Multivariate decoding of memory retrieval feedback signals

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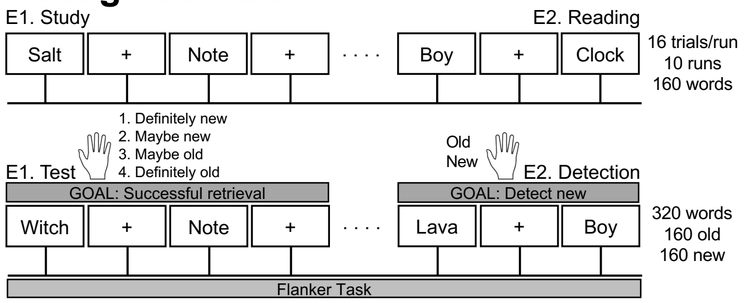
Introduction

- Is successful retrieval intrinsically rewarding?
- Frontocentral theta power (4-8Hz) dissociates both successful retrieval and tracks feedback/outcomes across cognitive control tasks Smith et al. 2024; Cavanagh & Frank, 2014
- Reward-related regions are more active during Hits compared to CRs in the absence of explicit reward Spaniol et al. 2009; Clos et al. 2015
- When CRs are rewarded, greater reward system activity for CRs than Hits Han et al. 2010

Question

- Do test-phase reward signals reflect successful retrieval or goal attainment?

Recognition task



Hit = identification of previously studied items | Correct rejection (CR) = rejection of novel lures

63 electrodes | self-paced test/detection | E1 N = 36, E2 N = 36, Flanker N = 72

References

Cavanagh, J.F. & Frank, M.J. (2014). Frontal theta as a mechanism of cognitive control. *Trends in cognitive sciences, 18*(8), 414-421.

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Han, S., Huettel, S.A., Raposo, A., Adcock, R.A. & Dobbins, I.G. (2010). Functional significance of striatal responses during episodic decisions: recovery or goal attainment? *The Journal of Neuroscience, 30*(13), 4767-4775.

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Acknowledgments

This research was supported by NIH/NINDS R01NS132872 to NML

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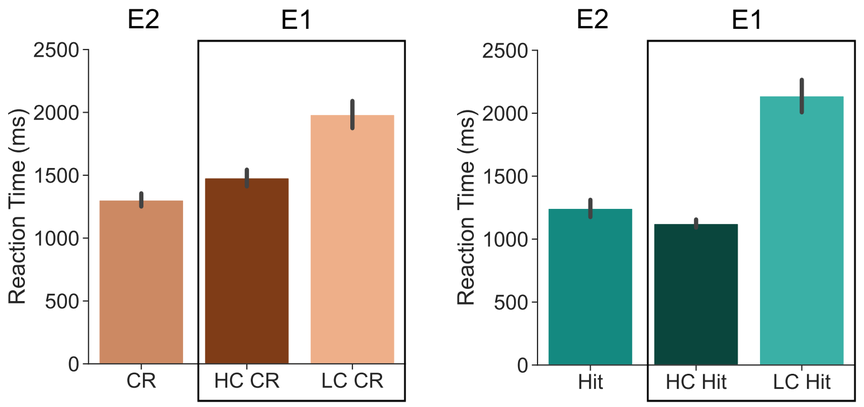
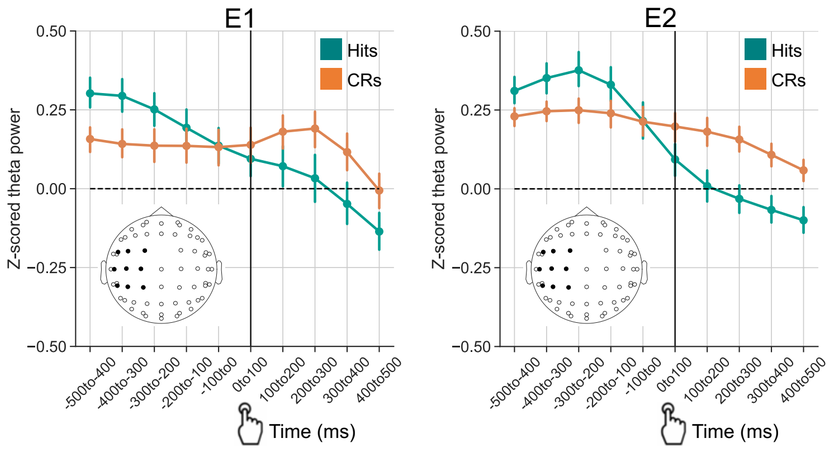
Faster reaction times when probe type and goal match



HC = high confident LC = low confident

Post-response left frontocentral theta power decreases for Hits vs CRs regardless of goals



Summary

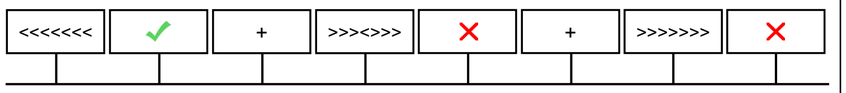
- Faster reaction times when probe type and goal match, suggesting the modified instructions shift subjects' goals
- Decreased theta power following Hits vs CRs in both E1 and E2
- Greater positive feedback for Hits compared to CRs in both E1 and E2, suggesting that successful retrieval is intrinsically rewarding

Future directions

- Connect feedback evidence to memory performance on final test

Cross study multivariate pattern analysis (MVPA)

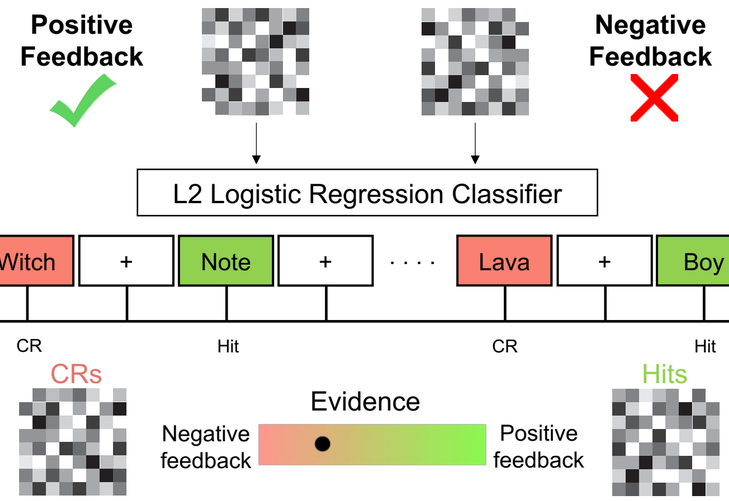
Flanker task



Logistic regression classifier trained on positive and negative feedback flanker trials and tested on hits and CRs in the test/detection phases of E1 & E2

Training Data: -100 to 0 ms pre-response

Features: 63 electrodes x 46 frequencies



Greater positive feedback evidence for Hits compared to CRs regardless of goals