

Memory experiment

Austin Lokey

Introduction

The aim of this study is to examine when human working memory becomes affected by change blindness. Other research shows that working memory in this context drastically drops from around six to eight. The hypothesis of this study is that the working memory of participants will be affected by change blindness around the 6th-8th object. The relevance of this study is to get a good grade in my class.

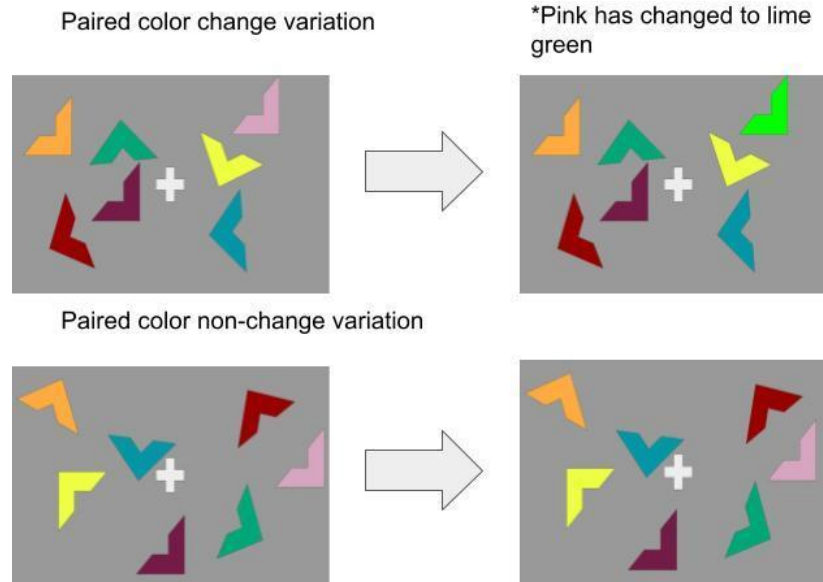
Method

A group of visual stimuli are prepared for each number of objects presented. Two variations of visual stimuli are used in each group. Objects change location between variations but remain in location within variations. Variation one: one object changes color between the two images.

Variation two: no changes to color.

The first slide of each variation is presented for three seconds, a one-and-a-half-second delay, and then the second slide is presented for five seconds. The participants were then asked to respond if a color had changed, with possible answers being yes, no, or guess. There is no time frame associated with participant response. After the response, a screen displaying their percentage complete is displayed. Once they click "ok," the next pair of visuals begins.

Seven Object Stimulus Slide



The number of object categories represented is 4, 6, 7, 8, 10, and 12. This sequence was selected to balance user attention, perceived progression, and time considerations and achieve the highest user participation from beginning to end.

To organize the data for analysis, I exported the data from Neurotask to Excel. Sorted all participants using the sort function from low to high on the participant number column. Cleared all blanks from the row with responses to the questions, thus deleting all information of “clicks.” Created a macro using the record function to transpose data from vertical to horizontal columns separated by the participant. Deleted blank space and aligned participant number at the start of each row of answers. Assigned headings labeled “Question 1-12”. Placed correct answers underneath table. “countif” function to quickly tally correct answers. Three graphs are created: combined, color change, and no change.

Results



Analysis

A qualitative analysis was done on this data to observe at what level of objects working memory begins to decline across participants. Eight objects begin the linear downward trend. To increase the validity of this claim, it is recommended that a repeated measures ANOVA be performed with a load of six levels for objects 8-13 and two levels for color change as a within-subjects factor. A linear contrast or post hoc paired t-tests can then show the significance between levels

of objects across levels of color. The main effect of change of color needs to be considered as the interaction effect between load and change via a post hoc analysis.

Discussion

The results confirm the expected outcome of seven being the standard number of objects in which human working memory can track change. Upon eight objects, correct responses drop off gradually. The strange results from “obj four col chg” and “obj eight col chg” are worth noting. The low score on “obj four col chg” is likely from it being the first trial. To improve this in future research, it is recommended to administer a practice round before the experiment begins. The stimuli associated with “obj eight col chg” had two objects change color instead of one on that slide. This deviation from the standard object color change has possibly increased participant error.

On average, participants demonstrate more errors in detecting color change when no color change happens. This might be due to the psychological pressure of the desire to answer correctly.

This experiment can be improved in several ways. Including all numbers of objects, referencing the omitted 5, 9, & 11, and increasing objects up to 15 will give more precise data on human working memory. The initial concern of losing participants from impatience can be offset by running data collection longer and possibly offering participants incentives for completion.

Using only one object for the trial or randomizing which object a participant gets for their entire trial will minimize variables in the design. This original object shape-changing model was aimed to keep users engaged.

The variable of music would best be excluded in a more pristine experiment. However, user feedback reported a high positive effect from the addition. This also increased user completion.

An issue arose in the scripting that prevented the final slide from being presented. This did not affect the experiment at all but confused participants and did not provide contact information for their scores. This issue was corrected by adjusting the final instruction box in the script to a text box. The reasoning behind the error is still unknown, but it is likely a one-off event.

Given the length of the current statistical method, it is recommended that only three levels of object numbers be chosen to improve the tests' accuracy. These findings and a review of other literature findings will allow future researchers to fine-tune the precise levels needed to find the working memory degradation point accurately in this context.

Appendix

All visual stimuli used are available for reference and reuse. The Google Slide that was used to create the images and has them stored is available to anyone who clicks the link below:

https://docs.google.com/presentation/d/1CZVsQEfiPzFpmOJuNzPqqbjr5MNqoUXt_7cbUVjnXhc/edit?usp=sharing

NeuroTask Script

```
sound.preload('playing_god.mp3');
```

```
var black_box = new Box("black," "black","white");
```

```
instruction("Congratulations! You are of the lucky few to test your memory in this fantastic 'Change Blindness' experiment. Click 'OK'");
```

```
instruction("Next, you will see three short pages of instructions. This test is approx 3 MINUTES (; HAVE FUN!");
```

```
instruction("Several series of before/after pictures will appear. Remember the colors of the  
objects as best you can between.");
```

```
instruction("In order to help with precise measurements, please select GUESS in the possible  
answers if you really aren't sure of the answer.");
```

```
instruction("LASTLY, after clicking 'ok' on this screen, some mad scientist jazz rock will play by  
POLYPHIA - Playing God. Adjust volume accordingly (:");
```

```
play('playing_god.mp3');
```

```
instruction("0% completed");
```

```
setimage("visual_memory_4_1.jpg");
```

```
await(3000);
```

```
hideimage();
```

```
await(1500);
```

```
setimage("visual_memory_4_2.jpg");
```

```
await(5000);
```

```
hideimage();
```

```
select("Did any color change?",
```

```
    [['yes', 1], ['no', 0], ['guess', 3]], "color_presence");
```

```
instruction("8% completed");
```

```
setimage("visual_memory_4_3.jpg");
```

```
await(3000);
```

```
hideimage();
```

```
await(1500);
```

```
setimage("visual_memory_4_4.jpg");
```

```
await(5000);
```

```
hideimage();
```

```
select("Did any color change?",
```

```
    [['yes', 1] , ['no', 0] , ['guess' , 3]], "color_presence");
```

```
instruction("16% completed");
```

```
setimage("visual_memory_6_1.jpg");
```

```
await(3000);
```

```
hideimage();
```

```
await(1500);
```

```
setimage("visual_memory_6_2.jpg");
```

```
await(5000);
```

```
hideimage();
```

```
select("Did any color change?",
```

```
    [['yes', 1] , ['no', 0] , ['guess' , 3]], "color_presence");
```

```
instruction("24% completed");
```

```
setimage("visual_memory_6_3.jpg");
```

```
await(3000);
```

```
hideimage();
```

```
await(1500);
```

```
setimage("visual_memory_6_4.jpg");
```

```
await(5000);
```

```
hideimage();
```

```
select("Did any color change?",  
      [['yes', 1] , ['no', 0] , ['guess' , 3]], "color_presence");
```

```
instruction("32% completed");
```

```
setimage("visual_memory_7_1.jpg");  
await(3000);  
hideimage();  
await(1500);
```

```
setimage("visual_memory_7_2.jpg");  
await(5000);  
hideimage();
```

```
select("Did any color change?",  
      [['yes', 1] , ['no', 0] , ['guess' , 3]], "color_presence");
```

```
instruction("40% completed");
```

```
setimage("visual_memory_7_3.jpg");  
await(3000);  
hideimage();  
await(1500);
```

```
setimage("visual_memory_7_4.jpg");  
await(5000);  
hideimage();
```

```
select("Did any color change?",  
      [['yes', 1] , ['no', 0] , ['guess' , 3]], "color_presence");
```

```
instruction("48% completed");
```

```
setimage("visual_memory_8_1.jpg");  
await(3000);  
hideimage();  
await(1500);
```

```
setimage("visual_memory_8_2.jpg");  
await(5000);  
hideimage();
```

```
select("Did any color change?",  
      [['yes', 1] , ['no', 0] , ['guess' , 3]], "color_presence");
```

```
instruction("56% completed");
```

```
setimage("visual_memory_8_3.jpg");  
await(3000);  
hideimage();  
await(1500);
```

```
setimage("visual_memory_8_4.jpg");  
await(5000);  
hideimage();
```

```
select("Did any color change?",  
      [['yes', 1] , ['no', 0] , ['guess' , 3]], "color_presence");
```

```
instruction("64% completed");
```

```
setimage("visual_memory_10_1.jpg");
```

```
await(3000);
```

```
hideimage();
```

```
await(1500);
```

```
setimage("visual_memory_10_2.jpg");
```

```
await(5000);
```

```
hideimage();
```

```
select("Did any color change?",
```

```
    [['yes', 1] , ['no', 0] , ['guess' , 3]], "color_presence");
```

```
instruction("72% completed");
```

```
setimage("visual_memory_10_3.jpg");
```

```
await(3000);
```

```
hideimage();
```

```
await(1500);
```

```
setimage("visual_memory_10_4.jpg");
```

```
await(5000);
```

```
hideimage();
```

```
select("Did any color change?",
```

```
    [['yes', 1] , ['no', 0] , ['guess' , 3]], "color_presence");
```

```
instruction("80% completed");
```

```
setimage("visual_memory_12_1.jpg");
```

```
await(3000);
```

```
hideimage();
```

```
await(1500);
```

```
setimage("visual_memory_12_2.jpg");
```

```
await(5000);
```

```
hideimage();
```

```
select("Did any color change?",
```

```
    [['yes', 1] , ['no', 0] , ['guess' , 3]], "color_presence");
```

```
instruction("88% completed");
```

```
setimage("visual_memory_12_3.jpg");
```

```
await(3000);
```

```
hideimage();
```

```
await(1500);
```

```
setimage("visual_memory_12_4.jpg");
```

```
await(5000);
```

```
hideimage();
```

```
select("Did any color change?",
```

```
    [['yes', 1] , ['no', 0] , ['guess' , 3]], "color_presence");
```

```
text("96% completed");
```

```
await(3000)
```

```
input("Would you like to give any feedback?");
```

```
text("99% complete. Click ok to finish , music will continue if you're jamming! Thank you for  
helping Neuroscience and Austin Lokey. You may email me for your time for results;  
AustinLokey7@gmail.com"
```

```
+ "Press ENTER to finish");
```

```
awaitkey("ENTER");
```

```
await('soundended');
```