A Geometrical Study on...

Is Seeing Believing?

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In this note, we would like to present some ideas on the question: Is Seeing Believing? - posing it as a geometrical problem! "Seeing is believing" as well as the saying "I'll believe it when I see it" are often-used terms which hold for most situations. However, there are some exceptions. In this article, we are concerned with a few of these exceptions - exceptions that crop up by way of the geometrical illusions. Important factors causing geometrical illusions relate essentially to the influence of location in the visual field, the influence of angles, extent, contrast and perspectivity. To elaborate further on these points, we consider the following examples:

1. *The location in the visual field* has an effect on illusions. An example would be figure 1, where the height and width of the diagram of the hat are equal, yet the height appears to be greater than the width. Likewise, when a tree is in a vertical position, it seems longer than when it is in a horizontal position.

2. *Angles*. When dealing with the influence of angles, it has been found that angles play an important role, either directly or indirectly, in the production of illusions. For a long time many geometrical illusions were accounted for by "overestimation" or "underestimation" of angles. A good example of the influence of angles on illusions would be figure 2.

3. *Extent*. In dealing with the illusions of "interrupted extent," the distance and area tend to change in extent depending upon the fullness or emptiness of the particular object. For instance, in figure 3, b seems to be longer as well as having more area than c, and a is even larger. Hence, the more light which can be seen, the longer objects appear, even though they are equal. Second, the illusions of contour are also related to distance as seen in figure 4. When concerning ourselves with this type of illusion, we can notice from the three squares (two incomplete and one empty square) that the outside squares are extensive. Besides this example, there is the well-known Müller-Lyer illusion (figure 5) which makes the left side appear longer than the right side, but in actual fact they are of equal length.

4. *Contrast*. This illusion refers to the lines, angles, and areas of different sizes. Contrast plays an important part in most of the geometrical-optical illusions. The illustration in figure 6 gives an effect that the middle segment of a seems to be longer than the middle segment of b. However, both segments are of equal length.

5. *Perspectivity*. Last, there is the illusion of perspectivity which deals with the influence of numerous factors such as lines,

angles, and occasionally contour and contrast. For instance, the square formations in figure 7 are of the same size, but the most remote formation looks much larger than the other two. Apparently, converging lines influence these equal figures in proportion as they suggest perspective.

Furthermore, there are other illusions such as "after-images" that are caused by continuous visual contact and they depend upon certain conditions. For instance, when looking at the sun for a moment and then looking at a plain colored wall you will notice there is an after-image or spot that will change in color frequently. Another example is when a spoked bicycle wheel is revolving so rapidly that the spokes become invisible, but occasionally, when there is a rapid eye movement in the direction of the wheel, the spokes may be seen for a brief moment.

One of the most remarkable illusions is that when the sun or moon rise, they appear to be closer. This is untrue. In fact, the distance of the moon or sun from the earth at the horizon is the same as when they are at the zenith or center of the sky.

To conclude, although we have not covered all the areas of geometrical and optical illusions, the facts that we have supplied support the view that seeing is not necessarily believing.

The following references will shed more light on the subject.

References

Campbell, Donald T., Marshall H. Segall, and Melville J. Herskovits. *The Influence of Culture on Visual Perception*. Indianapolis: Bobbs-Merrill Company, Inc., 1966.

Gregory, R.T. *Eye and Brain*. New York: McGraw Hill Book Company, 1969.

Luckiesh, M. *Visual Illusions*. New York: Dover Publications Inc., 1965. (Note: All illustrations are from this book.)

Illustrations

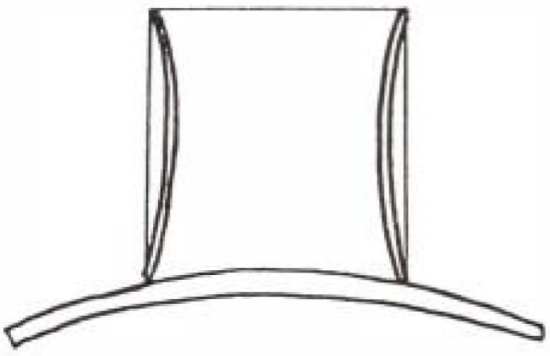

Figure 1.

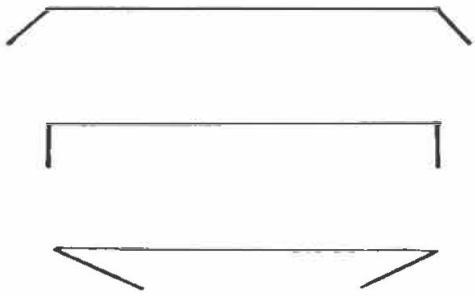

Figure 2.

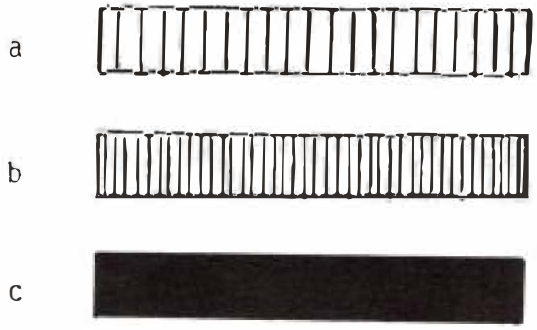

Figure 3.

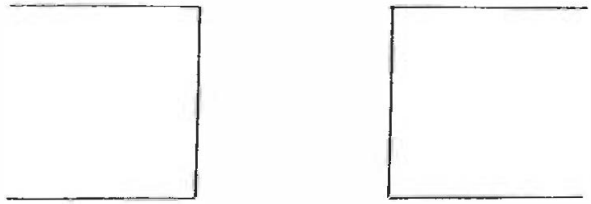

Figure 4.

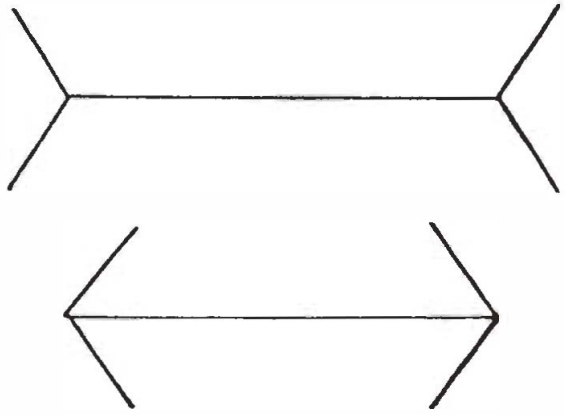

Figure 5.

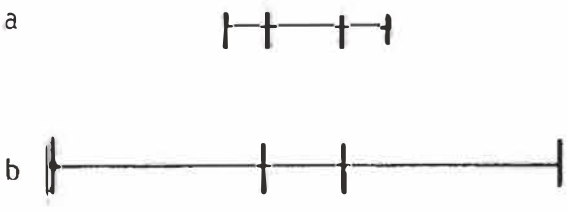

Figure 6.

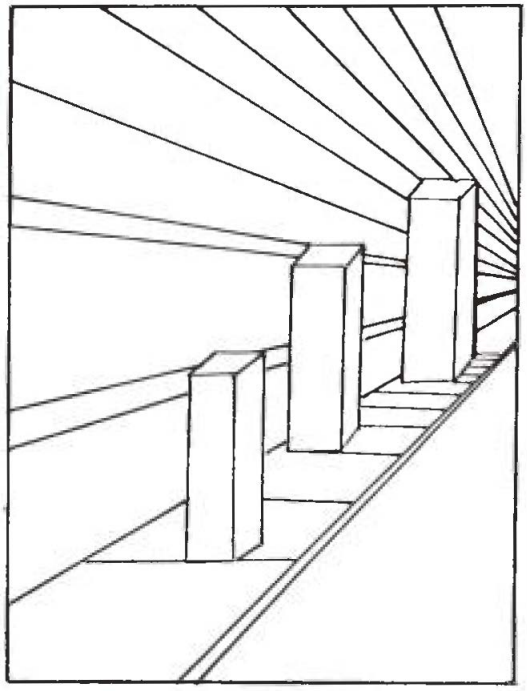

Figure 7.