Adaptive Staircase Procedure

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**Introduction**

Tom Norman Cornsweet invented the adaptive staircase approach in 1962, which transformed the process of measuring sensory thresholds by making them faster and more precise. When we try to locate the exact moment when a light is little visible or a sound is hardly audible. Rather than exposing you to a long sequence of stimuli at constant intensities, this approach dynamically modifies the level in response to your responses. The process increases the intensity when you miss the stimulus but decreases significantly if you recognize it properly. Finding the precise moment where you can perceive the stimulus 50% of the time is made easier with the help of this back-and-forth adjustment. This method improves precision while also expediting the testing procedure, making a grave improvement over older and more cumbersome methods.

**Method**

A 33-year-old working woman who is a young entrepreneur participated in this experiment. The participant was informed about the study, obtained consent for all the data that was to be gathered and collected, and was informed before the experiment began. The experiment was setup along with a laptop in which we used the PsychoPy v2024.1.5 (Peirce et al., 2019) tool for collecting data and analyzing the experiment using Python. I experimented with a 15.5” screen monitor with 1000 x 600 pixels. through the window from which the experiment was conducted.

The experiment was about orientation discrimination, where, after the fixation point, a sinusoidal pattern with a Gaussian mask and varying tilt intensities (Figure 1) was presented on the screen for 300ms with a spatial frequency of 8 and a contrast of 0.3. Now, I asked the participant to tell me whether the figure was tilted to the left or the right using the key symbols “left” and “right” (arrows). The final orientation was set at 10 degrees which was predisposed at random, titled left or right, with a minimum orientation of 1% and 20% maximum.

In Figure 2 of this experiment, I did the one-up, three-down staircase procedure which is shown in Figure 2, with step sizes of 2, 1.5, 1, and 0.5, with linear step types. With every trial I concluded by realising that once the participant made multiple or one key response, the data was exported as a CSV file and later extracted into Microsoft Excel to analyze the participant’s absolute threshold, response accuracy, and tilt intensity degree per trial.



*Figure 1: Image of stimulus - a Sinusoid over a Gaussian mask tilted slightly towards the left*

*Figure 2: Line graph representing the one-up and three-down procedure in the tilt in the stimuli over the duration of the experiment (i.e. number of trials/100)*

**Results**

*Figure 3. A graph representing my participant's responses to the stimuli over 100 trials on the scale, where 0 indicates an incorrect response and 1 indicates a correct response. The accuracy in discriminating the tilt of the stimuli was 47%.*

As a result, the participant responded with 47% accuracy in 100 trials of the experiment (Figure 3.).

Reversals are described as instances in which participants' answers change from being right to being wrong. We estimated the average orientation of the previous five reversals in order to get the difference threshold. On trials 20,19.5,18,17.5 and19, for example, these reversals occurred, and the average orientation was found to be 18.8. Therefore, 18.8 was the difference threshold that I measured.

*Figure 4. A graph showing us the absolute orientation value vs trial responses.*

**Discussion**

From the results of the experiment, we concluded the participant’s threshold for identifying tilt was 18.8 degrees, with a 47% accuracy rate. The final results demonstrate how difficult it is to distinguish between the varied tilt angles of the stimuli used in the experiment. However, the adaptable staircase approach is beneficial as it works best in controlled laboratory settings. These sinusoidal patterns don't account for the number of stimuli and distractions we encounter regularly in our daily routines. The current approach falls short of capturing the critical skill of being able to focus on a target stimulus while juggling competing inputs. Future studies should take into account the inclusion of distractor stimuli to have a deeper knowledge of how humans distinguish sensory information in more realistic and congested circumstances. This would provide a more comprehensive understanding of sensory discrimination despite everyday intricacies.