

## Questions For Investigation

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### 1. What is our independent variable? What is our dependent variable?

- The independent variable is whether the word condition is congruent or not. That is, whether the colour of the word you're trying to read matches the word name.
- The dependent variable is the time it takes to name the ink colours in equally-sized lists.

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

We want to investigate whether a congruent or incongruent word condition affects the time it takes to name the ink colours in equally-sized lists. Our hypotheses will be:

- $H_0: \mu_{congruent} = \mu_{incongruent}$
- $H_A: \mu_{congruent} \neq \mu_{incongruent}$

Where  $\mu$  is the mean time to name the ink colours. Although we imagine that  $\mu_{congruent} < \mu_{incongruent}$ , we are not asked to investigate this in the problem.

In natural language, the **null hypothesis** would read: "There is no significant difference between the mean time taken to correctly read a list of ink colour names when the colours and names are congruent and incongruent." The **alternative hypothesis** would read: "There is a significant difference between the mean reading time of a list of ink colour names when the word condition is congruent and incongruent. That is why the alternative hypothesis is non-directional.

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

- As the sample size is smaller than 30 and the population standard deviation is unknown (and should only be estimated from the sample data if  $n \geq 30$ ), a t-test will be used.
- If we assume that the distributions are gaussian, then we could use the Z-test. The requirement that the sample size be bigger than 30 to use the Z-test is to ensure that the sampling distribution is normal. If the underlying population distribution is normal, this condition can be relaxed.
- **For this hypothesis test we will use a t-test.**
- We will use a dependent t-test because the reading speed of the same people is measured when the word condition is congruent and incongruent. The two samples are dependent because they are taken from the same people.

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

- For the congruent dataset, our mean,  $\overline{x_{congruent}}$ , is 14.05.
- For the incongruent dataset, our mean,  $\overline{x_{incongruent}}$ , is 22.02.

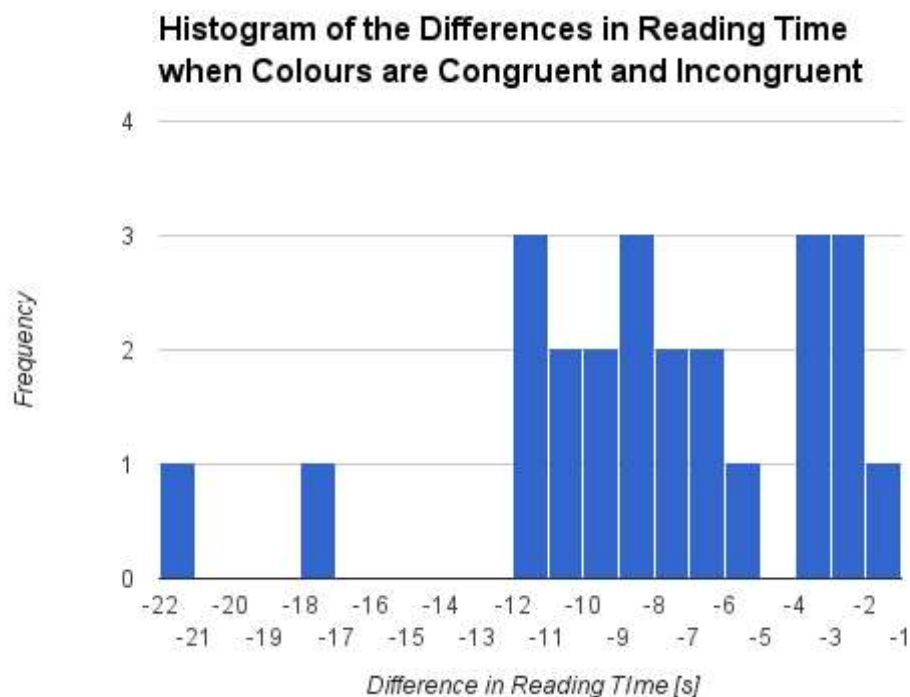
So our point estimate for

$$\overline{xdifference} = \overline{xc} - \overline{xi} = 14.05 - 22.02 = -7.97$$

Our standard deviation of the difference is:

$$S = 4.86$$

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.



Plotted is a histogram showing the frequency of different differences in reading times. The bin size is 1 second. The majority of the data resides around the mean.

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?

We will perform a 95% confidence level with  $\alpha = 0.05$ . As it's a two-tailed test, this probability value of 0.05 is split between either side of the distribution. For  $n = 24$ ,  $df = 23$ , therefore the t-critical value is 2.069.

The t statistic is:  $(\overline{xc} - \overline{xi}) / (s / \sqrt{n})$

$$(\overline{xc} - \overline{xi}) = -7.97$$

$$S = 4.86$$

$$N = 24$$

$$T = -8.04$$

As the t value > t-critical, we reject the null hypothesis. The congruency of color name and word colour significantly impacts the time required to read a list of colour names. This confirms my initial expectation.

**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!**

The value of r squared is 0.74. Therefore 74% of the variation in our outcome can be attributed to the congruence or lack of congruence of the colour and colour name. What could account for the remaining 26%? The mental state of the participant, talent.