The Stroop Effect

Project 1 by Casey Newell

Question 1: What is our independent variable? What is our dependent variable?

Answer 1: The independent variable is the congruence of the words, specifically if the color of the ink matches the name of the word. The dependent variable is the time it takes for the participant to name the color of the ink for each word displayed.

Question 2: What is an appropriate set of hypotheses for this task? What kind of statistical test do you expect to perform? Justify your choices.

Answer 2: The null hypothesis would be that the mean time to recite the color of ink for the congruent words is the same as the mean time to recite the color of ink for the incongruent words. The alternative hypothesis would be that the mean time for reading the color of ink for the incongruent words would be greater. I would choose these hypotheses because we are testing to see if incongruence increases the mean time to recite the color of the ink.

In the following H_0 is the null hypothesis and H_A is the alternative hypothesis, μ_0 is the mean time for the congruent words and μ_1 is the mean time for the incongruent words.

$$H_0: \mu_0 = \mu_1$$
$$H_A: \mu_0 \le \mu_1$$

I would expect to perform the a welch's t-test because it is used to determine if there is a statistically significant difference between the mean of two separate groups and it doesn't assume equal variance in the groups. I could possibly have chosen a student's t-test if I wanted to assume equal variance but I do not see a good reason to assume equal variance. I also decided to use an unpaired test since we are not assuming that the first trial has an impact on the second trial. However, an argument could be made that such an impact exists.

Question 3: Report some descriptive statistics regarding this dataset. Include at least one measure of central tendency and at least one measure of variability.

Answer 3:
The mean time to recite the color of ink for congruent words was 14.05 seconds. The median time was 14.36 seconds. The standard deviation was 3.56 seconds.

The mean time to recite the color of ink for incongruent words was 22.016 seconds. The median time was 21.02 seconds. The standard deviation was 4.80 seconds.

The mean difference between the two was 7.96 seconds. The median difference was 7.67 seconds. The standard deviation of the difference was 4.86 seconds.

Question 4: Provide one or two visualizations that show the distribution of the sample data. Write one or two sentences noting what you observe about the plot or plots.

Answer 4:
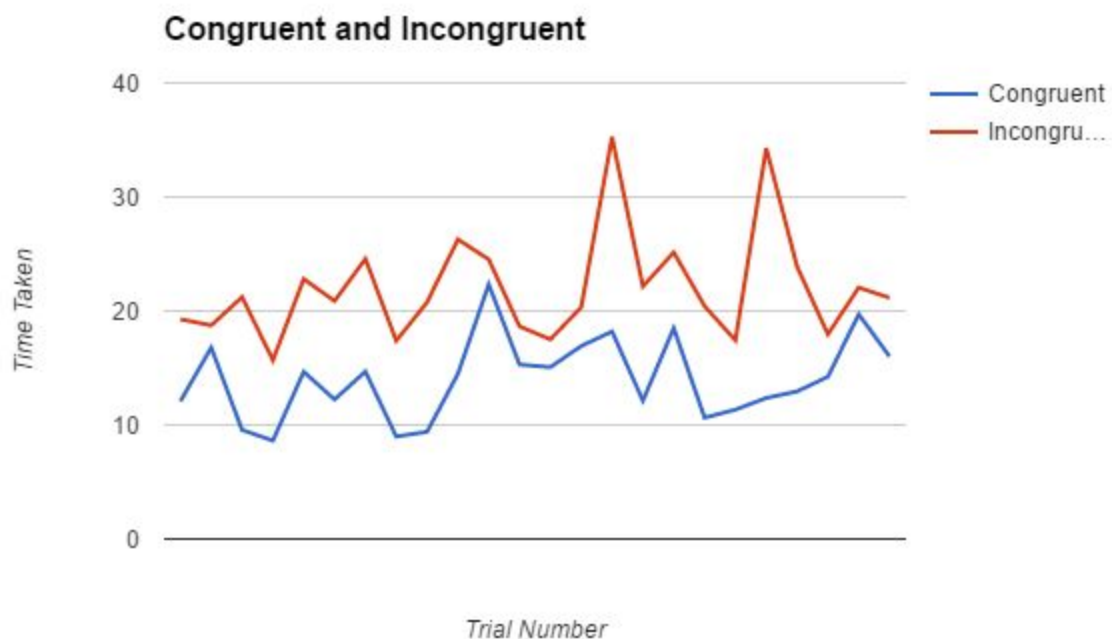
As can be seen in the chart, the time taken to speak out loud the ink color was consistently shorter for the congruent example.

Question 5: Now, perform the statistical test and report your results. What is your confidence level and your critical statistic value? Do you reject the null hypothesis or fail to reject it? Come to a conclusion in terms of the experiment task. Did the results match up with your expectations?

Answer 5:
The critical value for our T-test will be 1.7109, this would be for a 95% confidence interval. The p-value for the one tailed T-test is 0.00000003 and it is statistically significant. I would reject the

null hypothesis with over 99% confidence. I would conclude that the mean time for the incongruent words is greater than the mean time for the congruent words. Overall, this results matches intuition. It makes sense that it would take longer to recite the color of ink for incongruent words.

Question 6: Optional: What do you think is responsible for the effects observed? Can you think of an alternative or similar task that would result in a similar effect? Some research about the problem will be helpful for thinking about these two questions!

Answer 6:
One possibility that exists is there could be interference in the brain. When a person sees the word red but it is the color blue, mixed signals are coming through and the brain has to filter out which one is correct. Another possibility is that reading a word could be more automatic than color recognition. A third possibility is that there is simply a stronger association between verbalizing "red" and reading "red" than there is between verbalizing "red" and seeing the color red. An interesting way to test this theory would be to have the first trial be words, red, blue, yellow etc, and the second trial just be a box of that particular color. The trial could go through 20 or so samples and see if there is a difference in the time it takes to respond.

An alternative task could be the size of the words. Perhaps the words could be written small, medium, and large but the actual sizes would be incongruent with what is written.

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

I used google sheets to calculate all of the statistics and used no other references.