1. **What is the independent variable? What is our Dependent Variable?**

Independent Variable: Whether the ink color and word name are the same or different.
Dependent Variable: Response time in seconds to indicate the color.

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

H_0 (Null Hypothesis): There would be no or insignificant difference in the population mean between incongruent and congruent tests.

H_a (Alternative Hypothesis): There would be a noticeable increase in time duration for the incongruent tests versus the congruent tests.

The test should be a single-tailed type scenario as we need to test if the incongruency test increase response times. Since the sample is less than 30 (24 participants) and the distribution sample is a normal distribution and we don't know the standard deviation of the population (σ), the t-Test is the appropriate test to compare the samples means.

- The Dependent samples t-Test is the appropriate statistical test as the same subjects are assigned two different conditions. The incongruent times were mainly than the congruent times.
- The Paired t-Test is to measure the response time for congruent and incongruent word sets.

• $\mu 1$ = the mean of time spent for the participant group of congruent test
• $\mu 2$ = the mean of time spent for the participant group of incongruent test

The null hypothesis (H_0):
$\mu 1 - \mu 2 \geq 0$, the time duration difference of the congruent and incongruent tests would equal 0 or be greater than 0, meaning the incongruent times would be less or equal to the congruent times for the population.

The alternative hypothesis (Ha):
$\mu 1 - \mu 2 < 0$, the time duration difference of the congruent and incongruent tests would be less than 0, meaning the incongruent times would be greater than the congruent test times for the population.

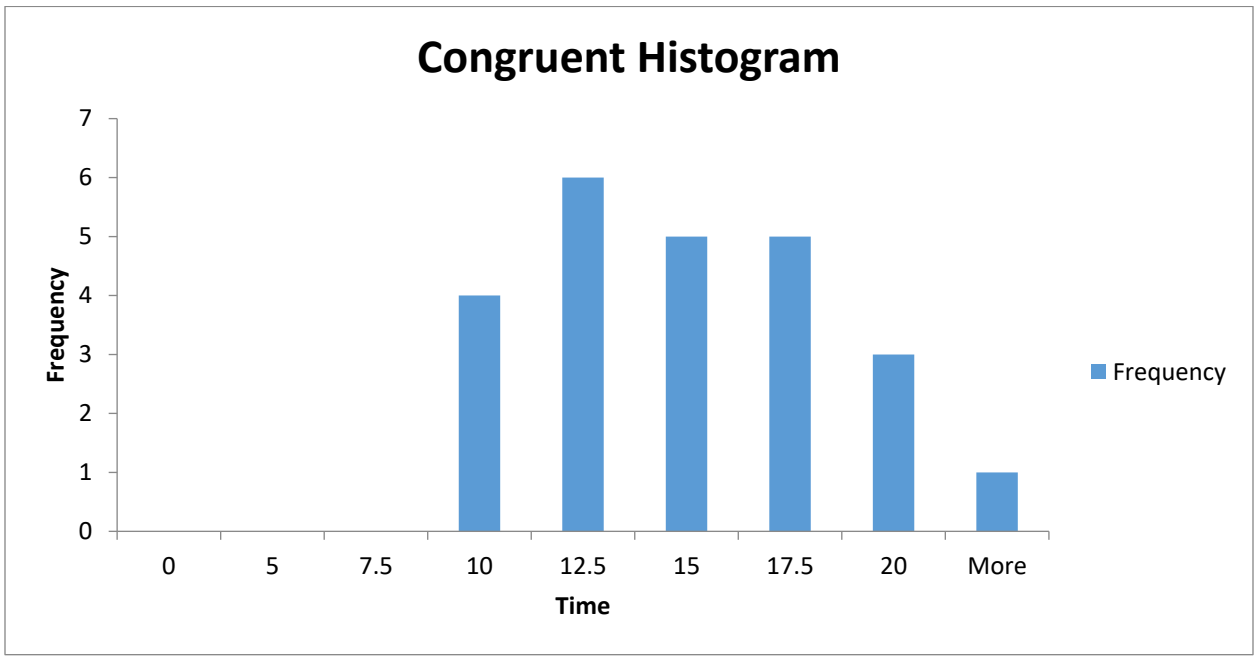
The Dependent samples t-Test is the appropriate statistical test as the same subjects are assigned two different conditions. The incongruent times were mainly than the congruent times.

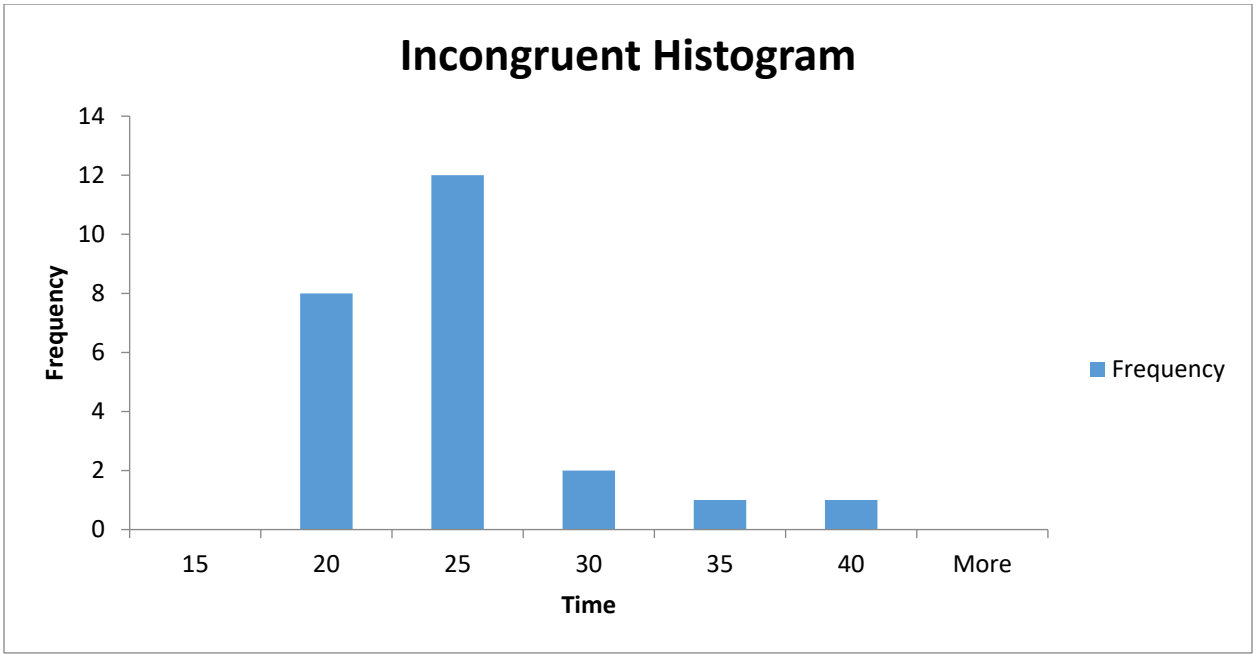
3. **Report some descriptive statistics regarding this dataset. Include at least one measure of central tendency and at least one measure of variability.**

***Central Tendency*:**	**Congruent**	**incongruent**
Mean ($\bar{x}$)	14.051	22.016
Median (M)	14.357	21.018

Variability :	**Congruent**	**incongruent**
Q1	11.895	18.717
Q3	16.201	24.052
IQR	4.306	5.335

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 congruent histogram resembles closely to a normal distribution curve, the time is between 8 and 22 seconds and has a lower average completion.
The incongruent histogram is right-skewed distribution, the time is between 15 and 25 with outlier at 34 and 35 and has a large average completion

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?**

From question 2, we or this experiment we will consider that the test will be dependent and paired since the group took both the congruent and incongruent tests (From Question 2 answer) and we will calculate the statistical T-test data.

We might calculate the point estimate to have the best guess on the difference between the two tests population means (Population difference estimate of congruent versus incongruent times) calculated in question 3.

$$\bar{x}_c - \bar{x}_i = 14.051 - 22.016 = -7.965$$

Since the standard deviation of differences (S = $\sqrt{\frac{\sum(x-\bar{x})^2}{n-1}}$)= 4.865 and our population is n =24

We will calculate the T-Statistic:

$$\text{T-Statistic} = \frac{\bar{x}c - \bar{x}i}{s/\sqrt{n}} = -8.026$$

Now we can compare the T-Statistic value to the T-Critical value to determine if the null hypothesis should be accepted or rejected, using the degree of freedom n-1= 23 (24 participants) and aiming to find it at 99% of Confidence level meaning α = 0.01 for one tail

So at the 99% confidence level (α =0.01) and 23 degrees of freedom the critical statistic value for a one-tailed test is -2.5 in the negative direction (since T-statistic is negative we are using the left tail t-Test). And since the T-Statistic is -8.026 we conclude that the null hypothesis should be rejected. That confirms that the incongruent tests would normally take longer time than congruent test as expected

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!**

I think that the brain is responsible for the effects observed, the brain read the word letters much faster than the color if it's different from the word.

I think we can have similar result if we time the response time when reading numbers from 0 to 9 and letters from A to J and if we do a mixture of letters and numbers as follow:

1) Read and time : 0-1-2-3-4-5-6-7-8-9-A-B-C-D-E-F-G-H-I-J
2) Read and time : 0-A-1-B-2-C……..9-J

I think that the mean time to read the second set of data will be higher than reading the first set of data.