

Stroop Effect - Test a Perceptual Phenomenon

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Background Information - Data

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.

Dataset

Xc	Xi
Congruent	Incongruent
12.079	19.278
16.791	18.741
9.564	21.214
8.63	15.687
14.669	22.803
12.238	20.878
14.692	24.5720
8.987	17.394
9.401	20.762
14.48	26.282
22.328	24.524
15.298	18.644
15.073	17.51
16.929	20.33
18.2	35.255
12.13	22.158
18.495	25.139
10.639	20.429
11.344	17.425
12.369	34.288
12.944	23.894
14.233	17.96
19.71	22.058
16.004	21.157

Measurement: in Seconds

Spreadsheet:

https://docs.google.com/spreadsheets/d/1Ak5WOH03pp6_oAffOYhLX8GuqHTKRmmHMUevK2AnUMQ/edit?usp=sharing

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Questions/Analysis for Investigation

1. What is our independent and dependent variable?

- **Independent variable:** Color words whose names match the colors or did NOT match the colors. Stated differently: it is the congruency of the color and text.
- **Dependent variable:** the time it takes to name the ink colors in seconds. Stated differently: Time it takes to recognize the colors/texts.

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

➤ **Hypothesis:**

H₀: $\mu_c - \mu_i = 0$

H_a: $\mu_c - \mu_i \neq 0$

- **Explanation:** We want to see if there is a significant difference with the time it takes to name the congruent ink colors vs the incongruent ink colors in equally-sized lists.

- **Assumptions and Statistical Test:** The assumption being made is that the distribution of sample means for samples taken are normally distributed, that the sampling is random, and that the treatment measures are being made to the same group, making the samples dependent. We also are unaware of the population, so the statistical test will be a dependent t-test. We will use an alpha level of 0.05 simply because R.A. Fisher (statistician) explains that a 0.05 level is the typically used level [1](#). (We would use a smaller level if we needed lower the probability of choosing a wrong decision, such as in airplane parts.) This will also be a two-tailed test as we do not need a specific direction for the test.

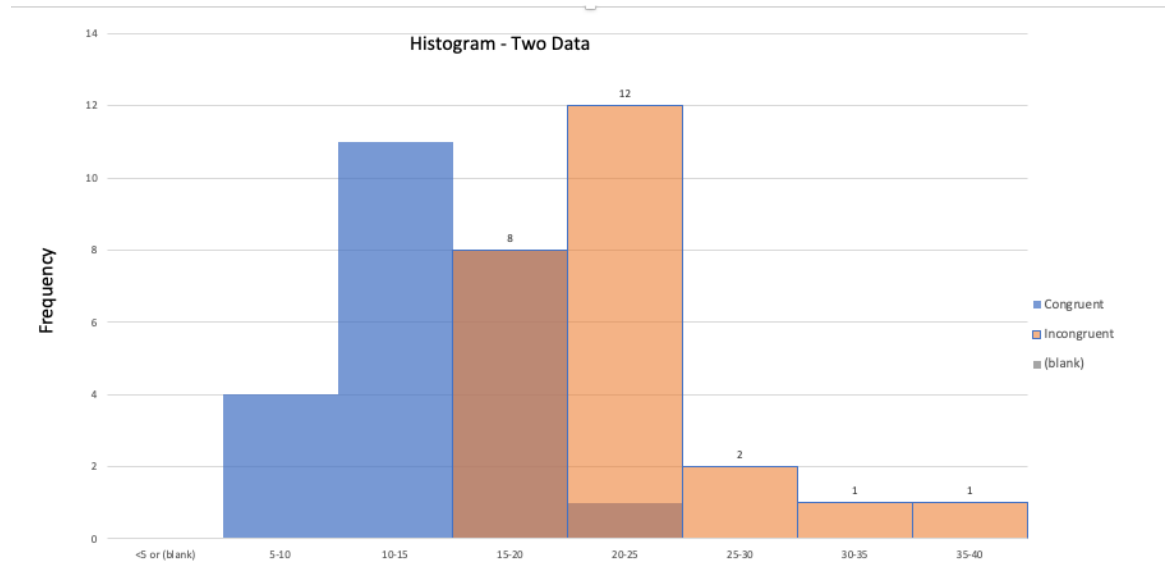
3. Report some descriptive statistics regarding this dataset. Include at least one measure of central tendency and at least one measure of variability.

- **Descriptive Statistics - Central Tendency and Variability**

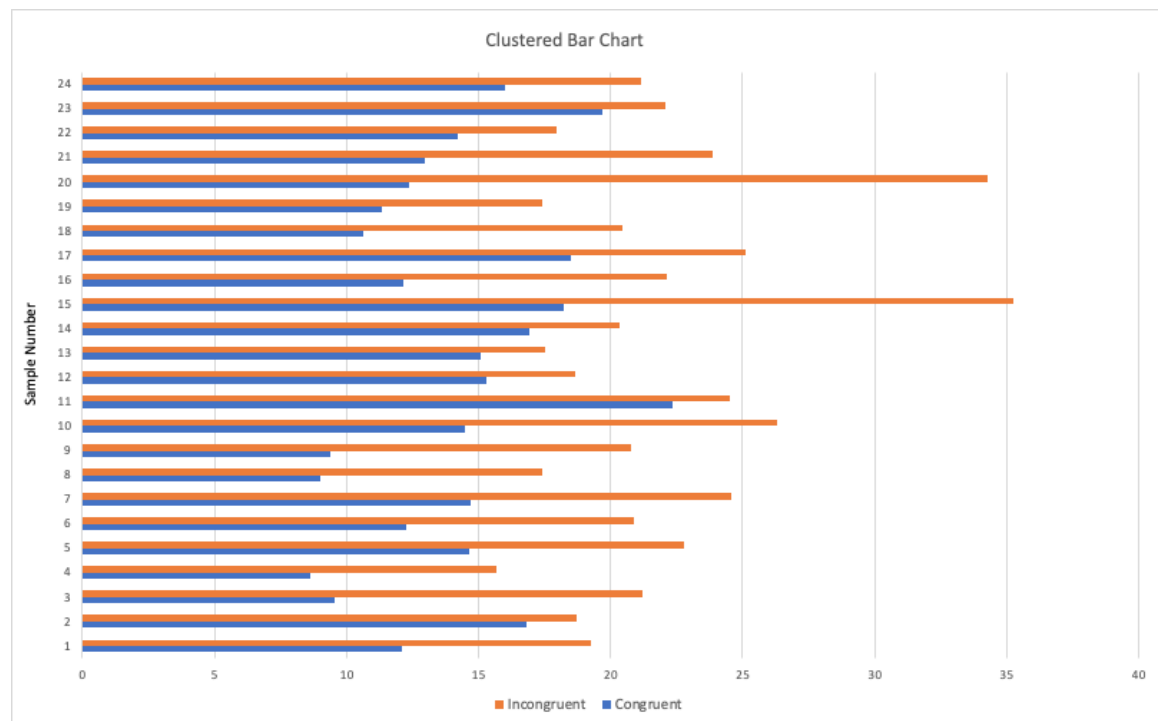
Central Tendency and Variability	
14.051	<i>mean - Congruent Sample</i>
22.016	<i>mean - Incongruent Sample</i>
-7.965	<i>mean difference</i>
14.357	<i>median - Congruent Sample</i>
21.018	<i>median - Incongruent Sample</i>
3.559	<i>Standard Dev - Congruent Sample</i>
4.797	<i>Standard Dev - Incongruent Sample</i>
23.667	<i>sum of squares divided by df (variance)</i>

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.

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Congruent: Blue; Incongruent: Orange



- **Observation of Visualizations:** The histogram and clustered bar chart shows the variance between the Congruent and the Incongruent samples. The clustered bar chart shows a clear before and after in a visual sense per sample. The histogram shows the frequency of each particular time period, labeled in groups of seconds by five second buckets.

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5. 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?

➤ Statistical Test

$\mu_c - \mu_i$	-7.965	point estimate					
S	4.865	Standard Dev					
t	-8.021	t-statistic					
df	23	degrees of freedom					
α	0.050	alpha level					
α - 2 tailed	0.025	2 tailed					
t-crit - \pm	2.069	t-critical value					
MoE - 95% CI	2.055	margin of error					
CI-low	-10.019	Confidence Interval					
CI-high	-5.910	Confidence Interval					
		(They score approx. 6 to 10 seconds worse on the incongruent test)					
d	-1.637	Cohen's d - effect size measure - the two means are about a third of a std deviation apart					
r ²	0.74	r squared - difference due to adding the incongruent effect - 78%					

- **Report:** I noticed that r-squared test revealed that 74% of differences are due to adding the incongruent effect. I also noticed that they were at least 6 to 10 seconds worse on the incongruent test based at a 95% confidence level. I noticed that the t-statistic -8.021 was far less than the t-critical value of -2.069. Therefore I reject the null hypothesis.
- **Conclusion:** There was a significant difference with adding the effect of changing the words to not match the color of the words (incongruent). This did match up with my expectation.

Sources Sited - Additional

¹ Tips and Techniques for Statistics and Quality Improvement - Minitab Statistical Software
Resource website: <https://blog.minitab.com/blog/alphas-p-values-confidence-intervals-oh-my>