Test a Perceptual Phenomenon

20-01-2019

Jonathan Mascarenhas

Overview

In psychology, the **Stroop effect** is a demonstration of interference in the reaction time of a task.

When the name of a color (e.g., "blue", "green", or "red") is printed in a color which is not denoted by the name (i.e., the word "red" printed in blue ink instead of red ink), naming the color of the word takes longer and is more prone to errors than when the color of the ink matches the name of the color.

The effect is named after John Ridley Stroop, who first published the effect in English in 1935.[1]The effect had previously been published in Germany in 1929 by other authors.

 The original paper has been one of the most cited papers in the history of experimental psychology, leading to more than 700 replications.[4] The effect has been used to create a psychological test (**Stroop test**) that is widely used in clinical practice and investigation.

Goals

In this project, we will compare the reaction times for a

1) Congruent Dataset - a set of reaction times for which the word is the same as the colour with which the word is printed.

   Example :- **Blue Red Green Yellow**

2) Incongruent Dataset :- a set of reaction times for which the word is not the same as the colour with which the word has been printed.

   Example :- **Blue Red Green Yellow**

Experimental Results

Q1) What are the dependent and independent variables in the experiment ?

Answer :-

In both cases, the independent variables are the colours which must be assessed by the individual who is recording his/her reaction times for the Stroop Effect experiment. The dependent variable is the reaction time of the individual.

Q2)

[a] What are the null and alternative hypotheses formed from this experiment?

Answer :-

Let u(mu1) be the reaction time for the congruent dataset

Let u(mu2) be the reaction time for the incongruent dataset

A Null Hypotheses N(0) would indicate that the reaction times for a congruent dataset and an incongruent dataset are equal to or fairly close to each other.

For N(0),

u(mu1) = u(mu2)   or   u(mu1) ~= u(mu2)   where ~= represents almost equal to

However, an Alternative Hypotheses H(0) suggests that the reaction time for an incongruent dataset is greater than that for a congruent dataset.

For H(0),

T2 > T1   where > represents a greater than symbol

(b) A statistical test is proposed which will distinguish the proposed hypotheses. Any assumptions made by the statistical test are addressed.

Answer:-

A t - test will be performed to distinguish the proposed hypotheses. The critical value for the test will be alpha = 0.05.

Assumptions:-

A one tailed t -test will be used in the forward direction(greater reaction times) since my hypotheses is that the reaction time of the incongruent dataset is greater.

I used a t - test over a z score since we do not know the standard deviation of the population and the sample size is less than 30.

Q3: Descriptive statistics, including at least one measure of centrality and one measure of variability, have been computed for the dataset's groups.

Answer:-

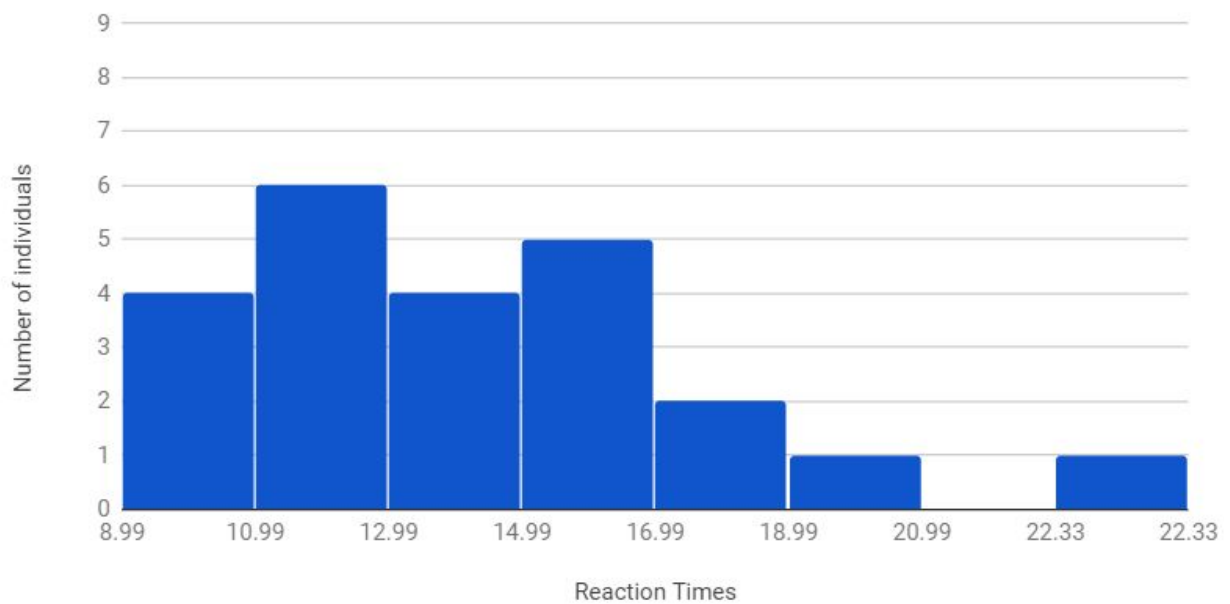The Mean Reaction Time for a congruent dataset is 14.05 seconds.

The Mean Reaction Time for an incongruent dataset is 22.015 seconds.

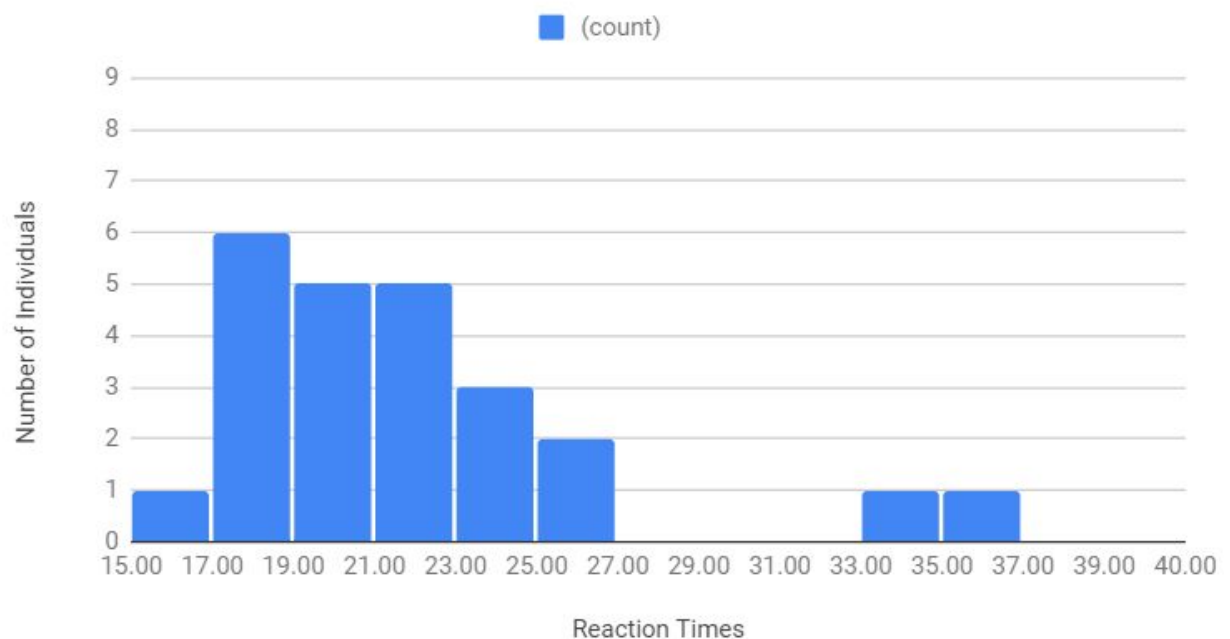The Standard Deviation for a congruent dataset is 3.4844 seconds.

The Standard Deviation for an incongruent dataset is 4.696 seconds.

Q4: One or two visualizations have been created that show off the data, including comments on what can be observed in the plot or plots.
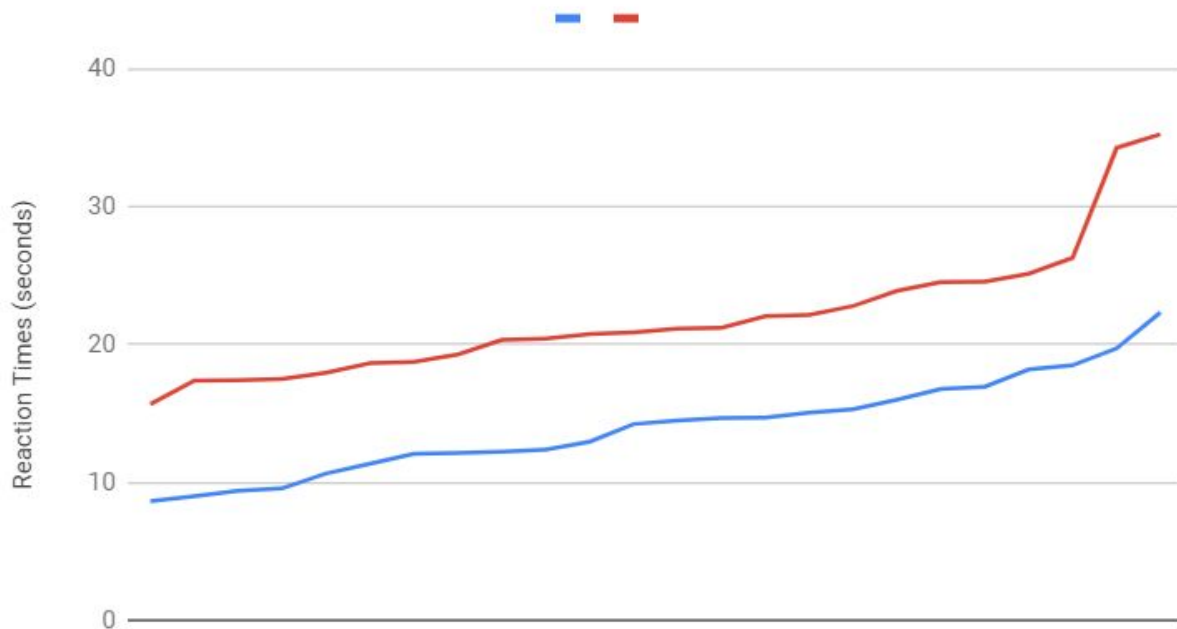

Congruent Dataset Reaction Times

Incongruent Dataset Reaction Times

It can be reasonably inferred from the above plots that the average reaction times for an Incongruent Dataset are greater than the average reaction times for a Congruent Dataset.

A better illustration of the difference between the reaction times T1 and T2 is given below.

Plot for Reaction TImes T1 and T2

The blue line is the plot for the reaction time of a congruent dataset.

The red line is the plot for the reaction time of an incongruent dataset.

Q5) A statistical test has been correctly performed and reported, including test statistic, p-value, and test result. The test results are interpreted in terms of the experimental task performed

Answer:-

The t-test

t = 6.67 for df = 23 (Degrees of Freedom which equals n-1)

The above t - statistic is significant for p < 0.0001 (Hence the result is obviously extremely significant at a p-value < 0.05).

This gives us another reason to reject the Null Hypotheses N(0) and accept the Alternative Hypotheses H(0).

Q6: Hypotheses regarding the reasons for the effect observed are presented. An extension or related experiment to the performed Stroop task is provided, that may produce similar effects.

Answer:-

The time taken to respond to an incongruent dataset is due to the mismatch of the colours and the words. Due to this mismatch, there will be additional time required to analyze the words in the incongruent dataset and this results in the difference between the two datasets.

Another experiment which could possible yield similar results as the stroop effect did is an

A to Z test.

For the first dataset, participants will be asked to say the alphabets in the regular sequence and the time must be recorded.

For the second dataset, participants will be asked to say the alphabets going backwards while looking at them.

My Null Hypotheses would be that the participants would take the same amount of time for both tests.

My Alternative Hypotheses would be that the participants would take different amounts of time for both tests.l

Note :- The idea for such and experiment and its hypotheses were formed by myself without any references.

References :

https://en.wikipedia.org/wiki/Stroop_effect

https://www.graphpad.com/quickcalcs/pValue2/

https://www.statisticshowto.datasciencecentral.com/probability-and-statistics/hypothesis-testing/t-score-vs-z-score/

Khan Academy AP Statistics