Udacity Data Analyst NanoDegree - Project1: Test a Perceptual Phenomenon

Background Information

In a Stroop task, participants are presented with a list of words, with each word displayed in a color of ink. The participant's task is to say out loud the color of the ink in which the word is printed. The task has two conditions: a congruent words condition, and an incongruent words condition. In the congruent words condition, the words being displayed are color words whose names match the colors in which they are printed. In the incongruent words condition, the words displayed are color words whose names do not match the colors in which they are printed. In each case, we measure the time it takes to name the ink colors in equally-sized lists. Each participant will go through and record a time from each condition.

Analysis

1. **What is our independent variable? What is our dependent variable?**The independent variable is the task condition, that is, incongruent words condition or congruent words condition. The dependent variable is the time it takes to name the color of the ink in equally sized lists.
2. **What is an appropriate set of hypotheses for this task? What kind of statistical test do you expect to perform? Justify your choices. Now it's your chance to try out the Stroop task for yourself. Go to this link, which has a Java-based applet for performing the Stroop task. Record the times that you received on the task. Now, download this dataset which contains results from a number of participants in the task. Each row of the dataset contains the performance for one participant, with the first number their results on the congruent task and the second number their performance on the incongruent task.**The time it took me for the Stroop task on the given link: **8s** (congruent), **31.86s** (incongruent)The hypothesis for this study could be as under:
   - *Null Hypothesis*: The task condition (congruent or incongruent words condition) has no effect on the time it takes to name the color of the ink in equally sized lists.
   - *Alternative Hypothesis*: The time taken to name the color of the ink in equally sized lists is greater in incongruent words condition.
3. The research publication by John Ridley Stroop (1935) and related websites on the Stroop effect suggest that it would take longer to read the name the colors in incongruent words condition, hence the alternative hypothesis.
   - H0, null hypothesis: $\mu c = \mu i$, $\mu c - \mu i = 0$
   - Ha, alternative hypothesis: $\mu c < \mu i$
   - μc – The population mean for the average time taken by the participants to name the color of the ink in a word list in case of congruent words condition
   - μi – The population mean for the average time taken by the participants to name the color of the ink in incongruent words in a word list in case of condition
   I would conduct a paired t-test since the datasets are dependent (reaction time of same participant). Based on the alternative hypothesis, I would do one-tailed t-test in the positive direction).
4. **Report some descriptive statistics regarding this dataset. Include at least one measure of**

central tendency and at least one measure of variability. Congruent Dataset:

- ○ Mean = 14.05
- ○ Median = 14.36
- ○ Sample Standard Deviation = 3.56

5. Incongruent Dataset:
    - ○ Mean = 22.02
    - ○ Median = 21.02
    - ○ Sample Standard Deviation = 4.79

6. Differences between the two sample dataset:
    - ○ Mean = 7.96
    - ○ Standard Deviation of differences = 4.86

7. **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.**The boxplot below for the congruent and incongruent conditions shows the distribution and the median values for the reaction time (in seconds) for the two task conditions.

8. **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?** This is a dependent samples study and repeated measures design (same participant is given two different conditions). Based on the alternative hypothesis, since we predict that the incongruent words condition might increase the reaction time, we will conduct one-tailed test in the positive direction. Let us choose
    - ○ α-level = 0.001 (0.1%)
    - ○ Number of samples, n = 24
    - ○ Degrees of freedom, dof = 23
    - ○ t-critical = 3.485 for α-level = 0.001, dof = 23
    - ○ Difference between means of the dataset, MD = 7.96
    - ○ Standard deviation of the differences, SD = 4.86
    - ○ t-statistic = 8.01

    t-statistic > t-critical which implies **p < α** or **p < 0.001**A calculation online for **t = 8.01** and **dof = 23** did not give the exact p-value but gave the result as **p-value < 0.0001**. We reject the null hypothesis. This implies that the alternative hypothesis holds, i.e. time taken to name the color of the ink in equally sized lists is greater in incongruent words condition. The confidence level is **99.8%** and the critical statistic value is **t-critical = 3.485**The results match up with my prediction that incongruent words condition might interfere with the participant's ability to name the color resulting in greater reaction time.

9. **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.**In congruent words condition, the difference in the color of the ink and what the word says creates an interference or conflict in the participant's mind, resulting in delayed reaction or incorrect response.Any other task which might create an interference might result in a similar effect. For example, if the words are printed from right to left as shown below, it might inhibit the participants ability to read the words as fast as they would if the words were printed as usual (left to right).

- First Condition
    - ○ ESROH TAOG NOIL TORRAP TNAHPELE
- Second Condition

○ HORSE GOAT LION PARROT ELEPHANT