Stroop Test

The Stroop test is a psychological test that measures the effect of cognitive interference on decision-making. Participants read out loud the color of ink in which a series of words that name colors are printed. In the first series, the words and ink color are congruent, that is to say that the word matches the ink color (e.g., RED). In the second series, the words and ink color are non-congruent; the word does not match the color of the ink (e.g., GREEN). In the previous example, the participant would have to say "blue," the color of the ink, instead of "green," the word. The time that it takes for participants to read each set of words is recorded.

In the experiment, the independent variable is the congruence of the set of words. The dependent variable is the time that it takes participants to read the words.

A reasonable hypothesis is that a population of people will take longer to read the non-congruent words than the congruent ones, because the difference between the word's meaning and its color creates a conflict between two processes of the brain, which takes extra time for the brain to resolve in order to say the correct word.[1]

The null hypothesis is that congruence has no effect on reading time, with the alternative hypothesis being that non-congruence lengthens reading time. Mathematically, this can be represented as:

$$H_0: \mu_C = \mu_{NC}$$
$$H_1: \mu_C < \mu_{NC}$$

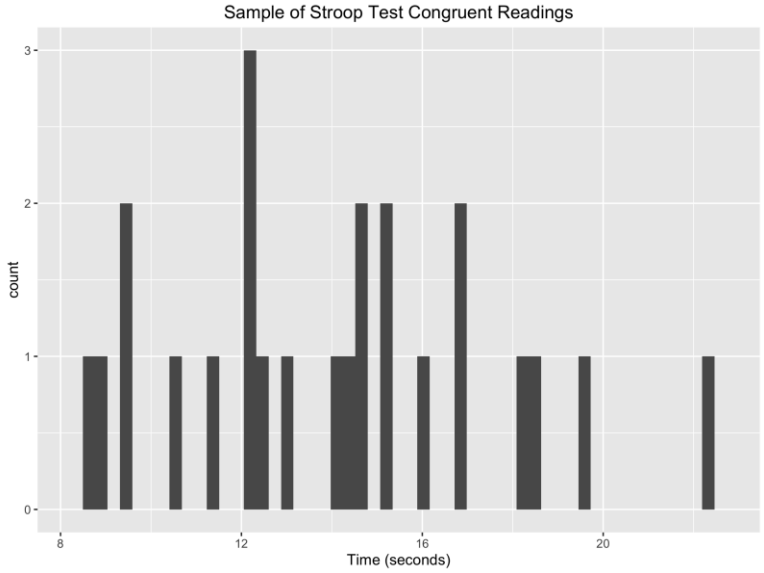
with μ_c being the mean reading time for the congruent words and μ_{NC} being the reading time for non-congruent words.

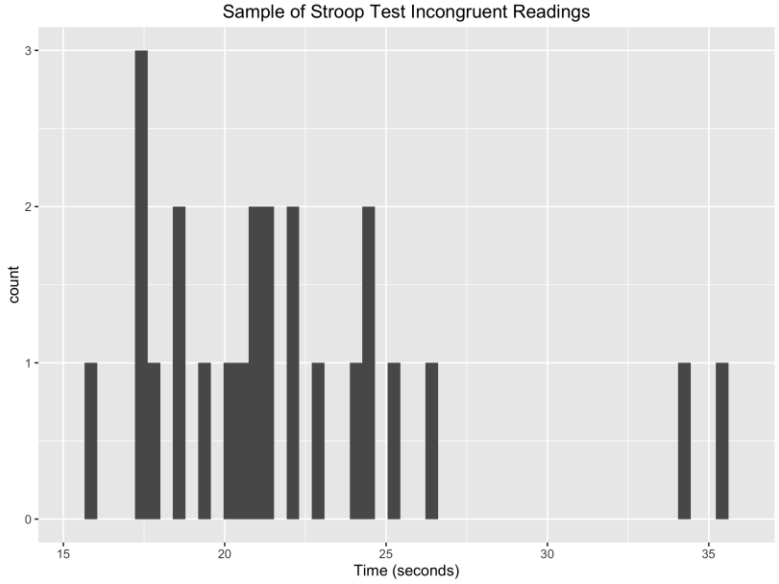
The hypotheses were tested using a one-sample, one-tailed t-test at $\alpha = .05$ and 23 degrees of freedom. The t-test is best one to use to test the alternative hypothesis that states that non-congruence leads to an increase in reading time because we do not know the population standard deviation, a necessary condition for a z-test, and because our sample size is less than 30, meaning that the t-distribution will not be as good of an approximation of the z-distribution. A one-sample t-test instead of a two-sample t-test is used because we are comparing the effects of a certain change (congruence) on a population, rather than comparing two independent samples to each other, in which case a two-sample t-test would be appropriate.

Sample data of Stroop tests was supplied Udacity. In this dataset, $\mu_c = 14.05$ and $\mu_{NC} = 22.02$, $s_C = 3.56$ and $s_{NC} = 4.80$.

[1] "Demonstration of Stroop Effect – 'Name That Color Test'", University of North Texas.

The statistical software program R was used to plot histograms of the data:





In the above histograms the congruent readings are mostly clustered below 20 seconds, while many of the incongruent readings took more than 20 seconds. The mode of the congruent histogram is around 12 seconds, while the mode of the incongruent histogram is around 18 seconds.

The results of the t-test are:

$$t(23) = -8.02, p < 0.01, one - tailed$$

The t-value of -8.02 is less than the α = .05 critical value of -1.714. The p-value of $2.052\ e^{-8}$ means that there is far less than a one percent chance that, if the means were equal, we would have obtained these results. In conclusion, the null hypothesis is to be

rejected in favor of the alternative hypotheses that non-congruence lengthens reading times in the Stroop test.

Possible ways to extend the experiment could be to determine whether demographic variables age, gender, or education level influence Stroop test reading times. Also, it has been noted that ADHD subjects tend to perform worse on the test, as their disorder increases the difficulty for their brains to resolve the cognitive conflicts between the words and colors of ink.[2] It would be interesting to explore whether different types of ADHD medications improve the performance of subjects with ADHD.

References:

Stroop Effect Test. Retrieved January 22, 2017, from http://www.math.unt.edu/~tam/SelfTests/StroopEffects.html

[2] Ibid.