

Fig. 2. The Müller-Lyer illusion occurs when (a) and (b) are compared and when (b) and (c) are compared.

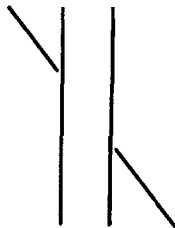


Fig. 3. The Poggendorff illusion still occurs even when the lines do not intersect.

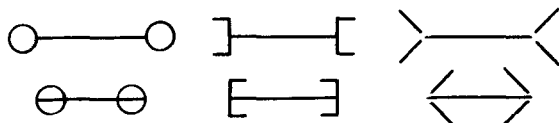


Fig. 4. Forms of the Müller-Lyer illusion not relying on intersections of lines at acute angles.

should also explain the variants (from Sanford, 1897) shown in Fig. 4. But the only intersections of lines in these figures occur at right angles and so the theory under discussion does not suffice as it relies on distortions occurring when lines actually intersect and do so at acute angles.

In summary, the theory appears inadequate at two levels. It invokes displacement and rotation of lines intersecting at an acute angle to explain geometrical illusions produced by crossing lines. But it does not satisfactorily explain why any such distortion should occur. And the occurrence of such distortion is not sufficient to account for all illusions of the type considered.

REFERENCES

- BINET, A. La mesure des illusions visuelles chez les enfants. *Rev. Phil.*, 1895, 40, 11-25.
- BYRAM, G. M. The physical and photochemical basis of visual resolving power. I. The distribution of illumination in retinal images. *J. Opt. Soc. Amer.*, 1944, 34, 571-591.
- CHUNG, CHIANG. A new theory to explain geometrical illusions produced by crossing lines. *Percept. & Psychophys.*, 1968, 3, 174-176.
- DAY, R. H. Inappropriate constancy explanation of spatial distortions. *Nature*, 1965, 207, 4999, 891-893.
- FRY, G. A. *Blur of the retinal image*. Columbus, Ohio: Ohio State University Press, 1955.
- HOUSIADAS, L., & BROWN, L. B. The effect of viewing slant and distance on some visual illusions. *Aust. J. Psychol.*, 1963, 15, 108-112.
- JENKINS, F. A., & WHITE, H. E. *Fundamentals of optics*. New York: McGraw-Hill, 1957.
- LEIBOWITZ, H., & TOFFEY, S. The effect of rotation and tilt on the magnitude of the Poggendorff illusion. *Vision Res.*, 1966, 6, 101-103.
- MARSHALL, A. J., & DI LOLLO, V. Hering's illusion with impoverishment of the stimulus in scotopic and photopic vision. *Amer. J. Psychol.*, 1963, 76, 644-652.
- PARKER, N. I., & NEWBIGGING, P. L. Decrement of the Müller-Lyer illusion as a function of psychophysical procedure. *Amer. J. Psychol.*, 1965, 78, 603-608.
- RIGGS, L. A. Visual acuity. In C. H. Graham (Ed.), *Vision and visual perception*. New York: Wiley, 1965.
- SANFORD, E. C. *Experimental psychology*. London: Heath, 1897.

NOTES

1. I am grateful to R. H. Day and M. Coltheart for critically reading a draft of this paper.
2. Now at the Institute of Experimental Psychology, University of Oxford.

(Accepted for publication July 8, 1968.)

Reply to Cumming's criticism

CHUNG CHIANG,
POLYTECHNIC INSTITUTE OF BROOKLYN

Comments are herewith presented in answer to Cumming's criticism (p. 375).

1. Cumming has misinterpreted my theory as using the interference principle. Actually it used the superposition principle. This principle applies to a slit experiment as well as to a case of image formation in the retina. Thus, it seems to me, his main objection is incorrect.

2. The vertical line in Poggendorff's illusion should, by the aberrations and diffraction accounts, appear broken. The reason that it does not so appear is that the line is too thick. This point has been discussed in the text.

3. The Poggendorff illusion occurs even though the lines may not intersect. However, it appears to me that the illusion does not

occur as effectively as when the lines intersect. Furthermore, if one views the illusion at a considerable distance so that the eye cannot see that the lines do not intersect, there is no difference to the S whether the lines intersect or not. It is predicted that the illusion occurs to a lessened degree.

4. I have little doubt that diffraction and aberrations are the main causes of the illusions. However, one cannot claim that they are the only causes, a consideration that is particularly true in the Müller-Lyer illusion.

5. The effects of illumination, distance, rotation, and tilt on illusions may be important parameters, but the effects of diffraction and aberrations seem to be the controlling variables. However, I do not feel that these factors contradict the influences of the major controlling variables.