Visual Illusions

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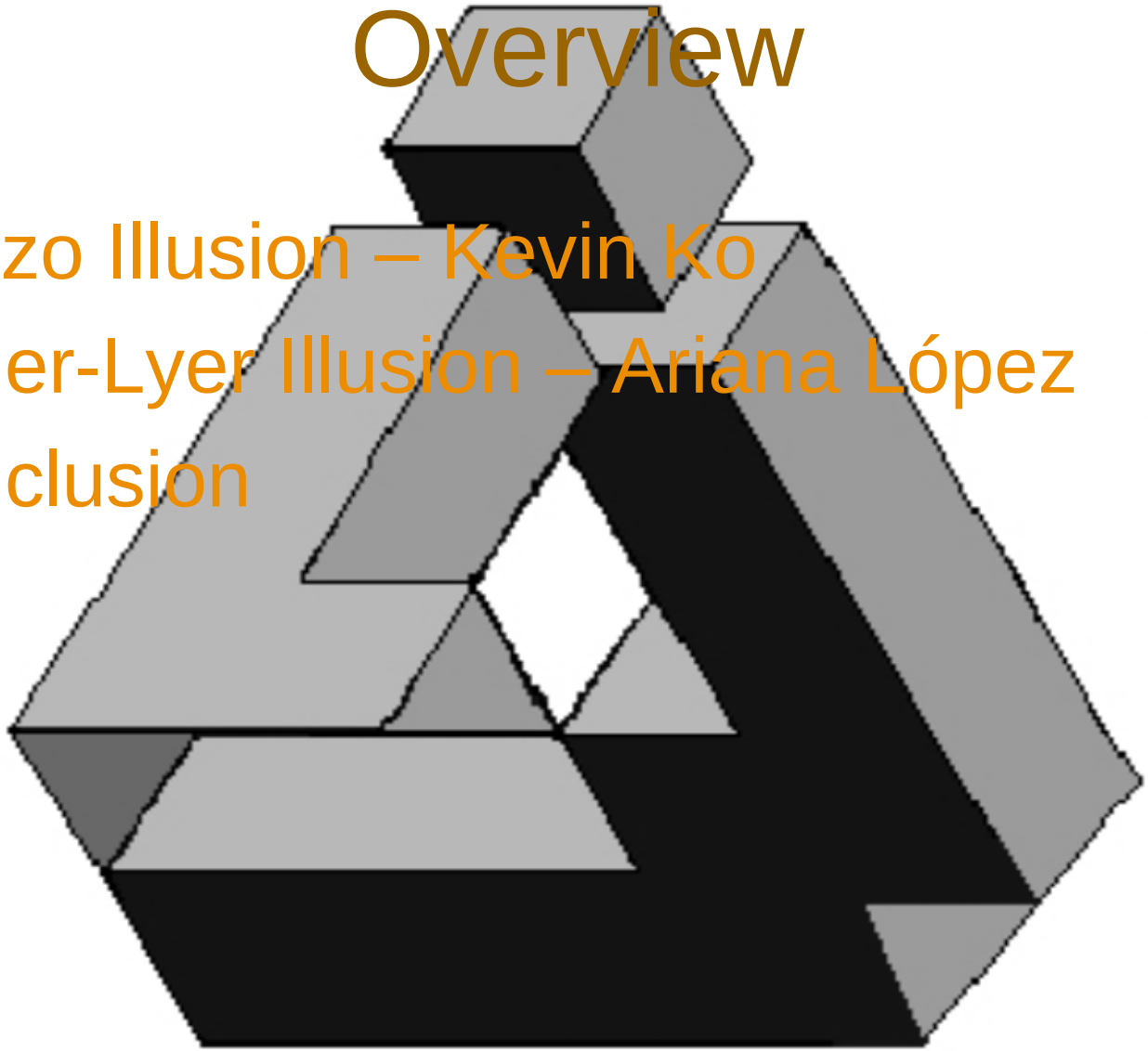
COSMOS 2004, UC Santa Cruz

Cluster 7

Overview

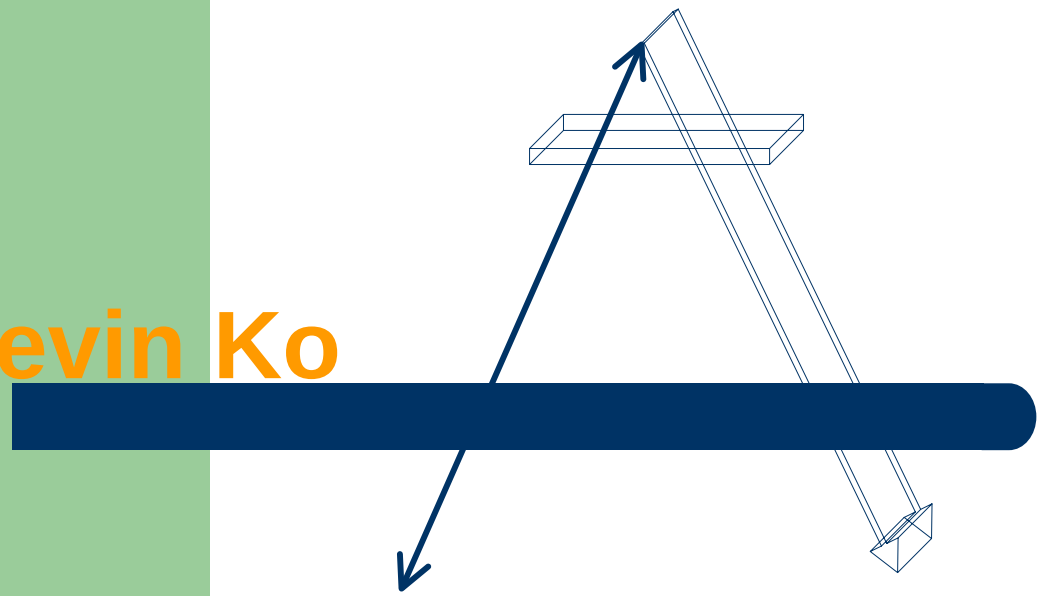
- Ponzo Illusion – Kevin Ko
- Muller-Lyer Illusion – Ariana López
- Conclusion



The Impossible Triangle

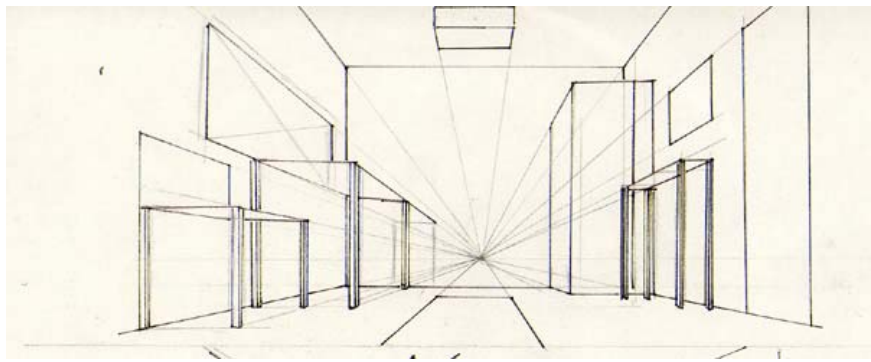
The Ponzo Illusion

Kevin Ko



Background Information

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

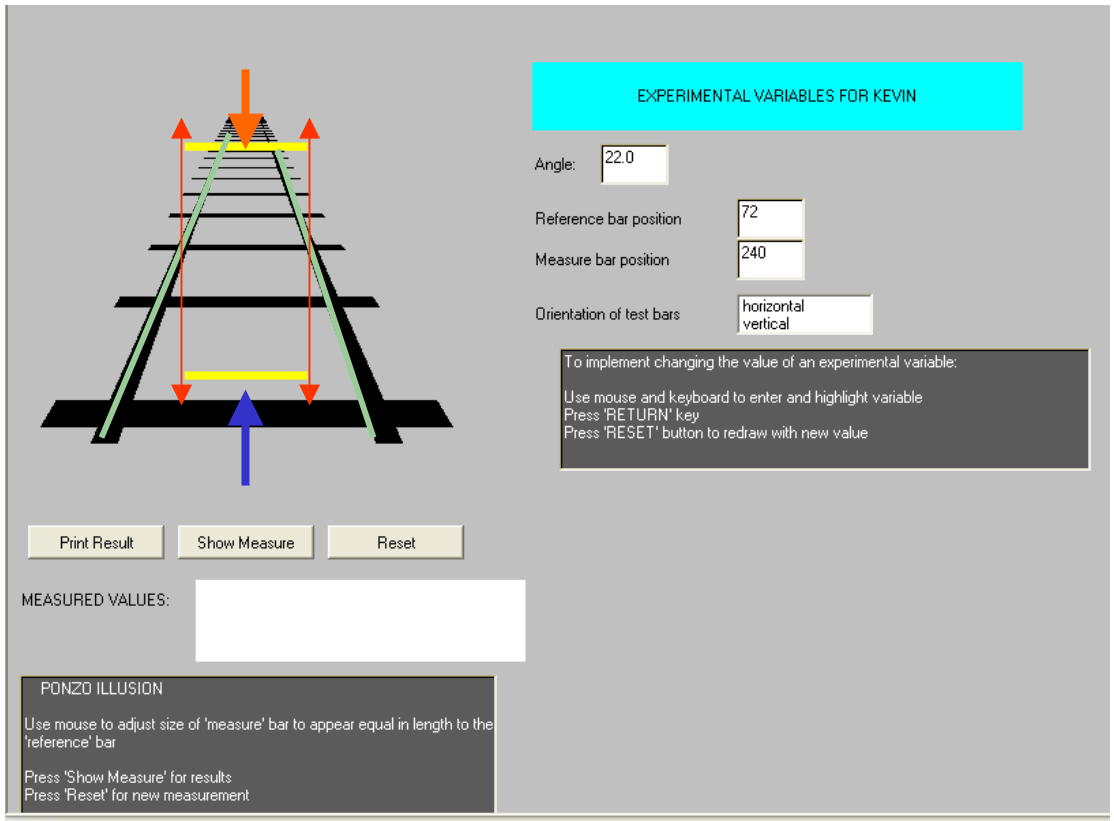


The Experiment

What is Ponzo Illusion?

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

Ratio: Test bar length/Ref. bar length



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).**

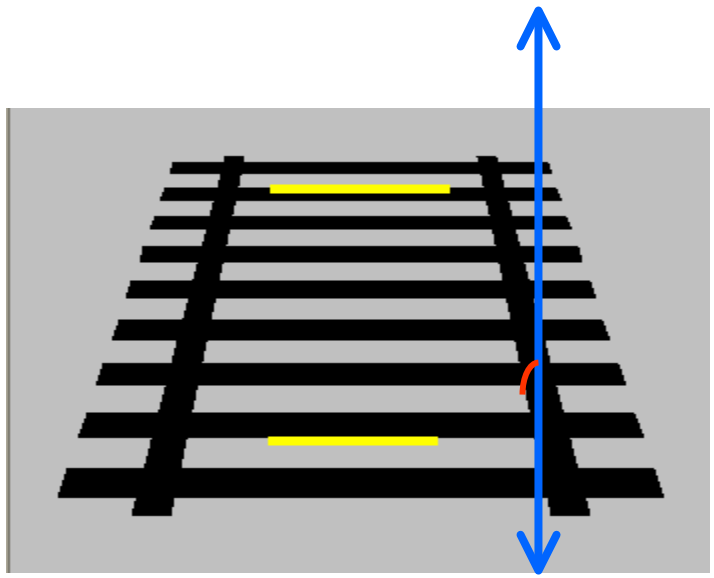
Data Results/Data Analysis

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

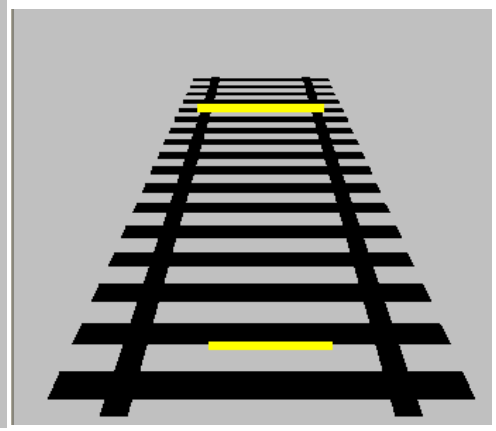
Experiment 1

Variables – Angle of Tracks

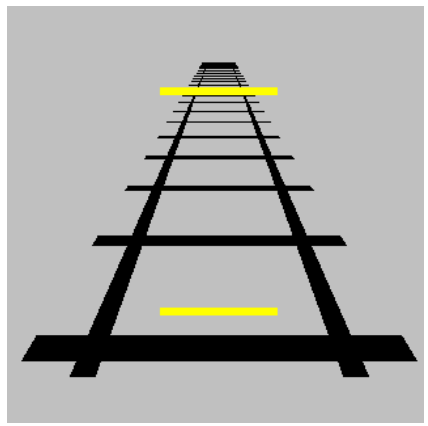


Angle = 10º

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



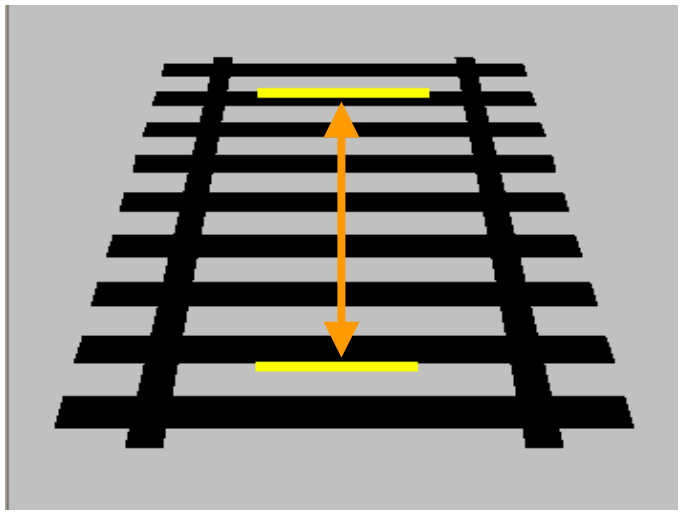
Angle = 17º

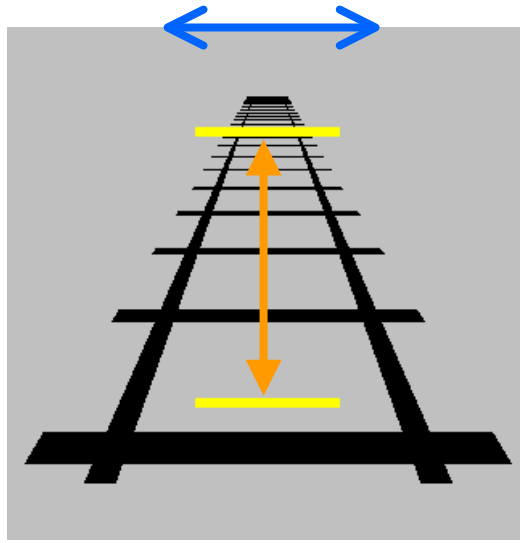


Angle = 22º

Theories

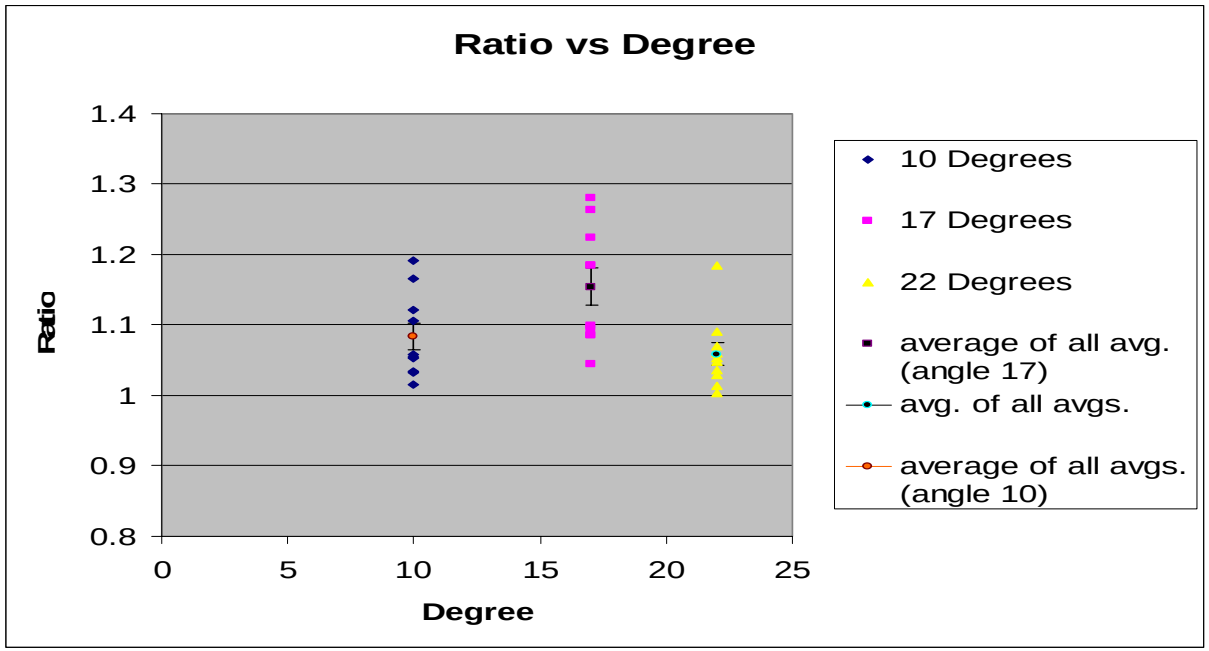
- As the angle of the track decreased, the perceived distance effect decreased.





Results – Angle of Tracks

- The actual data did not support the 1st hypothesis.
- The data implied that the visual effect reached its maximum at 17º.

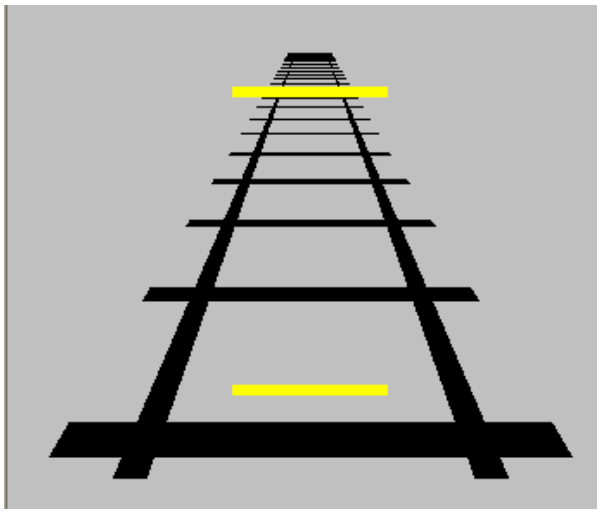


Confirmed significance with t-test ($p_{10º \text{ and } 17º} = 0.022094$ and $p_{17º \text{ and } 22º} = 0.003685$)

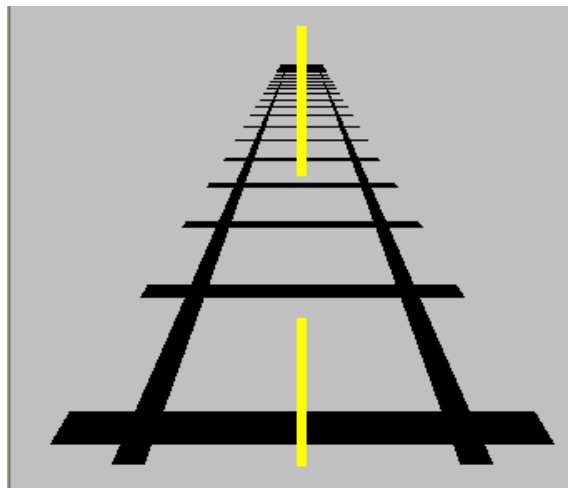
Experiment 2

Variables – Orientation of the bars

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



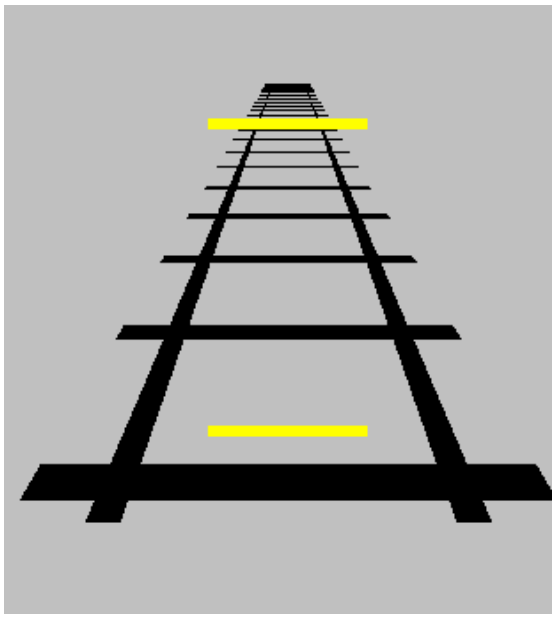
Horizontal

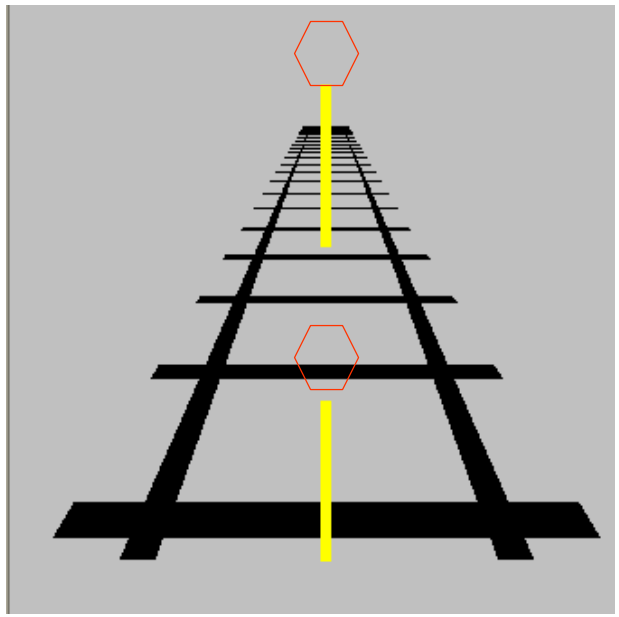


Vertical

Theories

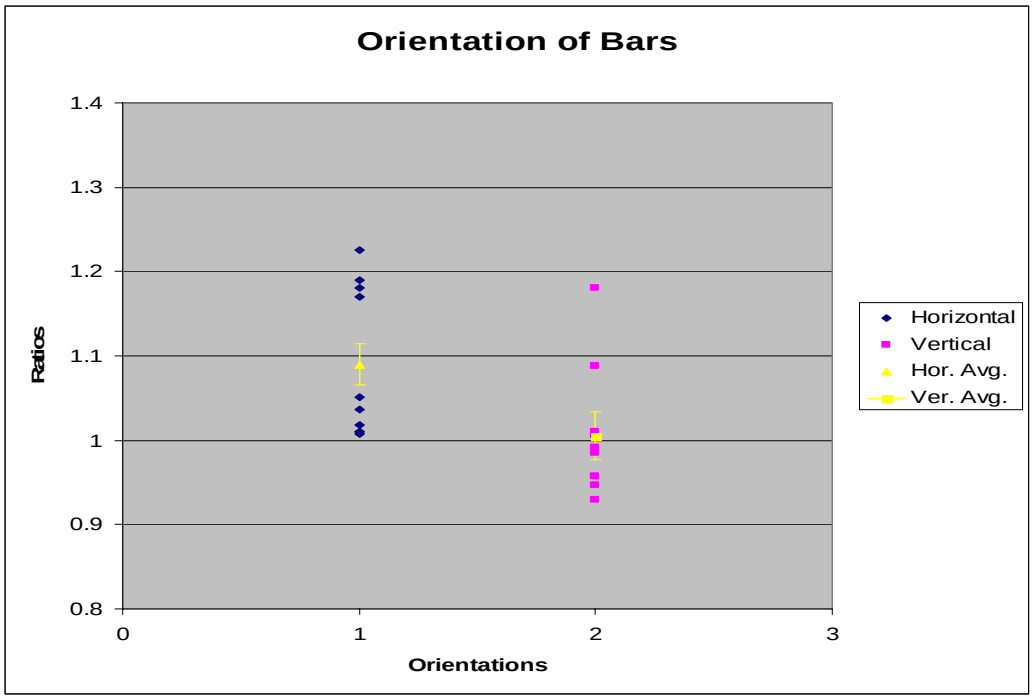
- Individual's visual perception of 2D vs. 3D affected the outcome.





Results – Vertical vs Horizontal bars

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

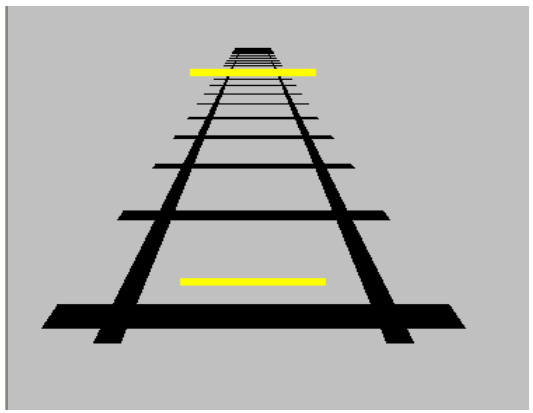


Confirmed significance with t-test ($p_{\text{horizontal and vertical bars}} = 0.017524$)

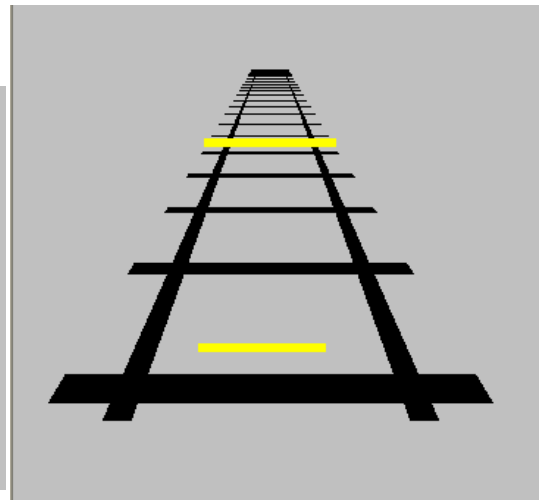
Experiment 3

Variables -Reference bar positions with respect to the vanishing point

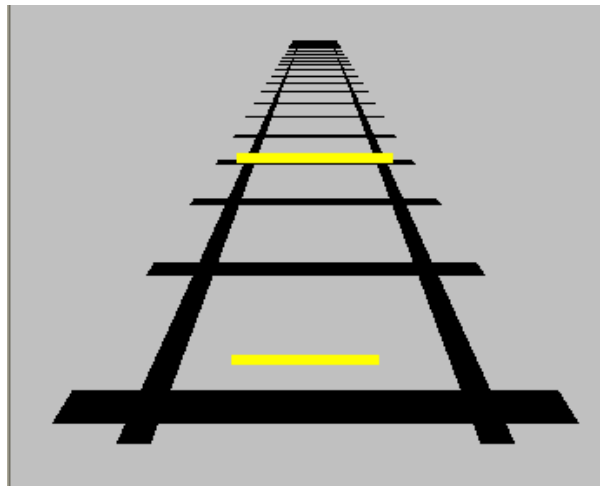
- H_3: It is easier to match the lengths of the bars if both bars are held closer together.



Bar at 70



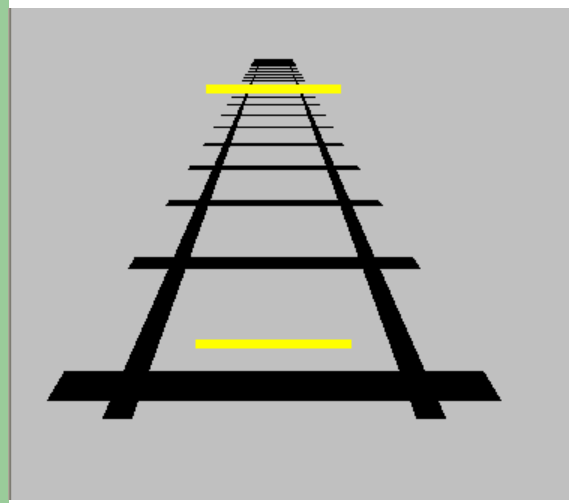
Bar at 100

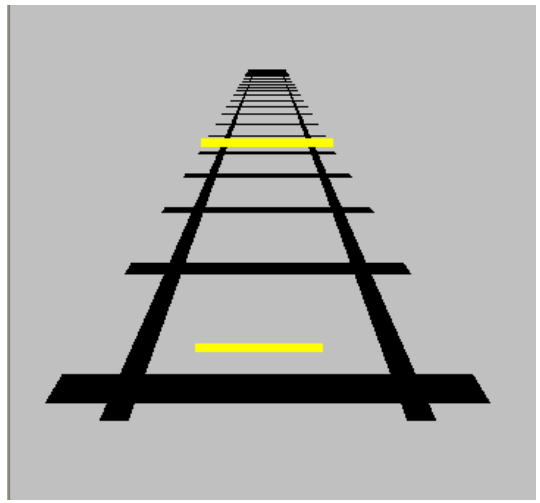


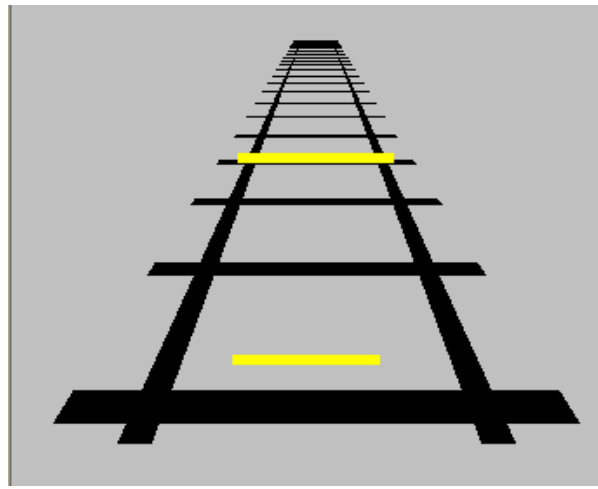
Bar at 120

Theories

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

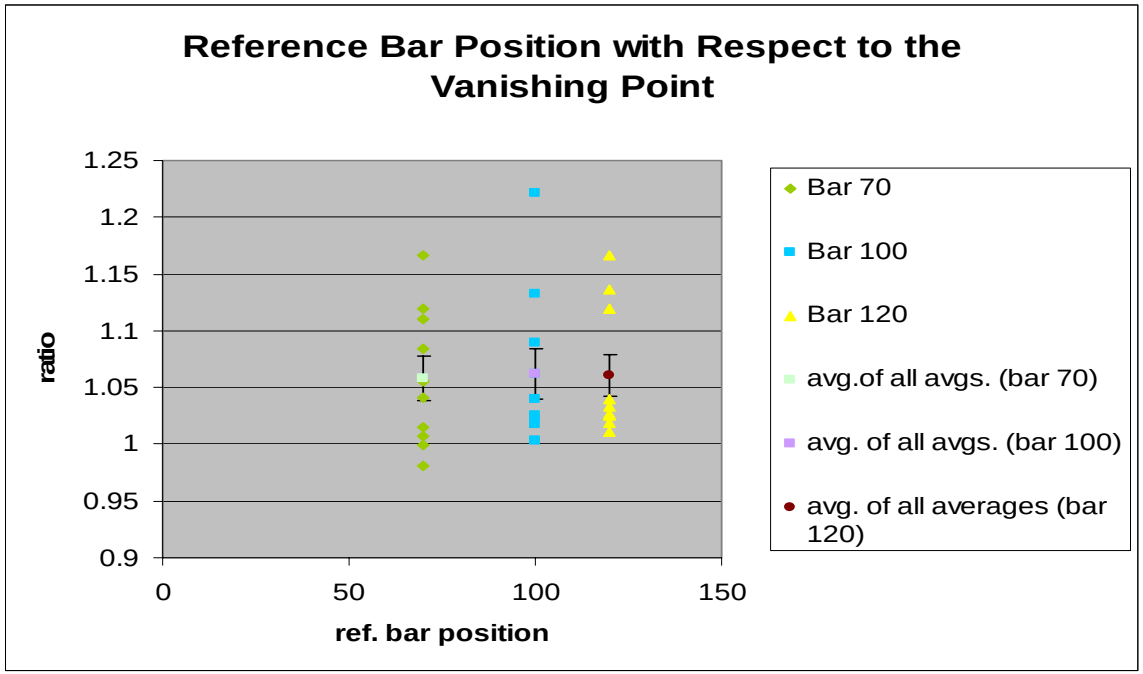






Result – Physical distance between bars

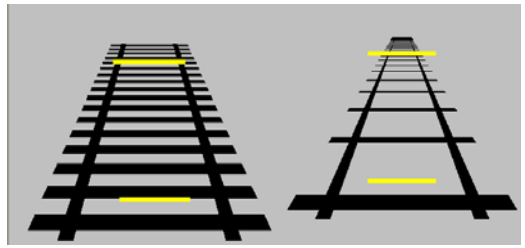
- The actual data did not support the 3rd hypothesis.
- The data implied that the physical distance between the two bars did not affect the results.



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 20º.
  -Angle test 17º
- **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

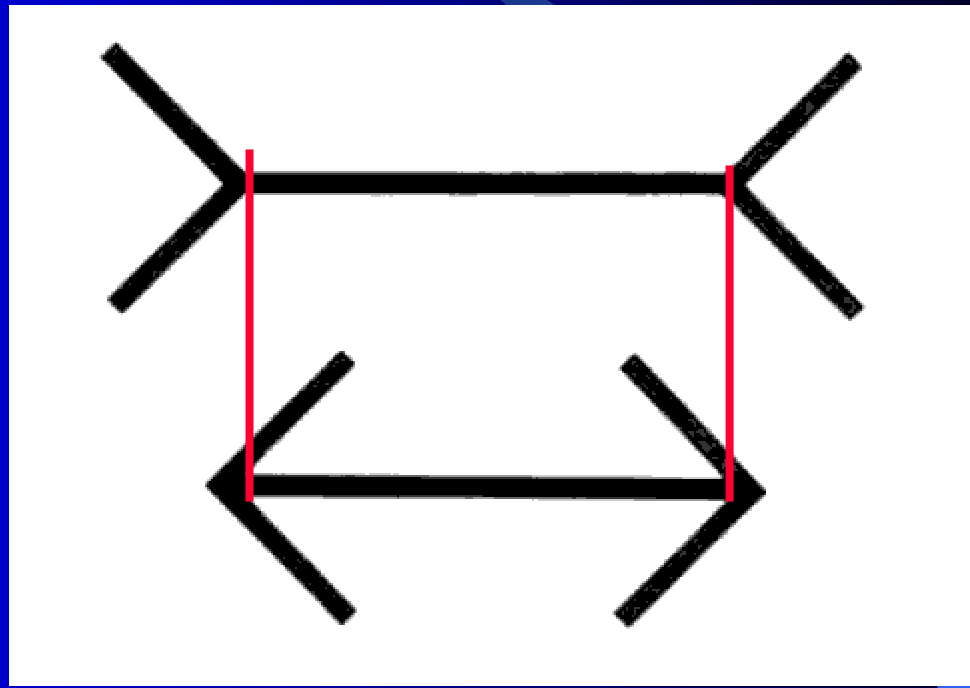
Thank you!

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 20th Century.
- (1966) illusion may be absent or reduced amongst people who grow up in certain environments.

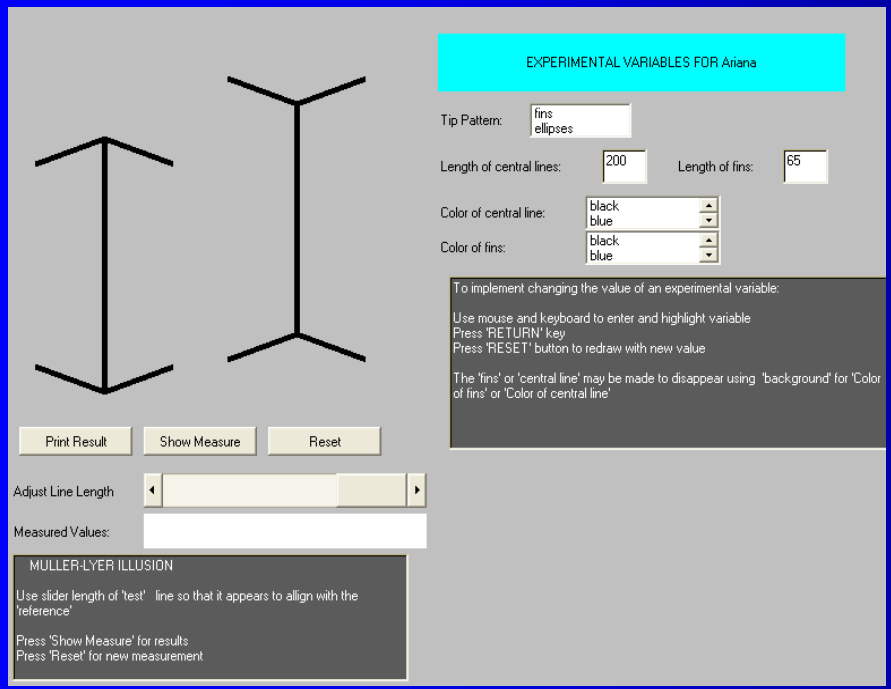


Which line is longer?

Why study Müller-Lyer Illusion?

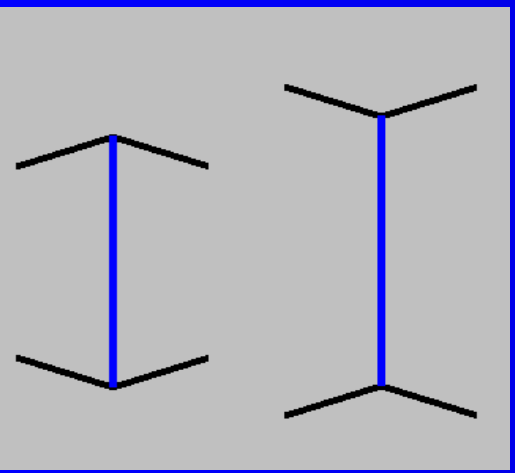
- To find the connection between sight and the brain.
- To find out why people relate pictures to something more familiar.
- To find out how society and environment affect perception.
- To find out why people perceive this illusion in very different ways.

What was the procedure?



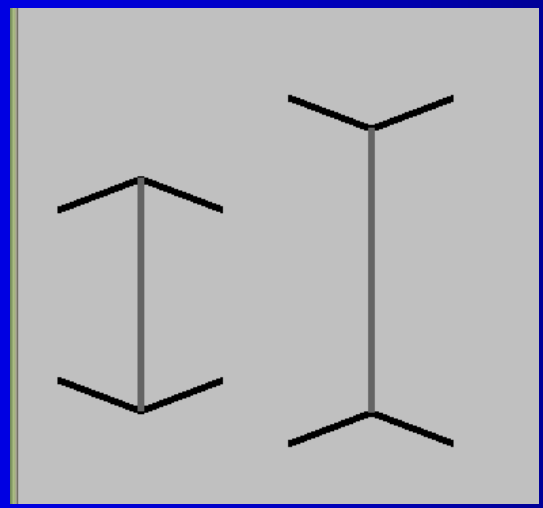
- I tested 11 people.
- Subjects were asked to change the length of the central line three times until they thought they were equal.
- I averaged the results from each subject.

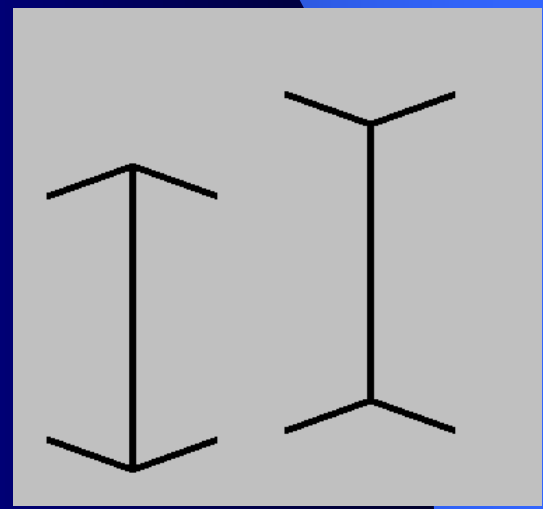
Variable A: Color of central line



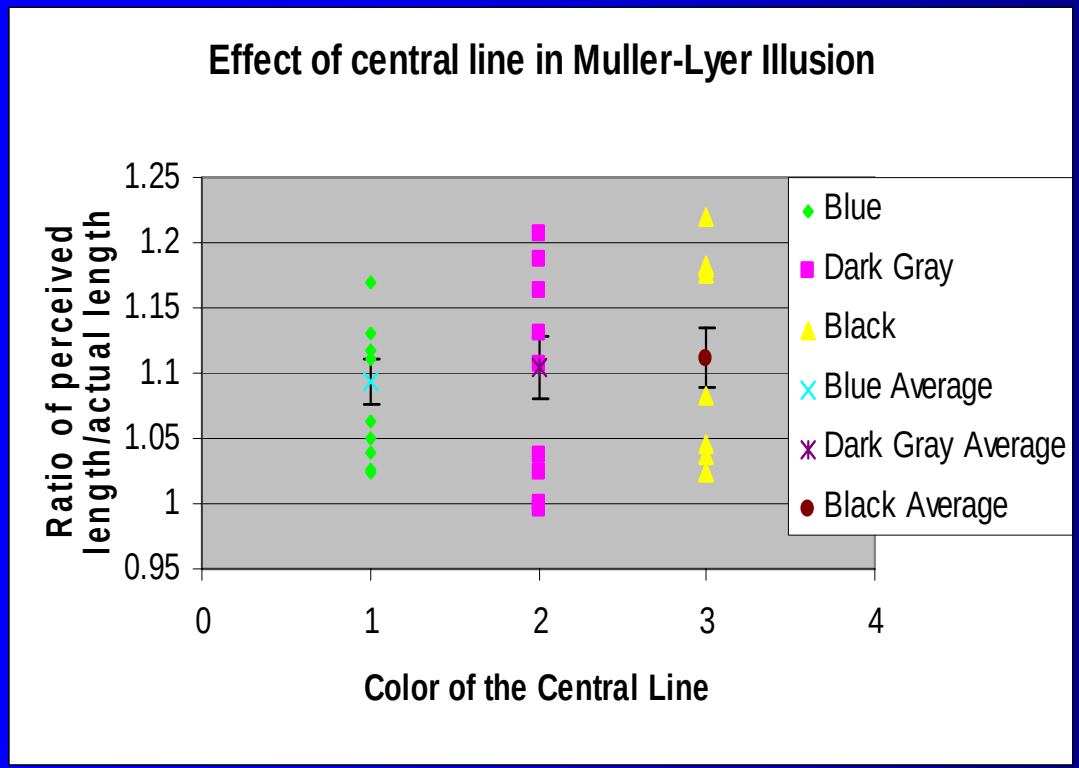
Hypothesis:

• 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

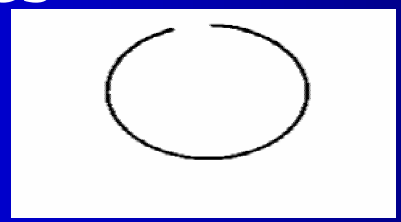


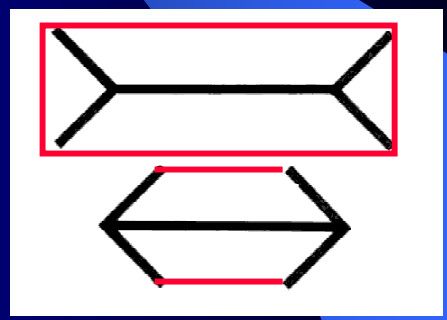
- There was no evidence to support my hypothesis.
- For some people the illusion was very strong, and for some it was very weak.
- The change of color did not make a big difference.

Theories and Explanations

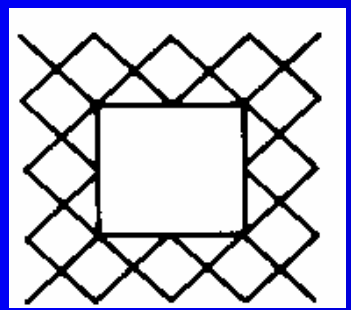
- Corner Theory

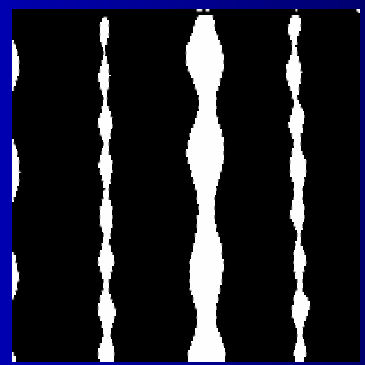
- Gestalt Principles
  - Closure





  - Area and Symmetry





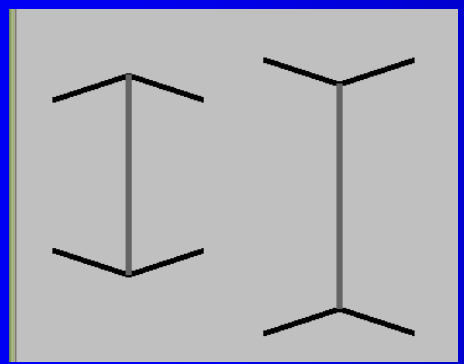
Conclusion for variable A

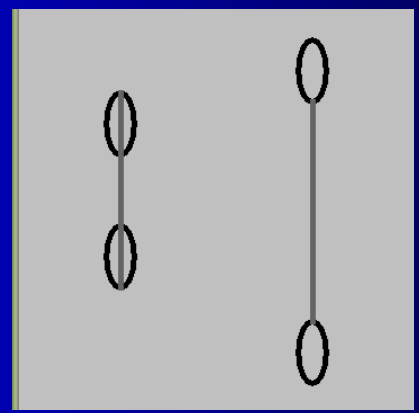
- Color did not affect the Corner Theory.
- If you have walls painted different colors, you would still see the same corner.
- Color did not affect the Area Principle.
- No matter what color the central line is, the area of the enclosed figure would still be the same.

Variable B: Fins vs. Ellipses

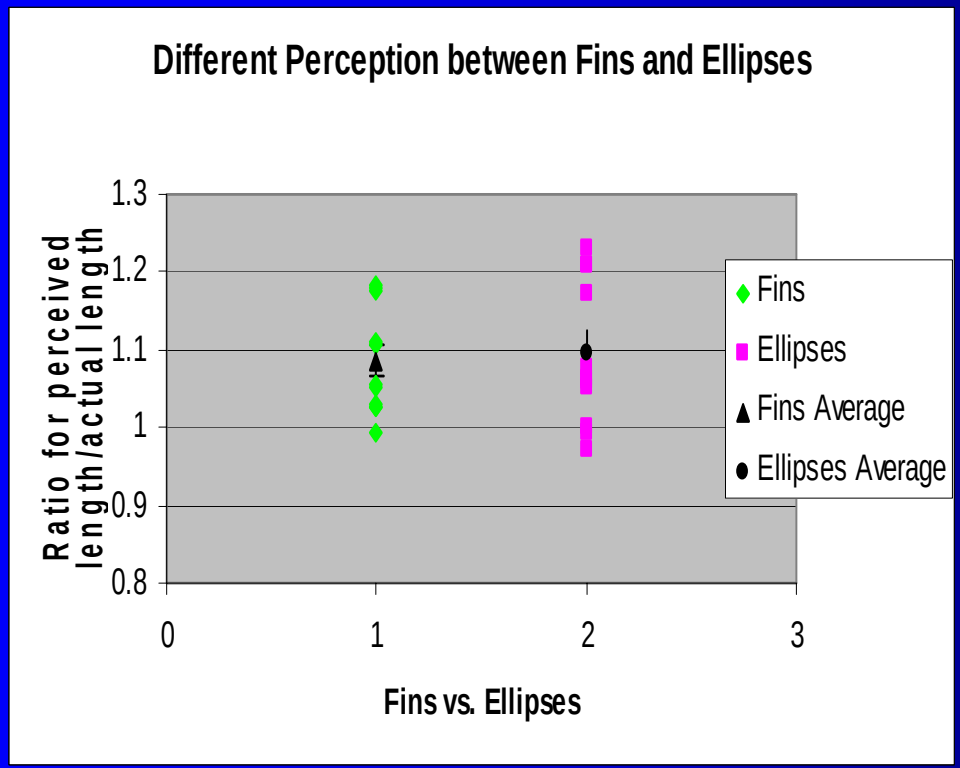
Hypothesis:

- 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



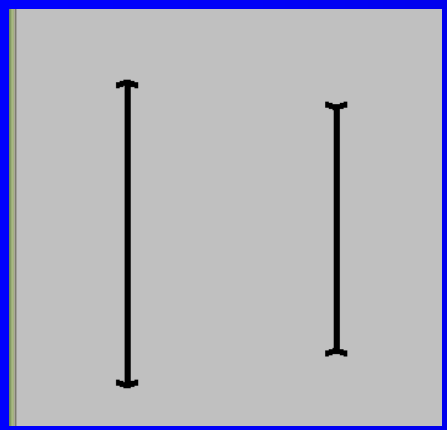
- There was evidence to prove my hypothesis right.
- Both averages were about the same, but data for ellipses was more spread out.

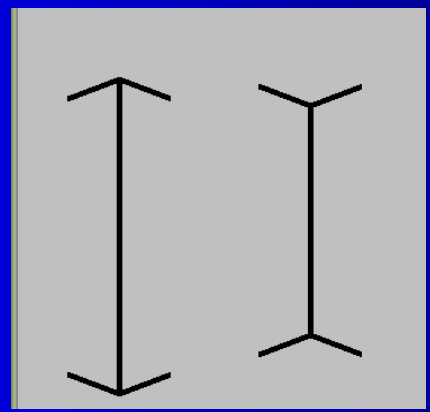
Conclusion for Variable B

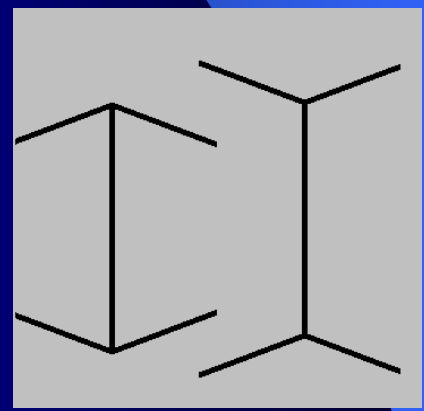
- There was evidence against Corner Theory.
- If Corner Theory was the only explanation for the Müller-Lyer Illusion, then there would not appear to be a difference in length for the lines with the ellipses.
- The Closure Principle and the Area and Symmetry Principle do explain my experimental results.

Variable C: Length of Fins

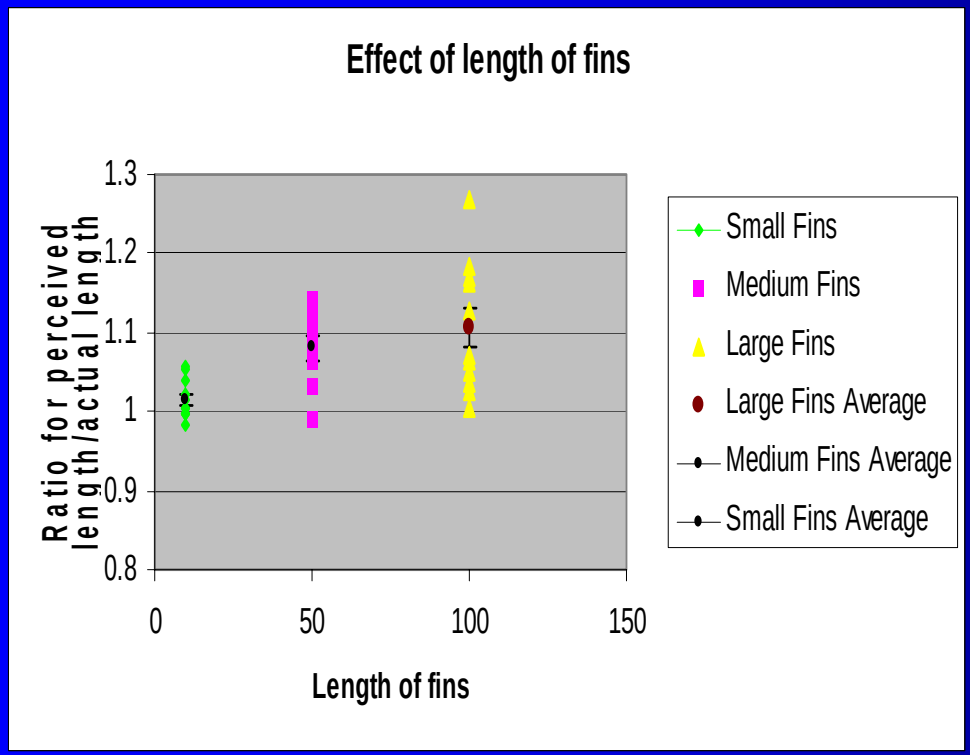
Hypothesis:
The longer the fins, the stronger illusion.







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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