Statistics: The Science of Decisions Project Instructions

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: for example RED, BLUE. In the *incongruent words* condition, the words displayed are color words whose names do not match the colors in which they are printed: for example PURPLE, ORANGE. 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.

Questions For Investigation

As a general note, be sure to keep a record of any resources that you use or refer to in the creation of your project. You will need to report your sources as part of the project submission.

1. What is our independent variable? What is our dependent variable?
The independent variable is the kind of treatment ("congruent words" or "incongruent words"), while the dependent variable is the time it takes to name the ink colors.

2. What is an appropriate set of hypotheses for this task? What kind of statistical test do you expect to perform? Justify your choices.
We are going to test whether the Stroop is true, so the null hypothesis (H_0) is that the mean of the time it takes to name the ink colors for the "congruent" sample is not significantly lower than the one of the "incongruent" sample and that difference it's due to chance, while the alternative hypothesis (H_A) is that the mean of the "naming time" for the "congruent" sample is significantly lower than the mean of the "incongruent" sample because they come from different populations.

$$H_0: \mu_c - \mu_i >= 0$$
$$H_A: \mu_c - \mu_i < 0$$

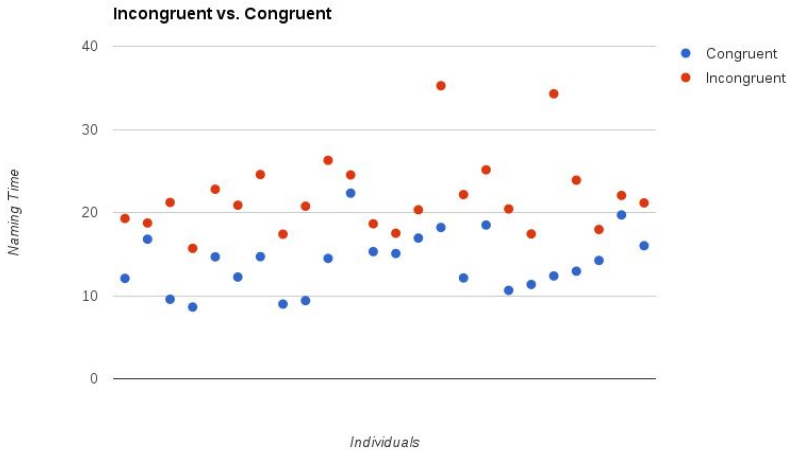
The most appropriate test in this case is a one-tailed dependent t-test for paired samples, because we don't have the population's parameters but just samples, and we have a within subject design where we measure the independent variables in two different conditions.

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 (you do not need to submit your times to the site.) 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.

3. Report some descriptive statistics regarding this dataset. Include at least one measure of central tendency and at least one measure of variability.
On the “congruent” condition the 24 participants spent on average 14.05s (SD = 3.56s) naming the ink colors, while on the “incongruent” condition it generally took more time (M = 22.02s, SD = 4.80s).

	Congruent	Incongruent
Mean	14.051125	22.016
Median	14.3565	21.018
Variance	12.66902907	23.012
Std. Deviation	3.559357958	4.797057122

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.



The scatterplot above shows the results of each participant, using different colors for the different conditions. It can be noticed that generally the “incongruent” time is higher and that each participant had a higher “naming time” in the “incongruent” condition.

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?
The dependent t-test for paired samples showed that the difference in “naming time” between the “congruent” condition (N = 24, M = 14.05s, SD = 3.56s) and the “incongruent” condition (M = 22.02s, SD = 4.80s) is extremely statistically significant, t(23) = -8.02, p = .000, 95% CI [-12.80, -3.13] , d = -1.64.
I therefore reject the null and accept the alternative hypothesis, which says that it takes more time to name the ink of “incongruent words” than naming the ink of “congruent words”.
The experiment confirmed as I expected the Stroop effect.

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!

I think a way the Stroop effect could be explained is that the brain takes more time to recognise colors than reading text. In this test the brain receives two different informations, which are the color of the word and the text. In all the cases the text is received first, it's compared with the color and in case it matches the text is said out loud otherwise the color gets recognised and then named.

These are just assumptions, but in case we were to test them, we could have a similar test where the two conditions are "reading text" where the text has just one color (e.g. black) and "name colors" where there's no text and then see if the difference between these two is significant. In case it is, we could test whether the text actually arrives first to the brain, and we would do so with the same experiment as the one just analysed, but both conditions would be "incongruent" and in one condition the participants would have to read the words, while on the other one they would have to name the colors.

Sources:

http://www4.uwsp.edu/psych/cw/statistics/Wendorf-ReportingStatistics.pdf
Used as reference for APA styles.
https://s3.amazonaws.com/udacity-hosted-downloads/t-table.jpg
Used to calculate the t-critical.
http://www.graphpad.com/quickcalcs/
Used to calculate the p-value.