Interleaved Training Improves Category Learning by Increasing Perceptual Similarity of Within-Category Exemplars

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BACKGROUND

Category learning paradigms using naturalistic stimuli have found that **interleaving exemplars across categories** during training (rather than blocking by category) leads to superior category learning[1,2,3].

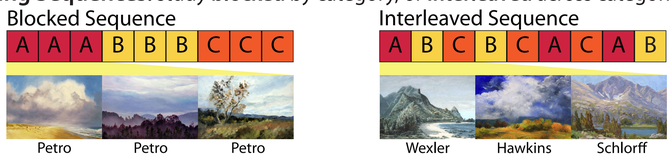
Behavioral paradigms have suggested that the interleaving benefit is driven by increased **between-category discrimination and differentiation**[2,3].

Using a cognitive model that infers feature representations from similarity judgments, referred to as **psychological embedding**, we quantified how learning-related changes in perceptual similarity differ by training sequence[4,5,6].

- We predict learning category groupings will **reduce variance among same-category exemplars**.
- We predict the interleaving benefit is driven by **increasing distance between categories**, which enhances category discriminability.

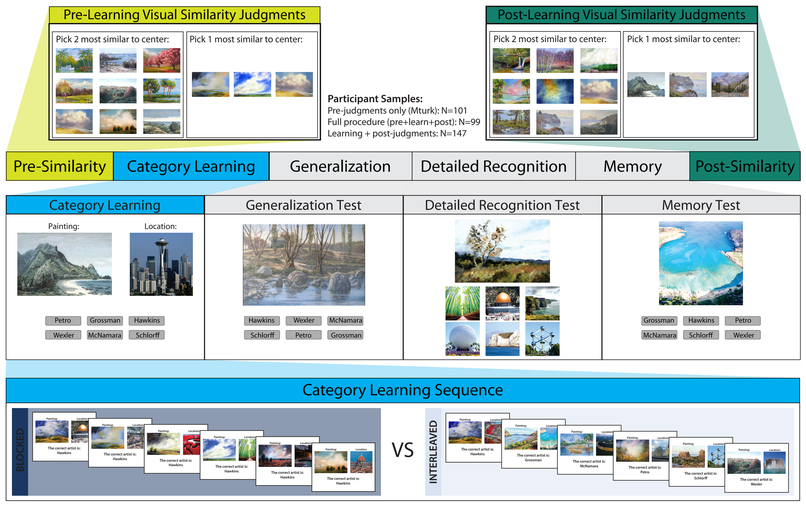
METHOD

Subjects: Recruited via Amazon Mechanical Turk (N=101) and UT Psych pool (N=246)
Stimuli: Landscape paintings from 6 artists (categories) × 12 unique paintings per artist
Design: Learning sequence (blocked vs. interleaved) manipulated between-subjects
Learning Sequences: study **blocked** by category, or **interleaved** across categories

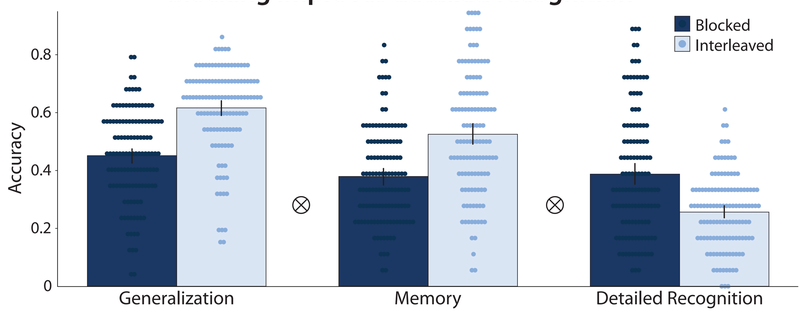


PROCEDURE

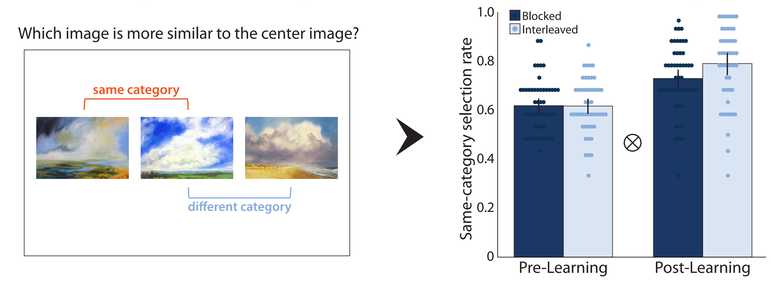
Similarity Judgments: Pick images most visually similar to center (query) image
Learning Phase: Study 36 painting+location pairs to learn artist styles
Generalization Test: Categorize 6 new paintings per artist (36 trials)
Detailed Recognition Test: For half of studied paintings, identify location
Memory Test: For half of studied locations, identify artist paired w/ that location



Interleaving benefits generalization and general recognition, blocking improves detailed recognition

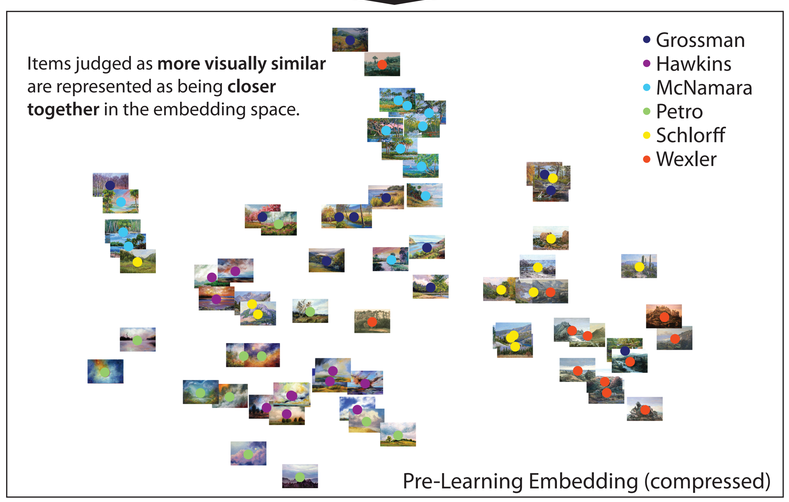


Participants judge exemplars from the same-category as being more visually similar after interleaved training



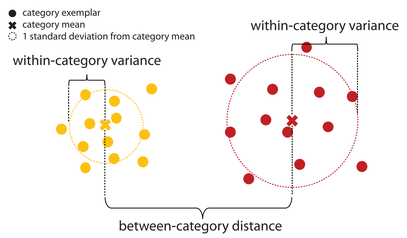
What drives the **increase in perceived similarity** for same-category exemplars?

PSYCHOLOGICAL EMBEDDING

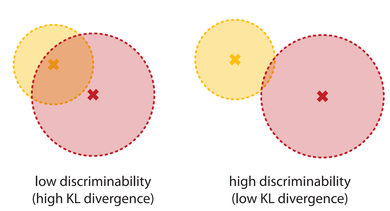


LEARNING-RELATED REPRESENTATION DIFFERENCES

Measures of within- and between-category distance

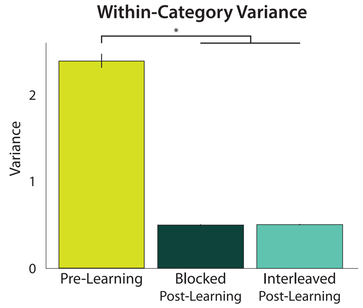


Measure of between-category discriminability (KL Divergence)

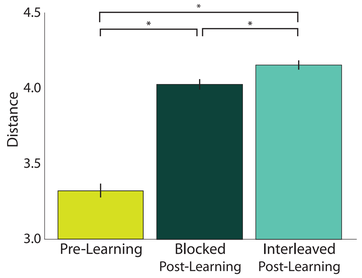


Interleaved training increases between-category discriminability

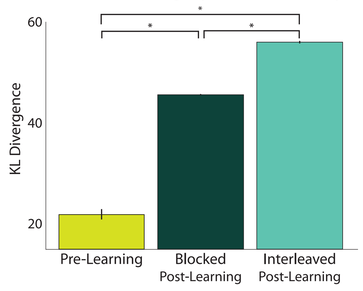
Within-Category Variance



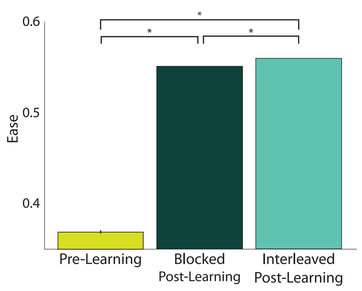
Between-Category Distance



Between-Category Discriminability



Predicted Ease



- Interleaving is beneficial for **improving general knowledge**, whereas blocking is better for **improving specificity** and learning of details.
- Category learning can **change perception** such that same-category exemplars **appear more visually similar**.
- Psychological embeddings reveal that the interleaving benefit is driven by **increasing between-category distance and discriminability**.

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Acknowledgments and funding sources: This work was supported by the NIMH (R01MH100121 to ARP), the NSF GRFP to SMN, the NINDS (F31NS105353 to SMN), NIH (1P01HD080679 to BCL), Wellcome Trust Investigator Award (WT106931MA to BCL), and Royal Society Wolfson Fellowship (183029 to BCL).