EXPERIMENTAL STUDIES OF A PERCEPTUAL ANOMALY

VI. THE APPLICATION OF THE "PEEPHOLE" ANALOGY TO THE PERCEPTION OF "ORGANIC" PSYCHIATRIC PATIENTS

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THE experiment to be reported in this paper stems from previous work on the block design rotation effect (Shapiro, 2, 3, 4; Yates, 9, 10; Williams, Lubin *et al.*, 7). As is well known, the block design test in its various forms: Kohs, Wechsler and Goldstein Scheerer, requires the subject to reproduce, with one-inch multi-coloured cubes, a series of abstract designs. It has been reported by a number of observers that subjects sometimes leave their reproductions in a rotated position, although otherwise the designs have been correctly reproduced. This is what we have called the block design rotation effect (Fig. 1).

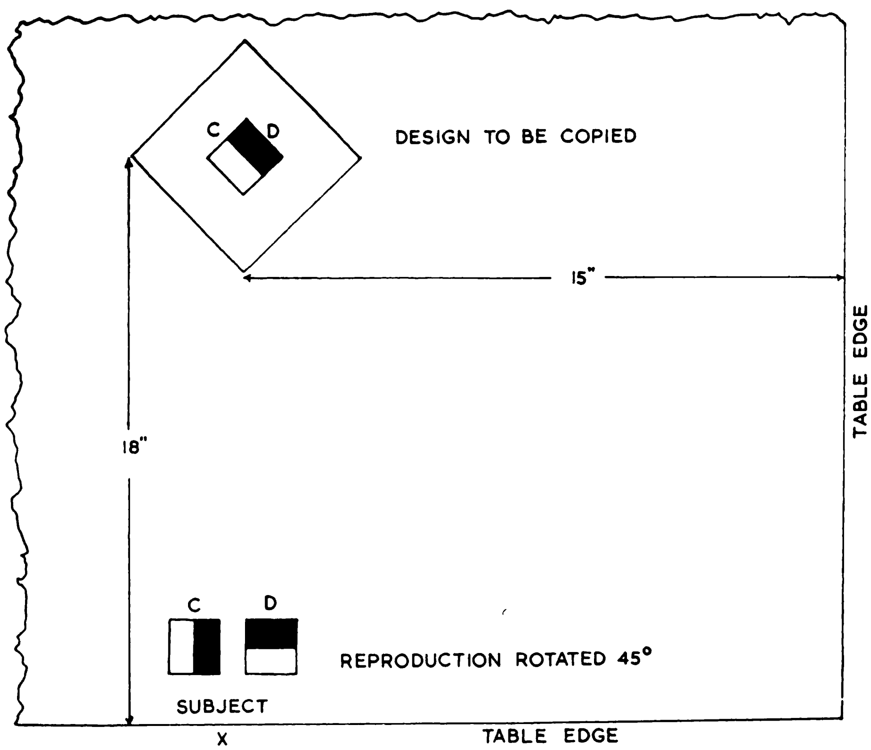

FIG. 1.—The block design rotation effect.

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Work on this effect has resulted in two main findings. The first of these is that the block design rotation effect is produced to a greater degree by brain damaged than by non-brain damaged subjects. For the purpose of our investigation we regard as "brain damaged" subjects who have a history and/or symptomatology clearly consistent with the probability that cells and/or interconnective tissue of the brain have been destroyed.

The second finding is that the amount of rotation varies in accordance with certain laws of organization of the material which has to be copied. There are three such laws:

1. When the line of symmetry of the design to be copied is at an angle to the vertical axis of the visual field more rotation is produced than when it is parallel to that axis. The line of symmetry is the imaginary line which divides a design into two equal and mirrored halves.

2. When the design is in a diamond orientation, more rotation is produced than when it is in a square orientation.

3. When the card on which the design is placed is in a diamond orientation, more rotation is produced than when it is in a square orientation. The cards used in these experiments are white and each of them is 6 inches × 6 inches in size. The designs are each 1 inch × 1 inch in size.

The explanation formulated to account for these findings (Shapiro, 3) was derived from the following two propositions:

1. Brain-damaged subjects tend to exhibit an intensification of inhibitory effects in the remaining parts of the brain. The term inhibition is used in its strictly conventional sense as an active preventer of an excitatory potential which is present.

2. One of the necessary mechanisms of attention and adaptive behaviour is that of negative induction as defined by Pavlov (1). This is to the effect that when one part of the nervous system is excited, the remaining parts may be thrown simultaneously into a state of inhibition. The nervous system is, at any given time, subject to a considerable amount of simultaneous stimulation, both from external and internal sources. For behaviour to be adaptive the effects of a great part of this stimulation must be prevented from being effective. This notion is, of course, derived from Sherrington's idea of reciprocal inhibition (5).

From these two propositions it is possible to derive the hypothesis that in brain-damaged persons negative induction effects would tend to be overstrong. Such exaggerated negative induction would have the effect of excluding from consciousness stimulation which would be available to the non-brain damaged person.

It follows from such theorizing that, in the block design test situation, the position of the brain-damaged subject would be analogous to that of a normal person who is working in a dark room, and for whom the cards and the blocks are illuminated in turn. Let us suppose that the subject is looking at a diamond oriented design on a diamond oriented card, and that the line of symmetry of the design is at an angle to the vertical axis of the visual field. We can then apply some of the work that has been done on directional perception under conditions of restricted illumination (8), and surmise that one of the two upper sides of the design will be seen as the upper side of a diamond oriented square (Side C or D in Fig. 1). For similar reasons the card will be seen as a square, again with one of the two upper sides being seen as "top". One can also surmise that the line of symmetry will have directional properties which will reinforce the perception of the square.

When the subject has illuminated for him the blocks which he is to manipulate, he perceives a situation which has a different directional organization. Features like the table edge, the graining of the table surface, and the visible parts of his body might result in there now being only one "top". This will now lie straight ahead of him, and not at an angle, as it did in the card. He will construct, in this different directional situation, what he perceived on the card above, a square, and hence he would appear to have rotated. This is because the design which he is copying is, as we stated above, actually in a diamond orientation.

A clear deduction follows from this explanation: normal subjects would, if deprived of the necessary directional cues when doing the block design test, rotate as much as brain-damaged subjects and do so according to the same laws.

Experiments have produced evidence consistent with this expectation (4, 7 and 10). In these experiments normal subjects do the block design test under conditions of cue reduction, e.g. wearing a special cue-restricting mask and working on a table covered with black felt. The mask covers both eyes completely except for a hole about $\frac{1}{8}$ inch in diameter for the dominant eye. It should be noted that although the main evidence from these experiments confirms the expectation, the observations are not in strict accord with the formulation as it stands. For example, it is reported (7) that rotation is *lessened* when brain-damaged subjects do the block design test under conditions of cue restriction. In addition, the fact that many rotations are between 0° and 45° is difficult to account for in terms of the current formulation. Strictly speaking, they should all be 45°.

The Present Experiment

The experiment reported in this paper was designed to test the idea that the perceptions of a brain-damaged person are literally like those of a normal person peeping through a little hole. We have quoted elsewhere (4) Bleuler's remarks on the disturbances of association in organic cases, where he concludes by saying "the paretic peeps at the world through a small hole". What would be the consequence if one took such a theory literally? One of the outcomes would be that stimuli outside the "peephole" would not be available to the subject, while stimuli within the "peephole" would be.

As we reported above, the diamond oriented card produces more rotation than the square oriented card. If the size of the card were made very large, and hence its edges were outside the supposed "peephole", then the influence of card orientation should be lessened. Hence the difference in the amount of rotation produced by diamond and square oriented cards should be reduced. If the cards were made smaller, and their edges inside the "peephole", their influence on the directional perception of the subject should increase, because of their increased availability. The difference in the amount of rotation produced by diamond and square oriented cards should, therefore, increase. The prediction could be formulated in the following manner. The difference in degrees of rotation produced by diamond and square oriented cards should be greatest for small sized cards, next largest for medium sized cards, and smallest for large sized cards.

Materials and Apparatus

A new test was devised to check our expectations. This consisted of 72 white cards, on each of which was drawn a yellow and blue design, 1 inch × 1 inch. Twenty-four of the cards were 6 inches × 6 inches in size. These were the dimensions of the cards used in the original experiments. Henceforth they will be called the 6-inch cards. Twenty-four of the cards were 12 inches × 12 inches in size and twenty-four were 3 inches × 3 inches. Henceforth these will be called the 12-inch cards and 3-inch cards. Each set of 24 cards contained the same six designs, presented in four different combinations of card and design orientation: (*a*) a square design on a square card, (*b*) a square design on a diamond card, (*c*) a diamond design on a square card, and (*d*) a diamond design on a diamond card. These designs were selected by eliminating two apparently easy and two apparently difficult designs from the original test. The six designs are illustrated in Figure 2 in both their diamond and square orientations. It will be seen that

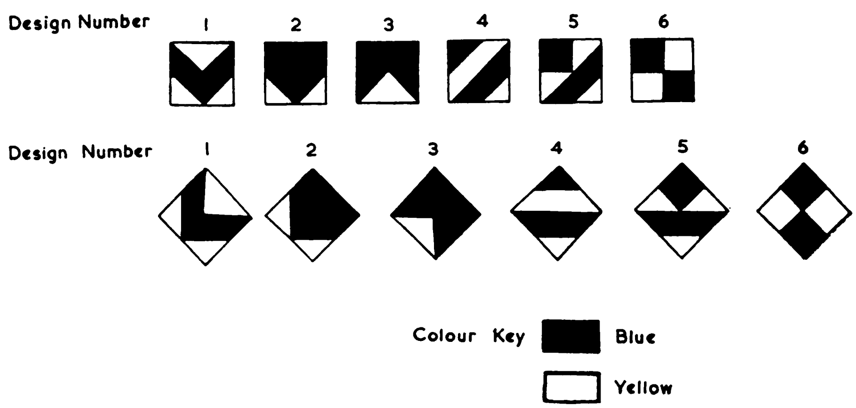

Fig. 2.—Showing the designs in the two orientations used.

there are two types of designs: (*i*) designs of diagonal symmetry, in which the line of symmetry forms a diagonal, and (*ii*) designs of rectangular symmetry, in which the line of symmetry divides the design into two equal rectangles.

The only additional equipment for this experiment was a camera suspended in a clamp above the table in such a way that it was possible to photograph each reproduction. The distance from the centre of each card to the edge of the table adjacent to the subject was 18 inches, and to the edge on the subject's right hand was 15 inches (see Fig. 1).

Procedure

The test was given to each subject in two separate sessions, one week separating each session. This was done to avoid over-fatiguing the patients. Each session lasted about 45 minutes. Each patient did all 36 versions of Designs 1, 2 and 3 at one session, and of 4, 5 and 6 at the other. Alternate patients were presented with alternate groups of designs first. The order in which the cards were presented within each session was determined by randomization within groups. Each card was selected by randomizing separately the size of card, the design, and the combination of Design and Ground, using a table of random numbers. In all other respects the procedure was the same as that reported by Shapiro in previous papers (2, 3 and 4).

A time limit of three minutes was observed, and at the end of each trial the subject was asked if his reproduction was correct. The time taken was recorded. The amount of rotation was measured by photographing each reproduction immediately after it was completed. The angles of rotation were measured later on the projected film.

SUBJECTS

The subjects, 20 in number, attended either the Maudsley Hospital or Springfield Hospital, Tooting. Since it was not possible to find, in the time available, sufficient patients in these hospitals who were unequivocally brain damaged and capable of completing the test, five idiopathic epileptics were included in the sample. It is of interest that their mean rotation score (11·72) is nearly as high as that of the group as a whole (13·19). The mean age of the group was 40·35 years, with a range from 20 to 60. The mean prorated Full Scale I.Q. on a shortened form of the Wechsler (Block Design, Vocabulary and Similarities) was 82·6, with a range from 63 to 114. Ten of the patients had a Weighted Vocabulary score of less than 6 points, and 8 were over 45 years of age. None of the patients in the previous samples had been more than 45 years of age, or had Weighted Vocabulary scores of less than 6 points. These differences from previous samples were not considered to be important, as our main concern was the experimental manipulation of the rotation effect, and not the finding of differences between brain-damaged and other groups. The main clinical data concerning these patients are given in Table I.

TABLE I

Experimental Subjects

No.	Age	Sex	Diagnosis	Mean Rotation Score
1	27	F	Idiopathic epilepsy	19·5
2	57	F	Arteriosclerotic dementia	14·2
3	31	M	Left temporal lobectomy	10·9
4	36	M	Huntington's chorea	22·9
5	20	M	Post-encephalitic dementia ..	11·8
6	40	M	Post-encephalitic Parkinsonism ..	4·1
7	20	M	Idiopathic epilepsy	17·8
8	36	M	Idiopathic epilepsy	6·6
9	51	F	Spastic paraplegia	14·5
10	50	F	Post-encephalitic Parkinsonism ..	25·4
11	54	F	Dementia paralytica	16·6
12	36	M	Dementia paralytica	13·8
13	60	F	Organic psychosis	17·3
14	32	M	Idiopathic epilepsy	5·3
15	42	M	Post-encephalitic Parkinsonism ..	16·6
16	29	M	Post-encephalitic dementia ..	4·6
17	59	M	Arteriosclerotic dementia	8·6
18	40	M	Idiopathic epilepsy	9·4
19	48	F	Dementia paralytica	9·4
20	49	F	Dementia paralytica	19·2

RESULTS

We first of all obtained three sets of scores for each subject. These consisted of the difference in rotation between diamond and square oriented cards for (*i*) the 12-inch cards, (*ii*) the 6-inch cards, and (*iii*) the 3-inch cards. Henceforth these particular scores will be referred to as difference scores. The means, standard deviations and ranges are shown in Table II.

TABLE II

Difference Scores for the Three Sized Cards

	3-inch Cards	6-inch Cards	12-inch Cards
Mean difference scores	24·55	32·50	6·37
Standard deviations ..	54·27	49·41	51·57
Ranges	−85 to +116	−75 to +108	−125 to +66

At first sight it would seem that the results are not wholly inconsistent with expectation. The mean difference score for the 12-inch card appears to be considerably smaller than it is for the 3-inch cards and the 6-inch cards, while the difference between the 6-inch and 3-inch cards is relatively small. These results could be due to the fact that the "peephole" used by these patients is, on the average, big enough to encompass the 6-inch card, and therefore it is also big enough for the 3-inch card. However, an analysis of variance only produced an F of 1·381. An F of 3·28 is necessary to reach the 5 per cent. level of significance. We have to conclude that the observations we have made could easily have arisen by chance, and cannot be accepted as evidence for the theory we were testing.

We next considered whether the negative findings might be a consequence of the character of our sample, and the fact that we were using new test material and procedures. Such an explanation is contra-indicated by the fact that the three laws are still operating on the whole in the same manner as they did in Shapiro's earlier studies. The difference between the angled line of symmetry and the vertical line of symmetry gave a "t" of 6·04, which was well above the ·001 level on a one-tail test. The difference between the diamond oriented design and the square oriented design gave a "t" of 2·437, which was significant at the 0·25 level on a one-tail test. This difference was less than that reported by Shapiro (3). The orientation of the card also produced the same differences as had been found before, the diamond oriented card producing more rotation than the square oriented card. The difference was significant at the ·025 level on a one-tail test. This difference was only slightly less than that reported by Shapiro. On the whole one can say that the three laws are operating strongly enough to prevent us from concluding that the new conditions of experimentation were responsible for our negative findings.

FURTHER INVESTIGATION OF THE DATA

It will be remembered that the difference between the diamond and square oriented cards only reached the ·025 level of significance (one-tail test) for all the designs combined. However, an analysis of variance reported by Tizard (6) showed that the orientation of the card only influences the amount of rotation in certain kinds of design. This second-order interaction is shown in Table III.

TABLE III

Second Order Interaction Table

Total Amounts of Rotation for Different Combinations of Card and Design

Type of Design	Square Card	Diamond Card
Designs of Rectangular Symmetry:		
1. Square designs	671	705
2. Diamond designs	4,214	4,482
Designs of Diagonal Symmetry:		
1. Square designs	1,530	2,398
2. Diamond designs	1,472	1,446

It will be seen that large differences between square and diamond oriented cards occur only when the line of symmetry is at an angle to the vertical axis of the visual field. Under these conditions designs with diagonal symmetry produce the most significant difference, reaching the ·0005 level (one-tail test), and the designs with rectangular symmetry produce a weaker difference, reaching the ·025 level (one-tail test). The remaining types of design produced differences between the square and diamond oriented cards which did not approach an acceptable level of significance.

It was, therefore, of interest to see whether our expectations concerning the effect of card size would still be negatived for those cards where the effect of card orientation is maximal, i.e. designs of diagonal symmetry in a square orientation. The means, standard deviations, and ranges are given in Table IV.

TABLE IV

Difference Scores for the Three Sized Cards: (i) *for Designs of Diagonal Symmetry in a Square Orientation;* (ii) *for Designs of Rectangular Symmetry in a Diamond Orientation*

	3-inch Cards	6-inch Cards	12-inch Cards
Means:			
(i)	21·47	24·78	4·26
(ii)	4·11	4·84	5·15
S.D.:			
(i)	41·58	32·13	35·91
(ii)	28·62	34·83	41·04
Ranges:			
(i)	−51 to +103	−24 to +95	−73 to +60
(ii)	−43 to +63	−63 to +66	−81 to +71
t's:			
(i)	2·646	3·04	0·70
(ii)	0·777	0·683	0·665

An analysis of variance was carried out on these designs. This produced an F of 2·543. An F of 3·26 would have been necessary to reach the ·05 level. As the direction of the differences was predicted, it seemed permissible to calculate t tests. The difference scores for the 6-inch cards were larger than those for the 12-inch cards, t being 2·131. This, on a one-tail test, is significant between the ·025 and the ·01 level. The difference scores for the 3-inch cards were also larger than those of the 12-inch cards. The t was 1·752, which is significant between the ·025 and the ·05 level on a one-tail test.

We next calculated t's for the differences between square and diamond oriented cards for each of the three sizes of cards of this type of design (see Table IV). The differences reached an acceptable level of significance for the 3-inch and 6-inch cards, but not for the 12-inch. That is, the effect of card orientation is not simply less in the largest cards; it tends to disappear.

A similar analysis was now necessary for the designs of rectangular symmetry in a diamond orientation. These had provided an overall difference between cards in a square and diamond orientation at the 5 per cent. level of significance. An examination of Table IV shows that the mean difference scores do not vary with size of ground. This result is inconsistent with our expectation. When, however, we examine the differences between diamond and square oriented cards for each size of card in designs of this type, none of the differences reach an acceptable level of significance (see Table IV). The highest of the 3 "t's" was 0·777. A "t" of 1·73 is necessary for the 10 per cent. level to be reached. If the orientation of the card is having no effect for each size of card, it is hardly likely that the different sizes of card will differ from each other in the effect of card orientation. The fact that, when the three sizes of cards combined, there is a difference at the ·025 (one-tail) level between the diamond and square orientation, must be due to the summed effect of small but consistent differences.

Discussion and Conclusions

An unexpected outcome of this experiment is the finding that the strength of the effect of ground is a function of the type of design which is being reproduced. It is the designs in which the line of symmetry is at an angle to the vertical axis of the visual field where the effects of ground are greatest. A possible explanation of this observation might be along the following lines. In our conditions the angle of the line of symmetry is a powerful determinant of directional perception. When it is parallel to the vertical axis of the visual field it produces a directional percept which is reinforced by all the other internal and external stimulation reaching the subject. The percept thus produced would be relatively stable. It would be less likely to be affected by a single and relatively weak anomalous directional cue like the diamond orientation of the card. When, however, the angle of the line of symmetry is at an angle to the vertical axis of the visual field, it is producing a directional percept which is out of harmony with the rest of the incoming stimulation. The percept thus produced might therefore be relatively unstable and the balance would easily be tipped by rather weak cues, like the orientation of the card.

The balance could be made even more precarious by the directional properties of the outline of the design. In the designs of diagonal symmetry in a square orientation, the orientation of the design reinforces the "reality cues", while in the designs of rectangular symmetry in a diamond orientation, the orientation of the design reinforces the effects of the line of symmetry. As a result, the first kind of design might be much more unstable than the second, and hence affected much more by differences in the orientation of the card as a whole.

These considerations serve to give more confidence to our findings, for they suggest a systematic reason for our observation that the orientation of the card affects rotation in some designs and not in others. On the other hand, this suggestion is at such a low level of generality that it is of limited use as it stands. The fundamental question still remains as to how the different aspects of a situation can combine to produce a certain percept. This is one of the fundamental questions of psychology, and for the time being at any rate, we have no answer to it.

At our present level of theorizing, however, it seems that our results are consistent with the notion that the perceptions of an organic psychiatric patient are similar to those of a normal person looking through a small hole. In this case the "hole" seems to be large enough to encompass a 6-inch but not a 12-inch card that is lying 18 inches away from the edge of a table at which the subject is sitting.

Summary

This paper describes an experiment to test the theory that the perceptions of organic psychiatric subjects are similar to those of normal subjects who are looking at the world through a small hole. The experiment was carried out on 20 brain-damaged and epileptic subjects. They were required to reproduce abstract designs with Kohs Blocks, the designs

being painted on 3 inch, 6 inch and 12 inch square cards. The same designs appeared on each set of cards.

Previous experimentation with 6 inch cards had shown that diamond oriented cards produced more rotation of the reproductions than did the square oriented cards. It was hypothesized that the edges of the 12 inch card were likely to be further outside the supposed peephole than those of a 6 inch card, which in turn would be further outside the hypothesized peephole than those of a 3 inch card. The further outside the peephole edges the card, the less likely would the orientation of that card be to influence the amount of rotation, and hence the smaller would be the difference between diamond and square oriented cards. Whilst the results may be regarded as consistent with expectation, they need to be repeated before the theory can be considered to have been reliably confirmed.

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