

P1: Test a Perceptual Phenomenon

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Project 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:

1. What is our independent variable? What is our dependent variable?

Independent Variable: The Congruent and Incongruent words.

Dependent Variable: The response time of participants to guess the correct color.

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

$$H_0: \mu_C \geq \mu_{IC}$$

The null hypothesis is that the time required for color recognition for congruent words is equal to or greater than the time required for color recognition of incongruent words.

$$H_a: \mu_C < \mu_{IC}$$

The Alternative hypothesis is that the time required for color recognition for congruent words is less than the time required for color recognition of incongruent words.

μ represents the population mean, the subscript "C" represents the congruent words, and the subscript "IC" represents the incongruent words.

A one tailed dependent samples t-test is performed in order to compare the average of congruent words with the average of incongruent words. We perform this test to prove the alternative hypothesis that the time required for color recognition for congruent words is less than the time required for color recognition of incongruent words.

A *t*-test is most commonly applied when the test statistic would follow a normal distribution if the value of a scaling term in the test statistic were known. When the scaling term is unknown and is replaced by an estimate based on the data, the test statistics (under certain conditions) follow a Student's *t* distribution. The *t*-test can be used, for example, to determine if two sets of data are significantly different from each other. Paired samples *t*-tests typically consist of a sample of matched pairs of similar units, or one group of units that has been tested twice (a "repeated measures" *t*-test). A typical example of the repeated measures *t*-test would be where subjects are tested prior to a treatment, say for high blood pressure, and the same subjects are tested again after treatment with a blood-pressure lowering medication. By comparing the same patient's numbers before and after treatment, we are effectively using each patient as their own control. That way the correct rejection of the null hypothesis (here: of no difference made by the treatment) can become much more likely.¹

¹ (n.d.). Student's t-test - Wikipedia. Retrieved March 21, 2018, from https://en.wikipedia.org/wiki/Student%27s_t-test

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

Measure of Central Tendency:

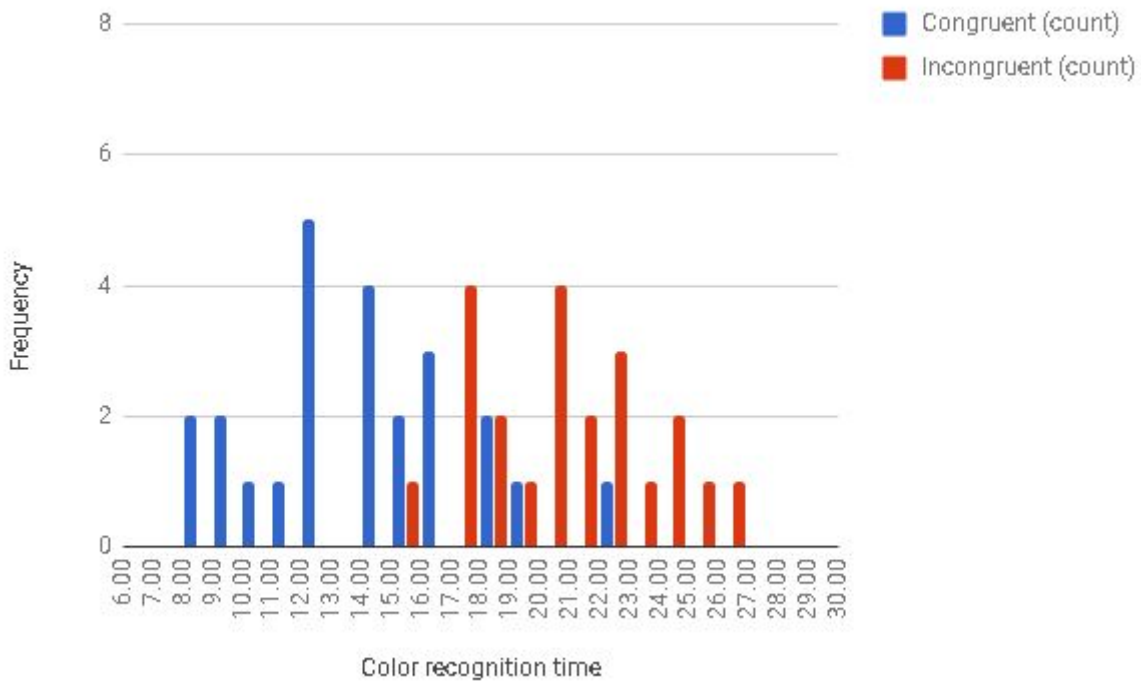
Central Tendencies	Congruent Words	Incongruent Words
Mean	14.05113	22.01592
Median	14.3565	21.0175

Measures of Variability:

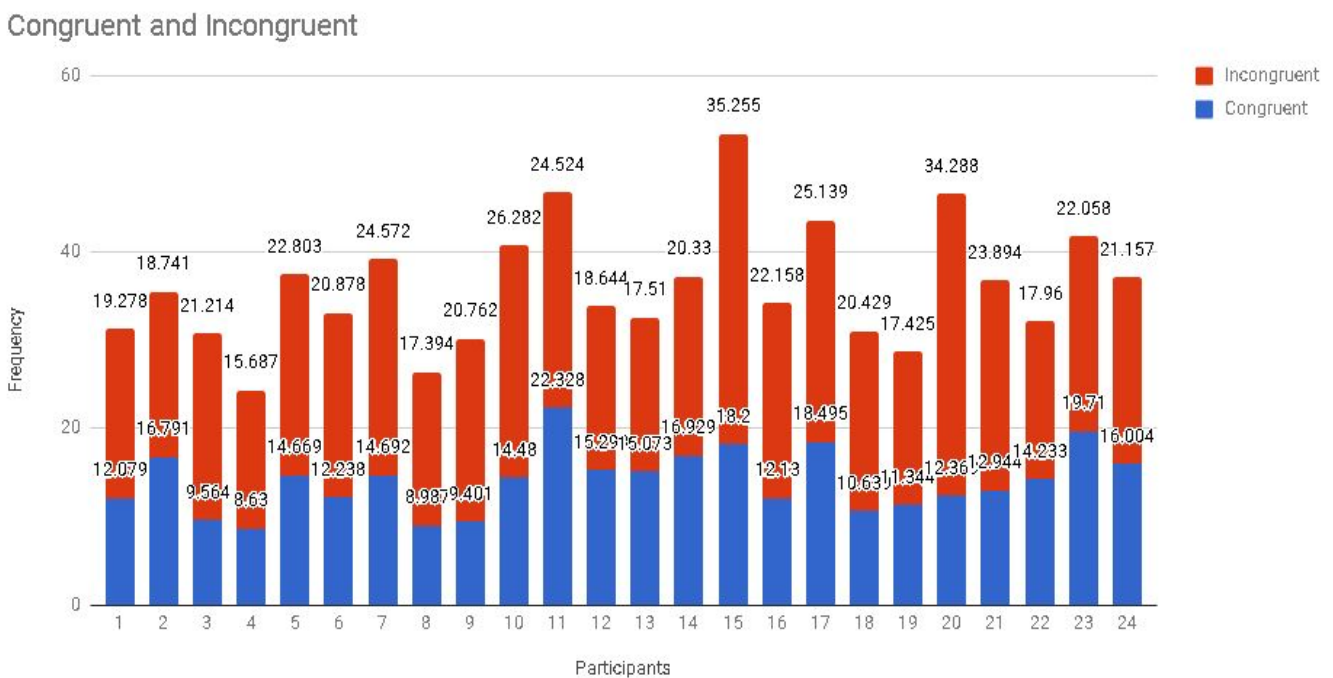
Variability	Congruent Words	Incongruent Words
Variance	12.67	23.01
Standard Deviation	3.56	4.80

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.

Histogram of color recognition time:



Stacked Column Chart of color recognition time:



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?

$\alpha = .05$

df(degree of freedom)=23

$t = -7.97$

$t_{crit} = -1.714$

p-value = $< .0001$

At confidence interval of 95% and degrees of freedom as 23, the critical value for a one-tailed test in the negative direction is -1.714 . The t-statistic value is -7.97 for difference between the mean of congruent and incongruent words. the t-statistic is in the critical region and therefore the null hypothesis can be rejected. The difference of -7.97 between means is considered to be extremely statistically significant. Therefore we can say that the time required for color recognition of congruent words is less than the time taken for color recognition of incongruent words.

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 me the difference in result is mostly because the person taking the test always focuses on the word rather than the color causing the effect. Therefore when the color is different from the word it takes more time for the person to recognize the color.

An alternative to the Stroop Test is the Animal words Test where the participants have to say the name of the animal given in the picture and the distractor is the word.

References:

1:https://en.wikipedia.org/wiki/Student%27s_t-test

2:<http://www.statisticshowto.com/probability-and-statistics/t-test/>