

Title

Investigating Human Reaction Time

Purpose

The objective of this experiment was to measure one person's reaction time, and to determine whether the term *reaction time* has different meanings in different experimental contexts.

Introduction

In many physics experiments, it is necessary to measure the time taken between two events. An example of this would be determining the time for an object to fall through a fixed distance under gravity. In this case, the two events would be the release of the ball and its impact with the ground. If this timing is performed by an experimenter with a stopwatch, then any time difference between the releasing of the ball and starting the stopwatch will result in an error in measurement. Similarly, any difference between the time when the ball makes an impact with the ground and the stopping of the watch will produce an error.

(Some references should be mentioned here.)

Methods

A third year Computer Science project at WLU produced a program which runs on an electronic interfacing board. The board has, among other things, a group of three LEDs, an LCD display, and a pushbutton.

In this experiment, a single left-handed subject did five trials for each of the following modes of the system:

- *anticipated* mode, with a 500 millisecond delay between each step of the sequence
- *anticipated* mode, with a 250 millisecond delay between each step of the sequence

- *random* mode, where there is no sequence and all three LEDs come on after a random time delay.

In each case the experiment was performed with both the right and the left hand to see if there were any apparent differences.

(More information is needed about how the apparatus works.)

Results

The precision measure of the system is 1 millisecond. In the following tables, σ refers to the sample standard deviation of a set of trials, and α refers to the standard deviation of the mean for the trials. Since, in each case, α is larger than the precision measure, it is taken as the uncertainty for the average.

Table 1 contains data produced with the left hand of a left-handed subject. There are a few things to note from the data in Table 1. First of all, as

Time (seconds)			
Mode	Anticipated		Random
trial #	500 ms	250 ms	
1	115	82	231
2	126	60	220
3	82	-49	209
4	38	-38	242
5	60	-49	220
\bar{t}	84.2	1.2	224.4
σ	32.9	57.6	11.2
α	14.7	25.7	5.0

Table 1: Data for the Left Hand

expected, the average time delay for the random trial is longer than the average delay time for either anticipated situation. The difference is statistically significant in both cases.

$$\begin{aligned} \text{Arithmetic mean} &= \bar{x} = \frac{\sum_{i=1}^n x_i}{n} \\ &= \frac{x_1 + x_2 + \dots + x_n}{n} \end{aligned}$$

$$\text{Standard Deviation} = \sigma = \sqrt{\frac{\sum_{i=1}^n (x_i - \bar{x})^2}{n - 1}} = \frac{1}{\sqrt{n - 1}} \sqrt{\sum_{i=1}^n x_i^2 - \frac{(\sum_{i=1}^n x_i)^2}{n}}$$

$$\text{Standard deviation of the mean} = \alpha = \frac{\sigma}{\sqrt{n}}$$

(Sample calculations should go here.)

Table 2 contains data produced with the right hand of the same left-handed subject. In each case, all five trials for the same mode were performed for the left hand first, and then for the right hand. The trials for the different modes were performed in the order of the table columns; ie. anticipated with 500 millisecond delay was first, anticipated with 250 millisecond delay was next, and random was last.

Time (seconds)			
Mode	Anticipated		Random
trial #	500 ms	250 ms	
1	-5	38	231
2	93	-93	220
3	126	38	99
4	93	93	198
5	60	-5	220
\bar{t}	73.4	14.2	193.6
σ	44.4	62.0	48.5
α	19.9	27.7	21.7

Table 2: Data for the Right Hand

Comparing these results to those in Table 1, again the average time delay for the random trial is longer than the average delay time for either anticipated situation. The difference is statistically significant in both cases. It should be pointed out that the differences between both hands are not statistically significant for any of the three modes.

One unexpected result is that the anticipated sequence gave an average equal to zero, within experimental uncertainty, for both hands *when the sequence delay was 250 milliseconds*. It would seem that the shorter delay in the sequence makes the anticipation more precise.

Discussion of Uncertainties

Because this experiment is trying to measure how quickly a subject responds to a stimulus, then any delay in a person's response due to factors like unfamiliarity with the equipment will obscure the effects we wish to observe. Since only five trials were taken in each case, it is quite possible that the results which would have been observed after many repetitions would be somewhat different.

The small sample size is another factor which must be considered.
(What else should I mention?.)

Conclusions

The average delay time for the left hand with an anticipated sequence and a 500 millisecond sequence delay was 84 ± 15 ms, while for the right hand it was 73 ± 20 ms. These values agree within experimental error. With a sequence delay of 250 milliseconds, the results were 1 ± 26 and 14 ± 28 for the left and right hands, respectively. Both of these equal zero within experimental error.

The delay time for a random event was found to be 224 ± 5 for the left hand and 194 ± 22 for the right. These do not agree within experimental error.

Since the reaction times for the three different modes (anticipated with different sequence delays and random) were not the same within experimental uncertainty, then the term "reaction time" must be understood in a specific context.

References

(Articles mentioned earlier should be here.)