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Eye-tracking Study: Systematic Effects of Task Instructions on Selective Attention and Inductive Learning

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ABSTRACT

Participants studied paintings with respective task instructions and were subsequently tested on identification performance for trained paintings as well as new paintings by the same artists. Eye tracking analyses indicate that each task instruction led to distinctive fixation patterns for the paintings, which may influence inductive learning performance. Generally, participants given the alternative pattern of the instructions performed significantly better than those who received the successive pattern of instructions both in trained and new paintings.

BACKGROUND, HYPOTHESES, & PROCEDURE

Background:

Kornell and Bjork (2008) shows that spacing by interleaving with other artists' paintings enhances inductive learning for both paintings by the artist that were already studied as well as the new paintings by the same artists. Metcalfe and Xu (2015) found that presenting each artist's works in massed condition led to more mind wandering, which precluded successful inductive learning. Our study proposes that varying tasks, while keeping materials interleaved, during training is another factor that can influence the success of inductive learning. Interleaving task instructions draws attention to different dimensions of the materials and also may keep the learner focused on task. Thus, we hypothesize that the interleaving condition will show better performance later on an identification task of studied and novel artists.

METHODS

Participants:

32 students at DePauw University participated for course credit.

Procedure:

During training, participants viewed two paintings by each of six unfamiliar artists. Each painting was presented three times (randomly mixed among the other paintings) and preceded by the artist's name and a different question per presentation that required a short typed response: What is the entry point? What is the dominant color? Is the transition between earth and sky smooth or abrupt?

Participants in the blocked condition viewed all 12 paintings with the same question before moving to the next question; participants in the interleaving condition answered different questions for each consecutive trial. Between the training and testing phase, participants were asked to complete a anagram worksheet for 3 minutes to reduce recency effects. During testing, participants identified the artist for the twelve previously viewed images as well as six new paintings (one by each artist). Then they completed a survey about their strategies and previous familiarity with the stimuli.

Materials:

- Tobii Pro X3–120 Eye Tracker was used to record saccade patterns and fixations.
- iMotions 7.1 software was used for presentation and analyses of fixation time and revisiting frequencies for certain areas of interests.
- 36 paintings were adapted by Kornell and Bjork's article (2008).

## METHODS (Continued)

Training

Participants were randomly assigned to one of two conditions: either they saw each picture with interleaved instructions or blocked instructions (all categories were interleaved). Two paintings by the same artist were spaced apart.

Instruction   4 sec   Response

What is the entry point?
What is the dominant color?
Is the transition between earth and sky smooth or abrupt?

Testing

After working on an anagram distractor task for three minutes, participants completed the identification task to identify each painting with the name of the artist.

4 sec
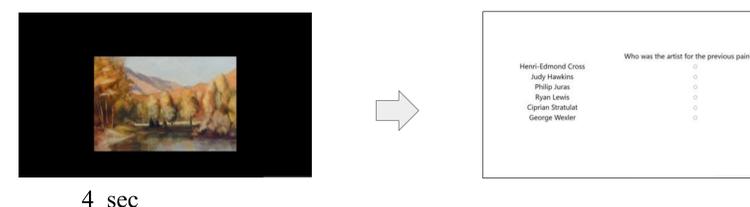
Heat map and areas of interests (AOIs) for three instructions

The different instructions generally lead to different fixation patterns. Below are heatmaps of all participants' fixations for the respective conditions. The colored areas represent high fixation zones (red) and low fixation zones (green). Unique fixation areas were turned into AOIs for each painting. AOIs are used to analyze the fixation time and revists. We used pilot data to determine AOIs, which we then tested via additional participants.

Color (AOI 1)   Horizon (AOI 2)   Entry (AOI 3)
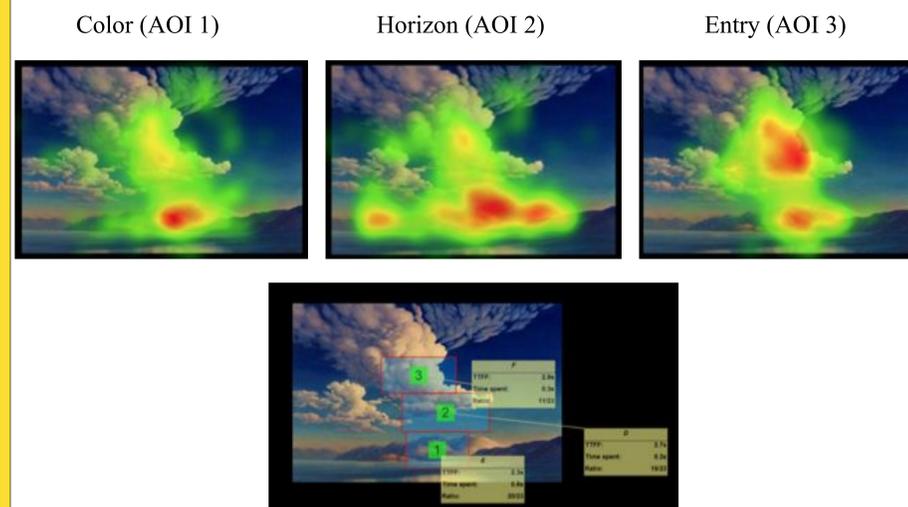
RESULTS

Eye-tracking Analyses

We examined the proportion of fixation time and the number of revisits for each of the three chosen AOIs per painting. Based on the pilot data, we predicted that the three different questions for a painting would correspond to higher values for respective AOIs. For each painting and instruction pair (i.e. 3 instructions per painting), we conducted a one-way repeated measures ANOVA to compare the amount of fixation time (or frequency of revisits) for the 3 AOIs. All paintings showed evidence of changing fixation and revisit patterns due to varying instructions. Most of the paintings showed differential fixation patterns for the three questions in line with our predictions; however, for a few paintings, a particularly salient AOI attracted the most attention regardless of question, and some repeated measures ANOVAs for other paintings were not significant due to the limited sample size.

- 4 paintings where the expected (based on our predictions from the pilot data) "dominant" AOI showed significantly larger fixation times and frequency of revisits for at least 2 of the instruction pairings.
- 2 paintings where the predicted ordering was found for at least 2 of the instruction pairings, but the differences were not significant.
- 4 paintings where 1 AOI was consistently dominant, but the dominance was at least decreased by the other instructions.
- 2 paintings where the pattern of AOI clearly changed but not in the predicted directions.

Behavioral Analyses

A 2x2 mixed measures ANOVA showed significant main effects for question order and identification performance for old vs. new paintings, as well as an interaction effect. Alternating questions led to higher accuracy than encountering each question as a set, and accuracy for old paintings was higher than new paintings. The interaction appears driven by low performance on new paintings regardless of question condition.

	Seen Before	New
Set	$M = .33$ $SD = .19$	$M = .05$ $SD = .03$
Alternating	$M = .58$ $SD = .30$	$M = .10$ $SD = .05$

DISCUSSION

Taken together, the accuracy and eye-tracking data provide a foundation for a larger study that examines interactive effects of self-directed learning and task context on subsequent inductive learning. Limitations of this study include limited sample size to show significant results for some of the cases.

References:

Kornell, N., & Bjork, R. A. (2008). Learning Concepts and Categories. *Psychological Science,19*(6), 585-592. doi:10.1111/j.1467-9280.2008.02127.x

Metcalfe, J., & Xu, J. (2016). People mind wander more during massed than spaced inductive learning. *Journal of Experimental Psychology: Learning, Memory, and Cognition,42*(6), 978-984. doi:10.1037/xlm0000216