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Estimation of Premorbid Intelligence in Organic Conditions

J. R. CRAWFORD, D. M. PARKER and J. A. O. BESSON

The validity of premorbid IQ estimates provided by the National Adult Reading Test (NART) and Vocabulary sub-test of the Wechsler Adult Intelligence Scale were evaluated, by comparison with matched, healthy control subjects, in Korsakoff psychosis, alcoholic dementia, dementia Alzheimer type (DAT), multi-infarct dementia (MID), Huntington's disease, and closed head injury (CHI). There was no significant difference in NART performance between control subjects and the alcoholic dementia, DAT, MID, and CHI groups. Although there appeared to be a decline in NART performance in the Korsakoff and Huntington's groups, it did provide a significantly higher IQ estimate than the Vocabulary sub-test. All clinical groups, with the exception of the CHI group, performed at a significantly lower level than the control group on the Vocabulary sub-test.

Whether for research or clinical purposes, attempts to quantify cognitive impairment in organic patients require a means of estimating premorbid IQ, since previous psychometric test results are rarely available. Lezak (1983) has noted that the most commonly used instrument for this purpose has been the Vocabulary sub-test of the Wechsler Adult Intelligence Scale (WAIS). An alternative possibility is to use word-reading ability. The National Adult Reading Test (NART; 1982) consists of 50 words that subjects have to read and pronounce. The stimulus words are predominantly short and of irregular pronounciation (e.g. 'deny'), so that, it has been argued by Nelson & O'Connell (1978) successful performance rests more on previous familiarity than current cognitive capacity. These authors compared the WAIS and NART performance of a group of patients with EMI scan evidence of cortical atrophy with a control group. The cortical atrophy group obtained significantly lower Verbal, Performance, and Full Scale WAIS IQs, but did not differ significantly from the control group on the NART. Since the NART is highly correlated with WAIS IQ in normal subjects (Nelson, 1982), these results suggest that the NART has validity as a measure of premorbid intellectual level in such cases.

Since publication of Nelson & O'Connell's (1978) findings, the NART has become increasingly used, in clinical practice and research, to provide a measure of premorbid IQ in a wide variety of clinical conditions. However, this use of the NART can be regarded as dangerously premature, as it is clearly important to establish firstly whether Nelson & O'Connell's (1978) results hold for all conditions in which cortical atrophy is a feature, and also whether similar results are obtained in conditions in which other neuropathological features are more prominent. The purpose of the present study was to evaluate the validity of the NART as a measure of premorbid IQ in a number of organic conditions (dementia Alzheimer type, multi-infarct dementia, alcoholic dementia, Korsakoff psychosis, Huntington's disease, and closed head injury) by comparing groups of patients with these conditions with sex, age, and education-matched control subjects. A secondary aim was to determine if the NART would prove superior to the Vocabulary sub-test of the WAIS in this regard.

Method

Clinical-subject groups

With the exception of the closed-head-injury group, clinical subjects ($n = 70$) were patients consecutively referred to a dementia project. Psychiatric interview, neurological examination (including EEG), and laboratory tests (as recommended by Glen & Christie, 1979) to exclude endocrine or metabolic causes were carried out. All patients in the final sample had results within normal limits for the following tests: haemoglobin, ESR, folate, urea and electrolytes, fasting blood glucose, T_4, Venereal Disease Research Laboratory test (VDRL), serum calcium, phosphorus and alkaline phosphatase, chest X-ray, and skull X-ray. With the exception of those who refused consent (8% of the final sample), all cases were brain-imaged using nuclear magnetic resonance (NMR). Regional cerebral blood flow imaging, using single photon emission computerised tomography (SPECT) and intravenous injection of ^{123}I isopropyl amphetamine (IMP), was also carried out. In order to ensure as much as possible the purity of the groups examined, any patients for whom diagnosis was doubtful, or in whom there was evidence of mixed pathology, were excluded. Although not used in differential diagnosis, formal psychometric testing was carried out with all cases in the final sample. All subjects passed a simple

test of visual acuity (reading standard typewriter lower-case letters), and had no evidence of marked hearing loss.

Korsakoff psychosis

Twelve patients who fulfilled DSM-III (American Psychiatric Association, 1980) criteria for a diagnosis of Korsakoff psychosis were obtained. All were commonly disoriented for time and place, and unable to recall day-to-day events. Retrograde amnesia was present in varying degrees. The mean age was 61.8 years, and mean years of education was 9.7 years.

Alcoholic dementia

Twelve patients met DSM-III criteria for a diagnosis of alcoholic dementia. Alcoholic dementia is a broad diagnostic category used to refer to cases with a history of alcohol abuse, who do not exhibit the full-blown Korsakoff amnesic syndrome, but in whom there is evidence of impairment in intellectual and social functioning persisting a minimum of 3 weeks after cessation of drinking. All cases had evidence of abnormal liver function, as indicated by raised gamma GT or MCV. NRM-imaging revealed evidence of cortical atrophy (particularly in the frontal poles) and ventricular dilation in a substantial number of cases. Blood-flow imaging revealed patchy perfusion deficits, most commonly in the frontal poles. Formal testing showed evidence of cognitive impairment, particularly on tests of memory and frontal-lobe function. The mean age was 54.6 years, and mean years of education, 8.8 years.

Huntington's disease

Six early cases of Huntington's disease were recruited. All patients showed evidence of impairment of memory and other cognitive abilities. Choreiform movements were present in a marked form in two cases, and in a mild form in the remainder. The mean age of this group was 45.2 years, and mean years of education, 9.3.

Differentiation between dementia Alzheimer type (DAT) and multi-infarct dementia (MID) was on the basis of Hachinski *et al* (1975) ischaemic scores. This scale, which records the presence or absence of clinical features associated with cerebrovascular disease, has received partial pathological verification (Rosen *et al*, 1980). In order to ensure further the purity of the groups, any patients identified as probably having DAT on the basis of the Hachinski scale, but in whom NMR imaging showed evidence of cerebral infarction, were excluded from the present study.

Dementia Alzheimer type

Using the above procedures, 14 patients with a strongly presumptive diagnosis of DAT were obtained. All patients met Glen & Christie's (1979) stringent exclusion criteria. Onset had been insidious, with memory impairment normally being the first manifestation. All patients commonly showed disorientation for time and place. Formal psychometric testing revealed severe cognitive impairment in the majority of cases (e.g. mean Block Design age-graded scaled score was 1.9). NMR-imaging typically revealed the presence (often severe) of cortical atrophy and ventricular dilation. Blood-flow imaging revealed marked bilateral perfusion deficits in the parieto-occipital watershed areas which have been reported as characteristic of DAT (Sharp *et al*, 1986). The mean age was 68.7 years, and mean years of education, 10.3 years.

Multi-infarct dementia

Eight patients met the criteria for MID. They had shown a relatively rapid onset, a stepwise course, and focal neurological signs or symptoms. Formal psychometric testing revealed severe cognitive impairment in the majority of cases (e.g. the mean Block Design age-graded scaled score was 4.0). Blood-flow imaging typically revealed a patchy overall reduction in perfusion with particularly striking focal reductions corresponding to areas of infarction imaged by NMR. The mean age was 66.4 years, and mean years of education, 9.3 years.

Closed head injury (CHI)

Subjects with a closed head injury ($n = 18$), who exhibited evidence of impairment of intellectual and social functioning, were recruited from an occupational therapy centre and a sheltered housing project. The mean age was 41.6 years, and mean years of education, 11.2.

Control groups

The 70 clinical subjects were individually matched for sex, age (± 3 years) and education (± 1 year) with a normal volunteer. Control subjects were recruited from the relatives of clinically referred patients, non-medical health-service personnel, and a pensioners' club. Potential control subjects were screened by interview to exclude those with a history of neurological disease, head injury, or alcohol abuse. All control subjects passed a test of visual acuity (see above) and had no marked hearing loss.

Tests and procedure

The National Adult Reading Test (Nelson, 1982) and Vocabulary sub-test of the WAIS (Wechsler, 1955) were administered and scored according to standard procedures, with the exception that testing was not discontinued after five consecutive failures on Vocabulary, as there are indications (e.g. Presly & McFadyen, unpubl.) that the order of word difficulty is not appropriate for British subjects. NART error scores were converted to estimated Full Scale IQ using Nelson's (1982) tables. Nelson & McKenna's (1975) regression equation was used to convert Vocabulary age-graded scaled scores to estimated full scale IQ, (FSIQ = 61 + 4 × Vocabulary age-graded scaled score).

TABLE I
Mean NART and Vocabulary estimated IQ for clinical and matched control groups

Group	NART	Vocabulary estimated IQ	NART vs Vocabulary estimated IQ[1]	Clinical vs control groups[2]	
				NART	Vocabulary
Total patient sample ($n=70$)	102.7	99.5	$t=3.27$**	$t=3.51$***	$t=6.26$***
Total control sample	106.5	106.7	$t=0.35$, NS		
Korsakoff psychosis ($n=12$)	99.9	95.7	$t=2.52$*	$t=2.42$*	$t=4.08$**
Control	106.6	106.0	$t=0.64$, NS		
Alcoholic dementia ($n=12$)	102.1	98.0	$t=2.48$*	$t=1.56$, NS	$t=2.48$*
Control	105.9	105.7	$t=0.18$, NS		
Huntington's disease ($n=6$)	100.8	93.0	$t=3.07$*	$t=3.33$*	$t=5.27$**
Control	108.0	105.7	$t=2.04$, NS		
DAT ($n=14$)	104.0	97.3	$t=2.77$*	$t=0.83$, NS	$t=3.82$**
Control	106.1	107.0	$t=0.63$, NS		
MID ($n=8$)	97.8	102.0	$t=1.04$, NS	$t=1.36$, NS	$t=2.38$*
Control	103.0	107.0	$t=1.52$, NS		
CHI ($n=18$)	106.9	105.9	$t=0.61$, NS	$t=0.63$, NS	$t=0.83$, NS
Control	108.2	107.9	$t=0.33$, NS		

1. All comparisons by two-tailed paired t-tests
2. All comparisons by one-tailed paired t-tests
NS = not significant at 0.05 level; *$P<0.05$; **$P<0.01$; ***$P<0.001$
NART, National Adult Reading Test; DAT, dementia Alzheimer type; MID, multi-infarct dementia; CHI, closed head injury

Although the principal aim of the present study was to examine the validity of NART and Vocabulary estimated IQ in discrete conditions, the results were initially analysed for the total sample. One-tailed paired-sample t-tests revealed that the patient sample ($n=70$) performed at a significantly lower level than control subjects on both the NART and Vocabulary (*see* Table I). These results suggest that, in the patient sample, as a whole, there had been some decline from expected levels of performance on both these tests. Paired t-tests (two-tailed) revealed that the NART provided a significantly higher IQ estimate than Vocabulary in the patient sample, suggesting that it is generally more resistant to the effects of cerebral dysfunction than the latter test. NART and Vocabulary estimated IQ did not differ significantly in the control subjects.

Mean NART and Vocabulary estimated IQs for the individual clinical and control groups are also presented in Table I. One-tailed, paired-sample, t-tests revealed that the NART performance of the alcoholic dementia, DAT, MID, and CHI groups did not differ significantly from their matched control groups, but the NART performance of the Korsakoff and Huntington's groups was significantly lower than their control groups. With the exception of the CHI group, all clinical groups performed at a significantly lower level than control groups on Vocabulary (see Table I).

Paired t-tests (two-tailed) revealed that the NART yielded a significantly higher estimated IQ than Vocabulary in the Korsakoff, alcoholic dementia, DAT, and Huntington's groups. There was no significant difference between NART and Vocabulary estimated IQ in the MID, CHI, and any of the individual control groups.

Discussion

As the NART performance of the alcoholic dementia, DAT, MID, and CHI groups did not differ significantly from their respective sex, age, and education-matched control groups, the present study suggests that the NART has validity as a measure of premorbid IQ in these conditions. However, as the numbers in each group were relatively small, replication of these results would be necessary before definitive statements could be made.

Comparison of the Korsakoff and Huntington's groups with matched control groups suggests that use of the NART is not valid in these conditions. However, although significant, the differences in performance were relatively small. Furthermore, as the NART yielded a significantly higher estimated IQ than the Vocabulary sub-test of the WAIS, it would appear that it is more resistant to decline than the latter test.

The apparently unimpaired NART performance of the DAT subjects examined in the present study is particularly noteworthy, given the indications of severe neuropathological and cognitive abnormalities in this group. The present findings are broadly consistent with two previous studies. In a study by Nebes *et al* (1984), DAT patients did not differ significantly from control subjects. Hart *et al* (1986)

reported that DAT patients performed at a significantly lower level ($P<0.05$) than control subjects on the NART. However, the degree of difference was relatively small and contrasted with severe impairment on the WAIS.

Ron (1983) reported that the NART performance of a group of long-term alcoholics (many of whom had CT scan evidence of atrophy) was significantly lower than that of a group of normal, healthy subjects. In a commentary on this study, McManus (1983) argued that, rather than "trying to make a silk purse out of a sow's ear", researchers should simply accept that they will normally be constrained by having no premorbid measures. However, the educational level of the younger (<43 years) subjects examined in Ron's (1983) study was also significantly lower than that of control subjects. Ron's observed difference in NART performance may have been a valid reflection of pre-existing differences in IQ rather than a result of impairment. The results of the present study support this interpretation, since, when educational level was controlled, the alcoholic dementia group did not differ from the control group.

Although the Vocabulary sub-test of the WAIS has commonly been used clinically as a means of estimating premorbid IQ, the results obtained in the present study suggest that it cannot validly be used for this purpose in the majority of organic groups examined. Thus, it seems the NART should be considered the test of choice in estimating premorbid IQ in organic conditions.

This study carried out a provisional examination of the validity of the NART in specific clinical conditions. As a valid measure of premorbid IQ is an extremely valuable asset for the clinician, future research should attempt to replicate these results with larger samples, and also evaluate the validity of the NART in other discrete conditions (e.g. multiple sclerosis, normal pressure hydrocephalus, dementia in idiopathic Parkinson's disease, schizophrenia, etc.).

Finally, although this and previous work indicates that the NART is a useful instrument, its present format limits its use to patients with reasonable visual acuity. As the NART is most commonly used with elderly patients, many of whom will have eyesight difficulties (and will also, if suffering memory problems, often misplace their glasses!), this limitation can be troublesome. Thus it would seem preferable that the stimulus materials be organised in booklet form so that words could be presented individually in a larger, more widely spaced typeface. Such a change in format would also reduce demands on attention, and would thus be more in keeping with the test's aim of tapping previous knowledge while minimising the demands on current cognitive capacity. As the WAIS-R replaces the WAIS in clinical practice, the NART will have to be re-standardised, and this would be the ideal opportunity to make such changes.

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*J. R. Crawford, BSc, MSc; D. M. Parker, BA, PhD, *Department of Psychology*; J. A. O. Besson, BSc, MB, ChB, BPM, MRCPsych, *Department of Mental Health, University of Aberdeen, Aberdeen*

*Correspondence: *Department of Psychology, University of Aberdeen, Aberdeen, UK*