Performance of Schizophrenic Patients on a Motor-Free Visual Perception Test

(MVPT, visual perception, figure ground)

Marilyn C. Eimon  Perry L. Eimon  Sharon A. Cermak

The Motor-Free Visual Perception Test (MVPT) was administered to 15 chronic schizophrenic patients and 15 normal controls, ages 10 to 60, to see whether perceptual deficits would be found on non-motor tasks. Groups significantly affected performance on the MVPT, as did occupational status. In the schizophrenic group only, efficiency of intellectual functioning was positively related to how well they performed on the MVPT. Age, educational level, and IQ had no significant impact on functioning on this test in either group. The schizophrenic patients made more errors on the more complex operations of the MVPT, and the only significant group differences in percentage of subjects' own errors was in figure-ground. The MVPT may be useful in screening for visual-perceptual deficits in adult schizophrenic patients.

One of the characteristics of schizophrenia is an impairment in perceptual functioning. Chapman (1) suggested that schizophrenic patients experienced changes in perception and feelings about the world long before the overt appearance of their schizophrenic symptoms. He found that among the earliest symptoms were disturbances of visual perception, and, if such disturbances were experienced at an early stage, that there was a tendency for the illness to take a more malignant course. Visual perceptual deficits in schizophrenic patients have been found in several different areas: attention or span of apprehension (2-7), figure-ground distinction (2,3,6,7), visual closure (8), processing rates (9,10), style of encoding (11-14), and feedback (15), although some researchers found that schizophrenic patients equaled normals in the basic processing required in simple discrimination and recognition tasks (16-19). Processing incoming information involves many complex events. Yates (20) identified four levels at which processing incoming information could fail in efficiency: sensory (peripheral receptor), perceptual (data processing level), central (cortical), and motor. It remains unclear which system or systems account for the perceptual deficits found in schizophrenia, although many tests have been used to assess these perceptual deficits. One problem with many standard visual perceptual evaluations is that they require not only perception (giving meaning to information from the senses), but also the ability to reproduce the percept through some motor process, usually, drawing. This includes tests such as the Bender Visual-Motor Gestalt Test (21), the Graham-Kendall Memory for Designs Test (22), and the Benton Visual Retention Test (23). The Block Design subtest of the Wechsler Adult Intelligence Scale (WAIS) (24), which does not require drawing, is a motor construction task of assembling blocks. Freidrich and Fuller (25) suggested that poor performance in visual-motor tasks may be caused by misperceptions, integrative dysfunction, motor execution difficulties, or any combination of these components.

Another problem in using most standard tests of visual perception is

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that the tests are timed, and research has indicated that schizophrenic patients show deficits in processing rates (9, 10). It is important for therapists who wish to evaluate the visual perceptual status of patients with schizophrenia to use a test that does not rely heavily on motor or timed components.

The Motor-Free Visual Perception Test (MVPT) is an instrument that occupational therapists have used to measure visual perceptual functioning in children (26), and, more recently, in adults with organic lesions (27). Unlike many other tests, this test assesses a broad variety of areas of visual perception, yet does not require a motor component and is not timed.

The present study, using the MVPT, investigated the visual perceptual functioning in schizophrenic patients. The purpose of this presentation is fourfold: to see whether the MVPT differentiates between normals and adult schizophrenic patients; to determine whether personality/organismic characteristics (education, work history, occupational status, intellectual efficiency and IQ) that have been shown to relate to some perceptual functions also relate to performance on the MVPT; to examine errors made by subjects on the five different areas of visual perception tapped by the MVPT: visual discrimination, spatial relationships, figure-ground discrimination, visual memory, and visual closure; and to familiarize the occupational therapy readership with the Calarusso Motor-Free Visual Perception Test.

Method

Subjects. Thirty male subjects between the ages of 40 and 60 were tested. Fifteen were hospitalized schizophrenic patients, and 15 were hospital employees of the Veterans Administration Medical Center, Brockton, Massachusetts. Prior to contact for participation in the study, the patient's record was reviewed for documentation of a diagnosis of schizophrenia (using the DSM-III criteria) (28). Minnesota Multiphasic Personality Inventory (MMPI) was also administered to each patient in order to support the diagnosis and to assess the patient's present state. The mean Minnesota Multiphasic Personality Inventory profile for the schizophrenic group met the criteria of the 86/68 code type (29), the profile type most commonly associated with a diagnosis of schizophrenia. The profile also met the Goldberg (30) criteria for psychosis—applying the Goldberg Index to individual profiles, all 15 profiles were classified as psychotic. The MMPI findings thus supported the diagnosis of schizophrenia and suggested a psychotic state at the time of the study. Education, work history, and current medication were obtained from the chart after the testing session. Demographic and clinical information are given in Table 1. Hollingshead's two-factor index of social position was used to rate occupational status (31). Present position was used for the control group, and highest occupation was used for the schizophrenic group. There was no significant differences between groups in terms of age, education, Shipley-Hartford Conceptual Quotient, and estimated WAIS IQ. However, differences in occupational status were significant and, as expected, normal subjects had been employed for significantly longer periods of time than the schizophrenic subjects. Thorazine equivalence was derived from Baldesserini's chart of equivalent doses of antipsychotic medication (32).

Instruments

Motor-Free Visual Perception Test (MVPT) (26). This is a test of "visual perception that avoids motor involvement and that is practical for screening, diagnostic and research purposes." (26, p 7) There are 36 multiple-choice designs that evaluate 5 types of visual perception skills: visual discrimination (the ability to discriminate dominant features in different objects), spatial relationships (the ability to orient

<table>
<thead>
<tr>
<th>Personality Characteristics</th>
<th>Normal Controls Mean</th>
<th>Normal Controls SD</th>
<th>Schizophrenic Patients Mean</th>
<th>Schizophrenic Patients SD</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>50.60</td>
<td>5.45</td>
<td>50.00</td>
<td>5.61</td>
<td>0.14</td>
</tr>
<tr>
<td>Education</td>
<td>10.20</td>
<td>2.57</td>
<td>10.67</td>
<td>2.67</td>
<td>0.48</td>
</tr>
<tr>
<td>Occupational Status</td>
<td>5.67</td>
<td>1.18</td>
<td>6.33</td>
<td>1.54</td>
<td>2.44*</td>
</tr>
<tr>
<td>Shipley-Hartford C Q</td>
<td>79.13</td>
<td>15.22</td>
<td>67.40</td>
<td>13.72</td>
<td>0.39</td>
</tr>
<tr>
<td>Estimated WAIS IQ</td>
<td>110.60</td>
<td>10.63</td>
<td>105.80</td>
<td>10.86</td>
<td>0.29</td>
</tr>
<tr>
<td>Years Employed</td>
<td>32.67</td>
<td>6.97</td>
<td>6.33</td>
<td>5.89</td>
<td>4.44†</td>
</tr>
<tr>
<td>Years Hospitalized</td>
<td>-</td>
<td>-</td>
<td>17.73</td>
<td>10.11</td>
<td></td>
</tr>
<tr>
<td>Thorazine Equivalence</td>
<td>-</td>
<td>-</td>
<td>130.53</td>
<td>115.14</td>
<td></td>
</tr>
</tbody>
</table>

*p < .05  †p < .001
one's body in space and to perceive the position of objects in relation to oneself and to other objects), figure-ground relationships (the ability to distinguish an object from its background), visual closure (the ability to identify an incomplete figure when only fragments are present), and visual memory (the ability to recall dominant features of one stimulus item or to remember the sequence of several items). Although the test purports to measure five areas of visual perception, there are no separate subtests and the items that "belong" in each category are not identified in the test manual.

The MVPT has been standardized on 881 children, ages 4 to 8, from 22 states. Test-retest reliability ranges from .77 to .91; split-half reliability ranges from .81 to .88.

Assessment of Personality/Organismic Characteristics: Shipley-Hartford (33). The Shipley-Hartford consists of a 40-item multiple-choice vocabulary test and a 20-item abstract reasoning test. It provides an estimated WAIS IQ and a measure of intellectual efficiency (the Conceptual Quotient). The Paulson-Lin age-corrected norms (34) were used to obtain estimated WAIS IQs. The estimated IQs are an average of the estimated IQ range.

Two-Factor Index of Social Position (31). This scale rates occupational status. The higher the score, the lower the social position. The data were based on the control subjects' present positions and the schizophrenic subjects' highest previous occupation.

Minnesota Multiphasic Personality Inventory (MMPI) (35). Only patients were given the MMPI, a 566-item true-or-false test. It was included to support the diagnosis of schizophrenia and to assess the presence of psychosis at the time of the study. In addition to mean code type, the Goldberg (30) psychotic index of each profile was also used.

Equivalent Doses of Antipsychotic Agents (32). This is a chart of equivalent doses of commonly used antipsychotic agents. The patient's record was reviewed for present dosage of antipsychotic medication, and the thorazine equivalent was computed by the Baldessarini method (32).

Procedure
After a review of patient charts and identification of appropriate candidates, individual appointments were made, at which time each subject was informed about the study and asked to participate. If the subject agreed to be in the study, he signed the consent form and was then tested individually by the principal author. After a brief interview, the Motor-Free Visual Perception Test (MVPT) was administered. Each item was scored as correct or incorrect, and a point was given for each correct item. In addition, the type of error was recorded. Inspection of the test items of the MVPT revealed that the five visual discrimination tasks were not always clear-cut and many items were combinations of two tasks (i.e., spatial relationships and figure-ground). Therefore, six categories were used for the type of error analysis. The Shipley-Hartford and MMPI were administered at a second session, and the results were analyzed by a clinical psychologist.

Results
In a hierarchical multiple-regression analysis, the dependent variable Motor-Free Visual Perception Test (MVPT) was regressed, respectively, first on Group (controls were coded one, and patients, minus one), then on the continuous personality or individual difference characteristics (age, education, occupational status, Shipley-Hartford Conceptual Quotient, estimated WAIS IQ, years employed, years hospitalized, and Thorazine equivalence); and finally, on interaction (cross-product of the group and the organismic characteristics). A multiple-regression analysis was used since this statistical technique enables an analysis of the relationship between a dependent variable (score on the MVPT) and a set of independent variables (group and continuous organismic/personality characteristics and their interaction) (SPSS). Means (x), standard deviations (SD), and normalized regression coefficients (beta) are reported below. Plots of significant interactive relationships are given in Figure 1.

The regressions of the MVPT on group, personality variables, and groups by personality variable interactions indicate that there was a

Figure 1
Interaction of Motor-Free Visual Perception Test and the Shipley-Hartford Conceptual Quotient

<table>
<thead>
<tr>
<th></th>
<th>Poor</th>
<th>Average</th>
<th>Mean</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MVPT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N = Normal Controls</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S = Schizophrenic Patients</td>
<td></td>
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significant group effect accounting for 39 percent of the variance. Schizophrenic patients ($x = 26.73, SD = 5.20$) performed significantly worse ($F = 18.17, df = 28, p < .001$) than did the normal controls ($x = 32.87, SD = 2.00$). There is a significant, positive relationship between Occupational Status and performance on the MVPT (beta = -.30, $r = .44$, $F = 4.53, df = 27, P < .001$). There was also a significant, positive relationship between Shipley-Hanford Conceptual Quotient and performance on the MVPT (beta = .38, $r = .57$, $F = 6.97, df = 27, p < .001$), and a significant Group by Conceptual Quotient interaction (beta = -.24, $r = .20$, $F = 3.60, df = 26, p < .05$). From an inspection of Figure 1, it can be seen that performance on the Motor-Free test is positively related to the Conceptual Quotient among patients, whereas it is essentially unrelated to the Conceptual Quotient in the normal control group. There were no significant age, estimated WAIS IQ, or education effects, and no significant interaction between groups and these variables.

### Table 2

Number of Errors for Schizophrenic and Normal Subjects for Each Task on the MVPT

<table>
<thead>
<tr>
<th>Task</th>
<th>Possible Errors</th>
<th>Normal Controls</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$X$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Vis Disc</td>
<td>3</td>
<td>0.07</td>
<td>0.26</td>
</tr>
<tr>
<td>Spa Rel</td>
<td>6</td>
<td>0.20</td>
<td>0.77</td>
</tr>
<tr>
<td>Fig Gr</td>
<td>6</td>
<td>0.20</td>
<td>0.56</td>
</tr>
<tr>
<td>Spa Gr/ Fig Gr</td>
<td>2</td>
<td>0.27</td>
<td>0.46</td>
</tr>
<tr>
<td>Vis Memory</td>
<td>8</td>
<td>1.07</td>
<td>1.03</td>
</tr>
<tr>
<td>Vis Closure</td>
<td>11</td>
<td>1.33</td>
<td>0.98</td>
</tr>
</tbody>
</table>

*$p < .01$

$^{*}p < .05$

**KEY:** Vis Disc = Visual Discrimination; Spa Rel = Spatial Relations; Fig Gr = Figure-Ground

### Type of Error

Items were divided into six exclusive categories: those items that involved primarily, 1. visual discrimination (items 1-3); 2. spatial relationships (items 9, 11, 33-36); 3. figure-ground (items 4-8, 10); 4. spatial relationships/figure-ground (items 12-13); 5. visual memory (items 14-21); and 6. visual closure (items 22-32). Each error was categorized, and the number of errors made between schizophrenics and normals was compared for each category. Results using between-group $t$-tests indicated that there were no significant differences between groups on visual discrimination items and spatial relationship items. Schizophrenic patients made significantly more errors than normals in all other categories (see Table 2).

Next, the percentage of each subject's own errors was calculated for each category. For example, if the subject made 18 total errors, 2 of which were in visual memory, the percentage of visual memory errors was .11 (2 ÷ 18). Between-group $t$-tests were computed for each category, and the only difference between the groups was in figure-ground, $t = 3.44$, with a greater percentage of schizophrenic patients' errors in this category (see Figure 2).

### Discussion

The expectation that people with chronic schizophrenia would show a deficit on a visual integration task not involving drawing or reconstruction was supported in that the MVPT differentiated normal controls and schizophrenic patients. A number of personality/organismic variables influenced performance. Occupational status was significant for both groups, indicating that the correlation between occupational status and MVPT is robust in the face of schizophrenia, though there is deterioration on the MVPT itself: the schizophrenic patients do not do as well as the normal controls. In addition, those subjects with poorer performance on the MVPT, both schizophrenic patients and normal controls, had very low-status jobs.

Performance on the MVPT for

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**Figure 2**

Percentage of subjects' own errors on the Motor-Free Visual Perception Test for schizophrenic and normal control subjects

![Graph showing percentage of errors](https://via.placeholder.com/150)

Visual Discrimination | Spatial Relations | Figure Ground | Figure Ground/ Spatial Relations | Visual Memory | Visual Closure

- Normal Controls
- Schizophrenic Patients

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* **Vis Disc = Visual Discrimination; Spa Rel = Spatial Relations; Fig Gr = Figure-Ground**
the schizophrenic group, but not for the normal controls, was related to cognitive or intellectual efficiency, as measured by the Shipley-Hartford Conceptual Quotient. This raises the question of how specific the obtained test deficits are; whether the deficits are merely correlated with other deficits; whether they result from distinct core pathology in some specific system; or whether they are general deficits in functioning caused by attentional, motivational, or emotional factors. Regardless of the etiology, however, the current findings do indicate a deficit on the MVPT.

In analyzing the type of errors made on the MVPT, it was found that on very simple discrimination tasks and tasks of spatial relationships the schizophrenic patients did as well as the normal control group. The schizophrenic patients, however, made more errors on the more complex operations of the test: figure-ground, figure-ground/spatial relationship, visual memory, and visual closure. This finding is consistent with the findings of researchers who have found that schizophrenic patients equal normal people in the basic processing required in simple discrimination and recognition tasks (16-19).

When the percentage of each subject's own errors was calculated, figure-ground tasks were the only ones to reach significance. The finding that a greater percentage of schizophrenic patients' errors were in figure-ground differentiation is consistent with the clinical description of schizophrenic perception as a failure to attend only to relevant information when irrelevant information is also present (7, 18, 36, 39), and with studies showing that, on simple recognition tasks, schizophrenic patients did well, but when visual "noise" was added, when embedded or when background was degraded, the patients showed a significant decrease in accuracy (7, 18, 36, 39). This may indicate a basic deficit in figure-ground distinction in chronic schizophrenic patients.

That the schizophrenic patients experienced greater difficulty than normals with figure-ground relationships, as measured by percentage of subject's own errors, is consistent with the possibility that the etiology may be organic, since brain-damaged subjects experience similar difficulties, loss of figure-ground relationships and interference of ground with figure (40). Replication of the present study on acute schizophrenic patients and subclinical types such as schizotypal personality would help to clarify this question.

**Implications for Occupational Therapy**

There are a number of implications of this research for occupational therapy evaluation/treatment of schizophrenic patients. First, the MVPT does differentiate between schizophrenic patients and normals. Thus, even though the test was standardized with children, it may be useful in screening for visual perceptual deficits in adult schizophrenics. Perceptual abilities have been noted to influence performance on a variety of tasks including self-care, motor coordination, job performance, and interaction with the environment (1-5, 15, 37). Perceptual abilities relate to how a person sees and deals with his or her environment. An understanding of the nature of perceptual problems of psychiatric patients may help to explain why patients have problems performing certain tasks.

The second implication involved treatment of the perceptual deficits. Since the schizophrenic subjects made a significantly greater percentage of their errors on items that involved figure-ground, this area might be important to emphasize in remediation of perceptual deficits of schizophrenics. A number of programs exist for remediation of figure-ground problems in the learning-disabled child (41, 42), and for remediation of perceptual deficits in the brain-injured adult (27) that may be helpful in the treatment of the schizophrenic patient. Although it might be questioned whether perceptual deficits can be remediated if etiology is organic, it may be that, even if underlying basic deficits cannot be "cured," splinter skills or compensating mechanisms can be developed that would enable the patient to function more effectively in the environment. For example, if the therapeutic goal is the performance of functional activities such as activities of daily living, reduction of background from the environment may prove useful.

**Conclusions**

The MVPT did show a significant difference between a chronic schizophrenic group and a normal control group, as did their occupational status. In the schizophrenic group only, efficiency of intellectual functioning, as measured by the Shipley-Hartford Conceptual Quotient, was positively related to how well they performed on the MVPT. Age, educational level, and IQ had no significant impact on functioning on this test in either group. In looking more closely at six different tasks of visual perception required in the MVPT, the schizophrenic group made more errors on figure-ground, spatial relationships and figure-ground, visual memory, and visual closure tasks, while doing as well as normals on the visual discriminations and spatial relationships.
tasks. The only group difference, calculating percentage of each subject's own errors, was in figure-ground tasks. Results were discussed in terms of use of the MVPT for screening of perceptual deficits in chronic schizophrenic patients and possible method for treatment of these deficits were suggested.

Acknowledgments
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