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Concurrent task interference in rule-based category learning

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Abstract

Ashby and Maddox (2005) propose that humans have multiple systems for learning different category structures. The explicit system is used when the category structure favors learning a uni-dimensional rule (RB task), and the implicit system is required when integrating information from multi-dimensions (II task). The explicit system is proposed to be conscious and require attentional resources. The implicit system is thought to learn more slowly but require fewer attentional resources. Waldron and Ashby (2001) provided the evidence for this in an experiment examining concurrent task interference. A simultaneous Stroop task significantly disrupted RB but not II category learning. The present study is a modified replication of Waldron and Ashby's experiment, using simpler attention grabbing visual stimuli that should be able to engage non-human animals. Participants were asked to learn either an RB or II categorization task either while doing a demanding working memory task or not. Both categorization tasks used a bright yellow/magenta color bar varying in color ratio and size. Initial results suggest that we have replicated the Waldron and Ashby (2001) findings. Next, we will extend the experiment to non-human primates and investigate whether they seem to have multiple learning systems like us.

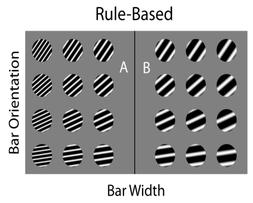
Background

Categorization:

- ❑ The process that categorizes different ideas and/or objects into different groups.
- ❑ Categorization tasks are sometimes complex; humans may use more than one process for different categorization problems.
- ❑Many multiple-system advocates have suggested that humans have separate explicit and implicit learning systems.

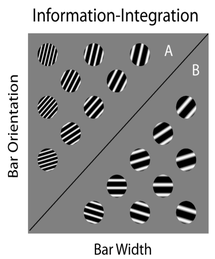
Explicit Categorization System

- ❑ analytic;
- ❑ attentional resources needed;
- ❑ rule-based;
- ❑ usually declarative;



Implicit Categorization System

- ❑ non-analytic;
- ❑ not consciously aware;
- ❑ information-integration
- ❑ difficult to declare;



Concurrent Load Interference

❑Waldron and Ashby (2001) found interference from a cognitive load when learning rule-based but not information integration tasks, suggesting a dissociation between implicit and explicit categorization.

Hypotheses

- ❑We expect to replicate Waldron and Ashby's (2001) results using completely different stimuli.
- ❑A concurrent cognitive load will reduce learning more in the rule-based task than the information-integration task.

Design Display

Categorization Stimuli Display:

Concurrent Stroop Task Display:

Methods

Participants: 115 undergraduate students of University at Buffalo

Design:

- ❑ 2x2x(2) mixed factorial design;
- ❑ between group variable: category structure (rule-based vs. info-integration)
- ❑ between group variable: cognitive load (with Stroop Task vs. without ST)
- ❑ within group variable: blocks (first 100 trials vs. last 100 trials)

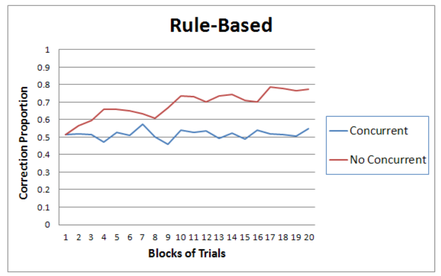
Stimuli:

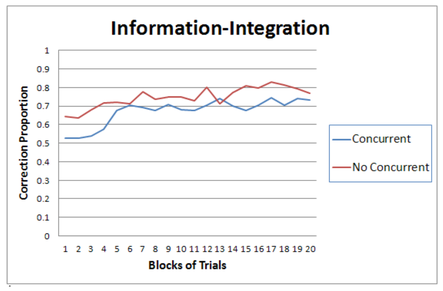
- ❑ a rectangular bar filled with two colors (yellow and magenta);
- ❑ each image varies in color ratio and size;
- ❑ a numerical Stroop task as concurrent task load
  - working memory demanding
  - 3 different features (value, size, color)

Procedure:

- ❑ non-concurrent condition
  - participants were asked to categorize stimuli into either category A or B.
  - -gain one point for a correct answer; lose one point and get an 8-second timeout for an incorrect answer.
- ❑ concurrent condition
  - 25 practice trials for numerical Stroop task first
  - then categorization task and Stroop task at the same time.

Learning Graphs





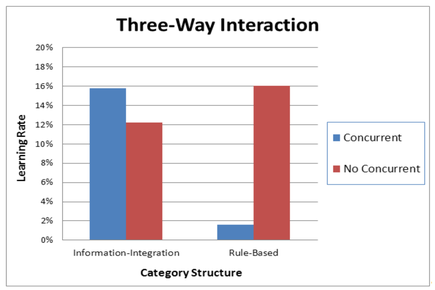
Result

2x2x(2) mixed ANOVA

- ❑ Significant main effect of concurrent cognitive load
  - $F(1,60)=19.135$, $p<0.001$
  - worse performance with cognitive load
- ❑ Significant main effect of category structure
  - $F(1,60)=10.693$, $p<0.005$
  - easier learning with rule-based task
- ❑ Significant 3-way interaction
  - $F(1,60)=6.488$, $p<0.05$
  - both category structures showed significant decrease in learning with load but decrease bigger for rule-based structure

Planned Comparison

- ❑ Information-integration task
  - $t(30) = 7.6223$, $p<0.0001$ (two-tailed)
  - significant decrease in performance between non-concurrent task and concurrent task.
- ❑ Rule-based task
  - $t(30)= 9.9010$, p-value<0.0001 (two-tailed).
  - significant decrease in performance between non-concurrent task and concurrent task.



* Learning rate = M(last 100 trials) – M(first 100 trials)

Conclusion

- ❑ We successfully replicated Waldron and Ashby's (2001) finding using different stimuli and modified method.
- ❑ When there was a presence of a concurrent load, the rule-based task was greatly disrupted; the information-integration task was less disrupted.
- ❑ This suggests that humans use at least two processes (explicit and implicit) to deal with different category structures.

Next Step

We will carry out the same experiment on non-human primates and investigate whether they have separate categorization systems as humans do.

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http://www2.gsu.edu/~wwwlrc/index.html

Major Literature Cited

Ashby, F. G., & Ell, S. W. (2001). The neurobiological basis of category learning. *Trends in Cognitive Sciences*, 5, 204-210.

Ashby, F. G., & Maddox, W. T. (2005). Human category learning. *Annual Review of Psychology*, *56*, 149-178.

Minda, J. P., & Smith, J. D. (2001). Prototypes in category learning: The effects of category size, category structure, and stimulus complexity. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *27*, 775-799.

Smith, J. D., Chapman, W., & Redford, J. S. (2010). Stages of category learning in monkeys (*Macaca mulatta*) and humans (*Homo sapiens*). *Journal of Experimental Psychology: Animal Behavior Processes*.

Smith, J. D., Coutinho, M. V. C., & Couchman, J. J. (2010). The l earning of exclusive-or categories by monkeys (*Macaca mulatta*) and humans (*Homo sapiens*). *Journal of Experimental Psychology: Animal Behavior Processes, 36*, 1–10.

Zeithamova, D., & Maddox, W. T. (2006). Dual task interference in perceptual category learning. *Memory & Cognition*, 34, pp. 387–398.

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