Patterns of Performance by Neuropsychiatric Patients on the Halstead Category Test: Evidence for Conceptual Learning in Schizophrenic Patients

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We attempted to determine whether schizophrenic patients can improve their performance on an abstract reasoning task through experience, and to ascertain how the degree of learning compares with brain-damaged patients and patient controls. Two hundred and two schizophrenic patients, 179 brain-damaged patients and 229 patient controls were compared with regard to their improvement on Subtest 6 relative to Subtest 5 of the Halstead Category Test. Since Subtests 5 and 6 are based on the same concept, experience with Subtest 5 should reduce errors on Subtest 6. Subjects were also compared on Subtest 7, which evaluates learning and retention of the concepts associated with subtests 1 to 6. The schizophrenic subjects showed improvement on subtests 6 relative to 5 that was equal to the controls, with both groups showing significantly greater improvement than the brain-damaged subjects. The schizophrenic subjects also obtained a better mean score on Subtest 7 than did the brain-damaged subjects, but made significantly more errors than controls. We conclude that schizophrenic patients are capable of conceptual learning, and may not have fixed, irreversible impairment of abstraction ability. © 1997 National Academy of Neuropsychology

Empirical studies of remediation of abstract reasoning with schizophrenic patients has largely involved training with the Wisconsin Card Sorting Test. Of five studies reviewed, one showed no learning effect as a result of detailed instructions (Goldberg, Weinberger, Berman, Pliskin, & Podd, 1987). However, the other four showed improvement in association with monetary reinforcement, detailed instructions and monetary reinforcement, or instructional cues alone (Bellack, Mueser, Morrison, Tierny, & Podell, 1990; Goldman, Axelrod, & Tompkins, 1992; Green, Satz, Ganzell, & Vaclav, 1992; Summerfelt, Alphs, Wagman, Funderburk, Hierholzer, & Strauss, 1991). An alternative approach to making a determination regarding learning of conceptual abilities that does not require direct cuing or coaching beyond what is contained in the task itself is to evaluate generalization from learning a concept with one set of materials.
to a different set of materials governed by the same concept. Using the Halstead Category Test (Halstead, 1947), Reitan (1959) tried to determine whether abstract principles can be learned by brain-damaged patients. In his study, Reitan found that while brain-damaged patients made more errors than normal controls on both Subtests 5 and 6 of the Category Test, there was not a statistically significant difference in percentage of improvement between the groups. Subtests 5 and 6 are based on the same principle. Thus, one generally finds a reduction in errors on Subtest 6 relative to Subtest 5. Another way of evaluating learning on the Category Test is to consider the score obtained on Subtest 7. Subtest 7 contains no new items, and the subject is asked to try to remember what the right answer was the last time the pattern was seen, and to give that same answer again. Thus, correct responses on this subtest reflect either chance or that the subject learned and retained the appropriate information. Both of these methods were used in the present study, with comparisons made among schizophrenic patients, non-schizophrenic brain-damaged patients, and non-schizophrenic, non-brain damaged patients. Using these procedures, an evaluation of learning can be made without use of modified instructions or reinforcing stimuli other than the buzzer and chime used with the Category Test to signal incorrect and correct responses. Furthermore, one can use Reitan’s data as reference points for the analysis involving Subtests 5 and 6. The brain-damaged group in his study made a mean of 2.19 (SD = 3.97) fewer errors on Subtest 6 than on Subtest 5, while the non-brain damaged controls obtained a mean improvement of 3.23 (SD = 3.59) errors (t = 1.42, p > .05).

METHOD

Subjects

The sample consisted of 202 schizophrenic patients, 179 non-schizophrenic patients with evidence of structural brain damage, and 229 non-brain damaged, non-schizophrenic patients. The schizophrenic patients consisted of a sample of 117 subjects previously described in Goldstein (1990) and a second, newer group of 85 subjects. For the first 117 subjects, diagnoses were based on a review of clinical records. Schizophrenia had to be the primary diagnosis made by a qualified psychiatrist, and explicit mention had to be made of appropriate symptoms in type and number to meet DSM-III-R criteria (American Psychiatric Association, 1987). The sampling for these cases was done retrospectively, being drawn from a large database of patients referred for neuropsychological testing. The additional 85 subjects were diagnosed with the Structured Clinical Interview for DSM-III-R (SCID-P) (Spitzer, Williams, Gibbon, & First, 1989). The SCID-P interview was administered by trained interviewers with reliability records of 80% or higher. The 85 new cases were recruited on a prospective basis through obtaining lists of schizophrenic patients and approaching them to consent to participate in the study. As well as being interviewed with the SCID-P these new patients were reviewed at a case conference attended by the program staff, with attendance or consultation by a board-certified psychiatrist when there were particular difficulties in establishing the diagnosis. Only patients gaining consensus among the SCID-P findings, the conclusion reached at the case conference, and the psychiatrist’s opinion when requested were admitted to the study. A study by Goldstein and Shemansky (1995) provided a comparison between the clinically and SCID-P diagnosed patients, finding no significant neuropsychological or clinical-demographic differences. All subjects were inpatients stabilized on medication at the time of testing. The non-schizophrenic, brain-damaged group consisted of a group of patients with a variety of brain disorders. Presence of brain damage was established by comprehensive neurological evaluation utilizing appropriate neuroimaging, laboratory, and examinational findings for the disorder in question. Definitive evidence
TABLE 1
Demographic and Diagnostic Data

<table>
<thead>
<tr>
<th></th>
<th>Schizophrenic</th>
<th>Brain-Damaged Group</th>
<th>Patient Controls</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Age</td>
<td>41.46</td>
<td>9.66</td>
<td>43.40</td>
</tr>
<tr>
<td>Education</td>
<td>12.03</td>
<td>2.47</td>
<td>11.40</td>
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<tr>
<td>WAIS-R IQ</td>
<td>92.38</td>
<td>13.14</td>
<td>90.65</td>
</tr>
</tbody>
</table>

Diagnoses of Brain-Damaged Subjects
- Alcohol Dementia: 57
- Brain Malformations: 7
- Epilepsy: 18
- Infectious Disorders: 6
- MS and Related Disorders: 5
- Neoplastic Disorders: 4
- Neuronal Degenerative Disorders: 9
- Trauma: 3
- Toxic Disorders (Non-Alcohol): 1
- Vascular Disorders: 24
- Unknown Etiology: 8

Diagnoses of Non-Brain Damaged, Non-Schizophrenic Subjects
- Anxiety Disorder: 58
- Personality Disorder: 25
- Mood Disorder: 60
- General Medical Disorder Not Effecting CNS: 26
- Peripheral Nerve and Spinal Disorders: 43
- Other: 17

*Not significantly different (p > .05); **significantly different (p < .001).

of structural brain damage was present in all cases. The non-brain-damaged, non-schizophrenic group consisted of a heterogeneous group of patients referred for neuropsychological testing as part of a comprehensive evaluation of suspected brain dysfunction, with negative findings. The distribution of diagnoses for both groups is provided in Table 1. All subjects were consenting patients at one of two Veterans Administration neuropsychiatric facilities. Demographic and diagnostic data are presented in Table 1.

Procedure

All subjects received the Halstead Category Test as part of a more extensive neuropsychological assessment. The standard version of the test was used, in which geometric forms and some verbal material are projected on a screen, below which are four keys numbered 1 to 4. The test consists of 7 subtests. Subtests 5 and 6 utilize the same principle; that is, the ratio of solid to dotted elements in a series of geometric figures. Subtest 7 is a review procedure containing items from previous subtests.

Data Analysis

Statistical comparisons were made to evaluate group differences in age, education, and general intelligence (Full Scale Wechsler IQ). Following the procedure of Reitan (1959), the error score for subtest 5 was subtracted from the error score of subtest 6 as a measure of improvement. Both subtest 5 and 6 consist of 40 items. We added a constant of 10 to the difference between error scores to avoid negative numbers. This score was the dependent
TABLE 2

<table>
<thead>
<tr>
<th></th>
<th>Subtest 5</th>
<th>Subtest 6</th>
<th>5 - 6 + 10</th>
<th>Subtest 7 Errors</th>
<th>Total Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td>M</td>
</tr>
<tr>
<td>Brain Damaged</td>
<td>20.15</td>
<td>6.84</td>
<td>15.99</td>
<td>7.94</td>
<td>14.15</td>
</tr>
<tr>
<td>Controls</td>
<td>16.10</td>
<td>6.80</td>
<td>10.63</td>
<td>6.73</td>
<td>15.47</td>
</tr>
<tr>
<td>(F)</td>
<td>19.79</td>
<td>28.20</td>
<td>5.26</td>
<td>14.63</td>
<td>15.32</td>
</tr>
<tr>
<td>(p)</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
<td>&lt;.01</td>
<td>&lt;.001</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

The measure and was used in a one-way analysis of variance (ANOVA) comparing the three groups. The Student-Newman-Keuls procedure \((p < .05)\) was used as the multiple comparisons statistical test. A similar comparison was made comparing inter-group performance on Subtest 7.

**RESULTS**

The analysis of demographic data indicated that the three groups did not differ \((p > .05)\) with regard to age and educational level. With regard to IQ, there was a significant overall difference among the groups, but the brain-damaged and schizophrenic subjects did not differ from each other, with both differing from the controls. Results related to total test performance and the improvement score are summarized in Table 2. On Subtest 5 of the Category Test, both the schizophrenic and brain-damaged groups made significantly more errors than the patient controls, but did not differ from each other. On Subtest 6 all three groups differed significantly from each other, with the brain-damaged group having the highest mean error score and the patient control group the lowest. There was a statistically significant difference among the groups for total score \((F(2, 607) = 51.32, p < .001)\) and for the improvement score \((F(2, 607) = 5.26, p < .01)\). The Student-Newman-Keuls procedure indicated that the schizophrenics did not differ from the patient controls on the improvement score, with both of these groups demonstrating significantly more improvement than the brain-damaged group. Power was equal to .85 with a small effect size equal to .13.

Data for subtest 7 are also contained in Table 2. The difference among groups was statistically significant \((F(2, 607) = 14.63, p < .001)\). Power was .99 with a small effect size equal to .22. The Student-Newman-Keuls test yielded a significant difference among all three groups. If one interprets the Subtest 7 scores in terms of learning, then the schizophrenic subjects learned and retained information less well than patient controls, but better than patients with structural brain damage.

**DISCUSSION**

The degree of improvement on Subtest 6 of the Category Test seen in a group of schizophrenic patients was identical to what was found in a non-brain damaged control group, and significantly greater than what was seen in a group of patients with heterogeneous forms of structural brain damage. The amount of improvement was small, but was statistically significant. It was, in fact, greater than that reported for Reitan’s (1959) controls; that is, a mean reduction of 5.45 errors for our schizophrenic group as opposed to the mean of 3.23 errors reported by Reitan for his controls. This improvement occurred in the presence of impairment on the Category Test as a whole relative to the patient controls and norms.
collected from a VA patient sample (Russell, Neuringer, & Goldstein, 1970). While the schizophrenic patients did not do as well on Subtest 7 as the patient controls, they significantly outperformed the brain-damaged group. These results are not readily attributable to demographic or general intellectual differences among the groups. Age and education did not differ significantly, but the schizophrenic sample had a significantly lower mean IQ score than the controls. It might therefore be suggested that the schizophrenic group obtained close to the same learning effects as the controls despite having a lower mean IQ. These results would be more consistent with those studies that reported success in gaining improvement by schizophrenic patients on the Wisconsin Card Sorting Test through providing instructional cues. The results of most of the Wisconsin Card Sorting Test studies and the present study would not concur with the view proposed by some (e.g., Goldberg et al., 1987) that these deficits are fixed and irreversible. The potential for at least modest rehabilitation of cognitive deficits in individuals with schizophrenia would therefore be a possibility.

REFERENCES