Investigating the workings of the nervous system: Factors affecting reaction time.

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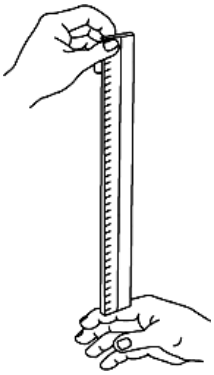
A hockey goalie has to have extremely fast reflexes to stop pucks that come flying toward the net at up to 100 mph. A goalie trying to stop a 90 mph shot taken from 30 feet away has about .22 seconds to react. Can you react that fast? In this exercise we're going to measure your reaction time and conduct some experiments to determine what factors affect reaction time.

Measuring Reaction Time.



One of the simplest ways to measure reaction time is to determine how quickly a person can grab a falling ruler. This test requires two people – one to drop the ruler and one to catch it.

Conducting the test. The test subject should sit in a comfortable position with their hand resting on the edge of a table. The thumb and forefinger should be extended and held about 2cm (approximately 1 inch) apart. The second person positions a ruler in between the extended thumb and forefinger as shown in the picture, making sure that the zero mark is aligned with the top of the subject's thumb. The stick should not be touching any part of the hand. After checking to make sure that the subject is ready, the holder waits a random time interval, and then releases the ruler. The test subject grabs the ruler, and the numeric position of the thumb is recorded.

Computing reaction time: Determine how far the stick fell before the subject was able to grab it. The laws of physics tell us how fast things fall, so we can use that information to convert the distance the stick fell into a time interval. The following formula will allow you to convert distance into time:

$$Time = \sqrt{\frac{2D}{a}}$$ where

D = distance the stick dropped (in cm.) and,
a = 980 cm/sec^2 (acceleration due to the force of gravity)

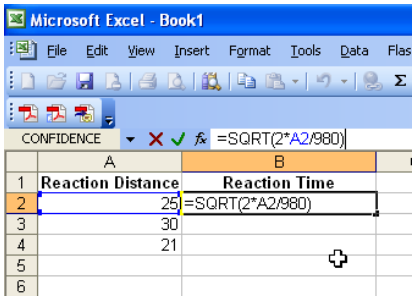
For example, if the stick dropped 40 cm, the reaction time would be calculated as the square root of 2x40/980, or .285 sec

Designing Experiments

In this exercise you are first going to measure your reaction time under normal conditions in class and then work with a partner outside of class to design a short experiment to determine how an external factor can affect reaction time.

In Class:

1. Your TA will help your class decide on a hypothesis to test. (e.g. Women have faster reaction times than men.) Then, working with a partner, you should use a ruler to determine your reaction time. Write your ruler distance (in cm.) on the board under the appropriate heading (e.g., Men or Women). Keep the list anonymous. After everyone has posted their data, work with your partner to enter those values into an Excel spreadsheet. You can then easily convert distance to time using the formula =sqrt(2D/980).



Note that after you have calculated the first reaction time, you can just copy that cell and paste it all the way down the column.

Once you have the reaction times calculated, use the Data Analysis package to run a t-test comparing the two class test groups. On a piece of paper, record:

1) the means of the test groups,
2) the t-value,
3) $t_{critical}$,
4) the p value,
5) a statement about whether your results support or refute your hypothesis.

Turn your paper in to your TA.

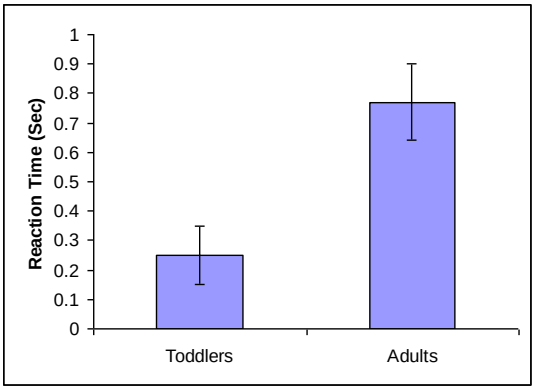
Outside of Class:

Get together with your partner and design an experiment to test the effects of some variable on reaction time. Those things most likely to affect reaction time are things that have the potential to either slow or enhance the movement of nerve signals. For example, you might consider the effects of a variable that reduces the effectiveness of the sensory receptors, or a variable that requires other parts of the brain to be active at the same time. Alternatively you might investigate differences between left and right sensors or effectors by considering the effects of eye dominance or hand dominance.

a. Construct a hypothesis that you will test. Write your hypothesis below:

b. Design the experiments necessary to test your hypothesis. You can ask as many people as you like to participate in this experiment, but should try to get at least 10 test subjects for each group, and test them each 3 times. Calculate the average reaction time for each participant and use those values for your statistical analyses.

c. Evaluate your results. After you have collected all your data, you will need to compare your control and experimental groups. Use a t-test to determine whether there is a statistically significant difference between these groups. You should also prepare a bar graph (which Excel calls a 'Column' Chart) of your results in PowerPoint . Use the figure below as a model. (*Note: error bars are optional. If you choose to add them, calculate a 95% confidence interval for each mean using the =CONFIDENCE(.05,STDEV(data range),sample size)*



d. Present your results to the class. When you have completed your analysis, you and your partner should prepare a 3 minute presentation to give to your class**.** Your presentation should include 3 PowerPoint Slides:

Slide 1. A summary of your experiment including:

A. A title
B. Your hypothesis
C. An explanation of how you tested your hypothesis
   - description of your control and treatment groups
   - the number of replicates you used

Slide 2. A graph of your results. (just copy your graph from Excel and paste it in PowerPoint

Slide 3. Show:

A. A summary of your statistical tests (show the t value and p value)
B. Your Conclusions

You should also print out this information on a piece of paper an turn it in to your TA.

This assignment is worth 10 points and will be graded according to the following rubric:

Item	Maximum Points	Your Points
Hypothesis clearly stated	1	
Experimental design appropriate to test hypothesis (at least 10 participants per group, 3 trials per participant)	2	
Bar Graph of results properly constructed and labeled. (axes labeled, no gridlines, clear background, appropriate caption)	2	
t-test properly calculated and interpreted (t-value, p value)	2	
Conclusions supported by data	1	
Class Presentation clear, understandable, and of appropriate length	2	
Total Points	10	

Extra Credit (1 pt) for error bars on graph.