Adaptive Staircase Report

This Sample Report is prepared by Ashmita Ukil (AU2320042) for PSY310: Lab in Psychology

Name of the Experiment: Adaptive Staircase

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Name of the student: Ashmita Ukil

Enrollment no.: AU2320042

GitHub Link: *https://github.com/ukilashmita-bot/Adaptive-Staircase-Experiment.git*

Introduction:

Adaptive staircase techniques lie at the core of psychophysics since they focus experiments on the perceptual threshold of the participant instead of wasting time at either too simple or impractically hard stimuli. Accurately changing the stimulus leads to the staircase converting effectively to the boundary where the perception is most uncertain. This boundary is the lowest angular inclination of vertical which can be reliably perceived in orientation discrimination tasks. The accuracy of visual encoding and decision-making can be understood by measuring such thresholds. The staircases normally start with bigger step sizes in order to find the approximate threshold and then fine-tune the approximation with smaller steps. Reversals the locations where the staircase turns direction is a longstanding method of stabilizing threshold estimates, since initial fluctuations can be noisy. This paper uses such a process on six subjects to test the question: Can reliable thresholds be obtained using relatively short runs, in addition to testing consistency between individuals.

Method:

One participant was asked to do 100 trials of an adaptive staircase orientation discrimination task. Each trial saw a line that was tilted left or right of the vertical. The participant was asked to point in the perceived direction of tilt. The staircase was 1-up/1-down: the amount of tilt decreased after a correct response and increased after an incorrect response. The method of threshold estimation was founded on reversals which are points at which the staircase turned.

The last threshold was estimated based on the average tilt throughout the last five 1-0 reversals of the 100 reversed individual.

Results:

The participant took 100 trials to complete with 30 responses being correct (30 per cent accuracy). Throughout the run there were reversals and the staircase converged at a small tilt magnitude. The 5 reversals with the last 5 reversals had a tilt value of -20deg, 20deg, -20deg, -20deg and 20deg respectively, with a mean threshold value of -4deg tilt. This value is the JND of the participant, which means that orientation differences of approximately 4deg were necessary to make perception reliable.

Table 1 *lists the final five reversal values and the computed threshold.*

Reversal #	Tilt Value (°)
1	-20
2	20
3	-20
4	-20
5	20
Threshold	-4

Figure 1: *Shows how the tilt values change across the 100 trials.*

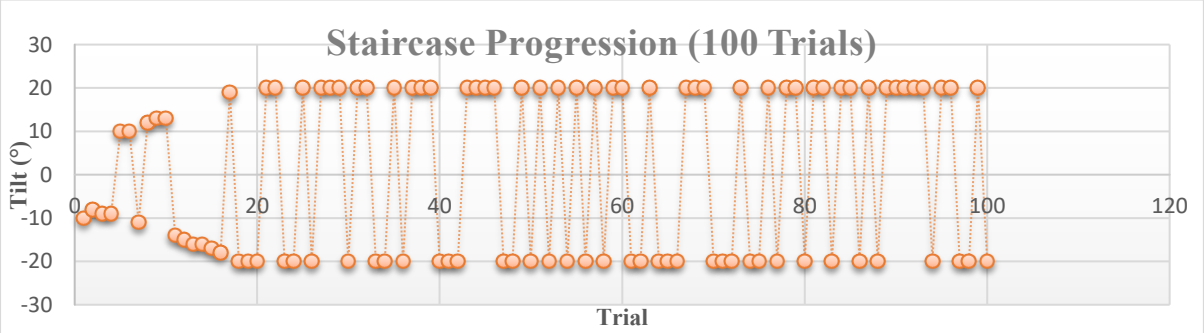
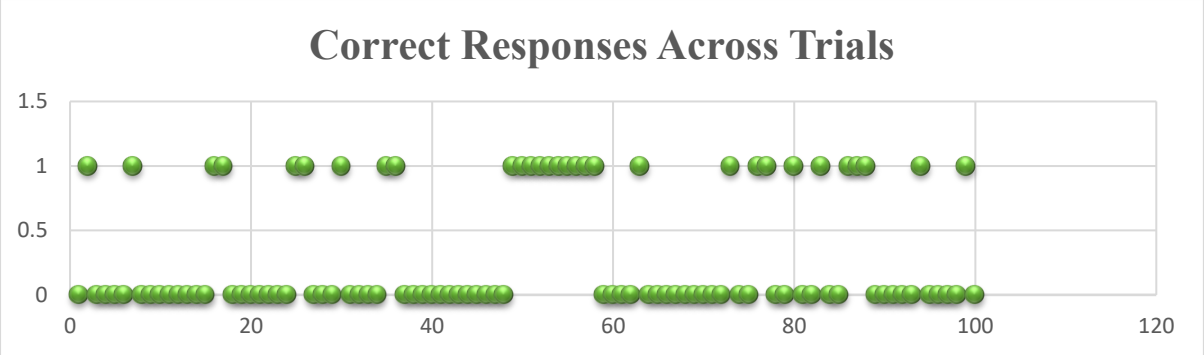


Figure 2: *Shows whether each trial was correct (1) or incorrect (0).*



Discussion:

The adaptive staircase was able to converge on an orientation discrimination threshold. The threshold of -4deg tilt in the participant indicates that the orientation changes smaller than -4deg was not reliably recorded. Despite the leftward tilt shown by the negative sign, the significant measure of sensitivity is the magnitude of the threshold.

The inconsistent performance of 30 percent is lower than the chance expectation of a binary choice task. However, despite staircase reversals, an estimate of the threshold was useful and illustrated the power of the method.

One advantage of the staircase method is its efficiency: the trials were concentrated around the perceptual limit of the participant as opposed to very steep slopes. Variation of reversal points and poor accuracy which can reduce the reliability are weaknesses. Moreover, a single participant has undergone the test and this cannot be generalized.

Future directions may include repeating the process with many subjects, doing more than 100 trials, or a different staircase rule (e.g., 3-down/1-up) to stabilize estimates of the threshold further. However, the current results indicate the usefulness of adaptive procedures to quantify perceptual sensitivity.

References:

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