THE INITIAL VALIDATION OF THE QUICK COGNITIVE SCREENING TEST

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ABSTRACT

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The purpose of this study was to validate a sensitive cognitive screening test for detection of a broad range of cognitive deficits, including those not usually identified by existing brief bedside mental status examinations. The Quick Cognitive Screening Test was designed to detect not only global cognitive dysfunction but also specific areas of dysfunction. Areas assessed included orientation, attention and concentration, memory, language, construction, perception, spatial ability, and abstract reasoning. Results showed that the Quick Cognitive Screening Test identified cognitive impairment in all of the neurological and psychiatric patients assessed. Futhermore, the test differentiated between the control group and both the psychiatric group and the neurological group. The reliability and validity of the test were determined. The Quick Cognitive Screening Test shows promise as a brief (less than 30 minutes) reliable and valid screening instrument for detection of cognitive dysfunction in neurological patients.

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In recent years an increasing number of health professionals have turned to neuropsychologists for help in the assessment and/or diagnosis of cognitive dysfunction in patients with known or suspected brain damage subsequent to some form of insult to the brain. Causes of brain insult or pathology include traumatic brain injury (TBI), cerebrovascular accident (CVA), dementia, neoplasms, infection, chemical or toxic agents, allergic reactions, psychiatric disorders. The resulting dysfunction is usually expressed neuropsychologically and therefore can be observed and measured by neuropsychological investigation (Lezak, 1983; Walsh, 1987; Kolb and Whishaw, 1990).

Lezak (1983) described three integrated functional systems of behaviour (cognition, emotionality, and control), and of these, the cognitive functions are the ones usually addressed in neuropsychological assessment, although brain damage usually involves all three systems (Lezak, 1983). Cognitive deficits are often prominent in symptomatology, and can readily be conceptualized, measured and correlated with neuroanatomically identifiable systems, whereas the structured nature of most medical and psychological examinations does not provide much opportunity for subtle emotional and control deficits to become evident (Lezak, 1983).

Lezak (1983) concluded that neuropsychological research findings show there is no general intellectual function, "...but rather many discrete ones that work together so smoothly when the brain is intact that the intellect is experienced as a single seamless attribute" (p 21). Nevertheless, for assessment purposes, Lezak (1983) classified cognitive functions within a conceptual framework that includes: (a) receptive functions including acquisition, processing, classification and integration of information,

(b) memory and learning involving storage and recall of information,

(c) thinking which involves the mental organization and reorganization of information, and (d) expressive functions through which information is communicated or acted upon. In accordance with this model, it therefore follows that neuropsychological assessment attempts to evaluate ability, or lack thereof, in discrete activities within these functional areas.

Identification of Impairment

The development of neuroradiological technologies such as computerized tomography (CT scan), positron emission tomography (PET scan) and magnetic resonance imaging (MRI) greatly assist in the detection of many brain abnormalities. Despite these advances however, there remain many conditions in which deficits in cognitive functioning go undetected by such resources (Smith, 1981; Lezak, 1983; Berg, Danziger, Storandt et al, 1984; Casson, Siegal, Sham, et al, 1984; Kiernan, Mueller, Langston and Van Dyke, 1987; Walsh, 1987; Kolb and Whishaw, 1990). Consequently physicians and other clinicians continue to rely on the expertise of the neuropsychologist and his/her compendium of tests to assist them in:

(1) diagnosing the presence and extent of cortical and subcortical damage or dysfunction and localizing it where possible

(2) arriving at valid assessment of the level of cognitive functioning of a particular patient

(3) determining the nature of the ongoing care of the patient

(4) setting realistic goals for the process of rehabilitation of the patient

(McFie, 1975; Lezak, 1983; Kolb and Whishaw, 1990; Walsh, 1987).

Neuropsychological assessment can provide what at times is crucial information with regard to diagnosis (McFie, 1975; Walsh, 1987). McFie (1975) emphasized the importance of correct diagnosis, not for a "mere pigeon-holing of the patient" but for identification of possible lesion and probable lesion site. Often it may be the results of assessment which first suggest the presence of organic cerebral disease (McFie, 1975). Walsh (1987) stated that it would be valuable if sensitive behavioural measures could be refined so as to promote the earlier diagnosis of cerebral lesions.

Although diagnosis is of prime interest, more critical is ascertainment of the level of cognitive functioning of the patient, for this will determine type of care, management, and rehabilitation plans for the patient. "Assessment is not a single or isolated episode but rather a part of the process of cure and care ... (an^) contributes to diagnostic basis for treatment" (McFie, 1975, p xii). Neuropsychological assessment can be used for re-evaluation to follow progress or to evaluate medical, surgical or psychological treatment, and can play an essential role in the process of rehabilitation (McFie, 19 '5; Walsh, 19897; Kolb and Whishaw, 1990). Determination of the patient's level of cognitive functioning provides an understanding of how pathology or dysfunction has affected the particular patient, and forms the basis for counselling the patient and family about the effects of the disorder and possible residual deficits (Walsh, 1987; Kolb and Whishaw, 1990).

Neuropsychological Assessment

There are well established batteries of neuropsychological tests in current use, of which the Halstead-Reitan Battery (HRB) (Reitan and Davidson, 1974) and the Luria-Nebraska Neuropsychological Battery (LNNB) (Christensen, 1975; Golden, 1981) are probably the most well known. However there is controversy over the diagnostic efficiency of both the HRB and the LNNB as evidenced by the vast amount of literature produced on the batteries. The empirically based HRB was developed over a period of many years through studies of thousands of patients with neurological disease or damage, and test results were correlated with independent diagnostic findings (Reitan and Wolfson, 1985; 1986; Reitan, 1986) Extensive research has been performed on the HRB to establish the validity of the measures in a number of clinical conditions and in normal controls, and Reitan and Wolfson (1985; 1986) cited numerous reports in the literature documenting the efficacy of the HRB. However, Kolb and Whishaw (1990) described a number of serious criticisms of the HRB including lack of theoretical foundation, inadequate norms, poor assessment of memory functions, lack of sensitivity to small focalized lesions, aging effects, lack of portability, and lack of thoroughness. Kolb and Whishaw (1990) suggested a revision of the battery with updated and extended norms and validation studies on patients with verified lesions. Luria and Majovski (1977) also criticized the HRB as lacking a theoretical basis. Russell (1986) however challenged this view. He stated there is an extensive theoretical basis for the psychological/psychometric approach (as in the HRB), which is derived from basic neurological theory, clinical lore,

and psychometrics. In fact, Reitan and Wolfson (1985; 1986) described a conceptual model of brain functions represented by the HRB.

The LNNB on the other hand is based on Luria's theoretical principles of higher cortical functioning. It was developed from Christensen's (1975) work (Luria's Neuropsychological Investigation) (Lezak, 1983; Golden, 1986; Golden and Maruish, 1986; Kolb and Whishaw, 1990) and represents an attempt to standardize Luria's techniques. It provides a quantitative approach to assessment while allowing for the integration of qualitative data (Golden and Maruish, 1986). Numerous studies supported the contention that the LNNB is a reliable and valid instrument for the assessment of neuropsychological functioning, and furthermore is equivalent to the HRB in discriminating brain-damaged from normal patients (Golden, 1981; Golden and Maruish, 1986). However, the LNNB has not been widely accepted by neuropsychologists (Kolb and Whishaw, 1990). Lezak (1983) and Kolb and Whishaw (1990) reported the LNNB is unreliable, and its usefulness and validity have not been proven except perhaps in the hands of the most highly skilled clinicial neuropsychologists. Spiers (1981) concluded that the LNNB is not capable of providing a comprehensive assessment of neuropsychological functioning in its present form (for example, employing a global score only, amongst other series flaws), and later stated (Spiers, 1984) that the LNNB should not be relied upon for clinical purposes without statistically valid and reliable replication studies. A critical review of the LNNB literature countered this criticism, stating that many assertions were factually incorrect, that conclusions were unbased, overgeneralized and inaccurate, and that none of the evaluations were empirically based

or tested (Moses and Maruish, 1989; 1990). A series of papers critically evaluated LNNB literature on psychometric and experimental design grounds, for the expressed purpose of providing "a balanced evaluation" of LNNB literature (Moses and Maruish, 1977; 1988a; 1988b; 1988c; 1988d; 1988e; 1988f).

Many neuropsychologists prefer to use selected groups of tests which, based on both practical experience and research findings, they have found to be more valuable, suitable or practical (McFie, 1975; Smith, 1981; Lezak, 1983; Kolb and Whishaw, 1990). Irrespective of the group of tests chosen, neuropsychological assessment is a very time-consuming and expensive proposition requiring highly trained, highly skilled professionals of whom there are relatively few to meet the increasing demand for such services. Assessment with an exhaustive collection of tests usually takes four to ten hours or more (Kiernan et al, 1987; Kolb and Whishaw, 1990), often spread over two to several days. To reduce testing time, sets of tests consisting of three (Eslinger Damasio, Benton and Van Allen, 1985) to five (Riley, Mabe and Shear, 1987) specifically selected tests have been proposed in lieu of longer test batteries, but these are still relatively time-consuming.

Screening Tests

Screening with selected single tests has been suggested by some authors as a means of providing an economic, quick, and accurate indication of cognitive dysfunction. Tests such as the Trail Making Test (Reitan and Wolfson, 1985) and the Bender-Gestalt Test (Hutt, 1977) have been proposed as examples of single instruments which could be

used to detect impairment in cognitive functioning (Lacks, Harrow, Colbeut and Levine, 1970; Radford, Chaney, O'Leary and O'Leary, 1978; Mezzich and Moses, 1980). The Trail Making Test assesses visual-conceptual and visuomotor tracking plus motor speed and attention functions. The Bender-Gestalt Test assesses visual spatial and visuo-constructional functions. While both tests are sensitive to brain damage (Lezak, 1983), and valid for the purpose for which they were designed, their focus is too narrow to adequately detect deficits in areas not served by the tests (Lezak, 1983; Faust and Fogel, 1989).

Assessment of cognitive functioning using two antithetical tests has also been suggested (Webster, Scott, Nunn et al, 1984), one to assess left hemisphere function (the Cognitive Capacity Screening Exam - CCSE [Jacobs, Bernhard, Delgado and Strain, 1977]), and one to assess right hemisphere function (Memory For Designs - MFD [Graham and Kendall, 1960]), but again a problem arises as to sensitivity. Studies show the CCSE to have a high rate of false negative results, with patients otherwise neurologically assessed as impaired scoring above the cutoff score (Nelson, Fogel and Faust, 1986; Schwamm, Van Dyke, Kiernan et al, 1987; Strain, Fulop, Lebovits et al, 1988). The MFD has a low accuracy rate (Lezak, 1983), and there is some doubt about its validity and the reliability of its scoring system (McFie, 1975). Although the two tests may indeed be synergistic (overall accuracy 81% for combined tests versus 73% for the MFD and 61% for the CCSE alone)(Webster et al, 1984) cognitive deficits may well be missed.

An adequate assessment of an individual presenting with a possible deficit in some areas of cognitive functioning is time consuming, and neuropsychological consultation is not always readily accessible. At the same time, however, the need often arises in many offices, clinics and institutions to rather quickly make a decision concerning a patient's level of cognitive functioning. In response to this situation several brief "bedside" screening tests were developed (Kahn, Goldfarb, Polack and Peck, 1960; Folstein, Folstein and McHugh, 1975; Pfeiffer, 1975; Mattis, 1976; Jacobs et al, 1977). These tests were designed with the objective of having an assessment tool available which could be used by clinicians, nurses, interns and others, to quickly (five to ten minutes) and accurately determine the mental status of the psychiatric, geriatric, or neurologic patient. However, both experience and research have shown these brief screening tests to have a high rate of false positive results (indication of deficit where none exists) (Nelson et al, 1986; Strain et al, 1988), and more critically, a high rate of false negative results (no indication of deficit which actually exists) (Nelson et al, 1986; Schwamm et al, 1987; Strain et al, 1988; Faustman, Moses and Csernansky, 1990). In addition these tests are reported to demonstrate low sensitivity (ability to reliably detect cognitive deficits that are not obvious clinically [Nelson et al, 1986; Schwamm et al, 1987; Kokmen, Naessans & Offord, 1987; Strain et al, 1988; Faust & Fogel, 1989; Baker, 1989; Faustman et al, 1990; Beatty & Goodkin, 1990]) and low specificity (ability to reliably identify only cognitive deficits [Nelson et al, 1986; Strain et al, 1988; Baker, 1989]).

Nelson et al (1986) critically reviewed the five most frequently cited bedside cognitive screening tests that use an interview format and require brief administration times, namely Kahn's Mental Status Questionnaire (MSQ [Kahn et al, 1960]), Mini-Mental State Examination (MMS [Folstein et al, 1975]), Short Portable Mental Status Questionnaire (SPMSQ [Pfeiffer, 1975]), Cognitive Capacity Screening Examination (CCSE [Jacobs et al, 1977]) and the Mattis Dementia Rating Scale (DRS [Mattis, 1976]). These reviewers found a rather limited range of validation studies on all of these tests and hence concluded none of the tests could be considered well validated. In examining the outcome of the studies they found all of the tests to have high false negative rates, some 50% and higher, as for example the CCSE with 51% false negative classifications in the Webster et al (1984) study. This finding was supported by a more recent study (Schwamm et al, 1987) which showed a 53% false negative rate for the CCSE and a 43% false negative rate for the MMS. Nelson et al (1986) additionally concluded that cognitive dysfunction due to focal lesions, especially of the right hemisphere, and mild diffuse cognitive dysfunction are the most likely deficits to be missed. While Nelson et al (1986) reported that the tests are able to detect moderate to severe delirium and dementia with "acceptable" accuracy, they also suggested these "..tests will fail where they would be most needed - in evaluating patients without manifest organic disease in which more subtle cognitive disorder might be crucial to diagnosis, case formulation, or treatment planning". Strain et al (1988) also compared two of these tests, the MMS and the CCSE, along with the Tachistoscope (T-Scope) Test all of which are commonly used to detect organic mental disorder. They found a high frequency of false negative and

false positive results, especially in the mildly dysfunctional group. In addition, Strain et al (1988) emphasized the fact that the MMS and CCSE used psychiatrists' diagnoses as the standard for comparison in test development, leading them to conclude that there is no objective and absolute validity standard.

Baker (1989) investigated how screening tests for cognitive impairment differed, and whether one should be selected rather than another for use with a specific (geriatric) population. He compared the same five screening tests of cognitive ability reviewed by Nelson, Fogel and Faust (1986) (MMS, SPMSQ, CCSE, MSQ, and DRS) since these screening devices are frequently used with the elderly in clinical practice. Limitations were reported for all of these tests, limitations related to content (for example delayed recall, language, visuo-spatial ability) and thus limitations in the assessment of specific functions. Therefore the choice of a screening test would depend on the area of concern (Baker, 1989); this could result in inadequate assessment and missed deficit if the test chosen was unsuitable. In Baker's (1989) review, sensitivity and specificity for the five tests were reported to "range from very good to not so good".

More recently two new brief tests of mental status have been developed, the Short Test of Mental Status (STMS [Kokmen et al, 1987]) and the Modified Mini-Mental State Examination (3MS [Teng & Chui, 1987]). Both of these tests may prove to be only slightly (if at all) better than some of the earlier tests since the only improvement is the addition of a few or different items for assessing specific functions. The authors of the STMS state the test shows acceptable sensitivity and specificity for differentiating demented from non-demented patients but nevertheless some patients with dementia score

high on the test and some patients without dementia score low. The 3MS incorporates minor changes to the MMS, that is, while retaining brevity the test samples a broader variety of cognitive functions and wider range of difficulty levels, which the authors state improve the sensitivity over the MMS. However the 3MS is only slightly more comprehensive than the MMS since it incorporates only four added items (date and place of birth, naming four-legged animals, similarities, a second recall) and some other minor changes in administration and scoring. Olin and Zelinski (1991) reported that the authors of the 3MS (Teng and Chui, 1987) have not assessed the validity or reliability of the 3MS nor have they suggested a cutoff score.

All of these brief screening devices were developed for specific use with specific populations for the purpose of quickly assessing the mental state of the patient; for example, the MSQ, the DRS, and the SPMSQ were designed for detecting dementias in the elderly, while the MMS and the CCSE were employed with medically ill and psychiatric patients. The use of these bedside screening devices was later arbitrarily extended to patient populations other than those for which they were designed, and to other situations such as assessing cognitive functioning in longitudinal and epidemiological studies. It cannot be assumed that a test validated on a clearly defined group is useful for assessment of other individuals, groups, or situations (Walsh, 1987). In fact, Olin and Zelinski (1991) specifically caution against the use of the MMS in longitudinal reasearch using elderly community samples because of its psychometric instability, and they lamented its continued popularity.

The question arises then of whether the use of very brief, almost cursory mental status examinations for detection of cognitive deficit is equivalent to, or as valid as, the use of a brief but more comprehensive cognitive screening test which (1) demonstrates good construct and criterion validity, (2) assesses a wider scope of cognitive abilities, and (3) is more appropriate for use with diverse populations ?

A review of the literature indicated that, other than the tests described above, very few screening instruments for assessing cognitive functioning exist, and as Faust and Fogel (1989) stated "...there is a gap between highly sensitive exhaustive methods and clinically convenient but less sensitive methods" (p 25). To bridge that gap two mid-range screening tests for detecting cognitive deficits have been recently developed, the Neurobehavioral Cognitive Status Examination (NCSE [Kiernan et al, 1987]) and the High Sensitivity Cognitive Screen (HSCS [Faust and Fogel, 1989]), both of which appear to be more comprehensive, sensitive and specific for detecting cognitive dysfunction than the earlier bedside screening instruments. The NCSE was designed for use with behaviourally disturbed patients in acute diagnostic units, and has been used by the authors as part of their psychiatric consultation on medical patients.

The NCSE uses a screen and metric approach, assesses skills within five major areas of cognitive functioning (language, constructions, memory, calculations, reasoning) by means of graded tasks, has a multidimensional scoring system, and takes five minutes to complete in the absence of impairment and 10 to 20 minutes if cognitive dysfunction is present. When compared to the CCSE and the MMS in a validation study (Schwamm et al, 1987) it was found to be more sensitive than either of the other two tests.

However, while the NCSE is an improvement over exisiting screening devices (Strain and Fulop, 1987), there have been no studies reported, other than the Schwamm et al (1987) study, of the reliability and validity of the NCSE. The NCSE has not been tested against a clinical standard to assess the clinical meaning of the deficits it measures, there are no reports on how the degree of cognitive impairment was derived using the NCSE, and the test has not been compared with other standard psychometric instruments (Strain and Fulop, 1987; Yazdanfar, 1990). Further studies therefore need to be carried out in order to validate the psychometric properties of this instrument.

The HSCS assesses skills across five cognitive domains (memory, language, visuomotor/spatial, attention/concentration, self-regulation and planning), uses a multidimensional scoring system, and takes 20 - 30 minutes to administer. Although it had a high accuracy rate for prediction of deficits it may not detect some discrete right hemisphere lesions (Faust and Fogel, 1989). The high accuracy rate may be partly due to the exclusion of patients with less than grade eight education, and the high interrater reliability may be partly due to the fact the raters were from the same institution (Faust and Fogel, 1989). A review of the literature failed to find any other references to further validity studies on the HSCS.

Inadequacy of Current Cognitive Screening Practices

Strain et al (1988) suggested that despite attempts to heighten the physician's awareness, up to 70% of organic mental disorders remain undetected, undiagnosed and untreated, particularly if the symptoms are minimal, compensated, or transitory. Gedhi,

Strain, Weltz and Jacobs (1980) reported that 33% of medically-ill patients screened for cognitive dysfunction within 24 hours after admission to a medical ward had significant clinically relevant cognitive deficits; 16% of these were undetected by hospital staff. Reassessment at discharge revealed 28% continued to show evidence of cognitive impairment.

Similar statistics have been reported in geriatric populations. In a study of physician behaviour as related to medical/surgical geriatric hospital admissions, McCartney and Palmateer (1985) found that 79% of cognitive deficits were missed by the examining physician. Also, out of 394 examinations only four (1%) mental status examinations were recorded. They argue that global techniques of evaluation require remediation if medical care of the elderly is to be improved, especially since a clear-cut deficit on admission was predictive of later episodes of acute confusion. Additionally, Palmateer and McCartney (1985) investigated nursing assessment techniques for detection of cognitive impairment in elderly patients and found nurses used indirect observation (descriptors such as "disoriented", "confused", "forgetful") rather than formal examination. Out of 182 patients assessed with a standardized cognitive screening test, 65 (36%) scored at a level suggestive of cognitive dysfunction; only 18 of these 65 patients (28%) had been identified by nurses as having cognitive deficits. There were no recorded formal mental status examinations performed by nurses for any of the 182 patients. Considering the fact that all three of these studies assessed cognitive impairment using the CCSE, an instrument which, as reported earlier, has been shown to have a high rate of false negative results, the incidence of undetected cognitive deficits in these

patients was likely greatly underestimated. Eaton, Stones and Rockwood (1986) also reported a greater prevalence of cognitive dysfunction in elderly hospitalized patients screened psychometrically (32%) than the prevalence indicated by criteria used by physicians (23%) or nurses (16%). Futhermore, they found that 90% of the patients aged 85 years or older showed evidence of cognitive impairment when assessed with a screening instrument. Only 46% of these patients were classified as cognitively impaired by physician's reports. Eaton et al (1986) stressed the importance of accurate assessment of cognitive impairment in geriatric patients since many conditions other than dementia may be the source of the dysfunction. Because some of these conditions are reversible, failure to detect cognitive dysfunction may preclude further investigation and treatment (Eaton et al, 1986).

Barclay, Weiss, Mattis et al (1988) investigated the prevalence of unrecognized cognitive impairment in chronic severe cardiac disease. They assessed clinically stable admissions (free of known stroke or dementia) to a cardiac rehabilitation service. Multiple cognitive deficits were identified in 40% of the patients and milder impairments in 30% of the patients. Barclay et al (1988) recommended routine cognitive screening for cardiac patients. It appears then, that although bedside screening tests exist, albeit with limitations, they are not routinely or universally used for assessing mental status in "at risk" patients.

As comprehensive neuropsychological testing is not usually requested for routine clinical examinations, the problem arises of how to briefly but validly assess a patient for possible impairment in cognitive functioning. Because the available screening tests for

detecting cognitive deficits are minimally successful (Nelson et al, 1986; Schwamm et al, 1987; Kokmen et al, 1987; Strain et al, 1988; Baker, 1989; Faust and Fogel, 1989; Beatty and Goodkin, 1990; Faustmann et al, 1990; Yazdanfar, 1990) the need exists for a reliable, valid, comprehensive yet relatively brief screening device with high sensitivity and specificity for differentiating between normally cognitively functioning individuals and those with cognitive deficits. It would be desirable to have an instrument which not only detects global cognitive dysfunction but preferably a specific area of dysfunction for example in language, memory, constructional or spatial abilities. Although accurate diagnosis and localization of lesions are important considerations, the more critical question is whether cognitive dysfunction exists, and if so, to what extent? Ideally such a test would also have the capacity to distinguish between clinical groups such as the brain injured versus the psychiatrically disordered (for example, those with schizophrenia and depression), and between those individuals with right hemisphere versus left hemisphere lesions. A screening test result suggestive of impairment in areas of cognitive functioning would then be the basis for initiating a full and comprehensive neuropsychological evaluation. A test result indicating performance within the normal range would allay the need for such an extensive assessment. Taken together, this would ensure the most efficient use of available neuropsychological services.

Purpose of the Study

The purpose of this study therefore was to validate a brief cognitive screening test, the Quick Cognitive Screening Test (QCST), based on original work by McFie (1975). The

objective was to devise a test with the sensitivity and specificity to tap a broad range of cognitive dysfunction, including dysfunction not usually detected by existing screening devices.

Hypotheses

(1) The QCST detects, with a high degree of sensitivity and specificity, cognitive deficits in brain injured individuals.

(2) The QCST differentiates between clinical groups.

(3) The pattern of the test scores differentiates between patients with primary neurological diagnoses such as cerebrovascular accident, traumatic brain injury, and other related disorders, and patients with primary diagnoses of psychiatric illness, such as schizophrenia and depression.

METHOD

Subjects

Eighty-five subjects took part in the study. There were 43 males and 42 females. The age range was 17 to 83 years (mean = 41.6, SD = 18.3). Handedness was assessed using the Annett Handedness Questionnaire. Seventy-seven of the subjects were right-handed, seven were left-handed, and one was of mixed-handedness. Number of years of education ranged from 5 to 17 years (mean = 11.1, SD = 2.8).

The total sample comprised three groups:

(1) **Neurological:** Thirty-nine patients with documented brain lesions were selected from those referred to the Psychology Department of the Nova Scotia Rehabilitation Centre for full neuropsychological assessment. One female patient refused to finish the testing. The remaining 38 patients ranged in age from 17 to 79 years (mean = 44.5 years, SD = 19.3) and consisted of 20 males (mean age = 42.1 years, SD = 18.6) and 18 females (mean age = 47.1 years, SD = 20.1). Years of education ranged from 6 to 15 years (mean = 10.1, SD = 2.5).

Inclusion criteria

(1) the presence of a documented and clearly defined right hemisphere lesion, or

(2) the presence of a documented and clearly defined left hemisphere lesion, or

(3) the presence of documented diffuse cerebral damage.

Pathology was confirmed by neuroradiological procedures such as computerized tomography (CT Scan) or magnetic resonance imaging (MRI), and full neuropsychological assessment.

Exclusion criterion

The presence of a coexisting psychiatric disorder such as schizophrenia or bipolar disorder, potentially affecting cognitive functioning.

The group was further delineated into diagnostic subgroups for subsequent analyses. These included a group of 16 patients (mean age = 58.6 years, SD = 16.7) with a diagnosis of cerebrovascular accident (CVA or "stroke"), a group of 15 patients (mean age = 29.3 years, SD = 9.7) with a diagnosis of traumatic brain injury (TBI), and a miscellaneous group (others) of seven patients (mean age = 44.4 years, SD = 15.4). Ten of the CVA patients had a right hemisphere CVA, while six CVA patients had a left hemisphere CVA. Diagnoses in the miscellaneous subgroup included two cases with Friedreich's Ataxia, one case each of meningomyelocoele, subarachnoid hemorrhage, cerebral palsy, left meningioma, heroin-overdose-induced coma.

(2) **Psychiatric**: Eight male and seven female residents at the Halifax County Regional Rehabilitation Centre agreed to participate in the study. The subjects ranged in age from 20 to 59 years (mean = 32.7, SD = 11.9). Years of education ranged from 5 to 14 years (mean = 9.3, SD = 2.5). According to medical records, psychiatric diagnoses included ten cases of chronic schizophrenia (eight paranoid, two undifferentiated), one of schizoid personality disorder, one of bipolar mood disorder with

obsessive-compulsive personality disorder, one chronic anxiety with depression and mixed personality disorder, two of mixed personality disorder.

Exclusion criterion

The presence of a coexisting neurological or medical condition, apart from the primary psychiatric diagnosis, which might additionally affect cognitive functioning.

All except one of the subjects in this group were on psychotropic medication at the time of testing and had a history of psychotropic drug therapy for more than two years. According to medical records those individuals with a diagnosis of schizophrenia were psychiatrically stable.

(3) **Controls:** Thirty-three healthy volunteers were recruited from Introductory Psychology classes at Saint Mary's University, from a Halifax Rotary Club and from a Halifax YWCA elder-aerobics class, to serve as age-matched normal controls. There were 16 males and 17 females. Data from one of the male volunteers was excluded from subsequent analysis because of poor performance (suspect of cognitive deficit) on the WAIS-R. The 32 remaining subjects ranged in age from 17 to 83 years (mean = 42.5, SD = 18.6). Years of education ranged from 10 to 17 years (mean = 13.4, SD = 1.8).

Exclusion criteria

(1) a history of a medical or a psychiatric condition,

(2) current use of prescribed drugs,

(3) misuse of alcohol or "recreational" drugs,

all of which could potentially affect cognitive functioning.

Design

An after-only between-groups experimental research design was used in the study. A cognitive deficit was operationally defined as a decrement in performance below an experimentally determined cutoff score in a specific cognitive ability, for example, delayed recall, visuospatial ability, perception. The dependent variable was the presence and extent of a particular cognitive deficit as measured quantitatively by performance on selected tests. The independent variables were the clinical group (normal versus brain lesioned versus psychiatric) and the organic subgroup (localized right-lesioned or left-lesioned versus diffuse lesioned).

Materials

Tests administered included the new Quick Cognitive Screening Test (QCST), the Wechsler Adult Intelligence Scale - Revised (WAIS-R [Wechsler, 1981]), the National Adult Reading Test (NART [Nelson, 1982]), and the Unconventional (Unusual) Views Test (UVT [Warrington and Taylor, 1973]), (see Appendix B).

The QCST consists of 78 items sorted into 17 subtests. These include Orientation, Attention/Concentration, Verbal Immediate Memory, Vocabulary, Naming, Similarities, Analogies, Mental Arithmetic, Arithmetic, Verbal Delayed Memory, Memory for New Learning, Visuo-Attention/Visuo-Spatial Ability, Constructional Praxis, Object Identification, Geometric Designs, Perceptual Closure, and Visual Delayed Memory. The scoring is multidimensional, each subtest having a score, plus a global score obtained by

summing all the subtest scores. Summary scores for verbal abilities and nonverbal abilities, verbal memory, and visual memory are also provided.

The **WAIS-R** is a well established, well validated instrument for the assessment of intellectual functioning with Full Scale, Verbal, and Performance (nonverbal) IQ scores. More significantly however, the WAIS-R provided individual subtest scores with which similar scores on the QCST could be compared, for example performance in Vocabulary, Similarities, and Arithmetic.

The **NART** is a well validated test (Nelson and McKenna, 1975) which was specifically designed to provide a means of estimating premorbid level of intellectual functioning in patients suspected of suffering from intellectual deterioration. The NART is comprised of a list of 50 words of increasing difficulty which are "irregular" with respect to the common rules of grapheme/phoneme representation and pronounciation. The NART score can be used to predict a WAIS-R FSIQ, VIQ and PIQ, and the probable extent of deterioration can be deduced from the discrepancy between the predicted premorbid IQ and the actual WAIS-R IQ (O'Carroll and Gilleard, 1986).

The **UVT** involves recognition of common objects presented pictorally in unconventional and conventional views and provides a good estimate of differential perceptual deficits and right hemisphere functioning (Warrington and Taylor, 1973).

Procedure

Permission was obtained from the Research and Ethics Committee of the Nova Scotia Rehabilitation Centre to assess patients referred for neuropsychological assessment. Selection of patients was carried out in consultation with the assigned staff physiatrist. Permission was also obtained from the Research and Ethics Committee of the Halifax County Regional Rehabilitation Centre to recruit volunteers from the psychiatric resident population at the centre. Approval for recruitment of volunteers to serve as normal controls, as well as sanctioning of the study under the auspices of the Saint Mary's University Psychology Department, was received from the Research and Ethics Committee. Student volunteers received credit towards their course mark for participation in the study. Elderly volunteers were offered an honorarium for their participation.

All subjects were assessed individually using the QCST, the UVT, the NART and the WAIS-R, in the order listed. The QCST took approximately 15 to 30 minutes to complete depending on the performance of the subject. Total testing time for the four tests ranged from approximately one and one-half hours to four hours per subject. Periodic breaks were given when necessary to reduce fatigue, and in some instances testing with the neurological group was carried out over two separate sessions. Informed consent (Appendix C) was obtained.

RESULTS

Group Differences

Table 1 and Figures 1 to 5 (Appendix A) show that there were differences between the three groups in the means of the five summary scores, namely the mean Global Score, mean Verbal Score, mean Nonverbal Score, mean Verbal Memory Score, and mean Visual Memory Score. To determine whether the differences in the mean summary scores were statistically significant, oneway analyses of variance were carried out. Results showed, that for all five summary scores, there were significant differences in performance between the three groups: Global Score, $F(2,82) = 27.13$, $p < .0001$; Verbal Score, $F(2,82) = 26.92$, $p < .0001$; Nonverbal Score, $F(2,82) = 18.14$, $p < .0001$; Verbal Memory Score, $F(2,82) = 47.24$, $p < .0001$; Visual Memory Score, $F(2,82) = 26.61$, $p < .0001$ (Table A-1, Appendix A). To compare the differences in performance between the groups, Scheffe's S Test for multiple comparisons was used. The Scheffe S procedure is one of the most flexible, conservative, and robust (with respect to nonnormality and heterogeneity of variance) a posteriori procedures available (Kirk, 1982). It can be used to compare all contrasts between means, not just pairwise, and can be used with an unequal sample number (Kirk, 1982).

Results were as follows:

Global Score: The performance of the control group differed significantly from the performance of the neurological group (Scheffe S, $p < .05$). In addition there was

a significant difference in performance between the control group and the psychiatric group (Scheffe S, $p < .05$).

Table 1

Mean and Standard Deviation of QCST Summary Scores for Each Group.

	QCST Summary Scores				
Group	Global Score	Verbal Score	Non-Verbal Score	Verbal Memory Score	Visual Memory Score
Control (n=32)	101.1 (5.9)	50.8 (3.7)	35.4 (2.8)	15.1 (2.8)	5.0 (1.6)
Psychiatric (n=15)	78.1 (13.4)	36.7 (8.9)	27.9 (5.3)	7.7 (3.4)	1.8 (2.0)
Neurological (n=38)	74.1 (21.4)	36.8 (11.0)	25.3 (9.8)	7.8 (3.8)	1.6 (2.3)
Subgroup					
CVA (n=16)	66.8 (18.2)	32.4 (10.6)	23.1 (7.5)	5.9 (3.2)	1.0 (1.9)
TBI (n=15)	85.7 (18.5)	42.8 (8.9)	29.5 (9.2)	10.1 (4.0)	2.5 (2.7)
Others (n=7)	65.9 (25.2)	33.9 (11.3)	21.1 (13.1)	7.0 (2.0)	1.1 (2.3)

There was no significant difference in global performance between the neurological group and the psychiatric group.

Verbal Score: There was a significant difference between the performance of the control group and the neurological group in verbal abilities (Scheffe S, $p < .05$). The control group also differed significantly from the psychiatric group (Scheffe S, $p < .05$) in this summary area. The performance of the neurological group and the psychiatric group was not significantly different in verbal abilities.

Nonverbal Score: In the nonverbal summary area there was a significant difference in performance between the control group and the neurological group (Scheffe S, $p < .05$), and between the control group and the psychiatric group (Scheffe S, $p < .05$). There was no significant difference in the nonverbal performance of the neurological group and the psychiatric group.

Verbal Memory Score: The control group differed significantly from both the neurological group and the psychiatric group in remembering verbal material (Scheffe S, $p < .05$). The neurological group and the psychiatric group demonstrated no significant difference in verbal memory performance.

Visual Memory Score: Memory for visual material significantly differentiated between the control group and the neurological group, and additionally, between the control group and the psychiatric group (Scheffe S, $p < .05$). However, there was no significant difference between the performance of the neurological group and the psychiatric group in remembering visual stimuli.

The control group had the highest mean scores in all five summary areas (Table 1). Futhermore, as Figures 1 to 5 (Appendix A) show, the Global Score, Verbal Score, Nonverbal Score, and Verbal Memory Score for the control group fell within a relatively restricted upper range compared to those for the psychiatric group and the neurological group. The range of scores for Visual Memory was the same for the three groups.

Subgroup Differences

In order to investigate the performance of the neurological group more closely, this group was broken down into CVA, TBI, and miscellaneous (others) subgroups. As Table 1 and Figures 6 to 10 (Appendix A) show, there was a difference in the mean summary score of the subgroups. The mean scores of the TBI subgroup were higher than those of the CVA subgroup and the miscellaneous subgroup. Because of the small sample size in the miscellaneous subgroup (n = 7), this subgroup was not included in subsequent analyses. For the same reason, the CVA patients were not further delineated into a subgroup with right hemisphere CVA (n = 10), and a subgroup with left hemisphere CVA (n = 6) for purposes of analyses, but rather, were treated together. Therefore the subgroups for analyses were control, psychiatric, CVA and TBI. Oneway analyses of variance were carried out on the summary scores by subgroup. Results showed that, for each of the summary scores, there were significant differences in performance between the subgroups: Global Score $F(3,74) = 26.18$, $p < .0001$; Verbal Score $F(3,74) = 24.76$, $p < .0001$; Nonverbal Score $F(3,74) = 16.48$, $p < .0001$; Verbal Memory Score

$F(3,74) = 35.59$, $p < .0001$; Visual Memory Score $F(3,74) = 18.23$, $p < .0001$ (Table A-2, Appendix A). As expected, post hoc multiple comparisons (Scheffe, $p < .05$) revealed that the performance of the control group was significantly different from the performance of the psychiatric subgroup, the CVA subgroup, and the TBI subgroup in verbal abilities, nonverbal abilities, verbal memory, visual memory, and globally. Additionally however, results showed that there were significant differences in the mean scores of the CVA subgroup and the TBI subgroup in verbal abilities, nonverbal abilities, verbal memory, and globally. There was no significant difference between the CVA subgroup and the TBI subgroup in visual memory performance. There were no significant differences between the psychiatric subgroup and the CVA subgroup on any of the summary scores, nor were there significant differences between the psychiatric group and the TBI group on any of the summary scores.

Group Differences on Subtest Scores

The means and standard deviations of the QCST subtest scores for all the groups are given in Table A-3, Appendix A. Because of the number of dependent variables in relation to sample size, multivariate analysis of variance was not an appropriate statistical technique to use to determine whether any of the subtests differentiated significantly between the original groups (control, psychiatric, neurological). Therefore, oneway analyses of variance of subtest by group were carried out. Results showed there were significant differences in mean scores between the three groups on all of the subtests:

Orientation $F(2,82) = 10.75$ $p < .01$; Attention/Concentration $F(2,82) = 4.50$, $p < .01$; Verbal Immediate Memory $F(2,82) = 4.63$, $p < .01$; Vocabulary $F(2,82) = 12.24$, $p < .01$; Naming $F(2,82) = 7.86$, $p < .01$; Similarities $F(2,82) = 5.74$, $p < .01$; Analogies $F(2,82) = 7.95$, $p < .01$; Mental Arithmetic $F(2,82)$, $p < .01$; Arithmetic $F(2,82)$, $p < .01$; Verbal Delayed Memory $F(2,82) = 16.33$, $p < .01$; Memory for New Learning $F(2,82) = 39.27$, $p < .01$; Visuoattention/ Visuospatial $F(2,82) = 8.09$, $p < .01$; Constructional Praxis $F(2,82) = 11.76$, $p < .01$; Object Identification $F(2,82) = 4.56$, $p < .01$; Geometric Designs $F(2,82) = 5.13$, $p < .01$; Perceptual Closure $F(2,82) = 4.15$, $p < .01$; Visual Delayed Memory $F(2,82) = 26.61$, $p < .01$.

Post hoc multiple comparisons (Scheffe's S Test) were used to determine which groups were significantly differentiated by the various subtests (Table 2). In summary, results were as follows:

(1) the control group differed significantly from the neurological group (Scheffe S, $p < .05$) on all of the subtests except Mental Arithmetic,

(2) the control group differed significantly from the psychiatric group (Scheffe S, $p < .05$) on eight subtests, namely Vocabularly, Naming, Similarities, Mental Arithmetic. Verbal Delayed Memory, Memory for New Learning, Visuo-Attention/Visuo-Spatial Ability, Visual Delayed Memory, and

(3) the psychiatric group differed significantly from the neurological group (Scheffe S, $p < .05$) only on the Orientation subtest.

Table 2

Post Hoc Multiple Comparisons (Scheffe S Test) of Mean Subtest Scores.

Subtests	Group Mean			Difference
	Control	Psychiatric	Neurological	
Orientation	11.41*	10.87*	9.42	Neurological
Attent/Concentration	3.34*	3.13	2.63	Neurological
Verbal Immed. Memory	4.97*	4.47	4.32	Neurological
Vocabulary	6.69*	4.60	5.11	Psych & Neuro
Naming	5.00*	4.40	4.32	Psych & Neuro
Similarities	3.53*	2.67	2.74	Psych & Neuro
Analogies	3.81*	3.07	2.89	Neurological
Mental Arithmetic	4.75*	3.67	4.08	Psychiatric
Arithmetic	11.66*	10.60	9.87	Neurological
Verbal Delayed Memory	3.34*	2.00	1.58	Psych & Neuro
Memory (New Learning)	6.81*	1.20	1.95	Psych & Neuro
Visuoattention/spatial	7.69*	5.87	6.18	Psych & Neuro
Constructional Praxis	8.53*	7.07	5.55	Neurological
Object Identification	4.56*	4.20	3.84	Neurological
Geometric Designs	4.84*	4.73	4.05	Neurological
Perceptual Closure	4.78*	4.20	4.00	Neurological
Visual Delayed Memory	5.00*	1.80	1.61	Psych & Neuro

* Scheffe S, $p < .05$

Reliability

Because test-retest, split-half and alternate-form methods were not appropriate nor available for this study, the inter-item consistency procedure was employed to determine the reliability of the QCST. The coefficient alpha formula estimates the reliability that would be obtained from all possible ways of subdividing the test, and gives the degree of correlation between the individual test items (Nunnally, 1972). Using the subtest scores (unscaled) plus the summary scores, the coefficient alpha was found to be .87 (cases = 85, items = 22). Thus, 87% of the variance in test scores was due to true variance in the cognitive ability measured, and 13% was error variance due to content sampling and content heterogeneity (Anastasi, 1988).

Construct Validity

Construct-related validity of the QCST was assessed by means of Pearson Product Moment Correlation Coefficients to ensure that the test provided a true measure of the cognitive processes it purported to measure. Construct-related validity is a comprehensive concept that is inclusive of the other types of validity (Anastasi, 1988). Therefore, in assessing construct validity using the Pearson r correlation coefficient procedure, the internal consistency and convergent validity were assessed, subsumed under construct-related validity. The Pearson r correlation coefficients were examined from four perspectives:

(1) Correlation of QCST Subtest Scores with Summary Scores: Table 3 shows there were significant correlations ($p \leq .01$) between QCST subtest scores and the QCST

summary scores and Global Score, confirming the internal consistency of the QCST as demonstrated above by the coefficient alpha. Additionally, QCST subtest scores comprising the verbal dimension correlated significantly with the Verbal Score and the Verbal Memory Score providing support for convergent validity within the test (Table 3). Alternatively, the subtest scores comprising the nonverbal (spatial) dimension correlated significantly with the Nonverbal Score and Visual Memory Score providing additional evidence for convergent validity within the test (Table 3).

(2) Correlation of QCST Summary Scores with WAIS-R, NART, and UVT Scores: Table 4 shows the correlation coefficients for the five QCST summary scores with the WAIS-R obtained IQ scores, the NART estimated premorbid IQ scores, and the UVT scores. The QCST Global Score was significantly correlated with the WAIS-R Full Scale IQ ($r = .80$, $p \leq .01$). In addition, the QCST Verbal Score correlated significantly with the WAIS-R Verbal IQ ($r = .82$, $p \leq .01$), and the the QCST Nonverbal Score was significantly correlated with the WAIS-R Performance IQ ($r = .74$, $p \leq .01$). Futhermore, the QCST Global Score correlated significantly with the WAIS-R Verbal IQ ($r = .74$, $p \leq .01$) and the WAIS-R Performance IQ ($r = .76$, $p \leq .01$). Table 4 also shows significant correlations bewteen the QCST summary scores and the NART estimated Verbal IQ, Performance IQ, and Full Scale IQ scores, and between the QCST summary scores and the UVT scores. These results provided evidence for the convergent validity of the QCST, that is, the QCST measured cognitive processes similar to those measured by established, well-validated tests, particularly the WAIS-R.

Table 3

Correlation Coefficients: QCST Subtest Scores with QCST Summary Scores.

QCST Subtest Scores	QCST Summary Scores				
	Global Score	Verbal Score	Non-Verbal Score	Verbal Memory Score	Visual Memory
Orientation	.75**	.66**	.65**	.53**	.45**
Attent/Concentration	.57**	.52**	.45**	.40**	.29**
Verbal Immed. Memory	.60**	.67**	.42**	.54**	.38**
Vocabulary	.75**	.83**	.57**	.63**	.43**
Naming	.62**	.67**	.50**	.48**	.43**
Similarities	.65**	.73**	.45**	.53**	.37**
Analogies	.80**	.76**	.73**	.64**	.54**
Mental Arithmetic	.69**	.77**	.46**	.58**	.33**
Arithmetic	.74**	.72**	.63**	.51**	.39**
Verbal Delayed Memory	.55**	.55**	.45**	.67**	.42**
Memory (New Learning)	.74**	.81**	.56**	.95**	.51**
Visuoattention/spatial	.66**	.51**	.78**	.46**	.43**
Constructional Praxis	.81**	.67**	.86**	.57**	.59**
Object Identification	.51**	.37**	.63**	.29**	.28**
Geometric Designs	.71**	.56**	.76**	.43**	.42**
Perceptual Closure	.75**	.62**	.82**	.49**	.43**
Visual Delayed Memory	.69**	.59**	.76**	.58**	1.00**
Global Score	1.00**	.95**	.91**	.83**	.70**
Verbal Score		1.00**	.73**	.90**	.59**
Nonverbal Score			1.00**	.64**	.76**
Verbal Memory Score				1.00**	.58**
Visual Memory Score					1.00**

**$p \leq .01$, two-tailed

Table 4

Pearson r Correlation Coefficients for QCST Summary Scores with WAIS-R IQ's, Estimated NART IQ's, and UVT Scores.

	QCST Summary Scores				
	Global Score	Verbal Score	Non-Verbal Score	Verbal Memory Score	Visual Memory Score
WAIS-R					
FSIQ	.80**	.81**	.68**	.76**	.60**
VIQ	.74**	.82**	.52**	.74**	.48**
PIQ	.76**	.72**	.74**	.69**	.65**
NART					
FSIQ	.69**	.72**	.55**	.57**	.36**
VIQ	.69**	.73**	.54**	.58**	.36**
PIQ	.69**	.73**	.54**	.58**	.36**
UVT					
UNUSUAL	.70**	.65**	.67**	.51**	.42**
USUAL	.69**	.64**	.66**	.55**	.45**

** $p \leq .01$, two-tailed.

(3) Correlation of QCST Subtest Scores with WAIS-R Subtest Scores: Intercorrelations between the QCST subtest scores and the WAIS-R subtest scores (Table A-4, Appendix A) provided further evidence for the convergent validity, and in addition, evidence for the divergent validity of the QCST. For example, QCST Vocabulary was significantly correlated with all the WAIS-R verbal subtests, but especially with WAIS-R Vocabulary ($r = .75$, $p \leq .01$), and correlated significantly with WAIS-R nonverbal subtests, for example Digit Symbol ($r = .44$, $p \leq .01$); QCST Similarities with WAIS-R Similarities (verbal) ($r = .63$, $p \leq .01$) and with WAIS-R Object Assembly (nonverbal) ($r = .37$, $p \leq .01$); QCST Memory for New Learning with all the WAIS-R subtests.

(4) Correlation of QCST Subtest Scores with UVT Scores: There were also significant correlations between most of the QCST subtest scores and the UVT scores (Table A-4, Appendix A). For example, Constructional Praxis was significantly correlated with Unusual Views ($r = .62$, $p \leq .01$) and Usual Views ($r = .63$, $p \leq .01$); Arithmetic with Unusual Views ($r = .58$, $p \leq .01$) and Usual Views ($r = .56$, $p \leq .01$).

DISCUSSION

Findings from this initial investigation have provided support for the first hypothesis that the QCST has the sensitivity and specificity to detect cognitive dysfunction in brain-injured patients. The QCST detected cognitive dysfunction in all of the neurological patients with a confirmed diagnosis of brain damage. Although some patients had a global score comparable to the global scores of some of the normal controls, their subtest performance indicated dysfunction in specific cognitive abilities which might well have been missed by interpreting global score alone, as is the norm with most other screening tests.

Because the QCST was sufficiently sensitive to detect cognitive dysfunction in all of the neurological patients assessed in this study, it therefore follows that the QCST was sufficiently sensitive to detect cognitive dysfunction in neurological patients with brain insult of different etiologies. Hence, cognitive impairment in neurological patients with diverse areas of injury or damage was being identified, as in cases of CVA with lateralized lesions, TBI with more diffuse damage, as well as in cases with other kinds of injury or damage (meningioma, subarachnoid hemorrhage, cerebral palsy).

The QCST detected the presence of impairment in the CVA group as a whole. However, because subdividing this CVA sample into a right CVA subgroup and a left CVA subgroup would have resulted in a sample that was too small and unequal to generate valid results, it was not possible to infer whether both right hemisphere and left hemisphere cognitive deficits were being appropriately identified. While it would be

beneficial to subdivide the CVA group in this manner in order to investigate more closely differences in performance between patients with right hemisphere versus left hemisphere lesions, and while it would be useful if performance on a screening test could indicate lateralization of a lesion, the more critical question at this point in the development of the QCST is whether or not the test can identify cognitive impairment, especially when it is not apparent in the patient's behaviour.

The QCST identified cognitive deficits in the TBI group as a whole, a group in which one patient was obviously severely organically impaired, but the degree of impairment in the other patients was not established. To delineate the TBI sample by some pre-established criteria into mild, moderate, and severe TBI subgroups for investigation of differences in performance between these groups would also have resulted in too small a sample. With severe TBI, cognitive deficits are often apparent. However with moderate and mild TBI cognitive impairment is not often manifest and it would be useful to establish whether a screening test can identify dysfunction in these cases, especially the mild ones. Failure to screen for cognitive deficits because they are not obvious or suspected, may mean that reversible and treatable conditions go unrecognized and untreated.

In the present study the TBI group performed better on the QCST than did the CVA group. This finding appears to lend support to the second hypothesis that the QCST could discriminate between clinical groups. However, these results may in fact be related to the extent of the injuries of the sample of TBI and CVA patients, rather than to the nature of the clinical group to which they belong. Because the CVA patients had more

severe and unilateral damage due to cerebral infarction, cognitive functioning in the lesioned hemisphere was more dramatically affected. This was expressed neuropsychologically by poorer performance on the QCST. On the other hand, the more diffuse, perhaps more covert, damage resulting from injury or bruising of the brain in the TBI patients affected cognitive functioning in a more subtle way. This was expressed neuropsychologically by better performance (than CVA) on the QCST, and in some cases, passable performance globally but poor performance on one or more subtests. Thus differences in performance between the TBI and the CVA groups provided evidence that the QCST could detect varying degrees of cognitive dysfunction, with the extent of the impairment reflected quantitatively in the QCST summary scores, and quantitatively (and qualitatively) in the QCST subtests. But within group differences exist with respect to degree of brain damage (and hence cognitive impairment) regardless of etiology. Mild impairment may be found in cases of CVA with less extensive infarction, and severe impairment may be found in TBI when the brain suffers more extensive damage subsequent to greater impact. Therefore, the difference in cognitive functioning between these two groups as measured by performance on the QCST is more likely related to extent of damage incurred rather than to the clinical group per se. Extent of damage is related to diagnostic category, but is not exclusive to it. Therefore the findings are equivocal with respect to whether or not the QCST discriminates between clinical groups.

The scores of the psychiatric group were also reflective of cognitive dysfunction. This finding suggests that the QCST was sensitive to impairment in cognitive functioning regardless of the source of the dysfunction. This means the third hypothesis was not

supported: the test did not discriminate between psychiatrically and neurologically caused cognitive deficit. This was not a totally surprising finding, given the difficulty historically of distinguishing between these two groups, not only with a single psychometric assessment device, but with a full neuropsychological evaluation, specially when there is a diagnosis of schizophrenia or bipolar disorder (Lacks et al, 1970; Lenzer, 1980; Heaton and Crowley, 1981; Goldstein, 1986; Yozawitz, 1986; Chandler and Gerndt, 1988). A screening test that could detect cognitive deficit of neurological etiology in a severely ill patient who has been given a provisional diagnosis of a psychiatric illness would be very useful, but perhaps not very realistic (as Chandler and Gerndt, 1988 concluded). Identification of suspected neurological origin for the psychiatric-like symptoms could lead to proper neurological and neuropsychological evaluation, rather than prolonged, sometimes inappropriate psychiatric assessment and psychotropic therapy. However, the QCST was not intended to diagnose organicity, but rather to identify cognitive impairment if it is present, and in which cognitive area it is present, whatever the source. In this psychiatric sample with its history of drug therapy, as in many like it, it is not clear how much of the cognitive dysfunction is a result of the illness, the psychotropic medication, or the combination of both. In any case, the identification of cognitive impairment in psychiatric patients is also important for the management and rehabilitation of the patient.

All except one member of the control group had a high global score (above 90), and correspondingly high subtest scores and summary scores. The one control subject with a low global score (82) performed very poorly on two QCST subtests and had a

large discrepancy between NART estimated premorbid IQ's and WAIS-R obtained IQ's, both of which raise a question of probable cognitive deficit. Therefore the QCST exhibited specificity in detection of cognitive dysfunction, since it did not identify cognitive deficits in the control subjects, except in this one case.

Results of this preliminary investigation of the QCST have supported the test's utility as a valid and reliable screening instrument for the detection of cognitive dysfunction. The use of the the WAIS-R, the NART and the UVT provided well-validated standards with which to compare the QCST. Although not originally developed as a neuropsychological test, the WAIS-R is generally considered to measure cerebral association area functioning (Russell, 1986) and is almost universally accepted and used by neuropsychologists in the United States and England (Russell, 1986; McFie, 1975; Lezak, 1983). An advantage of using the WAIS-R as a comparison standard was that performance on QCST subtests could be compared with performance on the WAIS-R subtests, rather than relying on global scores alone. The NART provided a more accurate indicator of premorbid intellectual functioning than a "hold" test such as the WAIS-R Vocabulary subtest (Nelson, 1982). The UVT provided a good comparative measure of right hemisphere functioning. Significant results of Pearson Product Moment correlational analyses showed high degrees of association between the QCST scores and the WAIS-R scores, the NART scores, and the UVT scores, solidly establishing the validity and reliability of the QCST.

Although it was not the intention originally to provide a cutoff score as such for the QCST, a preliminary review of the frequencies of the Global Score for the three

groups indicated that potentially a "questionable range" might be established around a Global Score of 95 (maximum score = 111). Only 9% of the control group scored below 95, whereas 93% of the psychiatric group and 90% of the neurological group scored below 95. The highest global score for both the psychiatric and neurological groups was 98, whereas 75% of the control group scored higher than this. Although a small number of neurological and psychiatric patients scored within the lower bounds of the control group scores, a cognitive deficit was still evident in each and every one of these patients because of a very poor score on a particular QCST subtest, for example memory. This stressed the importance of examining performance on each subtest, both quantitatively and qualitatively, in addition or in preference to the overall score.

Methological Issues and Limitations

A concern that might arise is whether the difference in mean age between the TBI patients (mean = 58.6) and the CVA patients (mean = 29.3) confounded the effect of brain damage on QCST performance. However, this was rejected (a) because the control group was age-matched (mean = 44.5) with the neurological group (mean = 42.5) as a whole, (b) because of the greater extent of damage in the CVA patients which was confirmed by CT scan, and (c) because there were only a few significant low correlations between age and some nonverbal subtest scores (Table A-5, Appendix A). In a future validation study it may be possible to match clinical groups for age more closely.

Another concern which might arise is related to the sample size in this study. However, in clinical research generally, initial studies tend to have small numbers of

subjects because of time constraints and the difficulty of access to subjects, as evidenced by other validity studies of screening tests (Schwamm et al, 1987; Faust and Fogel, 1989; Fisk, Braha, Walker and Gray, 1991).

Indications are that performance on the QCST may be affected by level of education (Table A-5, Appendix A). To investigate this problem more thoroughly, a future study should attempt to match the groups more closely in educational level, since in this study the control group had a higher mean level of education than the experimental groups.

Counterbalancing for order effects was initially considered but was not performed. The main reason was because the WAIS-R is a relatively lengthy (one hour plus) and tiring test for many brain-injured individuals and is the most difficult of the four tests so it was administered last. In addition, it was highly probable that carry-over effects would occur if the WAIS-R was administered before the simpler and briefer QCST, especially since there was some similarity in some of the subtests (for example Arithmetic, Similarities). Since the QCST is a much briefer test than the WAIS-R it was administered first, followed by the NART and the UVT which were the shortest tests (5 to 10 minutes each).

Another potential issue is that of a ceiling effect for the control group since the range of scores was small for this group. However, the QCST was designed to detect the presence of cognitive deficit in patients at risk, not to differentiate between degree of normal performance in healthy individuals.

There was some concern regarding statistical analyses. Because of the number of correlations performed, some coefficients may have indicated a significant relationship between variables when in fact there was none, thereby capitalizing on chance and committing a Type I error. However, attempts were not made to examine this in detail; a future study should examine this issue more closely.

Future Research

A cross validation study is recommended as a follow-up to the present investigation in order to independently determine the validity of the QCST. A larger sample of normal controls and a larger neurological sample should be assessed in order to increase the power of the statistical analyses. If practical, in addition to matching the control group in age and education to the neurological group, the neurological subgroups should also be matched with each other in education and age. A split-half cross validation procedure could be employed if the sample size was sufficiently large to delineate into a validation group and a prediction group. In any future study, it would be useful to have a good representation of CVA patients with right CVA, left CVA, and bilateral CVA so as to better evaluate the QCST in assessing cognitive functioning in patients with unilateral and bilateral pathology. This would provide valuable information with respect to the capacity of the QCST to discriminate between right hemisphere and left hemisphere lesions. It would also be beneficial to establish some criteria to delineate the TBI patients into those with mild TBI, moderate TBI, and severe TBI, to better evaluate the QCST in identifying cognitive deficits in patients with variability in extent of brain

injury and/or damage. Inclusion of an additional neurological group of sufficient number, with pathology other than CVA or TBI, would add valuable information.

With a larger data base, more comprehensive statistical analyses could be performed to further validate the test. For example, factor analysis (principal component) could be employed to determine the factor loading of the test, and additionally, confirm it's construct validity if WAIS-R results were entered into the analysis. Discriminant analysis could be used to assess whether QCST summary scores or the Global Score, or perhaps QCST subtest scores were predictive of normal versus impaired group membership, and predictive of right versus left hemisphere group membership where there is lateralization of damage. Evidence for criterion-related concurrent validity might also be investigated by designing a study in which some clinical criterion could be quantified for correlation with QCST scores. For example, results of a full neuropsychological assessment might provide a basis for a four-point (none, mild, moderate, severe) severity rating scale of cognitive impairment with which QCST scores may be correlated. It would also be informative to evaluate the false positive, and more importantly, the false negative rate of the test.

Additional studies could be undertaken to investigate the utility of the QCST in screening for cognitive impairment in geriatric patients, non-CVA cardiac patients, alcohol and drug-addicted patients, and other populations at risk for cognitive impairment. It is in populations where cognitive impairment is subclinical that the worth of a screening test is proven. Finally, a comparative evaluation of the QCST with other screening tests such as the briefer mental status exams, for example the Mini-Mental

Status examination, and the newer "mid-range" tests such as the Neurobehavioral Cognitive Status Examination and the High Sensitivity Cognitive Screen would be worthwhile.

IMPLICATIONS OF THE STUDY

The development of a brief but valid reliable, and sensitive screening test such as the QCST for detection of cognitive dysfunction is important for several reasons. Routine intake assessments in clinics, hospitals and institutions often rely on simple bedside screening devices such as the Mini-Mental Status examination to give health professionals an indication of the mental status of the patient. On the basis of the patients's performance on these mental status examinations, which is almost always expressed by a single total score, a decision is made as to whether or not the patient is cognitively dysfunctional and requires referral for further neuropsychological evaluation. As reponed earlier (Nelson et al, 1986; Strain et al, 1988; Faust and Fogel, 1989), in many cases cognitive deficits are missed, especially more subtle ones. A sensitive screening test can alleviate this problem. A cognitive screening test with a low false negative rate will detect the presence and nature of even the more subtle deficits. This may lead to more comprehensive evaluation earlier so that appropriate individualized programs can be initiated resulting in less time spent using up much needed facilities. A low false positive rate will ensure that valuable time and money will not be spent on extensive testing of individuals with normal cognitive abilities.

Findings from this study have shown the QCST is a valid, reliable and sensitive cognitive screening test. It is brief (15 to 30 minutes) yet comprehensive, simple, portable, and inclusive in that it does not require extra materials such as blocks, cards, score sheets, procedural and scoring manuals. The test is amenable to administration and interpretation by health professionals other than neuropsychologists. Because of its brevity and simple format, patients may find it easier to tolerate, less fatiguing and less intimidating than some other assessment instruments. Because the QCST consists of a series of brief subtests, each having its own score, it increases the likelihood of detecting impairment in a specific cognitive area, for example memory, when in certain instances a global score may not indicate impairment. This is essential when planning treatment and ongoing management of brain-injured patients during rehabilitation and later during discharge. It is also important in identifying impairment in other patients such as geriatric patients, chronic cardiac patients, and others who may have reversible and treatable conditions, so that therapeutic and preventitive measures may be taken before further decline in functioning occurs. Health professionals in various health services should find the QCST very useful as an aid in decision-making with respect to referrals to specialists.

It should be kept in mind however that a brief cognitive screening test like the QCST is just what the name implies - a screening device only! It is not intended to be a substitute for comprehensive neuropsychological evaluation by a trained specialist. It may be considered as an important initial evaluation strategy, a preliminary approach to assessment (Strain et al, 1988), or as Lezak (1983) described it, an "early warning" device. A screening test raises the question of probable impairment which requires

further investigation and should not presume to simply label the patient as brain damaged. Information obtained must be considered and integrated with other sources of information such as other means of clinical assessment, medical and/or psychiatric history, presenting complaints, overall functioning. There are other factors in addition to brain damage which may cause poor test performance, including anxiety, motivation level, or fatigue. It is crucial to know the limitations of the test and interpret the information elicited accordingly (Lezak, 1983). On the other hand, absence of impairment cannot be ruled out by negative results on a test (Lezak, 1983; Kolb and Whishaw, 1990). Webster et al (1984) cautioned against the use of cutoff scores alone to select who should or should not receive further neuropsychological evaluation and stressed the importance of the qualitative aspects of test performance. A coarse classification of cognitive function is adequate for many purposes (Faust and Fogel, 1989), but "when a clinician requires a detailed understanding of a particular deficit or a rather precise quantification of its range or severity an indepth assessment and the hypothesis testing approach of the neuropsychologist is necessary and irreplaceable" (Faust and Fogel, 1989, p 29).

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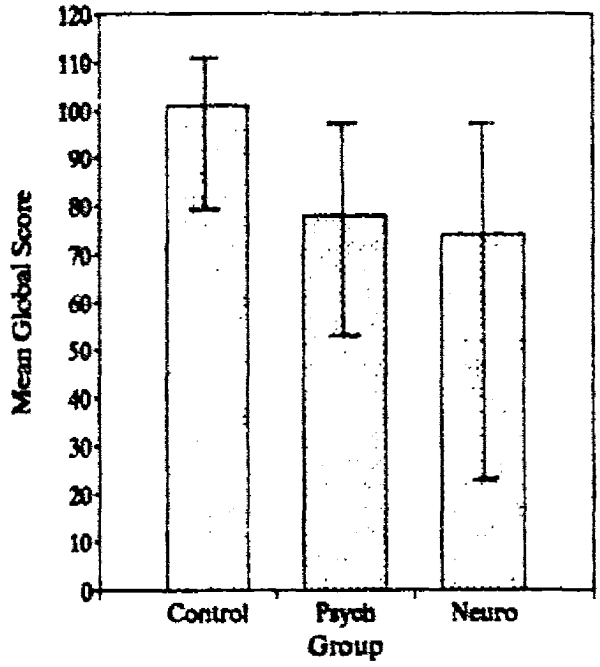
APPENDIX A

Figures **Page**

Tables



Fixure 1. Mean and Range of the QCST Global Score by Group.

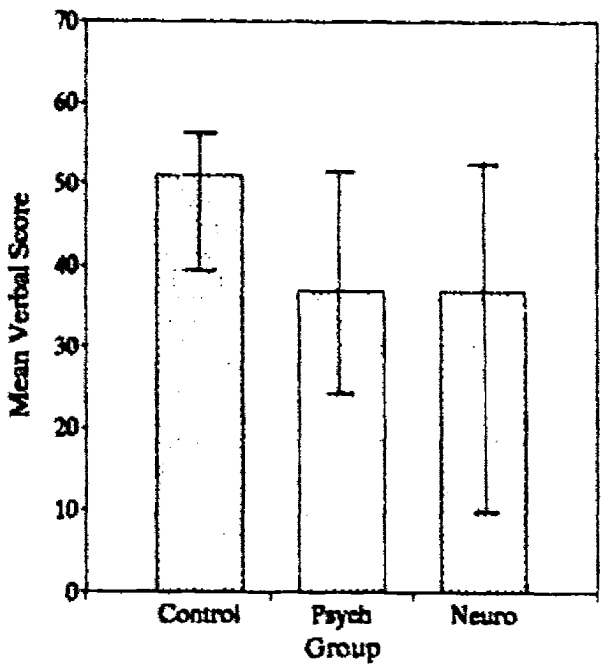


Figure 2. **Mean and Range of the QCST Verbal Score by Group.**

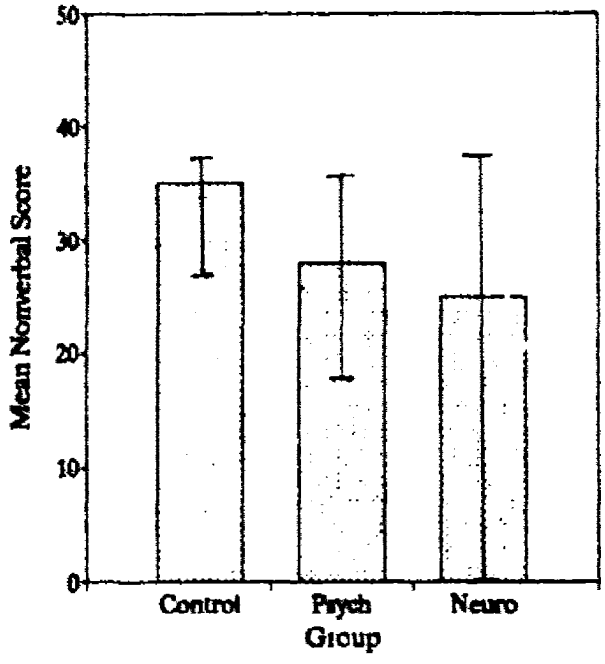


Figure 3. Mean and Range of the QCST Nonverbal Score by Group.

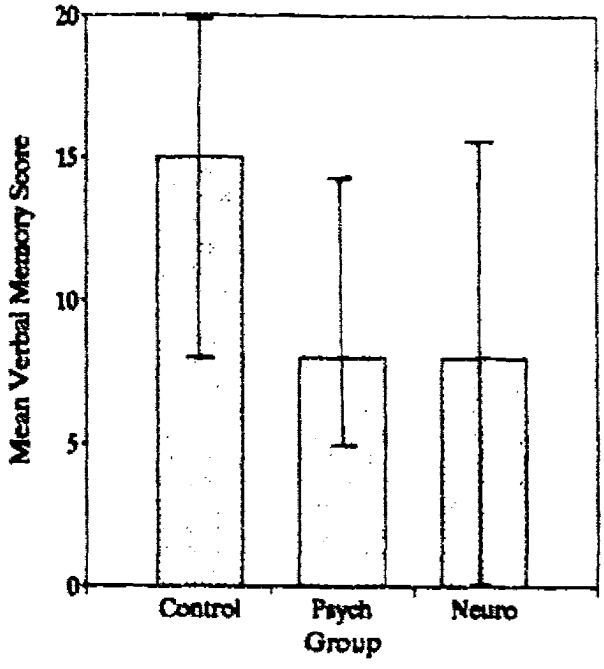


Figure 4. Mean and Range of the QCST Verbal Memory Score by Group.

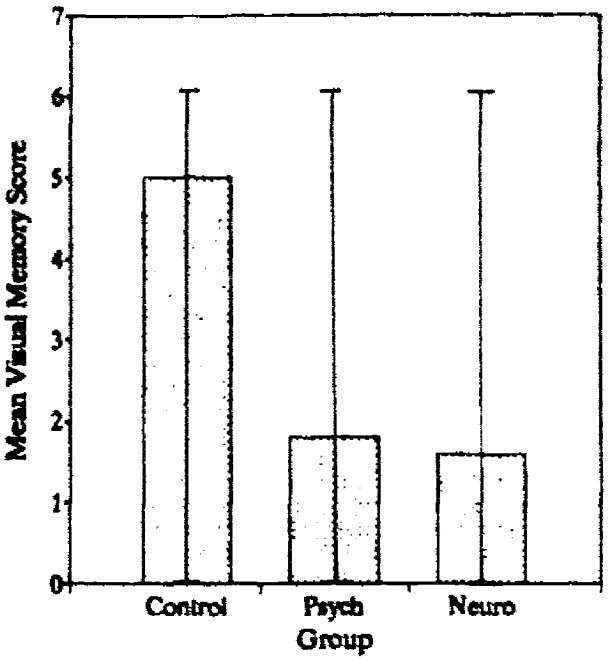


Figure 5. Mean and Range of the QCST Visual Memory Score by Group.

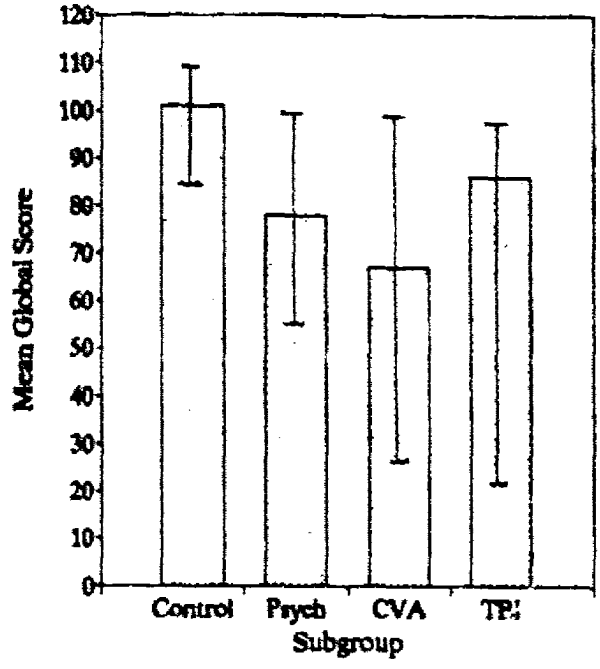


Figure 6. Mean and Range of the QCST Global Score by Subgroup.

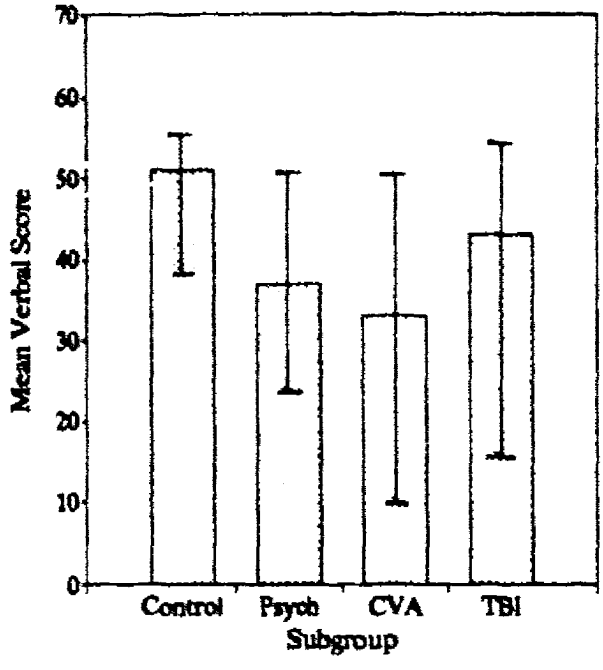


Figure 7. Mean and Range of the QCST Verbal Score by Subgroup.

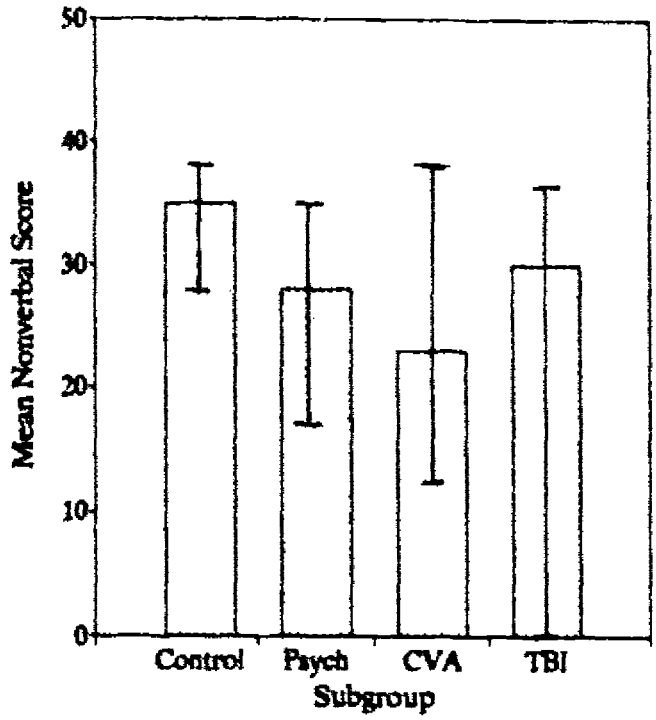


Figure 8. Mean and Range of the QCST Nonverbal Score by Subgroup.

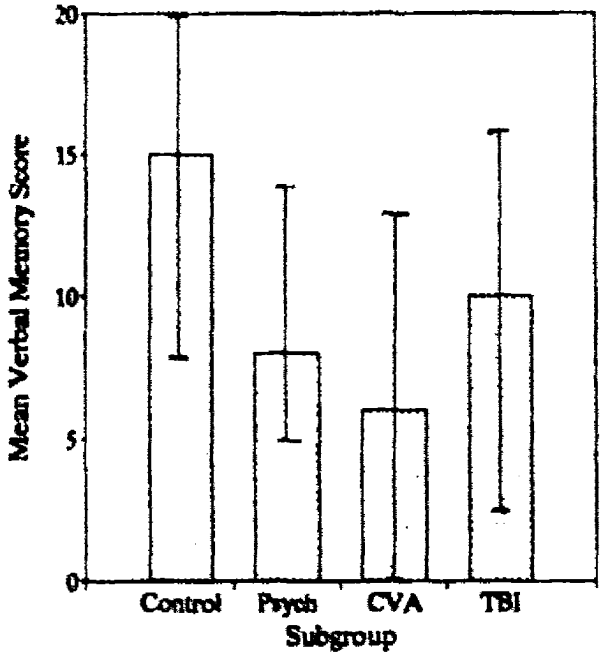


Figure 9. **Mean and Range of the QCST Verbal Memory Score by Subgroup.**

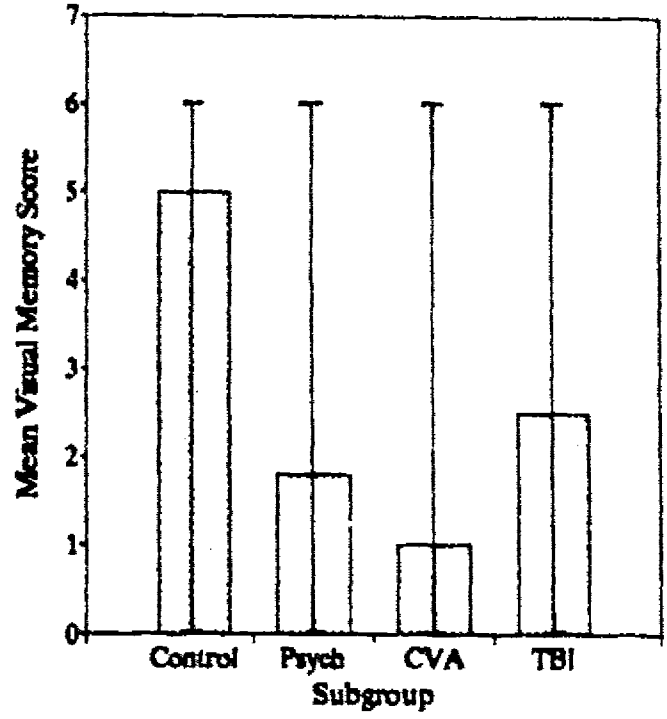


Figure 10. Mean and Range of the QCST Visual Memory Score by Subgroup.

Table A-1

Oneway Analysis of Variance: QCST Summary Scores by Group (1,3).

SOV	SS	df	MS	F-Ratio	F-Prob.	Effect
Global Score						
BG	13559.96	2	6779.98	27.13	.0000	.40
WG	20495.00	82	249.95			
Total	34055.95	84				
Verbal Score						
BG	3953.82	2	1976.91	26.92	.0000	.40
WG	6021.08	82	73.43			
Total	9974.89	84				
Nonverbal Score						
BG	1838.29	2	919.14	18.14	.0000	.31
WG	4154.82	82	50.67			
Total	5993.11	84				
Verbal Memory Score						
BG	1089.52	2	544.76	47.24	.0000	.54
WG	945.70	82	11.53			
Total	2035.22	84				
Visual Memory Score						
BG	222.95	2	111.47	26.61	.0000	.39
WG	343.48	82	4.19			
Total	566.42	84				

Table A-2

Oneway Analysis of Variance: QCST Summary Scores by Subgroup (1,4).

SOV	SS	df	MS	F-Ratio	F-Prob.	Effect
Global Score						
BG	14141.45	3	4713.82	26.17	.0000	.51
WG	13325.17	74	180.07			
Total	27466.62	77				
Verbal Score						
BG	4357.49	3	1452.50	24.76	.0000	.50
WG	4340.36	74	58.65			
Total	8697.85	77				
Nonverbal Score						
BG	1770.10	3	590.03	16.48	.0000	.40
WG	2650.12	74	35.81			
Total	4420.22	77				
Verbal Memory Score						
BG	1132.13	3	377.38	35.59	.0000	.59
WG	784.70	74	10.60			
Total	1916.83	77				
Visual Memory Score						
BG	217.41	3	72.47	18.23	.0000	.43
WG	292.13	74	3.97			
Total	511.54	77				

Table A-3

Mean and Standard Deviation of QCST Subtest Scores for Each Subgroup.

QCST Subtest Scores	Subgroup					
	Control	Psychiatric	Neurological	CVA	TBI	Others
Orientation	11.41 (.61)	10.87 (.92)	9.42 (2.61)	9.06 (2.74)	10.27 (1.75)	8.43 (3.55)
Attent./Concentration	3.34 (.94)	3.13 (.83)	2.63 (1.13)	2.25 (1.00)	3.13 (1.25)	2.43 (.79)
Verbal Immed. Memory	4.97 (.18)	4.47 (.99)	4.32 (1.15)	4.06 (1.53)	4.53 (.74)	4.57 (.79)
Vocabulary	6.69 (.54)	4.60 (2.06)	5.11 (1.94)	4.69 (2.21)	5.67 (1.50)	4.86 (2.12)
Naming	5.00 (.00)	4.40 (.91)	4.32 (.96)	4.19 (.98)	4.53 (.83)	4.14 (1.46)
Similarities	3.53 (.67)	2.67 (1.29)	2.74 (1.25)	2.31 (1.30)	3.40 (.83)	2.29 (1.38)
Analogies	3.81 (.40)	3.07 (.96)	2.89 (1.29)	2.56 (1.26)	3.67 (.72)	2.00 (1.53)
Mental Arithmetic	4.75 (.51)	3.67 (1.45)	4.08 (1.46)	3.56 (1.86)	4.60 (.83)	4.14 (1.21)
Arithmetic	11.66 (.75)	10.60 (1.84)	9.87 (3.22)	9.13 (3.10)	10.87 (2.67)	9.43 (4.39)

continued on next page

Table A-3 (continued)

Mean and Standard Deviation of QCST Subtest Scores for Each Subgroup.

QCST Subtest Scores	Subgroup					
	Control	Psychiatric	Neurological	CVA	TBI	Others
Verbal Delayed Memory	3.34 (1.23)	2.00 (1.13)	1.58 (1.43)	1.38 (1.54)	1.73 (1.22)	1.71 (1.70)
Memory (New Learning)	6.81 (2.44)	1.20 (2.51)	1.95 (2.70)	.75 (1.88)	3.80 (2.81)	.71 (1.89)
Visuoattention/spatial	7.69 (.74)	5.87 (1.73)	6.18 (2.35)	5.50 (2.22)	6.80 (2.14)	6.43 (2.94)
Constructional Praxis	8.53 (.84)	7.07 (1.39)	5.55 (3.64)	4.38 (3.36)	7.27 (3.08)	4.57 (4.35)
Object Identification	4.56 (.63)	4.20 (.86)	3.84 (1.26)	4.19 (.83)	3.93 (1.22)	2.86 (1.77)
Geometric Designs	4.84 (.37)	4.73 (.59)	4.05 (1.54)	4.00 (1.26)	4.53 (1.30)	3.14 (2.27)
Perceptual Closure	4.78 (.49)	4.20 (1.32)	4.00 (1.43)	3.94 (.93)	4.53 (1.30)	3.00 (2.16)
Visual Delayed Memory	5.00 (1.63)	1.80 (2.04)	1.61 (2.34)	1.00 (1.90)	2.47 (2.67)	1.14 (2.27)

Table A-4

Pearson r Correlation Coefficients: QCST Subtest Scores with WAIS-R Age-Scaled Subtest Scores and UVT Scores.

QCST Subtest Scores	WAIS-R Subtest Scores										UVT Scores	
	Verbal					Performance						
	DS	V	A	C	S	PC	PA	BD	OA	DS	Unusual	Usual
Orientation	.31**	.39**	.33**	.38**	.50**	.40**	.36**	.45**	.41**	.37**	.45**	.51**
Attent/Concentration	.38**	.37**	.41**	.30**	.40**	.40**	.35**	.36*	.40**	.39**	.38**	.44**
Verbal Immed. Memory	.51**	.55**	.50**	.49**	.49**	.42**	.34**	.35**	.29*	.29**	.40**	.46**
Vocabulary	.57**	.75**	.67**	.68**	.72**	.56**	.51**	.50**	.47**	.44**	.45**	.52**
Naming	.44**	.56**	.47**	.52**	.60**	.47**	.41**	.45**	.41**	.40**	.43**	.43**
Similarities	.50**	.59**	.54**	.51**	.63**	.50**	.51**	.47**	.37**	.40**	.50**	.51**
Analogies	.35**	.52**	.53**	.53**	.60**	.62**	.61**	.51**	.53**	.39**	.56**	.50**
Mental Arithmetic	.52**	.69**	.69**	.60**	.60**	.42**	.34**	.39**	.32**	.42**	.51**	.49**
Arithmetic	.42**	.40**	.53**	.39**	.45**	.45**	.46**	.54**	.45**	.49**	.58**	.56**
Verbal Delayed Memory	.25*	.36**	.32**	.39**	.40**	.28**	.31**	.31**	.35**	.26*	.28*	.32**
Memory (New Learning)	.57**	.60**	.71**	.64**	.59**	.58**	.60**	.57**	.54**	.66**	.50**	.41**
Visuoattention/spatial	.14	.37**	.35**	.44**	.41**	.56**	.57**	.43**	.45**	.47**	.50**	.48**
Constructional Praxis	.28**	.37**	.37**	.46**	.51**	.57**	.62**	.61**	.66**	.57**	.62**	.63**
Object Identification	.08	.23*	.22	.27*	.35**	.29**	.37**	.32**	.35**	.30*	.23*	.10
Geometric Designs	.18	.22*	.26*	.31**	.31**	.41**	.34**	.33**	.38**	.29**	.52**	.55**
Perceptual Closure	.26*	.37**	.40**	.41**	.44**	.54**	.50**	.45**	.49**	.39**	.53**	.51**
Visual Delayed Memory	.31**	.41**	.40**	.45**	.52**	.62**	.60**	.55**	.61**	.57**	.42**	.45**

** $p \leq .01$, two-tailed * $p \leq .05$, two-tailed

Table A-5
Correlation Coefficients: QCST Scores with Age and Education.

QCST Scores	Age	Education
Orientation	-.26*	.31**
Attention/Concentration	-.09	.25*
Verbal Immediate Memory	-.01	.28*
Vocabulary	.04	.42**
Naming	-.01	.41**
Similarities	-.10	.46**
Analogies	-.29**	.38**
Mental Arithmetic	-.02	.30**
Arithmetic	-.27*	.45**
Verbal Delayed Memory	-.19	.28*
Memory (New Learning)	-.05	.59**
Visuoattention/Visuospatial	-.29**	.31**
Constructional Praxis	-.35**	.43**
Object Identification	-.01	.17
Geometric Designs	-.31**	.29**
Perceptual Closure	-.24*	.33**
Visual Delayed Memory	-.29**	.45**
Global Score	-.26*	.56**
Verbal Score	-.14	.58**
Nonverbal Score	-.35**	.46**
Verbal Memory Score	-.12	.58**
Visual Memory Score	-.29**	.45**

** $p \leq .01$ * $p \leq .05$

Table A-6

Pearson r Correlation Coefficients for WAIS-R Obtained IQ Scores and NART Predicted IQ Scores

	NART Predicted IQ		
WAIS-R IQ	Verbal IQ	Performance IQ	Full Scale IQ
Verbal IQ	.81**	.81**	.81**
Performance IQ	.57**	.56**	.57**
Full Scale IQ	.72**	.72**	.72**

** $p \leq .01$

APPENDIX B

The Quick Cognitive Screening Test

The Unusual Views Test Score Sheet

Figure 11(i) Example from the Unusual Views Test.

Figure 11(ii) Example from the Unusual Views Test.

The National Adult Reading Test Score Sheet

QUICK COGNITIVE SCREENING TEST

Subject Number: _____ Patient Label

Sex: _____ Handedness: _____

Age: _____ Date of birth: _____

Highest level of education completed: _____

Occupation: _____

Orientation:

1. What time of day is it? _____
2. What day of the week is this? _____
3. What month is this? _____
4. What date of the month is this? _____
5. What year is this? _____
6. Where are you now ? _____
7. What is your age? _____
8. What is your date of birth? _____
9. What is the name of the Prime Minister? _____
10. Who was the Prime Minister before him? _____
11. Write or say all the days of the week.

12. Write or say your full address.

Total Score (items 1-12)

Maximum score: 12

Attention/concentration:

13. I want to see how quickly you can count by threes, beginning with one, like this : 1, 4, 7, etc.

1, 4, 7, 10, 13, 16, 19, 22, 25, 28, 31, 34, 37, 40

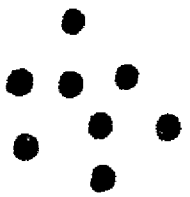
Errors: Circle errors and record actual response.

Score: All correct = 2 points. One error = 1 point. Two or more errors = 0 points.

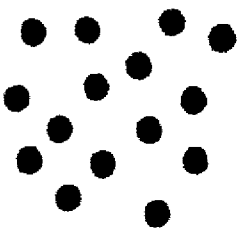
Score (item 13) _____

Maximum score: 2

How many dots are there in each set?



14. Number _ _



15. Number

Score (items 14-15) _ _ _

Maximum score: 2

Total Score (items 13-15) _ _

Maximum score: 4

Memory (Registration & Immediate Recall):

16. I am going to name some objects. When I am finished I want you to say them back to me.

pen watch tie car book

I want you to remember these words because I will ask you to repeat them back to me later.

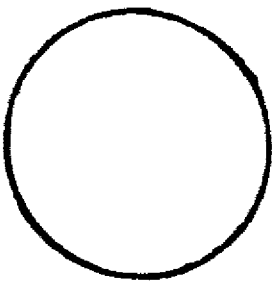
Total Score (item 16) _____

Maximum score: 5

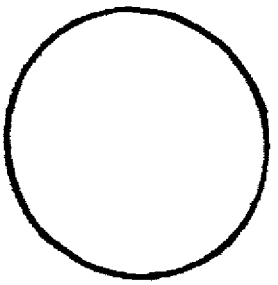
Visual Attention/Visuospatial:

Make a dot in the centre of each circle:

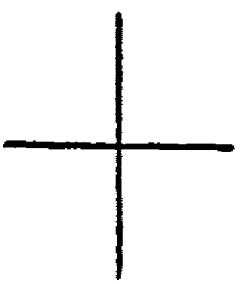
17.



18.



19. Mark North, South, East, West on this cross:



Make a stroke through the middle of each line

20. _____ _____

21. _____ _____

Total Score (items 17-21) ___

Maximum score: 8

Constructional Praxis:

22. Draw a clock face showing a time

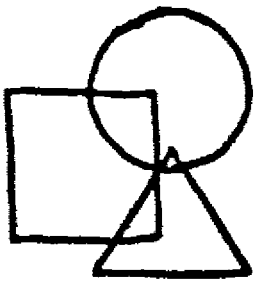
Score (item 22) _

(one point each for circle, hands, and numbers; minimum four numbers)

Maximum score: 3

Copy this drawing:

23.



Score (item 23) _ ____

(one point for each figure; one point for correct placement of each figure)

Maximum score: 6

Total Score (items 22-23) _ ____

Maximum score: 9

Verbal Functions:

I. Vocabulary

Underline the word in the group which means the same as the word in capital letters above the group, as in the example:

Example:	**EQUAL** Excellent Uneven Average **Same** Copy	
24. **ALLOW** Permit Forbid Refuse Help Fallow	25. **DELICATE** Flexible Tough Decompose Fragile Touch	26. **SILENT** Quiet Loud Whisper Shout Low
27. **CAUTION** Vigil Neglect Courage Care Despair	28. **PARTICLE** Piece Full Partial Point Complete	29. **REGENERATE** Erect General Live Restore New
	30. **INFERIOR** Superior Poor Inflamed Inflict Follow	

Total Score (items 24-30)

Maximum score: 7

II. Naming

Underline the word which is described in the phrase above the group, as in the example:

Example: **INSTRUMENT FOR WRITING WITH**

<u>pen</u>	book	wing	blackboard	word

---

31. **CONTAINER FOR MILK**

straw grass fork bottle book

32. **INSTRUMENT FOR TELLING THE TIME**

watch thermometer face microscope hand

33. **INSTRUMENT FOR MEASURING TEMPERATURE**

barometer micrometer manometer thermometer gasometer

34. **INSTRUMENT FOR LOOKING AT TINY OBJECTS**

stethoscope microscope periscope stroboscope telescope

35. **INSTRUMENT FOR LOOKING AT STARS**

stroboscope microscope telescope oscilloscope television

Total Score (items 31-35) _____

Maximum score: 5

Abstraction:

I. Similarities

Underline one word or phrase on the right which describes both the words on the left, as in the example:

Example:

Banana & Orange:	Round	Colour	Taste	**Fruit**	Buy Them
36. Knife & Fork:	Plate	Out	Spoon	Cutlery	Eat
37. Salt & Sugar:	Drink	Grow	Taste	Smell them	Eat them
38. Ruler & Scale:	Drawing	Cooking	Weighing	Straight	Measuring
39. Nose & Tongue:	On Face	Taste	Talking	Sense Organs	For eating

Total Score (items 36-39) _____

Maximum score: 4

II. Analogies

Underline the word which completes the sentence, as in the example:

Example:

Big is to Small as Large is to:	Enormous	Short	Huge	Narrow	**Little**
40. Hand is to Glove as Foot is to:	Hat	Cold	Leg	Shoe	Coat
41. Spider is to Web as Bird is to:	Nest	Egg	Tree	Fly	Wing
42. Sun is to Heat as Lamp is to:	Flower	Light	Star	Shadow	Fire
43. Spring is to Summer as Tuesday is to:	Wednesday	Saturday	Thursday	Monday	Friday

Total Score (items 40-43) _____

Maximum score: 4

Calculations:

I. Mental Arithmetic

Do these problems:

44. How much is $3.00 plus $6.00? _____

45. How many weeks in two years? _____

46. If one book costs $8.00, how much will two books cost? _____

47. If I have 29 articles and I sell 11, how many do I have left? _____

48. How many days will I take to earn $36.00 if I earn $6.00 a day? _____

Total Score (items 44-48) _____

Maximum score: 5

II. Arithmetic

Do these arithmetic problems:

49. Add + 2 / 7 = _____

50. Add + 17 / 13 = _____

51. Add + 113 / 113 = _____

52. Subtract - 4 / 3 = _____

53. Subtract - 13 / 11 = _____

54. Subtract - 65 / 56 = _____

55. Multiply x 2 / 4 = _____

56. Multiply x 6 / 3 = _____

57. Multiply x 20 / 3 = _____

58. Divide 2) 4 = _____

59. Divide 20) 60 = _____

60. Divide 12) 144 = _____

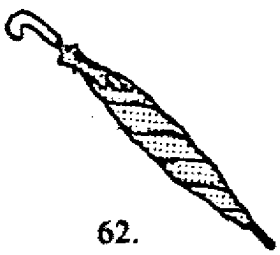
Total Score (items 49-60) _____

Maximum score: 12

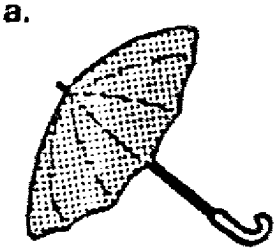
Object Identification:

Underline the picture on the right which shows the same thing as on the left:

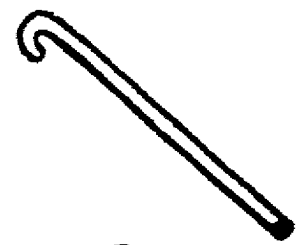
61.



a.

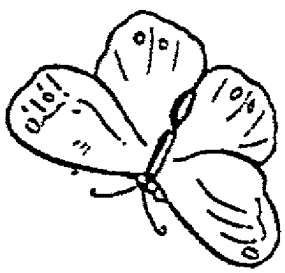


b.

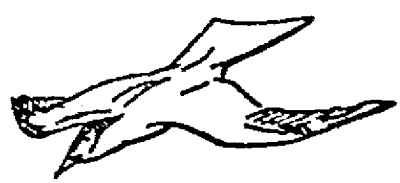


c.

62.



a.



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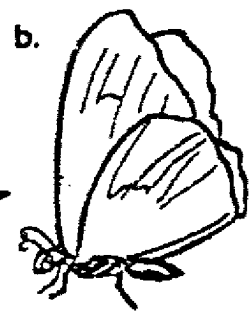

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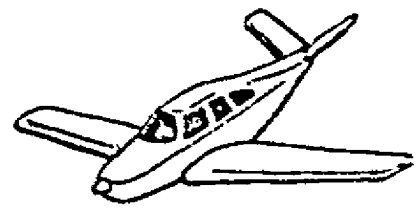
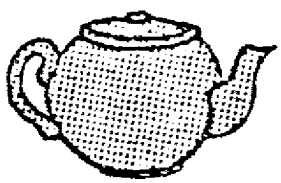
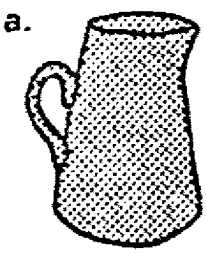


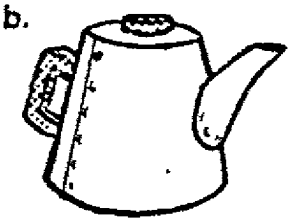
63.



a.

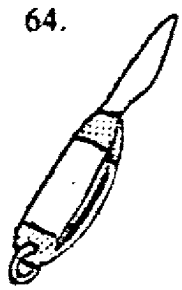


b.

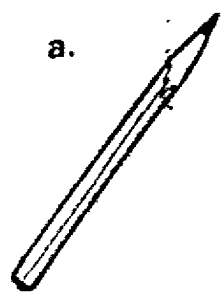


c.

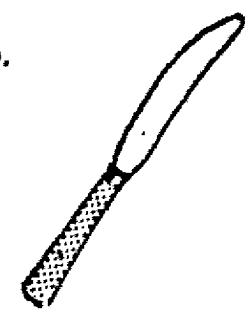
64.



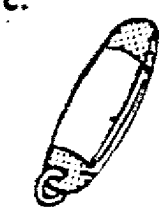
a.



b.

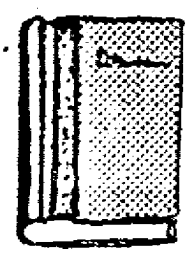


c.

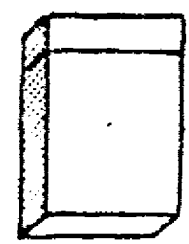


65.

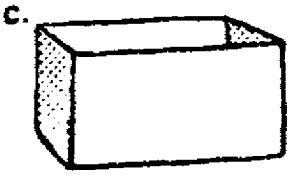
a.



b.



c.



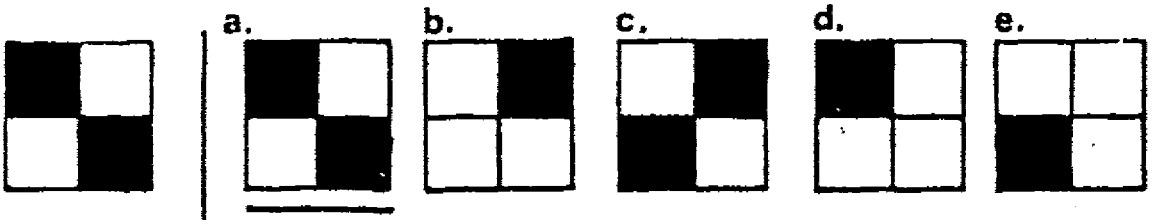
Total Score (items 61-65) _____

Maximum score: 5

Geometric Designs:

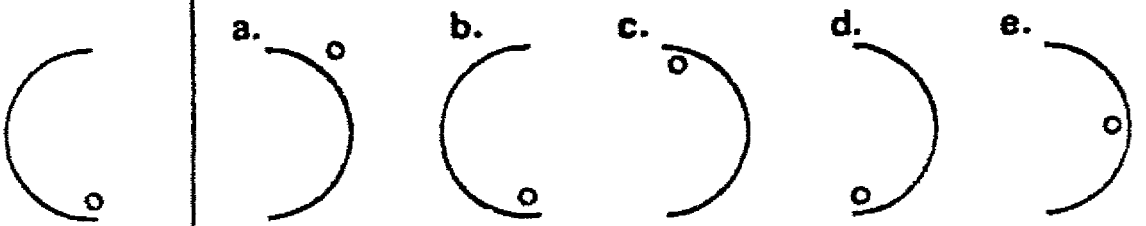
Underline the figure on the right which is the same as the figure on the left, as in the example:

Example:



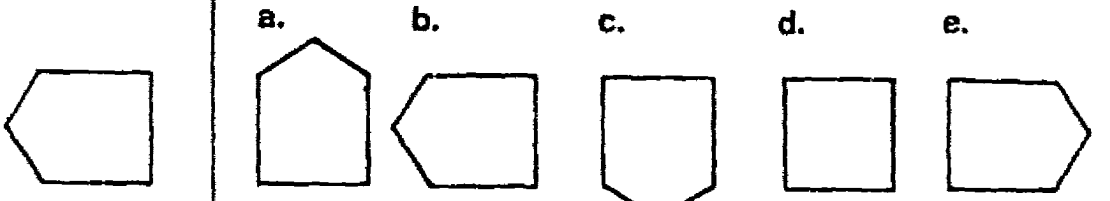
66.

67.

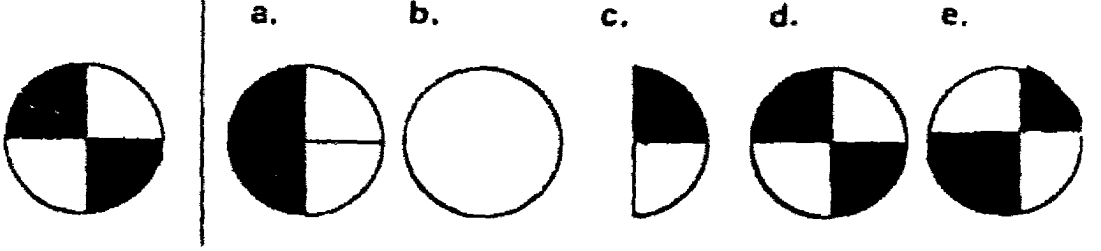


68.

69.



70.



Total Score (items 66-70) _____

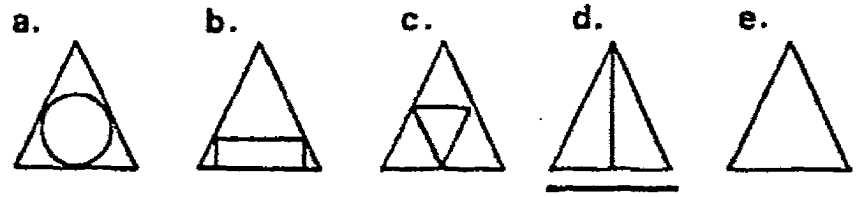
Maximum score: 5

Perceptual Closure:

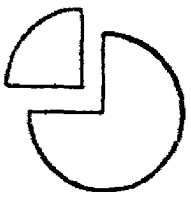
Underline the one figure on the right that can be made from the pieces on the left, as in the example:

Example:

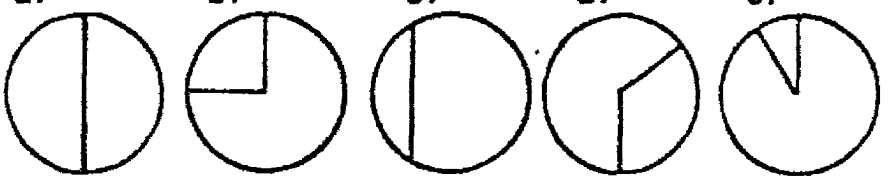
a. b. c. d. e.



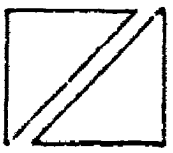
71.



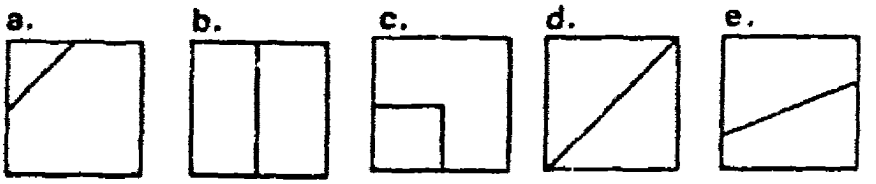
a. b. c. d. e.



72.



a. b. c. d. e.



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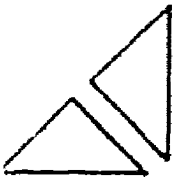

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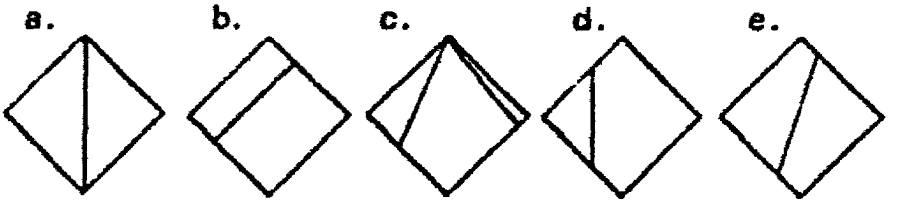

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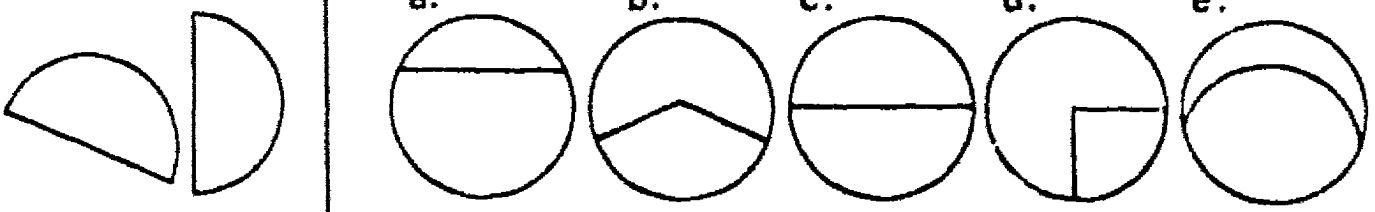

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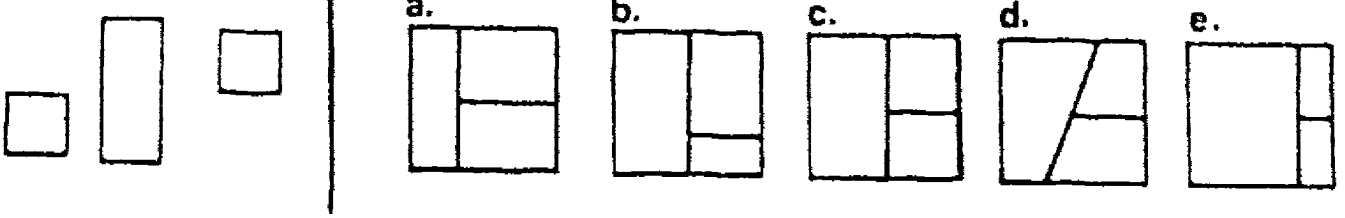


Total Score (items 71-75) _____

Maximum score: 5

Memory:

Delayed Recall

L. Visual:

76. I want you to draw the figure that you drew earlier:

Score (item 76)

Maximum score: 6

Delayed Recall

II. Verbal:

77. I want you to repeat back to me the five objects I named earlier.

pen watch tie car book

Score (item 77) _____

Maximum score: 5

Memory (New Learning):

78. I am going to say a sentence. Listen carefully, and when I am finished I want you to repeat the sentence back to me exactly as I say it to you..

"One thing a nation must have to be rich and great is a large secure supply of wood."

Trials:	1	2	3	4	5	6	7	8	9	10	>10
Score:	(10)	(9)	(8)	(7)	(6)	(5)	(4)	(3)	(2)	(1)	(0)

(Minus one point for each trial to correct repetition.)

Score (item 78) _____

Maximum score: 10

SCORE

1.	Orientation	_____ / 12
2.	Attention/Concentration	_____ / 4

Verbal Functions:

3.	Memory: Immediate Recall	_____ / 5
4.	Vocabulary	_____ / 7
5.	Naming	_____ / 5
6.	Similarities	_____ / 4
7.	Analogies	_____ / 4
8.	Mental Arithmetic	_____ / 5
9.	Arithmetic	_____ / 12
10.	Memory: Delayed Recall (Words)	_____ / 5
11.	Memory: New Learning	_____ / 10

Nonverbal Functions:

12.	Visual Attention/Visuospatial	_____ / 8
13.	Constructional Praxis	_____ / 9
14.	Object Identification	_____ / 5
15.	Geometric Designs	_____ / 5
16.	Perceptual Closure	_____ / 5
17.	Memory: Delayed Recall (Figure)	_____ / 6

GLOBAL SCORE (Subtests 1-17) _____ / 111

Verbal Score:	(Subtests 3-11)	_____ / 57
Verbal Memory Score:	(Subtests 3, 10, 11)	_____ / 20
Nonverbal Score:	(Subtests 12-17)	_____ / 38
Visual Memory Score:	(Subtests 17)	_____ / 6

MEAN AND STANDARD DEVIATION FOR THE NORMAL SAMPLE

	Mean	SD
1. Orientation	11.41	0.61
2. Attention/Concentration	3.34	0.94
Verbal Functions:		
3. Memory: Immediate Recall	4.97	0.18
4. Vocabulary	6.69	0.54
5. Naming	5.00	0.00
6. Similarities	3.53	0.67
7. Analogies	3.81	0.40
8. Mental Arithmetic	4.75	0.51
9. Arithmetic	11.66	0.75
10. Memory: Delayed Recall (Words)	3.34	1.23
11. Memory: New Learning	6.81	2.44
Nonverbal Functions:		
12. Visual Attention/Visuospatial	7.69	0.74
13. Constructional Praxis	8.53	0.84
14. Object Identification	4.56	0.62
15. Geometric Designs	4.84	0.37
16. Perceptual Closure	4.78	0.49
17. Memory: Delayed Recall (Figure)	5.00	1.63
GLOBAL SCORE (Subtests 1-17)	101	5.9
Verbal Score: (Subtests 3-11)	51	3.7
Verbal Memory Score: (Subtests 3, 10, 11)	15	2.8
Nonverbal Score: (Subtests 12-17)	35	2.8
Visual Memory Score: (Subtests 17)	5	1.6

THE UNUSUAL VIEWS (UNCONVENTIONAL TEST)

NAME: _____ SEX: _____

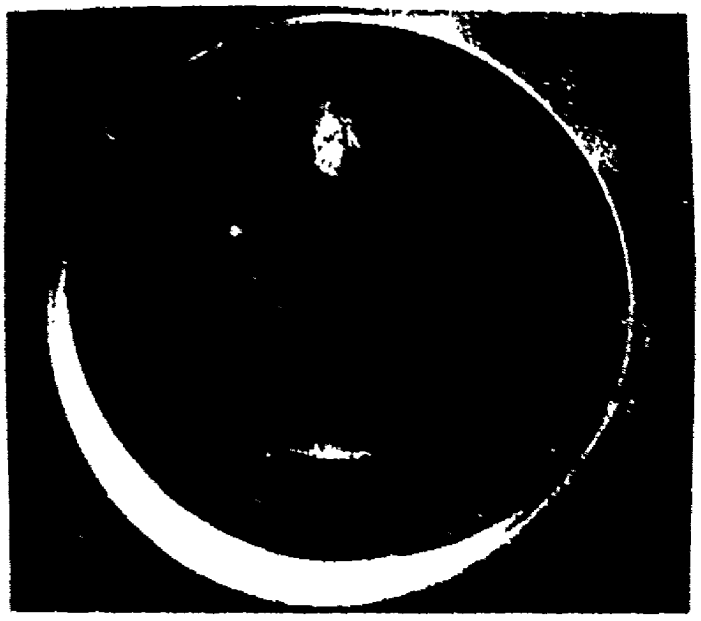
HANDEDNESS: _____ AGE: _____ DOB: _____

EDUCATION: _____ OCCUPATION: _____

NAME OF ITEM	RESPONSE* UNUSUAL VIEWS	USUAL VIEWS	NAMING
1. Cleanser			
2. Pot/Saucepan			
3. Shoe/Sandal			
4. Iron			
5. Egg Beater			
6. Vacuum Cleaner			
7. Plug			
8. Table Tennis Paddle			
9. Step ladder			
10. Telephone			
11. Goggles			
12. Trumpet			
13. Dust pan			
14. Pail			
15. Basket			
16. Kettle			
17. Hand drill			
18. Guitar			
19. Glove			
20. Flower pot			
# of errrors	_____	_____	_____
# of correct responses	_____	_____	_____

*[illegible] WRITTEN RESPONSE

Figure 11 (i). Example from the Unusual Views Test (Warrington and Taylor, 1973).



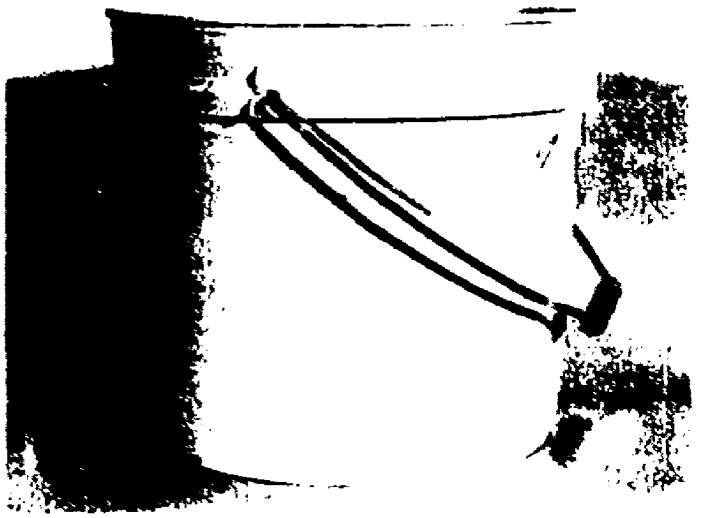


Figure 11 (ii). Example from the Unusual Views Test (Warrington and Taylor, 1973).

NATIONAL ADULT READING TEST (NART)

ANSWER/RECORD SHEET

NAME_____ DATE OF TEST_____

CHORD_____	SUPERFLUOUS_____
ACHE_____	SIMILE_____
DEPOT_____	BANAL_____
AISLE_____	QUADRUPED_____
BOUQUET_____	CELLIST_____
PSALM_____	FACADE_____
CAPON_____	ZEALOT_____
DENY_____	DRACHM_____
NAUSEA_____	AEON_____
DEBT_____	PLACEBO_____
COURTEOUS_____	ABSTEMIOUS_____
RAREFY_____	DETENTE_____
EQUIVOCAL_____	IDYLL_____
NAIVE_____	PUERPERAL_____
CATACOMB_____	AVER_____
GAOLED_____	GAUCHE_____
THYME_____	TOPIARY_____
HEIR_____	LEVIATHAN_____
RADIX_____	BEATIFY_____
ASSIGNATE_____	PRELATE_____
HIATUS_____	SIDEREAL_____
SUBTLE_____	DEMESNE_____
PROCREATE_____	SYNCOPE_____
GIST_____	LABILE_____
GOUGE_____	CAMPANILE_____

Obtained WAIS results:

Full Scale IQ ☐ Verbal IQ ☐ Performance IQ ☐

NART error score ☐

	Predicted IQ	Predicted-Obtained IQ	Abnormality (%)
Full Scale IQ			
Verbal IQ			
Performance IQ			

NART + Schonell error score ☐

	Predicted IQ	Predicted-Obtained IQ	Abnormality (%)
Full Scale IQ			

APPENDIX C

INFORMED CONSENT FORM

SUBJECT'S NAME _____

INVESTIGATOR'S: C. Maté-Kôlé, PhD., Ms. A. Major, B.Sc. B.Ed.,
I. Lenzer, PhD., J. Connolly, PhD.

You are invited to take part in a research investigation at the Nova Scotia Rehabilitation Centre. It is important that you read and understand several general principles that apply to all who take part in our research studies:

(1) Taking part in the investigation is entirely voluntary. If you are a patient, whether you participate or not will not affect the quality of medical care provided to you.

(2) Personal benefit may or may not result from taking part in the investigation, but knowledge may be gained that will benefit others.

(3) You may withdraw from the investigation at any time without loss of any benefit to which you are otherwise entitled. Withdrawal from the study will not affect the care you receive.

This study is concerned with the development and validation of a brief screening test for assessment of cognitive functioning in various populations. You will be interviewed by a research assistant in the Psychology Department of the Rehabilitation Centre. She will administer four psychological tests which are designed to detect strengths and weaknesses in various aspects of cognitive functioning such as memory capacity and problem solving ability. The testing will take approximately 1.5 hours. Whenever necessary, breaks will be permitted during the testing period.

When the results of a study such as this are reported in medical/scientific journals or at meetings, the identification of those taking part is withheld. Medical records of patients are maintained according to current legal requirements and a patient's chart is only available to the investigator(s) during the study.

Should the information obtained through this investigation be deemed important for your clinical management at a later time, the results will be released to the necessary department only with your informed consent. Should any problems arise with regards to your rights as a participant in this investigation, you should contact Dr. Charles Mate-Kole (422-1787, ext. 214).

I have read the explanation about this investigation and have been given the opportunity to discuss it and ask questions. I hereby consent to take part in the study.

Signature of participant and/or	Date
Signature of significant other	Date
Signature of investigator	Date
Signature of witness	Date