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Improved detection of cognitive impairment with the **NART:** An investigation employing hierarchical discriminant function analysis

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A series of discriminant function analyses was performed to examine the ability of the WAIS and NART to discriminate between healthy subjects and patients with dementia/cortical atrophy. Inclusion of NART estimated IQs in the analyses resulted in significantly greater discrimination than was achieved by WAIS IQs alone.

The National Adult Reading Test (Nelson, 1982) is widely used as a measure of premorbid intelligence. In clinical practice, Wechsler Adult Intelligence Scale (WAIS; Wechsler, 1955) performance is compared with NART estimated premorbid WAIS IQ, on the assumption that this will discriminate ^cognitively impaired individuals from the cognitively intact. A further implicit assumption is that this procedure will be more effective than use of the WAIS alone. Reviewers of the NART literature (Crawford, 1989; Klesges, Wilkening & Golden, 1981) have noted that these assumptions could be subjected to empirical scrutiny by conducting a series of discriminant function analyses with impaired and healthy subjects. In the present study, the ability of the WAIS and NART to discriminate between demented and healthy subjects will be examined. It is hypothesized that the classification accuracy achieved by the combination of these tests will be superior to that achieved by the WAIS alone. It was further hypothesized that the NART would not *directly* discriminate between impaired and healthy samples but would improve discrimination by acting as a suppressor variable (by partialling out the effects of premorbid IQ). This hypothesis was operationalized as follows: biserial correlation coefficients between group membership (i.e. impaired vs. healthy) and the NART would not differ significantly from zero. Secondly, the size of the correlations between group membership and WAIS IQs will *increase* when the relevant NART estimated IQ is partialled out.

Two clinical samples were employed. The first consisted of 24 patients with dementia Alzheimer type, plus eight patients with multi-infarct dementia. All subjects exhibited evidence of cerebral morphological abnormalities on CT scan. This group had been administered the NART and a full-length WAIS. Mean age was 66.5 (6.9) and mean years of education was 9.8 (1.8). Mean WAIS full-scale IQ (FIQ) was 83.9 (15.5). NART estimated IQs were derived from Crawford, Stewart, Parker, Besson & Cochrane's (1989^) equations. These equations combine NART errors with demographic variables (age, social class, sex) and have greater predictive accuracy than the NART alone. The second clinical sample consisted of 40 subjects with CT scan evidence of cortical atrophy. These subjects had been administered the NART

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and a short-form WAIS. Details of the samples' demographic characteristics and psychometric performance can be found in Nelson & O'Connell (1978). NART-estimated IQs were obtained from Crawford, Parker, Stewart, Besson & De Lacey's (1989^) equations for prediction of a short-form WAIS. These equations were derived from the combined NART standardization and cross-validation samples. A sample of the healthy adult UK population *(N* =151) was also employed. These subjects had been administered the NART and a full-length WAIS. Full details of this sample can be found in Crawford *et al.* (1989#). In analyses involving the *dementia* sample, NART estimated IQs in the *healthy* sample were derived from the NART/demographic equations referred to above. For analyses involving the *atrophy* sample, the *healthy* sample's IQs were recalculated using Nelson & ConnelPs (1978) short-form method and the short-form NART equation employed.

Three hierarchical discriminant function analyses were performed with the *dementia* sample and *healthy* sample. In the first of these, WAIS FIQ was entered into the analysis followed by NART estimated FIQ. The same procedure was followed for Verbal IQ (VIQ) and Performance IQ (PIQ). A second set of three analyses was then carried out with the atrophy sample and healthy sample, following the procedures set out above. Biserial correlation coefficients between group membership and psychometric variables were calculated; the clinical samples and healthy samples were coded as 1 and 2 respectively.

The classification accuracy achieved by the three WAIS scales, both alone and in combination with their respective NART estimated IQs, are presented in Table 1. It can be seen from Table 1 that the WAIS scales correctly classified a substantial percentage of the subjects. It can also be seen that the addition of the NART increased these percentages.

Table 1. Hierarchical discriminant function analyses: Percentage of cases correctly classified by WAIS scales alone and with the addition of their respective NART premorbid IQs

	FIQ	VIQ	PIQ
WAIS alone[a]	85.8	82.5	89.0
WAIS + NART	96.2	94.5	94.0
WAIS alone[b]	78.0	74.4	80.1
WAIS + NART	87.4	78.5	85.3

"Dementia sample vs. healthy sample. [b]
Atrophy sample vs. healthy sample.

As recommended by Tabachnick & Fidell (1989), McNemar repeated measures chi-square tests were used to compare the number of cases *incorrectly* classified by the WAIS but *correctly* classified after addition of the NART with the number of cases in which the converse occurred. In all six analyses, with the exception of VIQ in the atrophy vs. normals analysis, addition of the NART significantly improved classification *(p* < .001 in three of the five analyses, $p < .05$ in the remainder). The biserial correlation coefficients between NART estimated IQ and group membership ranged between —0.03 and 0.13. None of these achieved significance at the 0.05 level. The raw biserial correlation coefficients between group membership and WAIS FIQ, VIQ and PIQ ranged between 0.43 and 0.69. All six coefficients *increased* in magnitude after partialling out the relevant NART IQ estimate (range 0.51 to 0.80).

In summary, the present study indicates that using the NART in conjunction with the WAIS permits more accurate discrimination between impaired and non-impaired subjects than is achieved by use of the WAIS alone. The results further support the rationale underlying the use of the NART in that the test did not directly discriminate between the impaired and healthy samples but rather served to partial out unwanted variance in the WAIS measures.

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