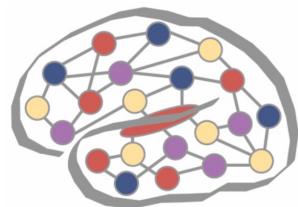


Memory distortions reveal different representations for specific and general knowledge

Marlie C. Tandoc, Cody V. Dong, Anna C. Schapiro

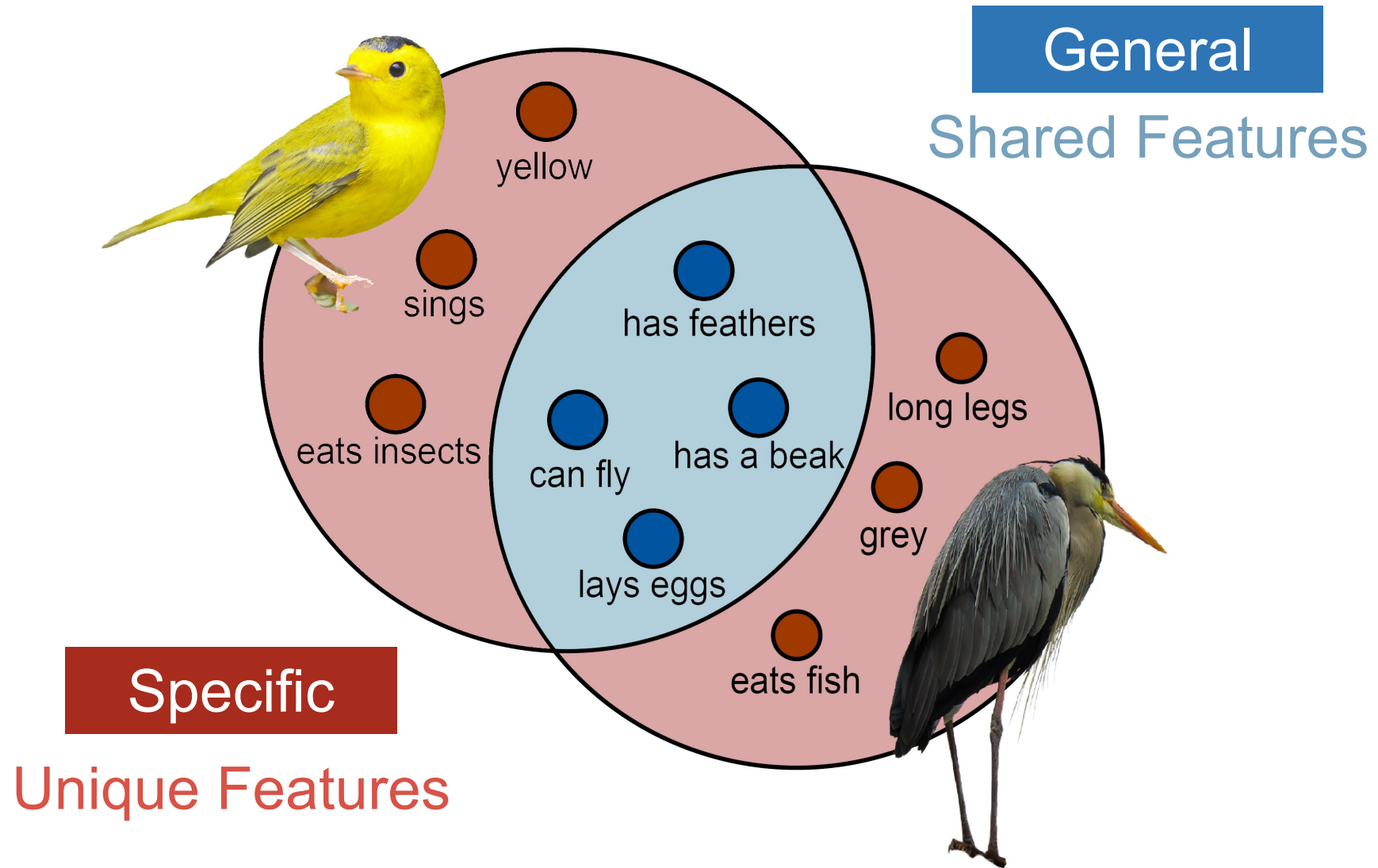
SfN 2022



Penn Computational Cognitive
Neuroscience Lab

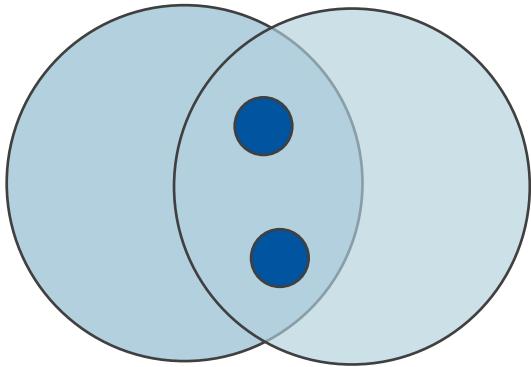




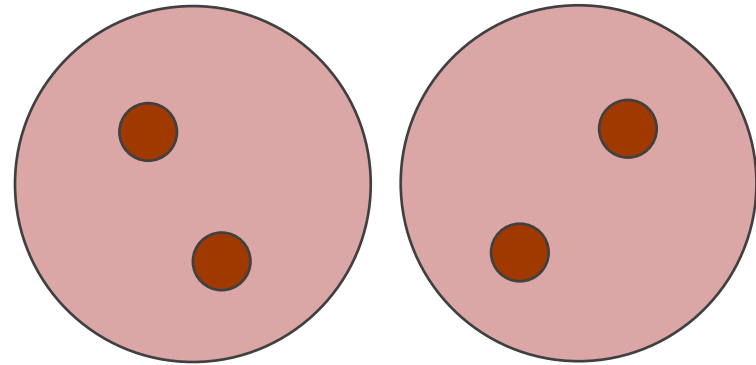


How are shared and **unique** features represented in memory?

Integrate

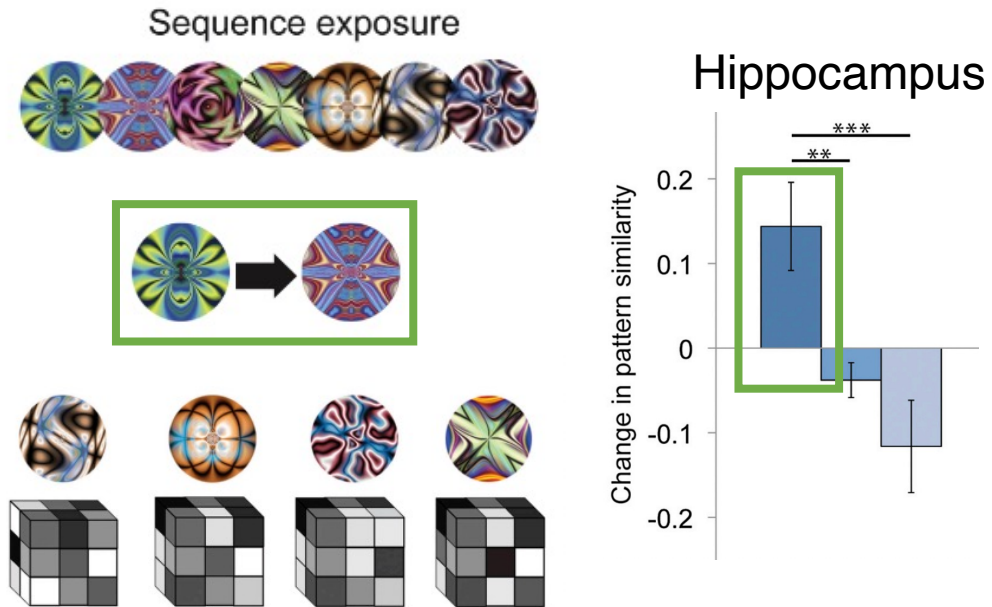


Separate



Items that “go together” have integrated neural representations

Statistical Learning



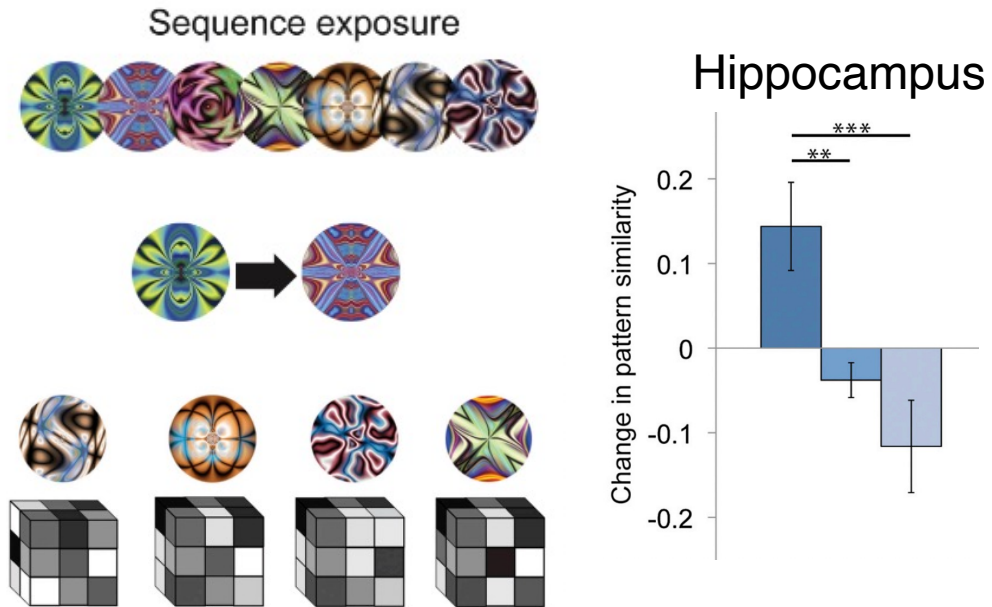
Schapiro et al. (2012, *Curr. Bio*)

Concept Learning

Shared features
“go together”
more than **unique**
features

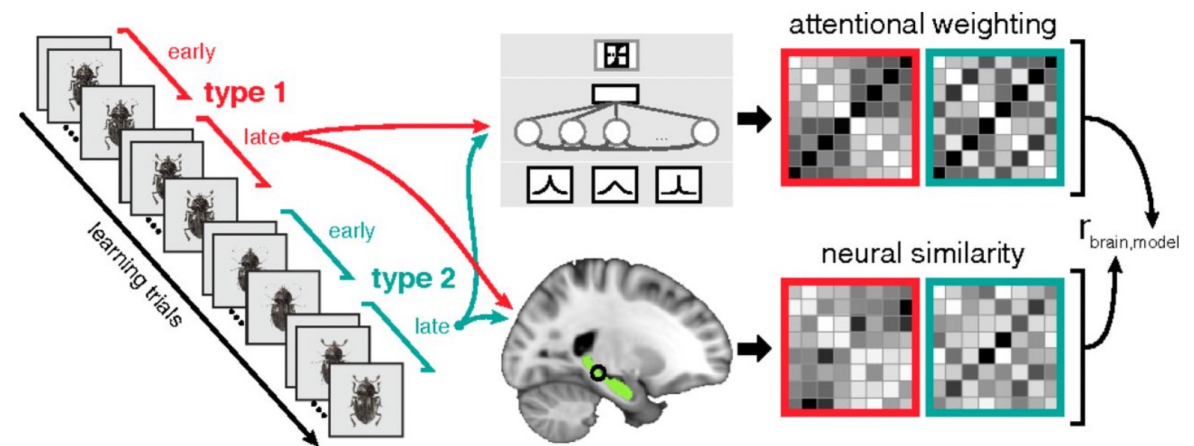
Items that “go together” have integrated neural representations

Statistical Learning



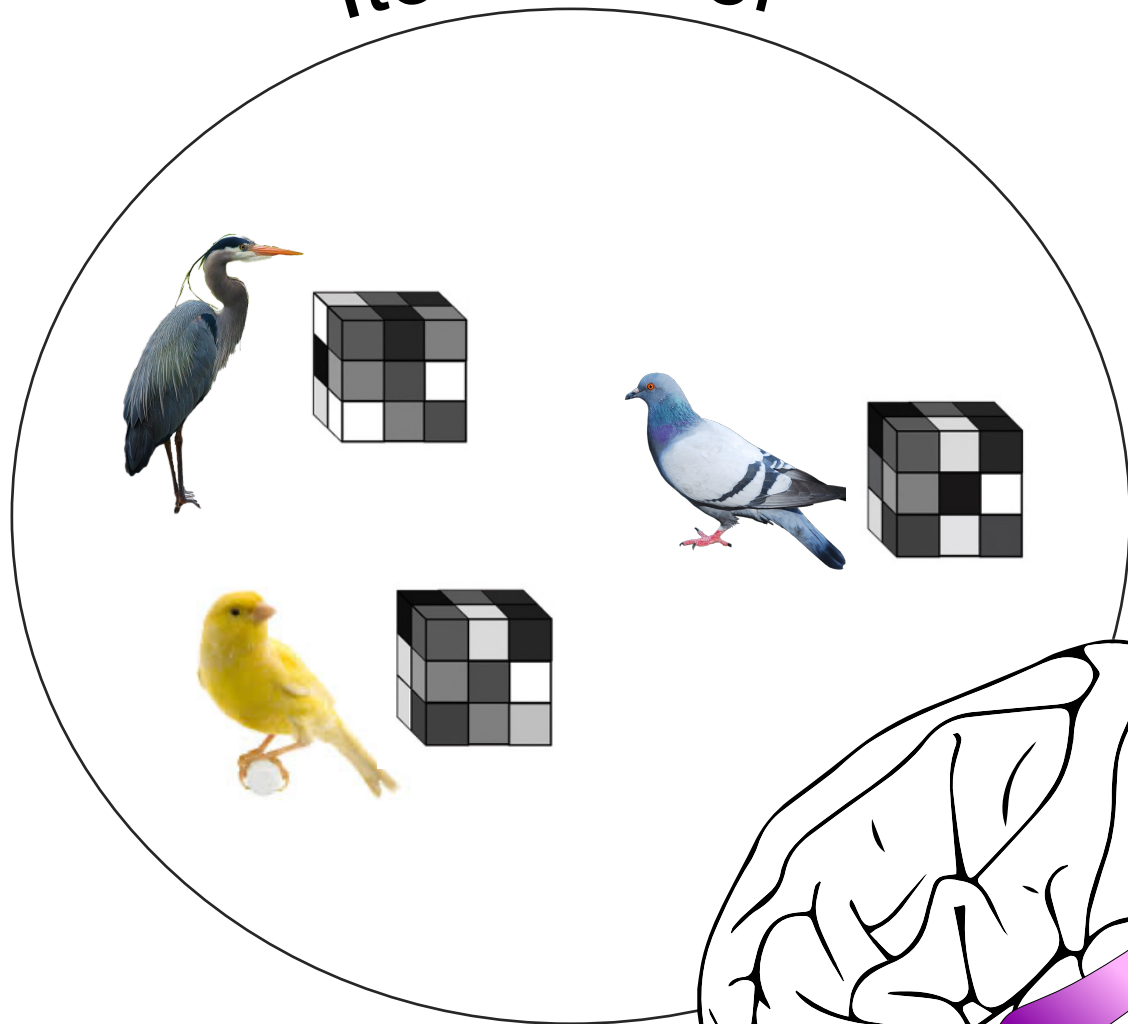
Schapiro et al. (2012, *Curr. Bio*)

Concept Learning

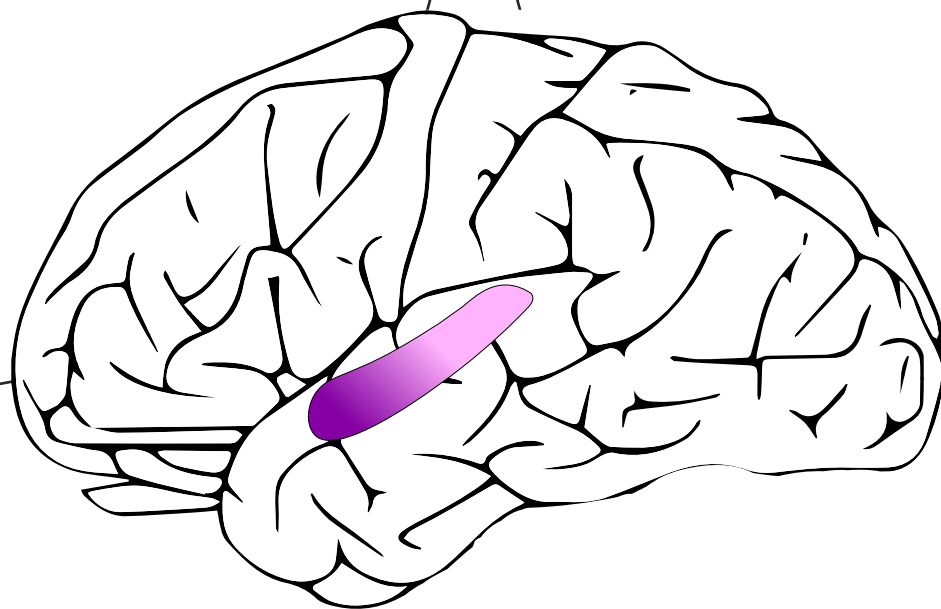
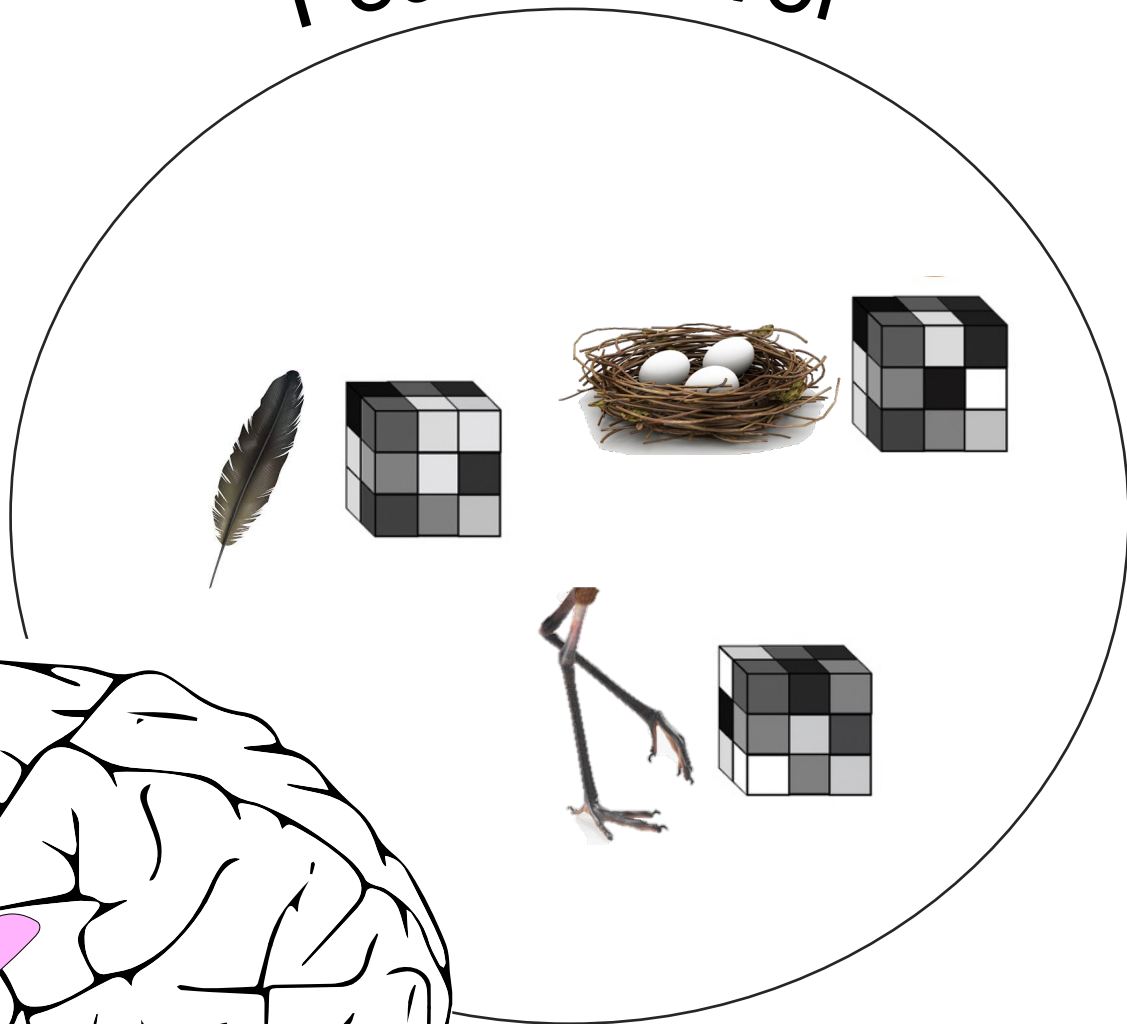


Mack et al. (2016, *PNAS*)

Item-Level

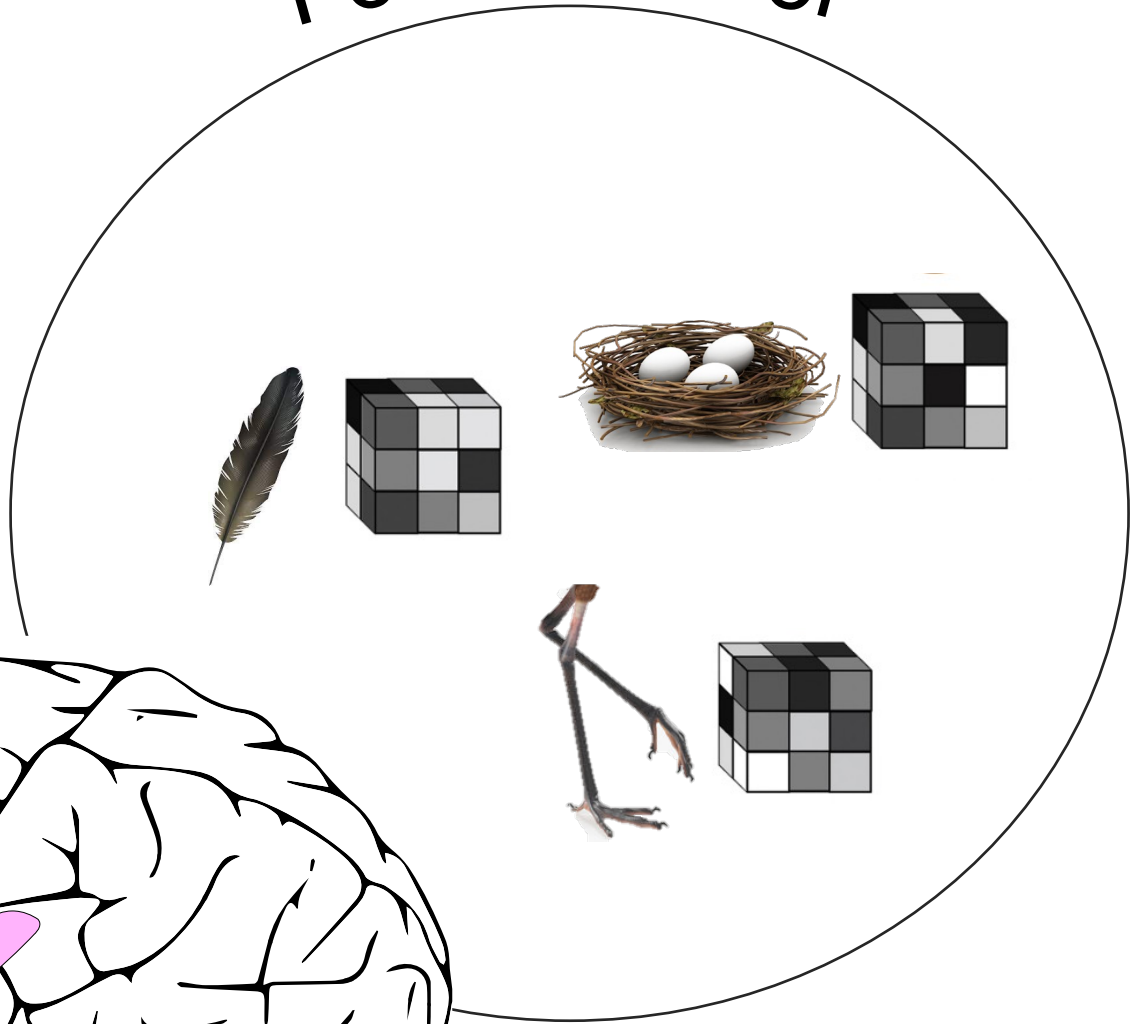
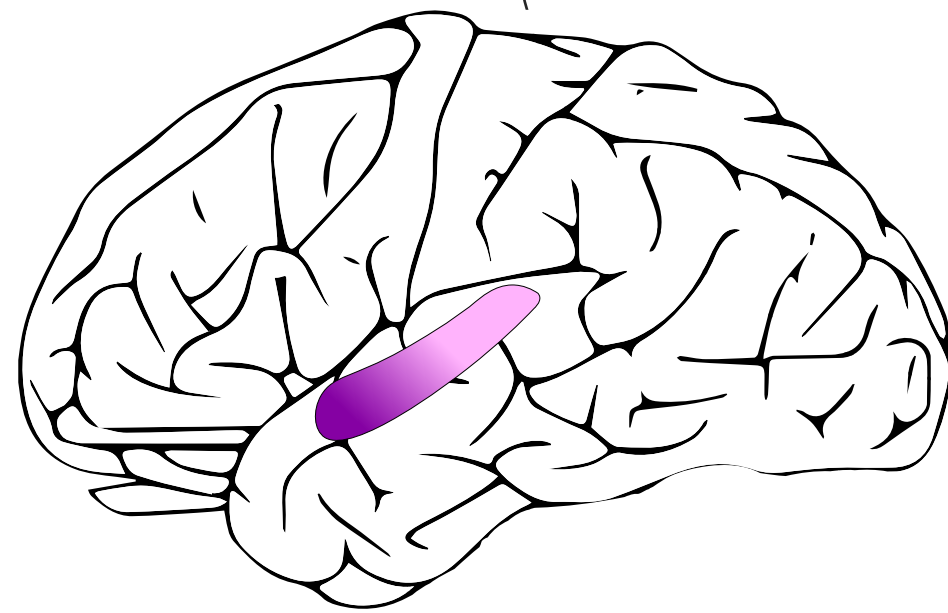


Feature-level

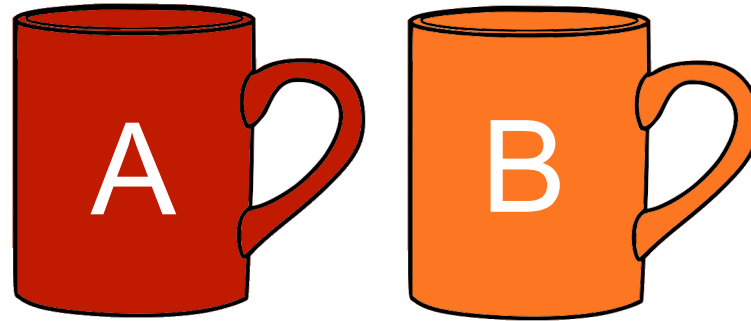


Feature-level

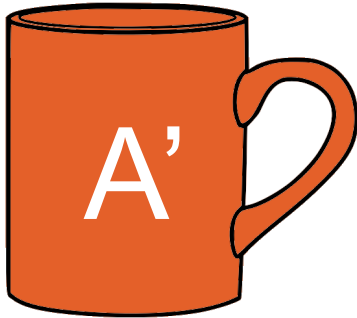
Memory distortions



Distortions in color memory

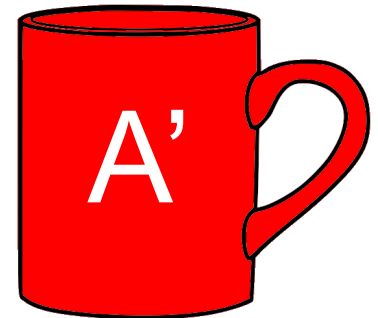


Attraction



Integration

Repulsion



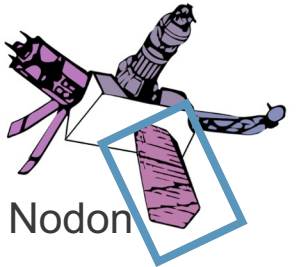
Separation

Design

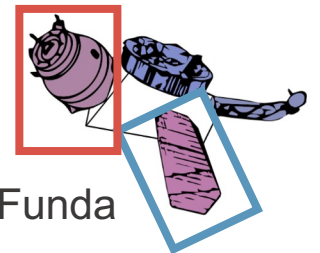
n = 85

Unique Shared

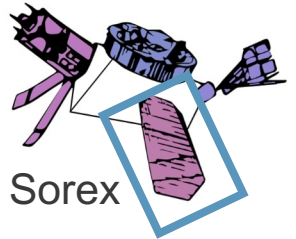
Alpha



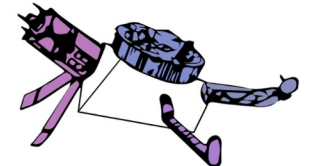
Nodon



Funda

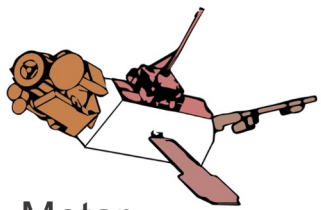


Sorex

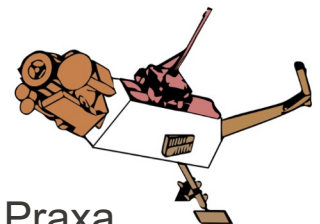


Volar

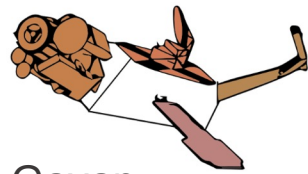
Gamma



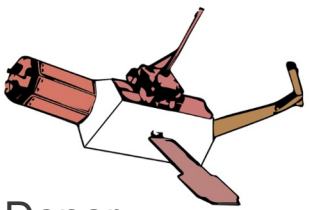
Motar



Praxa



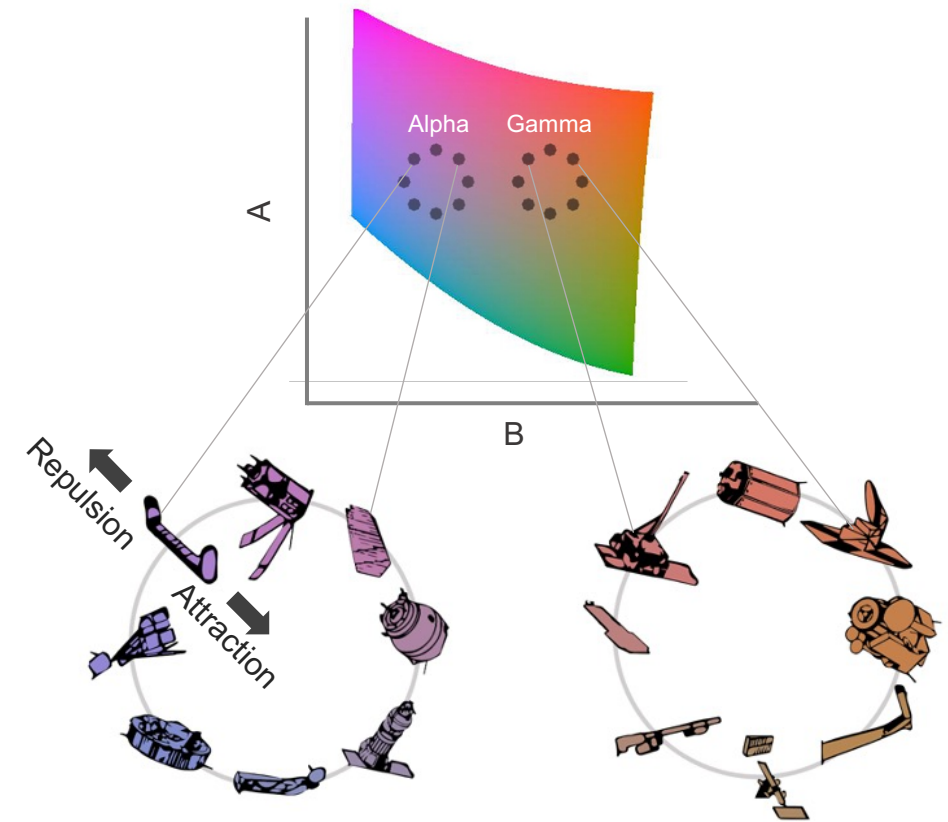
Gavan



Denor

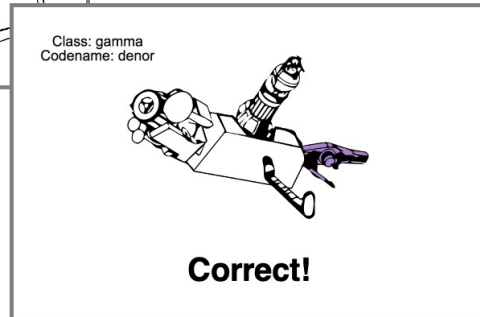
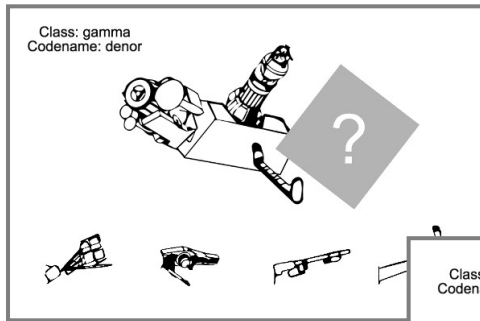
Items within a category share most parts (**shared** features)

Each item has an individuating part (**unique** features)



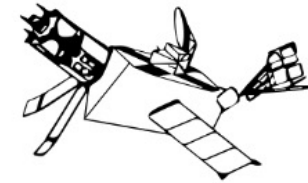
Attraction: Bias *towards* category features
Repulsion: Bias *away* from category features

Part learning

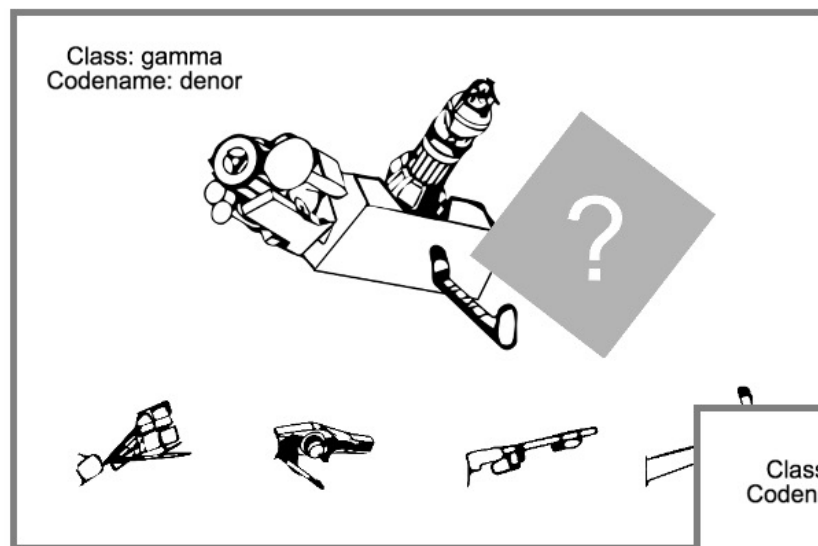


Color memory test

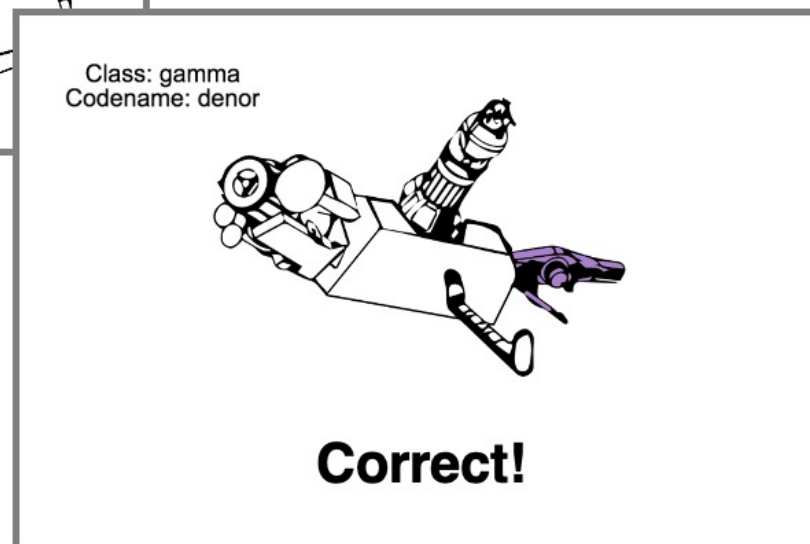
Class: gamma
Codename: sorex



Part learning trial



Guess-until-correct

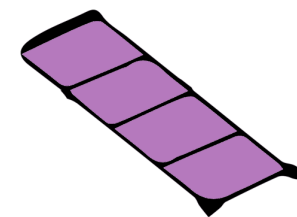
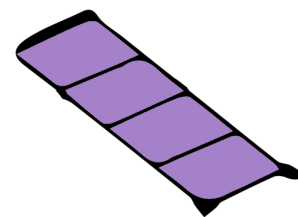
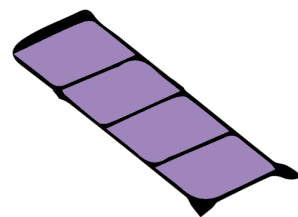
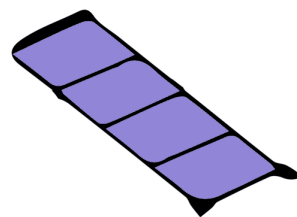
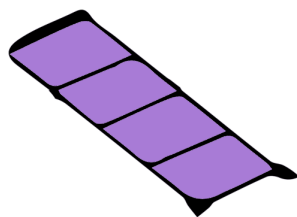
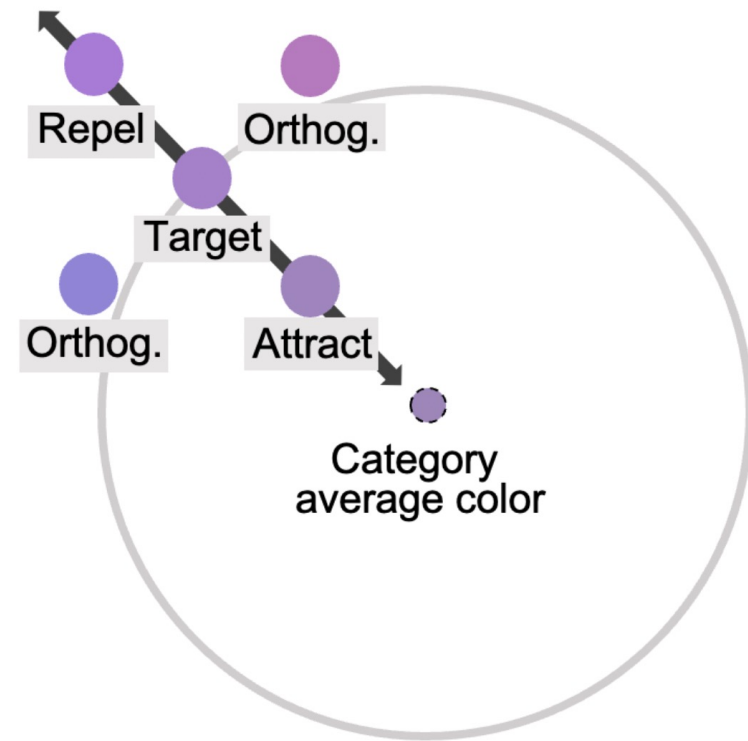
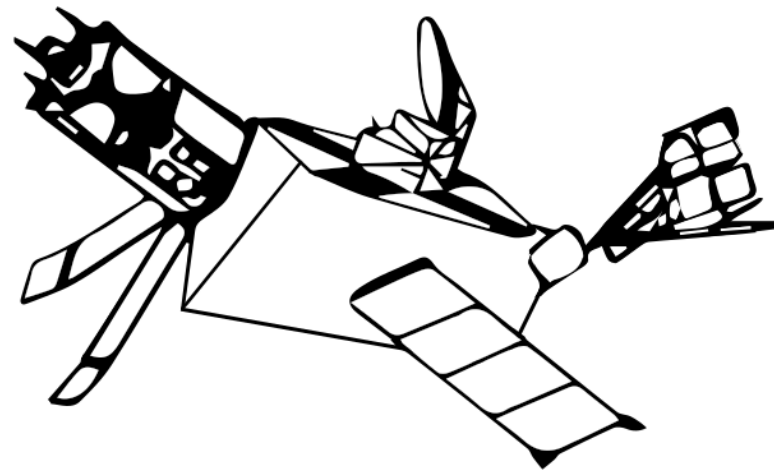


4s

Shared and unique
feature colors shown
with equal frequency

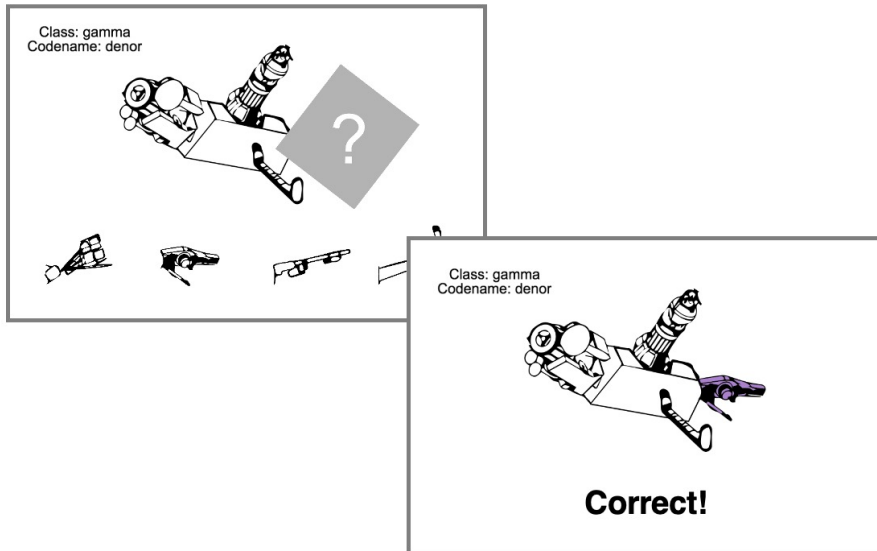
Color memory trial

Class: gamma
Codename: sorex

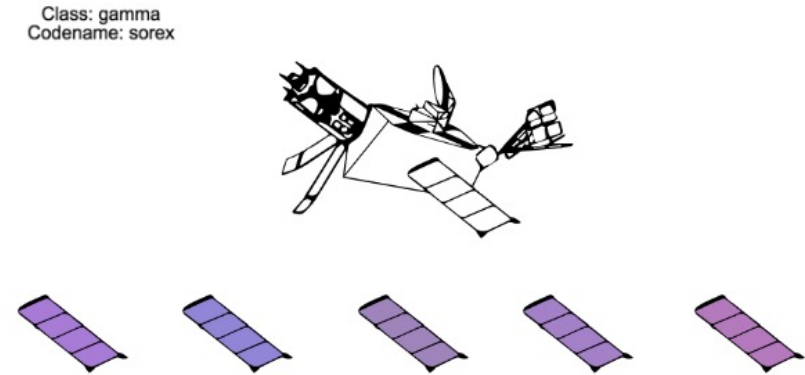


Continuously alternate between part learning and color memory

Part learning

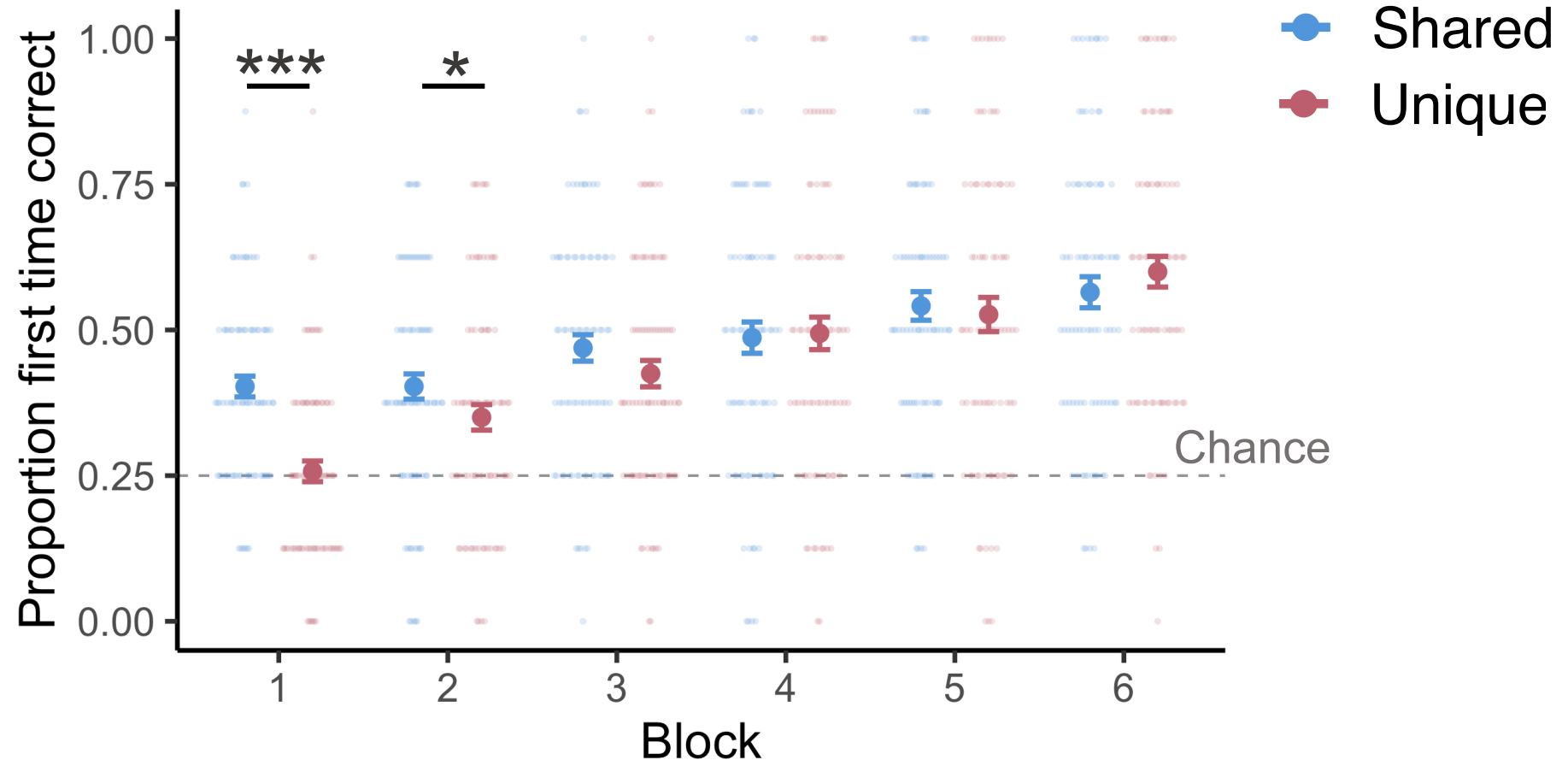


Color memory



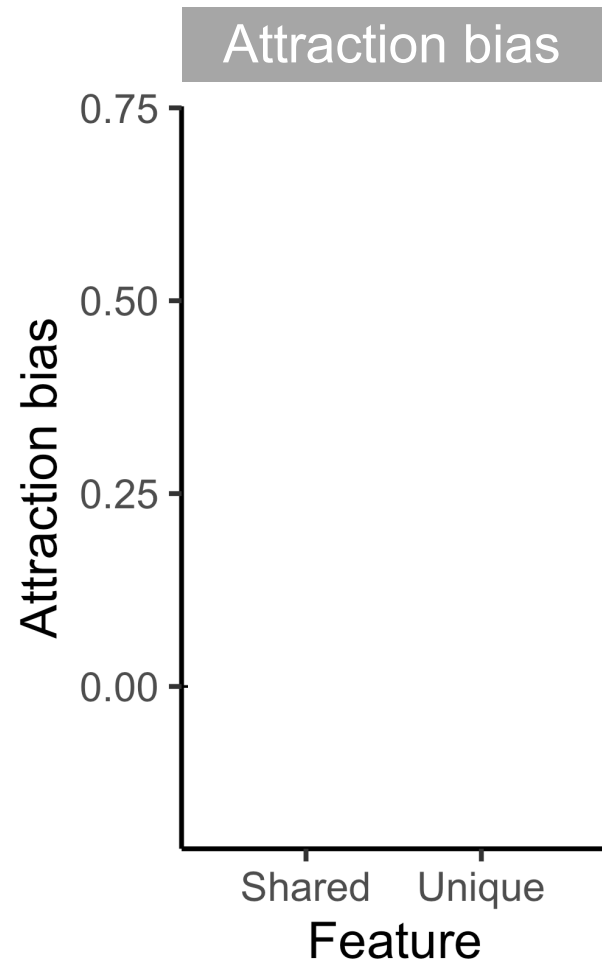
6 blocks (96 of each trial type total)

Part learning



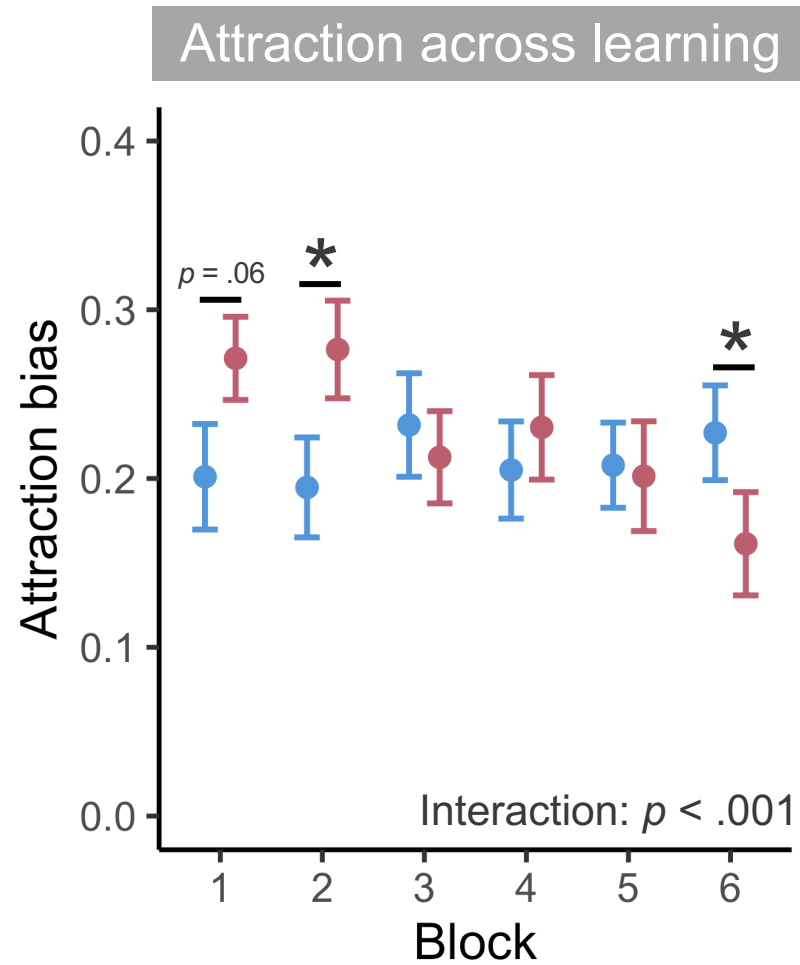
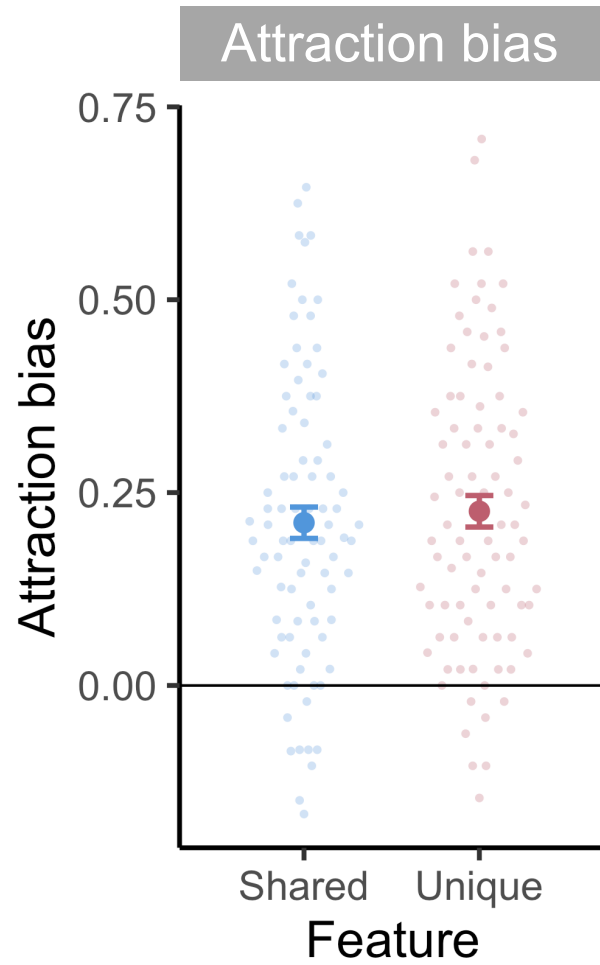
Color memory

● Shared ● Unique



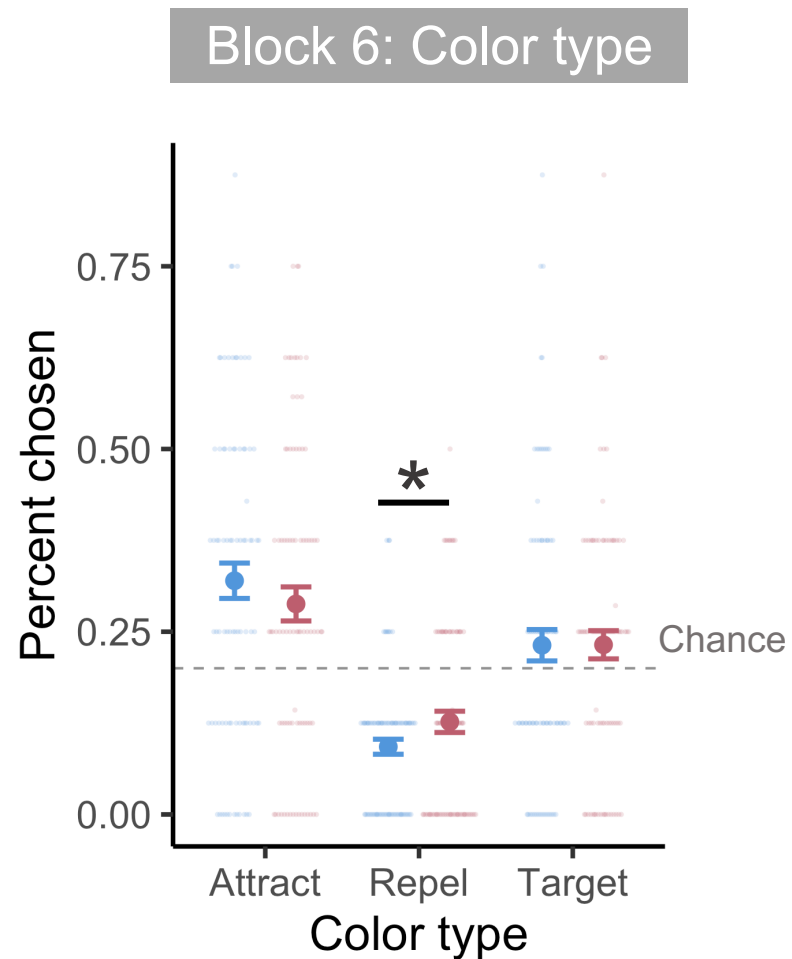
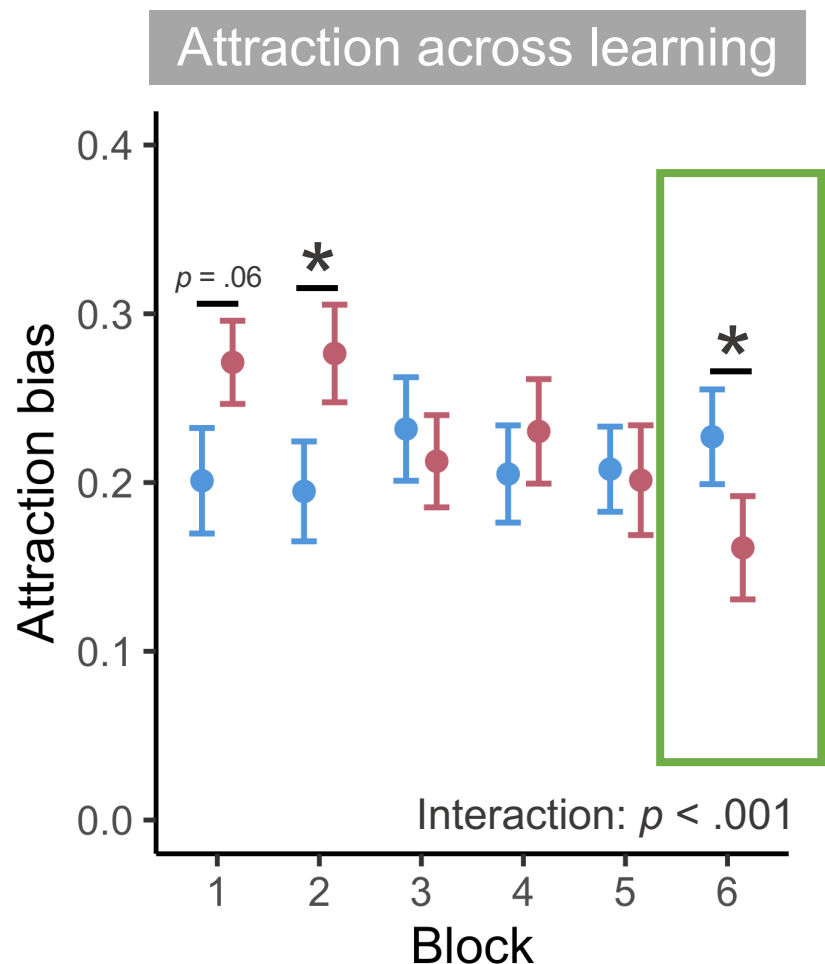
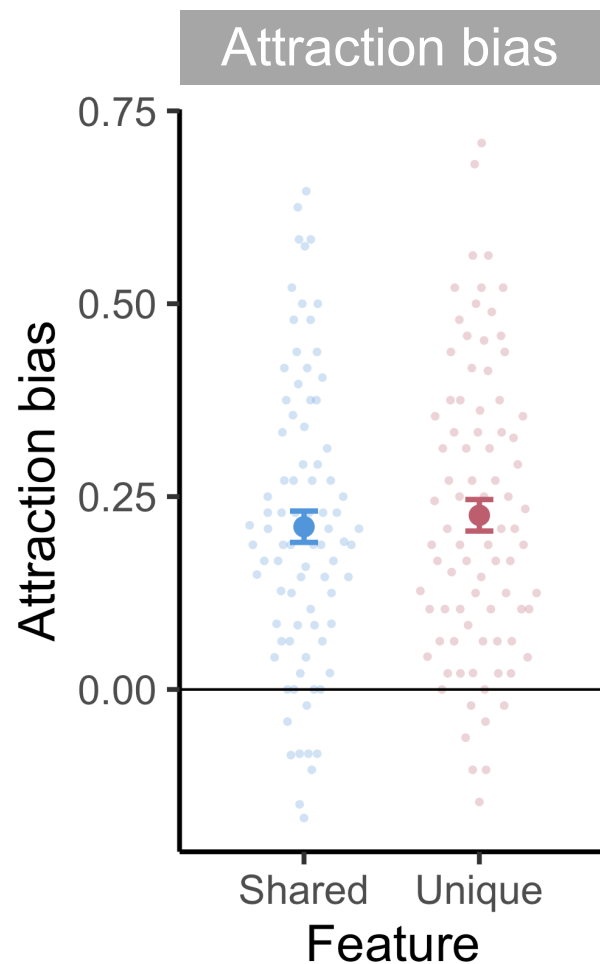
Color memory

● Shared ● Unique



Color memory

● Shared ● Unique



Unique features show less attraction with learning

Color memory

● Shared ● Unique

Attraction bias

Attraction across learning

Block 6: Color type

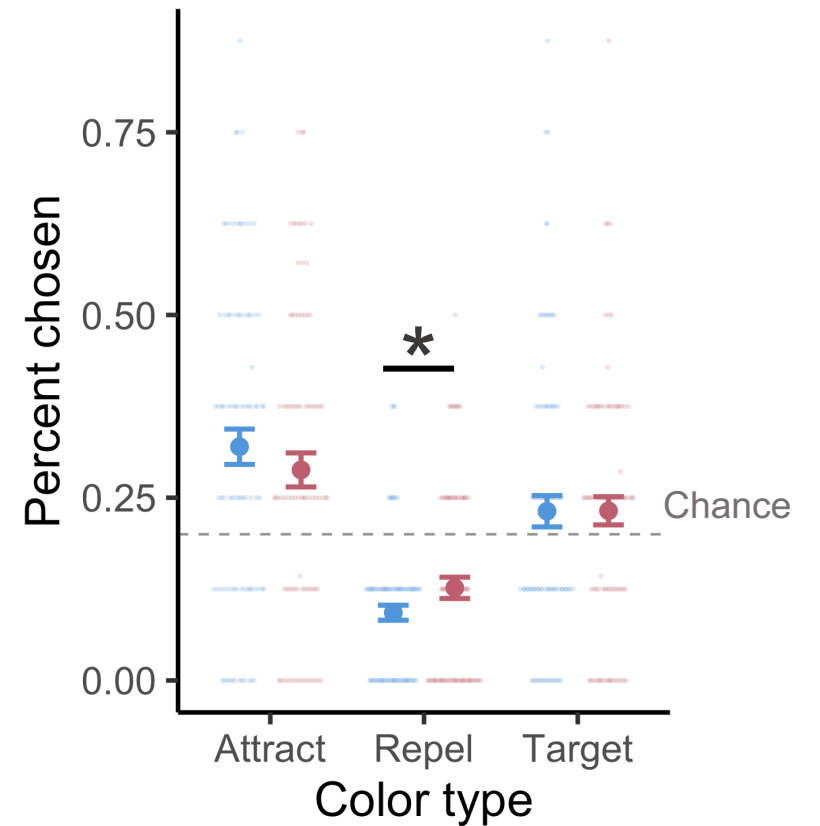
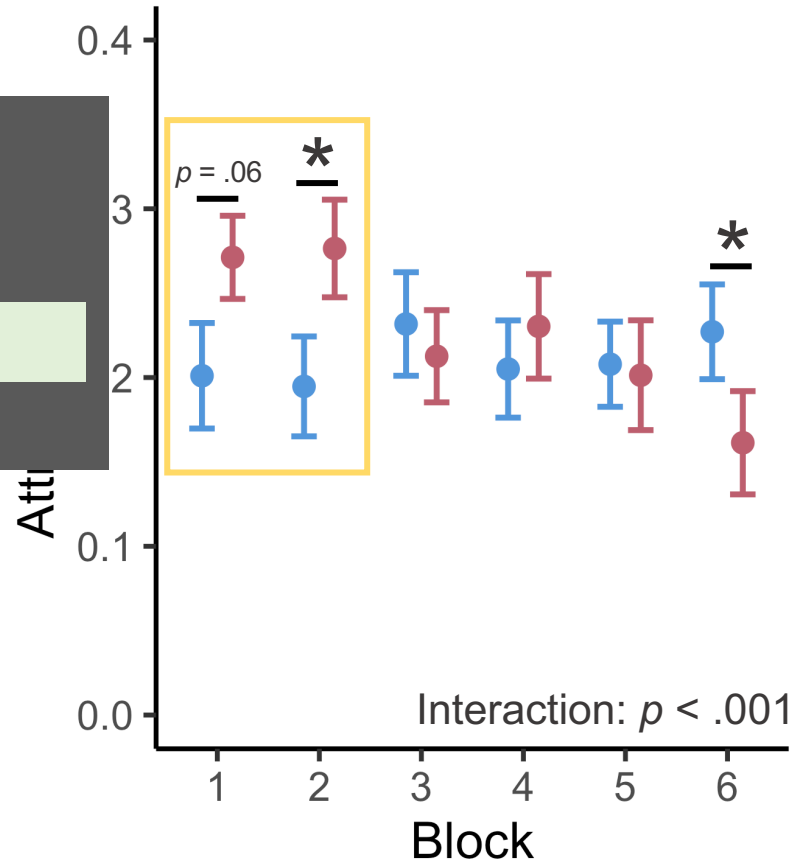
Influence of initial observation phase?

Observation

Learning

~4 min

~40 min

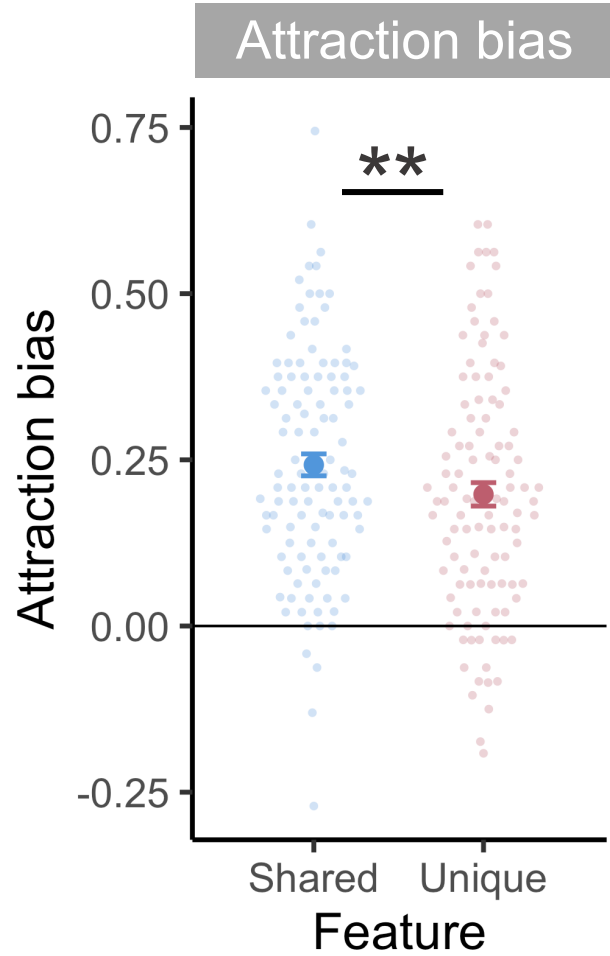


Unique features show less attraction with learning

Replication study (matched color frequency during early observation)

n = 109

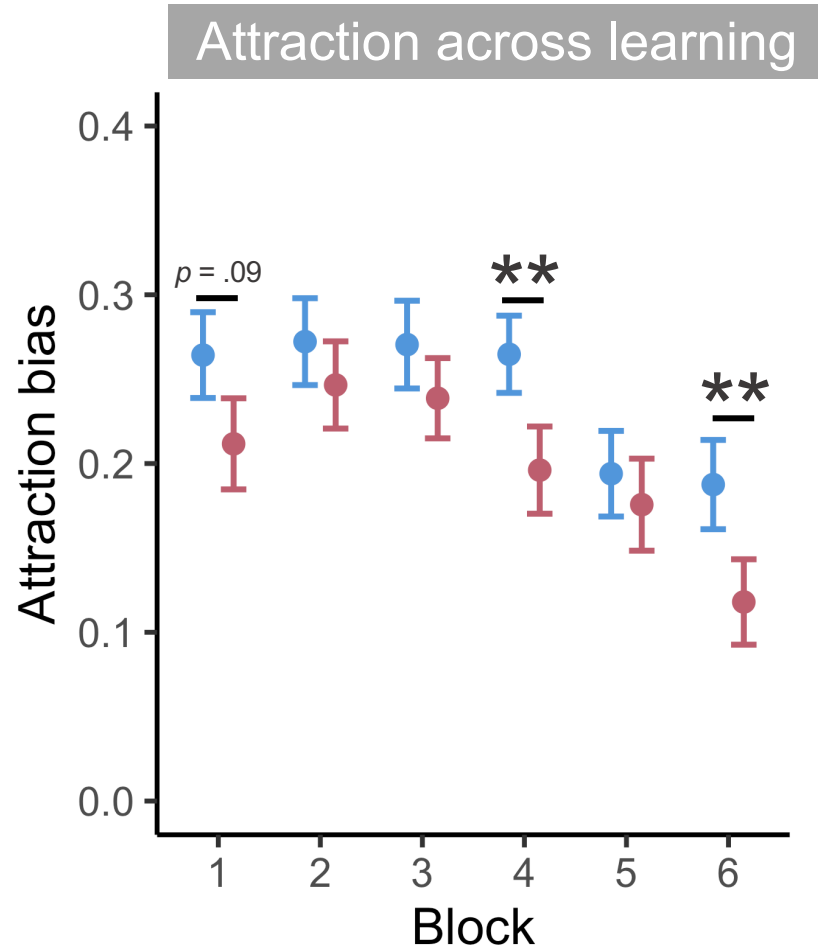
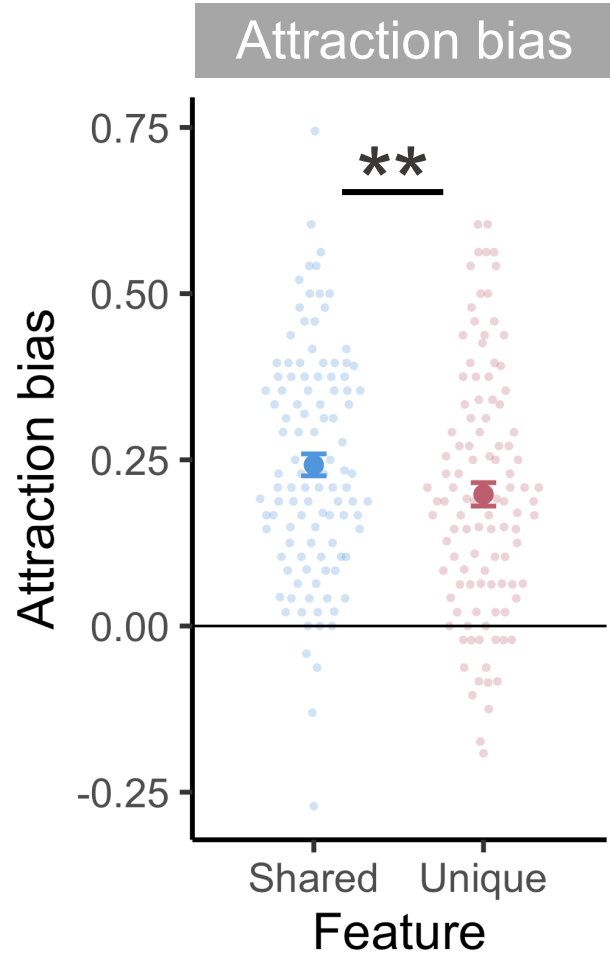
● Shared ● Unique



Replication study (matched color frequency during early observation)

n = 109

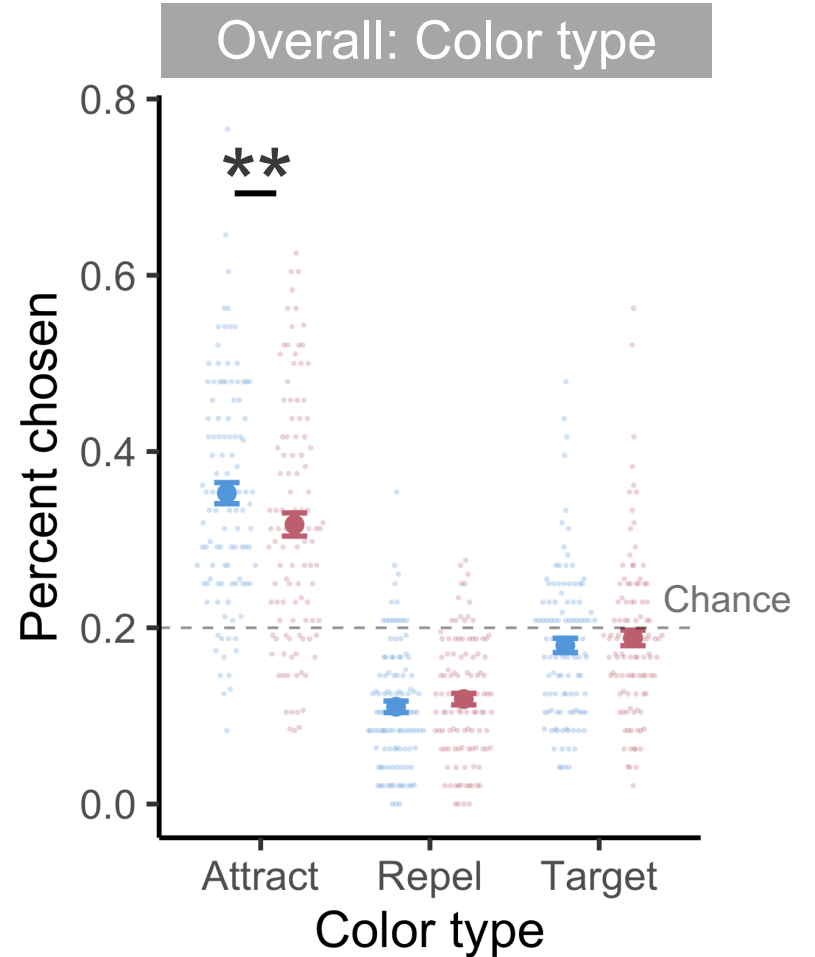
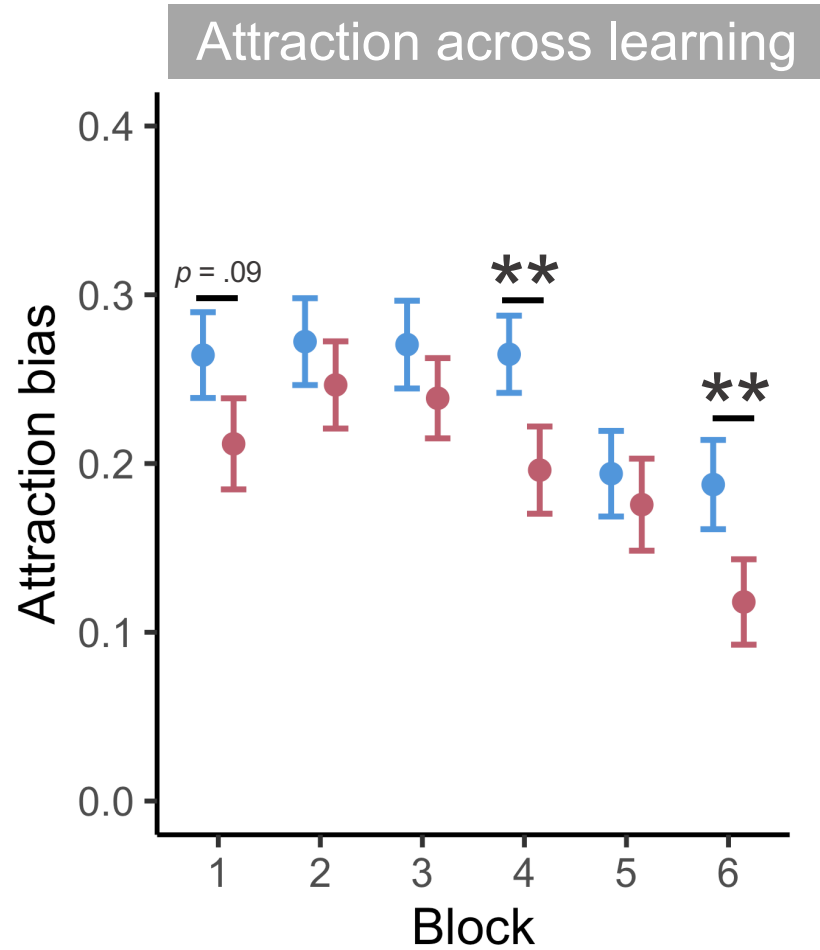
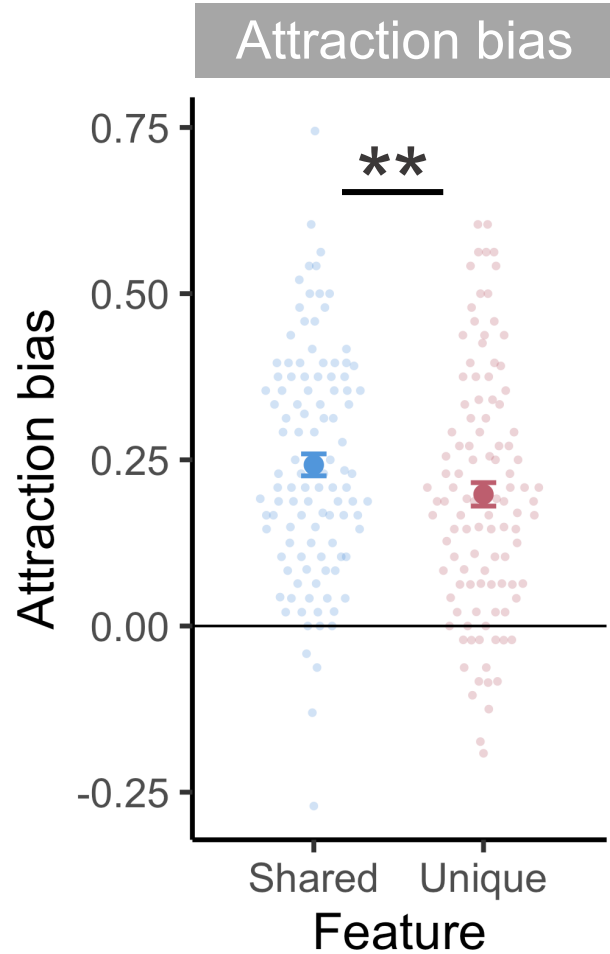
● Shared ● Unique



Replication study (matched color frequency during initial observation)

n = 109

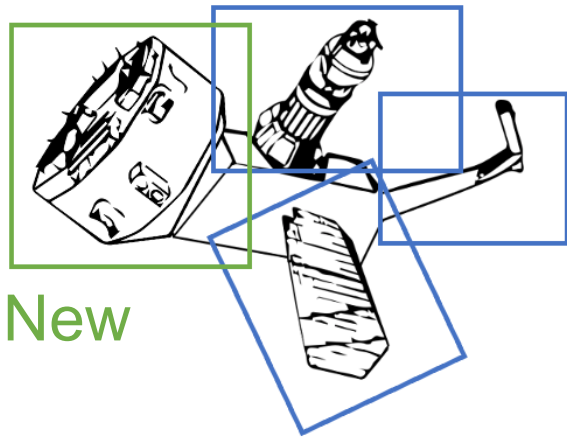
● Shared ● Unique



Stronger attraction bias overall for **shared features**

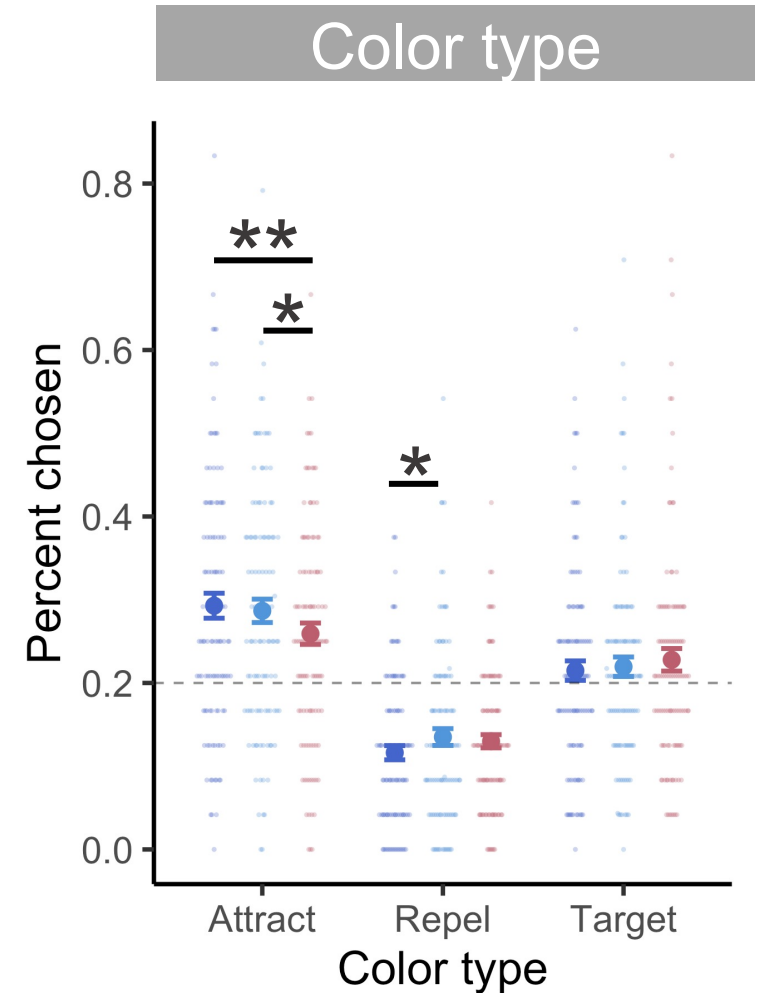
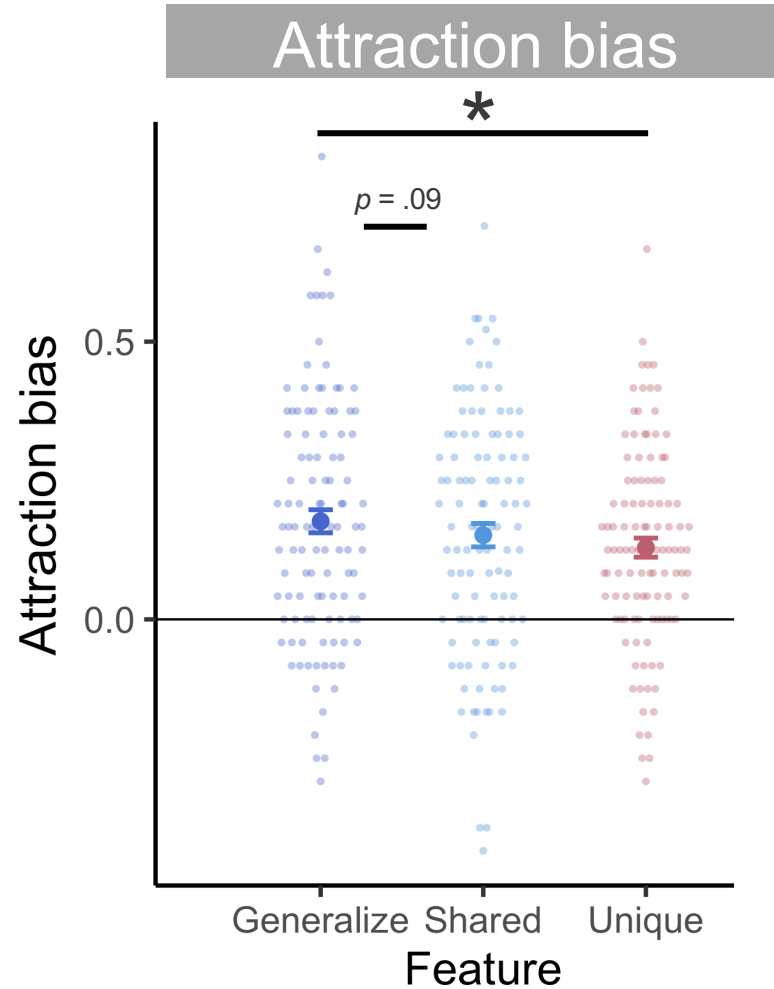
Post-learning: Generalization

Novel satellite



New

Shared parts, but on novel satellites
(generalize)



Strong attraction for **shared features** on novel exemplars

Shared features are more susceptible to category-based memory distortions than **unique features**

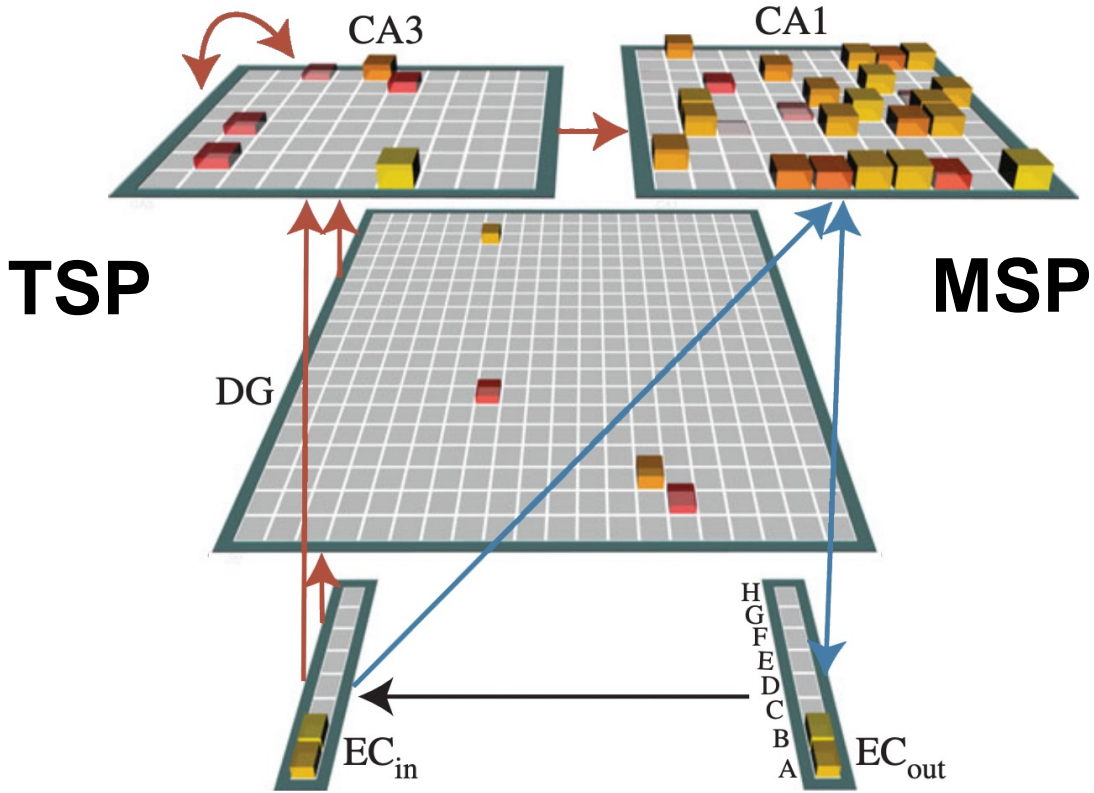
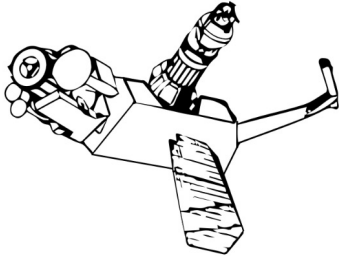
Shared features may have more integrated memory representations than **unique features**

Feature representations in a neural network model

C-HORSE

Complementary hippocampal operations for representing **statistics** and **episodes**

Train model on satellites



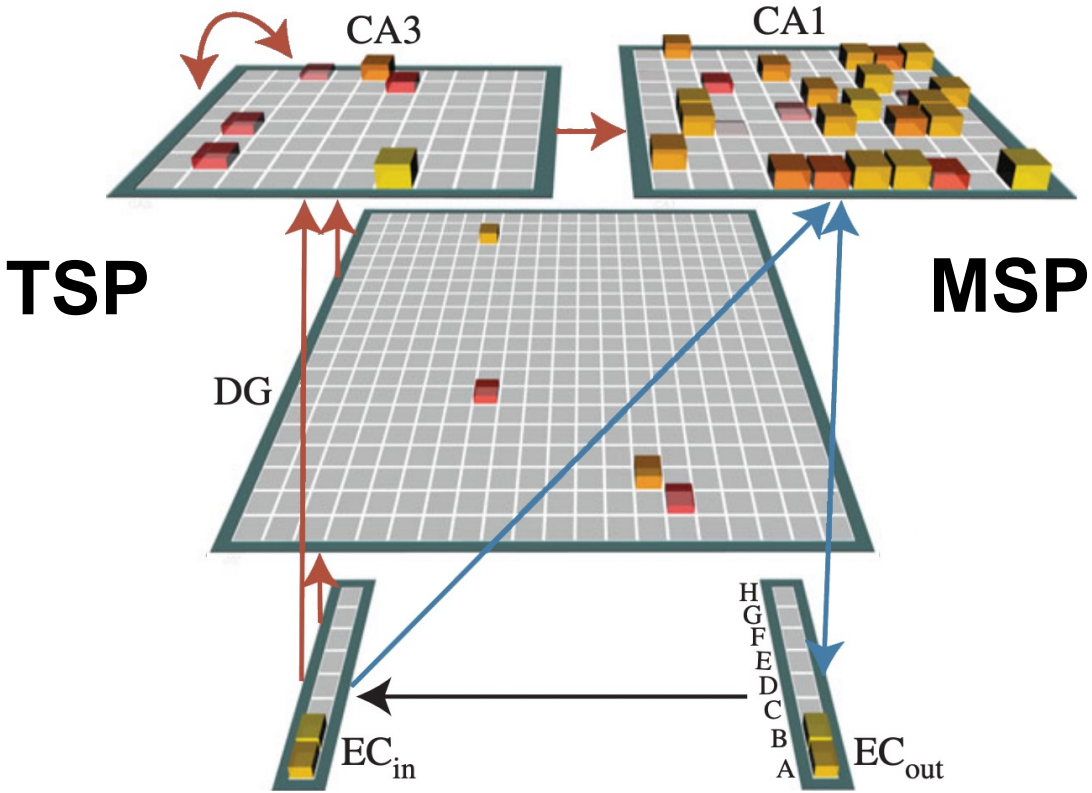
Schapiro et al. (2017)

Feature representations in a neural network model



C-HORSE

Complementary hippocampal operations for representing **statistics** and **episodes**

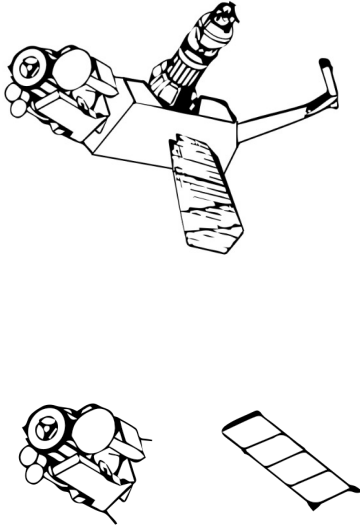


Schapiro et al. (2017)

Train model on satellites



Present features one-by-one

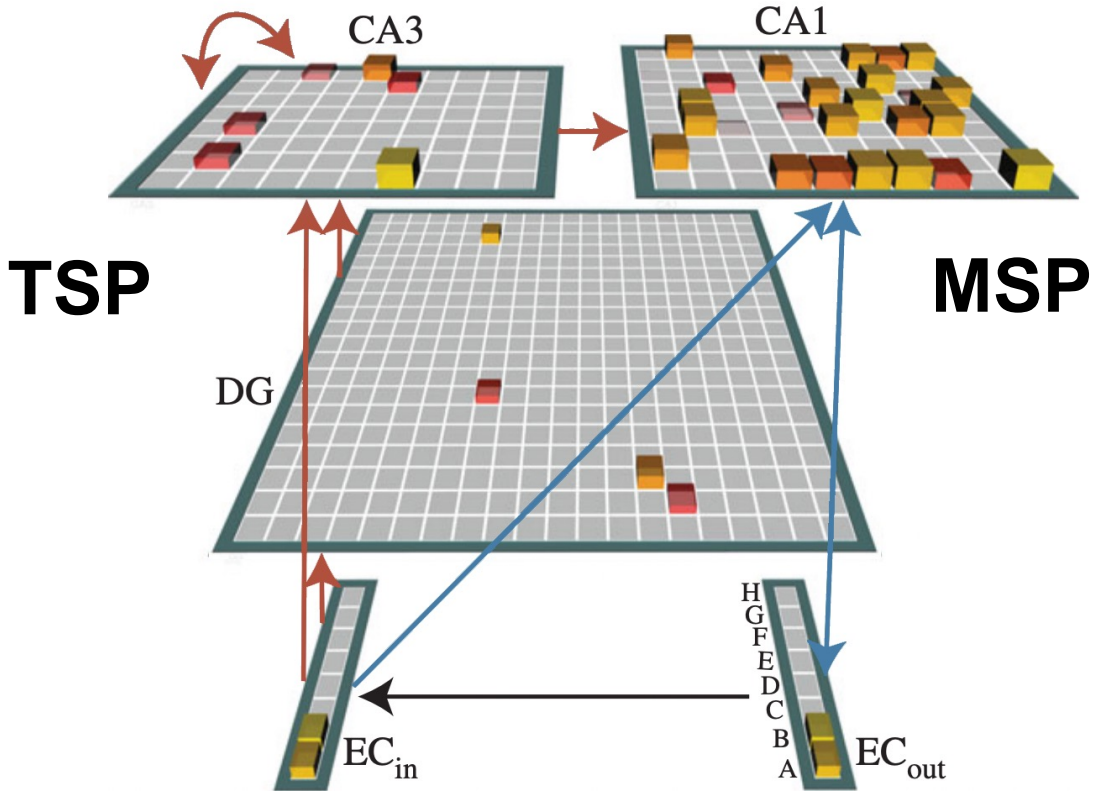


Feature representations in a neural network model



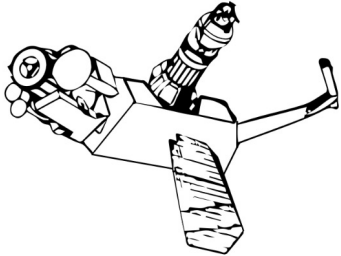
C-HORSE

Complementary hippocampal operations for representing **statistics** and **episodes**



Schapiro et al. (2017)

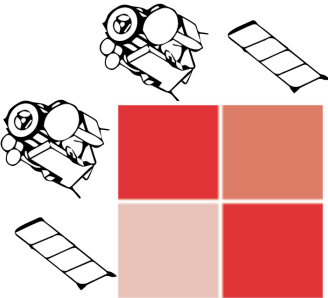
Train model on satellites



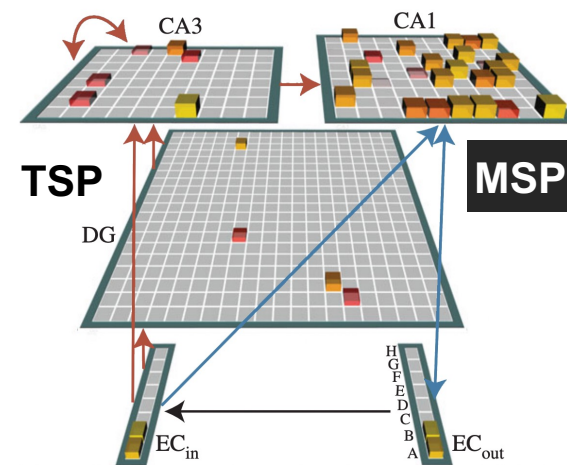
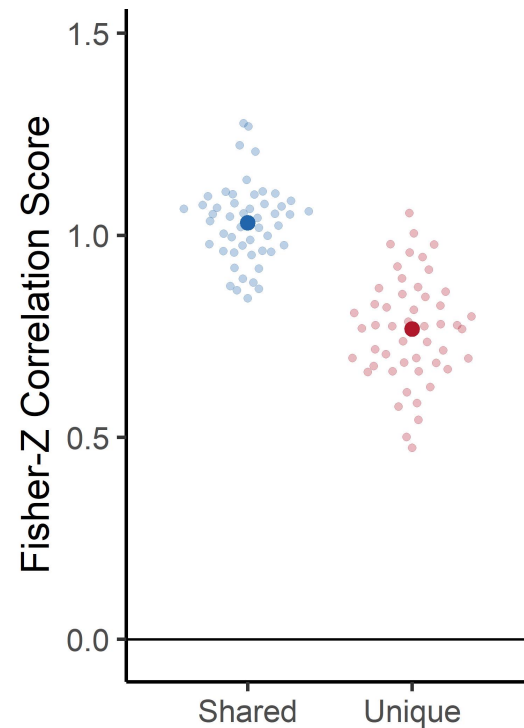
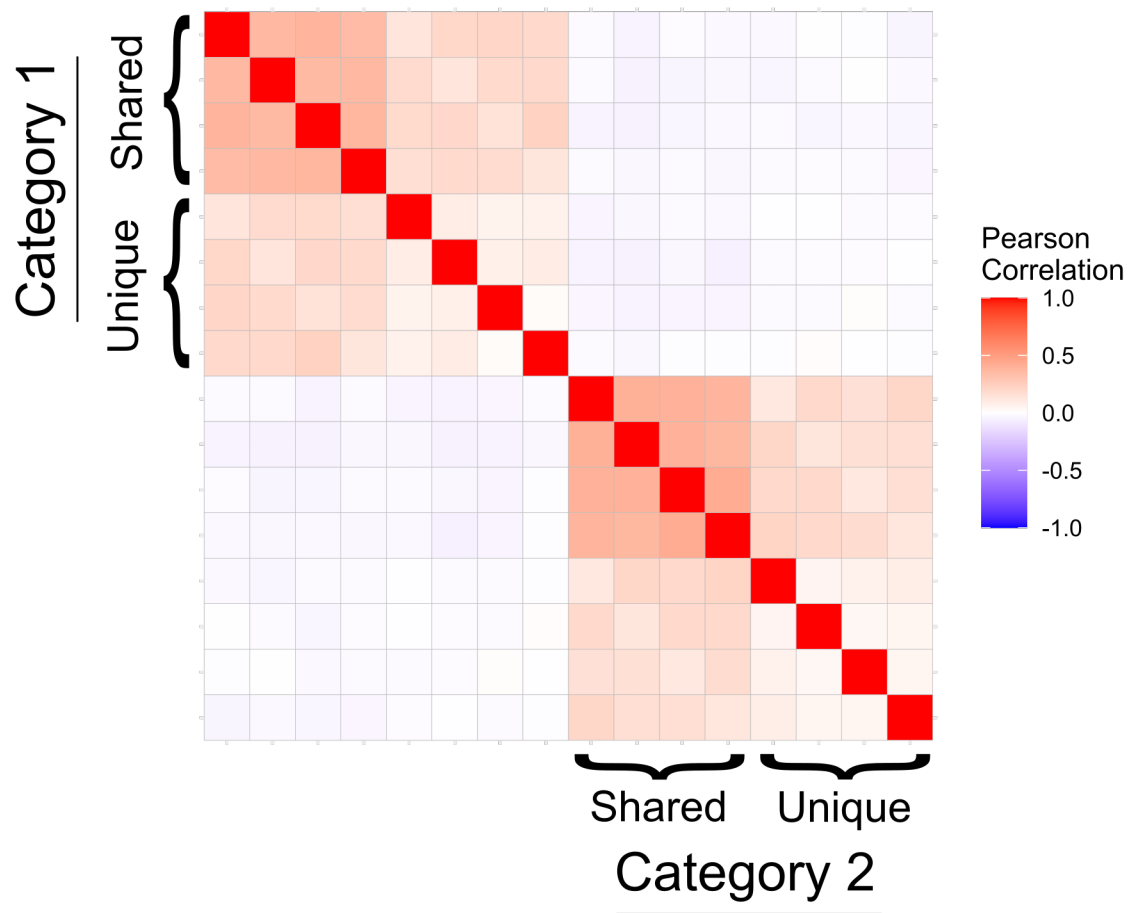
Present features one-by-one



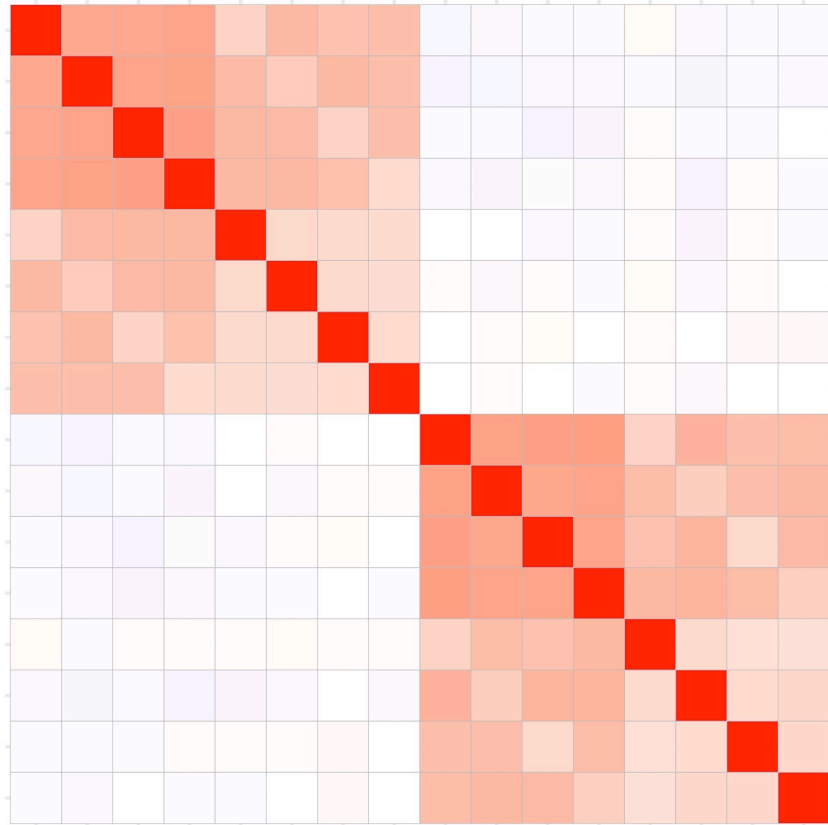
Calculate pattern similarity between all features



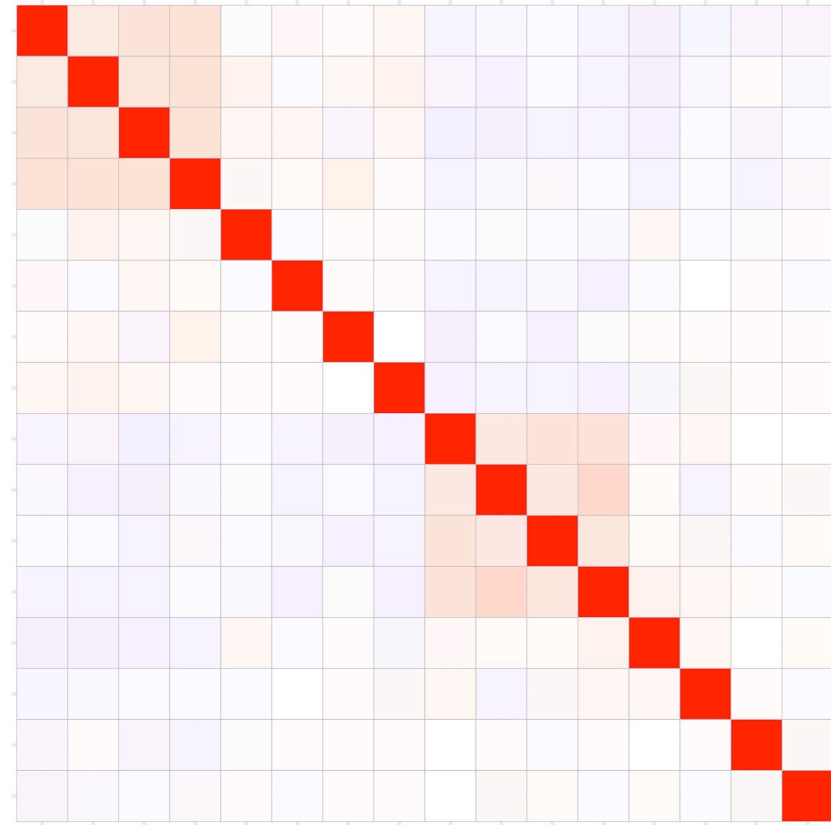
Feature representations in a neural network model



TSP lesion



MSP lesion



Shared and **unique** features are represented in memory according to their different computational-needs

