

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 type of test (Congruent & Incongruent). Meanwhile, the dependent variable is the time it takes of completing the test.

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

Null hypothesis H_0 : there is no significant population average time difference in completing the congruent and incongruent tests, which we can express in the following mathematical notation: $\mu_{\text{congruent}} - \mu_{\text{incongruent}} = 0$ ($\alpha = .05$).

Alternative hypothesis H_a : the population average time of test completion should be higher for the incongruent test. Therefore, we should have a one tail t test on the positive end (right tail). Expressed as the following in mathematical notation: $\mu_{\text{congruent}} - \mu_{\text{incongruent}} > 0$ ($\alpha = .05$).

In this example we have two related samples, since we have two related samples (same participants different tests), we should apply the dependent t-test for paired samples to examine if we our two groups are significantly different. This test is typically applied on small sample sizes ($n \leq 30$). Also, the sample distribution of the two-related groups must be normally distributed.

For our t-test to be valid we need these two requirements, a continuous dependent variable and a categorical independent variable. In our case the continuous dependent variable is the time it takes to complete a test. The categorical independent variable is the type of test, in our case it is either the congruent or incongruent test.

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.

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

Congruent Test	MEAN	MEDIAN	IQR 25	IQR 75	MAX	MIN	RANGE	STDDEV
	14.05	14.36	11.90	24.05	22.33	8.63	13.70	3.56
Incongruent Test	MEAN	MEDIAN	IQR 25	IQR 75	MAX	MIN	RANGE	STDDEV
	22.02	21.02	18.71	24.05	35.26	15.69	19.57	4.80

- 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.

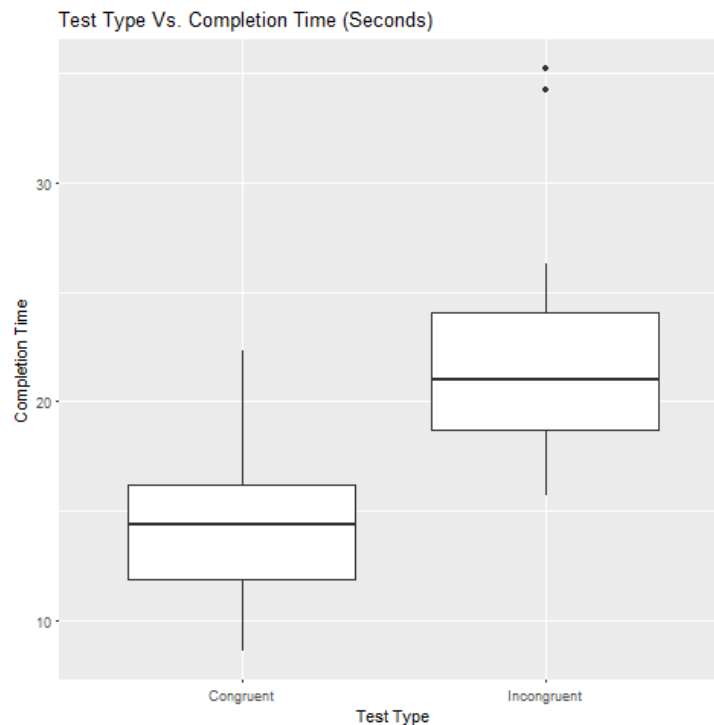


Figure 1.1

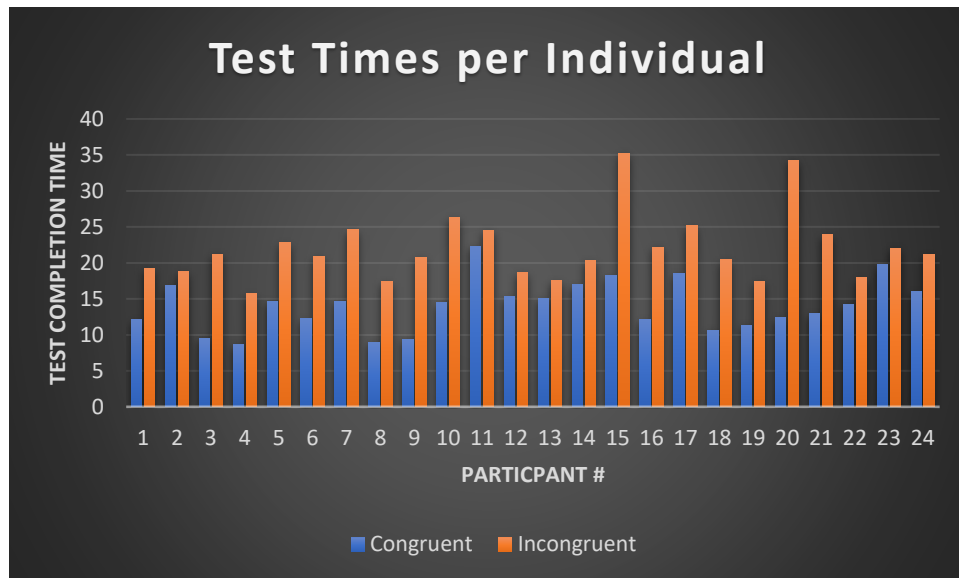


Figure 1.2

The boxplot (Figure 1.1) represents tests participants as a whole. The bar-plot (Figure 1.2) represents test taking times for each participant by test type. From the above graphs, we can safely conclude that all participants took longer times to complete the incongruent test.

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?

Results indicate significant longer time for completing the incongruent test ($M = 14.05$, $SD = 3.56$) over the congruent test ($M = 22.02$, $SD = 4.80$), $t(23) = 8.02$, $p < .05$. The two variables were strongly correlated, $r(23) = .74$, $p < .05$.

In laymen's terms it means that the t-test has proved that the incongruent test has a significant longer test completion time than the congruent test. It takes the incongruent test 8.02 seconds longer to complete on average. If we wanted to conclude that both tests are not significantly different (to accept the null), the t-value should have been 1.71 seconds or less, at that is the critical t-value.

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!

According to Prof. De Young of the University of Michigan, two main theories as to why the stroop effect happens is the brain reads words faster than it recognizes colors and that the brain needs more attention to recognize a color than it needs to read words (De Young, 2014).

Lurking variables might have unintended consequences on the test. I believe that the order of taking tests might have had an effect with the results of the test. As it takes time to familiarize oneself with the initial test. One could eliminate that possibility by giving a practice test beforehand.

Citations:

De Young, R. (2014). Using the Stroop effect to test our capacity to direct attention: A tool for navigating urgent transitions. Retrieved from <http://www.snre.umich.edu/eplab/demos/st0/stroopdesc.html>