Examining the Effect of Category Structure on Retroactive Changes in Memory

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Study Aim:

Move towards a unified framework for understanding the factors that determine whether later learning experiences of related material will enhance or impair initial memories

Introduction

Background

Selective Retroactive Memory Enhancement (RME)
- Within category *enhancement* effect
- The fear conditioning of items in a *superordinate level category* leads to memory enhancement of related items from the same category seen prior to the conditioning session.

Recognition Induced Forgetting (RecIF)
- Within category *forgetting* effect
- The practice of recognizing items in a *basic-level category* leads to the forgetting of related items from the same category seen before the practice session.

RME and RecIF paradigms have similar structures but they differ in various ways.
One critical difference between the tasks is the pertinent level of categorization.

Levels of Categorization

Superordinate	*Basic-level*	*Subordinate*
	Dog	**Beagle** / **Corgi**
	Rabbit	**Brush** / **Mini Rex**
Animal		
	Shark	**Grey White** / **Tiger**
	Monkey	**Macaque** / **Capuchin**

Research Questions

This study examines how **changing the categorical relationship** between items affects the kind of within-category retroactive effect present.

- **Does RME occur for items at the order of the basic-level (i.e., highly similar items?)**
- **Can certain basic-level categories be enhanced but not others under the same superordinate category?**

Hypotheses

Enhancement Hypothesis:
There will be a retroactive enhancement for items learned before the conditioning phase that are in the same basic-level categories as conditioned items, suggesting that the enhancement effect is highly selective.

Impairment Hypothesis:
There will be retroactive impairment for items learned before the conditioning phase that are in the same basic-level categories as conditioned items, suggesting that the enhancement effect only occurs for items related at a high level.

Methods: Data Simulation

Using parameters from studies on RME and recognition memory for highly similar items (effect size from Dunsmoor et al., 2015 and intercept and error estimates from Thorp et al. (in prep)), data was simulated from 40 adult human participants.

Methods: Study Design

Incidental Encoding Paradigm

	Pre-conditioning Phase	Conditioning Phase	Total # of exemplars
CS- Nothing happens	8 Basic-Level Categories different from CS+ categories) 4 exemplars for each category Ex. Monkey 1, Shark 1	Same 8 Basic-level Categories 4 exemplars for each Ex. Monkey 2, Shark 2	64 exemplars 8 categories
CS+ Money deducted	8 Basic-level Categories 4 exemplars for each category Ex. Rabbit 1, Dog 1	Same 8 Basic-level Categories 4 exemplars for each Ex. Rabbit 2, Dog 2	64 exemplars 8 categories
Old/New Recognition Memory Test	128 Old exemplars (All CS- and CS+ exemplars)	128 New exemplars (From the same 16 categories)	

Participants:
40 adult participants will be recruited and asked to complete the memory study online.
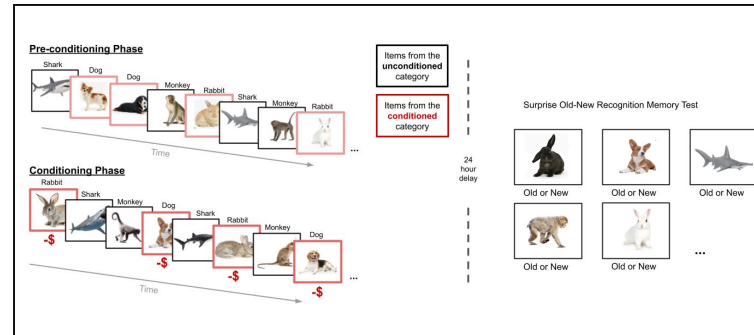
Stimuli:
All of the pictures shown are animals against a white background.

Conditioning:
Participants are given a bonus on top of their standard pay, and money will be deducted from their bonus when they see certain stimuli.

Example of Procedure and Stimuli

Discussion

- The data simulation used parameters from two related but different memory studies. We, therefore, expect differences between the simulated results and experimental results.

- This study design has the potential to parse patterns of recognition memory responses, specifically in regards to the effect of emotion on the quality of recently formed memories rather than just their overall strength in a way that wasn't able to be done in previous studies where items came from high-level categories.

- The experimental findings of this study will have important implications for learning because in revealing the circumstances that induce either retroactive and selective facilitation or impairment of memory, more effective ways of learning and studying can be devised.

Simulated Results

Recognition Memory Performance
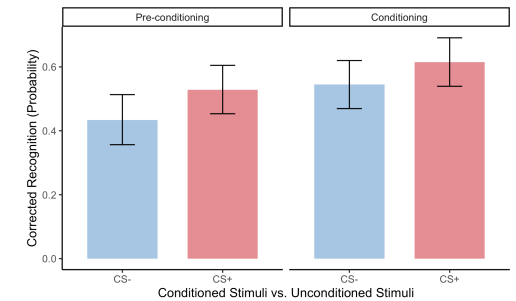
There is a not significant difference in corrected recognition memory for items in the CS- versus the CS+ category encoded during either pre-conditioning or fear conditioning. Below is an alternative presentation of weights of the Bayesian model in the posterior sample.
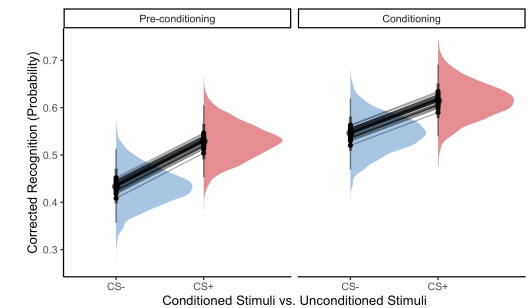
The data simulation didn't find any significant results for our main effects of category and phase (both the confidence intervals include 0), but this is hopefully due to the myriad of differences between the inputs of the simulation and the actual study paradigm that will be run on human subjects.

References

1. Dunsmoor JE, Murty VP, Davachi L, Phelps EA. 2015. Emotional learning selectively and retroactively strengthens memories for related events. *Nature* 520: 345–348
2. Maxcey, A. M., & Woodman, G. F. (2014). Forgetting induced by recognition of visual images. *Visual Cognition, 22*(6), 789–808.
3. Murayama, K., Miyatsu, T., Buchli, D., & Storm, B. C. (20140901). Forgetting as a consequence of retrieval: A meta-analytic review of retrieval-induced forgetting. *Psychological Bulletin, 140*(5), 1383. https://doi.org/10.1037/a0037505
4. Rosch, E. (2013). *Principles of Categorization.* https://doi.org/10.1016/B978-1-4832-1446-7.50028-5