Project No.1

The Science of Decisions

Question of Investigation:

1. a) What is our independent variable

The independent variable in this experiment is the different word condition. There is either the congruent word condition, which means the word has the same colour and meaning, or the incongruent word condition when the colour word doesn't match with the colour they are printed.

1. b) What is our dependant variable

The dependent variable is the time a participant needs to name the ink colour of the displayed word. The experiment is a test with dependant variables because each person does the test with both condition. So we are not using different kind of groups, instead one group of people does both tests.

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

The Null Hypothesis is: **Inference Statistic:**

The sample means for the two word conditions are:

x(congruent)=14.05 sec
x(incongruent)=22.02 sec

The population mean of the congruent word condition (μ(congruent condition)) equals the population mean of the incongruent word condition (μ(incongruent condition)).

$$\mu(\text{congruent condition}) \approx \mu(\text{incongruent condition})$$
or
$$\mu(\text{incongruent condition}) - \mu(\text{congruent condition}) \approx 0$$

The Alternative Hypothesis is:
Regarding our sample means the alternative hypothesis in directional (My conclusion because the difference is very high). Thus the population mean of the incongruent condition is larger than the population mean of the congruent condition:

$$\mu(\text{incongruent condition})>\mu(\text{congruent condition})$$
$$\mu(\text{incongruent condition})-\mu(\text{congruent condition})>0$$

The Hypothesis reference the population. Because it is a inference statistic we want to get more information about the whole population by using the paired sample for a point estimate (I will explain this point estimate in more detail when I calculate the t value)

In this experiment a one tailed paired sample t test is used. A paired t-test is used because the same group of people were tested twice (two conditions). It is a test with dependent variables. The same group of people are tested with both word conditions.

3. Descriptive Statistics: Measure of centrality, measure of variability

Measure of centrality:

Mean Difference of the two dependant samples:

$$\Delta x=7.965$$

Median of the Differences:

$$\text{median(incongruent-congruent)}=7.667$$

Measure of variability:

Standard deviation and Variance of the congruent and incongruent sample:

$\text{var(congruent)}=s^2=12.669$; $s(\text{congruent})=3.559$
$\text{var(incongruent)}=s^2=23.012$; $s(\text{incongruent})=4.797$

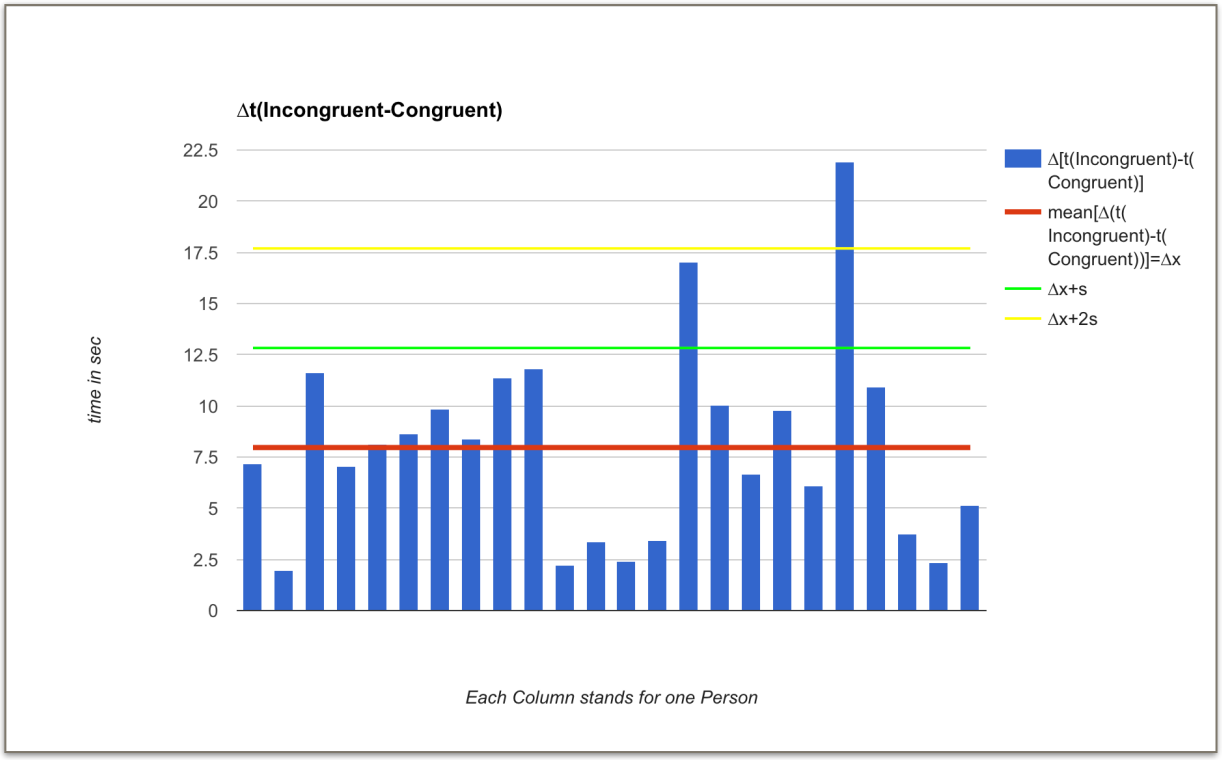
Standard deviation of the Differences:

$\text{var(differences)}=s^2=23.667$; $s(\text{differences})=4.865$

IQR Value (Interquartile Range) for the Differences (Calculated with Excel):

$Q1= 3.646$
$Q3= 10.259$
$IQR=Q3-Q1=6.613$

4. Provide visualisations and an interpretation



The Plot shows the differences of the time participants needed to read out loud the ink of the displayed words between the incongruent and the congruent word condition:

1. Δ[t(Incongruent)-t(Congruent)]

It is recognised that all of the differences are positive which means the time for the incongruent word
condition was always larger than for the congruent one.
The addition I plotted the mean of the differences Δx=7.965 sec. Moreover the sample standard deviation(s)
was calculated and inserted in the chart. On the one hand we have the 1*s interval (green lines) and on the other
hand the 2*s interval (yellow line). In this sample normal distribution about 75% of the values lie in the 1s interval
and 95.8% lie in the 2*s interval. Only one difference is bigger than Δx+2s

1*s Interval: $\Delta x - s \leq \Delta[t(\text{Incongruent}) - t(\text{Congruent})] \leq \Delta x + s$

2*s Interval: $\Delta x - 2s \leq \Delta[t(\text{Incongruent}) - t(\text{Congruent})] \leq \Delta\mu + 2s$

5. Perform a statistical t-test and report your results

The t-value for this one tailed t-test with depending variables is:
The point estimate for Δμ is the mean difference from our the paired samples:

$$\Delta\mu=\Delta x=7.965$$

$$t= \Delta\mu/(s/\sqrt{n})= 8.021$$

Depending on our significance level Alpha we can reject the Null Hypothesis:

For **Alpha=0.05** for a one tale test the critical value for t is (referring to the Data Sheet/ image) **t(critical)=1.714** (df=23). So our t value is exceeding the critical value therefore the Null Hypothesis is rejected. An we accept the alternative hypothesis.
Thus the population mean of the incongruent condition will be larger than the population mean of the congruent condition.
The confidence level is 95 % for this significance value.

If we choose **Alpha= 0.01** regarding a one tailed test with paired variables the critical value is **t(critical)=2.500** (df=23)

So our t value is exceeding the critical value therefor we reject the Null Hypothesis and stay we the alternative one:
The confidence level is 99% for this significance value.

We restricted our significance level Alpha, so one can conclude that the p-value for our point estimate (t-value) is smaller than 1%:

$$p(t=8.021)<1\%$$

I calculated the p value with the graphpad software for a one tailed t test:

$$p(t=8.021)= 0.00005.$$

To get this result by chance is very very unlikely. The p-value underlines that our result is extremely statistically significant

This matches up with my expectation. The incongruent word condition influenced in the way that the time increased. The expected
population mean for the incongruent word condition is larger that the population mean for the congruent condition.

6. What is responsible for the effects observed? Similar and alternative task which would prove the same effect?

The key words for the observed effect are explained by different theories. One of them is the selective attention theory which states that the colour recognition needs more attention than word encoding. According to Broadbent's Filter Model[1] we could perform a similar listening task. Imagine a participant has to listen to different music scales from the right ear and another speaker keeps saying the right music scale into his other ear (for example a C-major scale). After listening to both information he must say which real music scale he was listening to. The incongruent condition would be that the speaker tells him the wrong music scale than the one he is actually hearing and after listening he has to say the right music scale. I am pretty sure that the incongruent condition would take a participant longer than the other one because encoding a word is less difficult than encoding a music scale.
To sum up some tasks require more and other less attention, or regarding to the Stroop effect some tasks need more controlled attention for example colour recognition than encoding a word. But the uncontrolled attention (in this case word encoding) uses a part of our processing power (ability of attention) and that is one explanation why the incongruent condition takes longer.[2]

[1]Reference:Selective Attention (http://www.simplypsychology.org/attention-models.html)

[2]Reference: Stroop Effect Theories (https://en.wikipedia.org/wiki/Stroop_effect#Selective_attention)