Perceptual Organization Test (POT) for the Differentiation Between Schizophrenia and Brain Damage

A Pilot Study [1]

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INTRODUCTION

The Perceptual Organization Test (POT) has been designed for the purpose of measuring impairment in cognitive functioning as reflected in a purely perceptual task. Such a test is badly needed in view of the fact that the most widely used tests of perception are not really pure tests of perception.

Bender Gestalt (Bender, 1960), for example, requires a certain measure of motor skill in copying nine geometric figures. In spite of its usefulness, it does not help us determine how much of the abnormality reflected in the drawings is due to impairment in visual organization and how much of it is due to motor dysfunction. In addition, Bender Gestalt has been shown to be a very complex task because of its projective nature. Often pathological features in the task of copying the geometric figures can be explained in terms of personality characteristics or in terms of disorders not closely related to perception per se. Hutt (1969), for instance, makes use of Bender Gestalt both as a test of organicity, as it was intended by Bender herself, and as a projective test of personality dynamics.

An equally useful test in the literature which shares these difficulties is Benton's Visual Retention Test (1963). It is rendered even more complex by requiring the subject to reproduce a set of geometric figures from memory.

Wechsler Adult Intelligence Scale (Wechsler, 1955) and Wechsler Intelligence Scale for Children (Wechsler, 1949) include several subtests of visual organization. In order for the tasks to be completed, however, subjects have to undertake motor actions as well. Therefore, attainment in these subtests could not be considered a pure measure of visual organization.

Rapaport et al. (1968) drew our attention to the same problem in connection with Wechsler Bellevue scale:

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It is possible that one of the reasons for the inclination of Performance subtests to be more vulnerable than Verbal subtests is the delicacy of this interaction, which is so easily disturbed by maladjustment.

We are still far from the time when knowledge of the rules governing visual-motor coordination will be sufficient to serve us as the basis for judging achievements on tests, (p. 138)

The Perceptual Organization Test overcomes the difficulties encountered in the perceptual tests referred to above. It isolates visual organization from motor behavior. The only movement required from the patient is placing a card next to a picture.

Furthermore, it does not require the subject to use words. Therefore, any deficit in verbal ability will not be a factor determining attainment on the test. Thus, the POT focuses on a specific area of cognitive impairment; that is, the area of perceptual organization of visual stimuli. A test with such specificity is certainly a welcome addition to the battery of tests of cerebral dysfunction.

In this paper, we are going to report the results of a pilot study whose main objective was to acquaint ourselves with the nature of the instrument and to explore its potential as a diagnostic tool.

The test consists of three subtests assumed to draw upon three different, though possibly related, modes of cognition. Should this be the case, the test would not simply be useful in detecting impairment in perceptual organization in a generalized way, but would provide a differentiated picture of its internal structure.

TEST MATERIALS

Test materials consist of the following items:

First, the original set of pictures

Three plates of glossy white cardboard of equal size. Three pictures of different objects are printed on each plate, numbered from
1 to 3 on the first plate, from 4 to 6 on the second plate, and from 7 to 9 on the third. Below each picture is an empty square, $3^1/2$ x $3^1/2$ inches, the same size as the area occupied by the picture above. The plates can be placed on a table in such a way as to form a continuous row of pictures, with number 1 appearing at the extreme left and number 9 at the extreme right, with the nine empty boxes below the pictures.

The nine pictures are realistic drawings in black and white of well-defined and easily recognizable objects:

1. a horse nursing its foal;
2. a pair of shoes on a chair;
3. two trees of the same height with a smaller tree between them;
4. a tea kettle standing beside a cup and saucer;
5. an owl in flight;
6. a little girl squatting, her hair in a pony tail, placing an object in a circular tray;
7. a leaping tiger;
8. a telephone;
9. a young boy seated.

This set of pictures will be referred to as the original set of pictures.

Second, three series of suggestive drawings

These consist of three separate series of nine cards each. Each series is placed in a separate envelope. On each card there is a drawing that, with some effort, can be matched with one of the original pictures. Each series consists of an altered form of the original set. The mode of alteration varies from one series to the other and is consistent within each series. Matching the pictures of each series with the original set of pictures presents a different challenge, since each series draws upon a different mode of perceptual organization.

Let us describe each of the three series in more detail.

Series I

This series consists of schematic representations of the nine original pictures. The style of drawing is abstract, representing the overall forms of the objects, their contours (though in a curvilinear fashion), and their orientation in space (whether horizontal, vertical, or diagonal). Internal details and shadings have been obliterated, thus

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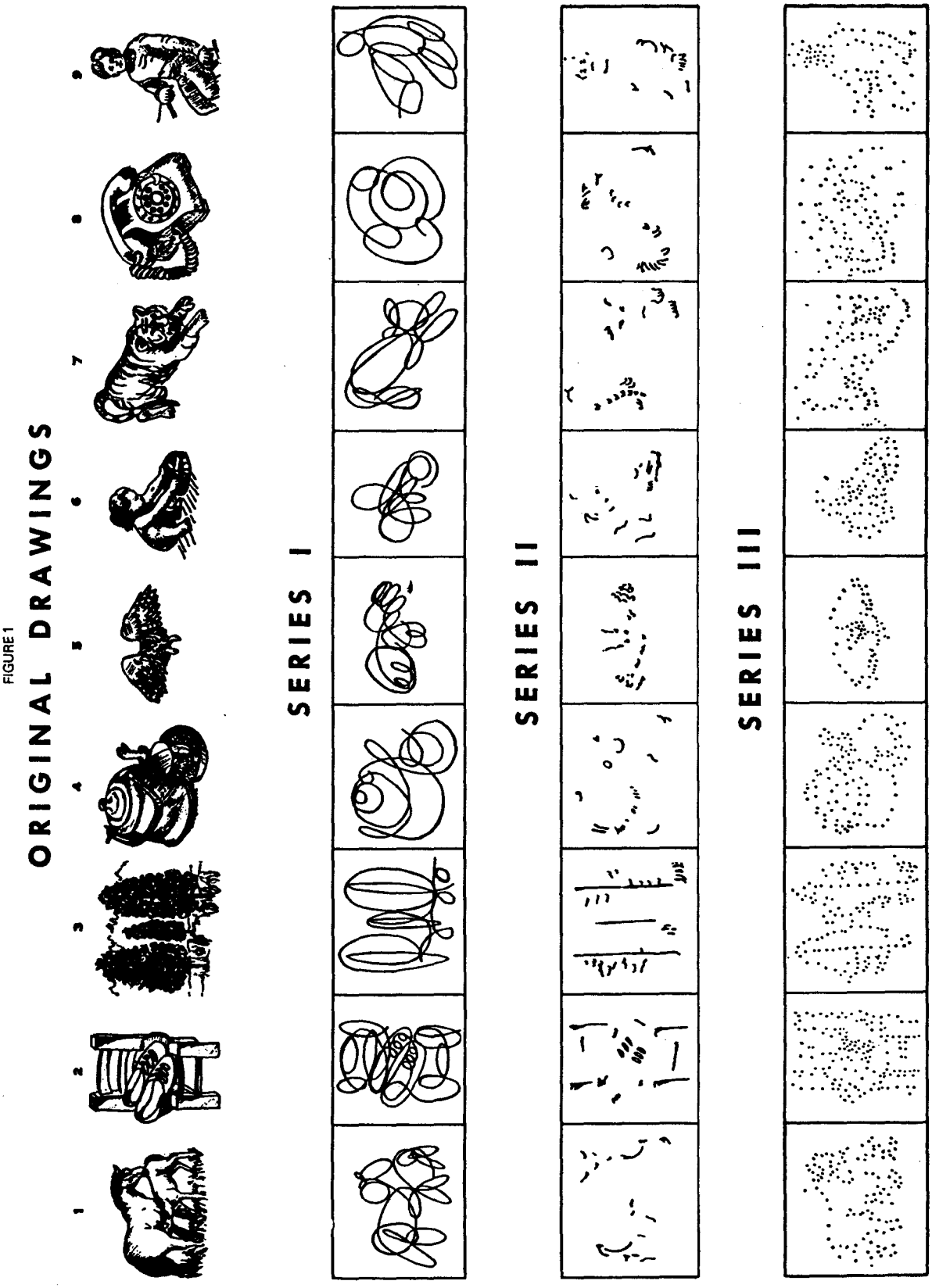
FIGURE 1



highlighting the basic structure and the spatial relations of major details within each object.

Success in matching this series with the original pictures depends on the subject's ability to identify objects on the basis of the essential properties of the gestalt. The individual must be able to grasp the similarities between a real object and a suggestive sketch of it. Subjects who are too dependent on details are likely to be impeded in this task. In other words, this series should detect impairment in abstract thinking in a task that requires no use of language.

Series II

This series represents the original objects in discontinuous lines and strokes which, if connected imaginatively, enable the subject to identify the objects. The lines and strokes mark the contours of each object and its major details. Internal features have been obliterated. Thus, each drawing appears as a fragmented form of the original object.

The components in each card in this series are accurate replicas of their counterparts in the original set. They also maintain their relative positions to the total figures. Thus, recognition of the object depends on the capacity of the subject to identify the details as interdependent parts within an integrated whole. Two opposite processes must work in concert in order to succeed in this task—breaking down the original pictures into their component parts, and integrating the fragmented details in the series. **Series III**

The drawings in this series represent a dissolution of the original objects into dotted outlines. The dots preserve the overall gestalt of the original pictures and are much closer to each other than are the strokes in Series II. Most people are able to identify the objects through the process of closure; that is, by mentally connecting the dots to each other. A normal subject usually experiences the spontaneous emergence of the object after a short interval of visual concentration.

ADMINISTRATION

The subject is asked to examine the nine original pictures placed on a table in a consecutively numbered row. The original pictures remain on the table throughout the test so that memory deficit will not hamper the perceptual task. The examiner then gives the following instructions: / *would like you to take a look at these pictures. As you see, there are nine pictures, and underneath each picture there is an empty box.*

The examiner pauses for the subject to look at the pictures. He then picks up Series I and, holding it in the hand, face down, adds:

/ *have here a series of nine drawings. Each one of these drawings represents one of these pictures (pointing to the original pictures). I want you to match these drawings (pointing to the representative series) with the pictures. For example, here is a picture of a horse and its foal (pointing to the horses). You are to pick out the card that looks most like it and place it in this box (pointing to the empty box beneath). When you are finished, each drawing you place here (pointing to the boxes) should be the one that looks most like the drawing above (pointing to the originals).*

The examiner should make sure that the subject has fully understood the instructions. He may repeat the instructions or variations thereof whenever the need arises. He should also ascertain that the subject has actually looked at the nine original pictures before showing the pictures of Series I.

The examiner then spreads the cards of the first series in front of the subject in random order, face up and properly oriented, i.e., not sidewise or upside down. The subject is then asked to start. As soon as the subject begins to examine the drawings, the examiner starts timing.

The examiner then presents the cards of Series II as he did with Series I and says:

/ *would like you to do the same thing with another set of drawings. Pick out the card that matches each picture and place it in the box underneath.*

The same procedure is followed for Series III. The examiner should not hesitate to repeat the instructions at the beginning of

each series whenever he suspects absent-mindedness or impaired memory of his subject. Repetition of the instructions within the same series may be necessary in testing confused patients, or those with serious memory deficit. The instructions are worded in such a way to involve the subject in a visual organization task of immediately perceived visual stimuli.

RECORDING AND SCORING

The Record Form

A record form (see Figure 2) is provided for recording and scoring the test. Space is provided at the top of the page for the subjects name, age, sex, education, diagnosis if available, IQ, and other pertinent information.

For each series, the box marked 'Time" is used to record the response time, that is the time spent to complete matching the nine drawings with the original pictures. Other boxes are provided for recording the subject's score on each of the nine cards in the series.

The Scoring System

Each card in any series is assigned one of these possible scores:

A score of 1—if it is the correct match and is placed in the upright position.

A score of *1/2*—if it is the correct match, but rotated so that it is sideways or upside down.

A score of 0—if it is a wrong match.

At the end of each row, the box marked "Score" is used to record the sum of the scores which have been entered in the boxes 1 through 9—a maximum of 9 points. When the three series of cards have been completed and scored, total scores are obtained by adding each column vertically. Maximum total score for each picture is 3, and maximum total score for all pictures is 27. Total time should also be recorded.

The lower half of the record form is to be used for recording behavioral observations. The first part is devoted to the subject's comments, and the second part to the examiner's observations, e.g., comments on the subject's test behavior, work habits, styles, etc.

Example (referring to Figure 2)

Here is a 20-year-old female schizophrenic. Her IQ is 115. It took her 3 minutes and 5 seconds to match the first series. This is a very long time compared to the average time derived from a sample of normal subjects, which is about 80 seconds. Yet she mismatched three pictures. She was assigned a score of zero for these. She recognized the similarity of three drawings in the series to the corresponding originals, but failed to orient them properly. That is to say, she rotated them. For that reason, a score of *V2* was assigned to each of these. The total score on this series is, therefore, 4.5. Again, this is much lower than the average score of our normal sample, which is 8.4. It is even lower than the average obtained by a small sample of acute schizophrenics, which is 7.2.

Looking at the values related to the second series, we note the following: the patient took 4 minutes, 55 seconds (almost 5 minutes) to complete the task. Nor/nal subjects complete it in less than 2 minutes. However, she did much better in terms of accuracy than she did on Series I. She matched all drawings correctly, rotating number 6. Total score on the second series is a near perfect 8.5.

Let us now examine the patient's performance on the third series. She completed the task in 2 minutes, 35 seconds, which was faster than on the first two series. She matched all drawings correctly, thus obtaining a maximum score of 9. Total time on the three series combined is 10 minutes, 35 seconds; total score on the entire test is 22.

Note that the patient's performance improved steadily as she moved from the first to the last series. Initially, she appeared bewildered. This was openly expressed by her comment on the first series (refer to subject's comments in Figure 2):

"Oh boy! I should not take the obvious."

On the second series she commented, "I am not sure they all match." In contrast is her expression of relief on the last series: "This is easy. The form suddenly appears."

FIGURE 2

RECORD FORM

PERCEPTUAL ORGANIZATION TEST

P.O.T.

A. EL-MELIGI & A. COTT

1970 EDITION

NAME Miss C.C. (Last / First / Middle)

SEX: M F AGE 20 DATE TESTED 10/15/70

REFERRED BY

SCHOOL OR INSTITUTION Clinic

Last Year of School Completed (circle one) I.Q. 115

1 2 3 4 5 6 7 8 9 10
11 12 13 14 15 16 17 18 19 20

DIAGNOSIS (or Classification) Schizophrenia

SERIES	TIME	1 Horse	2 Shoe	3 Tree	4 Kettle	5 Bird	6 Girl	7 Tiger	8 Telephone	9 Boy	SCORE
I	3'5"	1	0	1	1/2	1/2	0	1/2	1	0	4.5
II	4'55"	1	1	1	1	1	1/2	1	1	1	8.5
III	2'35"	1	1	1	1	1	1	1	1	1	9
TOTAL	10'35"	3	2	3	2.5	2.5	1.5	2.5	3	2	22

SUBJECT'S COMMENTS

I Oh boy! I should not take the obvious.

II I am not sure they all match. I can change that (#5) and make it the tiger's face. I cannot get this one (#6). Did you draw these (looked at the back of Card 6).

III Oh! This is easy. The form suddenly appears.

OBSERVATIONS

I The patient spends a long time inspecting the original pictures.

II Exchanged Cards 4 and 8 twice. Very slow.

III

Examiner

Incidentally, progressive improvement of performance on this test is a positive prognostic sign. It certainly rules out the possibility of serious organic impairment, as we found out from our clinical experience.

SUBJECTS

The test was administered to a sample of normal subjects and to five clinical groups belonging to different diagnostic categories. Let us define briefly each of the six samples.

First, Normals (N = 112-48 males and 64 females): Their ages range from 12 to 60 with an average of 33. This sample is composed predominantly of adult volunteers with no history of psychiatric disturbance, all of whom are well adjusted.

Second, Neurotics (N = 10—3 males and 7 females): These were all adults ranging in age from 21 to 40 with an average of 26, in a private clinic. They were diagnosed as neurotic reaction.

Third, Drug Users (N = 22, all males): They range in age from 17 to 42, with an average age of 22. This group actually consists of two subgroups: prison inmates in a correctional institution with drug charges, and private patients with a history of drug use.

Fourth, Acute Schizophrenics (N = 6—3 males and 3 females): These subjects are all adults ranging in age from 21 to 40, with an average of 35. They are in a private clinic and were tested within a few days of admission and diagnosed schizophrenic reaction without secondary diagnoses.

Fifth, Regressed Schizophrenics (N = 22, all males): These are all adults whose ages range from 31 to 63, with an average of 40. They were residential patients in a state hospital for a long duration, ranging from three to 15 years. They had received several electric shock treatments and heavy doses of drugs over the years. Their pathological condition was stabilized, and they were not receiving electric shock at the time of testing.

Sixth, Brain Dysfunction (N = 6—4 males and 2 females): The age of this sample ranges from 15 to 59, with an average of 27. One of these patients had major postencephalitic brain surgery. Another had been diagnosed as brain damaged since grade school and was 15 at the time of testing. The rest had received nonspecific diagnoses of organicity.

RESULTS

First, Speed of Functioning

Means and standard deviations of the time required to match each of the three series with the original pictures were calculated for the six samples separately. The values obtained will appear in Table 1.

The table was submitted to analysis of variance. F-ratios are presented in Table 3, from which it appears that performance time on each of the three series differentiates significantly between groups ($p < .01$ on the three series). Let us take a closer look at Tabid.

1. Starting with the first series, you will note that the fastest group is the drug abusers (71 seconds). Normal subjects are in second place, followed by acute schizophrenics. The neurotics and brain dysfunction group follow, and regressed schizophrenics are the slowest (180.3 seconds).

2. The second series required more time for all groups, with the exception of the chronic schizophrenics who spent less time on it than on the first series. Normals and neurotics were practically equal. The brain dysfunction group and regressed schizophrenics spent almost the same amount of time, whereas the acute schizophrenics were the slowest group on this series, although their scores vary considerably (s.d. = 193.9).

3. On the third series, the neurotic patients turned out to be the fastest group (55.3 seconds). The drug users came in second, followed by normals, brain dysfunction patients, acute schizophrenics, and regressed schizophrenics in that order.

4. Drug users are the fastest group on the first and second series, but lag slightly behind neurotics on the third series. On the whole, we can say that they are the fastest group and fluctuate the least from one series to another. Their speed may be due to impulsivity.

TABLE 1

Means and Standard Deviations of Response Time (in seconds) to each of the Three Series of The POT for Different Samples

	Series I		Series II		Series III	
Samples	Mean	s.d.	Mean	s.d.	Mean	s.d.
Normals (n=112)	79.3	53.6	101.2	53.11	58.14	49.02
Neurotics (n=10)	98.5	81.6	102.0	52.8	44.5	17.1
Drug Users (n=22)	71.1	49.3	83.8	45.3	55.3	23.4
Acute Schizophrenics (n=6)	89.8	57.4	241.7	193.9	123.5	100.3
Regressed Schizophrenics (n=10)	180.3	139.5	151.0	130.0	146.4	121.2
Brain Dysfunction (n=6)	122.7	68.2	150.0	55.9	112.8	75.3

Second, Correct Scores

Means and standard deviations of correct scores obtained by different groups on each of the three matching tasks have been computed. They are presented in Table 2. Analysis of variance (Table 3) shows that the groups vary significantly ($p < .01$).

Inspection of Table 2 reveals a number of findings:

first, normals and neurotics obtained the highest scores and were about equal in their performances.

Second, chronic schizophrenics obtained consistently the lowest scores, indicating severe impairment in perceptual organization. Furthermore, their performance became consistently worse as they proceeded from the first series to the third.

Third, patients with brain dysfunction showed milder impairment than the chronic schizophrenics, but were consistently worse than normals, neurotics, and drug users.

TABLE 2

Means and Standard Deviations of POT Scores for Different Samples

	Series I		Series II		Series III	
Samples	Mean	s.d.	Mean	s.d.	Mean	s.d.
Normals (n=112)	8.4	1.3	8.0	1.3	8.6	1.0
Neurotics (n=10)	8.3	1.0	8.0	1.1	8.9	.2
Drug Users (n=22)	7.8	1.8	6.9	1.2	8.3	1.2
Acute Schizophrenics (n=6)	7.2	1.7	6.9	1.8	8.0	.9
Regressed Schizophrenics (n=10)	5.7	3.2	4.2	2.2	3.7	2.6
Brain Dysfunction (n=6)	6.0	1.7	6.4	1.3	7.1	1.9

TABLE 3

Analysis of Variance of Response Times and Scores
F Ratios - df = 5,160*

Response Time		Scores	
Series I	5.392	Series I	8.128
Series II	6.738	Series II	16.410
Series III	5.385	Series III	30.324

* $p < .01$ on all

CONCLUSIONS

The performance of the regressed schizophrenics supports our contention that we have here a useful instrument in the detection of severe cognitive impairment as reflected in a visual organization task. We do not believe the impairment in this case to be due to the schizophrenic illness per se, since the acute schizophrenic group did relatively well both in terms of speed and correct matching. It could be due to the cumulative effect of massive doses of psychotropic drugs, overuse of ECT, and malnutrition.

This is further supported by data on the same patients from Bender Gestalt, on which the regressed schizophrenics showed definite signs of organicity in their drawings, whereas acute schizophrenics did not. The main issue, however, from the standpoint of this paper, is not whether the regressed schizophrenics are brain damaged or not, but rather that the POT is capable of measuring individual differences in perceptual organization of visual stimuli.

The POT has been able to differentiate between groups known to be free of impairment of function such as normals, neurotics, or delinquents on one hand, and groups expected to show impairment, such as regressed schizophrenics on the other hand.

This study was not intended to establish the validity of the test. Rather, it was meant to be a pilot study whose main objective was simply to explore its diagnostic potential. Although the test differentiated significantly among groups, the samples used are too small to yield conclusive results at this time. The results, however, are very encouraging.

This study has been concluded almost five years ago. We have since accumulated a great deal of clinical observations which convinced us of the capacity of the test as a screening device for patients with brain dysfunction. It helped us discriminate children with CNS dysfunction from schizophrenic children within the mixed group of minimal brain damage.

We have also noted that children with learning disabilities tend to do worse than their peers on this test. Further research is, of course, called for to put to test our empirical findings.

POT and EWI

It is important to point out that the perceptual phenomena explored by the present test are not identical with those explored by the Experiential World Inventory (EWI). The former focuses on a constricted area of perception, that is the capacity to organize visual stimuli in two-dimensional space, while the latter, the EWI, is concerned with perception of the real world of people, objects, and time, and cuts across all sensory modalities. In other words, the perceptual phenomena of the EWI are what one might call "life-size phenomena" (El-Meligi, 1972; El-Meligi and Osmond, 1970, 1973). A schizophrenic patient showing severe dysperception on the EWI may perform very well on the POT. It is not safe to extrapolate from one test to the other.

FUTURE REFINEMENTS AND USES

We have reason to believe that the test can be of great help to neurologists. One area in which the test can be particularly useful is the area of hemispheric specialization. Two distinct modes of thought or cognitive styles have been postulated by many researchers: verbal-logical, analytic (or propositional) and spatio-visual, synthetic (or appositional). Several writers postulate that the former mode draws more on the left hemisphere than on the right hemisphere, while the latter draws more on the right hemisphere than the left (Bogen and Bogen, 1969).

Ambiguities and uncertainties in this area could be greatly reduced if tests were available, which would focus exclusively on either modes. There is no difficulty finding tests which focus on the propositional mode.

In contrast, it is hard to find tests of the appositional type which are independent of functions pertaining to the first mode.

The POT is essentially a pure test of visual recognition. Furthermore, it will provide a differentiated view of an area that other tests cover only globally.

Testing Children and Retarded Adults

As mentioned earlier, the original set of pictures is printed on three separate plates, in groups of three pictures. This was done deliberately so that the examiner could use only six of the nine pictures for young children whose maturation has not yet reached a level that would enable them to cope with the complexity of the complete set. This also applies to mentally retarded adults. It is advisable in such cases to eliminate the last plate—pictures 7 through 9.

We have noted that normal children, as young as five years of age, can cope with the entire test, sometimes obtaining a perfect score, provided their attention is well sustained and the test is not timed.

Children with learning disabilities, brain dysfunction, or emotional disturbance often cannot sustain their attention beyond one series. They require a period of rest before the second series, and again before the third.

Scoring Refinements

The current method of administration does not impose a time limit. Therefore, in interpreting test results, both the raw scores and the response time must be taken into account. It should be noted that high scores indicate a high level of perceptual organization, while long response times indicate difficulty in perceptual organization. Subjects functioning at an optimal level are those who quickly match correctly as many drawings as their ability will permit.

Since many normal subjects and some psychiatric patients complete the test without error, further refinements in the scoring system are called for to increase the capacity of the test to differentiate among normals, and to minimize the overlap between normals and abnormal groups. Two refinements of scoring and administration are being considered by the authors.

First, timing the test. An investigation is being done to determine a time limit for each series.

Second, a credit system. The present scoring system does not differentiate between subjects on the basis of speed in making correct matchings. For this reason, we are now developing a credit system which will take speed into account. Under this system, subjects who complete a given series correctly within a specific time range will be assigned additional points. This will be useful in detecting subtle differences among normals, and in reducing the overlap between different pathological conditions.

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