Description of the tests in the London School of Hygiene test battery

by Nicola Cherry, PhD, Helen Venables, BSc, Harry A Waldron, MD[1]

The tests that are described were chosen to represent a range of skills that might be affected by minimal brain damage in workers exposed to organic solvents or to other neurotoxic substances. When the tests were chosen, an important requirement was that they should be easy to administer in the field. A second requirement was that the overall testing procedure should not be unduly time consuming, so that the subject carrying out the tests would be away from his work for as short a time as possible. On the average subjects take about 40 to 50 min to complete the tests in the battery.

Some of the tests had been widely used in the diagnosis of organic brain damage; examples are the Trail Making test and two tests of the Wechsler Adult Intelligence Scale (WAIS), Block Design and the Digit Symbol substitution test. Others had been less widely used, but seemed to cover relevant areas and could be adapted for use in the field. It is intended that the battery should cover a variety of skills, including perceptual speed, spatial abilities, and memory. The National Adult Reading Test (NART) has also been included so that an estimate can be made of intellectual (or at least educational) level before toxic substances were encountered.

Tests

Dotting test

The Dotting test is a form of reciprocal tapping where the subject has to make rapid hand movements to hit two targets alternately. In the first part of the test the subject has to make dots, with a pen, to the outside of two parallel lines which are 10.25 cm apart and 5 cm in length. The second part of the test requires more exacting movements from the subject; he has to place the dots inside two circles 1 cm in radius and 10.25 cm apart. The subject is timed for 10 s on both parts of the test, after an initial practice.

Trail Making test

This test was developed by United States Army psychologists (1) and was subsequently added to the Halstead test battery by Reitan (5) for use in the diagnosis of organic brain damage. Performance is related to both age and intelligence; care must therefore be taken in the interpretation of any individual score (4). In part A of the test, the subject is presented with a sheet of paper on which 25 small circles are printed, numbered from 1—25 in a random pattern. Using a pencil, the subject is instructed to join the circles in numerical order as quickly as possible. In part B, there are also 25 circles: 13 are numbered from 1—13 and the other 12 are labeled from A to L. The subject has to connect the numbers and letters alternately -1-A-2-B-3-C- and so forth.

Visual Search Task

The form of the Visual Search Task used in the battery was modified from a task devised by Goldstein et al (3). The subject is presented with a series of 12 grids consisting of 81 black and white squares. The white squares are divided into 25 smaller squares, two of which are filled in black. The composition and arrangement of the large white squares within the grid remains constant, except for the configuration of the large central white square, which varies from grid to grid. The subject's task is to search for the "target" white square within the grid which has the same configuration of small black squares as the central white square.

After being shown an example, the subject is given three practice grids before undertaking 12 timed trials, each with a time limit of 90 s. The mean response time for the trials for which the time limit is *not* exceeded is used as the measure of performance on this task.

Digit Symbol substitution test and Block Design test

The Digit Symbol and Block Design tests are both from of the Weschler Adult Intelligence Scale.

[1] TUC Centenary Institute of Occupational Health, London School of Hygiene and Tropical Medicine, Keppel Street (Gower Street), London WC1E 7HT, United Kingdom.

Grooved Peg Board Test

The Grooved Peg Board Test is a manipulative dexterity task requiring fine visual and motor coordination. The board itself consists of 25 holes with randomly positioned slots. The 25 pegs each have a key along one side and must be rotated to fit into the holes in the board. The subject performs the test first with his dominant and then with his nondominant hand and is only allowed to pick up one peg at a time. The time taken to place all of the pegs in the board is recorded for each hand.

Buschke Memory Test

The Buschke Memory Test, which requires the subject to learn a list of 20 animal names over several trials, examines components of both short-term and long-term memory. The tester reads slowly down the list, and the subject then recalls verbally as many names as he can remember. With the exception of the first trial, the subject is only reminded of the items he did *not* recall on the immediately preceding trial. The purpose of this selective reminding is to establish whether an item has been recalled from a stable long-term store or a rapidly decaying short-term store. If an item is recalled on two consecutive trials, it is said to be in long-term storage because the item was recalled without presentation between the trials and therefore could not just be stored within a short-term memory process.

After five trials, the following five measures of performance are scored: (i) the number of items recalled, (ii) the number of items in long-term storage, (iii) the number of items retrieved from long-term storage, (iv) the number of items retrieved from short-term storage, and (v) the number of intrusions made throughout the test, ie, a count of the animal names mentioned by the subject which were *not* part of the original list (2).

National Adult Reading Test

This short test was included as a measure of premorbid ability. The subject has to read aloud 50 words which cannot be pronounced correctly unless they are previously known by the reader because the words selected for the test do not obey the usual graphemephoneme and stress rules of the English language.

Simple reaction time

The test used to measure simple reaction time was devised by Wilkinson & Houghton (6). It employs a modified cassette recorder, which makes the test very suitable for use in the field. The subject responds to a red light appearing in the stimulus window by pressing a response button on the machine. The display is held for a further 1.5 s,and the light reappears at random intervals between 1 and 10 s. On the average, there are eight stimuli per minute. After a short practice, the subjects perform the task for 10 min, their responses being recorded on magnetic cassette tape. After the tapes have been decoded, the mean simple reaction time is computed.

Use of the tests

The tests have been used to investigate neuropsychological impairment in workers exposed to toluene and paint solvents.

References

1. Armitage SG. An analysis of certain psychological tests used for the evaluation of brain injury. Psychological Monographs 60 (1946) whole no 277.
2. Buschke H. Selective reminding for analysis of memory and learning. J Verb Learn Verb Behav 12 (1973) 543—550.
3. Goldstein G, Welch RB, Rennich PM, Shelly CH. The validity of Visual Searching Task as an indicator of brain damage. J Consult Clin Psychol 3 (1973) 434—437.
4. Goul WR, Brown M. Effects of intelligence on Trail Making test performance and validity. Percept Mot Skills 30 (1970) 319—326.
5. Reitan RM. Validity of the Trail Making test as an indicator of organic brain damage. Percept Mot Skills 8 (1958) 271—276.
6. Wilkinson RT, Houghton D. Field test of arousal: A portable reaction timer with data storage. Hum Factors 24 (1982) 487—493.