Project 3: Test a Perceptual Phenomenon

1. INDEPENDENT AND DEPENDENT VARIABLE

In this experiment, the congruency of the color and the text is the independent variable: In the first test, it matches, in the second one not.
The dependent variable is the time needed to say the color.

2. HYPOTHESES, KIND OF STATISTICAL TEST

I want to analyze the data to see if the population means of the two different test designs are different.
We know nothing about the complete population here, so a z-test is not possible. With the limited sample data we have, I will try to find evidence to say something about the population means.
I choose a two-tailed statistical test here as I want to know if there is a difference between the two tests in either direction. For this, I assume that the test results are normally distributed in the whole population and that these samples are randomly collected from the population.
Also, the two samples are dependent as every person takes both of them one after the other. So I will perform a dependant t-test with N = 24.

The null hypothesis for this test is 'The congruency doesn't make a difference in the time needed to say the color'.

H_0: $\mu_C = \mu_I$ oder $\mu_C - \mu_I = 0$

The alternative hypothesis is 'The congruency does make a difference in the time needed to say the color'.

H_A: $\mu_C \neq \mu_I$ oder $\mu_C - \mu_I \neq 0$

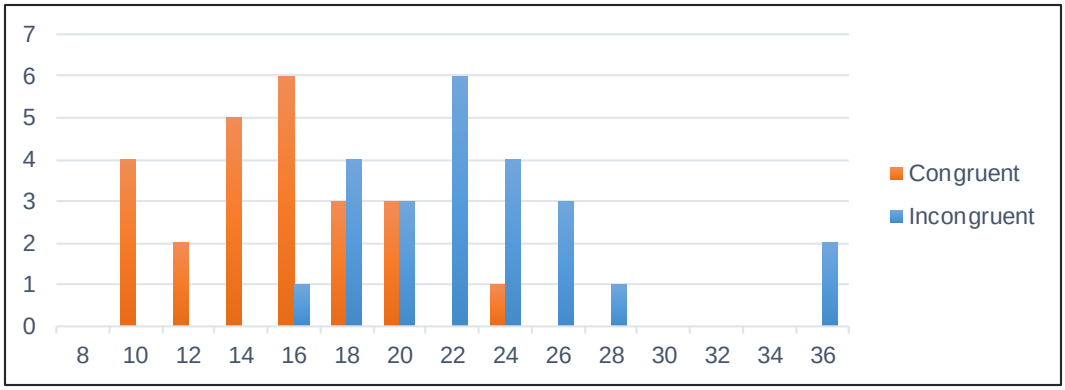
H_0: null hypothesis
H_A: alternative hypothesis
μ_C: population mean for the congruent test
μ_I: üopulation mean for the incongruent test

3. DESCRIPTIVE STATISTICS

All values are rounded to 2 decimals.
N = 24 for each test

	Congruent	**Incongruent**
Mean	14.05	22.02
Median	14.36	21.02
Variance	12.67	23.01
Standard deviation (sample)	3.56	4.80

4. DISTRIBUTION VISUALIZATION



The histogram shows that both data sets are approximately normally distributed, but the incongruent one is moved to the left. It also seems to have two outliers.

5. STATISTICAL TEST AND CONCLUSIONS

As the samples are dependent, I work with the difference $x_I - x_C$.
$\alpha = 0.05$
$df = 23$
$t_{crit} = \pm 2.069$
$\bar{X}_D = 7.96$
$SE_D = 0.99$

$t(23) = 8.02$, $p < .0005$, two-tailed
Confidence interval on the mean difference; 95 % CI = (5.91, 10.02)
$d = 1.64$
$r^2 = .74$

With $t > t_{crit}$, I reject the null hypothesis.
The difference is statistically significant for an Alpha-Level of $\alpha = 0.0005$.
74 % of the test result difference is related to the congruency.

This shows that it is significantly harder for a human to say the correct color of the word if the word itself says another color. This is exactly what I expected as I was worse in the second test myself.

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!

According to Wikipedia, there are several theories trying to explain this effect:

- the brains reads faster than it recognizes colors, so the read color is available faster
- color recognition requires more attention than reading, so it takes longer

- reading is more automatized by the brain than color recognition, so the brain hesitates to recognize the color
- the brain pathway for reading is stronger developed than the color recognition one, so it is preferred

A similar test would be to show a number of digits, like five 3s on a picture, and the person has to count them and say the quantity of 3s. This would mix the counting capability with the number reading capability.

SOURCES

- https://praxistipps.chip.de/excel-histogramm-erstellen_16818
- https://en.wikipedia.org/wiki/Stroop_effect