

### Determining Sensitivity to Deviations from Squareness

In today's lab you will experience the entire procedure for determining the manner in which your cognitive system makes decisions under conditions of uncertainty. You will finish the session with an isosensitivity function (aka "ROC" function) showing how you trade off one kind of error ("misses") for another ("false alarms").

You will see rectangular stimuli on the computer screen. Your task is to decide whether the stimulus is a "square" or a "rectangle." The noise-only condition is the "square". The signal is the slight addition of height or width that makes the rectangle look different from a square.

You are doing "square judging" because it is a task that can be computerized and the entire measurement procedure completed in a two-hour lab session. The teaching concern is not in finding out about "square judging". It is instead about the process of making decisions under conditions of uncertainty. The *Invariance Hypothesis* argues that the judgment process is the same (aka "invariant") regardless of the type of stimuli being judged. We can study "square judging" and find out about the judgment process used by radiologists in deciding whether or not that smudge on the x-ray is a tumor or the crime victim decides the person in the lineup is the perpetrator.

There are actually four tasks involved. The first two are calibration tasks. The third is finding a stimulus that is moderately difficult for you to judge. The fourth task is a rating scale task where you make the judgments that result in your isosensitivity function.

Launch the "SDT Task" Application

1. Determine the Aspect Ratio for your Monitor.
  - a. Click "Monitor Aspect Ratio".
  - b. Follow directions.
  - c. Watch out for parallax error!
  - d. Record the value of the aspect ratio for your computer screen.  
Aspect Ratio for your screen: \_\_\_\_\_
  - e. Quit the "Horizontal Vertical Illusion" application.
  
2. Determine the Height-Width Ratio that looks square for you.
  - a. Click on "Experiment Parameters"
  - b. Click on "Restore Default Values"
  - c. Set "Increment" to "0.10"
  - d. Set "Number of Trials" to "10"
  - e. Check "Display Results"
  - f. Click on "First" arrow-icon
  - g. Click on "Collect Data"
  - h. Click "Start"; Delete Previous Date should there be any.
  - i. Enter your first and last name
  - j. Complete 10 Trials. It is important you answer as they **appear**.

Your goal is to complete 10 trials without error. If you make an error, go back to the "Experiment Parameters" card/screen and change the value of the setting for "Height/Width Ratio for Square". Try "0.95". Keep repeating this data collection process until you find the "Height/Width Ratio" that accurately captures the way your cognitive system operates. If you proceed before you successfully complete this task you will not be able to analyze the rest of your data in a meaningful way.

Height/Width Ratio for square for your Cognitive System: \_\_\_\_\_

3. Determine an increment that is moderately difficult for you.

You will complete a data collection task 5 times. Each time you will be running 100 trials. On the first 100 trials, use an increment of "0.07". On the second 100 trials, use an increment of "0.05"; then "0.03", "0.02", and finally "0.01"

- a. On the "Experiment Parameters" card, click "Restore Default Values"
- b. Re-enter the proper values for the "Calibration" tasks.
- c. Set the Number of trials to "100", the increment to "0.07"
- d. You may check "Display Trial Number", if you so desire.
- e. Collect the data. You may have to click "Restart" to begin
- f. Save the data file to your desktop as you complete each task. Be sure you know where the file is being saved. The data file contains the parameter settings. Delete the current data after the data file has been saved.
- g. Go back to the first card, click "Process Data File".
- h. Load and process the data file. Be sure both "Horizontal Increments" and "Vertical Increments" are checked. Record the results in Table 1 given below. Plot them in the Unit Square (Figure 1). Use the increment value ("7", "5", etc.) as the plot icon.

4. Use the Rating Scale Task to generate the Receiver-Operating-Characteristic function that describes how your cognitive system operates on this task.

- a. On the "Experiment Parameters" card, click "Restore Default Values"
- b. Re-enter the proper values for the "Calibration Tasks."
- c. Set the Number of Trials to 300.
- d. Set the increment to the value for which you had "moderate" sensitivity. This setting depends on the sensitivity of your cognitive system to deviations of squareness. Look at the results of your five sets of 100 trials to decide upon an increment to use.
- e. You may check "Display Trial Number" if you so desire.
- f. Collect the data.
- g. Record the values displayed into Table 2 before you save the data file
- h. Save the data file to the desktop.
- i. Load and Process the data file. Know how the values for  $p(\text{CD})$  and  $p(\text{FA})$  were calculated.
- j. Plot the results in Figure 1. Sketch in a bow function.
- k. Calculate the value of  $d'$  and  $\beta$  for each criterion and post in Table 4.

Table 1: Results of Binary Judgment Task

<b>Inc (% STD)</b>	<b>P(FA)</b>	<b>P(CD)</b>	<b>d'</b>	<b><math>\beta</math></b>

Table 2: Data from Rating Scale Task

	(Rating 5) Unlikely	(Rating 4) Could Be	(Rating 3) Maybe	(Rating 2) Probably	(Rating 1) Definitely
N					
NS					

Indicate the "Increment" you used in the Rating Scale Task: \_\_\_\_\_

Table 3: Results of Rating Scale Task

<b>Criterion</b>	<b>Descriptor</b>	<b>f(CD)</b>	<b>f(FA)</b>	<b>p(CD)</b>	<b>p(FA)</b>
<b>Strict</b>	<b>Definitely a Rectangle</b>				
<b>Medium Strict</b>	<b>Probably a Rectangle</b>				
<b>Medium</b>	<b>Maybe a Rectangle</b>				
<b>Medium Lax</b>	<b>Could Be a Rectangle</b>				
<b>Lax</b>	<b>Unlikely to be a Rectangle but I'll call it one anyway</b>			<b>1.00</b>	<b>1.00</b>

Table 4: Sensitivity and Response Bias for Rating Scale Task

<b>Criterion</b>	<b>Descriptor</b>	<b>z(CD)</b>	<b>z(FA)</b>	<b>d'</b>	<b>h(CD)</b>	<b>h(FA)</b>	<b><math>\beta</math></b>
<b>Strict</b>	<b>Definitely a Rectangle</b>						
<b>Medium Strict</b>	<b>Probably a Rectangle</b>						
<b>Medium</b>	<b>Maybe a Rectangle</b>						
<b>Medium Lax</b>	<b>Could Be a Rectangle</b>						
<b>Lax</b>	<b>Unlikely to be a Rectangle</b>						

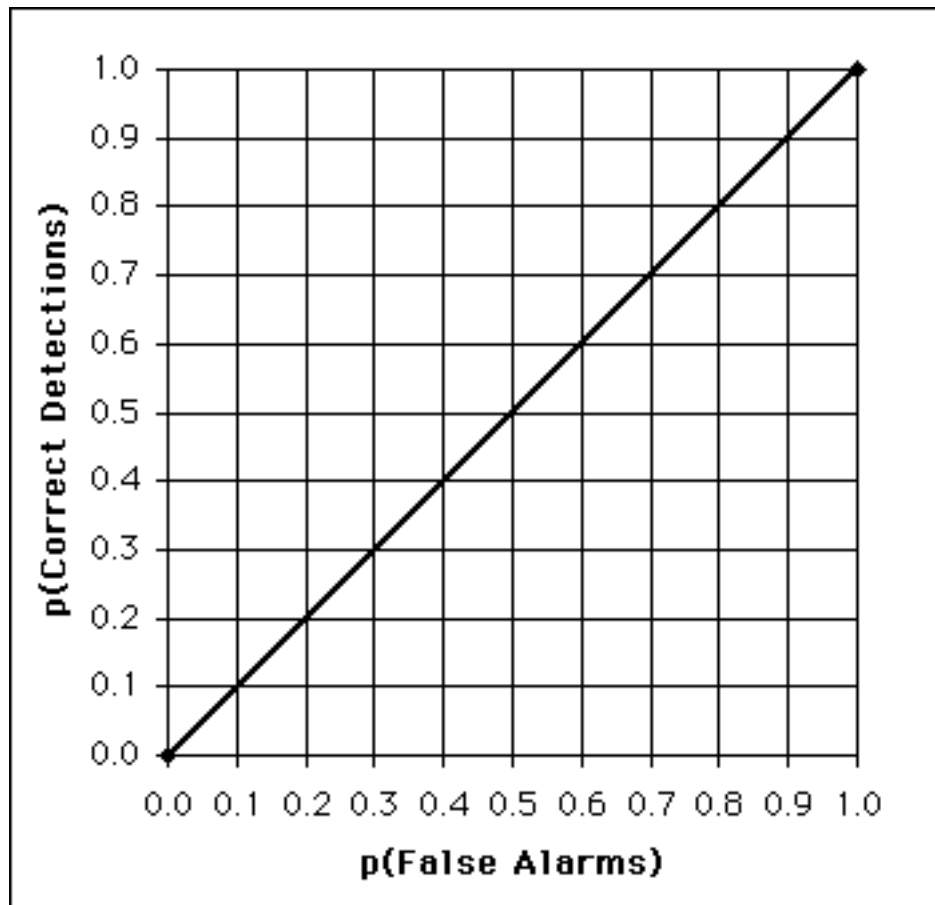


Figure 1. Results of the Binary and Rating Scale Judgment Tasks

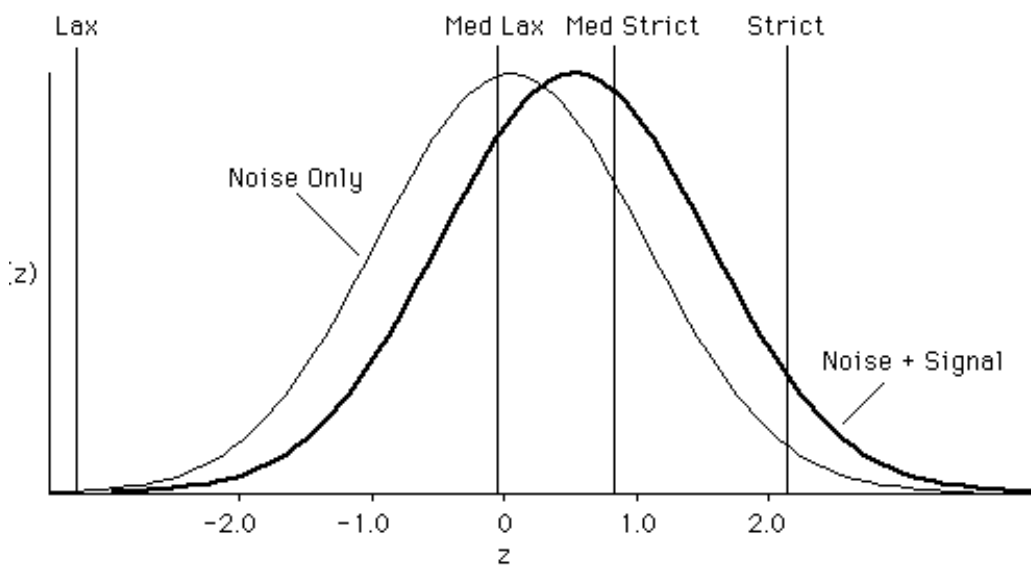


Figure 2. The hypothesized underlying model for a rating scale task.

Example Calculations for the Rating Scale Task

Table 2: Data from Rating Scale Task

	(Rating 5) Unlikely	(Rating 4) Could Be	(Rating 3) Maybe	(Rating 4) Probably	(Rating 1) Definitely
N	45	32	15	31	27
NS	20	19	30	28	53

Indicate the "Increment" you used in the Rating Scale Task: \_\_\_\_\_.07\_\_\_\_\_

Table 3: Results of Rating Scale Task

Criterion	Descriptor	f(CD)	f(FA)	p(CD)	p(FA)
Strict	Definitely a Rectangle	53	27	0.353	0.18
Medium Strict	Probably a Rectangle	81	58	0.540	0.387
Medium	Maybe a Rectangle	111	73	0.740	0.487
Medium Lax	Could Be a Rectangle	130	105	0.867	0.700
Lax	Unlikely to be a Rectangle	f(NS) = 150	f(N) = 150	1.00	1.00

Table 4: Sensitivity and Response Bias for Rating Scale Task

Criterion	Descriptor	z(CD)	z(FA)	d'	h(CD)	h(FA)	$\beta$
Strict	Definitely a Rectangle	0.3780	0.9166	0.5385	0.3714	0.2621	1.4171
Medium Strict	Probably a Rectangle	-0.1014	0.2879	0.3893	0.3969	0.3827	1.0370
Medium	Maybe a Rectangle	-0.6443	0.0337	0.6780	0.3242	0.3987	0.8130
Medium Lax	Could Be a Rectangle	-1.1137	-0.5253	0.5885	0.2145	0.3475	0.6174
Lax	Unlikely to be a Rectangle	X	X	X	X	X	X

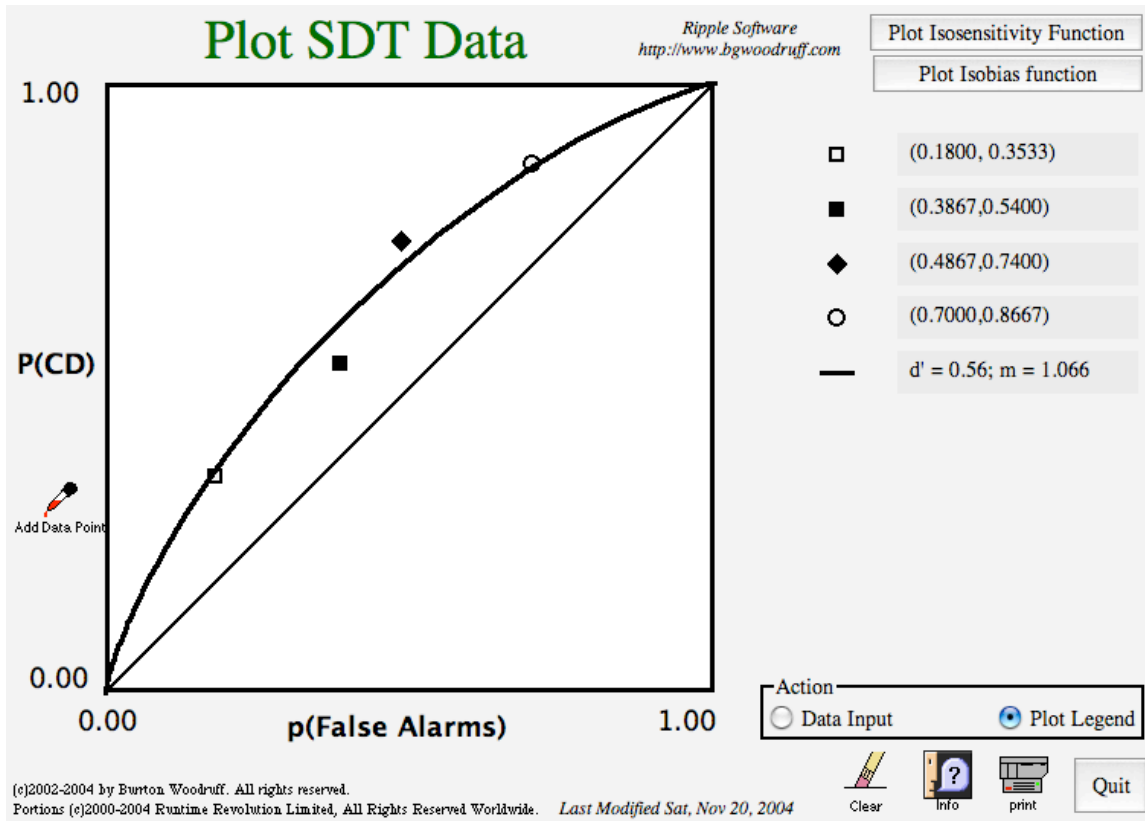


Figure 3. The Rating Scale data is plotted for the example results. The value of  $m$  is the slope of the best fit straight line calculated on the z-scores of  $p(\text{CD})$  and  $p(\text{FA})$ . The theoretical model predicts the value of the slope to be 1.00. This particular data set closely approximates the predicted slope. The increment used for this particular task was 0.07.