Signal Detection Experiment
PSY310: Lab in Psychology
Lab Report

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GitHub link:

Introduction

The Signal Detection experiment is based on the Signal Detection theory (SDT), which is a framework that explains how observers distinguish between significant signals and random noise in unknown and uncertain circumstances. It differentiates between the sensitivity (the observer's capacity to detect a signal) and the decision criteria (the observer's readiness to say "yes" or "no" to the signal).

It plays a central role in a variety of domains, most prominently in recognition memory (Holyoak, 2021). SDT helps in distinguishing sensitivity from response bias and characterizing optimal decision strategies (Maniscalco, 2024). It is useful in analyzing performance on tasks including information retrieval, medical screening, and sound identification in a variety of domains, including psychology, medicine, and engineering.

Method

Participants

A 19 year-old undergraduate female student of Ahmedabad University was taken as a participant. She was informed about the experiment's objective, and was briefed about the procedure, which was to identify her ability to be able to distinguish between signal and noise.

Materials and Procedure

The experiment was to determine the sensitivity (d') and response bias, with the ability of the participant to discriminate between signal and noise. We created a Signal Detection experiment on a desktop window with a resolution of 1440 x 900 pixels using the PsychoPy3 Experiment Builder (v2021.2.3). 100 trials of the experiment were conducted.

The trial began with a fixation presented for 1000 milliseconds, which was followed by the signal stimuli of a sinusoidal shape with a Gaussian mask (figure 1) presented for 300 milliseconds. The experiment was coded such that the orientation of the grating was to have either a tilt, or no tilt at all, based on a random probability at the start of the trial. The maximum tilt it would have, was 4 degrees, either to the left or the right, while the minimum was 0 degrees. If the orientation had no tilt (0 degrees), then the participant was supposed to press the 'up' (↑) key, and if there was a tilt, either to the left or right, the participant had to press the 'down' (↓) key.

As per the responses made by the participant, the answers can be categorised into 4 conditions of “hit”, “miss”, “false alarm”, and “correct rejection”. The response would fall under “hit” if the person identified a no tilt stimulus, and responded correctly, a “miss” if the same was identified incorrectly, “false alarm” if a tilt was present, but responded to incorrectly, and “correct rejection” if the tilt was responded to correctly.

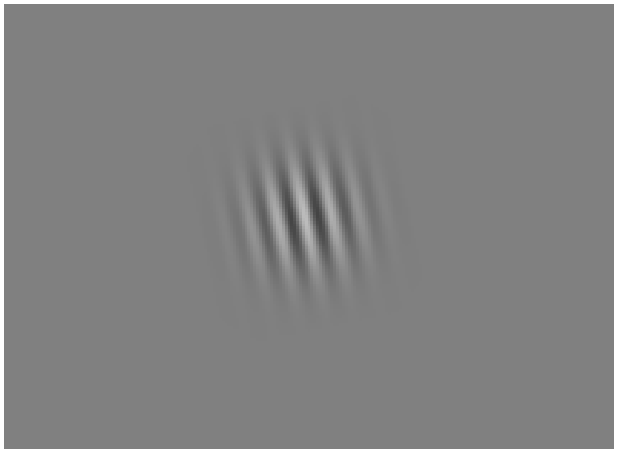

Figure 1. The grating stimuli: A Sinusoid with a Gaussian mask with a tilt

Result

The sensitivity index (d’) measures how well the participant can distinguish signal (target present) from noise (target absent). The criterion (c) measures whether the participant tends to say “yes, the signal is present,” or “no, the signal is absent”, more often.

As per the data collected, we calculated the sensitivity index (d’) value as 1.32 and the criterion, i.e. the decision bias (c) value to be -0.92.

Discussion

As per the calculations, the d’ is 1.322319933. This shows that the participant has a moderate level of sensitivity, and can distinguish signal from noise better than chance, but not perfectly. The c is -0.9200217431. This shows that the participant has a strong liberal bias, and has the likelihood of saying that they detect the signal, even if it means risking false alarms, rather than missing true signals.

This suggests that the participant can tell the difference between signal and noise fairly well, but their decision strategy favours having to say yes.

References

Holyoak, K. J. (Ed.). (2021). Testing the Foundations of Signal Detection Theory in Recognition Memory. *Psychological Review*, *128*(6), 1022–1050. https://doi.org/10.1037/rev0000288

Maniscalco, B. (2024). Optimal metacognitive decision strategies in signal detection theory. *Pychonomic Bulletin and Review*, *32*, 1041-1069. https://doi.org/10.3758/s13423-024-02510-7