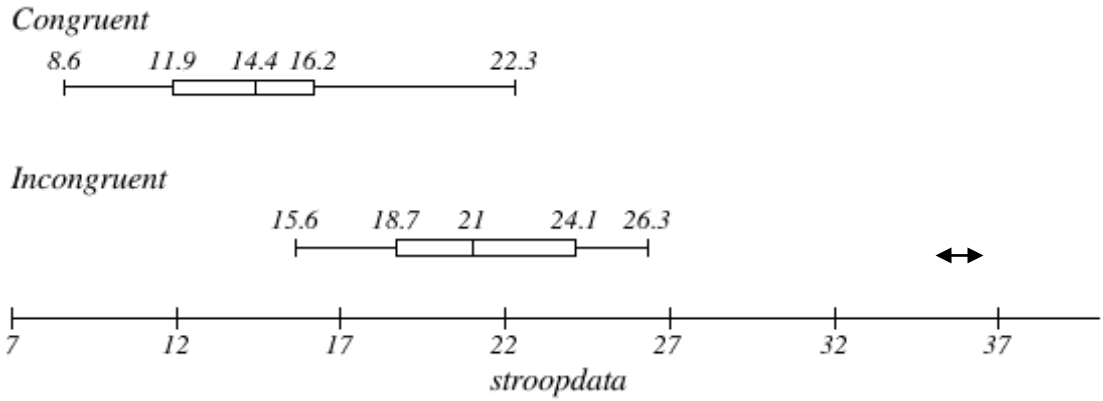
1. **What is our independent variable? What is our dependent variable?**
    - Independent variable: The ink color – whether the ink color and the color match.
    - Dependent variable: The the time it takes for a participant to name the ink colors in equally-sized lists, but for different congruency.

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: The mean of time it takes to name the ink colors is indifferent between congruent and incongruent words condition ($\mu_c = \mu_I$)
    - H_a: The mean of time it takes to name the ink colors is significantly different between congruent and incongruent words condition ($\mu_c \neq \mu_I$)
    - I expect to perform a dependent t-test, since we are determining whether the two datasets are significantly different from each other, while the the datasets are dependent*. Also, rather than knowing the mean of the whole population, we only have the data of samples, it is better to use t-test than z-test (to conduct z-test we need to know the population mean).

3. **Report some descriptive statistics regarding this dataset. Include at least one measure of central tendency and at least one measure of variability.**
    - The sample size is 24 (n=24)
    - The sample mean of congruent words condition is 14.05 ($\bar{x}_C = 14.05$); the sample mean of incongruent words condition is 22.02 ($\bar{x}_I = 22.02$)
    - The standard deviation of congruent words condition is 3.56 ($\sigma_c = 3.56$); the standard deviation of incongruent words condition is 4.8 ($\sigma_I = 4.8$)

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 boxplot above shows the distribution of both congruent and incongruent datasets. Since the congruent line is on the left of incongruent data, we can say that on average it took fewer time for a participant to name the congruent color cards. Also there are some outliers for incongruent dataset.

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?**

I perform a t-test, with a 95% confidence level, two-tailed test.

The t statistics = $\frac{\mu_I - \mu_C}{s/\sqrt{n}} = \frac{7.96}{4.86/\sqrt{24}} = 8.01$

The t critical value = ± 2.069 (looking up the t-table**, with dF = 23)

Confidence interval = $7.96 \pm 2.069 \times \frac{4.86}{\sqrt{24}} = (5.88, 10.04)$

As the calculated t statistics is bigger than the t critical value (8.01 > 2.069), I would reject the null hypothesis. This concludes that the time it takes to name the ink colors is significantly different between congruent and incongruent words condition – it takes significantly longer time for a participant to complete the task in incongruent words condition.

The conclusion did match up with my expectations, since the point estimate is already large (7.96) for the difference between two datasets. As I also tried the Stroop task myself and did badly in the incongruent condition, it's not surprising to me that the null hypothesis is rejected.

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 most commonly-accepted causation for the effect is that our brain is automated to respond to the meaning of words, while recognizing colors is not an "automatic process" ***. A similar task that would result in a similar effect is typoglycemia, where readers can understand the meaning of words in a sentence even when the interior letters of each word are scrambled****.

Reference:

* Student's t-test: https://en.wikipedia.org/wiki/Student%27s_t-test

** t-table: https://s3.amazonaws.com/udacity-hosted-downloads/t-table.jpg

*** Stroop effect: https://en.wikipedia.org/wiki/Stroop_effect

**** Typoglycemia: https://en.wikipedia.org/wiki/Typoglycemia