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Personality and Individual Differences 30 (2001) 1413–1425

PERSONALITY AND INDIVIDUAL DIFFERENCES

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Suitability of published neuropsychological test norms for urban African secondary school students in South Africa

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Received 3 November 1999; received in revised form 19 May 2000; accepted 22 June 2000

Abstract

Variations in neuropsychological test performance as a function of ethnic/cultural group membership, socioeconomic and educational status are widely documented. In South Africa, issues of cultural difference, sociopolitical disadvantage, cognitive and educational limitations, are of particular relevance. Accordingly, this study investigated the performance on a neuropsychological test battery of urban African high school students. A group of 100 Soweto students in Grades 8–12, and a second group of 152 sixth grade Soweto students aged 13–15 years, scored significantly lower on most of the measures than their American counterparts, as reflected in published norms. Results also demonstrated a significant difference in test performance as a function of educational grade. The findings confirmed the need for using norms and approaches which are appropriate to a given population when interpreting and addressing neuropsychological test performance.

Keywords: Cognitive/neuropsychological measures; Cultural/ethnic differences; Norms, South Africa

1. Introduction

Variations in neuropsychological test performance as a function of ethnic/cultural group membership and socioeconomic status (SES) are widely documented (Ardila, 1995). The issue of genetic versus cultural and/or environmental explanations for differences in intellectual abilities is

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0191-8869/01/$ - see front matter
PII: S0191-8869(00)00123-9

the basis of much controversy and debate (e.g. Herrnstein & Murray, 1994; Jencks & Phillips, 1998; Jensen, 1998). However, this issue is beyond the scope of this study.

In South Africa, issues of cultural difference, sociopolitical disadvantage, and cognitive/educational limitations, are of particular relevance. During the apartheid era, the White minority (about 15% of the population) implemented a system of statutory separation and discrimination in terms of which the African majority (about 75%) as well as the 'Coloured' (mixed race) and Indian/Asian minorities (about 8% and 2% of the population, respectively) had to live and be schooled separately from one another and from whites, were discriminated against, and were denied equal opportunities. Although the apartheid system was dismantled by the democratic elections of 1994, various factors, central among them the effects of apartheid, have perpetuated adverse social conditions for the African majority, including significant levels of unemployment, very limited and disorganised education facilities, unsatisfactory living conditions, and poor nutrition.

Lower mean psychological test scores are routinely obtained in African samples relative to Euro-American test norms (e.g. Lynn & Owen, 1994; Makunga, 1988; Murdoch, Fleming, Skuy, Painter, Schmidt & Schutte, 1994; Owen, 1992; Poortinga, 1971; Richter, Griesel & Wortley, 1989; Viljoen, Levett, Tredoux & Anderson, 1994). Yet, often as a result of the lack of suitable alternatives, foreign norms for neuropsychological tests continue to be used when assessing the presence of traumatic brain injury in individual African children.

Given the high incidence of road traffic accidents, assaults, and specific learning disabilities prevalent in South Africa, and the important role played by neuropsychological assessment in the diagnosis and rehabilitation of individuals suffering the consequences of these, it is essential that misdiagnosis does not occur by utilising norms not relevant to the population. Moreover, cognisance needs to be taken of previous findings (e.g. Ostrosky-Solis, Ardila, Rosselli, Lopez-Arango & Uriel-Mendoza,1998) that have indicated the importance of educational relative to age variables in determining test performance. Accordingly, the present study aimed to: (1) establish the validity for black (African) South Africans of the published norms of a battery of tests widely used for neuropsychological evaluation; (2) consider the relative influence of age and education on their test performance; and (3) provide an alternative set of scores relevant to this population group.

2. Method

This study was carried out in Soweto, situated in the greater Johannesburg area, and representing the largest urban concentration of Africans in South Africa. Soweto was one of the townships to which black people were confined during the apartheid era. Comprising about three million people, it is a polyglot society with most of the nine African (now official, together with English and Afrikaans) languages represented.

The study was conducted in two parts. Part I investigated the relevance of published neuropsychological test norms for African high school students and the relative effects of age and grade on test performance. Part II focused on a more narrowly defined grade level/age group of students, in order to provide an alternative set of scores for this group of children.

2.1. Subjects

Part I included 100 students from a secondary school in Soweto which draws pupils of varying home languages (Zulu, Tswana, Northern Sotho, Sotho, Tsonga and Xhosa) and is broadly representative of a Soweto high school population. Language of instruction in all high schools in Soweto is English. After excluding those students who had sustained significant brain injuries or other neurological problems, 20 students were randomly selected from each of the five grade levels of the school (i.e. grades 8–12). The age range was 12 years 0 months to 24 years 6 months and the mean age was 17 years 2 months. The unusually large age span reflected the presence of students of advanced age in 11th and 12th grades. Despite this, age and standard of education demonstrated a significant correlation ($r = 0.7$).

According to their responses on a socioeconomic deprivation questionnaire, students were generally of very low SES. A third of their fathers and mothers were unemployed, 40% were in unskilled jobs, while 25% were in semi-skilled jobs or conducted small businesses. Only about 2% were professional (largely teachers or nurses). Random selection resulted in approximately equal numbers of male and female participants.

For Part II of the study, 152 students were randomly selected from the 7th to 9th grades of four schools in Soweto. The four additional schools which participated in Part II of the study were, like the school in Part I, representative of the Soweto high school population. In this case, to ensure an equal number of males and females, half the pupils were randomly selected from among the males, and the other half from the females. Again, those who had suffered from any head injury or epilepsy were excluded. The group thus comprised 76 females and 76 males; the mean age of the girls was 14 years 3 months (standard deviation = 0.95 years) and of the boys, 14 years 4 months (standard deviation = 0.98 years).

In 1993, it was documented that black South African children spent an average of 11 years enrolled at school but the average attainment of school leavers was 9th grade (Macroeconomic Workgroup, 1993). The percentage of school failures in the present sample varied directly with age. While only 4% of the 13 year old students had failed a school year, 50.9% of the 14 year olds and 53% of the 15 year olds had done so.

2.2. Instruments

A range of tests commonly used in neuropsychological assessment both in South Africa and in England and the United States was selected for inclusion in this study. They are generally regarded (e.g. by Lezak, 1995) as valuable in the diagnosis of neuropsychological deficits. The tests were the same as those used in a pilot study conducted on a group of inner-city African high school students by two of the present authors in collaboration with others (Murdoch et al., 1994). This study afforded an opportunity for determining the degree of agreement between the results obtained here and those of the previous study.

For Part I, the instruments included the following: a combined battery of subtests from the "Wechsler Intelligence Scale for Children — Revised" (WISC-R; Wechsler, 1974) and the "Individual Scales for African Language Speaking children" (IS-A; Landman, 1991). The latter is based on the WISC-R but provides items, norms and a language medium relevant to each of the different African language groups. To avoid a practice effect, with the exception of the Problems and

Arithmetic subtests, which were both used to afford a direct comparison between performance on these similar subtests, different subtests were selected from the two intelligence scales.

Thus, from the WISC-R, the Similarities, Arithmetic, Digit Span, Picture Arrangement, Mazes and Coding subtests were used. The IS-A subtests included Comprehension, Problems, Block Design, Absurdities, and Story Memory.

In addition, a broad spectrum of abilities was assessed by the following psychological measures, commonly used in neuropsychological assessment:

(1) The Rey Auditory Verbal Learning Test (RAVLT) (Rey, 1964) provided an index of verbal acquisition, retention and susceptibility to interference. (2) The Stroop Colour Word Test (SCWT) (Stroop, 1935) with its dual dimension stimuli was used to measure an interactive interference effect. (3) The Wisconsin Card Sorting Test (WCST) (Grant & Berg, 1948) was directed at abstract concept formation and the ability to shift and maintain set. (4) The Bender Gestalt Visual Motor Integration Test (BGT) (Bender, 1946), a frequently utilised screening mechanism for organic integrity requiring the reproduction of a configurational whole, was directed at the assessment of visual-perceptual and fine motor abilities. (5) The Rey–Osterreith Complex Figure Test (ROCFT) (Osterreith, 1944; Rey, 1941) provided a measure of visuospatial constructional ability and subsequent visual memory. (6) The Trail Making Test (TMT) (Reitan, 1979) was administered as a measure of visuomotor and visual conceptual tracking. (7) Spatial Memory Test (Lhermitte & Signoret, 1972) provides an indication of visual spatial learning and memory. (8) The Draw-a-Person Test (DAP) (Harris, 1963) is an easily administered, non-verbal test of visual spatial ability which may be used as an indicator of organic deficit, mental age, body image and self-concept.

For Part II, the combined WISC-R and IS-A battery was replaced by the full WISC-R battery. A basis was thus afforded for obtaining scores on the full battery for the age group under consideration. With due consideration for the fact that this test population is being educated in a language other than their mother tongue, in addition to the WISC-R Vocabulary subtest, a test of Oral Word Fluency (FAS) which has been shown in other populations to be sensitive to frontal lobe impairment, was included as an indicator of language proficiency. For the rest, the same measures used in Part I of the study were used in Part II.

2.3. Procedure

In the interests of optimum standardised test conditions, testing was not carried out at the school but at a suitable locale that offered comfort, warmth and the minimum distractions to the subjects.

For Part I, four suitably experienced psychometrists each administered part of the battery of tests to each individual subject. Two of the four psychometrists were black and were fluent in both English and in the testees' mother tongue. They, therefore, administered the selected subtests of the relevant vernacular IS-A Scales. The other two psychometrists conducted the individual neuropsychological measures, and the selected subtests from the WISC-R battery, respectively. As a result of this arrangement, the order of presentation of tests differed among participants. Thus, problems associated with not being 'test wise', and the fatigue factor were spread among the tests, and not focused on one specific (sub)test.

For Part II of this study, nine graduate psychology students were trained on test procedure and fully familiarised with all aspects of the administration and scoring of the test battery. The direct

influence of tester variables was minimised by rotating the tests among the three groups of three testers. The order of testing was also varied among the subjects to ensure that the effects of exposure to psychological testing and of fatigue were distributed throughout the battery.

3. Results

3.1. Part I — Soweto Group 1

Scores obtained on the various tests administered to this sample are presented below, and compared with relevant standardisation samples. In the case of the WISC-R and the IS-A, only a proportion of the sample fell within the age range for which the test had been normed and the oldest available norm was utilised for the older testees.

3.1.1. Comparison of test scores for the Soweto Group 1 with published test norms

3.1.1.1. WISC-R. For the original standardisation sample (Wechsler, 1974) the mean score for each of the subtests of the WISC-R was 10. A subsequent comparison of black and white American subjects by Reynolds and Jensen (1983) yielded mean scores of between 8.13 and 9.51 for a black American population. The results for the 100 Soweto Group 1 subjects are presented in Table 1.

As Table 1 indicates, the means of the present sample were lower than those of both the original norm sample, and those reported by Reynolds and Jensen, and fell in the Below Average to Borderline Defective ranges of intellectual functioning.

3.1.1.2. IS-A. On the subtests of the IS-A administered here, the sample obtained mean-scaled scores ranging from 9.88 (Problems) to 12.13 (Comprehension). Although the IS-A has norms for each of the different African language groups in South Africa, the advanced age and degree of urbanisation of the present group could account for the slightly elevated scaled scores obtained on some of the subtests.

3.1.1.3. RAVLT. The present sample recalled 44.74 out of the total possible of 75 (i.e. 59.65%) on this test, as compared to about 53 words (70%) for a 13–16-year old North American sample (Spreen & Strauss, 1991).

Table 1
The mean performance of Soweto Group 1 ($n = 100$) on certain Wechsler Intelligence Scale for Children — Revised (WISC — R) subtests

WISC — R subtest	Mean scaled score	Standard deviation
Similarities	5.59	2.6
Arithmetic	6.08	2.4
Digit Span	7.08	2.7
Picture Arrangement	6.38	2.9
Mazes	7.84	3.3
Coding	6.12	3.0
Coding (short-term incidental recall-RAW)	7.83	–

3.1.1.4. SCWT. The test manual reports that, in young adults in the age group 16–44 years, the average number of words read in 45 s was 108, colours named, 80 and coloured words named, 45. For the Soweto sample, the average number of words read was 85.84 (S.D. = 14.4) colours named was 56.68 (S.D. = 8.8) and coloured words was 33.42 (S.D. = 7.4). Thus, the score for the Soweto group was considerably below that of the standardisation group.

3.1.1.5. WCST. On the WCST, Chelune and Baer (1986) report that 12 year olds are capable of completing 5.7 categories, and make an average of 12.3 perseverative errors. The Soweto sample completed 3.7 (S.D. = 1.7) categories, and made an average of 30.6 (or 24.3%) perseverative errors. This is comparable to the performance of the 6–7 year old group in Chelune and Baer's sample. The fact that their conceptual level score was below 50% suggests that the basic concept may have been unfamiliar to the Soweto group.

3.1.1.6. BGT. According to Pascal and Suttell's (1951) scoring system, the original normatisation sample of students aged 15–19 scored a mean of 19 errors (S.D. = 9.4). The Soweto sample, on the other hand, obtained a mean of 31.25 errors (S.D. = 23.32) thus, here again the sample scored substantially below the reported norm.

3.1.1.7. ROCFT. The mean standard of the copies produced by the Soweto sample was 31.27 (S.D. = 3.14), and thus, below that of Kolb and Whishaw's (1985) 16-year old plus group (namely, 35.1; S.D. = 1.5) and comparable to that of the 12–13-year old American sample. The reproduction, 30–45 minutes later, of the same figure from memory by the Soweto group was 19.39 (S.D. = 5.99), which was somewhat poorer than that of the original 12-year old sample (namely, 23.20) and comparable to that of the 10-year old American sample.

3.1.1.8. TMT. Due to the age of the majority of the students (mean age = 17), it was decided that the adult version of the TMT should be used. Spreen and Strauss (1991) suggested that subjects between the ages of 15 and 20 years usually require a mean of 23 s to complete Part A, and 47 s to complete Part B of the TMT. The Soweto sample took 38.51 s on Part A and 85.72 s on Part B. Measured against the norm standard of Spreen and Strauss, the mean performance of the present group of testees fell at the 10th percentile for Part A and below the 10th percentile for Part B.

3.1.1.9. DAP. Standardisation of this test by Harris (1963) yielded a mean of 100 and a standard deviation of 15. For the Soweto sample, the mean standard score was 83.17, with a standard deviation of 17.91. Thus, here too, the Soweto sample's score was considerably below that of the original standardisation sample.

3.1.1.10. Spatial Memory Test. For this test, students in the present sample took an average of 2.94 trials (S.D. = 3.28) to achieve perfect placement. Walsh (1985) suggested that subjects of normal intelligence will almost invariably reach a perfect score in six or less trials. Thus, in this instance, the score did not represent a difference from that of the performance expected of subjects in America/England.

3.1.2. Comparison of differences in test performance as a function of age and grade

Despite the small numbers included in each subgroup, means and standard deviations were computed for the various age and grade levels, and age and grade were employed as independent variables in separate analyses of variance (ANOVAs). Because of the relatively large number of psychometric measures incorporated in the study, Bonferroni's principle was applied to help control for spurious significance. It should, however, be noted that the Bonferroni principle does not guarantee the absence of spurious significance or obviate the possibility of overlooking actual significance (cf. Cohen, 1990).

Using this strict measure of significance, of all the measures, only the scaled scores for the IS-A Comprehension subtest demonstrated a statistically significant relationship with age ($F = 5.0$, $P < 0.00001$). Without the application of the Bonferroni principle, only eight of the 58 scores yielded by the various measures of the study were significantly related to age.

In contrast, an ANOVA on test performance as a function of educational grade suggested that 28 of the 58 scores yielded by the measures differentiated in terms of this variable. This is demonstrated in Table 2.

As Table 2 indicates, 11 of the measures were found to be significantly linked to educational level (grade), even according to the strictest criteria of significance, using the Bonferroni principle with $P < 0.0008$.

Given the age correction factor provided when raw scores were converted to scaled scores, it is important to note that, when differences in performance were analysed in relation to educational level, statistically significant differences as a function of grade level were not limited to the raw scores, but extended to the WISC-R scaled scores obtained on the Similarities, Digit Span, Arithmetic, Coding, Comprehension, Story Memory, Block Design and Absurdities tests.

Table 2
An analysis of variance in test performance of Soweto Group 1 according to educational standard[a]

Test	*F*	*P*	Test	*F*	*P*
Similarities (raw score)	10.7360	0.000000	Block Design (scaled score)	4.03911	0.004569
Similarities (scaled score)	4.47710	0.002336	Absurdities (raw score)	8.84734	0.000004
Digits (raw score)	2.83524	0.028607	Absurdities (scaled score)	5.51204	0.000315
Digits (scaled score)	2.67083	0.036738	Coding (scaled score)	4.08960	0.004231
Picture Arrangement (raw score)	3.41715	0.011761	Coding (raw score)	9.47708	0.000002
RAVLT List A Trial II	2.82261	0.029163	Arithmetic (raw score)	19.52107	0.000000
RAVLT List A Trial III	3.58904	0.009043	Problems (raw score)	9.14557	0.000003
RAVLT total I–V	2.61818	0.039796	Comprehension (raw score)	4.83913	0.001351
RAVLT List	3.15110	0.017665	Comprehension (scaled score)	9.81535	0.000001
Stroop Words read	2.74742	0.032766	Long term story recall	8.15052	0.000012
Stroop Coloured-Words	2.55328	0.043986	Block Design (raw score)	6.59329	0.000101
WCST% Perseverative responses	2.92991	0.024763	Story Memory (raw score)	7.84732	0.000017
WCST% Perseverative errors	3.11118	0.018776	Story Memory (scaled score)	2.95464	0.023846
Rey Osterreith Complex Figure	6.42890	0.000127	Arithmetic (scaled score)	3.47614	0.010747

[a] RAVLT, Rey Auditory Verbal Learning Test; WCST, The Wisconsin Card Sorting Test.

3.2. Part II — Soweto Group 2

In Part II of the study, data were collected from 152 African urban students aged 13–15 years and in the 7th to 9th grades at four Soweto schools. The mean performance and standard deviations of this group of students on the measures are presented in Table 3.

The consistency of these results with comparable samples of urban black scholars was investigated by comparing them with those obtained in Part I of this study, as well as with results obtained in a similar investigation by Murdoch et al. (1994) of black South African students attending an inner-city high school in Johannesburg. As the Murdoch study included only eighth-grade students, only this grade of Soweto participants were used in this comparison. The mean age of pupils in Parts 1 and II of the Soweto study was 14.38 years and 14.23 years, respectively, while the mean age of the inner-city group was 13.33 years.

For most of the measures, where uniformity of test version and procedure permitted it, the three South African samples were also compared with the American norm group. Where available, the American standard used was that against which a 13-year old's performance would be evaluated, irrespective of educational level, (which would, in any case, usually be the eighth grade).

The mean scores for the four groups are presented in Table 4 below.

As can be seen from Table 4, there is an almost consistent tendency for the results of the three South African groups to be similar, and to differ markedly from the American group. To test this statistically, the performance of the four groups was compared via *t*-tests with pooled variance. (ANOVA was not performed as the standard deviations of the American samples were unavailable).

Results of these statistical procedures indicate that, with the exception of the Copy trial of the ROCFT, there was no significant difference between the performance of the two Soweto groups on any of the measures. The inner-city group also did not differ significantly from the Soweto groups on most of the measures listed in the table, and those differences that *were* yielded did not reflect a consistent pattern. Thus, the inner-city students performed significantly better than the Soweto-Part II group on the TMT. The inner-city group also performed significantly better then both Soweto groups on Trials 2, 3 and 4 of the RAVLT. However, the inner-city group performed less well than the Soweto groups on the Recall trial of the ROCFT.

The comparison of the South African groups with the American standard indicated that there was no significant difference between them on List B of the RAVLT. Further, the inner-city group did not differ significantly from the American norm on Trial 1 of the RAVLT. For all the other measures, the statistical procedures demonstrated that the South African groups performed significantly ($P < 0.01$) below the American standard.

4. Discussion

In this study, a representative group of African students performed at significantly lower levels on a battery of neuropsychological tests than the respective American norm groups. Given the use here (and in many clinical/neuropsychological settings in South Africa) of the WISC-R, the norms of which were published many years ago (Wechsler, 1974), the results of this study repre-

Table 3
Mean performance of black urban scholars aged 13–15 years (Soweto Group 2) on the selected tests

Psychometric measure	Mean level of performance	
	Mean scaled score	Standard deviation
Wechsler Intelligence Scale for Children — Revised		
Information	4.66	2.33
Picture Completion	7.06	2.28
Similarities	4.89	2.32
Picture Arrangement	6.42	2.68
Arithmetic	6.01	2.20
Blocks	6.58	2.49
Vocabulary	2.85	1.64
Object Assembly	6.29	2.81
Comprehension	4.79	2.46
Coding	6.18	2.25
Digits	6.93	2.64
Mazes	7.60	2.90
Rey Auditory Verbal Learning	Mean no. words	
List A-I	5.36	2.11
List A-II	6.67	2.43
List A-III	8.21	2.96
List A-IV	9.59	3.10
List A-V	10.61	2.89
List A-after interference	9.47	2.97
List A-long term recall	10.11	2.98
Controlled Oral Word Fluency[a]	Mean no. of words	
Words starting with F	8.24	3.04
Words starting with A	4.17	2.03
Words starting with S	8.08	2.83
Stroop Colour Word Test	Mean score	
No. of words read	75.05	13.66
No. of colours named	52.83	8.70
No. of coloured-words named	29.20	6.37
Predicted coloured-words	30.76	4.63
Interference score	1.56	5.87
Wisconsin Card Sorting Test	Mean score	
Correct	68.39	15.10
Errors	52.98	21.58
Categories	3.97	1.81
Perseverative responses	33.02	18.37
Perseverative errors	28.04	14.68
Conceptual level responses	52.89	19.81
Failure to maintain set	0.74	1.02
Koppits Bender Gestalt Test	Mean score	
Errors	2.18	1.95

(*continued on next page*)

Table 3 (*continued*)

Psychometric measure	Mean level of performance	
	Mean scaled score	Standard deviation
Rey–Osterreith Complex Figure	Mean score	
copy trial	26.88	4.04
long term recall	18.00	5.39
Trail Making Test[b]	Mean seconds	
Trails A (children)	29.77	17.33
Trails B (children)	50.30	33.19
Trails A (adults)	56.10	26.77
Trails B (adults)	110.58	52.54
Spatial Memory Test[c]	Mean score	
Mean no. trials to 3× perfect	2.63	2.20
Mean no. correct after 30–45 min	8.88	0.50

[a] Table 3 represents the actual number of words pronounced during each of the 60 second trials and has not been adjusted for age, sex or educational level. The raw scores obtained by the male and female groups in this sample did not differ significantly. Even after the required adjustment both groups would thereafter still fall below the 50th percentile (i.e. males between 35–49 and females between 31–33).

[b] The age-appropriate version of this test was used throughout. The results are given firstly for the under 15s ($n = 107$) and thereafter for the over 15s ($n = 45$).

[c] This test was administered as suggested by Murdoch et al. (1994), with the trials terminating only after 3 sequential perfect placements or after 20 trials.

sent an underestimate of the gap between African test results and those of their North American counterparts. This is because, comparing the standardisation samples of the WISC-R and the more recent WISC-III, large gains were made by American school children by 1989 (Flynn, 1998), gains which may have continued in the past decade. This is part of the general phenomenon of rising IQ scores in industrialised societies (Neisser, 1998).

Significantly lower scores were yielded here for both verbal and non-verbal tests. The exceptionally poor performance of students on many of the verbal tasks supports the argument that language has a considerable effect on test performance, for this group are being raised in a multilingual environment and educated in a language other than their mother tongue.

A comparison was afforded between three different groups of eighth grade African students, two from Soweto, and one from an inner-city school. The results of the three groups were not significantly different, notwithstanding the wide age range that was spanned by these groups, particularly the initial Soweto group and the inner-city group. Since the results for the initial group of 20 Soweto eighth-grade students were, to a large extent, replicated with the second Soweto group of 119 students, one can tentatively suggest that the same replication would occur for the other grades assessed in the initial Soweto group.

Generally, previous findings in other societies of the importance of educational level to psychological test performance were supported here. The initial Soweto sample comprised students of varying ages across five scholastic levels. This enabled comparisons of performance to be made across age and educational level. There were highly significant differences as a function of scholastic grade, which far outweighed the influence of the age variable. This has important implications for

Table 4
Scores of South African and American pupils on a battery of psychometric tests

Psychometric measure	Soweto (1) ($n=20$)	Soweto (2) ($n=119$)	Inner City ($n=49$)	American[a]
Wechsler Intelligence Scale for Children — Revised subtest (scaled score)				
Similarities	4.3	4.79	4.92	10.0
Arithmetic	5.85	6.12	6.65	10.0
Digit Span	6.35	6.96	6.82	10.0
Picture Arrangement	5.95	6.46	7.55	10.0
Mazes	8.00	7.81	8.64	10.0
Coding	6.21	6.33	7.43	10.0
Rey Auditory Verbal Learning Test[b]				
I	6.0	5.48	6.08	6.8
II	6.9	6.72	8.14	9.5
III	8.1	8.43	9.84	11.4
IV	9.8	9.45	10.67	12.3
V	11.1	10.59	11.39	13.0
B	5.7		6.43	6.2
After interference	9.0	9.58	10.87	–
Long term recall	9.8	10.07	10.90	–
Stroop Colour-word Test[c]				
No. of words read	76.84	74.42	76.89	98
No. of colours named	53.47	52.98	51.83	73
No. of coloured-words	30.21	29.34	28.34	40
Predicted coloured-words	31.37	30.73	30.77	42
Interference Score	1.16	1.38	−2.43	0
Wisconsin Card Sorting Test[d]				
Correct	66.3 (53.2%)	68.7 (57.2%)	70.20 (57.4%)	
Errors	59.1 (46.7%)	53.2 (42.7%)	53.44 (42.5%)	28.2
Categories	3.4	3.97	3.91	5.2
Perseverative responses	43.2 (34.1%)	32.8 (26.4%)	32.82 (26.3%)	16.7
Perseverative errors	36.2 (28.6%)	27.9 (22.5%)	28.04 (22.4%)	16.7 (12.5%)
Conceptual level responses	51.8 (41.8%)	52.6 (44.3%)	54.37 (44.9%)	– (66.7%)
Trail-making Test[e] (time in s)				
Trails A	41.36	49.89	40.11	–
Trails B	87.57	99.82	86.87	–
Rey–Osterreith Complex Figure Test[f]				
Copy trial	29.3	26.77	25.0	32.63
Recall trial	19.3	18.26	15.5	24.59

[a] Sample size varies according to the group norm.
[b] Spreen and Strauss (1991).
[c] No. in 45 s compared to data reported in table II-B of the test manual.
[d] Card Placements compared to data gathered by Heaton (1981).
[e] All comparisons were based on the adult version of the TMT. Only 30 of the Soweto 2 standard 6 pupils were thus included in this analysis.
[f] Raw score compared to the data gathered by Kolb and Whishaw (1985).

assessment that takes place in a South African context, inasmuch as level of performance cannot be judged without taking educational level into consideration.

Further, while the use of appropriate norms is a *necessary* condition for accuracy of diagnosis, it is not *sufficient* either for understanding the basis of the difficulty or predicting possible changes in behaviour as a function of intervention. Various studies based on Feuerstein's (1979) theory of structural cognitive modifiability, and his technique of dynamic assessment have addressed this issue, both in South Africa (e.g. Skuy, Hoffenburg, Visser & Fridjhon, 1990; Skuy & Shmukler, 1987) and elsewhere (e.g. Kozulin, 1998).

For the purposes of differential diagnosis, in terms of which individuals within the group are assessed; for example, to be suffering from the effects of traumatic brain injury, it is essential that norms which are relevant to this particular group are applied. Thus, appropriate norm standards should be invoked on the basis of which to assess individual deviations. This study has taken a step in the direction of providing a set of suitable alternative norms for urban African students. However, further analysis of the data, as well as other investigations, should be undertaken to consider the effects of intra-group variables too, including gender, specific language sub-groups, and urban versus rural habitat. One cannot take for granted that there is homogeneity even within the African cultural group.

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