STAIRCASE PROCEDURE EXPERIMENT

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**Introduction**

The staircase method in psychophysics is a method in which stimuli are presented in an up (ascending) or down (descending) order. Hence it is also called the up-and-down method. The direction of the stimulus reverses with the change in the observer's response. This method is similar to the method of limits, and it concentrates on the responses around the threshold only. In this experiment, we used the staircase procedure to determine the threshold contrast of a visual grating.

There are a few alternative methods to find the stimulus threshold. One method is the method of adjustment in which the participants adjust the variable stimuli to match a standard. Another procedure is the method of limits, where the threshold is determined by gradually increasing or decreasing the stimulus's magnitude. The method of constant stimuli can also determine the threshold using randomly showing the stimuli close to the threshold.

**Method**

The experiment is built in PsychoPy software using a staircase method. The crucial part of the experiment is the titration procedure using the staircase procedure. The experiment is designed to show the change in contrast value with the participant giving correct/incorrect responses.

In PsychoPy, we titrate the contrast of a visual grating using the staircase method. In this experiment, the visual grating either comes on the left side or right side of the screen. The task is to press the 'Left arrow key' if it appears on the left side and the 'Right arrow key' if it comes on the right side of the screen.

**Design**

In the trial routine, we add a **static** which adds a blank screen interval between the trials. It starts at 0 s time and stops at 1 s (duration). In the stimuli, we add a **'cross' polygon,** a fixation that appears after the inter-stimulus interval and stays for 1 s. The cross appears in the center of the screen with a width and height of 10 each.  The spatial units are 'pix'.  Next, a **grating** is added. It starts at the time of 2 s, whereas the duration should be low; hence it is 300 milliseconds. The spatial unit used is from exp settings. The size of the gradient will be (0.1, 0.1). The position is the variable here. Hence, it is going to appear on the left or right side. So we add a '$location' set to 'set every repeat' indicating a reference to the coding. The 'constant' contrast will be '$level' indicating that the contrast will change in every trial. In the texture property of the grating, the mask is a 'circle', and spatial frequency is set to 5. In the **keyboard response**, we keep the duration blank to give the participants enough time to respond. Allowed keys are 'left' and 'right' only.

For storing the correct Answer, we refer to an excel sheet with a row of '$corrAns'. For randomly displaying the grating to the left and right sides, we code for it using a **code component.** Using the code, we give the stimulus a 50:50 - left: right probability of appearing on the screen. The codes are to be added to the "Begin experiment" and "End Routine". To add the key part of the experiment – the staircase procedure- we insert a loop with a Loop Type of 'interleaved staircases', making the loop a staircase loop. The number of repetitions will be 100. To run the procedure, we create an excel sheet with 5 parameters and 1 condition. The participant's task is to press the left and right arrow keys as a response to the stimulus.

**Results**

Here, the X-axis is the number of trials, and Y-axis has the intensity/contrast value.

A visual grating can have different levels of contrast. For an experiment designed using staircase procedure, the contrast level will go lower if the participant gives a correct response. If a mistake is made, the contrast levels go up so that the grating becomes more visible. If contrast is higher, the grating is clearly visible; if contrast is lower, it will be tougher to detect the grating. In this experiment, there is a gradual decrease in the contrast value with the number of trials. However, when the participant made a mistake in the 26th trial, the contrast value slightly increased.

The absolute threshold value of this plot is 0.047965.

Here, the X-axis has the number of trials, whereas the Y-axis has the accuracy level. The participant performed 100 trials. The accuracy can either be 0 or 1. The criteria is that if the participant gives a correct response i.e., pressed 'left arrow key' when the grating was on 'left' side and pressed 'right arrow key' when the grating was on the 'right' side, then the accuracy will be 1. If not, the accuracy will be 0. Here, the participant gives all correct answers except one; hence the graph is a straight horizontal line with a single point at 0.

The absolute threshold value of this plot will be 1 since the participant gave all the correct answers.

**Discussion**

The staircase method is efficient for interpreting the threshold value in a psychological experiment. However, the probability of the grading appearing on the left and right sides should be 50% or equal. If the position of the grating isn’t randomized, the participant can easily interpret the correct response, leading to incorrect assumptions.

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