

Signal Detection Theory (SDT) Simulation

The term "agent" is used by some cognitive psychologists to refer to a hypothetical construct that accomplishes a task. A cognitive agent might, for example, be the "software in the brain" that operates when you see and recognize the letter "A".

So, imagine you are the cognitive-perceptual "agent" in charge of evaluating the neurological evidence that a stimulus has occurred. If you decide the stimulus occurred, then there will be a conscious experience of the stimulus. If you decide the evidence is only indicating static, then there will NOT be a conscious experience of the stimulus. The "Degree of Evidence" the cognitive-perceptual system uses to make the decision of whether or not a stimulus occurred is a hypothetical construct. It is related to the type or amount of activity in the relevant part of the nervous system.

For your purposes, the "stronger" the evidence, the more likely the stimulus occurred. Just about any amount of evidence could be the result of random noise ("static") or that same amount of evidence could be random noise plus the additional strength added by the occurrence of the stimulus.

In Figure 1 you see that at this moment the amount of evidence is to the left of center. Would you decide this degree of evidence indicates "Noise" or "Signal"?

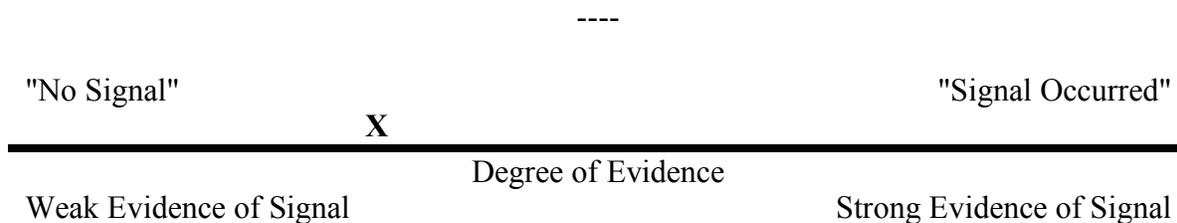


Figure 1. Internal hypothesized "Evidence" dimension used to decide whether or not a stimulus occurred.

There is no way you can complete the task without error. Almost every location for the momentary evidence (the "X") could be indicating static ("Noise") or the signal. What you do know is the further to the right the evidence, the more likely it was created by a signal and not just noise.

Instructions:

Launch the "sdt simulation" application.

Click on the "next" button to go to the data collection screen

For each data series

- Click the "Clear" button to delete any data already collected.

- Click on the "Parameters" button to reveal the choices available.

- Set the "Signal Strength" to the appropriate value.

- Leave the other settings as they are: "decision time" is 6, "P(NS)" is 0.5, "Feedback Time" is 500.

- Click the "Begin" traffic light to start.

- Complete the requested number of trials. If you run too many, that's OK.

For each trial, observe the black "poker chip" that appears somewhere above the line labeled "Hypothesized 'Evidence Dimension'."

Click on the "Noise Only" or "Noise + Signal" button

Feedback will indicate whether or not you made a correct decision

When you complete a data series

Click on the "Process Data" button. You will go to the next card.

When the processing is complete, print the processed events card.

Click on the Laserwriter icon.

Don't use the "Print Card" menu item

Be sure to print out "sideways"

Click on the "Calc" button and enter the values to calculate d' and β .

Click the "prior" button to return to the simulation.

The last page of the handout describes the conditions you should use to collect data and provides a space to record your results.

Complete 5 data series. Run series A, and B first. Flip a coin to decide whether you complete series C with a stimulus strength of 4 or 5 next. Then flip a coin to decide whether you are to complete the "Lax" instructions first or the "Strict" instructions first.

A. Run 150 Trials using a signal strength of 3

B. Run 150 Trials using a signal strength of 1.

C. Run 150 Trials using a signal strength of 4 or 5

D. Run 150 trials using a signal strength of 3 using a very lax criterion or very strict criterion. Flip a coin to decide which you are doing first.

Very Lax criterion--allow lots of false alarms. The instructions you might use would be: "I'm not sure, it could be a signal; so, I'll say 'yes'."

Very strict criterion--allow few false alarm. The instructions you might use would be: "I'm only going to say its a signal when I'm absolutely sure."

E. Run 100 trials using a signal strength of 3 using a the other criterion.

Data analysis tasks to complete

Complete the information on the last page of this handout by entering your values and plotting the 5 pairs of "p(false alarms)" and "p(correct detections) in a unit square. Read the directions carefully about how to identify the data points you are plotting.

Calculate d' and β (beta) for each of the data series. The "Calc" button opens a special purpose tool for those values. You must enter the values for your data--the values in the calculator are not those of your data.

Signal Detection Theory Predicts the Following:

d' will be smallest when signal strength = 1

d' will be largest when signal strength = 5

d' will be about the same value for all three tasks where signal strength was 3

Response bias will be larger where you set the criterion "strict" than when you set it "lax" when the signal strength was set to "3".

SDT Simulation Results

Collect 100 trials for each of the 5 sets of conditions in the order shown. For the third series, flip a coin to decide which signal strength to use. For the fourth series, flip a coin to decide whether you will run the "Lax" or "Strict" criterion condition. Run the other one in the fifth series.

Plot the $p(\text{FA})$ and $p(\text{CD})$ combinations for each of the five conditions. Use a letter or digit as the plot icon. Calculate the values of d' and β .

Order in which the tasks are completed	1st	2nd	3rd	4th or 5th	4th or 5th
Signal Strength	"3"	"2"	"4" or "5"	"3"	"3"
Criterion	?	?	?	Lax or Strict	Lax or Strict
Plot Icon	3	2	4 or 5	L or S	L or S
P(False Alarms)					
P(Correct Detections)					
Number of Trials					
d'					
β (beta)					

