A Model of Perceptual Deficits in MTL Amnesia

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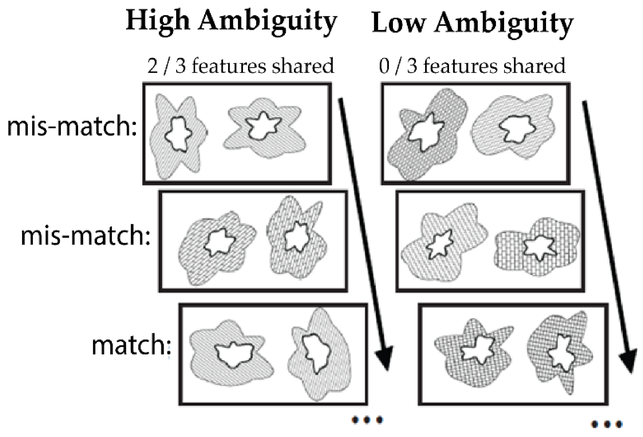
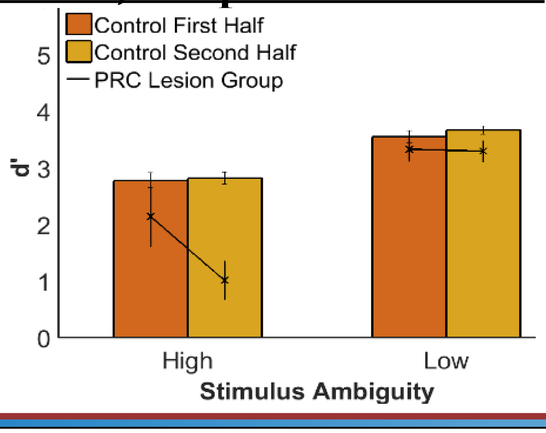
Overview

- Traditional accounts of Medial Temporal Lobe (MTL) predict a deficient ability to encode new declarative memories -- but preserved visual perception -- following MTL damage (Squire and Wixted, 2011).
- An alternative account proposes that declarative memory and visual perception rely on a single representational hierarchy (Murray, Bussey, and Saksida (2007); Cowell, Bussey, and Saksida 2010). A Neural network instantiation of this account simulates mnemonic deficits (Cowell et al. 2006).
- This latter account predicts that MTL damage also produces perceptual deficits. Indeed, MTL damaged participants are susceptible to perceptual interference (Barense et al., 2012).
- We propose that these perceptual deficits emerge from the reliance on a 'familiarity heuristic' (Goldstein and Gigerenzer, 2002). We instantiate this mechanism in the neural network and sucessfully simulate the observed perceptual deficits.

Task 1, Design

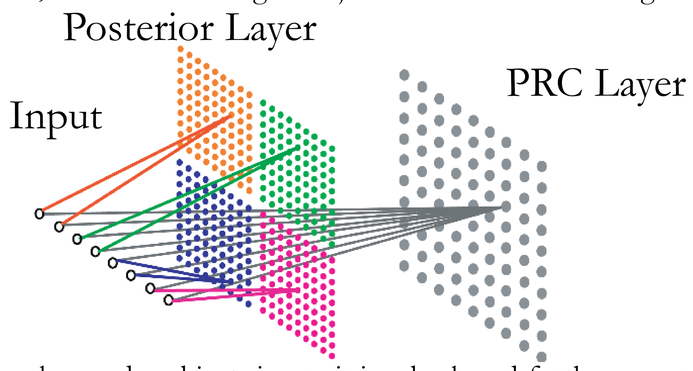


Task 1, Empirical Results

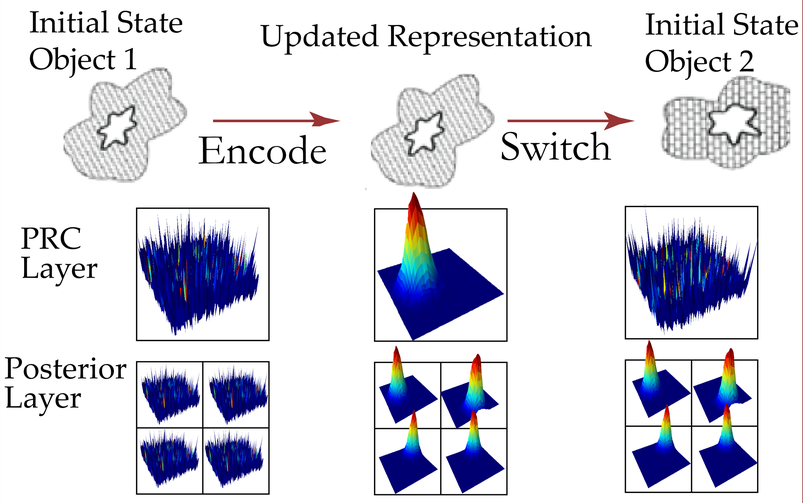


Network Architecture

- Objects are represented twice - once as 4 separate, 2-dimensional features, and once as a single conjunction of all features together.

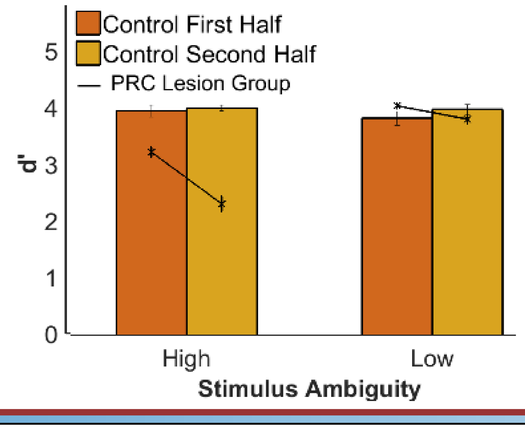


- Network encodes objects in a pair in a back-and-forth manner

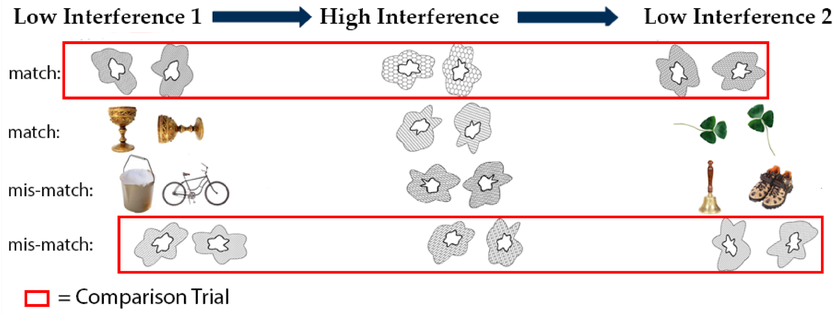


- Discrimination occurs by comparing to a criterion the difference in each grid's familiarity for the two objects. As repeating features become familiar, networks without PRC discriminate worse.

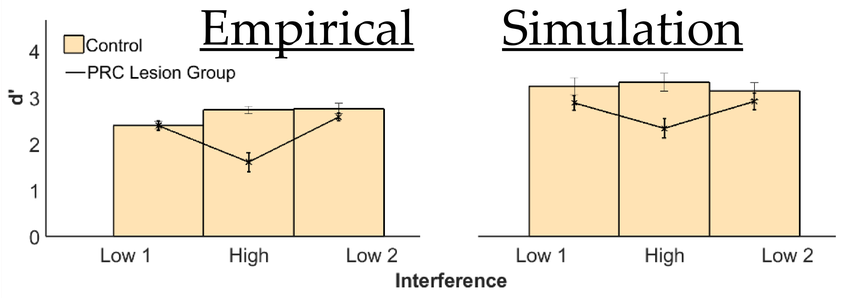
Task 1, Simulation Results



Task 2, Design



Task 2, Results



Conclusion

- Using A familiarity heuristic during visual discrimination enables a neural network designed to simulate mnemonic deficits following MTL damage to also simulate perceptual deficits in the same population.

Further Questions

- What mechanism allows familiarity to reset?
- What constitutes a feature in the different layers, and how are they combined?

References

Barense, M. D., Groen, I. I. A, Lee, A. C. H., Yeung, L. K.,Brady, S. M., Gregori, M., Kapur, N., Bussey, T. J., Saksida, L. M., Henson, R. N. A. (2012). Intact memory for irrelevant information impairs perception in amnesia. *Neuron*, 75(1), 157-167.

Cowell, R. A., Bussey, T. J., & Saksida, L. M. (2006). Why does brain damage impair memory? A connectionist model of object recognition memory in perirhinal cortex. *Journal of Neuroscience*, 26(47), 12186–12197.

Cowell, R. a, Bussey, T. J., & Saksida, L. M. (2010). Functional dissociations within the ventral object processing pathway: cognitive modules or a hierarchical continuum? *Journal of Cognitive Neuroscience*, 22(11), 2460–2479.

Goldstein, D. G., & Gigerenzer, G. (2002). Models of ecological rationality: The recognition heuristic. *Psychological Review*, 109(1), 75–90.

Murray, E. A., Bussey, T. J., & Saksida, L. M. (2007). Visual Perception and Memory: A New View of Medial Temporal Lobe Function in Primates and Rodents. Annual Review of Neuroscience, 30(1), 99–122.

Squire, L. R., & Wixted, J. T. (2011). The cognitive neuroscience of human memory since H.M. *Annual review of neuroscience* . 34, 259-288.