

The Effect of Second-Order Conditioning on Category Extrapolation for Learning Novel Color-Concept Associations

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Background

Color-Concept Associations

People form associations between colors and concepts based on their experiences in the world. (Schoenlein & Schloss, 2020a)

Category extrapolation hypothesis

When we form color-concept associations, our associations spread to all other colors within the seen color category.

(Falkenhainer et al., 2018; Schoenlein & Schloss, 2020c)

Previous work provides evidence for how people form associations for colors distributed over color space from exposure to direct color-concept associations. But, people also have such associations for concepts without directly observable colors such as leisure and safety. (Mueller et al., 2021)

Question: How are associations formed without direct color-concept co-occurrences?

Associative learning occurs at different levels of conditioning

First-order: Two objects directly linked together.

Category extrapolation occurs when people observe direct color-concept co-occurrences under first-order conditioning.

Second-order: Two objects indirectly linked together. (Schoenlein et al., 2020)

e.g., in a fictitious medical scenario, participants formed associations between bacteria and a disease indirectly linked. (Jaschinski et al., 2019)

Can people form color-concept associations indirectly paired through second-order conditioning? If so, do they perform category extrapolation?

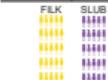


Methods

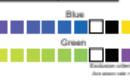
Planet Images



Alien Species



Color Sequence

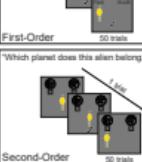
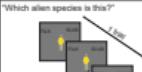


Planet Learning Task

"Which planet is this?"

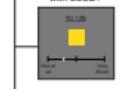


Alien Categorization Task



Association Ratings Task

"How much do you associate this color with SLUBB?"

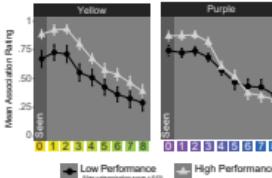


Two blocks of trials:
1 block for each species
All colors in the sequence were presented twice
40 total trials

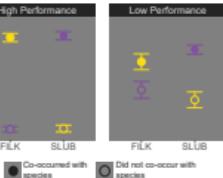
Results

First-Order Condition: n = 38 mTurk workers

Average Associations: Full Sequence

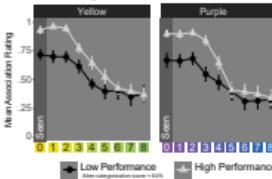


Average Associations: Seen Colors

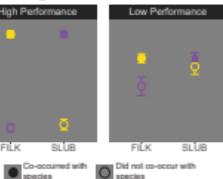


Second-Order Condition: n = 31 mTurk workers

Average Associations: Full Sequence



Average Associations: Seen Colors



LMEM: condition * performance (continuous) * color category * color distance: performance * color category: $F(1,65) = 7.338$, $p = .009$

LMEM: condition * performance (continuous) * co-occurrence: 3-way interaction $F(1,65) = 4.127$, $p = .046$

Conclusions and Future Directions

People can form associations for colors and concepts indirectly paired through second-order conditioning.

For indirectly paired colors and concepts, people perform category extrapolation to generalize associations to similar unseen colors.

Participants across levels of alien category learning performance form color-concept associations and demonstrate category extrapolation, suggesting association formation can occur during early stages of concept learning.

This work informs future research investigating color-concept association formation for abstract concepts (e.g., emotions, values) that do not have directly observable colors.

Together, this research furthers our understanding of how people form color-concept associations from their experiences, which can support research investigating human judgments that rely on these associations.



Acknowledgments and References

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