# Prototype representations in VMPFC and hippocampus during concept generalization

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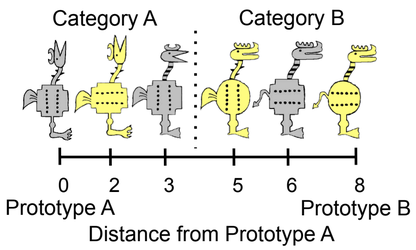
## Background

- **Exemplar models**[1-2]: categories represented as individual instances (exemplars). Generalization involves joint consideration of all category exemplars.
- **Prototype models**[3-4]: categories represented as central tendencies (prototypes). Generalization involves comparison to category prototypes.
- One study found exemplar correlates in visual and lateral prefrontal cortices.[5]
- Prototype correlates unknown, but ventromedial prefrontal cortex (**VMPFC**) and **hippocampus,** structures supporting memory integration[6], may also support prototype abstraction.[7]

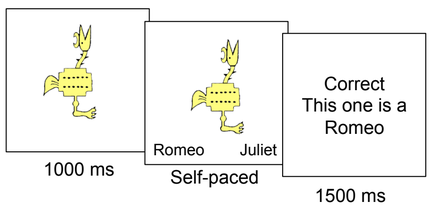
- **Do VMPFC and hippocampus support generalization judgments by tracking prototype information?**

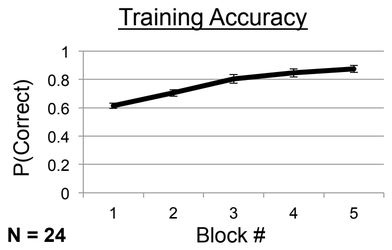
## Categorization Task




- 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

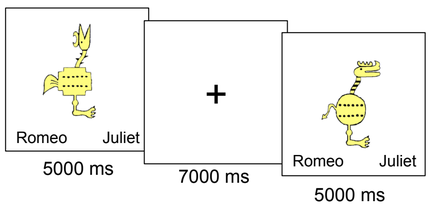
### Training (outside scanner)

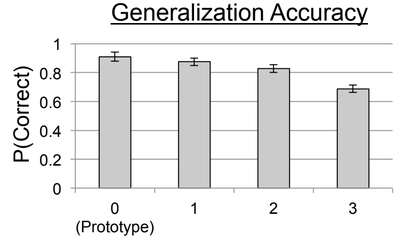



- 4 exemplars per category, differing from their prototypes by 2 features
- 6 repetitions per run, 5 runs

### Generalization



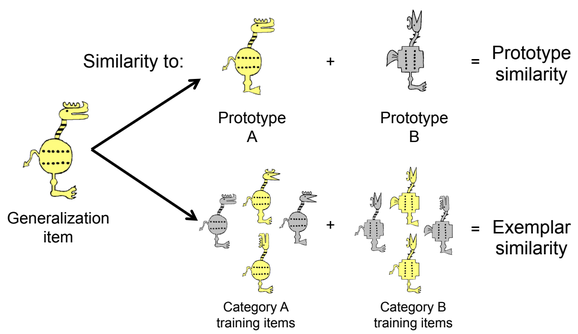




- All training items + new items at each distance from prototypes

- Better classification for items closer to the prototype

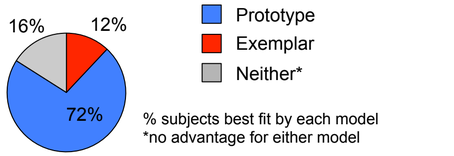
## Prototype & Exemplar model fits

### Generating Model Predictors



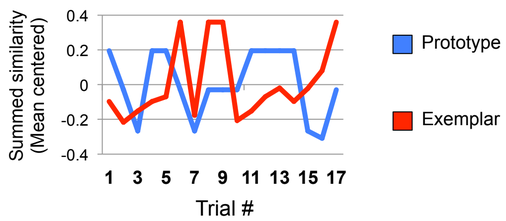

- Trial-by-trial predictors generated for each subject from behavioral generalization data and fit to fMRI data

### Behavioral Model fits



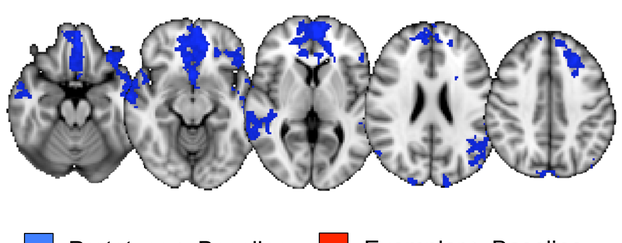

- Better behavioral prototype fit for most subjects

Regressors from a representative subject

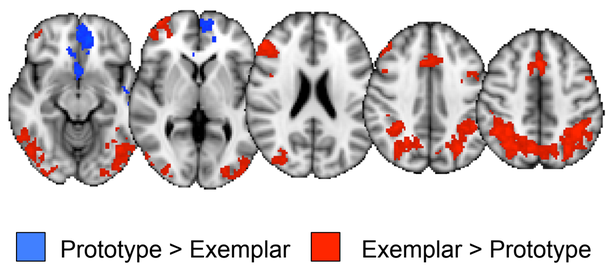



### Whole Brain

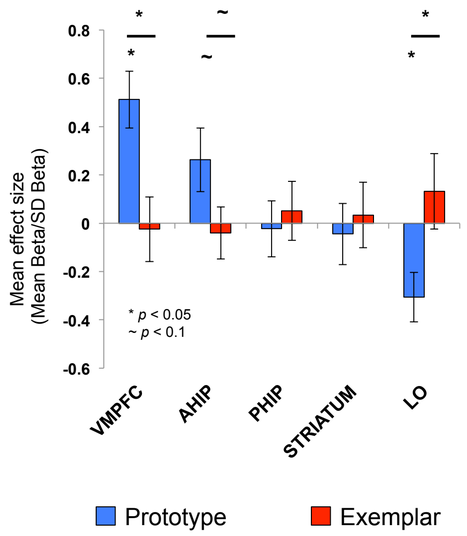
Model predictors versus baseline




Direct contrasts of model predictors



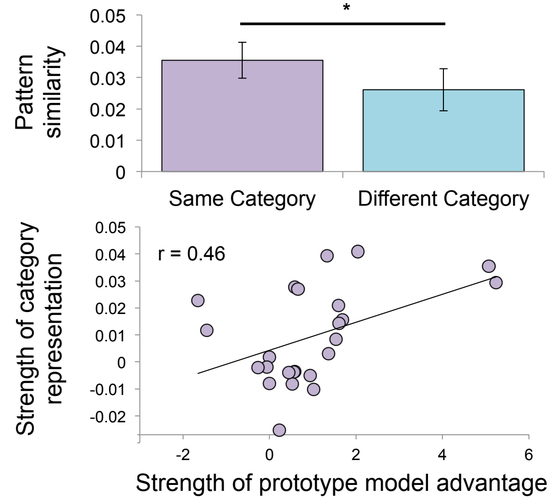

### Anatomical regions of interest




- Strong prototype brain correlates match prototype dominance in behavior
- Consistent with a prior report[5], visual and lateral prefrontal cortices track exemplar more than prototype predictors
- Marginal prototype correlates in anterior but not posterior hippocampus

## Pattern Similarity Analysis (PSA)

### VMPFC Category Representation




- VMPFC represents exemplars within a category more similarly than exemplars of equal physical similarity from other category
- Strength of this category representation tracks behavioral prototype advantage

## Conclusions

- With better prototype fit to behavior, prototype correlates identified, including in VMPFC
- VMPFC shows PSA-based category representation that tracks with strength of evidence for prototype representations in individual subjects
- Strong evidence that VMPFC represents abstract category information to facilitate generalization

## References

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