



# Visual Illusions

Kevin Ko and Ariana López

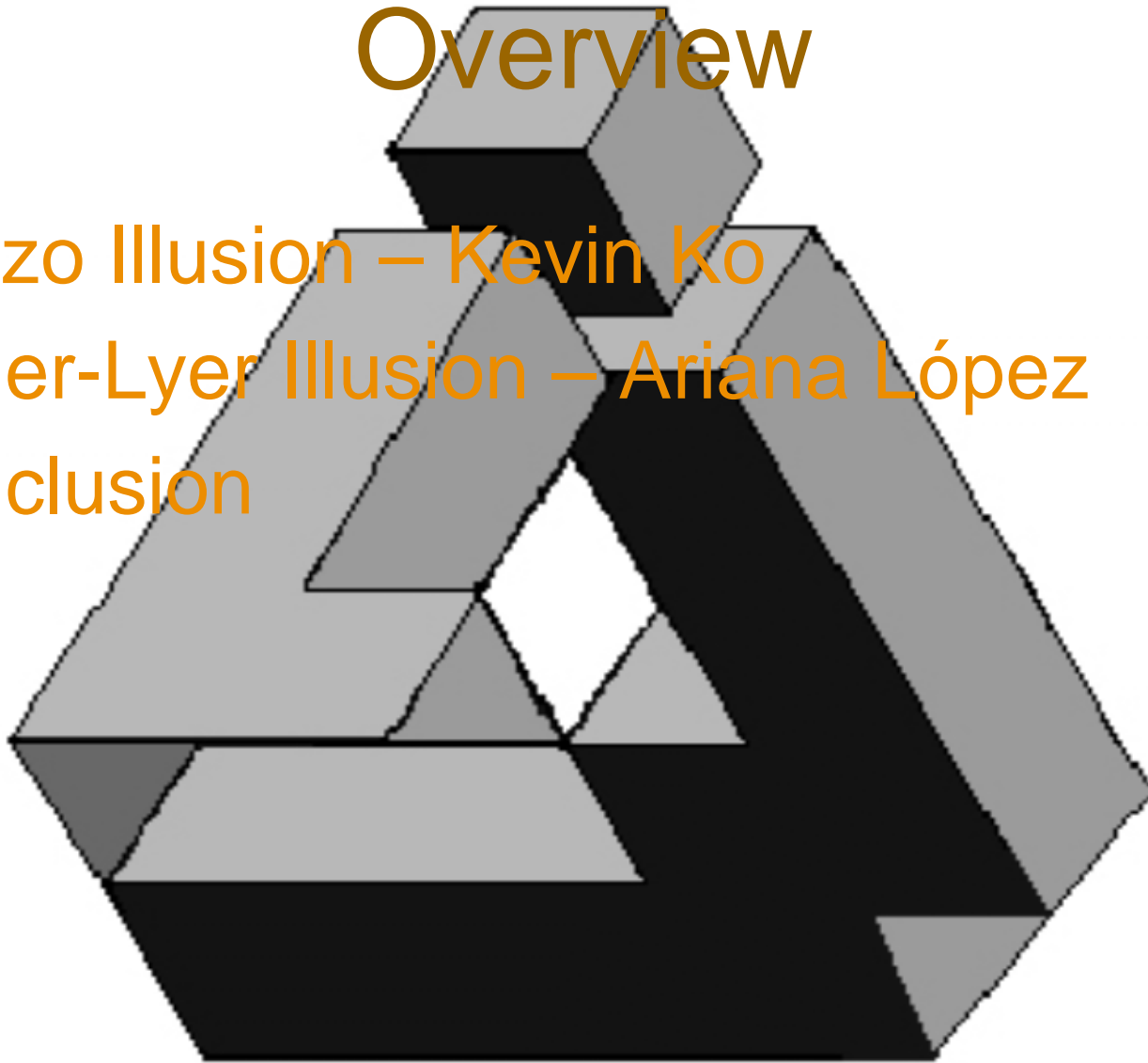
July 23, 2004

COSMOS 2004, UC Santa Cruz

Cluster 7

# Overview

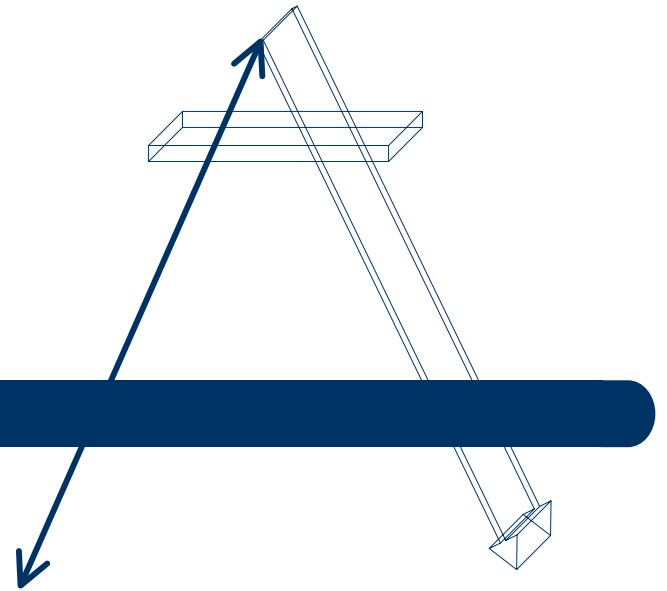
- Ponzio Illusion – Kevin Ko
- Muller-Lyer Illusion – Ariana López
- Conclusion



**The Impossible Triangle**

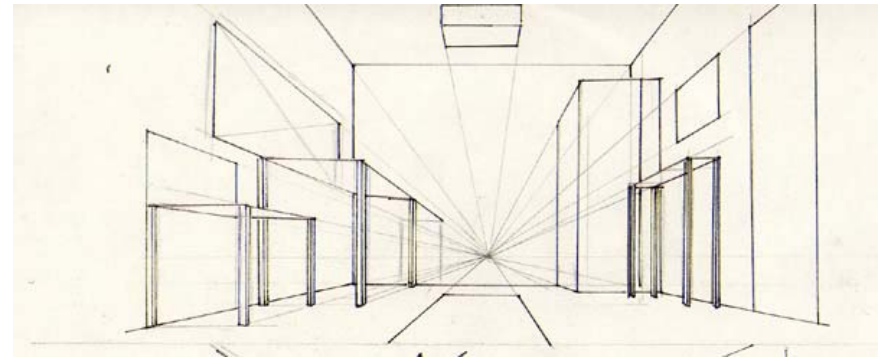
# The Ponzon Illusion

Kevin Ko



# Background Information

- First proposed by Mario Ponzo (1880 – 1960) in 1913  
-Italian scientist

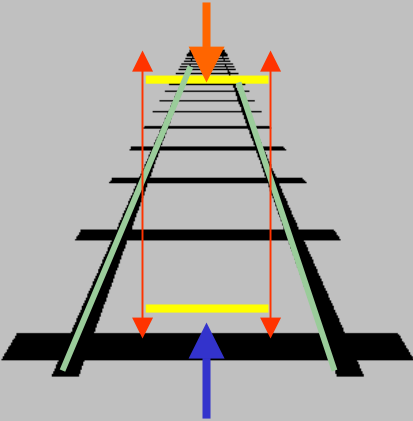


# The Experiment

## What is Ponzo Illusion?

**Task:** to match the length of the test bar with the reference bar

**Ratio:** Test bar length/Ref. bar length



**EXPERIMENTAL VARIABLES FOR KEVIN**

Angle:

Reference bar position:

Measure bar position:

Orientation of test bars:

To implement changing the value of an experimental variable:  
Use mouse and keyboard to enter and highlight variable  
Press 'RETURN' key  
Press 'RESET' button to redraw with new value

MEASURED VALUES:

**PONZO ILLUSION**  
Use mouse to adjust size of 'measure' bar to appear equal in length to the 'reference' bar  
Press 'Show Measure' for results  
Press 'Reset' for new measurement

# The Experiment

## The Sampling Process

- **10 subjects participated**
- **7 females, 3 males**
- **ages between 15 to 26 years old**

## Goal

- **To use the sample to make inferences of the general population about their perception (2D vs. 3D).**

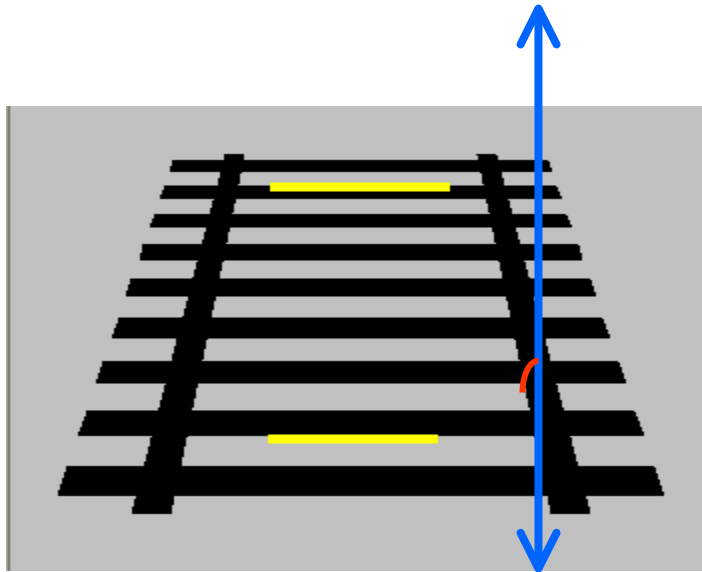
# Data Results/Data Analysis

1. Calculated individuals' ratio for each trial
2. Averaged all individuals' ratios
3. Average of all individuals' averages
4. Calculated standard Error  $\sigma/(n^{0.5})$

**Ratio = test bar length / ref.  
bar length**

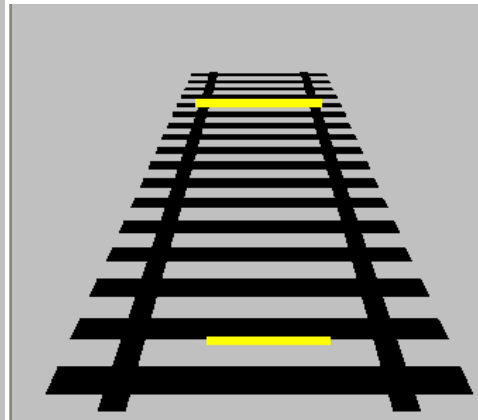
# Experiment 1

Variables – Angle of Tracks

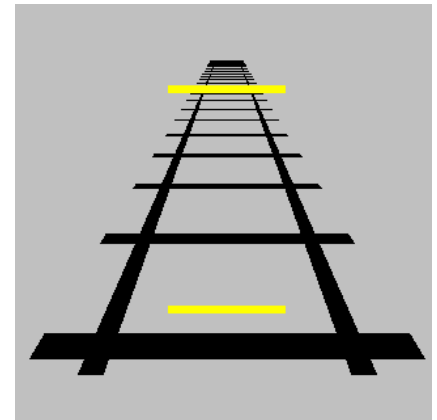


Angle =  $10^{\circ}$

- $H_1$ : It is easier to match the lengths of the bars if the angle of the track is smaller.



Angle =  $17^{\circ}$

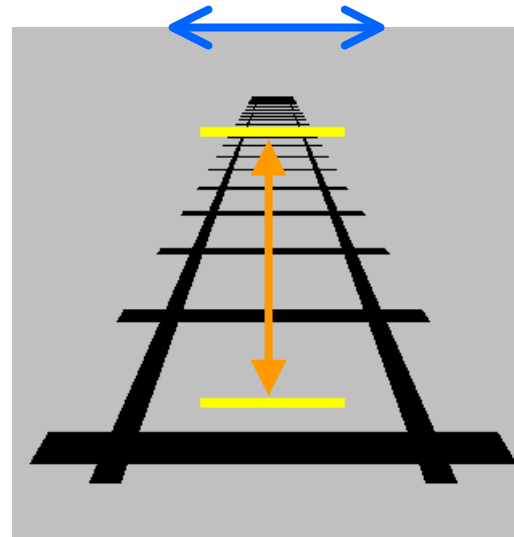
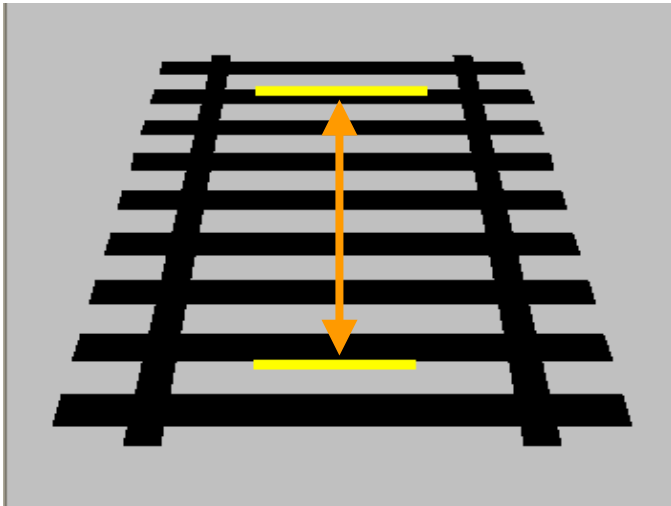


Angle =  $22^{\circ}$

# Theories



- As the angle of the track decreased, the perceived distance effect decreased.

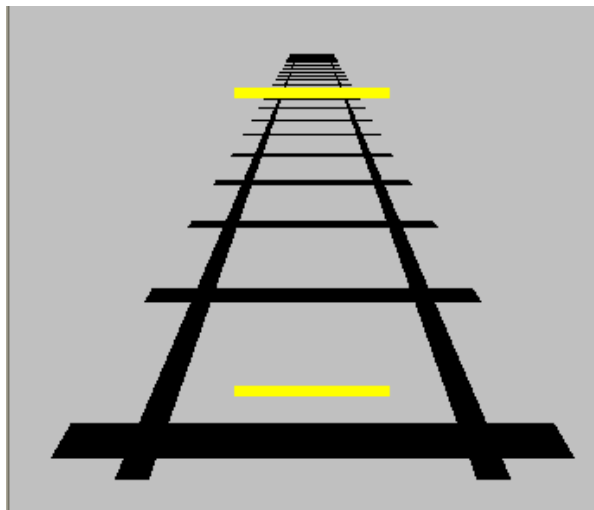




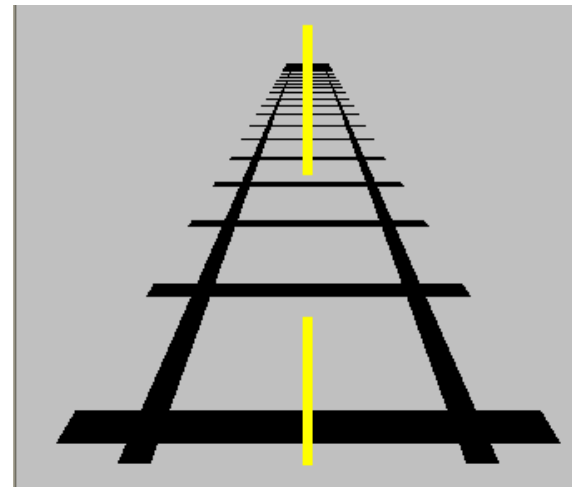
# Experiment 2

Variables – Orientation of the bars

- $H_2$ : It is harder to match the lengths of the bars if both bars are vertically-oriented.



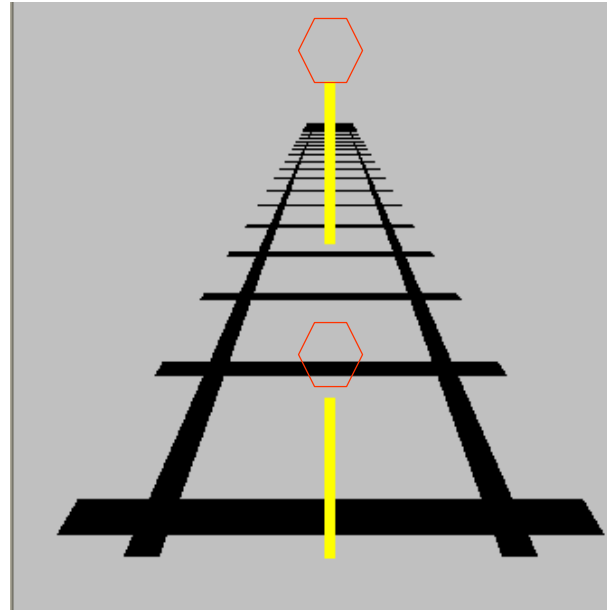
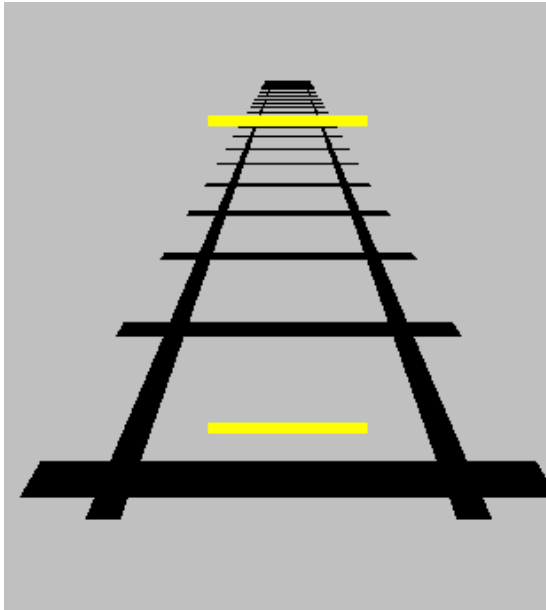
**Horizontal**



**Vertical**

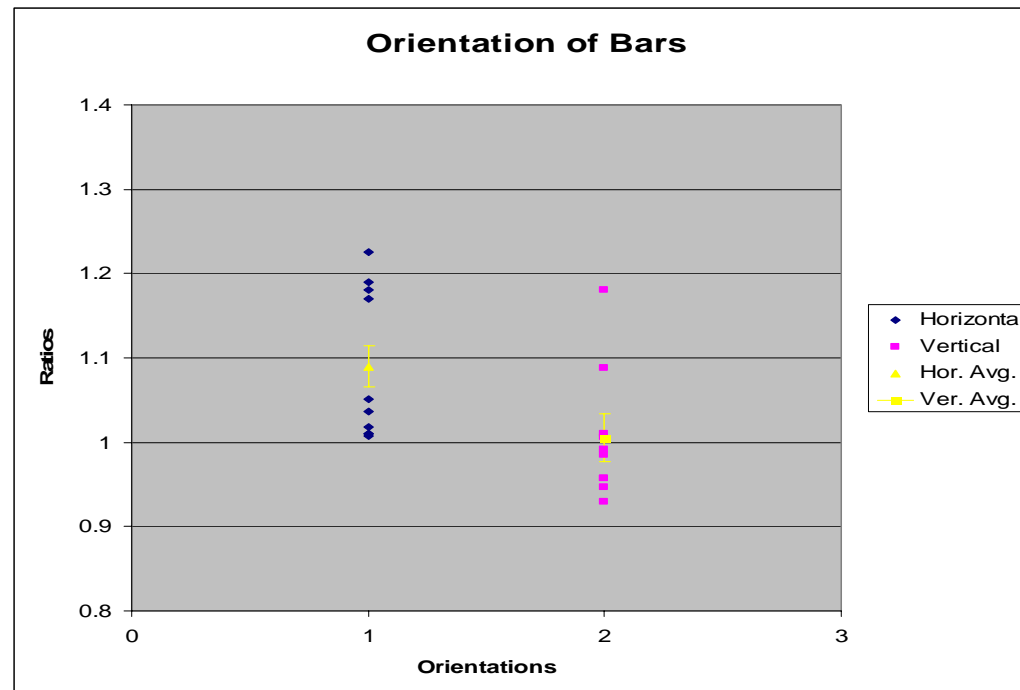
# Theories

- Individual's visual perception of 2D vs. 3D affected the outcome.



# Results – Vertical vs Horizontal bars

- The data did not support the 2<sup>nd</sup> hypothesis as well.
- The data implied that the subjects tended to do better when the bars were vertically-oriented.

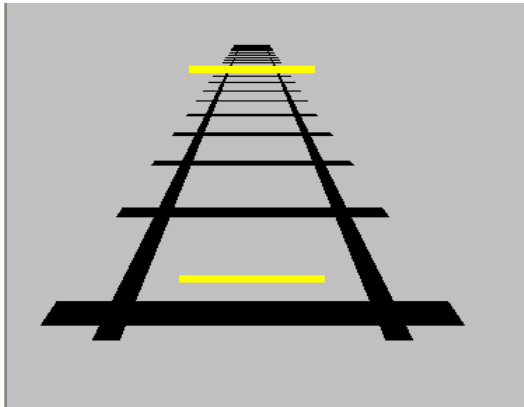


Confirmed significance with t-test ( $p_{\text{horizontal and vertical bars}} = 0.017524$ )

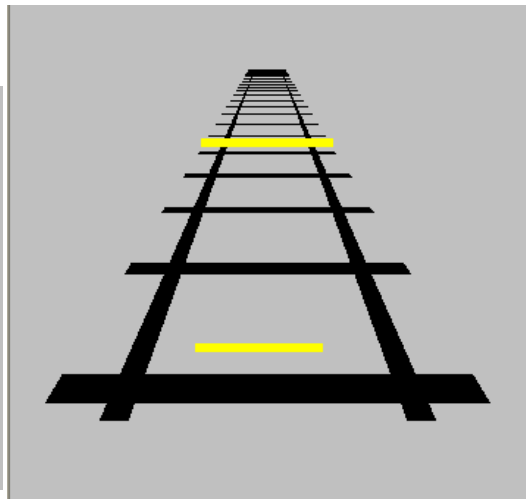
# Experiment 3

Variables -Reference bar positions with respect to the vanishing point

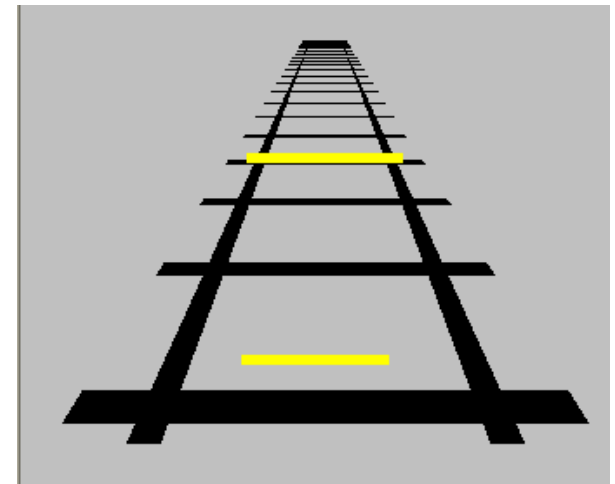
- H<sub>3</sub>: It is easier to match the lengths of the bars if both bars are held closer together.



Bar at 70



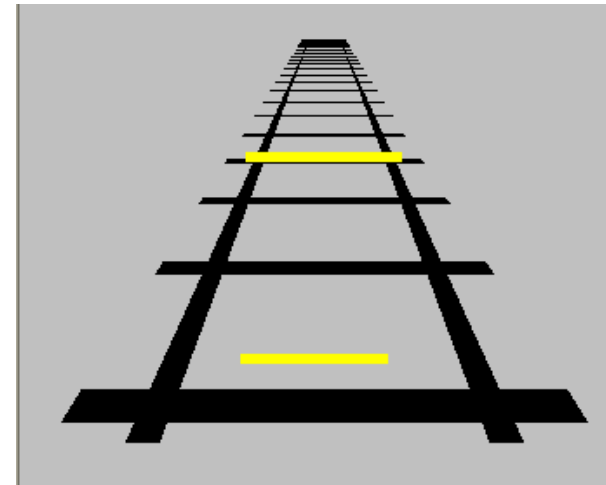
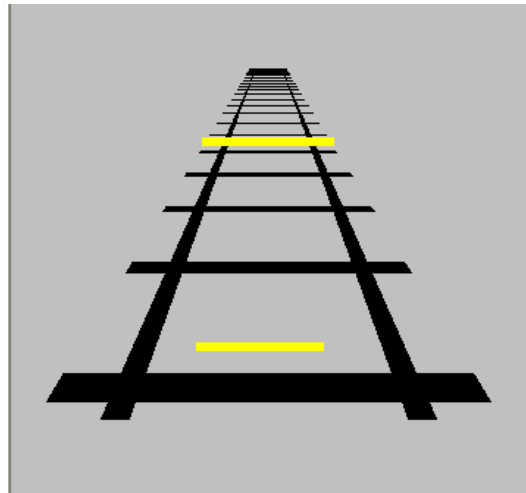
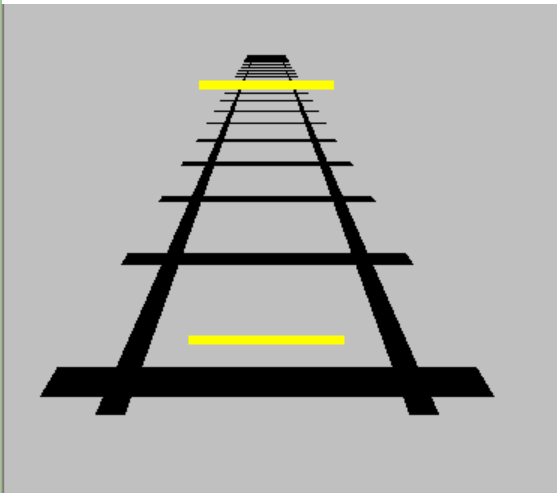
Bar at 100



Bar at 120

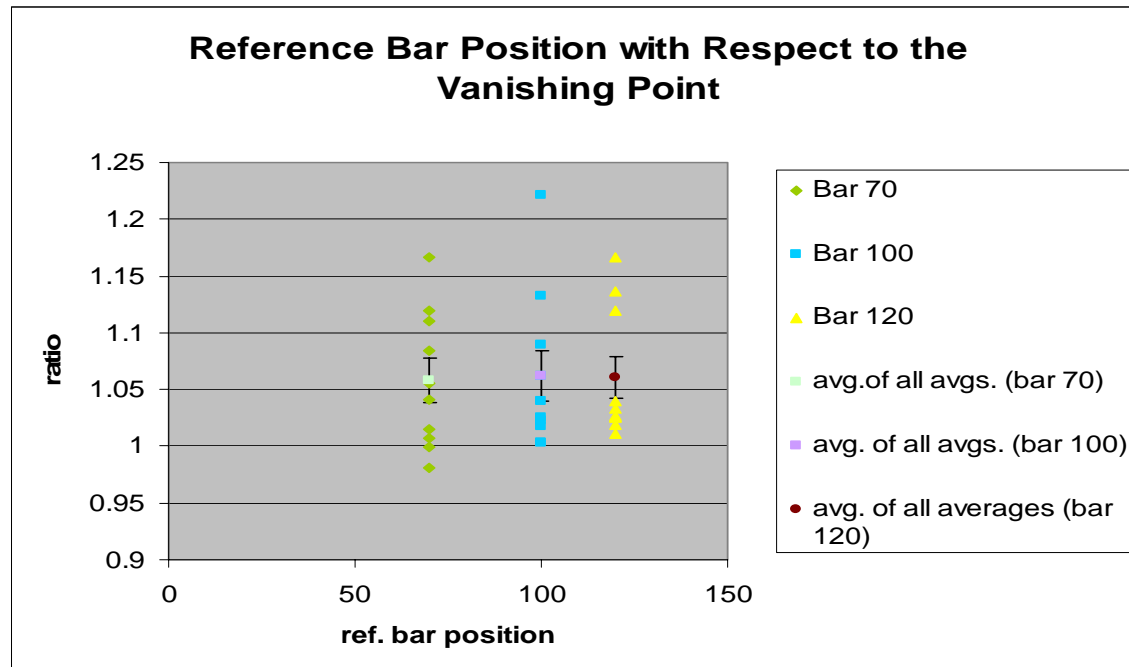
# Theories

- The closer the reference bar was to the horizon, the smaller the reference bar should appear.



# Result – Physical distance between bars

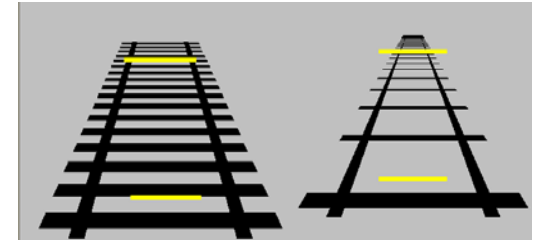
- The actual data did not support the 3<sup>rd</sup> hypothesis.
- The data implied that the physical distance between the two bars did not affect the results.



Confirmed significance with t-test ( $p_{\text{bar 70 and bar 100}} = 0.442203$  and  $p_{\text{bar 100 and 120}} = 0.474678$ ).

# Conclusion

What was happening?



- The number of ties was changed along with the angle.
- Mystery Spot in Santa Cruz
  - studies show visual illusion reaches its maximum effect between 15 and 20°.
  - Angle test 17°
- A few subjects changed the way they perceived objects during the test (from 2D to 3D or vice versa)

Lesson: actual data don't always support the hypothesis

-by chance?

-flaws in experiment?

-we don't really understand perception

# The Moon Illusion

- Scientists now apply this concept to the Moon



**Thank you!**



**Thank You!**

A 3D wireframe diagram of a rectangular prism is shown, oriented horizontally. The text "Thank You!" is written in a bold, orange font across the front face of the prism. The prism is composed of thin blue lines. Several lines extend from the vertices of the prism towards a single point on the right side of the image, creating a perspective effect. The background is white, with a green vertical bar on the left and a dark blue horizontal bar below the first "Thank you!" text.

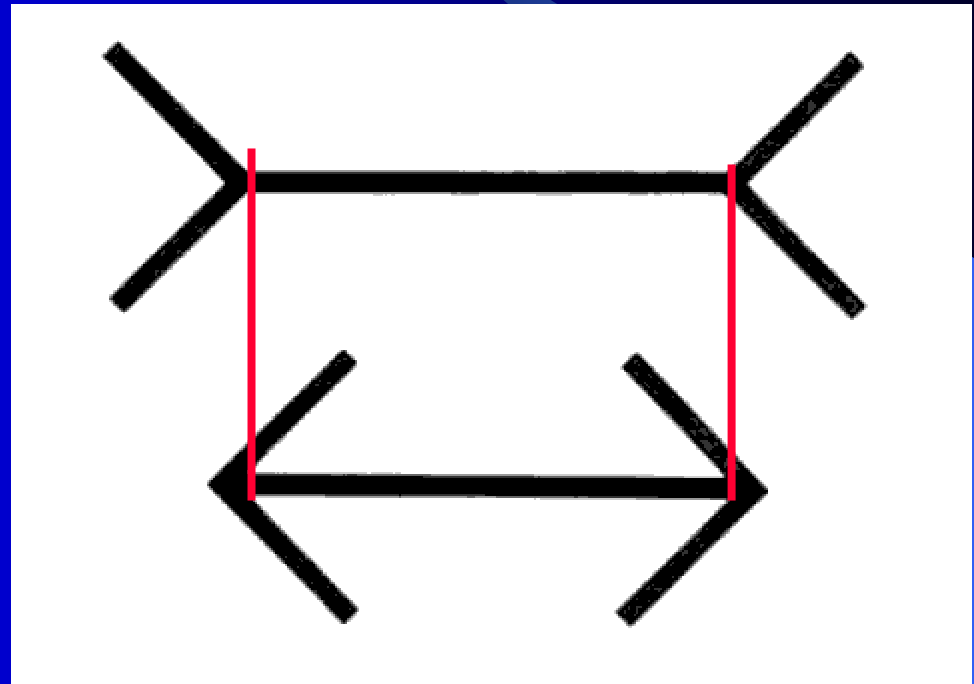
# Müller-Lyer Illusion

Ariana López



# What is the Müller-Lyer Illusion?

- Proposed by German psychiatrist Franz Müller-Lyer in 1889.
- It has been tested throughout the 20<sup>th</sup> Century.
- (1966) illusion may be absent or reduced amongst people who grow up in certain environments.



Which line is longer?

# Why study Müller-Lyer Illusion?

- To find the connection between sight and the brain.
- To find out why people relate pictures to something more familiar.
- To find out how society and environment affect perception.
- To find out why people perceive this illusion in very different ways.

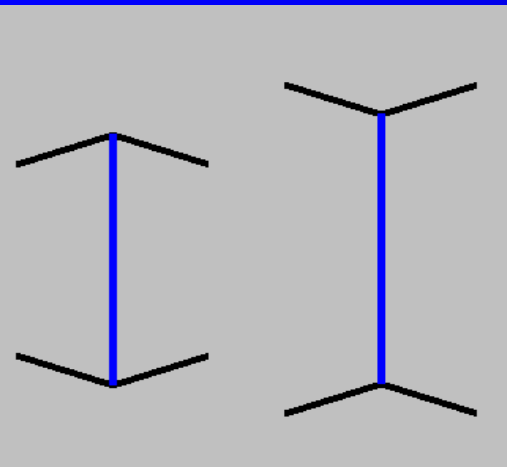
# What was the procedure?

The screenshot shows a software interface for a Muller-Lyer illusion experiment. On the left, there are two vertical lines: a 'reference' line with outward-pointing fins and a 'test' line with inward-pointing fins. Below them are buttons for 'Print Result', 'Show Measure', and 'Reset'. A slider labeled 'Adjust Line Length' is positioned above a 'Measured Values' input field. On the right, a cyan header reads 'EXPERIMENTAL VARIABLES FOR Ariana'. Below it, controls include a 'Tip Pattern' dropdown (set to 'fins'), 'Length of central lines' (200), 'Length of fins' (65), and dropdowns for 'Color of central line' and 'Color of fins' (both set to 'black'). A dark grey box contains instructions: 'To implement changing the value of an experimental variable: Use mouse and keyboard to enter and highlight variable. Press 'RETURN' key. Press 'RESET' button to redraw with new value. The 'fins' or 'central line' may be made to disappear using 'background' for 'Color of fins' or 'Color of central line'.

MULLER-LYER ILLUSION  
Use slider length of 'test' line so that it appears to align with the 'reference'  
Press 'Show Measure' for results  
Press 'Reset' for new measurement

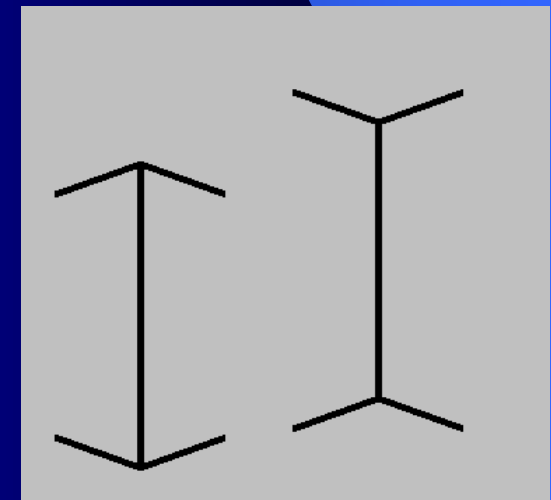
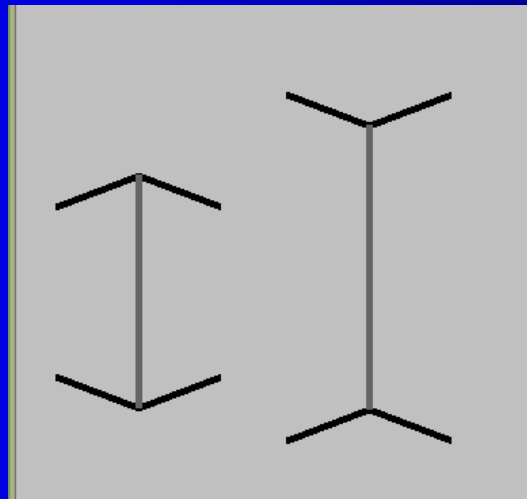
- I tested 11 people.
- Subjects were asked to change the length of the central line three times until they thought they were equal.
- I averaged the results from each subject.

# Variable A: Color of central line

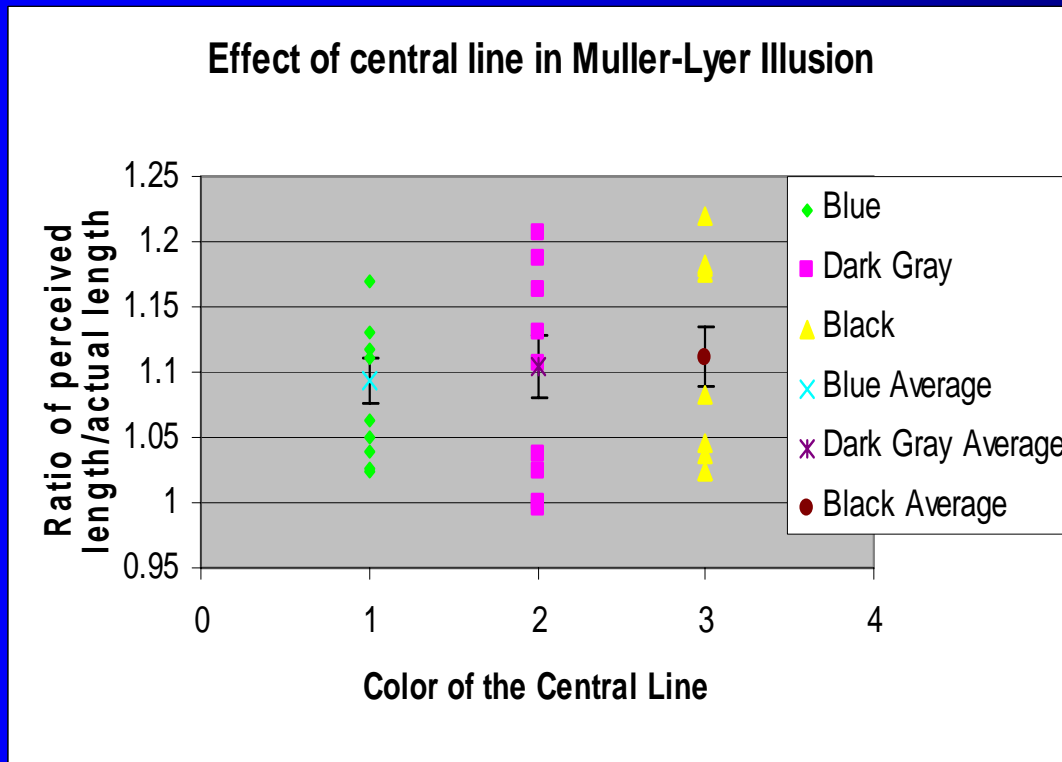


Hypothesis:

- It would be easier for the subject to get the right length by focusing on only one color rather than both.



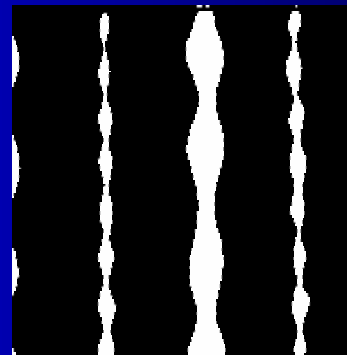
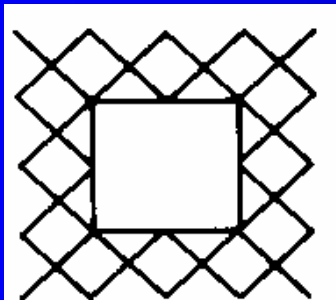
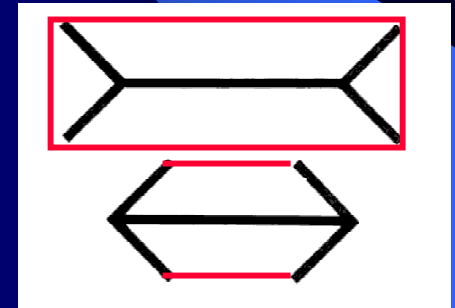
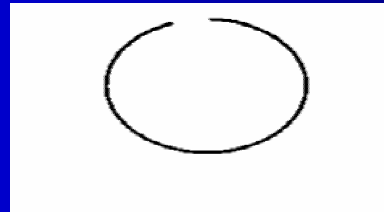
# Variable A: Color of the central line



- There was no evidence to support my hypothesis.
- For some people the illusion was very strong, and for some it was very weak.
- The change of color did not make a big difference.

# Theories and Explanations

- Corner Theory
- Gestalt Principles
  - Closure
  - Area and Symmetry



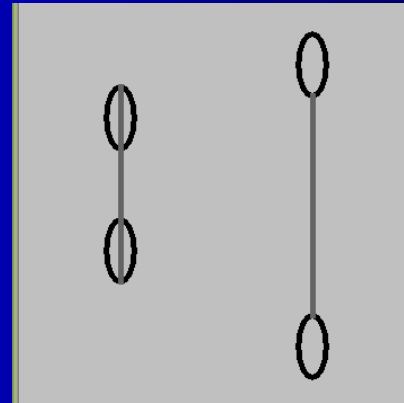
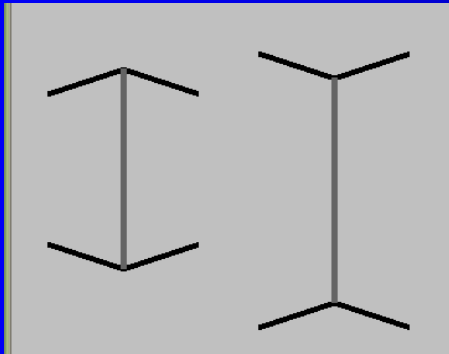
# Conclusion for variable A

- Color did not affect the Corner Theory.
- If you have walls painted different colors, you would still see the same corner.
- Color did not affect the Area Principle.
- No matter what color the central line is, the area of the enclosed figure would still be the same.

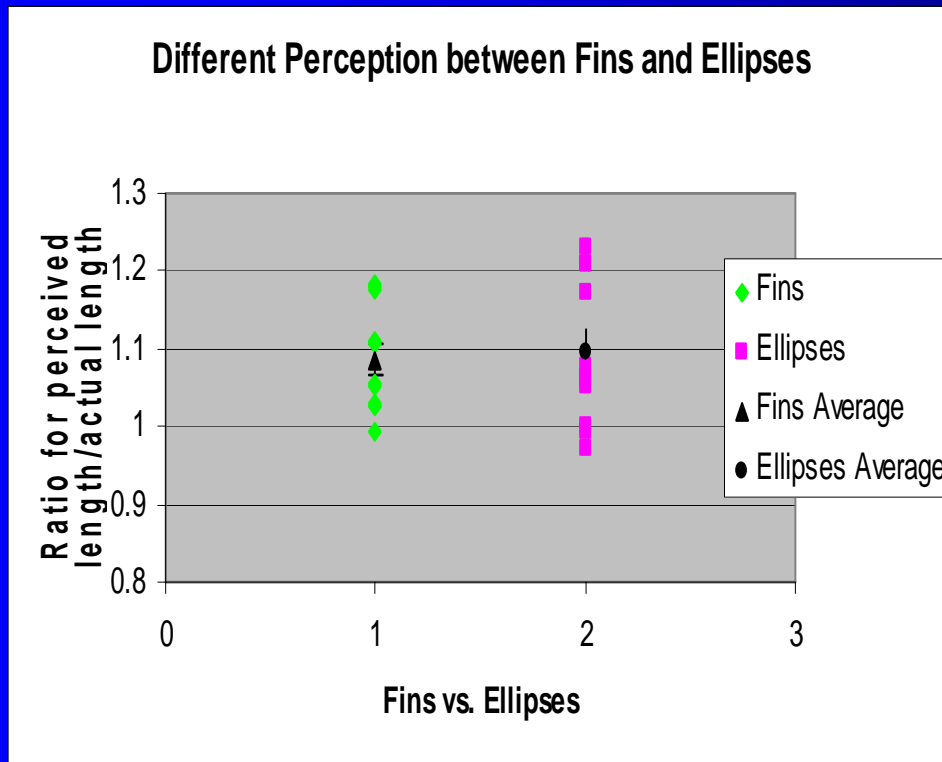
# Variable B: Fins vs. Ellipses

Hypothesis:

- People might have more difficulty focusing on the length of the bars with the ellipses.
- Illusion might be stronger for ellipses.



# Variable B: Fins vs. Ellipses



- There was evidence to prove my hypothesis right.
- Both averages were about the same, but data for ellipses was more spread out.

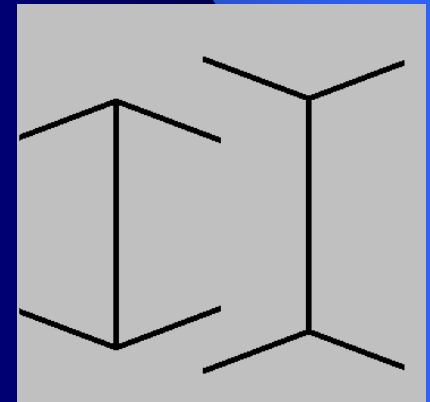
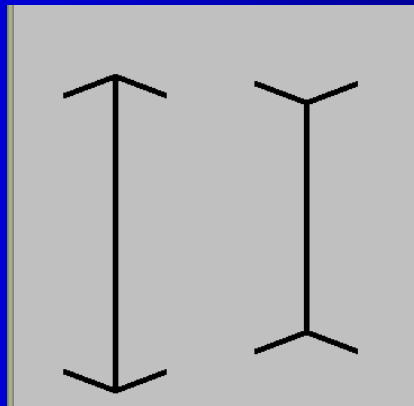
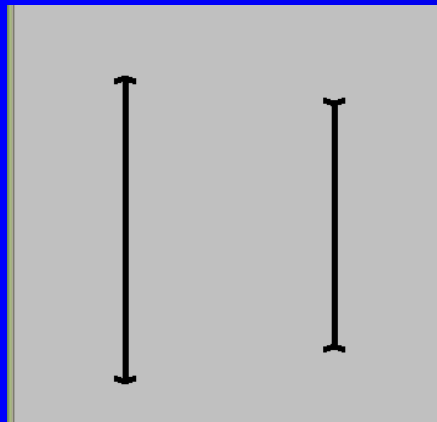
# Conclusion for Variable B

- There was evidence against Corner Theory.
- If Corner Theory was the only explanation for the Müller-Lyer Illusion, then there would not appear to be a difference in length for the lines with the ellipses.
- The Closure Principle and the Area and Symmetry Principle do explain my experimental results.

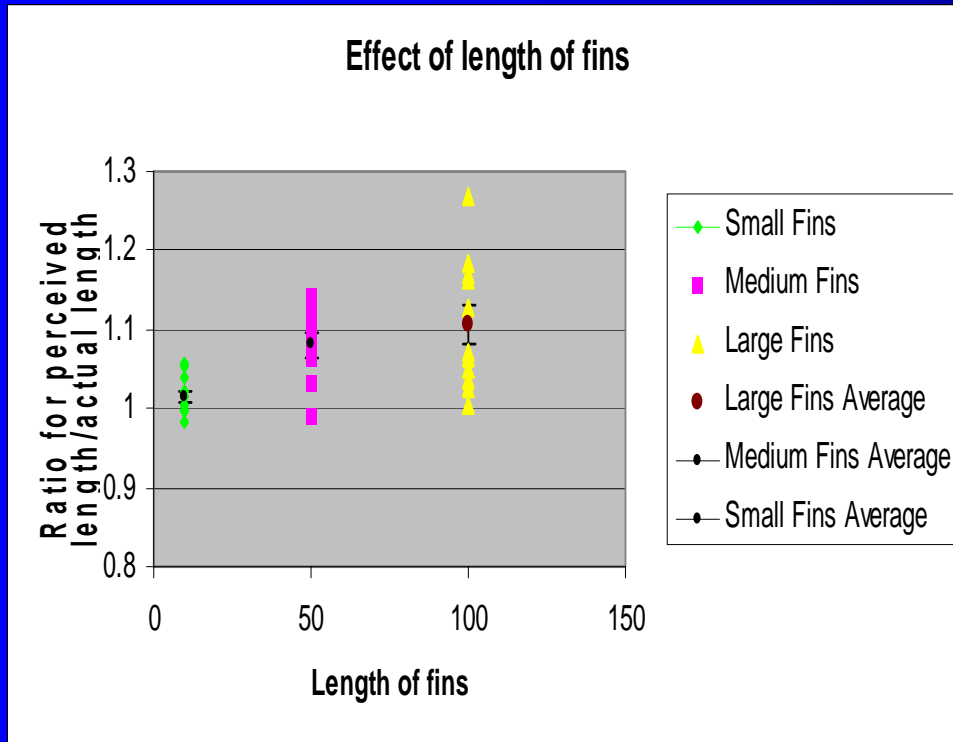
# Variable C: Length of Fins

Hypothesis:

The longer the fins, the stronger illusion.



# Variable C: Length of Fins



- There was evidence to prove my hypothesis right.
- Average ratio increased as length of fins increased.
- Error bars did not significantly overlap.

# Conclusion for Variable C

- Corner Theory did work because the longer the fins, the easier to relate the figure to a corner.
- Closure Principle and Area and Symmetry Principle worked because the longer the fins, the bigger the difference in area of the enclosed figures.

# Conclusions

- We studied the Müller-Lyer Illusion to try to understand how the eye and the brain interact.
- We changed the color of the central line, fins vs. ellipses and the length of the fins.
- The change in color did not affect the Corner Theory and the Area Principle.
- Corner Theory does not fully explain the Müller-Lyer Illusion.
  - Closure, Area and Symmetry Principles work.

# Acknowledgements



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