Tracking the development of specific and generalized representations during concept learning

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Background

- Ventromedial prefrontal cortex (VMPFC) and anterior hippocampus contribute to concept generalization by representing information abstracted from individual examples[1] as measured by formal categorization models:

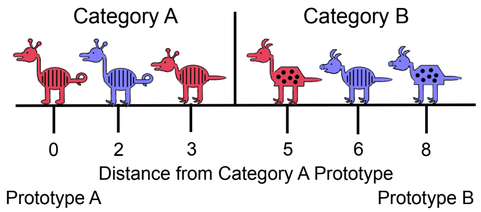
  Prototype models[2]: categories represented as central tendencies (prototypes). Generalization involves comparison to category prototypes.

  Exemplar models[3]: categories represented as individual instances (exemplars). Generalization involves joint consideration of all category exemplars.

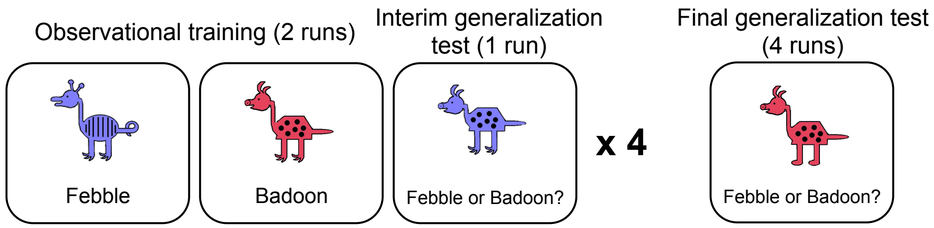
- Prior work suggests that memories transform from specific to generalized[4] and from hippocampus-based to cortex-based[5] over time.

Do concept representations in the VMPFC and hippocampus shift from exemplar-based to prototype-based across learning?

Categorization task

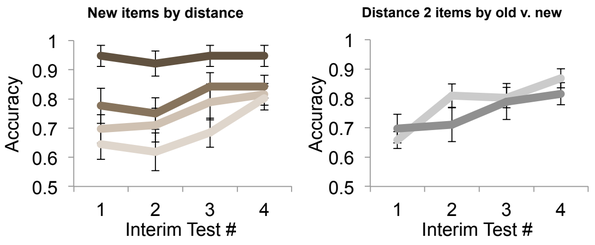


- Stimuli with 8 binary features
- One stimulus = category A prototype
- All other stimuli: 1-8 features different from the A prototype ("distance from the prototype A")
- Stimulus with all 8 features different = B prototype

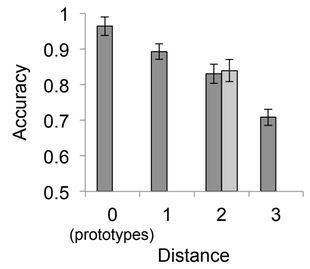


- 8 training items, all distance 2
- 3 repetitions per item, per run
- All training items + 2 new items at each distance
- All training items + 8 new items at each distance

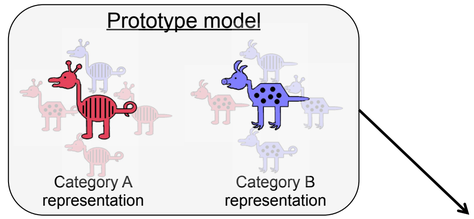
Interim generalization tests (N = 19)

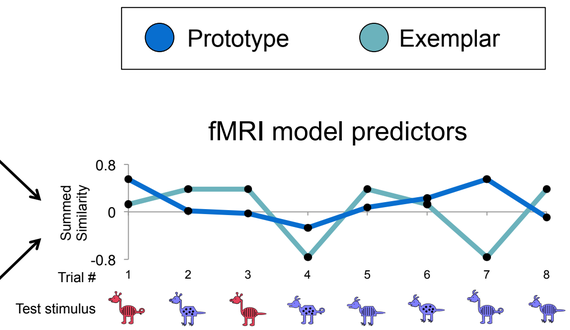


Final generalization test (N = 21)

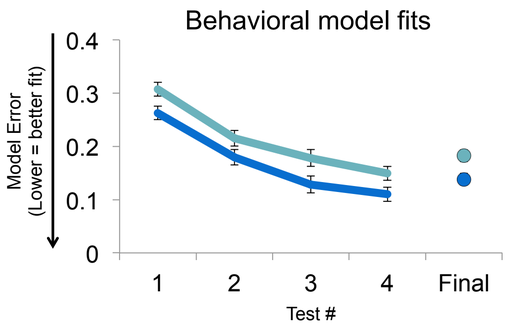


Categorization models

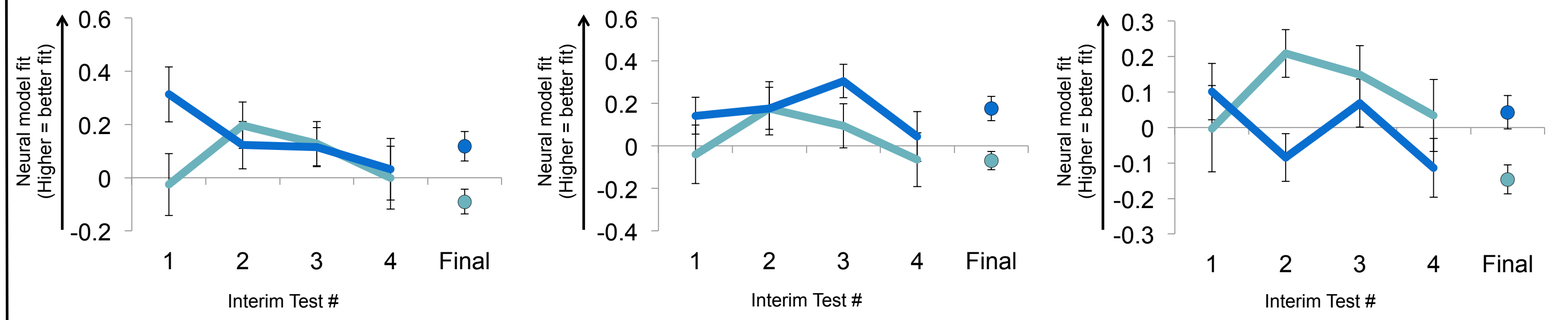




- Trial-by-trial fMRI predictors generated for each subject.



- Prototype advantage in behavior throughout learning and in the final test



- Final generalization: prototype correlates in the anterior hippocampus and VMPFC, but not posterior hippocampus.
- Interim tests: prototype correlates emerge in the anterior hippocampus before VMPFC. Exemplar correlates in the posterior hippocampus do not precede prototype correlates in the anterior hippocampus.

Conclusions

- Replicate previous study showing prototype correlates in the anterior hippocampus and VMPFC.
- Prototype correlates emerge in anterior hippocampus before they emerge in cortex (VMPFC).
- No evidence for shift from exemplar to prototype correlates.

References

1. Bowman & Zeithamova (2018). *J. Neuro.*
2. Smith & Minda (1998). *JEP: LMC.*
3. Nosofsky (1986). *JEP: General.*
4. Posner & Keele (1968). *JEP: General*.
5. McClelland, McNaughton, & O'Reilly (1995). *Psych. Rev.*

Acknowledgements

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