**Signal Detection**

PSY310: Lab in Psychology

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Github link-

**Introduction**

**In conditions where the discriminability between a signal and noise is extremely difficult then there is the Signal Detection Theory (SDT) developed by Swets and Tanner. This theory is in use in very many fields and can be applied in the doctor’s diagnosis or radar and communications. In the SDT, the trade-off is between sensitivity, how well the decision-maker can pick up signals and bias, and how ready the decision-maker is to report the signal. In any SDT scenario, four possible outcomes arise: A true positive result is obtained when a signal is accurately identified, a false negative result when it is not identified, a False positive result when there is an indication of the signal while it is non-existent and True Negative result when there is no signal while the system informs the same. Such outcomes make it possible for the researcher to estimate the criterion of the decision-maker to either lean towards a liberal or conservative model. Through these factors, SDT offers insight into how decisions occur in conditions of uncertainty and variability that define real-world decision-making.**

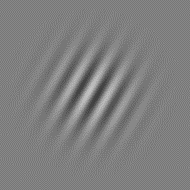
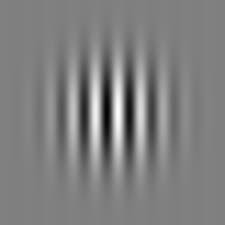
**Method**

This experiment's participant was a 20-year-old female undergraduate student from Ahmedabad University, affiliated with the university's psychology department.

The experiment was conducted using PsychoPy (PsychoPy Builder(v2024.15)). An 11.5” monitor with a resolution of 1920\* 1080 pixels and a refresh rate of 60 Hz was used.

For this task, subjects had to decide if a Gaussian surface was trained on a signal, which asked vertically or was tilted, a signal missing. All of the trials started with the instruction slide, then a 1. 0-second fixation point. After the fixation, a visual stimulus which was a Gaussian-masked grating was displayed for 0. 3 seconds. The obtained contrast of the grating was 0. One with amplitude 3, a spatial frequency of 5, and size (0. 3, 0. 3). The key variable, orientation, was determined through the tilt variable: a 0° alignment means that the stimulus is present whilst the slight tilts within ± 5° (but excluding 0°) imply the absence of the stimulus.

The subjects were asked to respond with the up arrow key for the vertically aligned stimulus when the signal is ON and the down arrow key for the tilted stimulus when the signal is OFF. Thus, whether the grating was shown vertically or tilted was determined randomly for every trial using Python’s random () function mixed into the program. Both d-prime (sensitivity) and criterion (bias) were estimated based on data from 100 randomized trials for each of the participating subjects which is saved in the CVS file. This was to go on until the participant made a response, and their performance accuracies were kept note of.

*(Figure 1)* *Images of grating used in orientation discrimination task: a sinusoidal shape with a Gaussian mask*

**Results**

The d' obtained from the experiment was **1.975069,** and the criterion (c) was found to be **-1.85337**

**Discussion**

Therefore, the decision-maker's orientation bias and sensitivity can be understood from the outcome of the orientation discrimination task. The estimated d-prime (d’) value being near to 2 shows high sensitivity and it confirmed that participants were indeed very accurate while differentiating between the signal, the vertical orientation, and the noise, the tilted orientation. This results in a lot of hits and a low false alarm rate and improves the ratio of hits to false alarms, thus distinguishing signal from noise.  
  
It is stressed that the criterion (c) in this study was less than zero which means the information search activity was based on conservative bias. Signal detection theory showed that participants needed more evidence for signal presence and were more likely to respond ‘no’ leading to fewer false alarms and more misses.  
  
The results reported here are also in congruence with Signal Detection Theory, the writer on decisional processes regarding sensitivity and bias. The experiment shows how people weigh precision and conservatism when evaluating probabilistic information, which generalizes to several practical uses, for example, in diagnostics or perceptual skills.

# References

RN, D. (2022). What Do Models of Visual Perception Tell Us about Visual Phenomenology? In S.-A. W. De Brigard F, *Neuroscience and Philosophy* (p. Signal detection theory (SDT) illustrated).

Swets, J. A. (1961). Decision processes in perception. *APA PsyNet*.