The effect of curved- and straight-line figures on apparent movement and apparent depth during rotation

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The relative influence of straight- vs curved-line figures on two aspects of the stereokinetic phenomenon were examined: apparent depth and apparent sliding of one figure part over another. Thirty Ss compared three stimulus patterns (two circles; circle and triangle; and two triangles) in successive counterbalanced pairs for a total of 18 judgments per S. The prediction that the two circles would yield the strongest effect, two triangles the least effect, and the circle and triangle a medium effect was strongly supported for both depth and sliding effects. The implication of these findings for pattern discrimination tasks was noted.

The term stereokinetic phenomena (SKP) encompasses conditions in which a rotating two-dimensional stimulus configuration presented in the frontal plane appears three-dimensional. Fischer (1956) reported the effect of a number of stimulus variables on the SKP. Among these were: differences in size of circles; placement of circles with reference to point of rotation; distance between centers of circles; and monocular vs binocular viewing. In addition to apparent depth effects reported with such figures, Wallach, Weisz, & Adams (1956) also reported apparent movement of a "sliding" of one circle over another.

In general, studies of the SKP have not, however, examined the relative effects of straight- and curved-line stimulus figures on the SKP. The present study deals with this variable. Specifically, it was hypothesized that perception of apparent depth and apparent movement would be strongest for a stimulus figure containing only curved lines, less strong for a curved and straight line figure, and least potent for a figure with straight lines only.

SUBJECTS

Thirty Ss, 20 male and 10 female, with either normal or 20/20 corrected vision participated. They were volunteers from undergraduate and graduate classes in psychology. Age ranged from 20 to 49 years. All had normal stereopsis, as tested with the Keystone Visual Survey Telebinocular.

APPARATUS

A geared-down motor was used to rotate the stimulus disks. A voltage regulator dampened current fluctuations, while a Variac transformer maintained rotation at 20 rpm. The stimulus disks were three white matte cardboard circles, 9 in. in diam, on each of which a pair of stimulus figures were drawn in India ink.

Two circles, a circle and triangle, and two triangles comprised the three stimulus figures (see Fig. 1). The areas of all circles and triangles were the same. The disks were viewed against a medium-gray background. Lighting was even and diffuse (daylight fluorescent tubes). Free binocular viewing from a distance of 98 in. was used, subtending a visual angle of 5 deg 16 min.

DESIGN AND PROCEDURE

The three pairs of geometric figures constituted the independent variable. The two dependent variables were comparison judgments of (1) more depth and (2) more sliding.

The S was shown each of the disks in successive comparison with the other two disks three times in a counterbalanced arrangement for a total of 18 comparisons for depth and 18 comparisons for sliding. Viewing time for each figure was 30 sec, which was ample for the effect to be perceived. The initial instructions were: "Look straight ahead at this card. When I remove it there will be a rotating disk with figures on it. I am going to ask you to watch the figures for a time, then I will ask you some questions about what you see (30-sec interval). This disk has two circles on it (or, two triangles; or, one circle and one triangle). Does one of the figures appear to be sliding over the other (or, do you see a depth effect; is one figure nearer)? Now you will see another pattern. Is it sliding more or less than the previous figure (or, does it show more or less depth than the previous figure)?"

RESULTS AND DISCUSSION

Table 1 presents for the three comparisons the ratio of the number of times Ss judged one stimulus pattern to show more depth (or sliding) over the total number of comparisons.

The data were analyzed by chi square. For the sliding movements, chi-squares for Pattern A were stronger (more sliding) than for Pattern B, stronger for A than for C, and stronger for B than for C, the chi squares being, respectively, 254.21, 238.95, and 233.95, $p < .01$ in each case with 60 df. For the depth comparisons, chi-squares for Pattern A were greater (more depth) than for Pattern B, greater for A than for C, and greater for B than for C, respectively, 254.21, 231.32, and 147.38, $p < .01$ in each case with 60 df. Thus the hypotheses that curved-line vs straight-line figures would affect the perceptionof apparent depth and apparent sliding were both strongly supported. For both effects, depth and sliding, the effect was strongest for the two-circle pattern, next for circle and straight-line (triangle) pattern, and last for the two-straight-line pattern. The introduction of the triangle (Pattern B) had a greater effect on the depth comparisons than on the sliding comparisons. Thus, while the two effects are positively related, they are to some degree independent. That this simple method, using such gross measures, results in such large differences indicates that in pattern perception the relationship between straight vs curved lines is a very potent stimulus characteristic. This implies

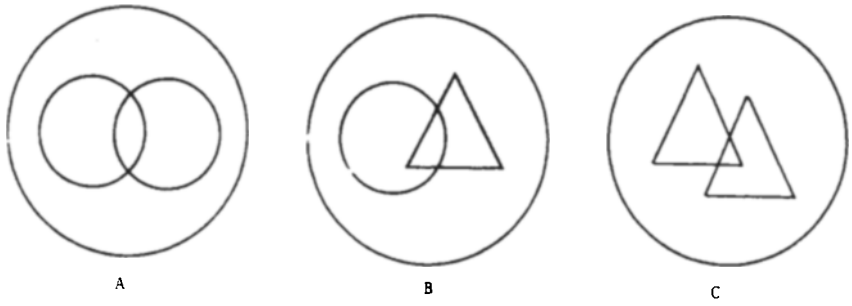

Fig. 1. The stimulus patterns.

Table 1
Ratios for the Pattern Comparisons: Number of Times a Pattern Was Judged Greater Over Total Number of Judgments*

	Patterns		
	A > B	A > C	B > C
	Depth Comparisons		
Judged Greater	180	162	96
Total Judgments	180	180	180
	Sliding Comparisons		
Judged Greater	180	174	168
Total Judgments	180	180	180

*A = two circles, B = circle and triangle, C = two triangles

that the perceptual mechanisms involved are extremely sensitive to straight vs curved line elements and that shape configurations will be more easily discriminated when they include straight and curved lines than when they contain either straight or curved lines alone.

REFERENCES

FISCHER, G. J. Factors affecting estimation of depth with variations of the stereokinetic effect. American Journal of Psychology, 1956, 69, 252-257.

WALLACH, H., WEISZ, A., & ADAMS, P. A. Circles and derived figures in rotation. American Journal of Psychology, 1956, 69, 48-59.