Using the Tactile Form Recognition Test to differentiate persons with brain damage from control subjects

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Abstract

The Tactile Form Recognition (TFR) Test, which evaluates stereognosis in each hand and requires less than 15 min for administration, was given individually to 50 persons with brain damage and 50 controls who were essentially equivalent in age and education. Scores for the two groups yielded mean values that were different at a statistically significant level. Evaluation of the two distributions of scores yielded a cutoff score that had an accuracy rate of 82% for the controls and 84% for the persons with brain damage. The results suggest that the TFR Test is a valid and useful procedure for differentiating persons with brain damage from controls and, thus, can serve effectively, in conjunction with tests of higher-level brain functions, in neuropsychological evaluation of individual persons. © 2001 National Academy of Neuropsychology. Published by Elsevier Science Ltd.

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1. Introduction

While the term neuropsychology, and the use of neuropsychological tests, implies a relationship between behavioral performance and the underlying neurological basis for that performance, rarely does the practicing neuropsychologist know the accuracy with which an individual test, or a battery of tests, identifies persons with known brain damage or disease as contrasted with persons having no evidence of brain damage. Although conclusions about

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normality or impairment of brain functions are often drawn on the basis of test results, the “hit rate” for groups either with or without brain damage has usually not been established on the basis of empirical research.

Some neuropsychologists have raised a question about the use of neuropsychological tests to detect brain damage, and have argued that the purpose of testing should be to delineate specific cognitive functions that may be of importance in effective adaptation to problems in living (Mapou, 1988). Of course, no one would argue with this purpose. However, unless the tests used to achieve this aim are also reflective of brain status, the testing becomes of such a generalized nature that the results fall within the domain of clinical psychology, and the “neuro” part of neuropsychology may become irrelevant. As neuropsychologists, we are inescapably devoted to the task of evaluating brain–behavior relationships and, consequently, must have evidence that our tests link the brain to behavior. In many, if not most, instances, the purpose is not primarily to “diagnose” brain damage, which may already have been accomplished through the use of specialized neurological tests such as MRI. However, we do need to know as much as possible about the differential significance of our test findings with relation to brain pathology if our tests are to fall within the domain of neuropsychology, as contrasted with other areas of psychology. Neuropsychological assessment obviously requires evaluation of both behavioral manifestations of brain function, as well as evidence that the tests used are validly related to brain status, and neither of these requirements should be dismissed.

This study was performed to provide such data for a particular test, the Tactile Form Recognition (TFR) Test from the Halstead–Reitan Neuropsychological Test Battery (Reitan & Wolfson, 1993).

The TFR Test evaluates the ability to recognize tactile form by asking the subject to identify flat plastic shapes (cross, square, triangle, and circle) as they are individually placed in his/her hand. The subject feels the plastic shape with one hand, held out of the range of vision, and with the other hand points to one of the four plastic shapes mounted on a board corresponding to the shape in his/her hand. The response element of this task is deliberately minimized (no verbal response is required), and the input sensory (afferent) aspect, together with central processing, predominates. The subject is instructed to respond as quickly, carefully, and accurately as possible.

2. Method

2.1. Participants

In order to preclude any selection bias with relation to the purposes of this study, a group of brain-damaged persons and a control group used for a totally different investigation were used in this study. The groups were fully described previously by Wolfson and Reitan (1995), but we will include a summarical description at this point. Each group included 50 subjects (20 men, 30 women). All participants except three persons with brain damage and five control subjects were right handed (using the preferred hand for writing as the criterion). All of the members of the group with brain damage were patients who had received comprehensive neurological evaluations, and there was unequivocal evidence of brain damage or
disease in every case. The control group consisted of 43 hospitalized patients and seven normally functioning persons. Every control subject had received a clinical neurological evaluation, and only those subjects who had no past or present evidence of brain disease or damage were included in the study. The two groups were closely equivalent for age and education. The group with brain damage had a mean age of 36.64 years (S.D., 14.83) and a mean education of 12.86 years (S.D., 3.37); the control subjects had a mean age of 36.36 years (S.D., 12.71) and a mean education of 12.78 years (S.D., 2.28). Statistical comparisons of the age and education distributions did not approach significance.

2.2. Procedure

In developing the Halstead–Reitan Battery into an evaluation that could focus validly on the individual person, Reitan and Kløve realized that the original tests developed by Halstead (1947) did not adequately assess lower-level (sensorimotor) aspects of brain functions. Lower-level brain functions are more closely and specifically dependent on the integrity of known tracts, nuclei, and cortical areas in the central nervous system than are higher-level aspects of brain functions, which are probably more dependent upon environmental opportunities and influences for development. It was apparent that an integration of lower-level and higher-level brain functions had great potential for valid and comprehensive neuropsychological evaluation of the individual person. The TFR Test was developed in this framework for evaluation of stereognosis, or recognition of objects through touch — a function that clearly is basic with respect to tactile perception and the efficient manipulation of objects.

The TFR Test was individually administered to each subject by carefully trained technicians who did not know whether a subject was in the control group or the brain-damaged group. Response-time measurements were made for each trial, and the total time required for the four trials for each hand was determined. Complete instructions for the administration of the TFR Test are given in Reitan and Wolfson (1993). The score reflected the total time required to identify the shapes for both hands. The TFR Test can usually be administered in less than 15 min.

3. Results

As shown in Table 1, the subjects with brain damage required more than twice as much time as the control subjects to complete the TFR Test. This difference was highly significant statistically (t ratio of 6.46; P < .001).

<table>
<thead>
<tr>
<th></th>
<th>Controls</th>
<th>Brain damaged</th>
<th>t Ratio</th>
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<tbody>
<tr>
<td>Mean</td>
<td>18.36</td>
<td>43.28</td>
<td>6.46 (P &lt; .001)</td>
</tr>
<tr>
<td>S.D.</td>
<td>4.19</td>
<td>26.65</td>
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While these results are impressive statistically, the practical question concerns the significance of the data for differentiation of individual subjects in the two groups. Differentiation between the groups, in terms of raw scores at various cutoff points, is shown in Table 2.

Table 2 indicates the percentage of correct predictions at various cutoff points in groups with and without brain damage. The results indicate that a cutoff of 21/22 s (total for both hands) provides the most accurate differentiation of the groups, with 82% of the persons with brain damage and 84% of the controls being identified correctly. Table 2 also provides information about the accuracy of classifications of additional cutoff scores. For example, very few of the persons with brain damage (4%) scored below 18 s, whereas 66% of controls met this criterion; few controls (4%) required more than 28 s, whereas 54% of the persons with brain damage exceeded this criterion.

A review of the persons with brain damage who scored well on the TFR Test (false negatives) indicated that they tended to be younger and better educated (mean age, 38.38 years; mean education, 12.50 years) than the controls who performed poorly (false positives) (mean age, 52.78 years; mean education, 10.88 years). Brain lesions in the brain-damaged group also tended to be stabilized and chronic, or, if focal, small and nonmalignant.

4. Discussion

The results reported above indicate that scores obtained with the TFR Test differentiate strikingly and significantly between controls and persons with brain damage. The results of this study were based only on level of performance, but we should also note that the TFR Test produces intraindividual data, in the form of differences in performances with the two hands, that provide a meaningful basis for the lateralization of cerebral damage (Reitan & Wolfson, 1993). Thus, the TFR Test appears to be an effective tool for drawing inferences about the biological condition of the brain, especially in conjunction with a range of measures of higher-level brain functions.

It must be mentioned that it is necessary for the TFR Test, like any neuropsychological test, to be administered strictly according to standard procedure. For example, it is scarcely possible for a subject to give a response within 1 s if the plastic figure is placed in the palm...
rather than the fingertips, and such an error in procedure might well produce scores for normal subjects that fall in the brain-damaged range. Precise instructions for administering and scoring the TFR Test are given and illustrated in Reitan and Wolfson (1993).

References


