USING THE TACTILE FORM RECOGNITION TEST TO DIFFERENTIATE BRAIN-DAMAGED FROM CONTROL SUBJECTS

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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 non-brain-damaged persons. Although conclusions about normality or impairment of brain functions are often drawn on the basis of test results, the Ahit-rate@ for either brain-damaged or control subjects has usually not been established on the basis of empirical research.

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

Method

Participants. In order to preclude any selection bias with relation to the purposes of this study, a brain-damaged group 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 brain-damaged persons and five control subjects were right-handed (using the preferred hand for writing as the criterion). All of the members of the brain-damaged group 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 7 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 brain-damaged group had a mean age of 36.64 years (SD, 14.83) and a mean education of 12.86 years (SD, 3.37); the control subjects had a mean age of 36.36 years (SD, 12.71) and a mean education of 12.78 years (SD, 2.28). Statistical comparisons of the age and education distributions did not approach significance.

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 Tactile Form Recognition Test was developed in this framework for evaluation of stereognosis, or recognition of objects through touch B a function that clearly is basic with respect to tactile perception and the efficient manipulation of objects.

The Tactile Form Recognition Test was individually administered to each of the subjects by carefully trained technicians who did not know whether a subject was in the control group or the brain-damaged group.

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.

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 Tactile Form Recognition Test are given in Reitan and Wolfson

(1993). The score reflected the total time required to identify the shapes for both hands. The Tactile Form Recognition Test can usually be administered in less than 15 minutes.

Results

As shown in Table 1, the brain-damaged subjects 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 1. Means and standard deviations on the Tactile Form Recognition (TFR) Test for a group with brain damage and a control group.

	Controls	Brain-Damaged	t-ratio
Mean	18.36	43.28	6.46 ($p<.001$)
SD	4.19	26.65	

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 brain-damaged and control subjects, in terms of raw scores at various cutoff points, is shown in Table 2.

Table 2. Cutoff points for differentiation of control subjects and subjects with brain damage using the Tactile Form Recognition Test.

	Correct Classifications				
	Controls			Brain-Damaged	
Cutoff Points (sec)	N	%		N	%
17/18	33	66		48	96
20/21	39	78		44	88
21/22	41	82		42	84
22/23	43	86		39	78
28/29	48	96		23	54

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 sec (total for both hands) provides the most accurate differentiation of the groups, with 82% of the brain-damaged subjects and 84% of the controls identified correctly. Table 2 also provides information about the accuracy of classifications of additional cutoff scores. For example, very few brain-damaged subjects (4%) scored below 18 seconds, whereas 66% of controls met this criterion; few controls (4%) required more than 28 seconds, whereas 54% of the brain-damaged subjects exceeded this criterion.

A review of the brain-damaged subjects who scored well on the Tactile Form Recognition 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 non-malignant.

Discussion

The results reported above indicate that scores obtained with the Tactile Form Recognition 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 Tactile Form Recognition Test produces intraindividual data, in the form of differences in performances with the two hands, that provide a meaningful basis for lateralization of cerebral damage. Thus, the Tactile Form Recognition 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 Tactile Form Recognition 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 one second if the plastic figure is placed in the palm rather than the finger-tips, 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 Tactile Form Recognition Test are given and illustrated in Reitan and Wolfson (1993).

References

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