

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?
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 (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.
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.
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?
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!

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

The independent variable is the type of word condition(*congruent words/ incongruent words*) and the dependent variable is actual 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.

H_0 : Null Hypothesis

H_a : Alternative Hypothesis

μ_c : Mean of the reading time to congruent words

μ_{ic} : Mean of the reading time to incongruent words

$H_0: \mu_c - \mu_{ic} = 0$ this hypothesis says that the time it takes to name the ink colors under the condition of words (congruent words/ incongruent words) is not different, it takes slightly same time

$H_a: \mu_c - \mu_{ic} \neq 0$ this hypothesis says that the time it takes to name the ink colors under the condition of words (congruent words/ incongruent words) is different, and it doesn't take same time

$H_a: \mu_c > \mu_{ic}$ this hypothesis says that the time it takes to name the ink colors under the condition of congruent words take more time than the condition of incongruent words. That mean if the condition of word is congruent that take more time compered to word is word that incongruent

$H_a: \mu_c < \mu_{ic}$ this hypothesis says that the time it takes to name the ink colors under the condition of incongruent words take more time than the condition of congruent words. That mean if the condition of word is incongruent that take more time compered to word is word that congruent

I need to look at first the null hypothesis $H_0: \mu_c - \mu_{ic} = 0$ if i reject the null hypothesis my hypothesis that i choose is going to be last one $H_a: \mu_c < \mu_{ic}$ the name the ink colors under the condition of incongruent words take more time than the condition of congruent words. Since, there are less people (24 people) than 30 in the test and we don't know actual population standard deviation, it is the better cohiece using t-test but that is going to be dependent t-test because in tests samples are the same. In Addition, for alternative hypothesis it will be the directional hypothesis because i am gonna look at specifically incongruent word take more time than the congruent word. Although i am looking at incongruent word taking more time, i don't know actually it s gonna be taking more or less time before testing it so i am using two-tailed test. Finally,

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

\bar{x}_c = mean of the time condition under congruent word

\bar{x}_i = mean of the time condition under incongruent word

$\bar{x}_c = 14.051$ and Median is 14.357 and the since there is no repeated data, there is no Mode, Variance is 12.670 and Standard Deviation(σ) is 3.55936

$\bar{x}_i = 22.016$ and Median is 21.0175 and the since there is no repeated data, there is no Mode, Variance is 23.0117 and Standard Deviation(σ) is 4.79706

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.

To visualize and read better i insert one more columns that show interval time(Table 1), i think about it like a bin size of a histogram. So that i can observe and categorize between what time interval is mostly spent by people. In Chart 1 and Chart 2 i am working on the test in condition under congruent word, Chart 3 and Chart 4 is about the test in condition under incongruent word. In Chart 1, I show the the number of people in an interval(i divide this interval as a bin size of histogram and in this plots the bin size or the interval is 3 seconds). The size of this interval is 3 seconds and Chart 1 shows that if the condition is congruent 9 people is complete test between 14 – 16 seconds instead of 4 people the test generally finish before 17 seconds. In addition, Chart 2 also shows that 41% of time spent compered to total finished test by people who finish his/her test between 14 – 16 seconds. On the other hand when the test made under incongruent word condition most people finished the test after 17. seconds as

shown below in Chart 3. According to Chart 3 and Chart 4, it can be relieved distribution is balanced in terms of total amount time that spent to finish test .

Table 1

Congruent	Bin size	Incongruent	Bin size
8,63	8 - 10	15,687	15 - 17
8,987	8 - 10	17,394	15 - 17
9,401	8 - 10	17,425	15 - 17
9,564	8 - 10	17,51	15 - 17
10,639	8 - 10	17,96	15 - 17
11,344	11 - 13	18,644	18 - 20
12,079	11 - 13	18,741	18 - 20
12,13	11 - 13	19,278	18 - 20
12,238	11 - 13	20,33	18 - 20
12,369	11 - 13	20,429	18 - 20
12,944	11 - 13	20,762	18 - 20
14,233	14 - 16	20,878	18 - 20
14,48	14 - 16	21,157	21 - 23
14,669	14 - 16	21,214	21 - 23
14,692	14 - 16	22,058	21 - 23
15,073	14 - 16	22,158	21 - 23
15,298	14 - 16	22,803	21 - 23
16,004	14 - 16	23,894	21 - 23
16,791	14 - 16	24,524	24 - 26
16,929	14 - 16	24,572	24 - 26
18,2	17 - 19	25,139	24 - 26
18,495	19 - more	26,282	24 - 26
19,71	19 - more	34,288	26 - more
22,328	19 - more	35,255	26 - more

Chart 1

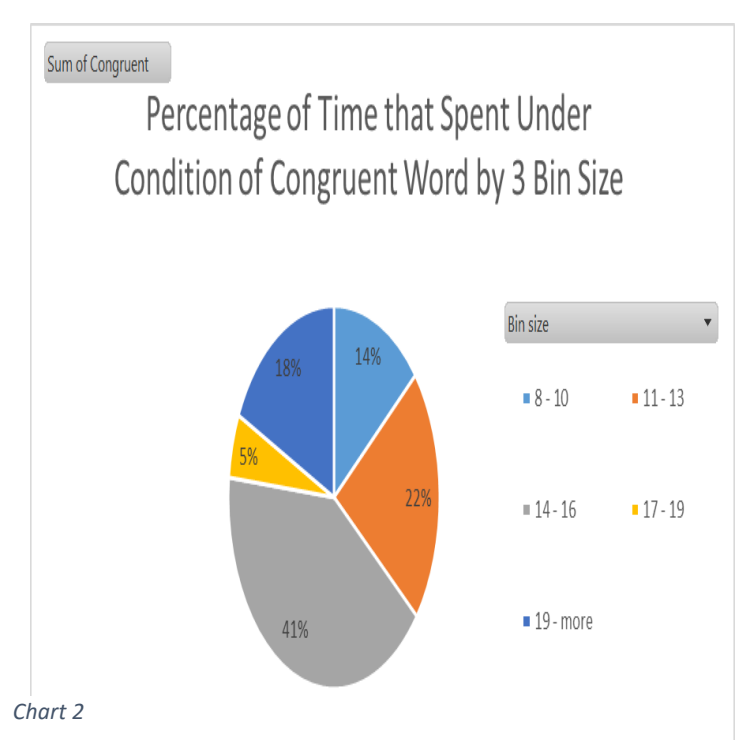
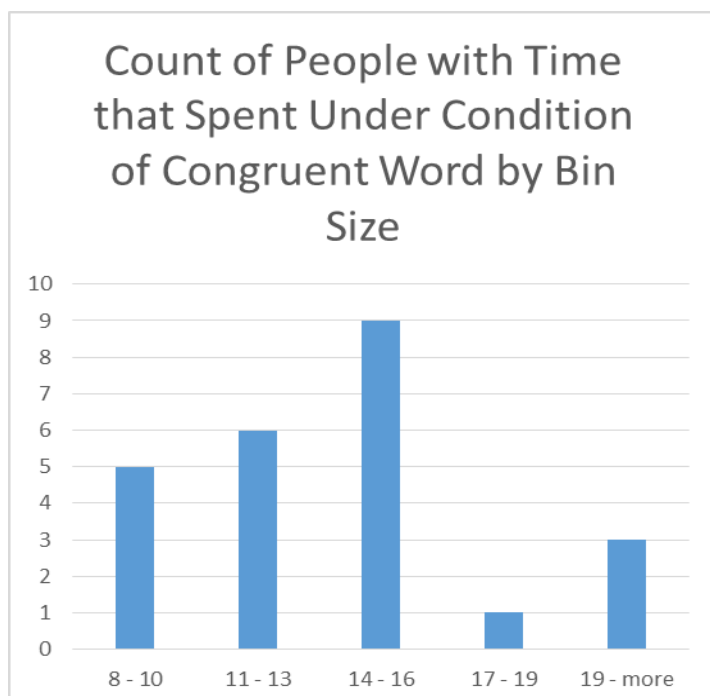


Chart 3

Count of People with Time that Spent Under Condition of Incongruent Word by Bin Size

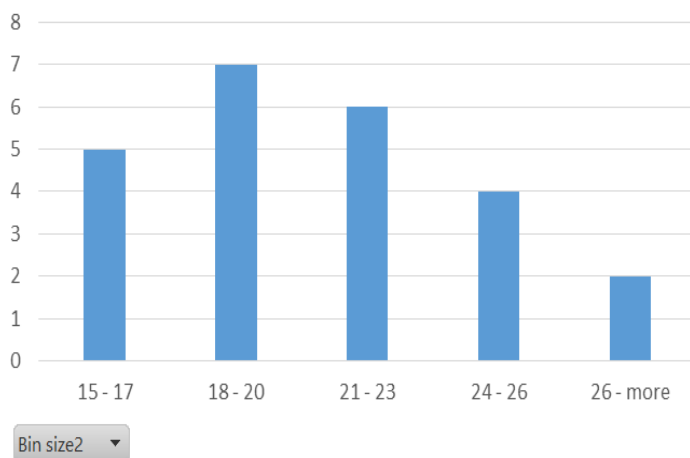
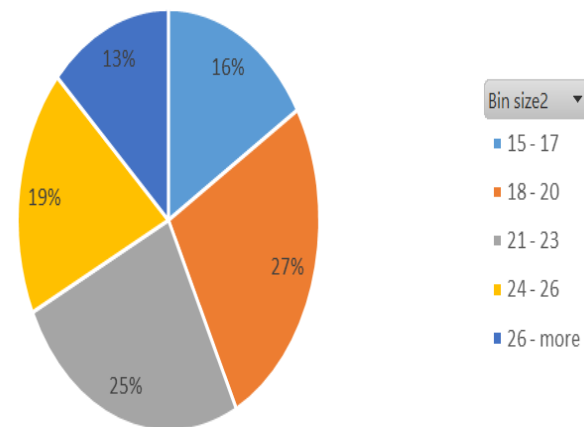


Chart 4

Percentage of Time that Spent Under Condition of Incongruent Word by 3 Bin Size



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?

Mean for Congruent (μ_c) =>	14.051125
Mean for Incongruent (μ_{ic}) =>	22.01591667
Standard Deviation for Congruent (σ_c) =>	3.55936
Standard Deviation for Incongruent (σ_{ic}) =>	4.79706
	Congruent/ Incongruent
Point of Estimate =>	$\mu_{ic} - \mu_c = 7.964791667$
Standard Deviation of Differences =>	4.86482691
Standard Error =>	0.993028635
N	24
T	8.020706944
t-Critical Values at $\alpha=0.05$ and $df=23$	± 2.069
Confidence Interval	(5.910215421 ,10.01936791)
Degree of freedom df	23

P - value	The two-tailed P value is less than 0.0001
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Firstly, This is a two-tailed test because we don't know where is direction of the test. Since P value is less than 0.0001, by conventional criteria, this difference is considered to be extremely statistically significant and $p < .05$. In Addition, There is a huge difference between critical value and t statistic value and it is out of critical range so that we reject the null hypothesis ($H_0 : \mu_c - \mu_{ic} = 0$). Since the points of estimate is positive that mean mean of reading time incongurent words bigger than reading time of congurent words. To sum up,reading time of Incongurent words take more time and than reading time of congurent words