Effects of Visual and Auditory Response Times in Males and Females by using Tactile and Mouse on Web Based Environment

Muhammad Suhaiib

Abstract: The purpose of this research work is to find out whether one of visual response time or auditory response time is faster than another on web based environment. Simple reaction time can be strong when an individual is asked to press a button as soon as a light or sound appears. A tool for capturing response times is created. This tool is a web application www.responsetime.muhammadssuhaib.com that runs on server and can be accessed through internet. R is commonly used in countless scientific disciplines for statistical analysis. Collected data will be analyzed by using R. It is concluded that on web based environment visual response times are not different than auditory response time. The data are also classified by gender to compare male response time and female response time, data analyzed based on gender, on visual stimuli, male react faster than female. However, on auditory stimuli, there is no difference between male and female. 

Keywords: Response Time, Visual Stimuli, Auditory Stimuli, Web Based Environment, Visual and Audio Response

I. INTRODUCTION

Human Response Time works by a nervous system acknowledge the stimulus. The neurons then communicate the message to the brain. The message then journeys from the brain to the spinal cord, which then arrived person’s hands and fingers. The motor neurons then communicate the fingers and hands how to react. Reaction time (RT) constrained by the rate of signal broadcast and it’s a measure of the response to a stimulus. Response Time plays a very significant role in our lives as its practical implications may be of great consequences. Obviously there are some important factors that can affect the average human Reaction Time include left and right hand, age vision, fasting fatigue exercise personality types and intelligence as well. Assumptions about intelligence managing drawn from RT are frequently made with consideration of assignment tentative design, boundaries in measurement skills and mathematical modeling, relationship amid reaction time and Intelligence quotient (IQ) marks includes a significant part of theoretical information processing approaches.

II. LITRATURE REVIEW

Reaction time (RT) is the elapsed time between the presentation of a sensory stimulus and the subsequent behavioral response. In psychometric psychology it is considered to be an index of speed of processing. [1] Human

III. SHAPIRO-WILK TEST

The Shapiro-Wilk test, proposed in 1965, The Shapiro-Wilk test is a test for usual spreading displaying high power, leading to decent results even with a little number of observations. In difference to other assessment tests the Shapiro-Wilk is only appropriate to check for normality.

![Figure 1. Shapiro-Wilk Tailed Test (Source Shapiro-Wilk)](source)

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The fundamental idea behind the Shapiro-Wilk test is to estimation the inconsistency of the sample in two ways: First is the regression line in the QQ Plot allows to approximation the inconsistency, and Second is the inconsistency of the sample can also be observed as an estimator of the people variance. Both can assess values must almost equal in the case of a normal distribution and would result in a quotient of close to 1. If the quotient is significantly lower than 1 afterward the null hypothesis must be rejected.

IV. TACTILE DEVICES

Tactile devices transport sensations like vibration, pressure, heat, motion and static electricity to the fingertips of their users. Typically, there is no physical response when pressing a button shown on the touchscreen of a smartphone making it difficult for the user to determine whether their input has been registered by the device.

This problem can be solved by the use of tactile devices that recreate the feeling of pressing an actual button by making the screen vibrate when pressed. Furthermore, by changing the way that the vibration is transferred to the user depending on which area of the screen is pressed it becomes possible for the user to distinguish between multiple buttons displayed on the same screen. Tactile texture is the real thing. It is the actual way a surface feels when it is felt or touched, such as rough, smooth, soft, hard, silky, slimy and sticky. Furthermore, methods of producing complex and distinct touch sensations through different ways of vibration are currently also being researched.

Figure 2. Tactile Actual and Smooth Surface

The sensation of pressing a physical button can be simulated by tactile devices. With the latest technology, more advanced sensations, such as the feeling of clicking or the feeling of a rough surface, can be realized as well.

V. METHODOLOGY

A tool for capturing response times is created. This tool is a web application that runs on server and can be accessed through internet.

The speed of our responses play a large part in our everyday life. Immediate reaction times can make big reward, for example, like saving a blistering soccer ball from entering the goal. Slow reaction times may come with consequences. User can record their visual and auditory response time by doing simple test online. The advantages are user can access it whenever and wherever they want. Secondly, we can get massive data from user around the world. However, this approach has many disadvantages.

First, the web application architecture divides the processes into 2 main part, server side and client side. It needs time for server to communicate with client or browser, and vice versa. Another disadvantage is that the client side environment cannot be predicted, especially their browser technology. To deal with this situation, in order to minimize the disadvantages, all processes related to the response time’s test are run in client side.

This will ensure the precise calculation of response time. In trade off, user environment should have been adopting the latest web technology to run the test properly. In the test, to get the visual response time, users have to click a colored shape as fast as the shape appears. The response time is calculated from the beginning of shape drawn on screen to the time user click the shape. This action will be repeated 5 times and then the average of the response times calculated. The delay time from one shape to another is randomized so users cannot predict when the shape appears. On auditory response time, the procedure of test is practically the same. Users need to measure their response time 5 iterations and the delay time from one sound to another is also randomized.
Figure 5. Flowchart of Visual and Auditory Test

Collected data will be analyzed using R. R is a free software environment for statistical computing and graphics. It compiles and runs on a wide variety of UNIX platforms, Windows and Mac OS. [3]

VI. DATA AND ANALYSIS

Data is collected after inviting participants 19 male and 15 female students physically normal, without any hearing or visual disorder in the age group 17-34 years were studied in Tokyo, Japan.

<table>
<thead>
<tr>
<th>No</th>
<th>Gender</th>
<th>Device</th>
<th>Visual RT (s)</th>
<th>Auditory RT (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>male</td>
<td>tactile</td>
<td>0.672</td>
<td>0.753</td>
</tr>
<tr>
<td>2</td>
<td>male</td>
<td>mouse</td>
<td>0.708</td>
<td>0.534</td>
</tr>
<tr>
<td>3</td>
<td>male</td>
<td>tactile</td>
<td>0.623</td>
<td>0.592</td>
</tr>
<tr>
<td>4</td>
<td>female</td>
<td>tactile</td>
<td>0.828</td>
<td>1.138</td>
</tr>
<tr>
<td>5</td>
<td>male</td>
<td>mouse</td>
<td>0.502</td>
<td>0.35</td>
</tr>
<tr>
<td>6</td>
<td>male</td>
<td>tactile</td>
<td>0.709</td>
<td>1.956</td>
</tr>
<tr>
<td>7</td>
<td>male</td>
<td>mouse</td>
<td>0.795</td>
<td>0.979</td>
</tr>
<tr>
<td>8</td>
<td>male</td>
<td>tactile</td>
<td>0.964</td>
<td>4.616</td>
</tr>
<tr>
<td>9</td>
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<td>tactile</td>
<td>2.839</td>
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</tr>
<tr>
<td>10</td>
<td>male</td>
<td>tactile</td>
<td>0.783</td>
<td>2.185</td>
</tr>
<tr>
<td>11</td>
<td>female</td>
<td>mouse</td>
<td>0.527</td>
<td>0.595</td>
</tr>
<tr>
<td>12</td>
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<td>tactile</td>
<td>0.769</td>
<td>3.515</td>
</tr>
<tr>
<td>13</td>
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<td>tactile</td>
<td>0.858</td>
<td>0.808</td>
</tr>
<tr>
<td>14</td>
<td>female</td>
<td>tactile</td>
<td>0.535</td>
<td>0.524</td>
</tr>
</tbody>
</table>

Users are more preferred using mouse on computer to do the test rather than using smart phone or pad. Mouse is used by 19 users, while users using tactile are 15.

Figure 6. Device used on test

For better understanding of characteristics of the data, a test for normal distribution is needed. First, excluding the gender, visual response time and auditory response time will be analyzed in order to determine are they normally distributed or not. To do this, density, quantile-quantile test and Shapiro-Wilk normality test are applied. Kernel density plots are usually a much more effective way to view the distribution of a variable.
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[4] The quantile-quantile (q-q) plot is a graphical technique for determining if two data sets come from populations with a common distribution. [5] The Shapiro–Wilk test utilizes the null hypothesis principle to check whether a sample x1, ..., xn came from a normally distributed population. [6]

Here is the result of distribution of visual response time.

![Figure 7. Visual RT data density](image)

**Figure 7. Visual RT data density**

![Figure 8. Visual RT data QQ Normal Plot](image)

**Figure 8. Visual RT data QQ Normal Plot**

Shapiro-Wilk normality test on Visual RT data produce the value of W = 0.60518 and p-value = 2.288e-08.

Regarding the fact of density plot, quantile-quantile normal plot and the result of Shapiro-Wilk test, Visual RT data is not normally distributed.

Moving on to auditory response time data. Here is the result.

![Figure 9. Auditory RT data density](image)

**Figure 9. Auditory RT data density**

![Figure 10. Auditory RT data QQ Normal Plot](image)

**Figure 10. Auditory RT data QQ Normal Plot**

Shapiro-Wilk normality test on Auditory RT data produce the value of W = 0.6684 and p-value = 1.668e-07.

From above 3 (three) facts, it can be said that Auditory RT data is not normally distributed.

To compare this 2 (two) non-normal distributed data, non-parametric analysis is used. Non parametric analysis use no assumptions whether distribution normal or not so it is suitable to be applied in this case.

Method used to compare Visual RT and Auditory RT is Wilcoxon Signed Rank test. The Wilcoxon signed-rank test is a non-parametric statistical hypothesis test used when comparing two related samples, matched samples, or repeated measurements on a single sample to assess whether their population mean ranks differ. [7]

Before analyzing data using Wilcoxon Signed Rank test, it is better to look into the box plot of the data. Box plot provide basic information about a distribution. Box plots are good at portraying extreme values and are especially good at showing differences between distributions. [8]
Before conducting the two-sided nonparametric test using the "Wilcoxon Test" command in R, Null Hypothesis need to be determined first. For this case, null hypothesis is that the median of visual response time is not different with median of auditory response time.

Shapiro-Wilk normality test on male visual response time data produce the value of $W = 0.95413$ and $p$-value $= 0.4631$. Based on previous result of Wilcoxon Signed Rank test on R, p-value is bigger than 0.05, so the null hypothesis cannot be rejected.

Next analysis is dividing data through gender. So, data is also checked for its distribution.
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Shapiro-Wilk normality test on male auditory response time data produce the value of $W = 0.64855$ and $p$-value = 1.44e-05.

Based on density of data, Quantile-Quantile Normal Plot and the result of Shapiro-Wilk normality test, above data are said to be non-normal distribution data.

Comparing the male visual RT and female visual RT, Mann-Whitney U test is used. Mann-Whitney U test is a non-parametric method appropriate for examining the difference in Median for 2 independent populations. Null hypothesis is determined as there is no difference between male visual response time and female visual response time.

The result says that there is enough evidence to say that male visual response time is different than female response time. With mean of male visual response time is 0.6744211 and mean of female visual response time is 1.0478, it can be said that on the case of visual stimuli, male response faster than female.

Comparing male auditory RT and female auditory RT with null hypothesis stated as there is no difference between male auditory response time and female auditory response time.

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Comparing male auditory RT and female auditory RT with null hypothesis stated as there is no difference between male auditory response time and female auditory response time.
Figure 22. Mann-Whitney U test result on male visual and female visual

From the result above, with p-value bigger than 0.05, there is no enough evidence to reject the null hypothesis.

CONCLUSION

Several studies have determined that the mean auditory reaction time is faster than the mean visual reaction time. This means you will react quicker to a sound than you would a light. The small explanation is that sound takes less time to reach the brain than does visual information. Several other studies have concluded that men have faster auditory reaction times than women. The precise reason is unknown, but supposing has been made that the reaction time is influenced by different cognitive strategies employed by females. From data and analysis above, it can be concluded that on web based environment visual response times are not different than auditory response time. But if the data analyzed based on gender, on visual stimuli, male react faster than female. However, on auditory stimuli, there is no different between male and female.

VII. FUTURE WORKS

Creating tool for measure response time on web based environment is a hard work. Still, some elements of this web application need to be perfected. Technologies used by this application are state of the arts to ensure the precise of measurements but in trade off with the compatibility of old browser. It is needed to find how to measure response time accurately but still compatible and work like a charm in all browser. Device category in this research is used to inform about the percentage of the usage only. It can be improved to explore whether using particular device can give different response time or not.

ACKNOWLEDGMENT

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