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LITERACY-BASED NORMATIVE DATA FOR LOW SOCIOECONOMIC STATUS AFRICAN AMERICANS

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Clinical neuropsychology relies on the use of appropriate test norms. Normative studies frequently stratify based on age, education, sex, and race. None to date has reported norms based on literacy, despite the substantial evidence that literacy impacts cognitive functioning. Some researchers have suggested that literacy is a more accurate reflection of academic achievement and quality of education than years of education, particularly for African Americans. The current study provides literacy-based normative data for multiple neuropsychological measures based on a sample of predominantly low socioeconomic status African Americans. These normative data should improve the diagnostic accuracy of performances by African-American clients with similar demographic backgrounds.

Keywords: Education; Ethnicity; Illiterate; Neuropsychological testing; Reading

INTRODUCTION

The use of appropriate norms is critical to the practice of clinical neuropsychology (e.g., Lezak, Howieson, Loring, Hannay, & Fischer, 2004; Mitrushina, 2005; Strauss, Sherman, & Spreen, 2006). Ideally, individual patient scores are compared to normative data gathered from a population that is similar to the individual on demographic factors such as age, education, sex, and race. Such demographic considerations are crucial considering the wealth of evidence that these variables affect cognitive performance (e.g., de Frias, Nilsson, & Herlitz, 2006; Lyketsos, Chen, & Anthony, 1999; Manly, Jacobs, Touradji, Small, & Stern, 2002; Schaie & Zanjani, 2006). Research suggests that diagnostic accuracy is limited by comparing individual scores to populations that are dissimilar demographically (Ardila, 1995). For example, cognitively normal African Americans are more likely to be misdiagnosed as impaired compared to whites due to lower scores on standard neuropsychological tests (Campbell et al., 2002; Manly et al., 1998a, 1998b; Welsh et al., 1995). Similarly, Marcopulos, McLain, and Giuliano (1997) reported that approximately half of their sample of healthy, rural, older adults scored below

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published cut-offs on their cognitive measures and would have been considered mildly to moderately impaired on many of the test measures. False positives may result in adverse psychological effects on the patient, unnecessary treatment, and negative financial repercussions (Patton et al., 2003; Strauss et al., 2006). In response to these findings, norms have been published based on a number of demographic factors, including age, education, sex, and race (e.g., Giannakou, & Kosmidis, 2006; Heaton, 2004; Lucas et al., 2005; Moering, Schinka, Mortimer, & Graves, 2004; Patton et al., 2003).

While normative studies frequently stratify groups based on these variables, none to date has reported norms based on literacy. This is surprising given the well-documented impact of literacy on cognitive performance (e.g., Ardila, Ostrosky-Solis, Rosselli, & Gomez, 2000; Ardila, Rosselli, & Rosas, 1989; Deloche, Souza, Braga, & Dellatolas, 1999; Lecours et al., 1987; Manly, Byrd, Touradji, Sanchez, & Stern, 2004; Manly et al., 1999, 2002; Reis & Castro-Caldas, 1997; Rosselli, Ardila, & Rosas, 1990). Illiteracy is associated with poor cognitive performance even after controlling for the effect of years of education (Manly et al., 2004, 2002), and literacy has been found to be a better predictor of cognitive performance than years of education (Byrd, Jacobs, Hilton, Stern, & Manly, 2005).

Differences in cognitive performance between literate and illiterate individuals have been attributed to a variety of factors. For example, it has been suggested that heuristics, which are associated with the development of test-taking strategies, are acquired when one learns to read (Byrd et al., 2005). Thus, illiterate individuals may be at a disadvantage in testing situations both because the testing environment is unfamiliar (Ardila et al., 2000) and because they lack appropriate test-taking strategies (Byrd et al., 2005). There is also evidence of differential functional organization of the brain in literate and illiterate individuals (Castro-Caldas et al., 1999; Castro-Caldas, Petersson, Reis, Stone-Elander, & Ingvar, 1998; Petersson, Reis, Askelof, Castro-Caldas, & Ingvar, 2000; Petersson, Reis, & Ingvar, 2001), which may at least partially underlie differences in cognitive performance. In addition, differences in cognitive abilities between literate and illiterate individuals have been attributed to intervening variables such as poverty and low socio-economic status (SES), which are associated with less cognitively stimulating environments and disorders of the nervous system (Alvarez, 1983; Ardila et al., 2000).

Manly and her colleagues suggested that literacy and reading level are more accurate reflections of academic achievement and quality of education than years of education (Manly et al., 1999, 2002). This may explain why literacy is a better predictor of cognitive performance than education level. This may be true particularly for African Americans, who have historically suffered discrimination, limited educational opportunities, and lower-quality education (Anderson, 1988; Manly, 2005). Manly and colleagues (Manly et al., 2004, 2002) found large discrepancies between years of education and actual literacy level among ethnic minorities and immigrants. They also found that racial group differences were attenuated on a number of cognitive tests after accounting for differences in reading ability, even after matching African-American and white elderly participants on years of education. Thus, they suggested that norms that correct for reading ability,

which is considered a proxy for quality of educational experience, may be more accurate than race- or ethnicity-specific norms that correct for years of education.

Given the absence of literacy-based norms and the evidence for the impact of demographic variables and reading ability on cognitive performance, the purpose of the current study was to provide literacy-based normative data for a number of neuropsychological measures based on a sample of community-dwelling, predominantly low SES African Americans.

METHOD

Participants

Data for the present study were obtained from the Healthy Aging in Neighborhoods of Diversity across the Life Span (HANDLS) study. The HANDLS study is a multidisciplinary, prospective epidemiologic longitudinal study that is collecting data from a representative sample of African Americans and whites between 30 and 64 years old. HANDLS is recruiting a fixed cohort of participants by household screenings from an area probability sample of 12 census segments in Baltimore, Maryland. After the baseline recruitment is complete in 2008, participants will be re-examined every 3 years. Data for the present study are from baseline examinations, which began in November 2004. For the purposes of this study, only the 599 African-American participants who had no missing demographic data were extracted from the total sample. Participants were self-defined as African-American. Individuals reporting multi-racial backgrounds were asked which race they identified with primarily and were categorized as such. A total of 70 participants were excluded due to a self-reported history of neurological disease, head injury with loss of consciousness, or schizophrenia. Thus, the final sample consisted of 529 participants (296 female, 233 male).

A summary of participant demographic and self-reported health information for the final sample is presented in Table 1. Participants ranged in age from 30 to 64 years (mean = 48.18, $SD = 8.68$), and ranged from 1 to 21 years of formal education (mean = 11.94, $SD = 2.67$). Male and female participants were similar in age, $t(527) = 0.45$, $p = .65$, and years of education, $t(527) = 0.12$, $p = .90$. The majority of participants (67.49%) reported income below 125% of poverty level as defined by the Department of Health and Human Services (DHHS; 2006). For example, income for participants with families of four would be $25,000 or lower because the poverty guideline for a family of four is $20,000. This cutoff was used because DHHS criteria are based on national averages; using the national criteria as a cutoff would not accurately capture individuals experiencing economic hardship in Baltimore, where the cost of living is higher than the national average.

Table 1 shows that a number of participants reported a history of medical and psychological conditions that are known to affect cognitive functioning. Rather than exclude these individuals from all analyses, participants were removed from the analysis of individual tests only if their health condition was shown to have a significant effect ($p < .05$) on the test score based on standard regression analyses in which demographic variables (age, sex, education, and literacy) and the medical condition of interest predicted each test score. However, because the prevalence of

Table 1 Demographic and health variables of the total sample

Variable	Total sample ($n = 529$)	Women ($n = 296$)	Men ($n = 233$)
Age			
Range	30–64	30–64	31–64
M (SD)	48.18 (8.68)	48.33 (8.87)	47.99 (8.44)
Education (Years)			
Range	1–21	1–21	1–21
M (SD)	11.94 (2.67)	11.95 (2.62)	11.93 (2.74)
Poverty			
Above 125% of poverty level	172 (32.51%)	87 (29.39%)	85 (36.48%)
Below 125% of poverty level	357 (67.49%)	209 (70.61%)	148 (63.52%)
Medical and Psychological Conditions			
Anxiety Disorders	38 (7.18%)	30 (10.14%)	8 (3.43%)
Bipolar Disorder	15 (2.84%)	6 (2.03%)	9 (3.86%)
Major Depression	97 (18.34%)	65 (21.96%)	32 (13.73%)
CES-D score $\geq$16	146 (27.60%)	92 (31.08%)	54 (23.18%)
Diabetes	77 (14.56%)	53 (17.91%)	24 (10.30%)
CASHD	29 (5.48%)	17 (5.74%)	12 (5.15%)
Hypertension	227 (42.91%)	146 (49.32%)	81 (34.76%)
Thyroid Disease	21 (3.97%)	18 (6.08%)	3 (1.29%)
Cancer	23 (4.35%)	21 (7.09%)	2 (0.85%)
HIV/AIDS	30 (5.67%)	15 (5.07%)	15 (6.44%)
Sickle Cell Disease	13 (2.46%)	12 (4.05%)	1 (0.43%)
Hepatitis C	51 (9.64%)	17 (5.74%)	34 (14.59%)
*Alcohol and Drug Problems**			
Alcohol	83 (15.69%)	22 (7.43%)	61 (26.18)
Opiates	92 (17.39%)	33 (11.15%)	59 (25.32)
Cocaine	93 (17.58%)	39 (13.18%)	54 (23.18%)
Marijuana	88 (16.64%)	37 (12.50%)	51 (21.89%)

Presence of medical and psychological conditions is self-reported. CES-D = Center for Epidemologic Studies Depression Scale. CASHD = coronary atherosclerotic heart disease.

*"Alcohol and drug problems" indicates a self-reported history of substance abuse treatment, tolerance, substance-related problems in the previous 6 months, or overdosing.

major depression and hypertension was particularly high in this sample, removal of individuals with these conditions would have resulted in small cell sizes for our norms. Thus, we provided raw score adjustments rather than remove the individuals from the analyses, similar to methods used in other normative studies (e.g., Moering et al., 2004).

Measures and procedure

The neuropsychological measures were administered as part of a larger evaluation that involved cognitive evaluation, physical examination, and an in-home interview that included questionnaires about the participant's health status, psychosocial factors, neighborhood characteristics, and demographics.

Neuropsychological measures were administered by psychometrists who were trained and supervised by a research psychologist (MKT).

California Verbal Learning Test (CVLT). A modified version of the CVLT (Delis, Kramer, Kaplan, & Ober, 1987), a measure of verbal learning and memory, was administered. Three, rather than five, learning trials were administered, and cued recall trials were not administered. Outcome measures were total correct for List A trials 1–3, the List B learning trial, and short- and long-delay free recall trials.

Benton Visual Retention Test – 5th edition (BVRT). The BVRT (form D, administration A) was administered as a test of short-term figural memory (Sivan, 1991). Administration followed standard instructions. Each trial was scored independently for errors by two trained examiners according to standard procedures. Discrepancies in scoring were adjudicated and a consensus score was achieved. If a scoring consensus could not be achieved by the two examiners, a research psychologist (MKT) decided the score. The outcome measure was the total number of errors.

Animal Fluency. Animal fluency assesses language and generative abilities. Participants were asked to generate as many animal names as possible within 60 seconds. If two consecutive category errors were made, the participant was reminded of the appropriate category. Responses were tape recorded. The total number of correct responses was calculated.

Card Rotation Test. The Card Rotation Test (Ekstrom, French, & Harman, 1976) is a timed test of visuospatial ability that requires the mental rotation of two-dimensional figures. Only part 1 of the test was administered; otherwise, standard administration procedures were used. The test was scored by subtracting the total number of incorrect responses from the total number of correct responses.

Brief Test of Attention (BTA). The BTA (Schretlen, 1989; Schretlen, Bobholz, & Brandt, 1996) measures auditory divided attention. The examiner read 10 lists of letters and numbers that increased in length from 4–18 elements. The participant was instructed to disregard the letters presented and count how many numbers were read aloud. During the test, participants were told to make their hands into fists to discourage them from counting on their fingers. The letters condition of the BTA was not administered. The total number of correct responses was scored.

Digit Span. The Wechsler Adult Intelligence Scale, Revised (Weschler, 1981) Digit Span subtest was administered using standard instructions. This test provides a measure of attention and immediate verbal memory. Outcome measures were the digits forward and digits backward total scores.

Trail Making Test (TMT). The TMT was administered to assess attention, cognitive control, and visuomotor scanning (Reitan, 1992). When errors were committed, the examiner corrected the error immediately, and the participant continued from his/her last correct response. The stopwatch continued to run while corrections were made. Dependent measures were time to completion (in seconds), calculated separately for parts A and B.

Identical Pictures. The Identical Pictures Test (Ekstrom et al., 1976) is a measure of processing speed, and part 1 of this measure was administered using standard procedures. On this measure, participants viewed a target item (a simple line drawing) and selected out of five possible responses the picture that was identical to the target. Forty-eight rows of items were presented across two pages. Participants were given 75 seconds to complete as many items as possible and were told to work quickly without sacrificing accuracy. Scores were calculated by subtracting the total number of incorrect responses from the total number of correct responses.

Reading subtest of the Wide Range Achievement Test – 3rd Edition (WRAT-3). The tan form of the WRAT-3 Reading subtest was administered to assess participants' ability to recognize and name letters and words. Standard administration and scoring procedures were followed.

Data analyses

Cognitive scores were regressed on age, sex, education, and the WRAT-3 Reading total score, which served as a measure of literacy. Squared semi-partial correlation coefficients were examined to evaluate the independent and unique influence of these variables on test scores. For the sex variable, women were coded as 0 and men were coded as 1. Using a Bonferroni correction for multiple comparisons, p values of less than .003 were considered significant. Significant variables were used to stratify groups for normative purposes.

Secondary analyses were performed to determine the incremental contributions of literacy and education to test performance using a hierarchical method. To determine the contribution of literacy above that of education, we compared the full models in which age, sex, education, and the WRAT-3 Reading total score served as predictors to models that omitted the reading score. Similarly, the contribution of education beyond that of literacy was examined by comparing the full models to models in which education was omitted.

RESULTS

Linear regression analyses were used to determine the effect of age, sex, education, and WRAT-3 Reading scores on cognitive performance. The results of the analyses are summarized in Table 2, and the intercorrelations of the predictor variables are presented in Table 3. Reading scores were significant predictors of each cognitive measure except for TMT part A, and were the strongest predictor of most measures. After Bonferroni correction, age was not a significant contributor to performance on the BVRT, Digits Forward, Digits Backward, or CVLT List B. Sex accounted for $\leq$1% of variance for most scores and no more than 5% for any score. Education did not have a significant unique effect on any of the cognitive measures after Bonferroni correction.

Secondary analyses revealed a highly significant incremental contribution of literacy to the prediction of all test scores except for TMT part A after the effect of education was partialed out (R^2 change = .024 to .197, $p < .001$). In contrast, after

Table 2 Contribution of demographic variables to cognitive test performance

Variable	Factor	Squared semi-partial correlation	*t*	*p*
BVRT errors ($R^2 = .125$)	Age	.01	2.23	.026
	Sex	.04	−4.49	<.0001*
	WRAT Reading	.06	−5.11	<.0001*
	Education	.01	−1.56	.120
CVLT Trials 1–3 ($R^2 = .212$)	Age	.03	−4.21	<.0001*
	Sex	.03	−4.36	<.0001*
	WRAT Reading	.11	7.77	<.0001*
	Education	.01	2.69	.007
CVLT List B ($R^2 = .112$)	Age	.01	−1.77	.077
	Sex	.01	−2.47	.014
	WRAT Reading	.06	4.99	<.0001*
	Education	.01	2.55	.011
CVLT SDFR ($R^2 = .183$)	Age	.07	−6.28	<.0001*
	Sex	.01	−1.80	.072
	WRAT Reading	.09	6.62	<.0001*
	Education	.00	0.82	.415
CVLT LDFR ($R^2 = .196$)	Age	.05	−5.29	<.0001*
	Sex	.02	−3.14	.002*
	WRAT Reading	.11	7.45	<.0001*
	Education	.00	1.20	.229
Animals ($R^2 = .113$)	Age	.02	−3.52	<.0001*
	Sex	.02	3.53	<.0001*
	WRAT Reading	.05	4.72	<.0001*
	Education	.01	1.67	.097
Card Rotation ($R^2 = .142$)	Age	.04	−4.13	<.0001*
	Sex	.05	4.44	<.0001*
	WRAT Reading	.04	4.15	<.0001*
	Education	.00	1.30	.195
BTA ($R^2 = .152$)	Age	.02	−3.35	.001*
	Sex	.00	−0.44	.662
	WRAT Reading	.10	6.17	<.0001*
	Education	.01	1.67	.096
Digits Forward ($R^2 = .147$)	Age	.00	1.30	.194
	Sex	.00	0.83	.405
	WRAT Reading	.13	7.62	<.0001*
	Education	.00	0.82	.414
Digits Backward ($R^2 = .231$)	Age	.00	−0.06	.956
	Sex	.00	0.23	.820
	WRAT Reading	.23	11.39	<.0001*
	Education	.00	0.30	.765
TMT A ($R^2 = .125$)	Age	.12	7.01	<.0001*
	Sex	.00	0.78	.435
	WRAT Reading	.00	−1.17	.244
	Education	.00	−1.30	.194

(*continued*)

Table 2 Continued

Variable	Factor	Squared semi-partial correlation	*t*	*p*
TMT B ($R^2 = .105$)	Age	.03	3.50	.001*
	Sex	.00	−0.09	.931
	WRAT Reading	.07	−5.10	< .0001*
	Education	.00	−0.67	.501
Identical Pictures ($R^2 = .267$)	Age	.19	−11.39	< .0001*
	Sex	.00	−0.70	.485
	WRAT Reading	.04	4.60	< .0001*
	Education	.01	2.91	.004

Women were coded as 0; men were coded as 1. WRAT = Wide Range Achievement Test; BVRT = Benton Visual Retention Test; CVLT = California Verbal Learning Test; SDFR = Short-delay Free Recall; LDFR = Long-delay Free Recall; BTA = Brief Test of Attention; TMT = Trail Making Test.
*$p < 0.003$ (Bonferroni corrected).

Table 3 Intercorrelations of predictor variables

	Age	Sex	WRAT-3 Reading	Education
Age	–	−0.02	−0.04	0.03
Sex		–	0.00	−0.01
WRAT-3 Reading			–	0.36**
Education				–

**$p < .001$.

Bonferroni correction education did not add significantly to the prediction of any test score after accounting for the effect of literacy (R^2 change = .000 to .013, $p > .004$).

Based on these results, age and literacy groups were formed for stratifying the norms. In order to maximize the information yielded from this normative sample, data were grouped into six overlapping midpoint age ranges (Pauker, 1988). In this procedure, data for each midpoint age group are derived from participants within 5 years of the midpoint age, but the norms are applied only to individuals within 2 years of the midpoint age. For example, norms for midpoint age 50 apply to individuals age 48–52, but are derived from individuals between the ages of 45 and 55. Using this methodology, the utility of the study sample is maximized because data from each individual contribute to the normative estimates of multiple midpoint age groups. A multivariate analysis of variance revealed that these age groups resulted in significant differences for the cognitive test scores, $F(65, 3368.7) = 2.89$, $p < .0001$. Descriptive statistics for the cognitive measures in each of the midpoint age groups are presented in Table 4.

Examination of the distribution of WRAT-3 Reading total scores revealed a median score of 40. For the ages in our sample, the WRAT-3 manual indicates that this cutoff distinguishes between participants at (≤40 total score) and above

Table 4 Means (+standard deviation) of test scores in each age group

	Midpoint age 35	Midpoint age 40	Midpoint age 45	Midpoint age 50	Midpoint age 55	Midpoint age 60
BVRT err	4.33 (2.54)	4.45 (2.76)	4.78 (2.88)	4.78 (2.98)	4.72 (2.93)	5.29 (2.82)
CVLT 1–3	25.12 (6.72)	24.38 (7.17)	23.52 (6.50)	22.51 (5.71)	22.36 (5.40)	22.36 (5.38)
List B	5.27 (1.86)	5.07 (2.13)	4.84 (2.01)	4.71 (1.82)	4.78 (1.87)	4.96 (1.85)
SDFR	7.54 (2.74)	7.33 (3.02)	6.81 (2.97)	6.05 (2.91)	5.73 (2.86)	5.58 (2.87)
LDFR	7.59 (2.66)	7.32 (3.04)	6.71 (2.98)	6.14 (2.77)	5.95 (2.78)	5.87 (2.89)
Animals	18.82 (4.96)	18.66 (4.75)	18.09 (4.94)	17.33 (4.88)	17.01 (4.67)	17.09 (4.84)
Card Rot	34.93 (16.95)	33.04 (17.39)	30.01 (16.55)	27.41 (15.03)	27.55 (14.57)	26.84 (14.36)
BTA	6.56 (2.05)	6.30 (2.23)	5.90 (2.20)	5.87 (2.14)	5.82 (2.17)	5.56 (2.34)
Digits For	6.86 (2.02)	7.01 (1.98)	6.91 (2.18)	6.96 (2.15)	6.91 (2.05)	7.14 (1.99)
Digits Back	5.12 (1.57)	5.07 (1.77)	5.03 (1.96)	5.07 (1.94)	5.17 (1.95)	5.05 (2.14)
TMT A	30.71 (9.94)	31.07 (9.06)	34.23 (12.22)	38.24 (15.28)	41.46 (16.83)	43.26 (21.59)
TMT B	93.06 (41.43)	100.59 (49.81)	110.51 (55.01)	118.78 (55.68)	115.15 (51.59)	114.89 (50.77)
Identical Pic	25.58 (5.25)	23.58 (5.97)	21.90 (5.92)	20.27 (5.76)	19.06 (5.77)	18.41 (5.73)

BVRT err = Benton Visual Retention Test errors; CVLT 1–3 = California Verbal Learning Test Trials 1–3; SDFR = Short-delay Free Recall; LDFR = Long-delay Free Recall; Card Rotat = Card Rotation; BTA = Brief Test of Attention; Digits For = Digits Forward; Digits Back = Digits Backward; TMT = Trail Making Test; Identical Pictures.

(>40 total score) an eighth-grade reading level. Two literacy groups were formed based on a cutoff of 40 on the WRAT-3 Reading total score. Although it is common practice for education-based normative studies to provide norms for less than and greater than a twelfth-grade education, a cutoff of eighth-grade or lower and ninth-grade or higher is more appropriate for a low SES African-American sample in which the mean education level is low. Use of this cutoff allowed us to maximize the sample size in both low and high literacy groups and corresponds with an educational distinction that is incorporated into education groupings in other normative studies (e.g., Heaton, 2004). A multivariate analysis of variance revealed that this categorization resulted in significant differences for the cognitive test scores, $F(14, 347) = 7.35$, $p < .0001$.

Raw scores on each of the cognitive measures were converted into age- and literacy-corrected scaled scores. Similar to procedures employed in other normative studies (Ivnik, Malec, Smith, & Tangalos, 1992a, 1992b; Lucas et al., 2005; Patton et al., 2003), raw scores were assigned percentile ranks based on the distribution of scores for each midpoint age by literacy group. Percentiles scores were then converted into scaled scores with a mean of 10 and a standard deviation of 3 using the percentile ranges as described by Ivnik et al. (1992a). This procedure offers the advantage of normalizing the distribution of test scores.

For some participants, one or more of the cognitive measures were not administered due to difficulty understanding the task, sensory or physical difficulties that interfered with task performance, illness, or the participants' choices to discontinue the task. Compared to participants without any missing cognitive data, those with missing data were older (49.32 years of age compared to 47.66 years of age), less educated (11.41 years compared to 12.19 years), less literate

(WRAT-3 Reading total score of 37.71 compared to 41.10), more likely to score 16 or higher on the CES-D (34% compared to 24%), and less likely to report that marijuana use was a problem in their lives (11% compared to 19%; all $ps < .05$). Tests that were completed by the participant were included in the norms, therefore there is some variation in sample size among tests in each age group. Sample size variation was also caused by the removal of individuals from the analysis of individual tests if they reported health conditions that significantly affected the test score.

Tables 5–10 provide raw score to scaled score conversions for the six midpoint age groups. Medical conditions excluded from the normative data for each test are listed in Table 11. To account for the effect of self-reported depression and hypertension on test scores, Table 12 provides raw score adjustments, which are based on differences in mean scores as a function of the presence or absence of depression and hypertension in each age group.

Note that normative data for individuals with an eighth-grade reading level or lower (WRAT-3 Reading total score of ≤ 40) are presented in the upper portion of the normative tables, while norms for individuals with at least a ninth-grade reading level (WRAT-3 Reading total score of >40) are presented in the lower section of the tables. To use these data, consult Table 12 to determine whether a raw score adjustment is required, select the normative table corresponding to the patient's age and the section of the table corresponding to the patient's literacy level, find the raw score for each test under the appropriate test heading, and refer across to the scaled score in the left-hand column, and the percentile range in the right-hand column. Nonstandard administration for some measures, as described in the Method section, must be kept in mind when using these normative data. In addition, sex differences on some cognitive measures must be considered (see Table 2). Although sex was a statistically significant predictor of some measures, sex accounted for minimal variance in test scores and stratifying norms based on sex in addition to age and literacy group would have resulted in unacceptably small cell sizes. Additionally, the contribution of sex to test scores in the current study was similar to that described in other normative studies in which demographic corrections for sex were not provided based on its minimal contribution to test scores (e.g., Lucas et al., 2005). Table 13 provides descriptive statistics based on age group and sex for those cognitive scores that were significantly predicted by sex. These data can be used in conjunction with the scaled scores for interpretation of performance on those measures.

DISCUSSION

In this study we present the only source of literacy-based normative data for a mostly low SES African-American population. Consistent with previous studies (Manly et al., 1999, 2002), we found that literacy was a better predictor of cognitive test scores than years of education and had a highly significant incremental contribution to test scores after the effect of education was partialed out. As expected, age was also a significant predictor of most of our measures. Thus, age- and literacy-corrected scaled scores are presented for a number of neuropsychological tests, including the BVRT, CVLT, and TMT. Both the use of literacy for

Table 5 Normative data for age 33–37 (midpoint age 35)

Scaled score	BVRT errors	Trials 1–3	List B	SDFR	LDFR	Animals	Card rot.	BTA	Digits Forward	Digits Backward	TMT A	TMT B	Ident. Pic.	Percentile range
8th grade reading level or lower ($n = 42$–51)														
2	–	<9	0–1	–	0–1	<6	–	<2	<3	<3	–	–	<13	<1
3	–	–	–	–	–	–	–	–	–	–	–	–	–	1
4	–	–	2	0–2	2	6–8	–	2	–	–	83+	273+	13–15	2
5	9+	9–10	–	–	–	9	<2	–	–	–	53–82	199–272	–	3–5
6	–	11–13	–	3	3	10–12	2–12	3	3	–	43–52	149–198	16–18	6–10
7	8	14–15	–	–	4	–	13–14	–	4	–	38–42	117–148	–	11–18
8	–	16–19	3	4	–	13–14	15–19	4	–	3	37	106–116	19–21	19–28
9	7	20–22	–	5	5	15–17	20–25	–	5	–	32–36	100–105	22	29–40
10	6	23–25	4	6–7	6–7	18–19	26–31	5	6	–	29–31	81–99	23–25	41–59
11	5	26	5	–	–	20	32–37	6	–	4	26–28	70–80	26–27	60–71
12	4	27	–	8–9	8	21–22	38–45	–	7	5	–	63–69	28	72–81
13	0–3	28–29	6	–	–	–	46–55	7–8	8	–	22–25	54–62	29–30	82–89
14	–	30–33	–	10	9	23–25	56–72	9	9	6	21	53	31	90–94
15	–	34–36	7	11	10	26–28	73–75	10	10+	7+	19–20	52	32–38	95–97
16	–	37+	8+	12+	11+	29+	76+	–	–	–	–	–	39+	98
17	–	–	–	–	–	–	–	–	–	–	18	51	–	99
18	–	–	–	–	–	–	–	–	–	–	<18	<51	–	>99

(*continued*)

Table 5 Continued

Scaled score	BVRT errors	Trials 1–3	List B	SDFR	LDFR	Animals	Card rot.	BTA	Digits Forward	Digits Backward	TMT A	TMT B	Ident. Pic.	Percentile range
9th grade reading level or greater ($n = 56–63$)														
2	–	<11	0	<4	<3	<8	<3	<4	0–2	0–2	56+	–	<14	<1
3	–	11–14	1	–	–	–	3–5	–	3	3	49–55	216+	14–15	1
4	–	–	–	–	–	–	–	–	–	–	–	181–215	–	2
5	8+	15–17	2	–	3	8–10	6–13	–	4	–	45–48	180	16–18	3–5
6	7	18	3	4	–	11–13	14–20	–	–	–	43–44	154–179	19–20	6–10
7	–	19	–	–	4	14	21–25	4	–	–	37–42	110–153	21–22	11–18
8	6	20–21	–	5	5	15–16	26–28	5	5	4	34–36	103–109	23	19–28
9	–	22–24	4	6	6	17–18	29–34	6	–	–	32–33	88–102	24	29–40
10	4–5	25–28	5	7–8	7–8	19–20	35–41	7	6	5	27–31	79–87	25–27	41–59
11	3	29–30	6	9	9	21–22	42–48	–	7	–	26	68–78	28–29	60–71
12	2	31–32	–	10	–	23	49–52	8	8–9	–	23–25	61–67	–	72–81
13	0–1	33	7	11	10–11	24	53–58	–	–	6–7	20–22	47–60	30–31	82–89
14	–	34–36	8–9	–	12	25–28	59–63	9	10	8	19	44–46	32–33	90–94
15	–	–	–	12	–	–	64–67	10	11+	9	18	36–43	34–35	95–97
16	–	37–40	10	13	13	29–30	68–71	–	–	10+	–	35	36–43	98
17	–	41+	11+	14+	14+	31+	72+	–	–	–	17	31–34	44+	99
18	–	–	–	–	–	–	–	–	–	–	<17	<31	–	>99

Note: Reading level is based on a cutoff of 40 on the Wide Range Achievement Test–Third Edition (≤40 total score = 8th grade or lower; >40 = 9th grade or higher). See Table 11 for a list of medical conditions that were excluded from the normative sample for each test.

Table 6 Normative data for age 38–42 (midpoint age 40)

Scaled score	BVRT errors	Trials 1–3	List B	SDFR	LDFR	Animals	Card rot.	BTA	Digits Forward	Digits Backward	TMT A	TMT B	Ident. Pic.	Percentile range
8th grade reading level or lower ($n = 46–65$)														
2	–	0–1	–	–	–	<9	<2	0	<3	<2	–	–	<8	<1
3	–	2–8	0	–	0–1	9–10	–	–	–	–	59+	305+	8–12	1
4	–	–	–	–	–	–	2–9	–	–	–	56–58	274–304	–	2
5	10+	–	–	0	–	11–12	10–12	1–2	–	–	48–55	227–273	13–14	3–5
6	–	9–11	1	1–2	–	–	–	–	3	–	43–47	170–226	15	6–10
7	9	12–13	2	–	2	13	13–16	3	4	2	40–42	149–169	16–18	11–18
8	8	14–15	–	3	3–4	14–15	17–19	–	–	–	38–39	117–148	–	19–28
9	7	16–18	3	4–5	5	–	20–26	4	5	3	36–37	103–116	19–21	29–40
10	6	19–24	4	6–7	6	16–17	27–30	5	6	–	30–35	82–102	22–23	41–59
11	5	25–26	5	–	7	18–19	31–36	6	–	4	28–29	74–81	24–26	60–71
12	4	27	–	8	8	20–21	37–41	–	7	5	25–27	63–73	27	72–81
13	0–3	28–29	6	9	9	22–23	42–53	7	8	–	21–24	59–62	28	82–89
14	–	30	7	10	–	24–25	54–61	8	–	6	19–20	53–58	29	90–94
15	–	31–34	8+	–	10	26–28	62–72	9	9–10	7–8	17–18	45–52	30	95–97
16	–	35–36	–	11–12	11–14	29	73+	10	11+	9+	16	44	31–34	98
17	–	37+	–	13+	15–16	30+	–	–	–	–	14–15	41–43	35+	99
18	–	–	–	–	–	–	–	–	–	–	<14	<41	–	>99

(*continued*)

Table 6 Continued

Scaled score	BVRT errors	Trials 1–3	List B	SDFR	LDFR	Animals	Card rot.	BTA	Digits Forward	Digits Backward	TMT A	TMT B	Ident. Pic.	Percentile range
9th grade reading level or greater ($n = 62$–84)														
2	–	<10	–	0–1	0	<8	–	–	<4	<2	–	–	<12	<1
3	9+	10–11	0	–	1	–	0–1	1	–	2	59+	249+	–	1
4	–	12	1	–	2	8–9	–	–	–	–	55–58	223–248	12–13	2
5	–	13–17	2	2–3	–	10	2–3	2–3	4	3	49–54	186–222	–	3–5
6	8	18	3	4	3	11–12	4–5	–	–	–	44–48	168–185	14–15	6–10
7	–	19–20	–	5	4	13	6–16	4	5	–	39–43	128–167	16–17	11–18
8	7	21	–	–	5	14–15	17–23	–	–	4	36–38	106–127	18–20	19–28
9	6	22–24	4	6–7	6	16–18	24–29	5–6	6	–	32–35	95–105	21–22	29–40
10	4–5	25–28	5	8	7–8	19	30–39	7	7	5	27–31	82–94	23–25	41–59
11	3	29–30	6	–	9	20	40–46	–	–	–	26	70–81	26–27	60–71
12	2	31	–	9–10	–	21–22	47–49	8	8–9	6	24–25	59–69	28–29	72–81
13	0–1	32–33	7	11	10–11	23–25	50–58	9	–	7	21–23	52–58	30–31	82–89
14	–	34–36	8	–	12	26–27	59–63	10	10	8	20	46–51	32	90–94
15	–	37–39	9–10	12–13	13	28–29	64–68	–	–	9	–	44–45	33–41	95–97
16	–	40	11+	14	14	30	69–70	–	11	10+	19	40–43	42–43	98
17	–	41+	–	15–16	15–16	31+	71+	–	12+	–	17–18	31–39	44+	99
18	–	–	–	–	–	–	–	–	–	–	<17	<31	–	>99

Reading level is based on a cutoff of 40 on the Wide Range Achievement Test–Third Edition (≤40 total score = 8th grade or lower; >40 = 9th grade or higher). See Table 11 for a list of medical conditions that were excluded from the normative sample for each test.

Table 7 Normative data for age 43–47 (midpoint age 45)

Scaled Score	BVRT errors	Trials 1–3	List B	SDFR	LDFR	Animals	Card rot.	BTA	Digits Forward	Digits Backward	TMT A	TMT B	Ident. Pic.	Percentile range
8th grade reading level or lower ($n = 81–113$)														
2	–	<9	–	–	–	<11	–	0	0–1	0	–	–	<7	<1
3	–	9	–	–	–	11	0	–	2	1	79+	305+	7–8	1
4	–	10	–	–	–	–	–	1	–	–	70–78	294–304	9	2
5	–	11	0	0	0	–	1–2	–	3	–	59–69	255–293	10–12	3–5
6	10+	12–13	1	1–2	1	12	3–6	2	–	–	48–58	192–254	13–14	6–10
7	9	14–15	2	–	2	13	7–11	–	–	2	43–47	159–191	15–16	11–18
8	8	16–17	–	3	3	14	12–16	3	4	3	38–42	136–158	17–18	19–28
9	7	18–19	3	4	4	15	17–24	4	5	–	36–37	112–135	19	29–40
10	6	20–22	4	5–6	5–6	16–17	25–31	5	–	–	33–35	94–111	20–22	41–59
11	5	23–24	5	7	7	18–19	32–35	6	6	4	30–32	81–93	23	60–71
12	4	25–26	–	8	–	20	36–39	–	7	5	25–29	73–80	24	72–81
13	0–3	27–28	6	9	8–9	21–22	40–46	7	8	6	23–24	60–72	25–27	82–89
14	–	29–30	–	–	–	23–24	47–55	8	–	7	20–22	51–59	28	90–94
15	–	31–32	7	10	10	25–27	56–61	–	9	8	18–19	45–50	29	95–97
16	–	33–34	8	11–12	11–14	28–29	62+	9	10	–	16–17	44	30–32	98
17	–	35–36	9+	13+	15–16	30+	–	10	11+	9	14–15	41–43	33–34	99
18	–	37+	–	–	–	–	–	–	–	10+	<14	<41	35+	>99

(*continued*)

Table 7 Continued

Scaled Score	BVRT errors	Trials 1–3	List B	SDFR	LDFR	Animals	Card rot.	BTA	Digits Forward	Digits Backward	TMT A	TMT B	Ident. Pic.	Percentile range
9th grade reading level or greater ($n = 81–104$)														
2	–	<11	–	0–1	0	<9	–	0	–	0–1	–	–	<12	<1
3	10+	11	0–1	–	1	–	0–1	1	0–3	–	99+	–	–	1
4	–	12	–	–	2	9	2	–	–	2	70–98	249+	–	2
5	9	13–16	–	2	3	10	3–4	–	–	–	58–69	207–248	12–13	3–5
6	8	17–18	2	3–4	–	11	5–6	2–3	4	3	49–57	186–206	14	6–10
7	–	19	3	–	4	12	7–16	–	5	–	44–48	150–185	15–16	11–18
8	7	20–21	–	5	5	13	17–20	4	–	4	39–43	129–149	17	19–28
9	6	22–23	4	6	6	14–17	21–29	5	6	–	35–38	101–128	18–21	29–40
10	4–5	24–27	5	7–8	7–8	18–19	30–36	6	7	5	30–34	80–100	22–23	41–59
11	–	28	–	–	–	20	37–43	7	8	–	27–29	70–79	24–25	60–71
12	1–3	29–30	6	9	9	21–23	44–46	8	9	6	24–26	61–69	26–29	72–81
13	0	31–32	7	10	10	24–25	47–53	9	–	7	23	54–60	30	82–89
14	–	33–34	8	11	11	26–29	54–60	10	10	8	20–22	47–53	31–32	90–94
15	–	35–36	9	12–13	12–13	30–32	61–68	–	11	9–11	17–19	46	33–34	95–97
16	–	37	10	14	14	33	69–70	–	12+	12+	16	45	35–41	98
17	–	38–39	11+	15–16	15–16	34+	71+	–	–	–	<16	40–44	42+	99
18	–	40+	–	–	–	–	–	–	–	–	–	<40	–	>99

Reading level is based on a cutoff of 40 on the Wide Range Achievement Test–Third Edition (≤40 total score = 8th grade or lower; >40 = 9th grade or higher). See Table 11 for a list of medical conditions that were excluded from the normative sample for each test.

Table 8 Normative data for age 48–52 (midpoint age 50)

Scaled score	BVRT errors	Trials 1–3	List B	SDFR	LDFR	Animals	Card rot.	BTA	Digits Forward	Digits Backward	TMT A	TMT B	Ident. Pic.	Percentile range
8th grade reading level or lower ($n = 105–138$)														
2	–	<10	–	–	–	<7	–	0–1	0–2	0	119+	–	<8	<1
3	–	–	–	–	–	7–9	−2	–	–	1	84–118	294+	8	1
4	–	10	–	–	0	–	−1	–	3	–	80–83	288–293	–	2
5	–	11	0	0	–	10–11	0	2	–	–	70–79	255–287	9–10	3–5
6	10+	12–14	1	1	1	–	1–4	–	–	–	57–69	209–254	11–12	6–10
7	9	15–16	2	2	2	12	5–10	–	4	2	50–56	176–208	13	11–18
8	8	17	3	3	3	13	11–15	3–4	–	3	45–49	158–175	14–15	19–28
9	7	18–19	–	–	4	14	16–20	–	5	–	38–44	132–157	16–17	29–40
10	6	20–21	4	4–5	5	15–16	21–29	5	–	4	35–37	104–131	18–20	41–59
11	5	22–23	–	6	6	17	30–33	6	6	–	31–34	91–103	21	60–71
12	3–4	24–25	5	7	7	18–19	34–40	–	7	5	29–30	79–90	22–23	72–81
13	0–2	26–27	–	8	8	20–22	41–44	7	–	6	26–28	72–78	24	82–89
14	–	28–29	6	9	9	23	45–51	8	8	–	24–25	60–71	25–27	90–94
15	–	30–31	–	–	10	24–25	52–59	9	9	7	22–23	50–59	28–29	95–97
16	–	32	7	–	–	26–27	60–61	10	10	–	21	46–49	30–34	98
17	–	33	8	10	11–12	28–29	62+	–	11+	8–9	20	45	35+	99
18	–	34+	9+	11+	13+	30+	–	–	–	10+	<20	<45	–	>99

(*continued*)

Table 8 Continued

Scaled score	BVRT errors	Trials 1–3	List B	SDFR	LDFR	Animals	Card rot.	BTA	Digits Forward	Digits Backward	TMT A	TMT B	Ident. Pic.	Percentile range
9th grade reading level or greater ($n = 84–106$)														
2	–	<12	–	0	0	<6	<2	0	–	0–1	–	–	<12	<1
3	10+	12	0–1	–	–	6–7	2	1	0–3	2	99+	–	–	1
4	–	–	–	–	1	8	3–4	–	–	–	92–98	249+	–	2
5	9	13–15	–	1	2	9	5–6	2	4	3	65–91	209–248	12	3–5
6	8	16–17	2	2–3	3	10	7–11	3	5	–	56–64	186–208	13–14	6–10
7	–	18–19	3	4	4	11–12	12–15	–	–	–	45–55	155–185	15	11–18
8	7	20	–	–	–	13–14	16–18	4	6	4	42–44	131–154	16–17	19–28
9	6	21–22	4	5	5	15–16	19–27	5	–	–	38–41	109–130	18–19	29–40
10	4–5	23–25	5	6–7	6–7	17–19	28–32	6	7	5	32–37	81–108	20–22	41–59
11	–	26–28	–	8	8	20–21	33–36	–	8	6	29–31	70–80	23–24	60–71
12	1–3	29	6	9	9	22	37–42	7–8	9	7	25–28	62–69	25–26	72–81
13	0	30–31	–	10	–	23–24	43–47	–	10	–	23–24	58–61	27–29	82–89
14	–	32–33	7	–	10	25–26	48–53	9	–	8	20–22	52–57	30	90–94
15	–	34	8–9	11	11–12	27–32	54–60	10	11	9–11	17–19	46–51	31–32	95–97
16	–	35–36	10+	12	13	33	61–66	–	12–13	12–14	16	45	33	98
17	–	37+	–	13+	14–16	34+	67+	–	14	–	<16	<45	34–41	99
18	–	–	–	–	–	–	–	–	–	–	–	–	42+	>99

Reading level is based on a cutoff of 40 on the Wide Range Achievement Test–Third Edition (≤40 total score = 8th grade or lower; >40 = 9th grade or higher). See Table 11 for a list of medical conditions that were excluded from the normative sample for each test.

Table 9 Normative data for age 53–57 (midpoint age 55)

Scaled score	BVRT errors	Trials 1–3	List B	SDFR	LDFR	Animals	Card rot.	BTA	Digits Forward	Digits Backward	TMT A	TMT B	Ident. Pic.	Percentile range
8th grade reading level or lower ($n = 77–103$)														
2	–	<10	–	–	–	<7	–	–	0–2	–	–	–	<5	<1
3	–	–	–	–	–	–	−2	0	3	0–1	119+	268+	5–7	1
4	–	10	–	–	0	7–8	–1	1	–	–	85–118	255–267	8	2
5	–	11	0–1	0	–	9	0–2	–	–	–	80–84	223–254	9	3–5
6	10+	12	–	1	1	10–11	3–4	2	–	–	69–79	210–222	10	6–10
7	9	13–16	2	2	2–3	–	5–12	–	4	2	56–68	196–209	11–12	11–18
8	8	17	–	–	–	12	13–16	3	–	–	50–55	161–195	13	19–28
9	7	18–19	3–4	3–4	4	13–14	17–20	4	5	3	44–49	143–160	14–15	29–40
10	6	20–21	–	–	5	15–16	21–27	5	–	4	38–43	105–142	16–19	41–59
11	5	22–23	–	5	6	17	28–33	6	6	–	31–37	95–104	20	60–71
12	4	24–25	5	6	–	18–19	34–40	–	7	5	29–30	83–94	21–22	72–81
13	0–3	26	6	7–8	7–8	20–21	41–42	7	–	6	27–28	77–82	23	82–89
14	–	27–29	–	9	9	22–23	43–49	8	8–9	–	25–26	61–76	24–25	90–94
15	–	30–33	7	10–12	10	24–25	50–57	9	10	7	24	46–60	26–33	95–97
16	–	34	8+	13+	11–12	26–30	58–59	10	11+	8+	23	45	34	98
17	–	35+	–	–	13+	31+	60+	–	–	–	20–22	41–44	35+	99
18	–	–	–	–	–	–	–	–	–	–	<20	<41	–	>99

(*continued*)

Table 9 Continued

Scaled score	BVRT errors	Trials 1–3	List B	SDFR	LDFR	Animals	Card rot.	BTA	Digits Forward	Digits Backward	TMT A	TMT B	Ident. Pic.	Percentile range
9th grade reading level or greater ($n = 71–92$)														
2	–	<13	–	–	–	<6	0–1	0	–	0–2	–	–	<10	<1
3	–	–	0–1	0	0	6	2–5	1–2	0–3	–	99+	249+	10	1
4	–	–	–	–	–	7	6–7	–	–	3	92–98	221–248	11	2
5	9+	13–15	2	–	1	8	8–9	–	4	–	67–91	186–220	–	3–5
6	–	16–17	–	1–2	2	9–10	10–12	3	–	–	60–66	172–185	12	6–10
7	8	18–19	3	3	3	11–12	13–15	–	5	4	50–59	140–171	13–14	11–18
8	7	20	–	4	4	13–14	16–17	4	6	–	45–49	115–139	15–16	19–28
9	6	21	4	5	5	15–16	18–27	5	–	–	41–44	100–114	17	29–40
10	5	22–24	5	6	6	17–19	28–32	6	7	5	33–40	81–99	18–21	41–59
11	4	25–26	–	7	7	20	33–36	7	8	6	30–32	71–80	22–23	60–71
12	0–3	27–28	6	8	8	21–22	37–42	–	–	7	28–29	63–70	24–25	72–81
13	–	29–30	7	9	9	23	43–45	8	9–10	–	24–27	59–62	26–27	82–89
14	–	31	–	–	10	24	46–56	9	–	8–9	23	52–58	28–29	90–94
15	–	32–33	8	10–11	11–13	25	57–60	10	11	10–11	22	–	30–31	95–97
16	–	34	9	12+	14	26+	61–66	–	12–13	12–14	19–21	51	32–33	98
17	–	35+	10+	–	15–16	–	67+	–	14	–	17–18	49–50	34+	99
18	–	–	–	–	–	–	–	–	–	–	<17	<49	–	>99

Reading level is based on a cutoff of 40 on the Wide Range Achievement Test–Third Edition (≤40 total score = 8th grade or lower; >40 = 9th grade or higher). See Table 11 for a list of medical conditions that were excluded from the normative sample for each test.

Table 10 Normative data for age 58–62 (midpoint age 60)

Scaled score	BVRT errors	Trials 1–3	List B	SDFR	LDFR	Animals	Card rot.	BTA	Digits Forward	Digits Backward	TMT A	TMT B	Ident. Pic.	Percentile range
8th grade reading level or lower ($n = 48–67$)														
2	–	<10	–	–	–	<7	<3	–	<4	0–1	–	–	<7	<1
3	–	10	–	–	–	–	–	–	–	–	–	–	7	1
4	–	–	–	–	–	7–8	–	–	–	–	164+	255+	–	2
5	–	11	0	0	0	–	3–4	0	–	–	95–163	217–254	8	3–5
6	10+	12–13	1	1	1	9–10	5	1	4	–	72–94	209–216	9	6–10
7	9	14–15	2	2	2	11	6–10	2	–	–	68–71	179–208	10–11	11–18
8	–	16–17	3	3	3	12–13	11–14	–	–	2	55–67	146–178	12	19–28
9	8	18–19	–	4	4	14	15–18	3	5	–	48–54	133–145	13	29–40
10	7	20	4	5	5	15–16	19–24	4–5	–	3–4	41–47	116–132	14–17	41–59
11	6	21–22	5	6	6	17–18	25–31	–	6	–	34–40	102–115	18–19	60–71
12	5	23–25	6	7	7	19	32–36	6	7	5–6	29–33	95–101	20–21	72–81
13	3–4	26	–	–	8	20–21	37–40	7	8–9	–	27–28	77–94	22–23	82–89
14	0–2	27–28	7	8–9	9	22	41–48	8	–	–	26	62–76	24–25	90–94
15	–	29–30	8+	10–12	10	23–25	49–51	9	10	7	24–25	42–61	26–28	95–97
16	–	31–34	–	13+	11+	26–30	52+	10	11+	8+	23	–	29–33	98
17	–	35+	–	–	–	31+	–	–	–	–	22	41	34+	99
18	–	–	–	–	–	–	–	–	–	–	<22	<41	–	>99

(*continued*)

Table 10 Continued

Scaled score	BVRT errors	Trials 1–3	List B	SDFR	LDFR	Animals	Card rot.	BTA	Digits Forward	Digits Backward	TMT A	TMT B	Ident. Pic.	Percentile range
9th grade reading level or greater ($n = 51–72$)														
2		<12	0–1	–	–	<7	–	0	0–2	–	–	–	<7	<1
3	9+	12	–	–	–	7	<1	1	3	0–1	–	–	7	1
4	–	–	–	–	0	8	–	–	–	–	80+	271+	–	2
5	–	13–16	2	0	1	9–10	2–8	2	4	2	67–79	183–270	8	3–5
6	–	17	–	1	–	11	9–10	–	5	3	53–66	174–182	9	6–10
7	8	18–19	3	2	2–3	12	11–16	3	–	–	47–52	147–173	10–11	11–18
8	–	20	–	3	4	13–15	17–19	4	6	4	44–46	120–146	12	19–28
9	6–7	21–22	4	4	–	16	20–27	5	–	–	40–43	103–119	13	29–40
10	5	23–25	5	5–6	5–6	17–19	28–33	6	7	5	33–39	85–102	14–17	41–59
11	4	26	–	–	7	20	34–39	7	8	6	30–32	72–84	18–19	60–71
12	1–3	27–28	6	7–8	8	21	40–42	–	9	–	28–29	64–71	20–21	72–81
13	0	29	–	9	9	22	43–45	8	–	7–8	25–27	57–63	22–23	82–89
14	–	30–31	7	–	10	23–24	46–56	9	10	9	22–24	53–56	24–25	90–94
15	–	32–33	8	10–11	11–13	25	57	10	11	10	20–21	51–52	26–28	95–97
16	–	34	9	12+	14	26–30	58–65	–	12–13	11	18–19	50	29–33	98
17	–	35+	10+	–	15–16	31+	66+	–	14	12–14	17	49	34+	99
18	–	–	–	–	–	–	–	–	–	–	<17	<49	–	>99

Reading level is based on a cutoff of 40 on the Wide Range Achievement Test–Third Edition (≤40 total score = 8th grade or lower; >40 = 9th grade or higher). See Table 11 for a list of medical conditions that were excluded from the normative sample for each test.

Table 11 Medical conditions excluded from normative data for individual tests

	Medical conditions
BVRT errors	HIV/AIDS, CASHD
CVLT	
List B	Hepatitis C
SDFR	Sickle Cell Disease, HIV/AIDS
LDFR	HIV/AIDS
Animals	Anxiety Disorders
Card Rotation	Cocaine problems*
BTA	Cocaine problems*, CASHD
Digits Forward	Opiate problems*
TMT A & B	Diabetes

Presence of medical and psychological conditions is self-reported. CASHD = coronary atherosclerotic heart disease; BVRT = Benton Visual Retention Test; CVLT = California Verbal Learning Test; SDFR = Short-delay Free Recall; LDFR = Long-delay Free Recall; BTA = Brief Test of Attention; TMT = Trail Making Test.

*"Alcohol and drug problems" indicates a self-reported history of substance abuse treatment, tolerance, substance-related problems in the previous six months, or overdosing.

stratifying groups and the characteristics of the normative sample (i.e., a mostly low SES African-American population) provide a unique and valuable resource for clinicians. The validity of normative data largely depends on the degree to which an individual shares the demographic features of the normative sample. The use of inappropriate norms may result in a high number of false positive conclusions of impairment in individuals whose scores are actually within the expected range of performance for individuals with their demographic characteristics (Ardila, 1995; Campbell et al., 2002; Manly et al., 1998a, 1998b; Welsh et al., 1995). Thus, the current normative data are aimed at improving diagnostic accuracy in low SES African-American clients.

It should be noted that the use of demographically adjusted norms, particularly race-based norms, has been debated (Campbell et al., 2002; Fastenau, 1998; Fastenau & Adams, 1996; Heaton, Taylor, & Manly, 2003; Lezak et al., 2004; Manly, 2005; Manly & Jacobs 2002; Reitan & Wolfson, 1995). Race-based norms have a number of limitations. For example, because they do not explain why ethnic differences in cognitive test performance exist or address the lack of cultural equivalence in cognitive measures, they may inappropriately provide a basis for negative comparisons between groups (Manly, 2005; Sattler, 2001). The use of such norms carries the risk of harmful misinterpretation when factors that likely underlie observed group differences are not taken into account, including cultural differences (e.g., variability in response set and test-taking attitudes), and a history of racial discrimination and unequal access to educational opportunities. It has also been noted that race-based norming is limited by the complexities inherent in measuring ethnicity and culture (Gasquoine, 1999; Manly, 2005). Additionally, concerns have been raised that race-specific norms may lead to lower expectations for children from groups that differ culturally and linguistically from the majority, and that they have little relevance outside of the geographic area in which they were collected (Sattler, 2001).

Table 12 Self-reported hypertension and depression adjustments for selected raw test scores

	Ages 33–37 (Midpoint age 35)		Ages 38–42 (Midpoint age 40)		Ages 43–47 (Midpoint age 45)		Ages 48–52 (Midpoint age 50)		Ages 53–57 (Midpoint age 55)		Ages 48–62 (Midpoint age 60)	
Depression	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
CVLT Trials 1–3	+2	0	+3	−1	+1	0	+1	0	+1	0	+1	0
Identical Pictures	+3	−1	+2	0	+1	0	+1	0	+1	0	0	0
Hypertension	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Card Rotation	+5	−1	+2	−1	+2	−1	+2	−2	+2	−3	+3	−5
TMT A	0	0	0	0	−1	+1	−1	+1	−2	+1	−3	+4
Identical Pictures	0	0	0	0	0	0	+1	−1	+1	−1	+1	−2
Depression + Hypertension												
Identical Pictures	+1	0	+1	0	+1	0	+2	0	+1	0	+1	0

CVLT = California Verbal Learning Test; TMT = Trail Making Test.

Table 13 Means (+standard deviation) of selected test scores for men and women in each age group

	Midpoint age 35	Midpoint age 40	Midpoint age 45	Midpoint age 50	Midpoint age 55	Midpoint age 60
Men						
BVRT err	3.56 (2.59)	3.71 (2.66)	4.09 (2.68)	4.22 (2.86)	4.24 (3.05)	4.90 (3.22)
CVLT 1–3	24.24 (6.49)	23.12 (6.96)	22.27 (6.65)	21.49 (5.77)	21.20 (5.53)	21.24 (5.94)
LDFR	7.43 (2.91)	6.98 (3.16)	6.47 (3.09)	5.82 (2.87)	5.37 (2.71)	5.16 (2.92)
Animals	19.24 (4.68)	18.71 (4.55)	18.69 (5.02)	18.65 (4.95)	18.14 (4.59)	30.34 (14.91)
Card Rotat	37.63 (16.26)	36.24 (16.84)	35.48 (14.94)	32.20 (14.85)	29.63 (15.17)	17.91 (4.63)
Women						
BVRT err	4.88 (2.37)	5.03 (2.72)	5.38 (2.92)	5.25 (3.01)	5.07 (2.81)	5.51 (2.56)
CVLT 1–3	25.89 (6.88)	25.44 (7.22)	24.60 (6.19)	23.37 (5.54)	23.28 (5.14)	23.13 (4.84)
LDFR	7.74 (2.43)	7.60 (2.93)	6.92 (2.88)	6.40 (2.67)	6.38 (2.77)	6.34 (2.79)
Animals	32.73 (17.35)	30.51 (17.55)	25.61 (16.56)	24.21 (14.36)	26.21 (14.10)	24.49 (13.60)
Card Rotat	18.44 (5.20)	18.61 (4.97)	17.51 (4.83)	16.18 (4.53)	16.09 (4.55)	16.47 (4.93)

BVRT err = Benton Visual Retention Test errors; CVLT 1–3 = California Verbal Learning Test Trials; LDFR = Long-delay Free Recall; Card Rotat = Card Rotation.

Nonetheless, when used appropriately separate norms provide improved diagnostic accuracy, resulting in tremendous benefits to patients (Ardila, 1995; Campbell et al., 2002; Manly et al., 1998a, 1998b; Welsh et al., 1995). The current norms are not designed to replace previously published normative data. Rather, they provide an additional source of information for clinicians to use in clinical decision making. At times, comparing the patient to the general population would provide the most useful information (e.g., learning disability evaluations). The present data are most valuable when establishing whether patients who are demographically similar to the normative sample have declined from a previous level of cognitive functioning, or for establishing cognitive strengths and weaknesses relative to the typical individual in their demographic group. In those instances, comparing the patient's current level of functioning to that of our normative sample would likely result in fewer false positives than if the patient's scores were compared to norms derived from exclusively or predominantly white samples.

A few limitations of this study should be noted. First, our sample was drawn exclusively from the Baltimore area; thus, the inclusion of African Americans from other regions would have been valuable in addressing the validity of the normative data we have provided. Second, determination of the presence of psychological and medical conditions was based on self-report of a lifetime history of each condition, rather than medical record review or structured diagnostic interview. Thus, the limits of self-reported health information as well as the lack of distinction between active, controlled, and past conditions must be considered. Third, although sex was a significant predictor of some cognitive measures, stratifying groups based on sex, in addition to age-group and literacy, would have resulted in very small cell sizes. Future normative studies with larger sample sizes will be useful in providing norms that are based on age, literacy, and sex. In addition, the sample sizes for

some of our age by literacy groups are small and thus susceptible to low reliability. Clinicians should use norms for these groups with caution. Nonetheless, the present data are useful in that they provide much needed information about the neuropsychological test performance of low SES urban-dwelling African Americans, and provide norms based on literacy, which appears to be a more accurate reflection of educational experiences than years of education.

In conclusion, this paper has provided clinicians with normative data designed to assist in the clinical decision-making process by improving the diagnostic accuracy of performances by low SES African-American clients. Our hope is that literacy-based norms will become available for a variety of neuropsychological measures and across different races and age groups. In addition, it is crucial that future research aims to improve our understanding of the meaning of test performance among culturally diverse clients by examining the contribution of differential cultural experiences to neuropsychological test performance.

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