The basis of the Poggendorff effect: An additional clue for Day and Kasperczyk

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For the last century, visual scientists and psychologists have speculated about the processes which underlie visual illusions. Since much controversy and confusion continue to exist, it is important to note commonalities among illusion effects and consistency in research findings. Day and Kasperczyk's (1985) recent work, in spite of their statements to the contrary (e.g., p. 78), is consistent with Greist-Bousquet and Schiffman's (1981a, 1985) suggestion that two very different illusion effects share a common basis.

In the classic Poggendorff illusion (Figure 1A), the two collinear oblique lines or transversals appear to be non-collinear or misaligned. Several investigators (e.g., Pressey, 1971; Quina-Holland, 1977; Zanuttini, 1976) have suggested that this misalignment illusion is due to an underestimation of the distance between the parallels. Figure 1 illustrates how underestimation of interior extent may promote a misalignment effect. Following much earlier work (Judd, 1899), Greist-Bousquet and Schiffman (1981a) verified empirically the intertransversal underestimation, and suggested that the underestimation is due to the influence of an amputated form of the wings-in Müller-Lyer figure contained within the Poggendorff parallels (Figure 2B). Although an analogous wings-out figure is also present (Figure 2C), previous research on the Müller-Lyer illusion (e.g., Greist-Bousquet & Schiffman, 1981b; Warren & Bashford, 1977) indicates that this amputated variation produces little, if any, overestimation.

Various findings lend support to the suggestion that the Poggendorff and Müller-Lyer illusions share a common basis. Both wings-in and wings-out Müller-Lyer illusions have been found to be a function of the number (Greist-Bousquet & Schiffman, 1981b; Warren & Bashford, 1977), length (Restle & Decker, 1977), and angle (Restle & Decker, 1977) of wing components. Analogously, the Poggendorff effects have been found to be a function of the number and type of parallel components (for spatial distortion, see Greist-Bousquet & Schiffman, 1981a; Judd, 1899; Quina-Holland, 1977; Weintraub & Tong,

1974; Zanuttini, 1976; for misalignment, see Day, 1973; Day & Dickinson, 1976; MacKay & Newbigging, 1977; Weintraub & Krantz, 1971). Furthermore, misalignment effects have been found to change as a function of the length (Greist-Bousquet & Schiffman, 1985) and angle (Greist-Bousquet & Schiffman, 1985; Weintraub & Krantz, 1971) of the parallel components.

In addition to a Müller-Lyer effect caused by the parallels, another Müller-Lyer effect that may contribute to Poggendorff misalignment is a displacement of the transversals away from each other. This transversal-displacement effect is caused by an elongation of the parts of the parallel that form obtuse angles with the transversals owing to a minimal Müller-Lyer wings-out effect. Day and Dickinson (1976) and Judd (1899) have suggested that the transversal-displacement effect is inadequate to account for the total Poggendorff misalignment effect.

Indeed, verification of the subsidiary nature of the transversal-displacement effect was provided early (Hotopf & Ollerearnshaw, 1972), was extended to Poggendorff underestimation effects (Greist-Bousquet & Schiffman, 1981a), and was recently confirmed by Day and Kasperczyk (1985). More specifically, Greist-

Figure 1. The classic Poggendorff illusion (A) may be attributable to an underestimation of the distance between the parallels. By moving the right parallel laterally, an increase in interior extent produces the impression of subjective collinearity (B), whereas a decrease in interior extent accentuates the misalignment effect (C).

Figure 2. The Poggendorff figure (A) contains an amputated version of the wings-in Müller-Lyer illusion (B) and an amputated version of the wings-out Müller-Lyer illusion (C). (The complete Müller-Lyer figure is shown above B and C.)

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Figure 3. Rotated Poggendorff figures used by Day and Kasperczyk (1985). In their Experiments 1 and 2, subjects adjusted the upper line or dot along the oblique parallel so that an imaginary extension vertically bisected the space between the lower lines (in A) or dots (in B). In their Experiment 3, subjects adjusted the upper line (in C) or dot (in D) so that it was in the same vertical axis as the lower line or dot.

Bousquet and Schiffman (1981a) found that the inherent underestimation in Poggendorff variations increased when the transversals were removed. Thus, transversal presence *reduced* interior spatial distortion, presumably due to the elongation of the parts of the parallel that form obtuse angles with the transversals. Day and Kasperczyk (1985) found no effect of transversal presence: no significant differences in illusory magnitude were noted when subjects had to vertically bisect the space between pairs of lines or dots in rotated Poggendorff figures (Figures 3A and 3B). Similarly, vertical alignment of lines and dots produced equivalent illusion effects in rotated Poggendorff figures (Figures 3C and 3D). Although these results seem contradictory, taken together they indicate that Poggendorff effects occur even when transversals are removed; we must conclude that the transversal-displacement effect is subsidiary to interior spatial distortion.

The recent results of Day and Kasperczyk (1985) indicate a more limited transversal-displacement effect than that suggested by Greist-Bousquet and Schiffman (1981a). However, Day and Kasperczyk's findings are consistent

with the parallel-promoted effect of interior underestimation. Removing transversals does not obliterate interior spatial distortion; hence, Poggendorff misalignment along a vertical axis is consistent with the position that the central effect of the Müller-Lyer and Poggendorff illusions is the inner spatial distortion due to the wing/parallel components.

In short, the thrust of Day and Kasperczyk's (1985) report is to delimit the role of transversal segments in promoting the illusory effect in the Poggendorff figure. However, neither their data nor their argument rule out the contribution of general underestimation effects (achieved with dots or lines) shared by the Poggendorff and Müller-Lyer illusions.

REFERENCES

- DAY, R. H. (1973). The Poggendorff illusion with obtuse and acute angles. *Perception & Psychophysics*, *14*, 590-596.
- DAY, R. H., & DICKINSON, R. G. (1976). The components of the Poggendorff illusion. *British Journal of Psychology*, *67*, 537-552.
- DAY, R. H., & KASPERCZYK, R. T. (1985). Apparent displacement of lines and dots in a parallel-line figure: A clue to the basis of the Poggendorff effects. *Perception & Psychophysics*, *38*, 74-80.
- GREIST-BOUSQUET, S., & SCHIFFMAN, H. R. (1981a). The Poggendorff illusion: An illusion of linear extent? *Perception*, *10*, 155-164.
- GREIST-BOUSQUET, S., & SCHIFFMAN, H. R. (1981b). The role of structural components in the Müller-Lyer illusion. *Perception & Psychophysics*, *30*, 505-511.
- GREIST-BOUSQUET, S., & SCHIFFMAN, H. R. (1985). Poggendorff and Müller-Lyer illusions: Common effects. *Perception*, *14*, 427-447.
- HOTOFF, W. H. N., & OLLEREARNSHAW, C. (1972). The regression to right angles tendency and the Poggendorff illusion: II. *British Journal of Psychology*, *63*, 369-379.
- JUDD, C. H. (1899). A study of geometrical illusions. *Psychological Review*, *6*, 241-261.
- MACKEY, D. C., & NEWBIDDING, P. L. (1977). The Poggendorff and its variants do arouse the same perceptual process. *Perception & Psychophysics*, *21*, 26-32.
- PRESSEY, A. W. (1971). An extension of assimilation theory to illusions of size, area, and direction. *Perception & Psychophysics*, *9*, 172-176.
- QUINA-HOLLAND, K. (1977). Spatial distortions within the Poggendorff figure and its variants: A parametric analysis. *Perception & Psychophysics*, *21*, 118-124.
- RESTLE, F., & DECKER, J. (1977). Size of the Müller-Lyer illusion as a function of its dimensions: Theory and data. *Perception & Psychophysics*, *21*, 489-503.
- WARREN, R. M., & BASHFORD, J. A. (1977). Müller-Lyer illusions: Their origin in processes facilitating object recognition. *Perception*, *6*, 615-626.
- WEINTRAUB, D. J., & KRANTZ, D. H. (1971). The Poggendorff illusion: Amputations, rotations, and other perturbations. *Perception & Psychophysics*, *10*, 257-263.
- WEINTRAUB, D. J., & TONG, L. (1974). Assessing Poggendorff effects via collinearity, perpendicularity, parallelism, and Oppel (distance) experiments. *Perception & Psychophysics*, *16*, 213-221.
- ZANUTTINI, L. (1976). A new explanation for the Poggendorff illusion. *Perception & Psychophysics*, *20*, 29-32.

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