

CB 9 Anatomy and Physiology of Human Response Rates

Are quick responses important for survival? Are they needed for humans to survive in a urban environment? How quickly do humans react to sensory stimuli? What differences are there among individuals or groups of individuals? Do males have quicker reaction times than females? Will your reaction rate be quicker if the initial stimulus is by sight, by touch, or by hearing? You will be testing experimentally your reaction rates to 3 major sensory pathways to the brain -- visual, auditory, and touch.

Materials

- meter stick
- graph paper
- blindfold goggles
- Casio fx2 Graphing Calculator

Procedure

1. Construct a data table in your Log similar to the one shown below.

Observed distances on meter stick and calculated times to visual, auditory and tactile stimuli

Trial Number	Part A Visual		Part B Auditory		Part C Touch	
	You	Partner	You	Partner	You	Partner
1						
2						
3						
4						
5						
Average Distances						
Calculated Time						
Class Average Distances						
Class Average Calculated Time						

2. Study the diagram on the following page for an illustration of how to hold and release a meter stick (top photo). Note that the partner being tested should align her/his thumb and index finger with the bottom (0 cm mark) of the meter stick (bottom photo).



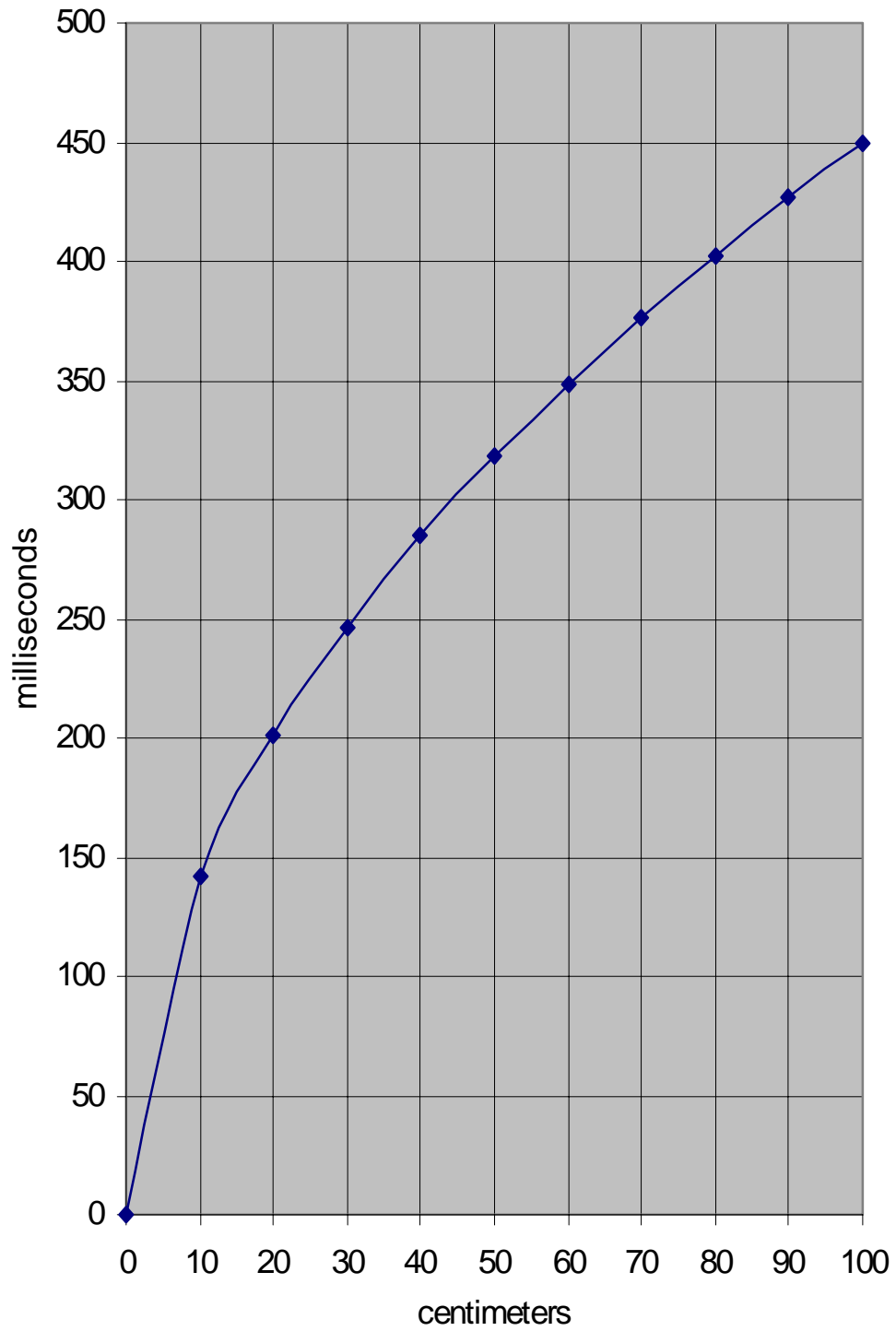
3. Construct a hypothesis which predicts which of the three stimuli should allow you to grab the stick most and least quickly.
 - **visual**: being able to see when the stick is dropped
 - **tactile**: being touched exactly when the stick is dropped, but being unable to see
 - **auditory**: a sound is made exactly when the stick is dropped but without seeing
4. You will want to preserve the condition of your meter stick. Place a book or something soft on the floor directly under where the meter stick would drop if it is not caught. The meter stick's edges can chip if it strikes a hard surface.
5. Test the Visual Stimulus variable.

Your partner will hold the meter stick at the 0 cm mark, while you stand with your hand extended at shoulder height. The top of your thumb and first finger should be aligned with the bottom (0 cm mark) of the meter stick. When you see your partner release the meter stick, grab it with your hand. Read the centimeter value from the top of your thumb and first finger (the same point where you set the meter stick at the beginning). Record this value in the data table. Repeat 4 more times for a total of 5 trials. Record each number in your *Log* data table. Now switch roles and repeat the trials.
6. Test the Auditory Stimulus variable.

Stand as before, but this time put on the blindfold goggles. When your partner releases the stick, he/she will say something like "Go." Your job is to grab for the stick as quickly as possible. Repeat 4 more times and record the centimeters values in the data table. Now switch roles and repeat the trials.
7. Test the Tactile Stimulus variable.

Using your blindfold goggles so that you cannot see. Instead of saying "Go" as above, your partner will touch your opposite hand as the stick is released. Try to grab the stick as soon as you feel this touch. Repeat 4 more times, and record the centimeter values in the data table. Now switch roles and repeat the trials.
8. Distances on the meter stick are not a direct measure of reaction time. The relationship is actually not linear. You now need to convert your average distances on the meter stick to actual reaction times using the graph on the following page. Find where the distance you wish to convert in centimeters on the X axis intersects with the graph line. Then read the time in milliseconds directly to the left of that point on the Y axis. Record that figure for your and your partners average time in milliseconds on the data table.
9. Record the class average distances on your data table when it is calculated. Convert these to times in milliseconds also.

Curve for Converting Distance to Reaction Time



Interpretations Write a response in your *Log*.

1. How do your findings support your hypothesis?
2. Compare the average reaction time for each stimulus area for both you and your partner. Was your hypothesis supported. Explain.
3. Compare your time and your partner's time to the class average. What differences appear to exist?
4. Pool your data with that of your classmates and determine class averages for the three conditions.
5. Prepare a bar graph of the data, showing both your partner's, and the class's average reaction times.
6. After studying your graphs, evaluate your hypothesis again. To which sensory stimulus were you able to react the most quickly? To which stimulus did you react the most slowly?
7. Write a paragraph conclusion about the resulting graph. Explain, based on the data you collected, what the results show and how the class data related to data you collected.
8. Propose a hypothesis, based on your data, which may explain the differences in reaction time among the three stimuli.
9. Discuss some of the many sources of error or inconsistency in this experiment. What would you do differently if you were to conduct this experiment again and better control for errors?
10. Optional for the mathematically inclined: The equation for the curve which converts distance on the meter stick to milliseconds of reaction time is based upon the acceleration due to gravity. This formula is: $d = .5 a t^2$ where **d** is the distance traveled in meters, **a** is the acceleration due to gravity (a constant = 9.8 meters per seconds squared) and **t** is the time in seconds. Solve this equation for t. Enter the values for g and d in your new equation and calculate t for several values of d to check the conversion curve. Watch your units carefully because your measurements are in cm and milliseconds and in the formula, **d** is in meters and time is in seconds. Did it agree? Check to see if you got

$$t = 0.452\sqrt{d} \text{ sec.}$$

Applications Write a response in your *Log*.

1. In what other ways does the body prepare itself for action? Did you feel any of these responses? (It is sometimes called the "flight or fight" response.)
2. What experiment could you design to test whether female reaction rates are faster than males? Explain how many subjects you would need, your testing procedure, the number of trials needed, and your hypothesis.
3. Optional for the experimentally inclined: Design an experiment to further test this your hypothesis in #6 above.

Casio FX 2.0 Calculator Procedures For CB 9

Calculating Average Distances

In Part A of the table, you will write each of the distances you and your partner observed for five different trials. Recall that you are measuring the distance the meter stick falls after you observe it being dropped by your partner. If any of the observed distances are extremely different from the others, you may want to repeat that trial or simply throw that result out when determining the average distance. To average the distances, you will add them all together and divide by five (or by whatever number of observed distances you totaled). When you add these distances using the FX 2.0 you can either use two separate steps or do the calculation in a single series of operations, involving parentheses. If you want to do it all at once in a single series of operations, press the grey [MENU] button and choose [1] for RUN-MAT.

- ☞ Press the left parenthesis button that is located above the [8] and [9] keys. Enter each of the recorded distances, separated by the [+] button. Once you have entered all the distances, close the expression using the right parenthesis.
- ☞ Press the [÷] key then the number of distances that you added together in the parentheses. That is, if you added 5 distances together, then divide by 5.
- ☞ Finally press [EXE] to get the average. You will use this format to find the average reaction distance for each of the different stimuli used.

Bar Graph for the Data

To construct a bar graph of the results, you must decide whether you want to compare your reaction rates for different stimuli or whether you want to compare your reaction rate with other classmates reaction rates for a particular stimuli. Press the grey [MENU] button and choose [2] STAT.

- ☞ If List1 and List2 are not clear, highlight any entry and press [F4] for DEL-A and [EXE] for Yes.
- ☞ In List1, enter consecutive numbers, enough for each item of comparison. For example, if you are comparing your own reaction rates for different stimuli, enter 1 for sound, 2 for touch, and 3 for sight. If you are comparing different students' reaction rates for a particular stimuli, enter 1 for yourself, then 2, 3, 4, ... for as many students as you are comparing.
- ☞ In List2, enter the average reaction rates you calculated for that situation. Be sure that the reaction rate entered in List2 is directly across for the correct corresponding number in List1. That is, if your reaction rate for touch (listed as 2 in List1) is 22 cm, then be sure that 22 in List2 is directly across from 2 in List1.
- ☞ Press the green button [CTRL] and [F3] for SET UP. Be sure that Stat Wind is set to Auto by pressing [F1] if necessary. Press [ESC] to return to main List screen.
- ☞ Press [F1] for GRPH then [5] for Set.
- ☞ Press [F1] for GPH1 and cursor down.
- ☞ Press [F6] for more options, then [F1] for Hist, and cursor down.
- ☞ Press [F1] for LIST and [1] for List1 in XList, then [EXE], and cursor down.

- ☞ Press [F2] for LIST and [2] for List2 in Frequency list, then [EXE], then [ESC] to return to the main List screen.
- ☞ Press [F1] for GRPH, the [1] for S-Gph1.
- ☞ Start should be [1] and pitch should be [1].
- ☞ Press [EXE]. (You may need to press [EXE] twice to activate the graph.)