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The Poggendorff illusion in imagination*

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Four groups of Ss were tested on the Poggendorff illusion in which the angle of the oblique line varied from 20 to 30 deg. One group was asked to project an objective oblique line, and the remaining three groups were asked to project an imagined oblique which, in some cases, had to be subjectively rotated. There was no evidence that imagining the oblique line produced a smaller illusion than the condition in which the oblique line was objectively present. These results contradict theories of illusions which state that distortions are retinal in origin but are compatible with judgmental theories such as the assimilation theory of illusions.

Several investigators have utilized neurophysiological constructs such as statistical peaking of excitation and lateral inhibition to explain geometric illusions (Blakemore, Carpenter, & Georgeson, 1970; Burns & Pritchard, 1971; Chiang, 1968; Ganz, 1966). These theories have focused primarily on illusions in which two contours join, or cross each other, to form an acute angle. An example of such an "angle" illusion is the Poggendorff configuration illustrated in Fig. 1. It is argued that, either because of the peculiar distribution of excitation at the apex, or because of lateral inhibition, the acute angle is enlarged perceptually. In other words, the oblique line on the left of Fig. 1 turns away from the vertical line and thus appears to point above the oblique line on the right.

One of the assumptions underlying all neurophysiological theories is that the contours forming the acute angle must exist as objective stimuli and must be processed through the receptor system. From this it would be predicted that, if an acute angle were *imagined* rather than perceived, no illusion should be exhibited. This deduction was tested in the present study.

METHOD

Subjects

The Ss were 62 men and women who were enrolled in an introductory psychology course at the University of Manitoba. Only those with good vision (with or without glasses) were asked to participate.

Apparatus

The apparatus consisted of a white target holder that was 36.8 cm wide and 39.5 cm high. The face of the holder was tilted backwards 20 deg in order to ensure that the entire target was perpendicular to the line of sight. A chinrest was placed in front of the holder so that the distance between the S's eyes and the face of the frame was approximately 41 cm.

Two sets of targets were prepared, and each target was printed on a 21.5 x 28.0 cm sheet of white paper. All contours were black and were 0.5 mm wide.

The first set of targets consisted of two vertical parallel lines 3 cm apart and 15 cm long. Three black dots were drawn on the left parallel line at 0, 3, and 6 cm from the top. An oblique line, which was 3 cm long, joined the left vertical line at the middle dot (Fig. 2A). The angles formed by the oblique line and the vertical line were 20, 25, or 30 deg.

The second set of targets was the same as the first except that the oblique line did not join the left vertical line. Instead, it was located 9 cm to the left and slightly below the left vertical line (Fig. 2B). Once again, the oblique line joined the middle of a set of three dots. The angles formed by the oblique line and a hypothetical line joining the three dots were 20, 25, or 30 deg.

Design and Procedure

A 2 x 3 design was employed in which there were two forms of illusion (objective vs imagined oblique line) and three angles of the oblique line. The form of illusion was a between-Ss variable and the angle of oblique line was within-Ss. The three angles were presented twice in a different random order to each S. The Ss were assigned alternately to the two forms of illusion.

Each S was seated in front of the apparatus, placed his chin on the rest, and was shown a sample target formally similar to the experimental targets. For the condition in which the oblique line met the left vertical line, Ss were instructed to extend visually the oblique line until it crossed the right vertical line and to mark the point of crossing with a small dot. In the condition in which the oblique line was separated from the left vertical line, Ss were asked to imagine that the three dots with the short oblique line were superimposed over the three dots on the left vertical line. The top dot of one pattern was to correspond to

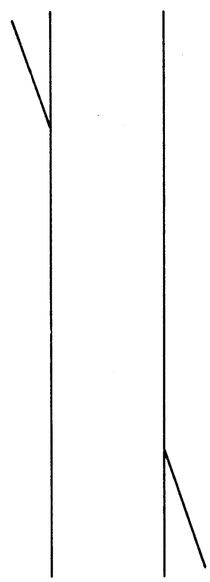

Fig. 1. The Poggendorff illusion.

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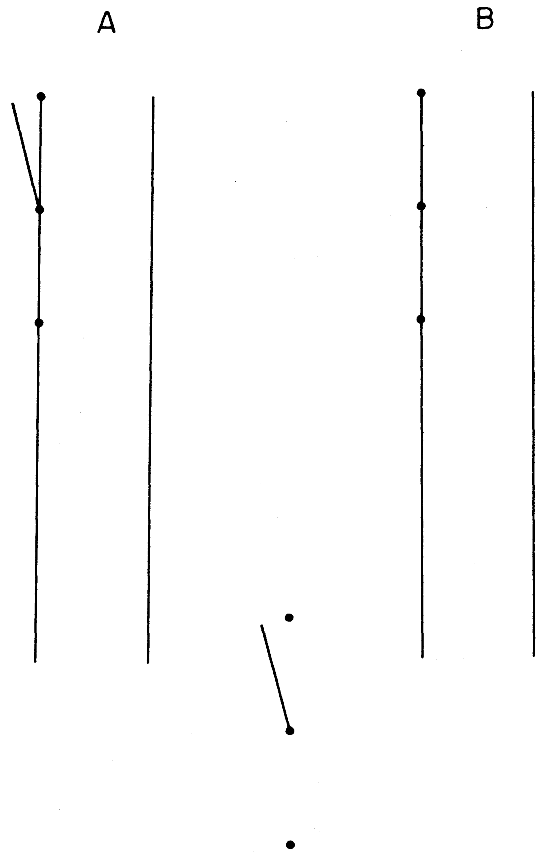

Fig. 2. Poggendorff targets employed in the experiment.

the top dot of the second pattern. They were then asked to project the (imagined) short oblique line so that is appeared to cross the right vertical line and to mark the point that it would cross. The targets were presented manually and Ss were allowed as much time as they required to respond.

After the task was completed, the following questions were asked: (a) How did you make your judgments? (b) Do you have any visual defects? and (c) Have you ever seen, or worked with, targets similar to these?

The data from 12 Ss were discarded. Three Ss were rejected because they reported visual defects not remedied by their glasses; two were rejected because they claimed prior experience with illusion, and seven were rejected because they did not follow instructions.[1] No attempt was made to score the rejected data, and the protocols were destroyed immediately after the Ss left the experiment.

RESULTS AND DISCUSSION

For each target, the oblique line was projected objectively until it crossed the parallel line on the right. This crossing point was considered to be the point of objective equality, and the responses were calculated in relation to this point of objective equality. Judgments that were above the point of objective equality, i.e., in the direction of the classic illusion, were scored positive, and those below the point of objective equality were scored negative. A mean illusion was derived from the two targets at each angle so that each S had three scores. The means of the groups are shown in the two bottom functions of Fig. 3. An analysis of variance for a mixed design showed that the effect of angle was significant, with $F(2,96) = 66.7$, $p < .001$. The Angle by Target interaction was also significant with $F(2,96) = 3.88$, $p < .05$. The effect of type of target was not statistically significant, with $F(1,48) = 1.49$, $p > .05$. This latter result indicates that the overall amount of distortion produced by imagining an oblique line was not significantly different from the case in which the oblique line was objectively present. The significant interaction indicates that a relatively greater degree of illusion was present at the very acute angle with an imagined oblique than with a real oblique, but the reason for this result is not at all obvious.

Although these results are highly suggestive in indicating that retinal processes are not necessary for the Poggendorff illusion to occur, they are not conclusive. It can be argued that afterimages were not entirely ruled out by the experimental procedure and that eye fixations could superimpose the afterimage of the oblique line on the left vertical line. Because of this kind of argument, two additional conditions were tested. In one condition, the oblique line that was to be imagined was on the left of the three dots, but pointed *up* and to the right. In the second condition, the oblique line pointed *downward* and to the left. The orientations are presented schematically in Fig. 3. In the instructions, Ss were asked to rotate the angles subjectively so that they pointed to the right and downwards. The remaining instructions and procedure were identical to those followed in the first two conditions. Nineteen Ss were tested in each of these two additional conditions. The means, as a function of angle and orientation of imagined oblique, are shown in the two upper functions in Fig. 3. Analysis of scores indicated that distributions and variability were very similar across conditions, and

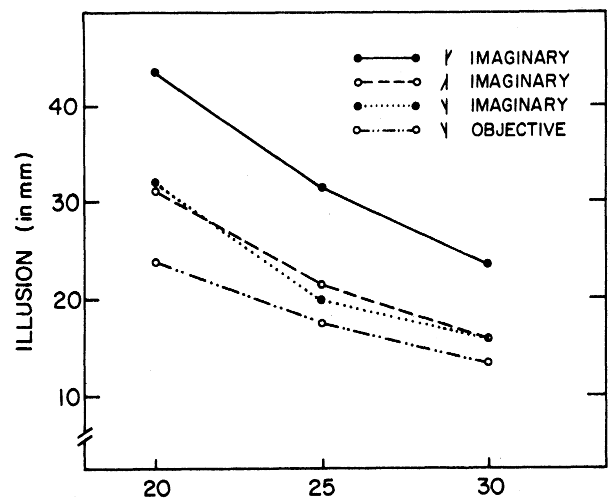

Fig. 3. Magnitude of illusion as a joint function of angle and type of oblique line.

therefore, all conditions were combined into a single analysis of variance. In this case, all three variables reached statistical significance at the .05 level. These results indicate that, if anything, a larger illusion was present when the oblique line was imagined than when it was present objectively.

The results of these experiments clearly contradict any theory of the Poggendorff illusion which attempts to explain the illusion on the basis of processes that occur at the retinal level, and it appears that the theories proposed by Chiang (1968) and by Ganz (1966) are disqualified on this basis. The theories which argue that the Poggendorff illusion is caused by lateral inhibition between orientation detectors (Blakemore et al, 1970) are also challenged by these results, unless, of course, it is argued that an imagined oblique line is also mediated by an orientation detector. The idea that an orientation detector can be triggered by instructions to imagine a line of certain orientation is certainly novel and logically possible, but, to our way of thinking, it is not a very plausible alternative.

The results of this study are compatible with the assimilation theory of geometric illusions, which has been extended recently to the Poggendorff illusion (Pressey, 1971; Pressey & Sweeney, 1972). The assimilation theory explains illusions on the basis of systematic distortions in the way focal and contextual information is processed. According to this theory, it would not matter whether an oblique line which is to be projected is real or imagined. The information, regardless of its source, will be distorted in a similar manner.

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NOTE

1. Typical responses were "I thought the bottom dot was a clue to the point where we were to mark, so I marked all points straight across from it" or "I thought I was supposed to superimpose the oblique on the top (bottom) dot."

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The stimulation-seeking motive: Relationship to conceptual category breadth

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A hypothesis that breadth of categorization would increase linearly with increases in the stimulation-seeking motive was tested on 43 males and 43 females, using Pettigrew's Category Width measure and a measure of individual differences in the stimulation-seeking motive. The results did not support the hypoth
r work of Taylor and Levitt (1967). There was a slight trend toward
between stimulation seeking and category breadth, but the
and earlier work suggested the conclusion that there is no reliable
seeking motive and conceptual category breadth.

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recently been substantially documented (Farley, 1971; Lester, 1969). Measures of arousal seeking have been shown to be related to preference for visual complexity,