

Carleton University

Laboratory Report

Course #: PHYS 1003

Experiment #: 1

Reaction Time

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Lab Period: Friday PM, A5

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Purpose: In this experiment we are going to determine the visual and auditory reaction time by measuring the time between visual and auditory stimulation and the reaction.

Theory: Reaction time is the time interval between external stimulation and the time it takes to complete a reaction. In this experiment that specific time interval is measured and recorded.

$$t_{av} = \sum \frac{t_i}{N}$$

$$t_{av} = \frac{t_{auditory} + t_{visual}}{2}$$

$$\sigma_{sd} = \sqrt{\frac{1}{N-1} \sum (t_i - t_{av})^2}$$

$$\sigma_{mean} = \frac{\sigma_{sd}}{\sqrt{N}}$$

$$\Delta = |t_{av,vis} - t_{av,aud}|$$

$$\sigma_{\Delta} = \sqrt{(\sigma_{mean,vis})^2 + (\sigma_{mean,aud})^2}$$

$$\frac{\Delta}{\sigma_{\Delta}} = \frac{|t_{av,vis} - t_{av,aud}|}{\sigma_{\Delta}}$$

Apparatus: The apparatus for this experiment is very straightforward. The clock will start when the remote trigger switch is activated. The switch can be activated with or without a sound. There is also a second switch that will allow the clock to be stopped. The clock was made by SW for the University of Carleton Physics Department. It reads to two decimal places, and has an error of ± 0.02 seconds. The data collected was recorded and processed using Logger Pro Software.

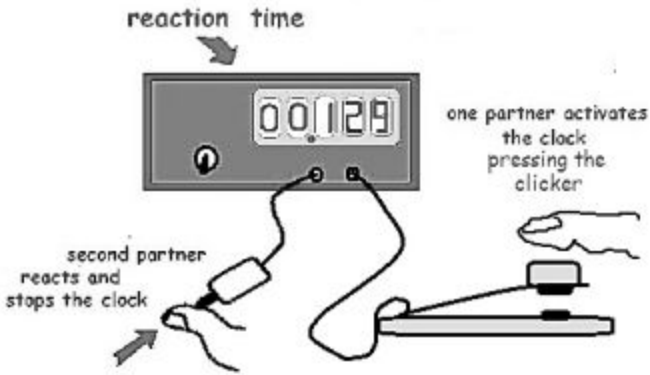


Figure 1: Reaction Time Apparatus.

Observations:

Please refer to Chart 1. and Chart 2. For raw experimental data.

Table 1. Condensed Calculations

	Average time (s)	Standard deviation (s)	Number of samples, N	Standard deviation of the mean	Percent of data in $t_{av} \pm \sigma_{sd}$ (%)
Visual	0.2000	0.04503	30	0.00822	48
Auditory	0.1890	0.04161	29	0.00773	60

Calculations

Visual:

$$\sigma_{mean} = \frac{\sigma_{sd}}{\sqrt{N}}$$

$$\sigma_{mean} = \frac{0.04503}{\sqrt{30}}$$

$$\sigma_{mean} = 0.00822 \text{ s}$$

$$\sigma_{mean} = 8.22 * 10^{-3} \text{ s}$$

$$data \varepsilon (t_{av} \pm \sigma_{sd}) = \frac{14}{29} * 100$$

$$data \varepsilon (t_{av} \pm \sigma_{sd}) = 48$$

Auditory:

$$\sigma_{mean} = \frac{\sigma_{sd}}{\sqrt{N}}$$

$$\sigma_{mean} = \frac{0.04161}{\sqrt{29}}$$

$$\sigma_{mean} = 0.00773 \text{ s}$$

$$\sigma_{mean} = 7.73 * 10^{-3} \text{ s}$$

$$data \varepsilon (t_{av} \pm \sigma_{sd}) = \frac{18}{30} * 100$$

$$data \varepsilon (t_{av} \pm \sigma_{sd}) = 60$$

Comparison;

$$\Delta = |t_{av,vis} - t_{av,aud}|$$

$$\Delta = |0.2000 - 0.1890|$$

$$\Delta = 0.11$$

$$\sigma\Delta = \sqrt{(\sigma_{mean,vis})^2 + (\sigma_{mean,aud})^2}$$

$$\sigma\Delta = \sqrt{(0.00773)^2 + (0.00822)^2}$$

$$\sigma\Delta = 0.011$$

$$\frac{\Delta}{\sigma\Delta} = \frac{|t_{av,vis} - t_{av,aud}|}{\sigma\sqrt{(\sigma_{mean,vis})^2 + (\sigma_{mean,aud})^2}}$$

$$\frac{\Delta}{\sigma\Delta} = \frac{0.11}{0.011}$$

$$\frac{\Delta}{\sigma\Delta} = 9.09$$

$9.09 \geq 2$, data is inconsistent

Average reaction and its uncertainty:

$$t_{av} = \frac{t_{av,aud} + t_{av,vis}}{2}$$

$$t_{av} = \frac{0.389}{2} = 0.1945 \text{ s}$$

$$\sigma_{t_{av}} = \frac{|t_{av,aud} - t_{av,vis}| + (\sigma_{t_{aud}} + \sigma_{t_{vis}})}{2} = \frac{0.02695}{2} = 0.013$$

Discussion:

In this experiment we derived our average reaction time by finding our reaction times to auditory and visual stimuli. I did not expect both reaction times to be statistically consistent because the auditory reaction time was sometimes hindered by the abundance of noise in the room meanwhile the visual reaction time had less impeding factors. Nevertheless I was surprised to see how the auditory reaction time was still less than the visual one.

The statistical error is smaller than the reading error on the clock (0.02 s) so it would help us gather more specific data as well as improve our calculations. However we can just increase the number of trials to get more accurate and precise results. The cost of a precise clock is not worth the money when more trials could be added to the experiment.

A good example of reaction time is when somebody's phone slips out of their hands and they have a limited amount of time to catch it before it hits the ground and breaks. In this situation your reaction time is crucial. This is why, to prevent people from having to rely on their reaction time, people buy sturdy phone cases.

It takes time for us to react to stimulation because as it is happening, our body needs time to process and register the information that it is receiving before reacting. The brain sends signals to our muscles and various other parts of our bodies that are required for the specific reaction.

A driver needs a reaction time of 0.2 seconds before applying the brakes after seeing the need for it. However circumstances such as stress, sickness and age could slow that down to 0.8 seconds. In a situation that could be potentially dangerous, every tenth of a second counts. (source 1. <https://www.howacarworks.com/advanced-driving/reaction-times>)