# Test a Perceptual Phenomenon

## Questions for Investigation

Q1. What is our independent variable? What is our dependent variable?
A1. The Independent variable is the test method (congruent and incongruent).

The Dependent variable is the reaction time of the person.

Q2. What is an appropriate set of hypotheses for this task? What kind of statistical test do you expect to perform? Justify your choices.
A2. The null hypothesis should be that the mean time for color recognition for congruent words is equal to or greater than the mean time for incongruent words, therefore implying a one-tailed test. The alternative hypothesis should be that the congruent words mean is less than the incongruent words mean.

$H_0$: $\mu_C \geq \mu_I$

$H_A$: $\mu_C < \mu_I$

where μ is a population mean, the subscript "C" represents the congruent words condition, and the subscript "I" represents the incongruent words condition.

A one-tailed, dependent samples t-test comparing the difference in means (the time to name the ink colors for congruent words and incongruent words) should be performed. With this test, we seek to determine whether there is enough evidence in the provided sample of data to infer that the congruent words mean color recognition time is less than the incongruent words mean color recognition time for the entire population and not just the sample data.

A t-test is appropriate because the population variance is unknown and the sample size is less than 30. When the sample size is less than 30, the sample data no longer approximate a normal distribution, which makes the use of a Z-value inappropriate.[1] The following assumptions are required for t-tests for dependent means:[2]

- Interval or ratio scale of measurement (approximately interval)
- Random sampling from a defined population
- Samples or sets of data used to produce the difference scores are linked in the population through repeated measurement, natural association, or matching
- Scores are normally distributed in the population; difference scores are normally distributed

A one-tailed test is appropriate under the assumption that incongruent word conditions will not improve recognition times, which is intuitive. The one-tailed test allows for a more scrutinous examination of the negative impact of incongruent word conditions on recognition times.

The t-test should be of the dependent samples variety because the same subject is exposed to two conditions and tested for each, which are the defining criteria for "within-subjects" or "repeated-measures" statistical tests.[3]

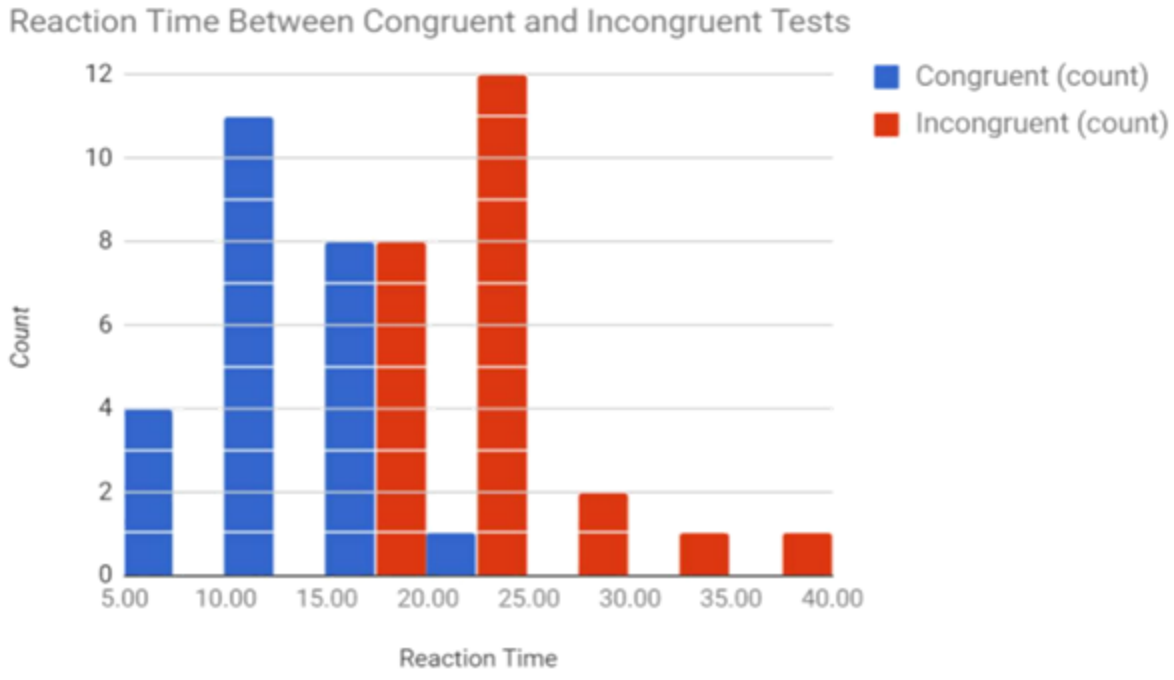
Q3. Report some descriptive statistics regarding this dataset. Include at least one measure of central tendency and at least one measure of variability.

A3.

| Statistic | Congruent | Incongruent |
|---|---|---|
| Sample Size | 24 | 24 |
| Mean | 14.05 | 22.0159 |
| Median | 14.3565 | 21.0175 |
| Variance | 12.67 | 23.01 |

Q4. 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.

A4.




From the graph, we can see that the incongruent reaction time is leaning towards the right, which means people generally take more time to react during incongruent tests.

Q5. 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?

A5. $\alpha = .01$

$df = 23$

$t_{crit} = -2.50$

$t = -8.02$

p-value = < .0001

At the 99% confidence level ($\alpha = .01$) and 23 degrees of freedom, the critical statistic value for a one-tailed test in the negative direction is -2.5. The calculated t-statistic for the difference in color recognition time means of the congruent and incongruent word data is -8.02. Since the t-statistic is in the critical region, the null hypothesis is rejected. With the data presented, it is very unlikely that the 7.96 second difference in mean time for color recognition for the congruent data vs. the incongruent data is obtained if the two means are actually the same (or if $\mu_C > \mu_I$). By conventional criteria, this difference is considered to be extremely statistically significant.

There is sufficient evidence at the $\alpha = .01$ level of significance to support the claim that it takes less time to recognize the color of words with the congruent condition compared to words with the incongruent condition.

# Bibliography


1. https://s3.amazonaws.com/udacity-hosted-downloads/t-table.jpg
2. https://en.wikipedia.org/wiki/Stroop_effect