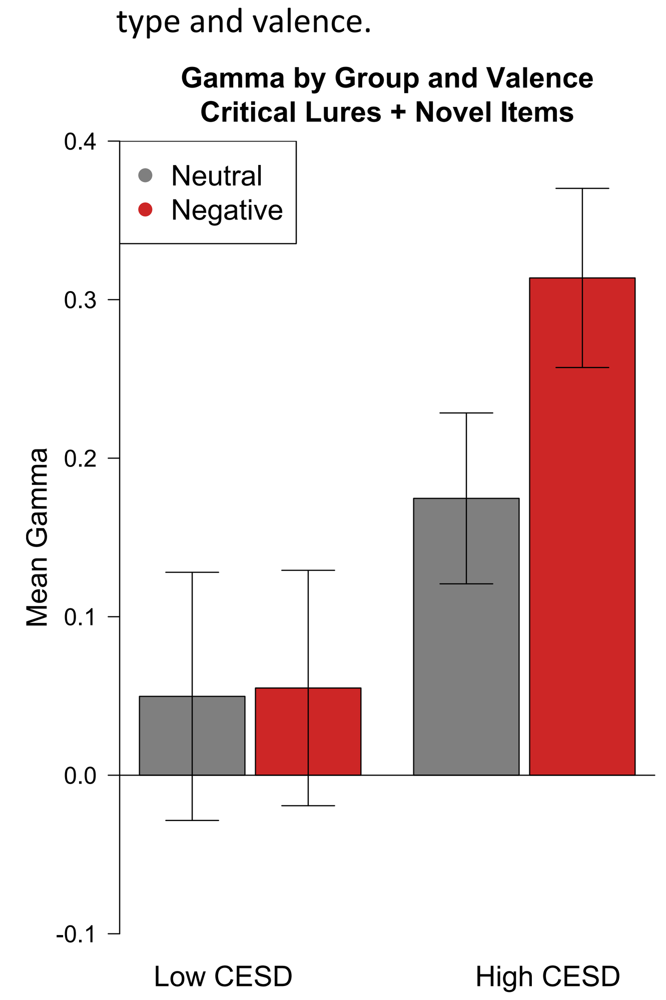

Figure 6. Mean Gamma by group and valence.

- No significant effects of group or valence on hit rate.
- Significantly more false alarms for neutral versus negative lures, ($F_{(1,58)}$ = 23.66, p < .001, μ_p^2 = .08).
- Significantly more false alarms for critical lures than novel items, ($F_{(1,58)}$ = 185.08, p <.001, μ_p^2 = .12).

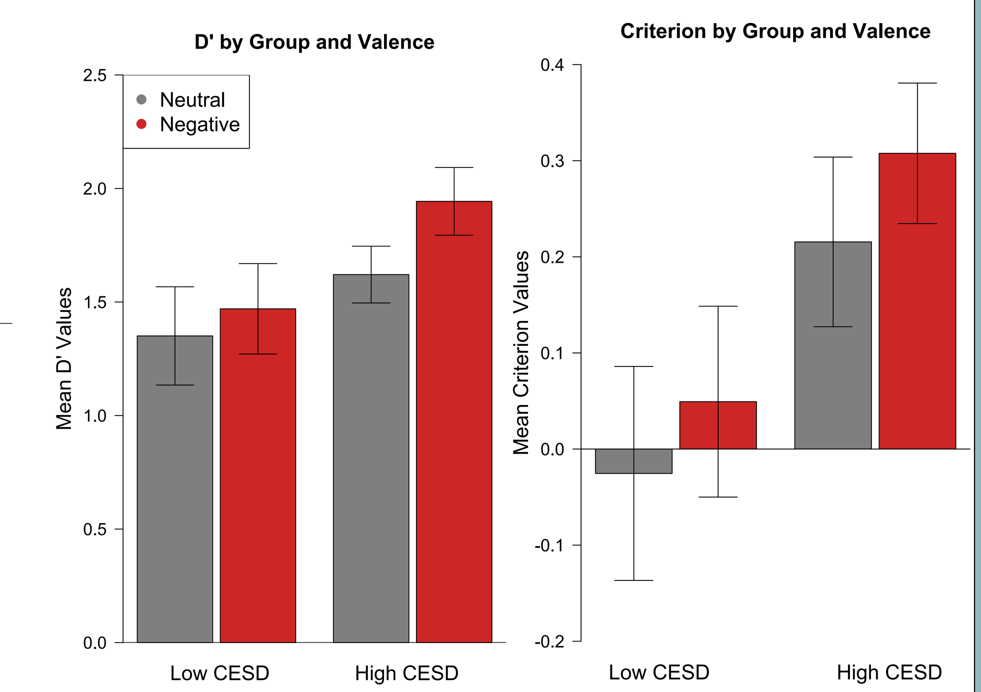

Figure 5. Mean D' and Criterion by group and valence.

- Greater mean d' for the High than the Low CESD group, ($F_{(1,116)}$ = 4.44, p = .04, μ_p^2 = .04.).
- Greater mean criterion for High than Low CESD group, ($F_{(1,116)}$ = 7.05, p = .01, μ_p^2 = .06).

- Confidence ratings split into high and low scores to compute gamma.
- Collapsing across critical lures & novel items, High CESD group has significantly greater gamma than the Low CESD group, ($F_{(1,116)}$ = 8.30, p = .005, μ_p^2 = .07).

Experiment 2 – ERP Study Methods

Participants

- 28 adults, fluent English speakers; 13 females (mean age = 19.3, SD = 0.9).
- Participants completed CESD and Positive and Negative Affect Schedule (PANAS)[6]. Scores from both measures were analyzed as continuous variables.

EEG Recording

- 64 channels of continuous EEG, plus one electrode on each mastoid.
- Four additional electrodes were placed to monitor electrooculargraphic (EOG) activity (vertical and horizontal eye movement).
- A BioSemi II amplifier was used to amplify all channels, and impedances were kept within the recommended ±40mv operating range.

Experiment 2 – Results

Behavioral Results

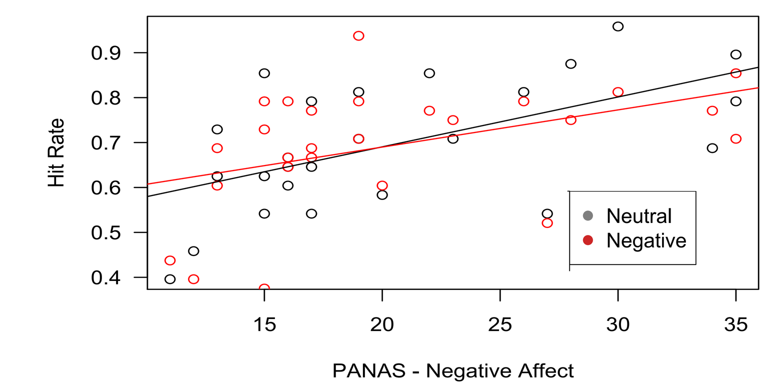

Figure 7. Hits by PANAS score and valence.

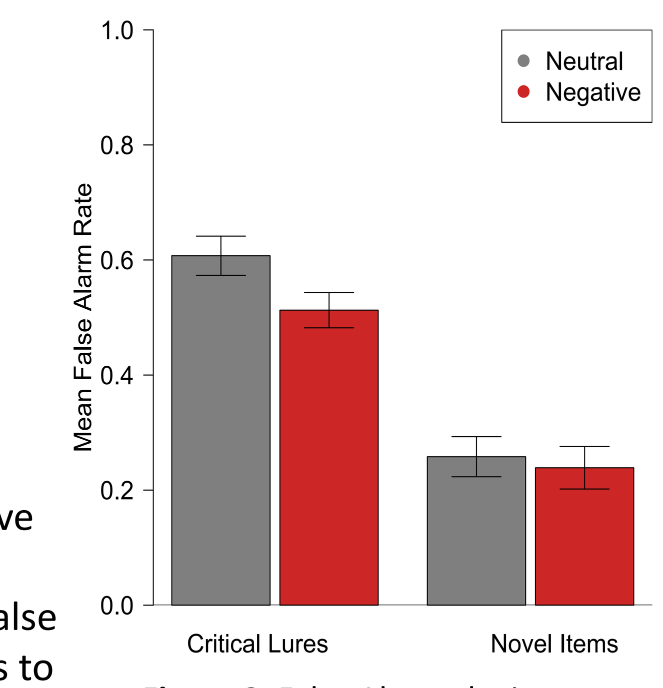

Figure 8. False Alarms by item type and valence.

- Hit rate increases as a function of PANAS Negative Affect score, (F(1,25) = 9.39, p = .005, R^2 = 0.28).
- Significant interaction for false alarms; greater false alarms to neutral items, and greater false alarms to critical lures (F(1,24) = 61.79, p < .001, μ_p^2 = .09).

EEG Results – Pointwise Non-Parametric Randomized Permutation Analysis

- Significance threshold determined for each location & time point. Thresholds from estimated t-distribution from 20000 random permutations under H_0. Locations of sig. t-values used to determine clusters of significant activation differences.
- Type I Error Correction: 20000 permutations to determine null distribution of clusters exceeding significance. Exceedance mass for each cluster computed.
- Use exceedance masses to determine truly sig. clusters against non-permuted clusters in standard max step down correction of null distribution. Clusters w/ mass > p = .05 are considered significant.

True Memory (Hits vs. Correct Rejections [CR])

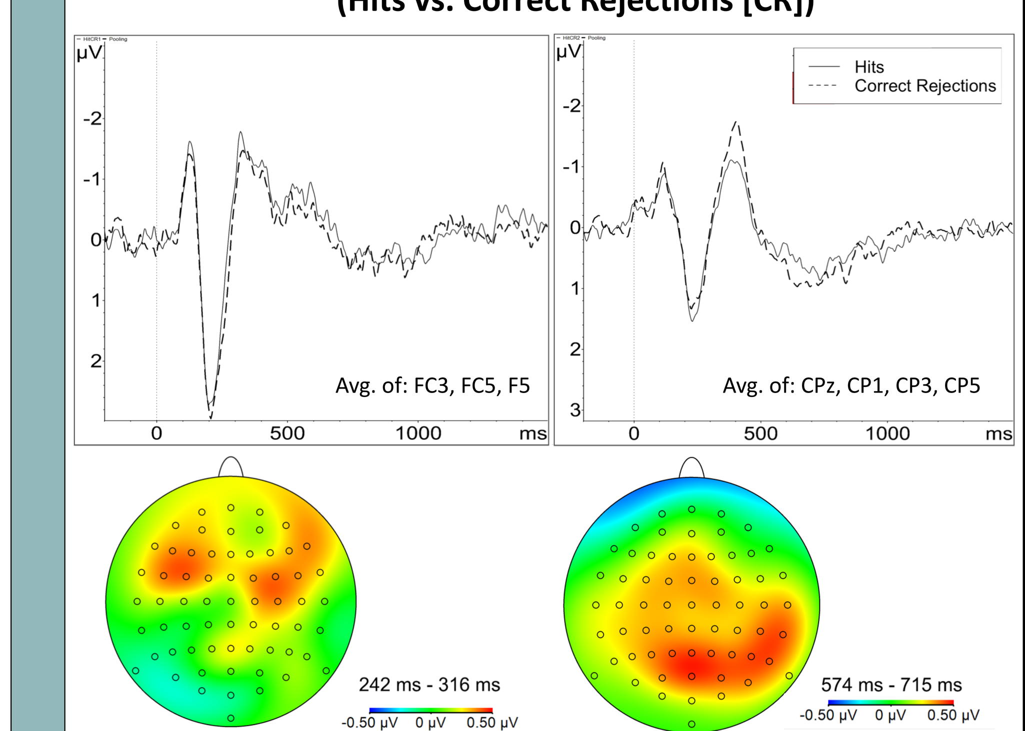

Figure 9. Head maps and local ERP averages showing activation for Hits vs. CR.

False Memory (False Alarms [FA] vs. Correct Rejections)

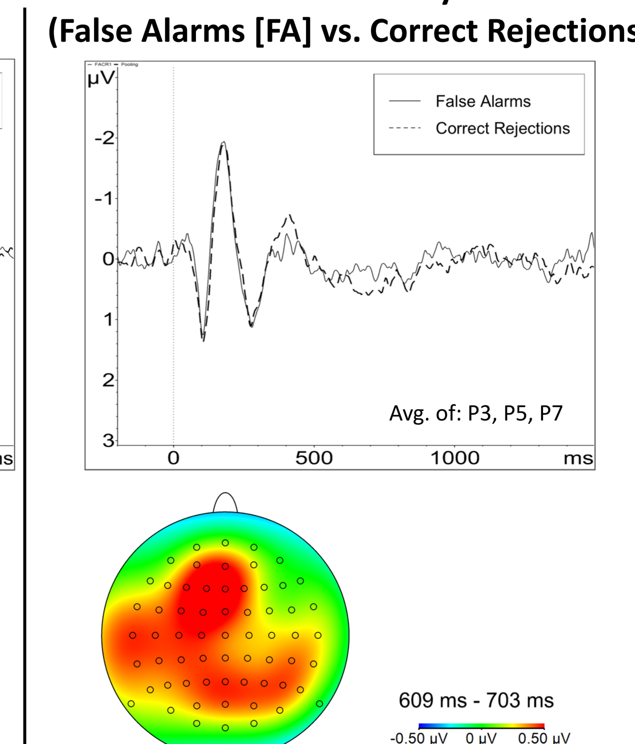

Figure 10. Head maps and local ERP averages showing activation for FA vs. CR.

- Hits vs. CR differences: early frontal, similar to FN400[7]; late posterior, similar to LPC[7].
- FA vs. CR differences: late left parietal activity (LPC)[7].

Trends with behavior

- True Memory, Cluster 1: As negative affect increases, Hit-CR becomes more positive, t(1,25) = 1.69, p = 0.1, r = 0.32.
- False Memory, Cluster 1: As false memory increases, FA-CR becomes more negative, t(1,25) = -1.69, p = 0.1, r = -0.31.

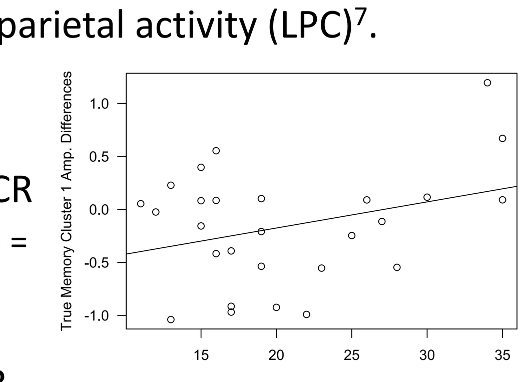

Figure 11. True Memory ERP Amp. and Negative Affect.

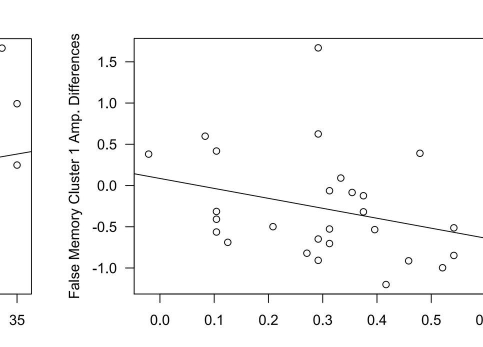

Figure 12. False Memory ERP Amp. and false memory rate.

Discussion

- With greater D' and criterion scores, the High CESD group showed greater calibration for correct responses at test than the Low CESD group.
- Confidence tracked memory accuracy better for High CESD group, suggesting more effortful endorsements of test items.
- Behavior in Exp. 2 was more strongly predicted by Negative Affect than CESD, indicating that testing differences may be more trait- than state-dependent.
- Preliminary ERP evidence suggests Negative Affect may be associated with shift in strategy toward post-retrieval monitoring; different item types may lead to relatively similar ERP response as mood state becomes more extreme.

References

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Acknowledgements

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