

DAND Stroop Project

The Stroop Effect was developed by John Ridley Stroop. In the Stroop study, subjects are shown a list of words, each in a different color of ink. This study is measured in two ways. In the first measurement(condition), the subjects are first given a list where the color of the word matches the word. The second measurement(condition) differs in that the color of ink and the word do not match.

The independent variable in the study is the color/word association. The dependent variable is time in seconds it takes the subject to speak the proper word.

In this study, we are predicting(hypothesis) how the population would respond to the test based on our results of the 24 subjects(sample) in this study. Because the subjects are the same for the two tests, a paired sample (dependent) t-test will be performed. We use a t-test because our population Standard Deviation is not known, and our sample size is less than 30.

The hypothesis for this test is expressed as thus:

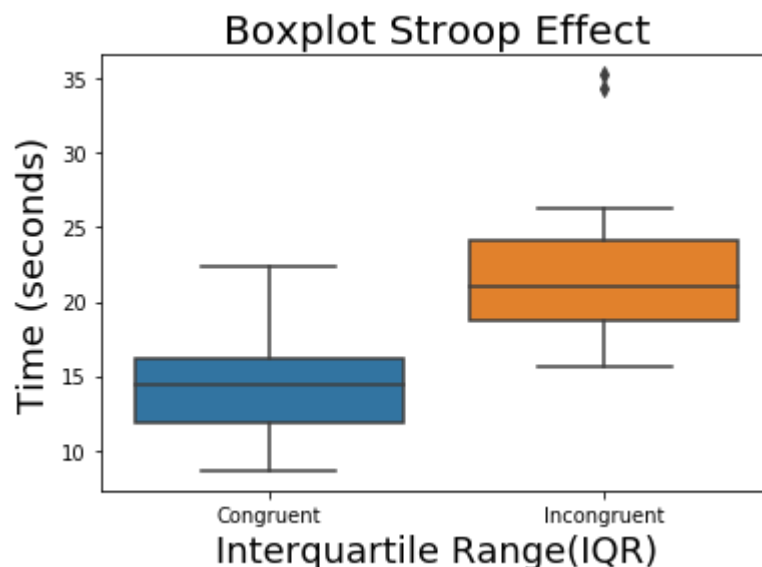
$$H_0 : \mu_c = \mu_i$$

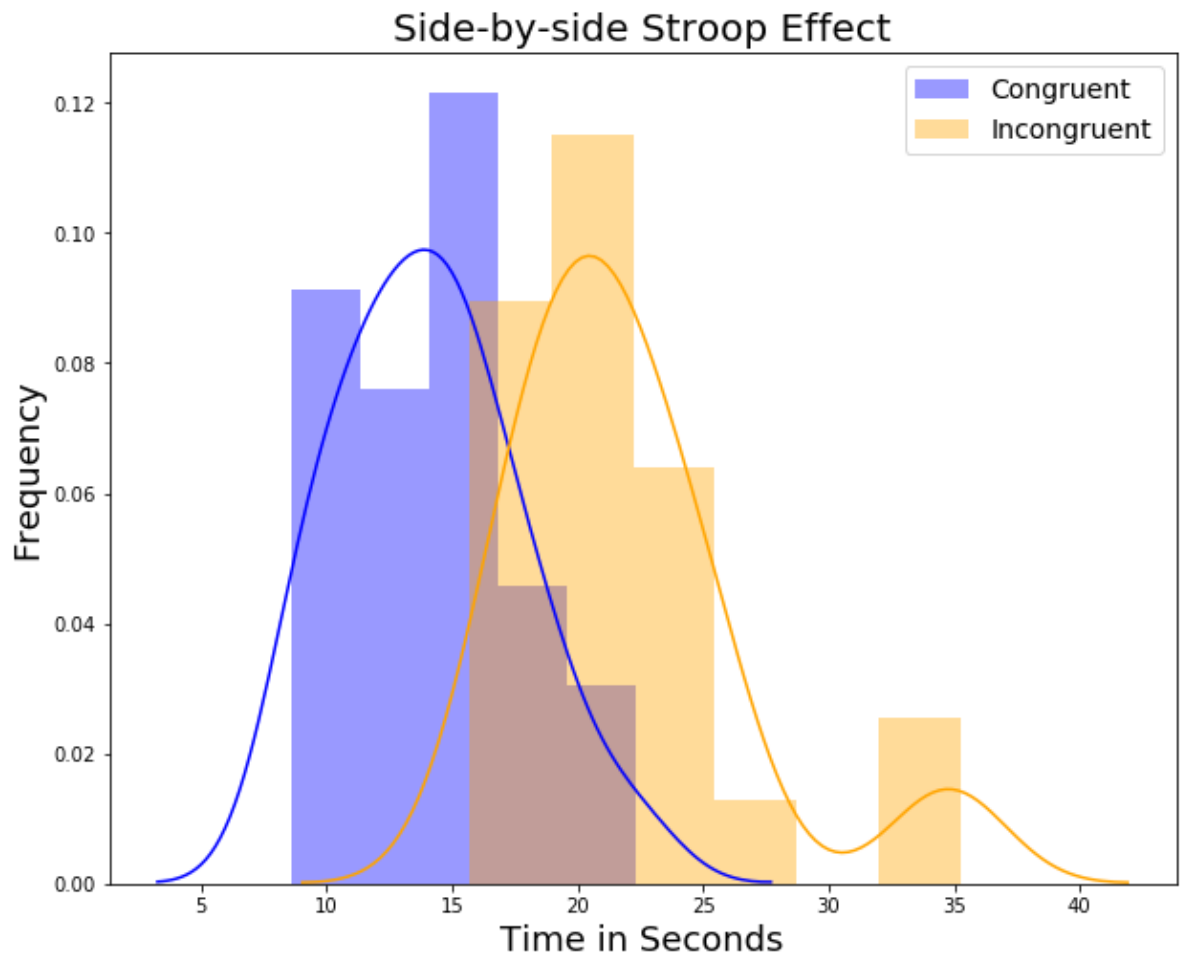
$$H_A : \mu_i > \mu_c$$

μ_c = word congruency

μ_i = word incongruency

The null hypothesis states that the congruent(μ_c) times and the incongruent(μ_i) times will remain the same for the Stroop test. The alternative hypothesis states that the times for the incongruent test will be greater than the congruent times.





	Congruent	Incongruent
count	24.000000	24.000000
mean	14.051125	22.015917
std	3.559358	4.797057
min	8.630000	15.687000
25%	11.895250	18.716750
50%	14.356500	21.017500
75%	16.200750	24.051500
max	22.328000	35.255000

In the histograms above, we can clearly see a shift in the time taken between the congruent list and the incongruent list. The subjects average time(mean) to speak the word is 14.05 seconds for the congruent list. While the average time(mean) to speak the incongruent word is 22.02 seconds. The apex of each histogram shows the middle(median) response times to be 14.36 for congruent and 21.02 for incongruent. The mode, or most common value, is a bit trickier to determine. Because the test calculates the results down to the thousandth of a second, each value is unique and therefore each is the mode. If we reduce the data to whole numbers we see that the mode for congruent returns a range of values (12, 15). The results for incongruent values show 21 as the most common.

Median
Congruent 14.3565
Incongruent 21.0175

Mode
Congruent
0 12.0
1 15.0
dtype: float64

Incongruent
0 21.0
dtype: float64

Unrounded Mode Results

	Congruent	Incongruent
0	8.630	15.687
1	8.987	17.394
2	9.401	17.425
3	9.564	17.510
4	10.639	17.960
5	11.344	18.644
6	12.079	18.741
7	12.130	19.278
8	12.238	20.330
9	12.369	20.429
10	12.944	20.762
11	14.233	20.878
12	14.480	21.157
13	14.669	21.214
14	14.692	22.058
15	15.073	22.158
16	15.298	22.803
17	16.004	23.894
18	16.791	24.524
19	16.929	24.572
20	18.200	25.139
21	18.495	26.282
22	19.710	34.288
23	22.328	35.255

The results of the boxplot and histogram support the use of a one-tailed test. Their results suggest that the null hypothesis may be rejected. This one-tailed t-test will be a dependent test because both samples use the same population and each result is directly related to the other.

Results

t(23) = 8.04, p < .025, one-tailed. At $\alpha = .05$ and a Confidence Interval on the mean difference(7.97); 95% CI = (5.92, 10.01).

The p-value is significantly smaller than our alpha level at a 95% Confidence Interval which indicates that we should reject the null hypothesis in favor of the alternative hypothesis. This is further supported by the **r²** value which shows a very strong correlation at 74%.

$$r^2 = \frac{t^2}{t^2 + df} = .74$$

$$\mathbf{t\text{-}statistic} = 8.04$$

$$\mathbf{T\text{-}critical} = 1.174$$

$$\mathbf{n} = \mu = 24$$

$$\mathbf{df} = n - 1 = 23$$

$$\mathbf{sd} = \sqrt{\frac{\sum d^2 - \frac{\sum(d)^2}{n}}{n-1}} = 4.86$$

$$\mathbf{Standard\ Error\ of\ Differences} = \frac{sd}{\sqrt{n}} = 0.99$$

The mean difference is calculated by taking sum of the difference between the congruent(μ_c) and incongruent(μ_i) datasets divided **n**. This further supports a rejection of the null hypothesis and indicates that there is a significant increase in the response time of the subject with the incongruent test.

$$\mathbf{Mean\ difference\ }(\bar{x}) = \frac{\sum(\mu_i - \mu_c)}{n} = 7.97$$

Conclusions

The resultant data clearly shows that once the treatment effect was applied, the subject's reaction time significantly increased. Therefore, I reject the null hypothesis in favor of the alternative hypothesis. The results were not at all unexpected. When we challenge our brains to process information in new ways there is a significant learning curve to overcome to become proficient. The Stroop Effect t-test results clearly support this.

Sources

[Stroop Effect \(https://en.wikipedia.org/wiki/Stroop_effect\)](https://en.wikipedia.org/wiki/Stroop_effect)

[Testing a Hypothesis for Dependent and Independent Samples \(https://www.ck12.org/book/CK-12-Probability-and-Statistics-Advanced-Second-Edition/section/8.5/\)](https://www.ck12.org/book/CK-12-Probability-and-Statistics-Advanced-Second-Edition/section/8.5/)

[Code Visibility \(http://chris-said.io/2016/02/13/how-to-make-polished-jupyter-presentations-with-optional-code-visibility/\)](http://chris-said.io/2016/02/13/how-to-make-polished-jupyter-presentations-with-optional-code-visibility/)