# Statistics: The Science of Decisions Project

**Question #1**

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

The independent variable is the word conditions . There are two types of word conditions - Congruent words condition and an Incongruent words condition.

Dependent variable is the time taken by the participant to name the ink colors in each words condition.

**Question #2.**

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

The appropriate set of hypotheses would be

$H0 : \mu c = \mu i$

$H_A : \mu c \neq \mu i$

Where ,

H0 is the null hypothesis states that there is no significant difference between congruent and incongruent words

$H_A$ is the alternative hypothesis states that there is a significant difference between congruent and incongruent words

$\mu c$ is the average population response time of the congruent words

$\mu i$ is the average population response time of the incongruent words

T -tests are performed when

- The population parameters are unknown

- When you have a sample of small size

We assume that the sampling distribution is approximately normal because of the small sample size.

A paired t-test is used when we have two related observations (ie each participant take part in two word conditions). Hence it falls under the dependent sample or repeated measures .

Non-directional alternative hypothesis does not predict whether $\mu c$ is larger or smaller than the $\mu i$ .we are interested in knowing whether $\mu c$ is equal to $\mu i$ or not.

**Two tailed ,dependent t-test at $\alpha = 0.05$ is our statistical test**

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

The central tendency

Mean of the congruent words condition= 14.05
Mean of the incongruent words condition = 22.02

The dataset can be modified as below to calculate the mode

| Value Range | Congruent words | Incongruent words |
|---|---|---|
| 0-5 | 0 | 0 |
| 5-10 | 4 | 0 |
| 10-15 | 11 | 0 |
| 15-20 | 8 | 8 |
| 20-25 | 1 | 12 |
| 25-30 | 0 | 2 |
| 30-35 | 0 | 2 |

Congruent words has highest occurences in the value range 10-15

Incongruent words has highest occurences in the value range 20-25

Measure of Variability

| | Congruent words | Incongruent words |
|---|---|---|
| Sum of squares | 291.39 | 529.27 |
| variance | 12.67 | 23.01 |
| Standard deviation | 3.56 | 4.80 |

| Congruent | Incongruent | congruent | Incongruent | | | |
|---|---|---|---|---|---|---|
| 12.079 | 19.278 | 3.889277016 | 7.496187674 | | | |
| 16.791 | 18.741 | 7.506915016 | 10.72507917 | | congruent | incongruent |
| 9.564 | 21.214 | 20.13429077 | 0.6430703403 | variance= | 12.66902907 | 23.01175704 |
| 8.63 | 15.687 | 29.38859627 | 40.05518617 | std deviation= | 3.559357958 | 4.797057122 |
| 14.669 | 22.803 | 0.3817695156 | 0.6195001736 | | | |
| 12.238 | 20.878 | 3.287422266 | 1.29485434 | | | |
| 14.692 | 24.572 | 0.4107207656 | 6.533562007 | | | |
| 8.987 | 17.394 | 25.64536202 | 21.36211367 | | | |
| 9.401 | 20.762 | 21.62366252 | 1.572307007 | | | |
| 14.48 | 26.282 | 0.1839337656 | 18.19946701 | | | |
| 22.328 | 24.524 | 68.50665977 | 6.290482007 | | | |
| 15.298 | 18.644 | 1.554697266 | 11.36982201 | | | |
| 15.073 | 17.51 | 1.044228516 | 20.30328501 | | | |
| 16.929 | 20.33 | 8.282164516 | 2.842315007 | | | |
| 18.2 | 35.255 | 17.21316377 | 175.2733275 | | | |
| 12.13 | 22.158 | 3.690721266 | 0.02018767361 | | | |
| 18.495 | 25.139 | 19.74802502 | 9.753649507 | | | |
| 10.639 | 20.429 | 11.64259702 | 2.518304507 | | | |
| 11.344 | 17.425 | 7.328525766 | 21.07651584 | | | |
| 12.369 | 34.288 | 2.829544516 | 150.6040293 | | | |
| 12.944 | 23.894 | 1.225725766 | 3.527197007 | | | |
| 14.233 | 17.96 | 0.03307851562 | 16.45046001 | | | |
| 19.71 | 22.058 | 32.02286627 | 0.001771006944 | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 16.004 | 21.157 | 3.813720766 | 0.7377378403 | | | |
| | | | | | | |
| mean= | mean= | sum of squares= | sum of squares= | | | |
| 14.051125 | 22.01591667 | 291.3876686 | 529.2704118 | | | |

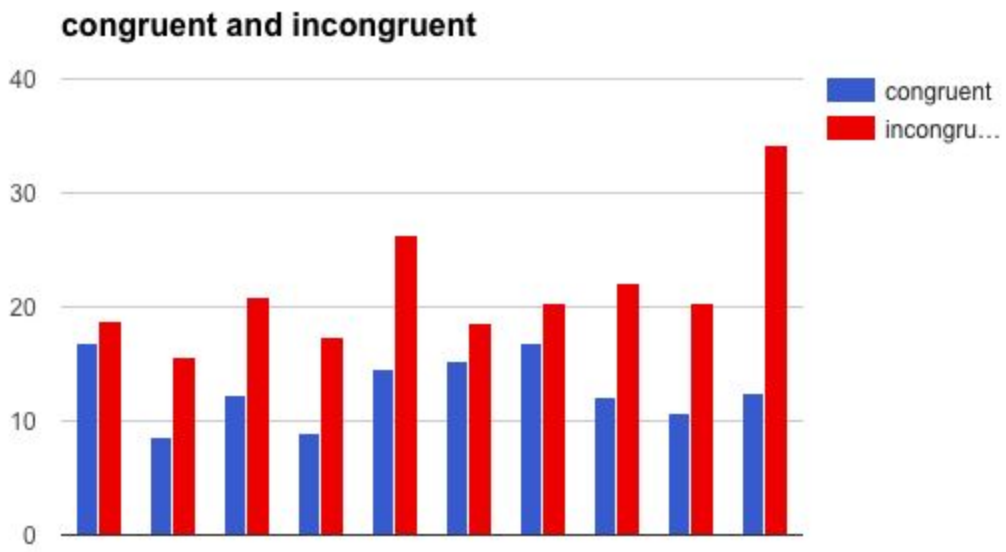
**Question #4**

**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.**

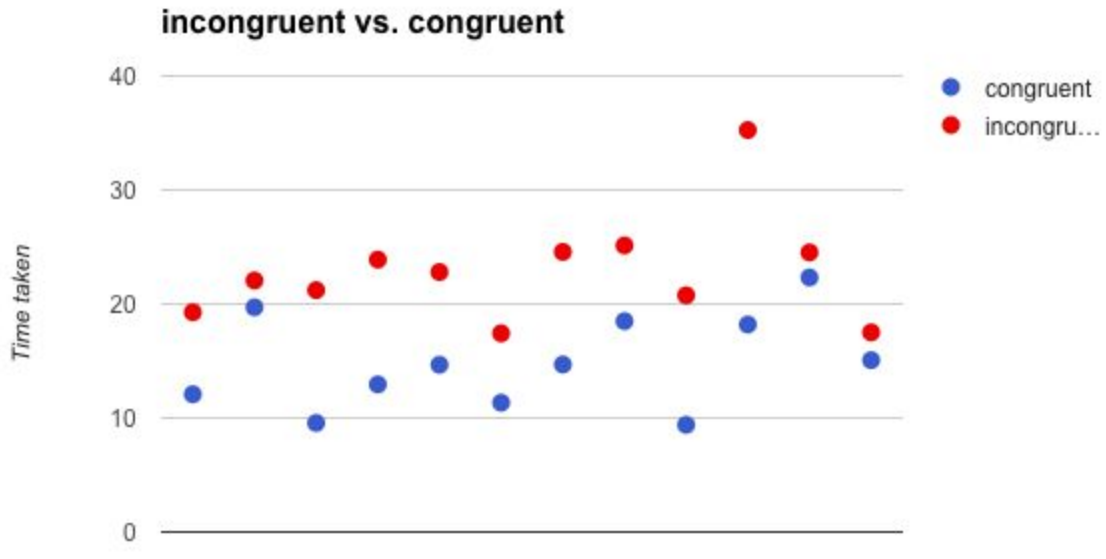
The sample data can be visualized using a bar diagram ,scatterplot or histogram

On visualizing the sample data ,the data points of incongruent words are higher than the datapoints of congruent words.

Bar diagram :




Scatterplot:




**Question #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?**

| Congruent | Incongruent | difference | |
|---|---|---|---|
| 12.079 | 19.278 | -7.199 | 0.5864368767 |
| 16.791 | 18.741 | -1.95 | 36.17771879 |
| 9.564 | 21.214 | -11.65 | 13.58076046 |
| 8.63 | 15.687 | -7.057 | 0.8240857101 |
| 14.669 | 22.803 | -8.134 | 0.02863146007 |
| 12.238 | 20.878 | -8.64 | 0.4559062934 |
| 14.692 | 24.572 | -9.88 | 3.66802296 |
| 8.987 | 17.394 | -8.407 | 0.1955482101 |
| 9.401 | 20.762 | -11.361 | 11.53423104 |
| 14.48 | 26.282 | -11.802 | 14.72416779 |
| 22.328 | 24.524 | -2.196 | 33.27895729 |
| 15.298 | 18.644 | -3.346 | 21.33323646 |
| 15.073 | 17.51 | -2.437 | 30.55648071 |
| 16.929 | 20.33 | -3.401 | 20.82819438 |
| 18.2 | 35.255 | -17.055 | 82.63188754 |
| 12.13 | 22.158 | -10.028 | 4.256828627 |
| 18.495 | 25.139 | -6.644 | 1.744490627 |
| 10.639 | 20.429 | -9.79 | 3.33138546 |
| 11.344 | 17.425 | -6.081 | 3.548671043 |
| 12.369 | 34.288 | -21.919 | 194.7199302 |
| 12.944 | 23.894 | -10.95 | 8.911468793 |
| 14.233 | 17.96 | -3.727 | 17.95887821 |
| 19.71 | 22.058 | -2.348 | 31.54834863 |
| 16.004 | 21.157 | -5.153 | 7.906172377 |
| | | | |
| mean= | mean= | mean= | sum= |
| 14.051125 | 22.01591667 | -7.964791667 | 544.33044 |

Sum of squares= 544.33

S=4.86482691

Standard error =0.993

n=24
df=23

t statistic = -8.02
t critical = ± 2.069

Margin of error =2.05

95% Confidence Interval =( -10.02 , -5.91)

The t statistic value falls in the critical region hence **we reject the null.**

Our statistical test shows that there is a significant difference between congruent and incongruent words . The results did match up with the visualized data.

**Question #6**

**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!**

The carryover effects might have caused this trend. When a participant takes part in the congruent words ,it is easier to read the colour of ink as it matches with its colour name. Brain gets used to this and when the same participant takes incongruent words ,they tend to read the words by congruent way initially and corrects themselves later .so the time taken in reading a incongruent words is higher.Hence I say carryover effects has an impact.

The stroop effect with direction likely to have same effect of this one .
The stroop effect with direction is carried by showing Up,Down,left and right in a square. In congruent method, each directional word matches with its position whereas in incongruent method,each directional word does not match with its position in the square.
Stroop effect with incongruent method likely to take more time than congruent method.

References:

http://study.com/academy/lesson/identifying-interpreting-independent-dependent-variables.html

https://faculty.washington.edu/chudler/words.html

http://www.math.unt.edu/~tam/SelfTests/StroopEffects.html