Where is Distraction?

The effect of bottom-up distraction in category learning

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1. Introduction

1-1. How people learn categorization?

- Selective attention : cognitive process of focusing on specific information while simultaneously suppressing irrelevant or distracting information.
- It operates attending selectively on category-relevant information, and filtering out category-irrelevant dimensions.
  (Reed 1972; Mendin & Shaffer 1978; Nosofsky 1986; Carroll & Chang ,1970)
- The representative cognitive model ALCOVE uses attention parameters(λα) within a neural network framework to simulate this learning process. (Kruschke, 1992)

1-2. Developmental Differences

- A cost of selective attention occurs when previously irrelevant information later becomes relevant. (Best, Yim, & Sloutsky, 2013)
- This cost appears clearly in adults but not in children, which is called diffused attention. (Deng & Sloutsky, 2013)

▶ Where is Distraction?

Previous models primarily explain how attention is allocated, but they do not adequately address filtering(distraction), which may be critical in real category learning situations.

▶ Research Goal

- Develop an experimental design that dissociates filtering in adult category learning
- Examine individual differences in filtering ability via correlations with an attentional control task
- Evaluate the need to extend existing cognitive models of selective attention.

2. Experiment

2-1. Participants

91 Participants (49 Females, *M 21.81 yrs, SD 2.52 yrs*)

2-2. Procedure

(A) Category Task

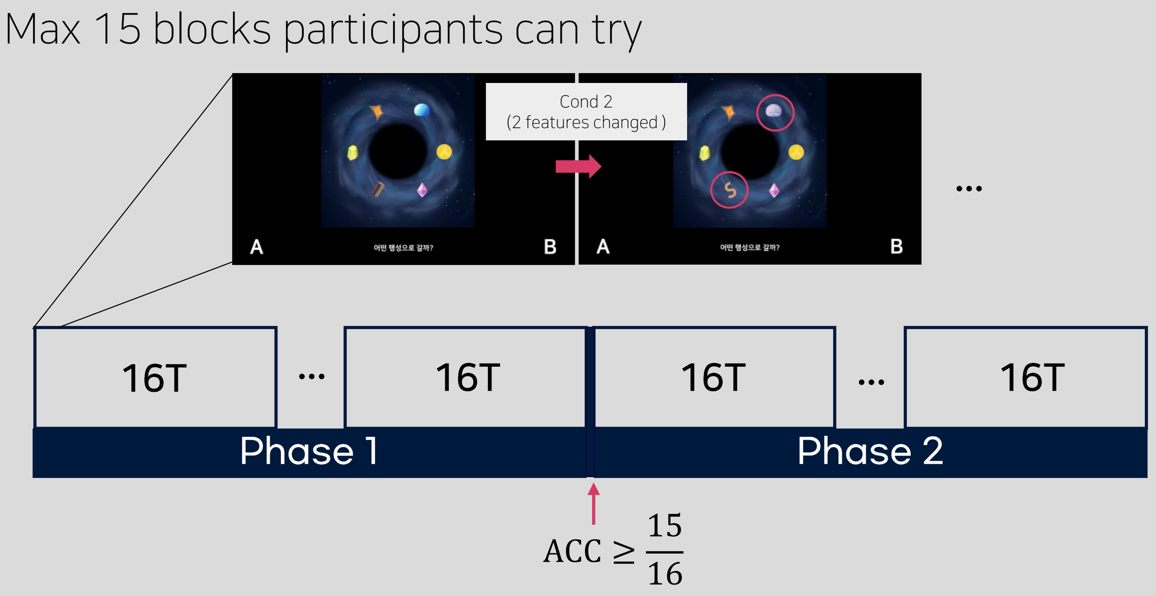
- Classify whether the wormhole stimuli belongs to planet A or B
- Participants receive feedback in each trials to find the categorization rule
- Eye gaze recorded with eye tracker (Eyelink 1000 plus), sampling rate 2K Hz

◆ Materials

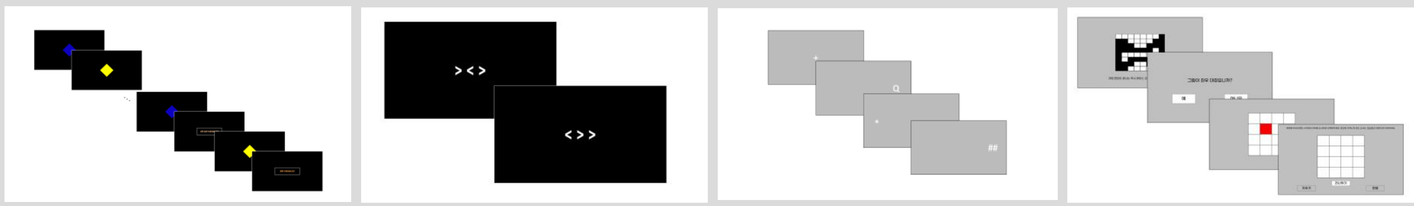
- Wormhole Stimuli with 6 dimensions, each dimension is binary
- One is category-relevant dimension
- Condition (2 or 3): Number of features changed each trial (distraction lv)

◆ Design

- 16 Trials in each block
- Category-relevant dimension change unbeknownst to the participants if 14 corrects per block
- Max 15 blocks participants can try



(B) Attentional Control Task



(a) Go/No-go Task (b) Spacing flanker Task (c) Antisaccade Task (d) Symmetry Span Task

3. Conclusion

- Similar overall learning patterns of category learning task, differences in selective attention cost *(p = .098)*, distraction *(p = .041)*, and entropy *(p = .084)*.
- A significant correlation with the attentional control task (Antisaccade) only in the Condition 3 *(p = .002)*. → Attentional control ability becomes critical when the task is more demanding (not under easier tasks).
- Even with identical stimuli and the same information, learning performance can vary depending on the level of distraction. Faster learning occurs when the learning sequence remains stable.

▶Contribution

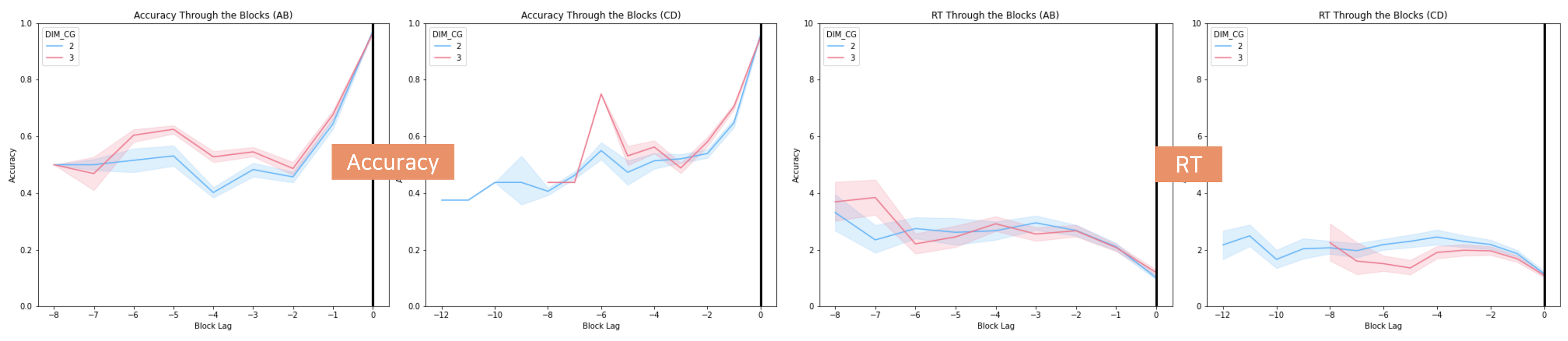
- Experiment methodological implication
  Proposes a novel experimental design, which can measure and dissociate distraction factor.
- The need to extend existing cognitive models
  A new model that incorporates filtering (ignoring distraction) mechanisms is needed to more accurately account for human category learning.
- Applicability in practical educational environment
  Design effective learning sequences for those who have low or impaired attention function (infants, the aged, ADHD, etc.). Guide more targeted instructional strategies.

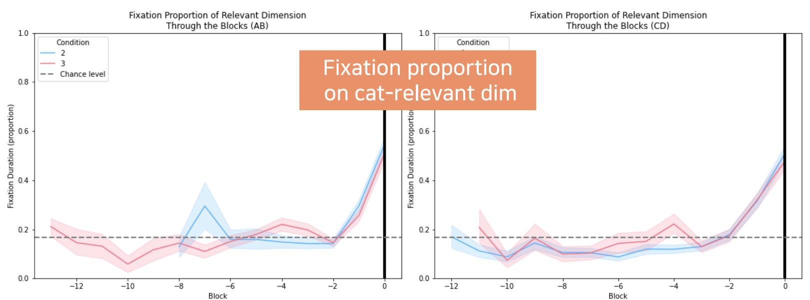
3. Results

3-1. Learning

- Learners
  Cond 2 (7 out 46 fail), Cond 3 (12 out 50 fail)
- Number of Trials consumed to learn in Phase 1
  Cond 2 (*M = 56, SD = 30.72*) < Cond 3 (*M = 68.32, SD = 49.41*)
  p = .103, Student's t-test
- Cost of selective attention (Differenced in Trials consumed in each phase)
  Cond 2 (*M = -17.231, SD = 60.53*) < Cond 3 (*M = 0.571, SD = 37.58*)
  p = .098, Student's t-test

3-2. Optimization

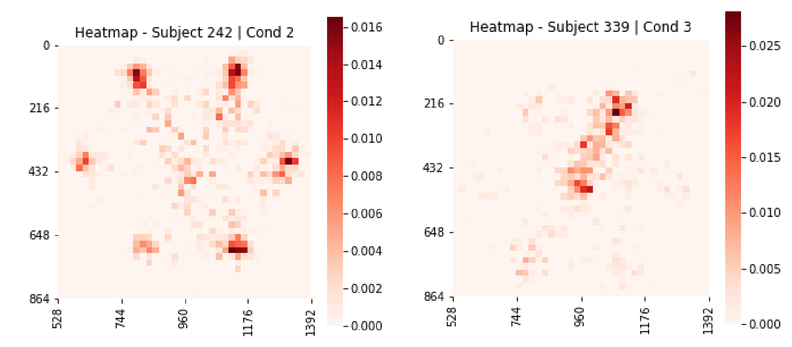




- No difference in learning trajectory
- Can check participants optimizing on category-relevant dimension

3-3. Distraction

- Fixation Count Heatmap
  Difference in distraction Cond 2 vs 3.



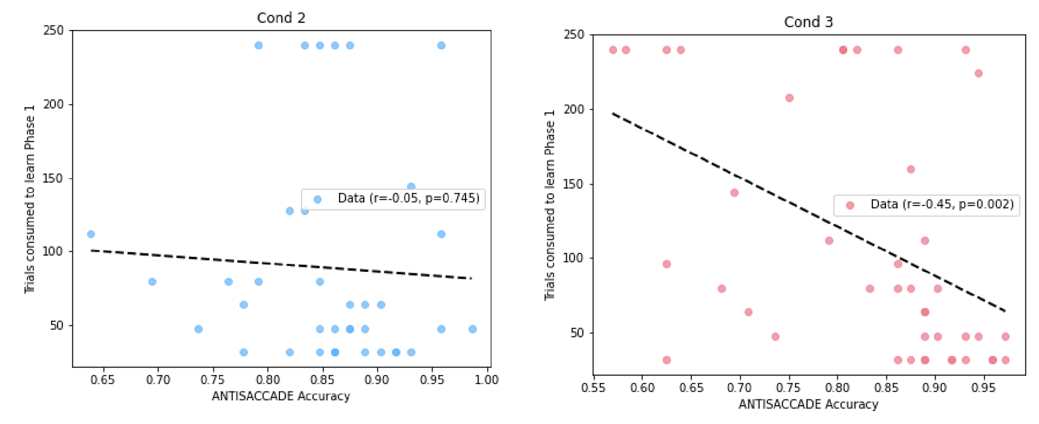
- Distraction / Entropy
  Cond 2 < Cond 3

	t	*p*
DISTRACT	1.775	.041
Entropy	1.396	.084

*Distraction: Fixation duration on looking changed dimensions on first 2 block
*Entropy: Entropy of fixation

3-4. Attention Correlation

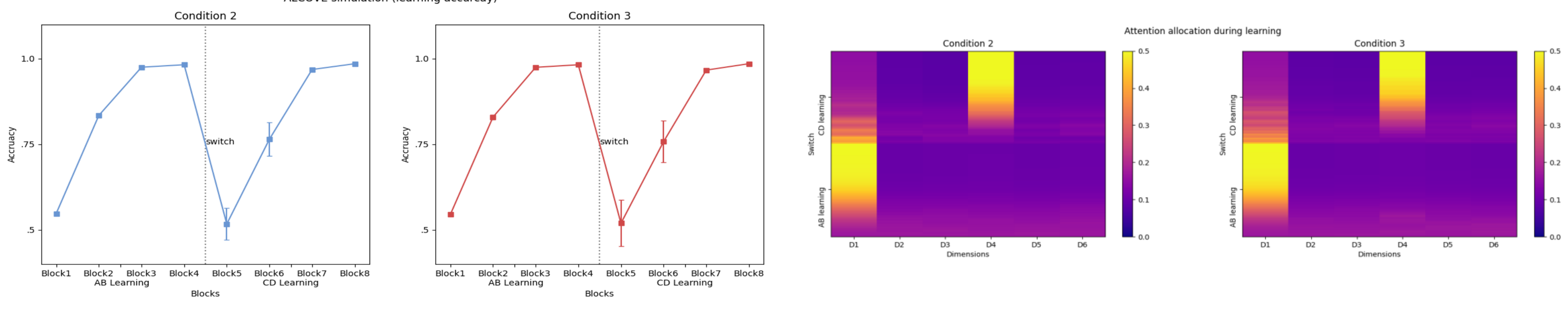
- Antisaccade task & Number of trials consumed to learn Phase 1



Only Cond 3 showed correlation. *(p = .002)*

3-5. ALCOVE Model Simulation

- Parameter: c = 5, φ =2, λα = 1.0E-2, and λw = 5.0E-2
- No difference between Cond 2 vs 3



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