

PROJECT

Test a Perceptual Phenomenon

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.

Dataset

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	24.572
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

Questions for Investigation

Question-1:

What is our independent variable? What is our dependent variable?

In the Stroop effect the **dependent variable is the reaction time**, which is the time taken by participants to say out loud the name of the colour and the **independent variable is the colour of the words**.

Question-2a:

What is an appropriate set of hypotheses for this task?

In Stroop effect, the null hypothesis is that there is no significant difference, which means if the congruent condition is extended to everyone in the population then it will be equal to the population mean when incongruent condition is extended to everyone in the population and the alternative hypothesis is they are not equal which means slower reaction time on incongruent words than on congruent words.

H₀:-Null Hypothesis

$$\mu_C = \mu_{IC}$$

Where ,

μ_C - denotes the population mean when congruent condition is applied to the entire population.

μ_{IC} - denotes the population mean when incongruent condition is applied to the entire population.

H_A:-Alternative Hypothesis

$$\mu_C \neq \mu_{IC}$$

$$\mu_{IC} - \mu_C > 0$$

Where ,

μ_C - denotes the population mean when congruent condition is applied to the entire population.

μ_{IC} - denotes the population mean when Incongruent condition is applied to the entire population.

Question-2b:

What kind of statistical test do you expect to perform? Justify your choices.

We are going to perform a statistical test using stroop effect, where we are going to test whether there is any change in the reaction time of the participants under the two conditions.

Let us assume the samples are dependent samples meaning the same sample undergoes the test twice and let the alpha level (α) be 0.05. Since the same sample undergoes test twice under different conditions we are going to perform t-test with dependent samples and determine the hypothesis.

Question-3:

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

In the given scenario since there are two condition to the sample so initially let us ,calculate the centrality terms such as the mean and variability terms such as standard deviation sample under each condition.

\bar{X} –denotes the sample mean of the sample that has undergone congruent condition

$\bar{X}=14.05$

\bar{Y} - denotes the sample mean of the sample that has undergone incongruent condition

$\bar{Y} =22.01$

S_c = denotes the standard deviation of the sample that has undergone congruent condition

$S_c=3.56$

S_{IC} = denotes the standard deviation of the sample that has undergone incongruent condition

$S_{IC}=4.79$

The below diagram showcases all the descriptive statistics of sample undergoing condition 1:

Mean	14.05113
SD	3.55936
SEM	0.72655
N	24
90% CI	12.80591 to 15.29634
95% CI	12.54814 to 15.55411
99% CI	12.01145 to 16.09080
Minimum	8.63
Median	14.8825
Maximum	22.328

The below diagram showcases all the descriptive statistics of sample undergoing condition 2:

Mean	22.01592
SD	4.79706

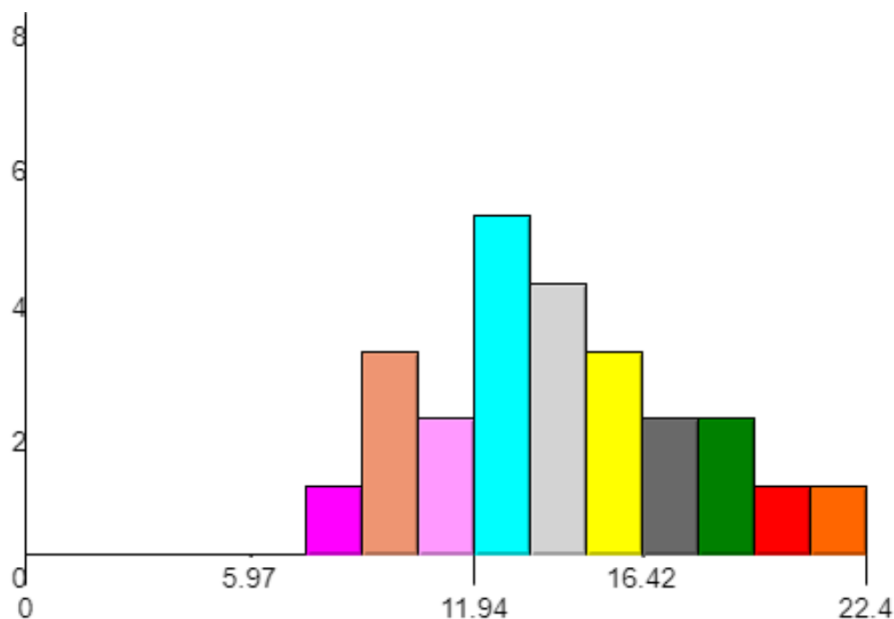
SEM	0.97920
N	24
90% CI	20.33770 to 23.69413
95% CI	19.99030 to 24.04154
99% CI	19.26699 to 24.76485
Minimum	15.687
Median	20.82
Maximum	35.255

Question-4:

Provide one or two visualizations that show the distribution of the sample data.

Let us plot the sampling distribution of the sample under the two conditions:

Under congruent condition:



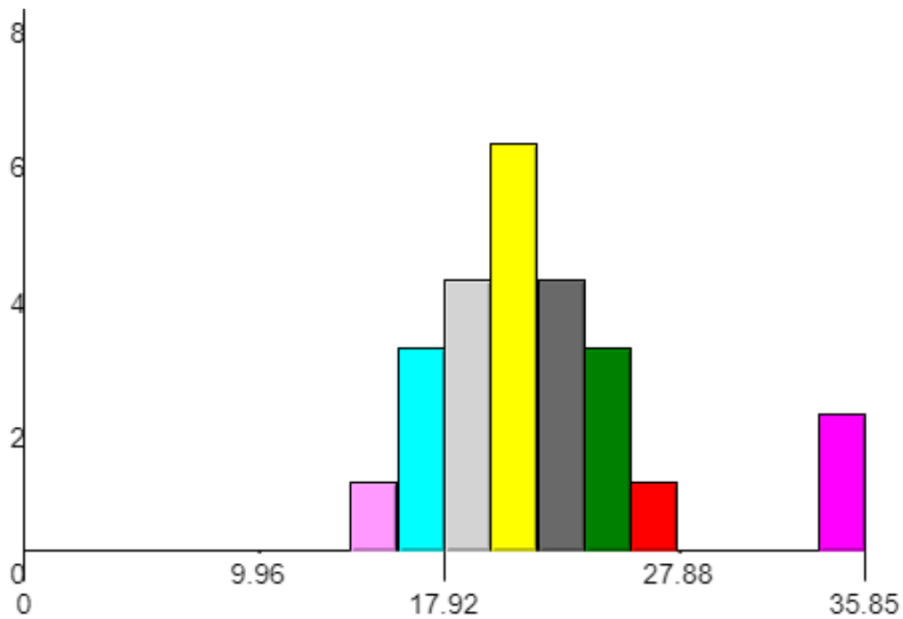
From the above histogram it is clear that the bin size is 1.493.

The x-axis represents the time taken to name the colors.

The y-axis represents the frequency.

The sampling distribution is normal in nature.

Under incongruent condition:



From the above histogram it is clear that the bin size is 1.992
 The x-axis represents the time taken to name the colors.
 The y-axis represents the frequency.
 The sampling distribution is normal in nature

Question-5:

Perform the statistical test and report your results. What is 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?

We are going to perform t-test:

Steps:

1. We should be taking the difference which estimates the difference between populations for calculating t-statistic and then calculate their mean and standard deviation using Bessel's correction

Incongruent	Congruent			
19.278	12.079	7.199	-0.765	0.585225
18.741	16.791	1.95	-6.014	36.1682
21.214	9.564	11.65	3.686	13.5866
15.687	8.63	7.057	-0.907	0.822649
22.803	14.669	8.134	0.17	0.0289
20.878	12.238	8.64	0.676	0.456976
24.572	14.692	9.88	1.916	3.671056
17.394	8.987	8.407	0.443	0.196249
20.762	9.401	11.361	3.397	11.53961
26.282	14.48	11.802	3.838	14.73024

24.524	22.328	2.196	-5.768	33.26982
18.644	15.298	3.346	-4.618	21.32592
17.51	15.073	2.437	-5.527	30.54773
20.33	16.929	3.401	-4.563	20.82097
35.255	18.2	17.055	9.091	82.64628
22.158	12.13	10.028	2.064	4.260096
25.139	18.495	6.644	-1.32	1.7424
20.429	10.639	9.79	1.826	3.334276
17.425	11.344	6.081	-1.883	3.545689
34.288	12.369	21.919	13.955	194.742
23.894	12.944	10.95	2.986	8.916196
17.96	14.233	3.727	-4.237	17.95217
22.058	19.71	2.348	-5.616	31.53946
21.157	16.004	5.153	-2.811	7.901721
22.01592	14.05113	7.964792		544.3305
				23.66654
				4.864827

S=denotes the standard deviation=**4.864**

2. Calculate the **point estimate**

point estimate: 22.01-14.5=7.964

3. Since we have to prove slower reaction time on incongruent words than on congruent words we take one tailed test with alpha value 0.05(5%).

Degree of freedom **df=23**

Hence t-critical value **t_{critical}=1.714**

4. Calculate the t-statistic value:

$$t = \frac{\mu_Q - \mu_A}{S/\sqrt{n}}$$

n=24

S=16.98

t =7.964/ (4.864/4.898)

=**8.0201**

Since t statistic value lies in the t critical region reject the null hypothesis.

Hence we can say the participants or the population show slower reaction time on incongruent words than on congruent words.