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Lab Report

Abstract

The following assessment mentions about the staircase method and an experiment which was designed by the faulty. We worked on Psychopy, and created the experiment and performed as well. It further consists of the method which was used; limitations of the method are also discussed.

Introduction

A **staircase method** is a limited technique variant where stimuli are shown in ascending and descending sequence. The stimulus sequence's orientation is reversed when the observer's reaction modifies. Because it does not deliver stimuli that are much above or below threshold, this strategy is effective. When evaluating a point of subjective equality or a sensory threshold, adaptive psychophysical techniques are often utilized instead of the method of continual stimulation to reduce the amount of time required for data collection (Watson & Fitzhugh, 1990). There are two broad groups of adaptive processes, which put the stimulus on each trial based in part on the response history. In essence, these approaches vary the stimulus range in steps that are determined by a straightforward set of criteria. The greatest likelihood techniques are included in the second group. Traditionally, maximum likelihood methods fit a set of parametric models of the psychometric function to the data gathered on all prior trials in order to identify the best stimulus location on each trial. The best estimate of the point of subjective equality or threshold is obtained at the conclusion of the session using the same approach. Despite maximum likelihood processes tend to be more theoretically sound than staircase procedures, they may be rather challenging to comprehend, especially for researchers without a background in mathematics, and they need more assumptions regarding the shape of the psychometric function. On the other hand, the common staircase is the experimenter's first preference since it is simple to comprehend and use in computer-controlled studies. Comparing the efficiency of different methods should thus be interesting.
Alternative methods which can be used are:
Firstly, the classical technique of limits allows for the definition of stimulus reversals, which occur when the order of stimulus presentations shifts from an ascending to a descending series of stimulus intensities, or the converse. The average of these turning points, which is kept track of,

serves as the stimulus threshold value. The process starts by estimating the likely range in which the threshold may be located and selecting a fixed set of stimulus values to span that range. After the initial trial, the threshold value will simply be the most intense stimulus in the range for an incorrect response, and the least intense stimulus in the set for correct detection.
Secondly, The adaptive staircase adjusts the signal intensity over a number of trials and advances in fixed step sizes. The adaptive staircase takes a lot of trials to create the turnarounds needed to determine a threshold, whereas the maximum likelihood technique does it after a limited number of trials. In a SO-trial two alternative forced-choice methods with experienced observers, comparisons of these two adaptive algorithms have demonstrated to give identical threshold estimations. Both, however, eventually converge on threshold. It has been demonstrated in simulations that using three choices makes it easier to get reliable threshold estimations, but doing so also lowers the likelihood of a right response when the signal is undetectable. A faster rate of convergence in the estimate of threshold utilizing adaptive psychophysics may be anticipated as a result of both of these effects.
The stimulus to be detected is shown in exactly one of k periods during a k-alternative forced-choice process, and the S selects the interval in which he believes the stimulus is most likely to have happened. This approach is found to create better stability in the S's criteria than is gained with yes-or-no processes, since it allows for the use of feedback to let the respondent know whether or not his response was right. The forced-choice staircase method is most frequently applied when there are only two options. Due to these factors, we have opted to research the staircase method's characteristics when it is combined with either the yes-or-no or the two-alternative forced-choice technique.

Method:

Finding the threshold contrast of a visual grating was the goal of this investigation. The subject group for this investigation were university students. All of the participants in this experiment underwent each of the experiment's conditions as part of its within-subject experimental design. Simple procedures were used in the experiment's design. It started with a blank screen which lasted for approximately a second. Then, either on the left or right side of the screen, a grating picture debuted, followed by the appearance of a fixation polygon in the center of the display. The grating's placement was decided at random. The participants were told to use the left and right keyboard keys to determine the grating's location and indicate it. Each trial's grating had a different amount of contrast, starting at 0.05. The contrast level would go down if the individual gave the right answer, and up if the wrong answer was given. The answer data was downloaded onto an excel sheet after 100 trials. The data for contrast level (trial.intensity) and accuracy (key resp.corr) were plotted and transmitted for additional investigation.

Computers and keyboards are the equipment needed.

Contrast level is an independent variable.

The left or right key being pressed is a dependent variable.

In **Custom**, select *'static'*. Change the **ISP properties** to **Start** → '**time'** at *'0.0'* and **'Stop'** → *'1'* and choose **'duration'**. In **stimuli**, select **'polygon'**; in **Basic polygon properties**, **shape** is *'cross'*, **time** is *'0.1'* (after the static), **duration** is for *'0.1'*. In **'layout'** in **polygon properties**, in **spatial units** change to *'pix'*; keep **position** *'0,0'* (center); **size** should be *'10,10'*. Then click **OK**. In **'stimuli'** and choose **'grating'**; in **grating properties**, **start time** is '*2.0'*, **stop duration** is *'0.3'*. And change the **size** to *'0.1, 0.1'*, in **position** '*$location'*; and change from the **constant** to *'set every repeat'*. Then go to **appearance** and in '**contrast'** put **'level'** and change the **'constant'** blank to *'set every repeat'*. Then click **OK**. In **texture** in **mask** should be *'circle'*, & **spatial frequency** should be *'5'*. Then click **OK**. Go to **'response'** select **'keyboard'**; in the properties, in **'Basic'** → **start time** should be *'2.0*'; in allowed keys change it to **'left, right'**. In **'data'** and *check in the box* for **'store answer'**, in the **'correct answer'** option write '*$corrAns'*. Then click **OK**. Name the **polygon** as **'fixation'**; then go **'data'** and *uncheck the box* for **'Save onset/offset times'**. Then click **OK**. Then go to **'custom'** and select **'code**, in **'code properties'** select **'begin routine'**, and write

```
' if random()>0.5: # 50:50 probability
      location = (-0.2, 0)
      corrAns= 'left'
else:
  location = (0.2,0)
  corrAns = 'right' '
```

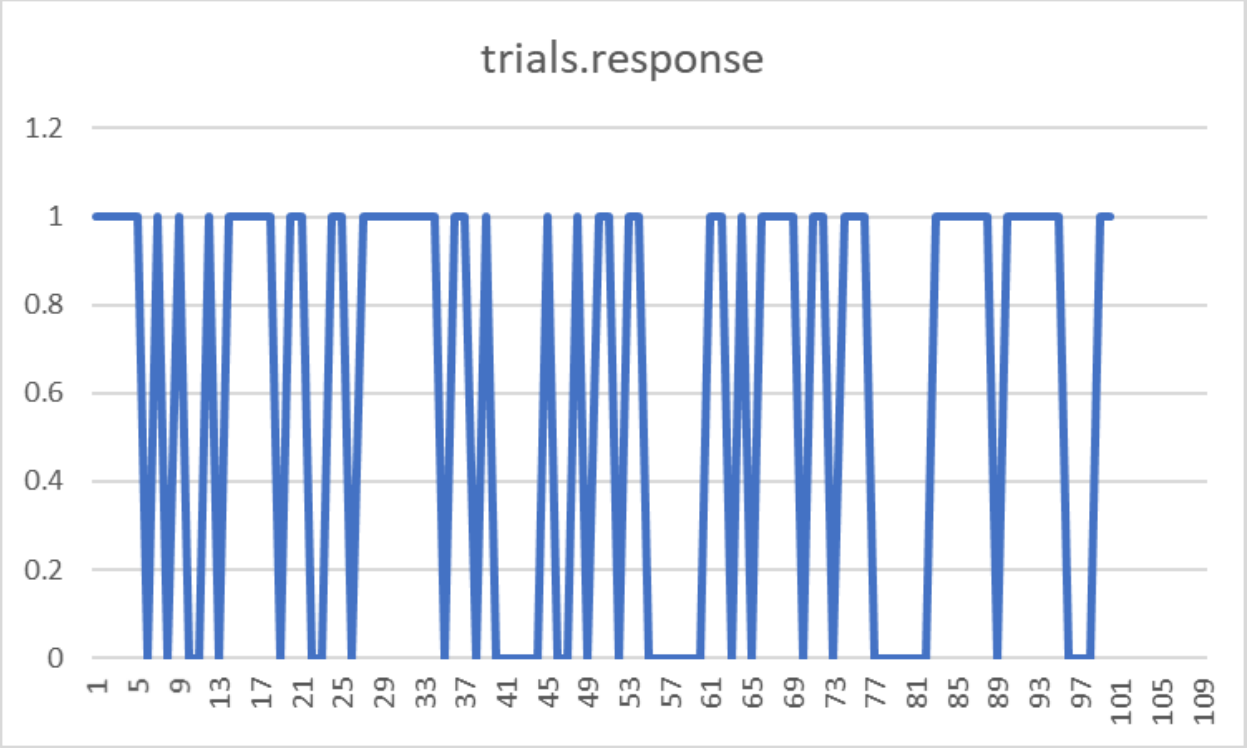
Then click **OK**. Then go to **'insert loop'**, then in **loop properties**, in **'loop type'** select *'interleaved staircase'*. Then Click **OK**.

Then go to excel, and write:

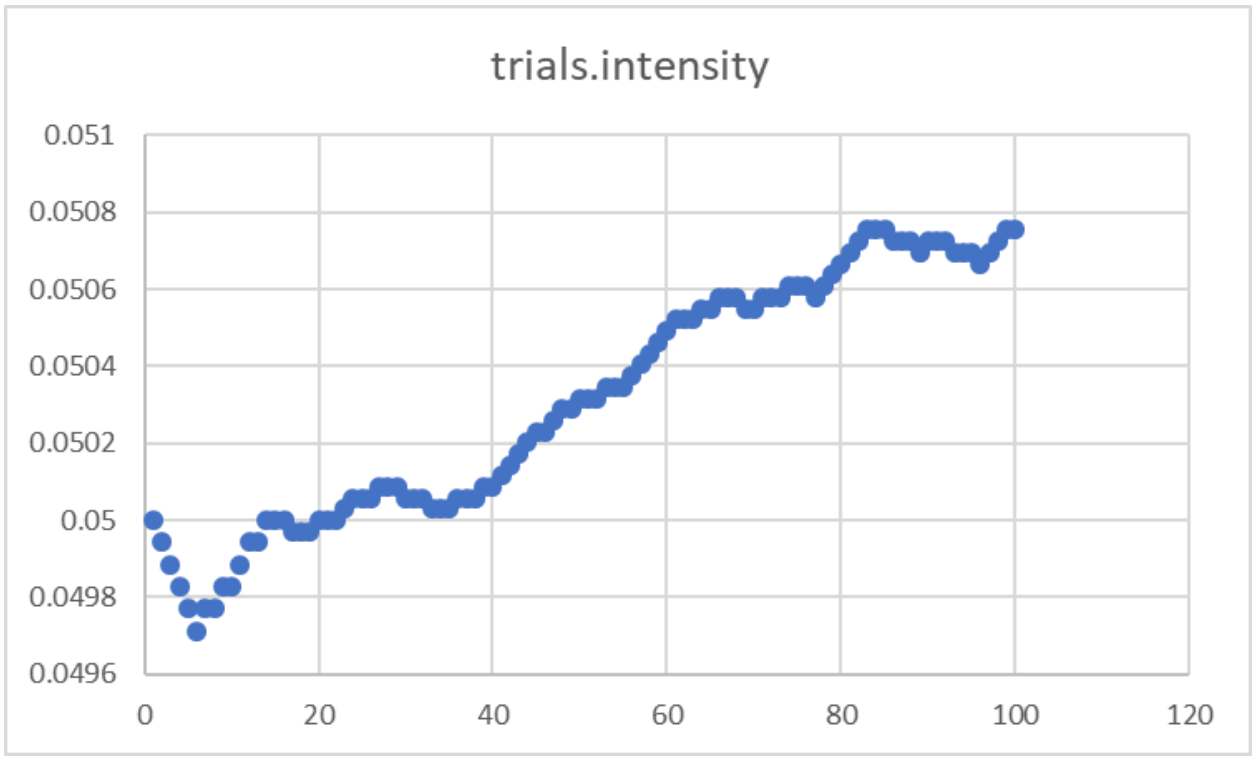
Label	startVal	stepSizes	maxVal	minVal
cont	0.05	(0.01,0.01,0.005,0.005)	1	0

Then save the excel as **'conditions'** on the PC. Go to the **'trails'** which was already inserted and *add the conditions excel file* in **'conditions'**; then in **'nReps'** put the value *'10'*. Recheck the values and changes made. Then RUN the experiment.

Results:



Accuracy (key resp.corr): The accuracy of the subjects' responses is shown in the following graph.
Here, a 1 denotes an accurate response whereas a 0 denotes one that was erroneous. As seen, most\sof the dots in this graph are drawn at 1, implying that most replies supplied by the participant were right.



Trials per intensity level of contrast: The link between the contrast value and the total number of trials is shown in the following graph. The graph shows that as the trials go on, the grating's degree of contrast is shown to be decreasing starting at 0.05. The data appears to be quite reliable. For this data set, the findings pointed to a threshold of 0.050314498.

Discussions:

A psychophysical method that measures the sensory threshold by incrementally raising or lowering the stimulus's intensity over time. Finding out how much the sensory response's amplitude increases as stimulus intensity rises is a key issue in psychophysics. Disadvantages. When using the staircase approach, Might estimate a threshold that is not backed up by clear evidence (i.e., spurious threshold). Given that the stimulus is not provided in a systematic manner, may involve several trials. might lead to inaccurate findings (compared to others).

References:

https://dictionary.apa.org/staircase-method

Novelty, complexity, and hedonic value
URL https://link.springer.com/content/pdf/10.3758/BF03212593.pdf

GREEN, D. M. (1976). Introduction to hearing. Hillsdale, N.J: Erlbaum. HALL, J. L. (1983). A procedure for detecting variability of psychophysical thresholds. Journal of the Acoustical Society of America, 73, 663-667. LEVITT, H. (1971). Transformed up-down methods in psychoacoustics. Journal of the Acoustical Society of America, 49, 467-477. PENTLAND, A. (1980). Maximum likelihood estimation: The best PEST. Perception & Psychophysics, 28, 377-379

Feeny, S., Kaiser, P. K., & Thomas, J. P. (1966). An Analysis of Data Gathered by the Staircase-Method. *The American Journal of Psychology*, *79*(4), 652–654. https://doi.org/10.2307/1421309

Dallenbach, K. M. (1966). The Staircase-Method Critically Examined. *The American Journal of Psychology*, *79*(4), 654–656. https://doi.org/10.2307/1421310

Two-alternative versus three-alternative procedures for threshold estimation - Attention, Perception, & Psychophysics
URL https://link.springer.com/article/10.3758/BF03206343