Person, individ. Diff. Vol. 11, No. 11, pp. 1153-1157, 1990
Printed in Great Britain.
0191-8869/90 $3.00 + 0.00

ESTIMATING PREMORBID INTELLIGENCE BY COMBINING THE NART AND DEMOGRAPHIC VARIABLES: AN EXAMINATION OF THE NART STANDARDISATION SAMPLE AND SUPPLEMENTARY EQUATIONS

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(Received 30 March 1990)

Summary—There are two main approaches to the-estimation of premorbid intelligence. One of these uses an oral reading test, the National Adult Reading Test (NART). The other estimates premorbid intelligence from demographic variables. It was recently reported that combining the NART and demographic variables in a multiple regression equation provides more accurate estimation of IQ than is afforded by either method alone. The present study was undertaken to determine if this finding would hold in another sample. The sample employed *(n* = 120) was that used to originally standardise the NART against the WAIS. Combining demographic variables (age, sex, social class) with the NART significantly increased predicted variance over use of the NART alone. The NART standardisation sample had been administered a short-form of the WAIS. This sample was combined with additional subjects *(n* = 151) to produce new equations for the estimation of premorbid IQ. The equations permit clinicians to estimate a client's *premorbid* intelligence with the NART/demographic method when time pressures have necessitated the use of a short-form WAIS as the *current* IQ measure.

INTRODUCTION

In order to detect and quantify intellectual impairment it is necessary to compare a client's IQ test performance with an estimate of their premorbid intellectual level. At present, the most widely recommended measure of premorbid intelligence is the National Adult Reading Test (NART; Nelson, 1982). This test consists of 50 words which Ss have to read and pronounce. The NART would appear to meet the three criteria necessary for a measure of premorbid IQ; i.e. it has high reliability, is capable of predicting a substantial proportion of IQ variance (in the normal population) and is largely resistant to neurological or psychiatric disorder (Crawford, 1989). An alternative approach is to estimate premorbid IQ from demographic variables. Wilson, Rosenbaum, Brown, Rourke, Whitman and Grisell (1978), using the WAIS standardisation sample (Wechsler, 1955), built a regression equation based on five demographic variables (age, sex, race, education and occupation) which predicted 53% of WAIS IQ variance.

In a recent report, Crawford, Stewart, Parker, Besson and Cochrane (1989b) argued that demographic variables might mediate the relationship between NART performance and IQ. If this were the case, then combining the two approaches outlined above should improve the accuracy with which premorbid intelligence could be estimated. They tested this by building a multiple regression equation based on the NART and demographic variables and reported that the equation predicted more IQ variance than either the NART or demographic variables alone.

Subsequently, Crawford, Cochrane, Besson, Parker and Stewart (1990) have demonstrated that this premorbid IQ estimate has high construct validity. They factor analysed the NART/demographic estimate along with the 11 subtests of the WAIS and reported that it loaded highly (0.9) on *g,* i.e. the first unrelated principal component.

At present, the combined approach to the estimation of premorbid IQ must be viewed with some caution as its applicability has yet to be examined in a cross-validation sample. The purpose of

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the present study was to assess whether the mediating effects of demographic variables reported by Crawford *et al.* (1989b) is a general phenomenon or was simply a result of the specific characteristics of their sample. The sample employed for this purpose was that used in the original standardisation of the NART (Nelson, 1982).

In contrast to the sample tested by Crawford *et al.,* 5s in the NART standardisation sample were administered a short-form of the WAIS. It would therefore have been inappropriate to attempt a direct cross-validation of Crawford *et* a/.'s equation. Instead, it was proposed that equations for the estimation *of short-form* WAIS IQs be built from the standardisation sample. These equations could then be cross-validated on Crawford *et* a/.'s sample, following rescoring of IQs in this latter sample using Nelson's (1982) short-form method.

Finally, when regression equations are applied to a cross-validation sample there is commonly a shrinkage in the variance predicted. If this shrinkage is not excessive, equations should be built from the combined standardisation and cross-validation samples as these will have more stability than the original equations (Pedhazur, 1982). It was planned to carry this out, provided the foregoing precondition was met.

Such equations for the estimation of short-form IQs should be of immediate benefit to clinical psychologists. Because of large caseloads, clinicians are commonly forced into using short-form versions of the WAIS. This view is reinforced by Holmes, Armstrong, Johnson and Ries (1965) who have estimated that shortened versions of the Wechsler scales are administered in over 80% of cases.

METHOD

The first sample consisted of the 120 5s used to standardise the NART against the WAIS. All 5s were free of neurological or psychiatric disorder. 5s had been administered the following WAIS subtests; Arithmetic, Similarities, Digit Span, Vocabulary, Picture Completion, Block Design and Picture Arrangement. IQs were pro-rated from their subtests using the conventional procedure. A full description of this sample's demographic and psychometric details can be found in Nelson (1982) or Nelson and O'Connell (1978).

The second sample consisted of Crawford *et al.'s* (1989) 5s. All 5s were free of neurological or psychiatric disorder and had been administered a *full-length* WAIS. The IQs of these 5s were recalculated using Nelson's (1982) short-form method. This procedure yielded a mean Full Scale IQ of 111.6 (SD = 12.4). Full details of this samples' demographic characteristics can be found in Crawford *et al.* (1989b).

For 5s in both samples, social class was coded from their occupations using the OPCS (1980) classification of occupations. Sex was dummy variable coded with males = 1, females = 2.

RESULTS

In the first sample, three hierarchical multiple regression analyses were performed with FIQ, VIQ and PIQ as the dependent variables. In each, the NART was entered first, followed by the three demographic variables that Crawford *et al.* found mediated the relationship between the NART and IQ (age, sex and social class). The results of this procedure are presented in Table 1. It can be seen that addition of the demographic variables to the regression models increased the variance predicted. To determine whether this increase was statistically significant, *F* tests were performed on the change in the residual sum of squares following entry of the demographics. For all three WAIS scales, significant /"values were obtained *($P < 0.001$)*. The regression equations generated from the first sample were then applied to the second sample. The percentage of IQ variance predicted by these equations is presented in Table 1. The percentage of variance predicted by the NART alone is also presented for comparison purposes. It can be seen that the equations combining the NART and demographics predict more IQ variance than the NART alone. Comparison of the percentage variance predicted by the combined equations in the second sample with the percentage variance predicted in the first sample indicates that a shrinkage in predicted variance did not occur.

Table 1. Percentage of (short-form) WAIS IQ variance predicted by the NART alone and in combination with demographic variables

	FIQ	VIQ	PIQ
Standardisation sample			
NART alone	53	60	31
NART + demographics	60	66	36
Cross-validation sample			
NART alone*	60	64	30
NART/demographic equation	64	66	39
Combined samples			
NART alone	57	63	31
NART + demographics	63	66	38

•As noted, the cross-validation sample consisted of Crawford *el al.'s* (1989b) Ss for whom IQs had been rescored using Nelson's (1982) short-form method.

This latter result suggested that it was justifiable to build equations based on both samples *(n* = 271). These equations are presented below with their corresponding standard errors of estimate.

$$\text{Predicted short-form WAIS FIQ} = 133.47 - 0.75\,(\text{NART errors}) + 0.09\,(\text{age}) - 4.2\,(\text{sex}) - 1.8\,(\text{class})$$

SEest = 7.17

$$\text{Predicted short-form WAIS VIQ} = 136.1 - 0.86\,(\text{NART errors}) + 0.05\,(\text{age}) - 4.0\,(\text{sex}) - 1.58\,(\text{class})$$

SEest = 7.36

$$\text{Predicted short-form WAIS PIQ} = 124.84 - 0.53\,(\text{NART errors}) + 0.14\,(\text{age}) - 4.1\,(\text{sex}) - 1.5\,(\text{class})$$

SEest = 9.1

When used in the individual case, the *estimated premorbid IQs* derived from these equations should be compared with the *current IQ* obtained by testing. A discrepancy in favour of premorbid IQ raises the possibility of intellectual impairment. The probability that a particular size of discrepancy could occur in the healthy population can be assessed by referring to Table 2. For example, in the case of FIQ a discrepancy of 13 IQ points occurred in <5% of the present sample.

Table 2. Distribution *of positive* predicted minus obtained IQ discrepancies*

Predicted — minus obtained discrepancy	5s when FIQ is predicted (%)	Ss when VIQ is predicted (%)	5s when PIQ is predicted (%)
1	51	50	49
2	43	44	45
3	37	36	42
4	34	32	36
5	26	28	33
6	21	23	28
7	17	21	26
8	14	17	22
9	12	14	20
10	10	10	19
11	7	7	14
12	5	4	10
13	3	3	7
14	3	2	6
15	3	2	4
16	2	2	3
17	1	1	3
18	1	1	2
19	0	0	1
20	0	0	1
21	0	0	0
22	0	0	0
23	0	0	0
24	0	0	0
25	0	0	0

•The figures opposite the discrepancy scores represent the percentage of normal Ss who exhibited that size of positive discrepancy or larger. For example, in the case of FSIQ, 2% of Ss exhibited a discrepancy of 12 IQ points and a further 3% of 5s exhibited a discrepancy > 12. Therefore the percentage opposite a discrepancy of 12 is 5%.

Table 3. Social class codings for commonly encountered occupations

(1) Professional:	architect; chartered accountant; dentist; doctor; economist; lawyer; lecturer; pilot; church minister
(2) Intermediate:	computer programmer; estate agent; librarian; manager—advertising/public relations/purchasing/marketing; nurse; social worker; teacher
(3) Skilled:	carpenter; chef; clerk; driver—bus/lorry/train; electrician; fire(wo)man; hairdresser; plumber; police(wo)man; salesperson; secretary; telephone operator; toolmaker
(4) Semi-skilled:	assembly line worker; barperson; fisher(wo)man; glazier; hospital porter; storekeeper; telephone receptionist; traffic warden; waiter
(5) Unskilled:	cleaner; docker; kitchen porter; labourer; refuse collector; sewage worker

Therefore, a discrepancy of this size would be significant at the 0.05 level (1-tailed). A discrepancy of 19 points would be needed for significance at the 0.01 level.

DISCUSSION

The present study confirms that demographic variables mediate the relationship between NART performance and IQ. As this effect has now been demonstrated in two samples recruited from widely different geographical locations, one can be reasonably confident that it is a general phenomenon.

Because of the mediating effect of demographic variables, equations which combine the NART and demographics provide more accurate estimates of premorbid intellectual level than are obtained with the NART alone. This is demonstrated by the significant increases in predicted variance obtained when demographic variables were added to the present regression models.

Crawford, Parker, Stewart, Besson and De Lacey (1989a) have previously examined the accuracy with which the NART predicts short-form WAIS IQ in the combined sample (« =271) employed in the present study. The discrepancy table (Appendix 1, p. 272) reveals that for Full Scale, Verbal and Performance IQ respectiely, a discrepancy of 23, 22 and 23 points was required for significance at the 0.01 level (1-tailed). It can be seen from Table 2 of the present report that the equivalent discrepancies required for this level of significance when the NART is combined with demographic variables is 19, 19 and 21 respectively. This provides a further illustration of the improvement in accuracy that results from incorporating demographic variables in the regression equations.

The equations and discrepancy tables presented here should be of immediate practical value to clinicians. As noted, heavy caseloads often dictate that a short-form of the WAIS is administered in clinical practice. A short-form would also be appropriate where there is the danger of a client suffering from fatigue. The need to develop equations specifically for the short-form version of the WAIS employed here is demonstrated by the differences in the constants and *$* weights in the present equations compared with those presented by Crawford *et al.* (1989b, p. 794) for use with the full-length WAIS.

To ease the calculation of estimated premorbid IQs, the social class codings of some commonly encountered occupations are presented in Table 3.

Finally, the present results suggest that, when equations are developed to estimate premorbid WAIS-R IQ (Wechsler, 1981; Lea, 1986) from the NART, demographic variables should be included.

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