British journal of Clinical Psychology (1991), **30,** 223-229 *Printed in Great Britain*

The Short **NART:** Cross-validation, relationship to IQ and some practical considerations

J. R. Crawford* and D. M. Parker
Department of Psychology, University of Aberdeen, Aberdeen AB9 2UB, UK

K. M. Allan, A. M. Jack and F. M. Morrison
Department of Mental Health, University of Aberdeen

Beardsall & Brayne (1990) have presented a method whereby the full-length National Adult Reading Test (NART) scores of subjects who are of below average reading ability can be predicted from performance on the first half of the test (termed the Short NART). The accuracy with which the Short NART predicted full-length NART scores was examined in a large cross-validation sample (N = 674). A subgroup of this sample (N = 142) was administered the WAIS. The results indicated that the Short NART was only moderately successful in predicting full-length NART scores. However, comparison of the accuracy with which the full-length NART and Short NART predicted WAIS IQs, revealed that the superiority of the former was very minimal. It is concluded that, despite some reservations regarding the Short NART's practical utility, it can be used with reasonable confidence in clinical practice to estimate premorbid IQ.

In order to detect and quantify intellectual impairment, a client's current test performance is compared with some estimate of his/her premorbid intelligence. At present the most widely used measure of premorbid IQ is the National Adult Reading Test (NART; Nelson, 1982). This oral reading test consists of 50 words of irregular pronunciation (e.g. *ache, deny}.*

An optional criterion for discontinuation of the NART (14 incorrect in 15 consecutive responses) is presented in the test manual (Nelson, 1982, p. 5). However, Beardsall & Brayne (1990) have reported that, in a sample of elderly subjects, this criterion was rarely met. Therefore, most subjects may have to complete the whole test. Beardsall & Brayne suggest that this could provoke anxiety or distress in subjects with poor reading skills. To counter this perceived problem, they have developed an equation which estimates a subject's score on the *second half* of the NART (i.e. items 26 to 50) from they?™/ *half* (which they term the 'Short NART'). Beardsall & Brayne suggest the following procedure for using the Short NART; *(a) If a* client scores less than 12 correct on the Short NART, this should be taken as

* Requests for reprints.

the total NART score, *(K)* if a Short NART score of between 12 and 20 correct is obtained the equation should be employed to predict the NART total from the Short NART, *(c)* if a score of more than 20 is obtained, the whole test should be administered.

The sample used to build and cross-validate the Short NART regression equation, and upon whose results the above guidelines are based, was very homogeneous with respect to demographic characteristics. All subjects were female, aged between 70 and 80, and were resident in a circumscribed rural location. Because of this homogeneity, it is necessary to examine the accuracy of the Short NART in a cross-validation sample more representative of the adult population before applying the method in general clinical practice. Furthermore, the purpose of the NART is to estimate premorbid WAIS IQ (Saville, 1971; Wechsler, 1955). As the WAIS was not administered in Beardsall & Brayne's study, the accuracy with which their method can estimate IQ, as opposed to NART score, remains to be examined.

The present paper aims to carry out these tasks and to consider other issues that are pertinent in assessing the Short NART's practical utility.

Method

A sample of 674 subjects (378 females, 296 males) free of neurological, psychiatric or sensory disorder was administered the NART according to standard procedures. All subjects were resident in the north-east of Scotland and most were urban dwellers. Most received a small honorarium for their participation. Mean age was 47.3 (SD = 20.4) with a range of 16—90 years. Mean years of education was 11.8 (SD = 3.0) with a range of 6-20 years. Social class was derived from a subject's occupation using the Office of Population Censuses and Surveys (1980) Classification of Occupations. The percentage of the adult UK population in each social class was determined from the 1981 census, as was the percentage falling into three arbitrary age bands (16—34, 35—54, 55—90). These percentages are presented below in parentheses along with the corresponding percentages for the present sample. The social class distribution of the sample was as follows; social class 1=9% (5 %), 2 = 29 % (23 %), 3 = 41 % (48 %), 4 = 15 % (18 %), 5 = 6% (6 %). The percentages of the sample in the three age bands were as follows; 1 = 35 % (27 %), 2 = 26 % (35 %), 3 = 39 % (38 %). It can be seen from these figures that the sample did not diverge markedly from the adult UK population in terms of social class and age distribution.

Predicted total NART scores were derived using Beardsall & Brayne's procedures. It should be noted that, for subjects scoring more than 20 on the Short NART, the 'predicted' and 'obtained' scores were identical since the procedure demands that such subjects are administered all items.

A subgroup of the above sample *(N* = 142; 75 males, 67 females) was administered a full-length WAIS (Saville, 1971; Wechsler, 1955) according to standard procedures. The mean age of this subgroup was 41.2 (SD = 17.1) and mean years of education was 12.7 (SD = 3.0). Error scores in this subgroup were converted to estimated premorbid IQs using Crawford, Parker, Stewart, Besson & De Lacey's (1989) equations for the full-length WAIS (the original NART equations were standardized for a short-form WAIS). Premorbid IQs were also recalculated with *predicted* NART scores substituted for *obtained* NART scores in the equations.

Results

Mean NART errors in the overall sample was 21.7 (SD = 10.0) with a range of 0—45. Mean predicted NART errors was 22.5 (SD = 10.5) with a range of 0—46. A repeated measures *t* test revealed that these two means differed significantly (/ = 10.17, $p <$ .001). The correlation (Pearson product moment) between predicted and obtained

NART scores was .98 ($p < .001$). This correlation, of course, yields an inflated estimate of the Short NART's predictive accuracy as those subjects scoring over 20 on the Short NART ($N = 337$) were included in its computation. The correlation between predicted and obtained NART scores was calculated for those subjects ($N = 55$) in whom the Short NART was taken as the total and for those ($N = 282$) in whom total score was predicted from Short NART scores. The correlations were .88 ($p < .001$) and .83 ($p < .001$) respectively. The percentage of subjects exhibiting varying sizes of discrepancy between the full-length NART and the Short NART prediction are presented in Table 1.

Table 1. Percentage of subjects exhibiting a discrepancy between NART error score and Short NART predicted error score (regardless of sign[a])

	Size of discrepancy					
	0	1–3	4–6	7–9	10–12	12
Subjects scoring less than 12 on Short NART ($N = 55$)	24	69	7	0	0	0
Subjects scoring between 12 and 20 on Short NART ($N = 282$)	12	61	21	6	1	0

[a] In the case of those subjects scoring less than 12 the discrepancies were necessarily all positive (i.e. the Short NART overestimated NART error score).

Mean Full scale (FIQ), Verbal (VIQ) and Performance IQs (PIQ) in the subgroup administered the WAIS are presented in Table 2. The available evidence suggests that the WAIS yields IQs in the contemporary UK population that are inflated by around half a standard deviation (Crawford, Allan, Besson, Cochrane & Stewart, 1990; Crawford, Morrison, Jack, Cochrane, Allan & Besson, 1990). Therefore, the mean WAIS IQ in the present study (111.7) indicates that the present sample was of essentially average intellectual ability.

Estimated IQs derived from the NART and the Short NART are also presented in Table 2. Paired samples /tests revealed that none of the mean *estimated IQs* differed

Table 2. Mean WAIS IQs and mean predicted IQs for the subgroup administered the WAIS

	Full Scale	Verbal	Performance
Obtained IQ	111.7 (12.07)	112.2 (13.72)	109.7 (11.07)
NART predicted IQ	112.0 (10.16)	112.2 (11.87)	110.2 (6.52)
Short NART predicted IQ	111.3 (10.57)	111.4 (12.36)	109.8 (6.79)

Note. SDs in parentheses.

significantly from mean *obtained* IQs (/ values ranged between 0.23 and 1.26, $p > .1$ for all comparisons). These results indicate that neither method of prediction systematically underestimated or overestimated IQs.

The correlations between NART estimated IQ and obtained IQ are presented in Table 3 together with the correlations obtained when NART error scores estimated using the Short NART method were substituted in the equations for actual NART scores. Hotelling (1940) developed a method of determining whether the size of correlation coefficients differs significantly when the coefficients are themselves correlated (see Guilford, 1973, p. 167 for a more readily accessible presentation of this method). The results of applying Hotelling's formula to the present correlations are presented in Table 3. It can be seen that, although the differences in the size of the coefficients are small, the NART's correlations with FIQ and VIQ were significantly higher than those obtained using the Short NART. These significant differences arose because of the high correlation between the two methods of estimation (i.e. .988 in the WAIS subgroup).

Table 3. Pearson product moment correlations between WAIS IQs and predicted WAIS IQs plus accompanying significance tests

	IQ with NART	IQ with Short NART	t	p
FIQ	.811	.797	1.82	$p < .05$
VIQ	.850	.832	2.61	$p < .01$
PIQ	.544	.539	0.45	n.s.

The practical implications of these differences were investigated by comparing the percentage of subjects exhibiting varying sizes of discrepancy between obtained IQ and IQs estimated by the two methods. The relevant data are presented in Table 4. It can be seen that the distribution of errors in predicting IQ is very similar for both methods. However, in the case of FIQ and VIQ, a small percentage of subjects exhibited extreme discrepancies with the Short NART that were not produced with the full-length NART.

Discussion

The first aim of this study was to examine the accuracy with which the Short NART can predict the full-length NART. The present sample differed from Beardsall & Brayne's original sample in that the subjects had been recruited from a different geographical location and were markedly more representative of the general population in terms of age, sex and social class distribution. It therefore constitutes a suitable cross-validation sample with which to examine the generalizability of Beardsall & Brayne's results.

The correlation between the Short NART and the full-length NART was highly significant for the subgroup in which, following Beardsall & Brayne's directions, the

Table 4. Percentage of subjects exhibiting varying sizes of discrepancy between obtained IQ and estimated IQs

	IQ points discrepancy (regardless of sign)					
	0–5	6–10	11–15	16–20	21–25	26–30
NART est. FIQ	54.7	30.8	11.2	2.8	0	0
Short NART est. FIQ	52.5	33.8	9.2	2.8	1.4	0
NART est. VIQ	53.5	31.0	12.0	3.5	0	0
Short NART est. VIQ	50.7	34.5	10.6	3.5	0.7	0
NART est. PIQ	47.9	25.4	17.6	7.0	1.4	0.7
Short NART est. PIQ	51.0	21.0	19.7	7.0	1.4	0.7

Short NART was taken as the NART total. A highly significant correlation was also obtained in the subjects for whom the full-length NART was predicted from Beardsall & Brayne's regression equation. However, in both subgroups, application of the Short NART still left a reasonably substantial proportion of the variance in NART performance unexplained (23 and 31 per cent respectively). The effects of this unexplained variance on the accuracy of prediction was demonstrated in Table 2. A sizeable percentage of subjects exhibited discrepancies between predicted and obtained NART scores (i.e. 28 per cent of the subgroup for whom the equation was used to predict NART totals exhibited a discrepancy of four points or more).

The above results could be viewed as casting some doubt on the validity of the Short NART. However, in clinical practice, calculation of predicted NART score from the Short NART would not be an end in itself. Rather, this score would be used to provide an estimate of a client's premorbid intelligence. Comparison of the accuracy with which the Short NART and full-length NART predicted WAIS IQ yielded more encouraging results. Although the NART appeared superior to the Short NART, (as judged by its correlation with WAIS IQ and the discrepancies between predicted and obtained scores) the differences were of minimal practical importance. This suggests that the Short NART could be used in place of the full-length version in clinical practice. Some caution is necessary, however, until the accuracy of the Short NART in predicting IQ has been examined in another sample.

Given the errors in prediction obtained when the Short NART was used to predict the full-length NART, it is surprising that the differences in the accuracy with which IQ was predicted were so minimal (particularly when it is remembered that Short NART predictions of IQs were derived from equations built using the full-length NART). A probable explanation lies in the scoring reliability of items in the second half of the NART. Crawford *et al.* (1989) carried out a study of the NART's inter-rater reliability: although they found that the overall reliability of the NART was more than adequate, they reported substantial variation in the reliability of individual items. The five words with the lowest inter-rater agreement rate were *aeon, puerperal, aver, sidereal* and *prelate*; it is noteworthy that all of these words appear in the second half of the test.

In classical test theory, any observed test score is considered to be made up of two quantities; a true score component and a random error component. The high correlation between the Short NART and the full-length NART indicates that for most subjects the two measures would not differ markedly in the estimates they provide of 'true' NART scores. For other subjects, the full-length NART would provide more accurate estimates of'true' NART scores, e.g. those subjects whose pronunciation knowledge of items in the second half truly diverged from that which would be predicted from the Short NART equation. However, for some others the Short NART may have provided a *better* estimate of ' true' scores because of the unreliability of some items in the second half.

Having examined the psychometric properties of the Short NART, consideration will now be given to its practical utility. One of the strengths of the NART lies in the ease with which it can be administered and scored. The Short NART complicates both of these tasks. A running tally of errors must be kept so that the discontinuation rules can be observed. Secondly, Short NART scores must be converted to NART error scores before the client's estimated premorbid IQ can be obtained. Both of these features increase the possibility of clerical error, a factor which deserves consideration. In view of this, and the fact that the predictive accuracy of the full-length NART is superior (albeit minimally) a good case needs to be made for adoption of the Short NART in clinical practice.

As noted, Beardsall & Brayne introduced the Short NART because they considered that administering the full-length NART to poor readers would produce distress or anxiety. Such a view is at variance with the experience of the present authors in testing the present sample. Furthermore, in the course of administering the NART to large numbers of clients suffering from a wide variety of clinical conditions, few individuals have been encountered who exhibited such reactions. Indeed, for many clients, the NART can provide a boost to morale as it draws on previously established knowledge and does not demand a high degree of cognitive effort. With regard to a client who *does* exhibit distress when administered the NART, it could be pointed out that the NART is rarely, if ever, used in isolation. In clinical practice it is used to provide an estimate of premorbid ability against which performance on IQ tests or other impairment sensitive measures can be compared. These impairment sensitive tests are, by their nature, more challenging and anxiety-provoking than the NART. Therefore, if a client is encountered who reacts badly to the NART, it would be unlikely that a meaningful assessment could be successfully carried out.

In conclusion, although it could be argued that the Short NART is of limited practical utility, the present results suggest that its accuracy in estimating premorbid IQ is virtually equivalent to that of the full-length NART. Therefore, it can be used with reasonable confidence by those who consider it would be a useful or convenient instrument in their clinical practice.

References

Beardsall, L. & Brayne, C. (1990). Estimation of verbal intelligence in an elderly community: A prediction analysis using a shortened NART. *British journal of Clinical Psychology,* 29, 83—90.

Crawford, J. R., Allan, K. M., Besson, J. A. O., Cochrane, R. H. B. & Stewart, L. E. (1990). A comparison of the WAIS and WAIS-R in matched UK samples. *British journal of Clinical Psychology,* **29,** 105-109.

Crawford, J. R., Morrison, F. M., Jack, A. M., Cochrane, R. H. B., Allan, K. M. & Besson, J. A. O. (1990). WAIS vs. WAIS-R in matched UK samples. *Personality and Individual Differences,* **11,** 427-428.

Crawford, J. R., Parker, D. M., Stewart, L. E., Besson, J. A. O. & De Lacey, G. (1989). Prediction of WAIS IQ with the National Adult Reading Test: Cross-validation and extension. *British Journal of Clinical Psychology,* 28, 267-273.

Guildford, J. P. (1973). *Fundamental Statistics in Psychology and Education,* 5th ed. Tokyo: McGraw-Hill.

Hotelling, H. (1940). The selection of varieties for use in prediction, with some comments on the general problem of nuisance parameters. *Annals of Mathematical Statistics,* **11,** 271—283.

Nelson, H. E. (1982). *National Adult Reading Test. Test Manual.* Windsor: NFER-NELSON.

Office of Population, Censuses and Surveys (1980). *Classification of Occupations.* London: HMSO.

Saville, P. (1971). *A British Supplement of the Manual of the Wechsler Adult Intelligence Scale.* Windsor: NFER-NELSON.

Wechsler, D. (1955). *Manual for the Wechsler Adult Intelligence Scale.* New York: Psychological Corporation.

Received 22 March 1990; revised version received 25 July 1990