

Psychophysical method of pairs indirect scaling

Likhitha Nagahanumaiah; Rochester, New York, USA.

Abstract

The main objective of this lab is to learn about psychophysical method in indirect scaling using pairwise comparisons among image stimuli. This lab is essentially a quantified photo contest from the photo scavenger hunt. We design a 2AFC experiment to present observers with pairs of images, have them evaluated based on image preferences, and produce an interval scale of perceived aesthetic quality.

Introduction

Psychophysics is the study of the response of psychological phenomenon and the study of the methodology used to produce the stimulus. It is a powerful tool that can be used to measure the perception of observers and record their performance [1].

A paired comparison is a forced choice method in which the observer is subjected to pair of stimuli with and without intensity and is forced to choose one. The function then applied to the results yields a threshold. Pairwise comparison in any relative experiment is used to identify which stimulus is preferred or quantitatively desirable. This method is generally very useful to rank order stimulus along a relative dimension like preference or importance [2].

In other words, a paired comparison is used for comparative judgments. Rank ordering tends to be difficult thus, the simplest approach of the experiment is to present all possible pairs of the stimulus to the observers. The response is used to estimate the scale values along the desired dimension, estimated for an individual or for a group of observers. Paired comparisons give out a lot of information on the observers' preferences for the set of input stimulus. The information is useful for indicating scale of dimension and the reliability the choices made by the observers [3]. Based on the number of participants and image set the F matrix is created which is the sum of times each image was preferred over the other in each pair then get the proportion matrix and correct it and calculate the 95% confidence interval for the matrix. Simple arithmetic mean preference scores can be calculated that designate the relative location of the stimulus on

the desired dimension, minimum score indicating an ordinal relation and the relative sizes of the intervals between them.

Materials and Methods

In this laboratory simulation, we were asked to click images of given locations as a part of scavenger hunt event. Six landmarks were selected for this experiment and images were collected from the participants for each landmark, total of thirty-five images. A MATLAB GUI was built that displays the stimuli (images) and records the responses. The GUI is programmed to show all paired images under each landmark in random order and presented under neutral background. Observers are asked to select the preferred image between a pair of images displayed under each landmark. There were 5 to 6 manipulated images in each set and 6 subsets of images. Further, there were 11 observers, thus 11×2 , total 22 observations for all 6 groups. All the observers' responses are recorded into a excel file. The demonstration of the GUI is shown in Figure 1.

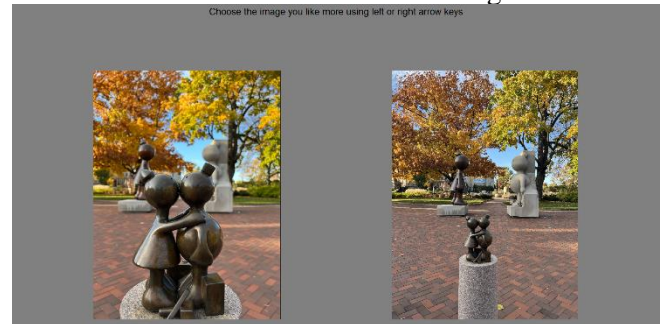


Figure 1. shows the GUI setup that was used in the experiment.

Procedure-

The procedure to perform the experiment is as follows: The GUI loaded with initials of the observer. The GUI displays a screen with instructions. A pair of random images is displayed. The observer then selects the preferred image by pressing the left or right arrow keys. The images keep appearing in a randomized order for all images. The data file is saved in MATLAB for each observer.

Results and Discussion

The responses are sorted and analyzed based on the number of participants and image set the F matrix is created which is the sum of times each image was preferred over the other in each pair then get the proportion matrix and correct it and calculate the 95% confidence interval for the matrix and plot it on the image preference scale by plotting error bars.

Landmark 1 – Museum of Art

Figure 2 shows the plot for landmark 1.

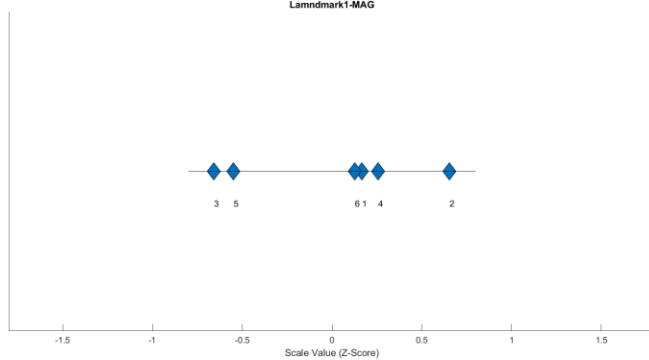


Figure 2. Preference scale for 1st landmark

The scale shows that image number two is a clear winner that is the observer's preferred image, and the resulting image is shown in figure 3.



Figure 3: Preferred image for Landmark 1

The z-matrix score for highest preferred image is 0.65 and is image 2 and lowest preferred image 3rd is -0.65. The image 6,1,4 also got positive score (mostly preferable) and images.

Landmark 2 – Sentinel

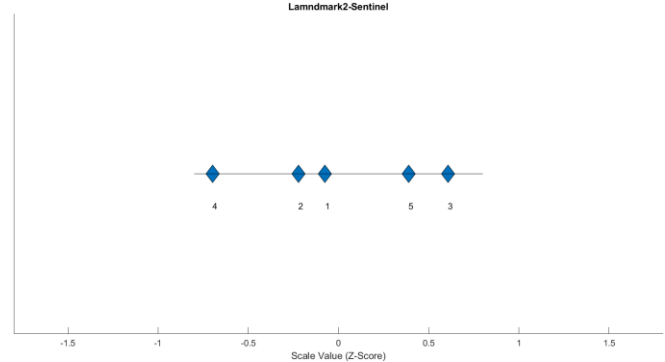


Figure 4- Preference scale for 2nd landmark

The z-matrix score for highest preferred image is 0.6073 and is image 3 and lowest preferred image 4th is -0.69. The image 5 also got positive score (mostly preferable) and images.

Landmark 3 – Color Cube

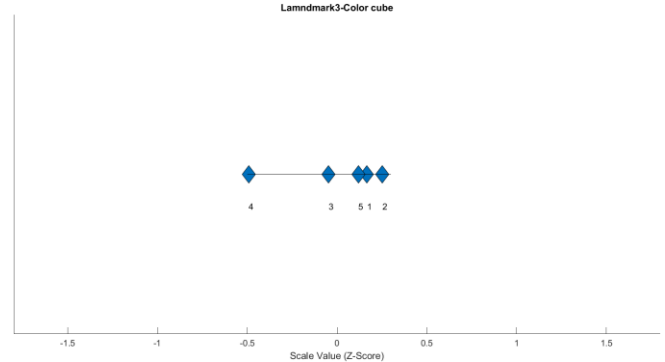


Figure 4- Preference scale for 3rd landmark

The z-matrix score for highest preferred image is 0.25 and is image 2 and lowest preferred image 4th is -0.49. The image 5,1 also got positive score (mostly preferable) and images.

Landmark 4 – Museum Color cube

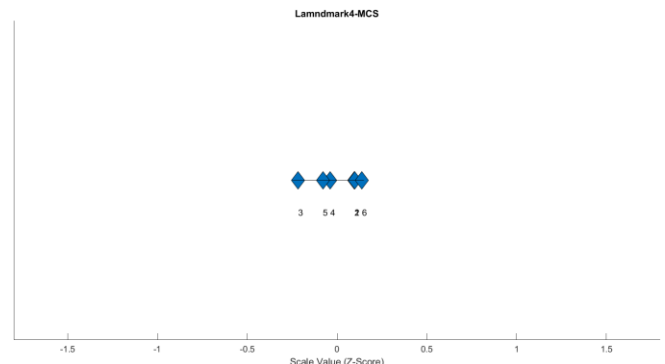


Figure 5- Preference scale for 4th landmark

The z-matrix score for highest preferred image is 0.14 and is image 6 and lowest preferred image 3rd is -0.21. The image 2,1 also got positive score (mostly preferable) and images.

Landmark 5 – Liberty Pole
Lamndmark5-Liberty pole

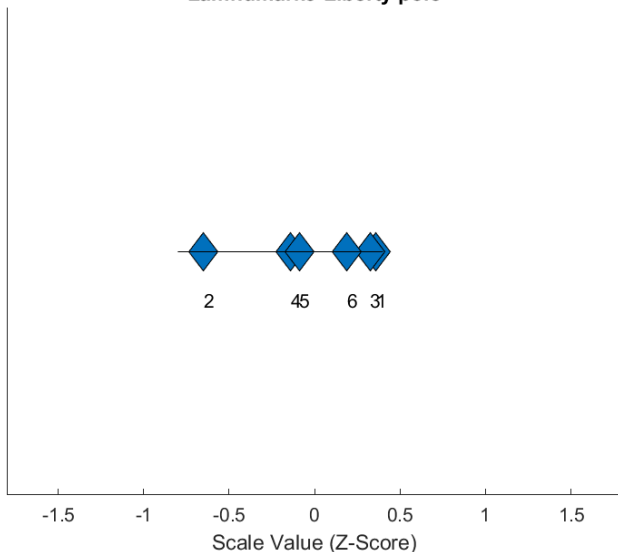


Figure 6- Preference scale for 5th landmark

The z-matrix score for highest preferred image is 0.4 and is image 1,3 and lowest preferred image 2nd is -0.64. The image 6 also got positive score (mostly preferable) and images.

Landmark 6- Tiger
Lamndmark6-Tiger

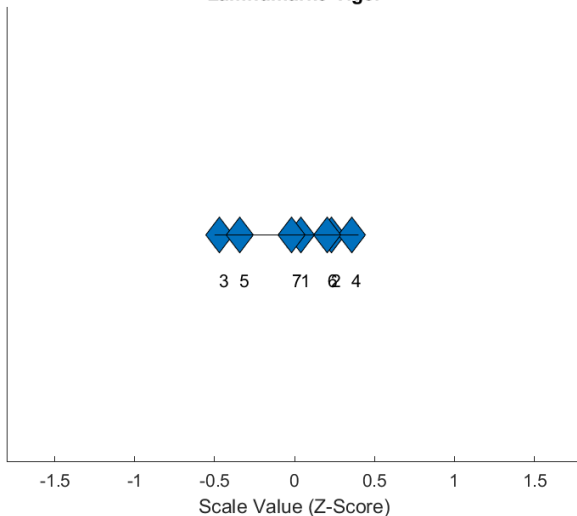


Figure 6- Preference scale for 6th landmark

The z-matrix score for highest preferred image is 0.35 and is image 4 and lowest preferred image 3rd is -0.47. The image 1,6,2 also got positive score (mostly preferable) and images.

Conclusion:

The experiment showed that the people are generally, more tolerant towards clear, elegant, and straight-angle images and least tolerant towards bluer and wide-angle images. Humans are sensitive to high quality and less sensitive to low aesthetic quality and this experiment correlates to this known fact.

All observers followed a similar trend across some images indicating similar preferences across different image sets with minor discrepancies but for some images preference trend is different for observers.

References

- 1]. Stevens, S. S. (1951). Mathematics, measurement, and psychophysics. In S. S. Stevens (Ed.), *Handbook of experimental psychology* (pp. 1–49). Wiley.
- 2]. Thurstone, Louis L. "A law of comparative judgment." *Psychological review* 101.2 (1994): 266.
- 3]. Brown, Thomas C., and George L. Peterson. "An enquiry into the method of paired comparison." *US Department of Agriculture, General Technical Reports. RMRS-GTR-216WWW, Fort Collins, CO, USA* (2009).