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Abstract

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# Experiment 1

In the Experiment 1, we tested the validity and the reliability of the Multi-Items Rearrangement measurement. The experiment is separated into two blocks. The first block employed the Multi-Items Rearrangement measurement to measure the similarity between abstract faces. The second block used the Paired comparison measurement to validate the result acquired from the Multi-Items Rearrangement measurement.

## Method

Participants. Ten students recruited from University of Zürich. Participants were rewarded with course credits or 30 Swiss Francs after completed the experiment.

Materials. Both Multi-Items Rearrangement task and the Paired-Comparison task shared the same set of stimuli. Color patches are used in the practice trials. The colors are randomly selected from all the possible colors in the 24 bits RGB color space. Abstract faces are used in the experiment trials. The faces are varied on four dimensions: the width between eyes, the height of eyes, the length of nose, and the position of mouth, with each dimensions have two possible configurations. The faces are shown in the Figure 1.

Procedure. Experiment 1 is consisted of two identical sessions, and the sessions are carried in two different days. Each session contains two blocks. The first block is the Multi-Items Rearrangement measurement task, and the second block is the Paired comparison measurement task. On average, each session takes about 45 minutes.

Multi-Items Rearrangement Task. The Multi-Items Rearrangement task consists of two practice trials and 12 experiment trials. In each trials, 8 items were randomly scattered on the screen without overlapping. Participants were instructed to rearrange the items by using mouse to drag-and-drop the items, and the distance between items should reflect the similarity between the items, where the farther distance between items indicates the more dissimilar between items. After participants were satisfied with the arrangement of the items, they can press space bar to continue to next trial. Participants were instruction to take as long as they want to rearrange the items.

The Multi-Items Rearrangement task requires 6 trials to complete the similarity matrix between 16 items. We repeated the procedure twice in order to obtain more accuracy measurement of the similarity matrix. The items were rearranged into different subgroup for the second repetition.

Paired-Comparison Task. The paired comparison task consists of 4 practice trials and 240 experiment trials. In each trial, two items were presented on the screen with a 9 points scale below the items. Participants were instructed to rate the similarity between the two items by clicking on the 9 points scale, with 1 to be the most similar, and 9 to be the most dissimilar. After the similarity is selected, a blank screen appeared for 1 second and was followed by the next trial. Participants were instructed to take as long as they want to complete the trial.

The Paired-Comparison task requires 120 trials to complete the similarity matrix of 16 items. We repeated the measurement twice in order to increase the accuracy of the similarity matrix.

## Results

The similarity matrix acquired from the Multi-Items Rearrangement task is based on the distance between items in the trial. If the distance between two items were measured multiple times, the average of the distance is used as the similarity between the items. The similarity matrix acquired from the Paired-Comparison task is based on the rated similarity between items. Similar to the Multi-Items Rearrangement task, if an items pair is rated multiple times, the similarity between the items pair is calculated as the average between ratings.

To test the reliability of Multi-Items Rearrangement task and the Paired-Comparison task, we compare the similarity matrixes acquired from the first session and the second session. The comparison between the similarity matrices is done through Random Skewers method {cite random skewered method}. The correlation between the similarity matrices acquired from first session and the second session for both tasks of each participant are listed in Table 1. To test the validity of the Multi-Items Rearrangement task, the similarity matrices acquired from Multi-Items Rearrangement task and the similarity matrices acquired from Paired-Comparison task were compared with the Random Skewers method. The correlation between the similarity matrices are listed in Table 1, where the lowest correction is 0.85. To ensure both similarity matrices are aligned, we plotted the with acquired similarity matrices with Multidimensional Scaling, as shown in Figure 2.

The average time required to complete the Multi-Items Rearrangement task is 475.6s, and the Paired-Comparison task takes average 905.1s to complete. The time required for both tasks were compared in R (R. Core Team, 2016) with BayesFactor package (Morey & Rouder, 2015), and the data strongly supported that Paired-Comparison task takes longer than Multi-Items Rearrangement task ().

# Experiment 2

In Experiment 2, we replicated the same method used ion Experiment 1 with different material. The faces in Experiment 1 were defined with multiple discrete features. In Experiment 2, we want to test the ability of measuring the similarity matrix with material with continuous feature of Multi-Items Rearrangement task, hence we used color patches as material.

### Method

Participants. Ten students recruited from University of Zürich. Participants were rewarded with course credits or 30 Swiss Francs after completed the experiment. All the participants in Experiment 2 did not participant in Experiment 1.

Materials. Both Multi-Items Rearrangement task and the Paired-Comparison task shared the same set of stimuli. The faces from the Experiment 1 were used in the practice trials. Color patches were used in the experiment trials. 16 color patches were selected from a color wheel which was created in the CIE L\*a\*b\* color space with radius of 60 and centered at luminance set to 70, set to 20, and set to 38. All the color patches were evenly distributed on the color wheel. The color patches are shown in the Figure 3.

Procedure.

## Results

References

Last Name, F. M. (Year). Article Title. *Journal Title*, Pages From - To.

Last Name, F. M. (Year). *Book Title.* City Name: Publisher Name.

Footnotes

1[Add footnotes, if any, on their own page following references. For APA formatting requirements, it’s easy to just type your own footnote references and notes. To format a footnote reference, select the number and then, on the Home tab, in the Styles gallery, click Footnote Reference. The body of a footnote, such as this example, uses the Normal text style. (Note: If you delete this sample footnote, don’t forget to delete its in-text reference as well. That’s at the end of the sample Heading 2 paragraph on the first page of body content in this template.)]

Tables

Table 1

Reliability and Validity of Experiment 1

|  |  |  |  |
| --- | --- | --- | --- |
| Participant | Paired-Comparison | Multi-Items Rearrangement | Validity |
| 1 | 0.98 | 0.91 | 0.95 |
| 2 | 0.87 | 0.84 | 0.91 |
| 3 | 0.78 | 0.80 | 0.91 |
| 4 | 0.79 | 0.81 | 0.85 |
| 5 | 0.87 | 0.96 | 0.87 |
| 6 | 0.81 | 0.74 | 0.91 |
| 7 | 0.94 | 0.83 | 0.87 |
| 8 | 0.95 | 0.86 | 0.86 |
| 9 | 0.91 | 0.95 | 0.91 |
| 10 | 0.85 | 0.71 | 0.89 |

Table 2

The RGB values of the color patches used in Experiment 2.

|  |  |  |  |
| --- | --- | --- | --- |
| Item | R | G | B |
| 1 | 255 | 90 | 109 |
| 2 | 255 | 97 | 65 |
| 3 | 255 | 116 | 0 |
| 4 | 255 | 137 | 0 |
| 5 | 238 | 156 | 0 |
| 6 | 204 | 171 | 0 |
| 7 | 170 | 182 | 0 |
| 8 | 141 | 188 | 49 |
| 9 | 118 | 191 | 101 |
| 10 | 107 | 190 | 145 |
| 11 | 117 | 180 | 180 |
| 12 | 149 | 176 | 204 |
| 13 | 191 | 162 | 213 |
| 14 | 234 | 144 | 206 |
| 15 | 255 | 122 | 183 |
| 16 | 255 | 101 | 150 |

Figures



Figure 1. The material used in the Experiment 1. The faces are constructed with four dimensions: the width between eyes, the height of eyes, the length of nose, and the position of mouth.



Figure 2. The material used in the Experiment 2. All the color patches are equality distributed on a color wheel which centers at set as 70, set as 20, and set as 38 with radius 60.