

The Halstead-Reitan neuropsychological test battery

Description and application

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Criteria for a good neuropsychological test battery

Damage to the brain can profoundly alter a wide range of human behavior. Especially during the past decade findings in systematic investigations of brain-behavior relationships have been translated into test procedures and made available for diagnosis, rehabilitation, and research within the area of clinical neuropsychology.

The selection of neuropsychological test procedures for assessing the cerebral functional status of a person suspected of brain damage should be governed by well-documented validity for diagnosing brain damage and by a sound knowledge of the relationship between brain and behavior. The methods chosen should reflect, as closely as possible, the full range of human abilities in order best to assess not only the presence of brain damage but also the effect of different types of brain damage, ie, diffuse or focal, and, if focal, left-sided or right-sided, anterior or posterior. In the hands of an experienced neuropsychologist using the full range of different inferential methods, it should also be possible to diagnose the kind of specific neuropathological process behind the sampled test behavior. Sensory and motor deficits, amnesic syndromes, intellectual impairment, and preferably also organic personality changes should be assessable in a general-purpose neuropsychological test battery.

It is of course an advantage to choose internationally merited tests, because the neuropsychological profile of a person can then be compared with the profiles of defined clinical groups and, in this way, contribute to a fuller understanding of the person in question.

The selection of test methods should also be based on the availability of explicit and standardized rules for the administration and scoring of the tests. In this

manner a reasonable equality of results between different neuropsychologists and different neuropsychological laboratories should be achievable. Both psychometric (ie, cut-off scores, performance levels, and summary indices) and clinical inference methods (ie, pathognomonic signs, right-left comparisons, pattern of performance, and matching with "model profiles") should be integrated and possible to use in the assessment enterprise. Norms representative of performance in different strata of the general population are desirable. The strata should be defined to allow for simultaneous control of chronological age and level of formal education. It is a great advantage if the results of the neuropsychological examination can be plotted in a graphic summary profile of standardized scale scores for the easy identification of level and, in particular, pattern of performance. In this way the neuropsychologist's interpretation and communication of the results of the assessment are facilitated.

Summary description of the Swedish version of the Halstead-Reitan battery

The most widely used and best validated of clinical procedures designed to assess the brain-behavior relationship outside Sweden, and particularly in the United States, are those originally developed and validated by Ward Halstead in Chicago before the Second World War. Halstead's procedures have been extended, modified, and introduced as practical instruments with individual patients by Ralph Reitan in Indiana and his collaborators, including Hallgrim Klöve in Norway. In the Halstead-Reitan battery (HRB) sensory, motor, and more complex intellectual functions are assessed by means of experimental psychological apparatus procedures and paper and pencil tests. The sensory and motor tests are carried out with both the dominant and nondominant hand and, of course, are less dependent on formal education than are the intellectual tests.

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On the basis of a factor analysis of the original HRB, Halstead proposed the following four-factor theory of human performance: (i) a central integrative field factor (C) representing the organized experience of the individual, (ii) an abstraction factor (A) concerning a person's basic capacity to group to a criterion, (iii) a power factor (P) reflecting the undistorted power of the brain, and (iv) a directional factor (D) constituting the medium through which factors C, A, and P are expressed. Halstead's four-factor theory has not proved to be of much practical value in clinical neuropsychological work. His factor C should correspond to the entities referred to as psychometric and crystallized intelligence, while the other three factors can be regarded as aspects of biological and fluid intelligence.

The original American version of the HRB satisfies most of the criteria of a good neuropsychological test battery, at least when used in combination with a measure of general intelligence and a personality questionnaire of clinical relevance. In the American version of the HRB the following tests are used: (i) the *Halstead Category Test* (abstract concept formation and mental efficiency); (ii) the *Tactual Performance Test*, time, memory, and localization (tactile perception, psychomotor coordination, and incidental memory); (iii) the *Rhythm Test* (nonverbal auditory perception, attention, and sustained concentration); (iv) the *Speech-Sounds Perception Test* (auditory-verbal perception, sustained attention, and concentration); (v) the *Finger Oscillation Test* (motor speed), and (vi) the test *Trail Making*, parts A and B (speed in visuomotor scanning and flexibility). The last mentioned has been added by Reitan.

The results are summarized in a neuropsychological "impairment index," computed from the eight scores derived from the six tests of the battery. The total number of scores falling in the "impaired" range, ie, below the cut-off score of each test, is divided by eight and rounded off to a scale from 0.0 to 1.0.

The HRB has been standardized and further developed for use in Sweden by Bergman and collaborators at the Magnus Huss Clinic, Karolinska Hospital, Stockholm. However, the Speech-Sounds Perception Test has been left out. In order to obtain a better assessment of amnesic syndromes, our neuropsychological test battery also comprises the Clae-son-Dahl test of verbal learning and retention, as well as the Memory-for-Designs Test of visuospatial short-term memory.

To obtain a measure of general intelligence, the SRB (Synonyms, Reasoning, and Block Design) battery is used. An overall rating of intellectual impairment is also carried out. A number of personality traits of clinical relevance are assessed by means of questionnaires.

The neuropsychological test battery of the Magnus Huss Clinic has been standardized and normed for a

random sample of 400 men and women from the general population of the Stockholm area, stratified with regard to chronological age and divided into two levels of formal education. Thus, age- and education-scaled T-score tables (mean = 50, SD = 10) are available for converting raw scores to standardized scores for plotting the test results in a graphic profile chart. Intercorrelations between tests in the battery, reliability coefficients, the correlation between results and age, intelligence quotient, verbal understanding and formal education, and much other useful information for using the test battery is presented in a psychologist's manual (2). The manual also contains a number of references with regard to validity examinations of the HRB.

Application in clinical alcohol research

In our department a series of studies has been carried out dealing with the connection between alcoholism and brain damage. Both alcoholic patients and randomly selected persons from the general population with varying alcohol habits were investigated with the neuropsychological test battery referred to, and with computer tomography of the brain. Many alcoholic patients showed morphological cerebral changes when examined by computer tomography of the brain; these changes appeared as enlargement of the ventricular system, particularly the third ventricle, and widening of cortical sulci. These changes are often found in alcoholic patients with no clinical signs or symptoms of cerebral disorder, and they have been interpreted as indicating central and cortical atrophy of the brain.

Widened cortical sulci are often observed even in quite young alcoholic patients, below the age of 30 years, whereas enlargement of the ventricular system is more common in older alcoholics with a long history of heavy drinking. Such cortical and ventricular changes seem to follow different courses, and they correlate with somewhat different patterns of neuropsychological deficit.

Neuropsychological assessments of the patients have shown increased incidence of intellectual impairment, particularly with regard to such complex abilities as abstracting and problem-solving skills on visuospatial tasks. Long-term memory-dependent abilities and sensory or motor functions are less often impaired.

The correlation between morphological cerebral and neuropsychological deficit is generally modest, with the possible exception of cases involving old alcoholics who often have clinically manifest signs of cerebral disorder (1).

In a recent study (1) we found no correlation between the amount of alcohol reported to be consumed at each drinking session and neuropsychological and neuroradiological signs of cerebral disorder

in the age-stratified random sample of 200 men and 200 women taken from the general population. Moderate to heavy social drinking, as assessed by an index based on the amount of alcohol consumed during each drinking bout, and the answers to certain other alcohol-habit questions was not associated with signs of cerebral disorder. Alcohol dependence was, however, associated with signs often diagnosed in alcoholic patients, but they were milder in degree. There were apparently important differences between men and women with regard to the relationship between advanced drinking habits and cerebral disorder.

Both the computer tomographic findings and the neuropsychological test results speak in favor of a premature cerebral ageing process in connection with long-term heavy drinking.

Our neuropsychological test results and those of other laboratories support the hypotheses that (i) the right cerebral hemisphere is more sensitive than the left to long-term heavy drinking and (ii) fronto-limbic-diencephalic brain structures are more sensitive than other brain structures to such drinking. The

premature ageing, right hemisphere, and fronto-limbic-diencephalic hypotheses might help to suggest possible sites of action of toxic agents other than ethyl alcohol. Experiences from neuropsychological alcohol research might be useful in other fields of behavioral toxicology, not only with regard to the selection of test methods, but also with regard to the kind of damage the human brain might suffer from prolonged exposure to toxic agents.

References

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