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African American acculturation and neuropsychological test performance following traumatic brain injury

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Abstract

The present study examined the influence of African American acculturation on the performance of neuropsychological tests following traumatic brain injury (TBI). Seventy one participants already enrolled in a larger-scale study assessing the impact of TBI (i.e., the South Eastern Michigan Traumatic Brain Injury Model Systems project) completed a self-report measure of African American acculturation (African American Acculturation Scale–Short Form; Landrine & Klonoff, 1995) in addition to a standardized battery of neuropsychological tests. Hierarchical regression analyses were conducted to evaluate the relationship between level of acculturation and test performance after controlling for injury-related (initial Glasgow Coma Scale score, time since injury) and demographic variables (age, sex, years of education, and socioeconomic status). Lower levels of acculturation were associated with significantly poorer performances on the Galveston Orientation & Amnesia Test, MAE Tokens test, WAIS–R Block Design, Rey Auditory Verbal Learning Test, and Symbol Digit Modalities Test. Decreased levels of acculturation were also significantly related to lower scores on a composite indicator of overall neuropsychological test performance. In addition, the examiner's ethnicity (Black or White) was related with scores on a few of the tests (i.e., Block Design, Trail Making Test), but was not significantly associated with the overall neuropsychological test performance. Overall, these findings suggest that differences in cultural experience may be an important factor in the neuropsychological assessment of African Americans following TBI, and provide additional support for the hypothesis that cultural factors may partially account for the differences among ethnic/cultural groups on neuropsychological tests. (*JINS*, 2004, *10*, 566–577.)

Keywords: Culture, Neuropsychology, Acculturation, Assessment

INTRODUCTION

An increasing number of studies have indicated that educational, linguistic, and cultural factors may have a significant influence on neuropsychological test performance (e.g., Heaton et al., 1996; Manly et al., 1998a; Welsh et al., 1995). Some authors have argued that such findings reflect differences in underlying cerebral development and organization among cultural groups (Kennepohl, 1999; Wong et al., 2000). Some research has also suggested that certain minorities, including African Americans, may be at increased risk for a number of neurological conditions, including dementia (Welsh et al., 1995), stroke (Giles et al., 1995), spinal cord injury (Devivo et al., 1992), and TBI (Rosenthal et al., 1996).

Although some researchers have suggested that this gap may be shrinking (e.g., Flynn, 1999; Vincent et al., 1991), it remains well established that African Americans as a group typically obtain significantly lower scores on most measures of general cognitive ability (e.g., Kaufman et al., 1988; Reynolds et al., 1987). In their re-analysis of the standardization sample of the WAIS–R, for example, Kaufman et al. (1988) found significant effects for ethnicity in each of the age groups assessed. The largest Black–White differences between groups were observed on the Block Design and Vocabulary subtests, tasks that correlate best with Full Scale IQ.

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There is also accumulating evidence that current neuropsychological measures may be culturally biased. Several studies with medically healthy individuals have indicated that minorities in the United States are considered cognitively impaired at much higher rates than European Americans, even if one controls other variables such as years of education and socioeconomic status (e.g., Jacobs et al., 1997; Loewenstein et al., 1993, 1995; Manly et al., 1998a; Marcopoulos et al., 1997; Welsh et al., 1995). Johnson-Selfridge et al. (1998) reported a significant relationship between ethnicity and word fluency after covarying for income level, education, and single-word reading (WRAT–R Reading), with European Americans producing significantly more words (FAS and Animal Names) than Hispanic Americans, who in turn scored better than African Americans. Manly et al. (1998a) found that when using a standard cut-off (more than 1 *SD*), at least 25% of a relatively large medically healthy African American sample ($N = 170$) scored in the impaired range on 12 of 16 neuropsychological measures administered. Sixty-five percent would have been classified as impaired on a naming task (Boston Naming Test).

In light of the above findings, there has been increased demand for the development of more appropriate normative data for use with African Americans (Manly & Jacobs, 2000; Nabors et al., 2000). However, there remain several unanswered questions, not the least of which concerns the origin of these differences. Cultural explanations for such findings have been increasing (e.g., Helms, 1992, 1997; Neisser et al., 1996). Culture may be defined as "the customs, values, traditions, and behavioural practices (including information-processing strategies) that define a group" (Helms, 1997, p. 520). In its most general form, the "cultural hypothesis" argues that limited exposure to mainstream (in this case American) culture will deleteriously affect performance on tests developed for use within the majority ethnic/cultural group (Helms, 1997).

The concept of acculturation has emerged as an important and practical concept in the study of cultural factors in pluralistic societies, and occurs when two or more groups come into continuous first-hand contact with each other for an extended period of time (Berry, 1989). Level of acculturation has been defined as the degree to which an individual espouses the cultural values, beliefs, and practices of a given ethnic group *versus* that of the dominant ethnic/cultural group (Landrine & Klonoff, 1995). Although such research has traditionally been conducted with immigrants, the concept of acculturation has more recently been applied to other minority groups, including the development of specific acculturation scales (e.g., African American Acculturation Scale; Landrine & Klonoff, 1994).

Few studies have formally assessed the degree to which level of acculturation may affect neuropsychological test performance. Arnold et al. (1994) assessed the relationship between Mexican American acculturation (Cuellar et al., 1980) and neuropsychological test performance. Their findings revealed a significant effect of acculturation for the Category test, Tactual Performance Test, and Seashore Rhythm Test after controlling for age, sex, and educational level. These authors speculated that these differences might reflect variations in problem solving and bilingualism among the cultural groups.

Manly et al. (1998a) conducted two studies assessing the impact of African American acculturation on neuropsychological test performance. In a first study, neurologically normal African American participants were asked to complete a battery of neuropsychological tests as well as an acculturation measure (African American Acculturation Scale–Short Form; Landrine & Klonoff, 1995). Level of acculturation predicted a significant amount of variance on many of the tests (Category Test, Trails A and B, WAIS–R Information, Block Design, and Digit Symbol, Boston Naming Test, the learning components of the Figure and Story Memory Tests, and Grooved Pegs). After controlling for the influence of demographic factors (age, sex, and years of education), acculturation effects remained significant for WAIS–R Information and the Boston Naming Test. In a second study, HIV-positive African American and European American participants were matched for age, education, sex, and HIV disease stage. Black participants scored significantly lower on the Category Test, WAIS–R Vocabulary, Boston Naming Test, WAIS–R Block Design, Grooved Pegboard (non-dominant), and the learning components of verbal (Story Learning) and visual (Figure Learning) memory tests. Covariance for acculturation scores resulted in all but one of these scores (Story Learning) becoming non-significant.

Some have proposed that mistrust of institutions among some African Americans may be another factor explaining certain ethnic/cultural differences. Terrell et al. (1981) directly assessed the role of mistrust on cognitive test performance. One hundred Black college students were administered a questionnaire (Cultural Mistrust Inventory) to assess their tendency to mistrust Whites. Participants were then divided into two groups (high *vs.* low mistrust) on the basis of their scores on this scale. Half the sample was administered the WAIS by a White examiner, the other half by a Black examiner. Although no main effects of examiner ethnicity or mistrust were evident, two significant interactions were found. Of those scoring high on the mistrust measure, those assessed by a Black examiner performed significantly better than those assessed by a White examiner (Black examiner–high mistrust > White examiner–high mistrust). If examined by a White examiner, those with lower mistrust performed better (White examiner–low mistrust > White examiner–high mistrust). Taken together, these findings suggest that underlying attitudes of mistrust in some Black test-takers might moderate cognitive test performance under specific circumstances. Furthermore, Steele (1997) has suggested that the underlying threat of negative stereotyping may also affect performance on cognitive tests among African Americans. In an intriguing set of studies, African American and European American university students were given a subset of items from the Graduate Record Examination (GRE). Half were told that it was a measure of "in-

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tellectual" ability; the remaining were told it was an assessment of "problem solving" ability. African Americans told that the measure was an indicator of general intelligence obtained lower scores than their matched European American counterparts; no such differences were found in the groups told the test was assessing a general ability to solve problems. In a follow-up study, simply asking participants to identify their racial background seemed to negatively affect the scores of African American participants on a problem-solving task. African Americans who were not asked their ethnic background performed just as well as the European American groups (Steele, 1997).

The goal of the present study was to specifically assess the influence of acculturation on neuropsychological test performance in a sample of individuals who had sustained a traumatic brain injury (TBI). There are a number of reasons why such a study seemed important, particularly in the case of TBI. First, this study represents one of very few to directly assess the influence of cultural factors on neuropsychological testing, and would potentially provide direct support for the cultural hypothesis of group differences on cognitive/neuropsychological tests. Second, some authors have suggested that minorities (including African Americans) are disproportionately represented in TBI populations, thereby increasing the relevance of such issues in TBI-related research (Rosenthal et al., 1996). If African American acculturation were found to be a significant predictor of neuropsychological test performance, this would likely increase the risk of misdiagnosing a significant proportion of individuals with TBI. Third, it seemed important to replicate the findings regarding level of acculturation and neuropsychological test performance within a TBI population, particularly as some of the prior literature could potentially be considered contradictory. On the one hand, there seems to be preliminary evidence that the influence of cultural factors on neuropsychological test scores may actually become more prominent with increased neurological impairment (e.g., Loewenstein et al., 1993). However, these findings should be contrasted with other reports suggesting that the use of demographic adjustments or corrections (of any kind) following TBI may not be necessary in the assessment of clear cases of neuropathology (e.g., Reitan & Wolfson, 1995).

It was generally hypothesized that individuals who espouse more traditional African American cultural values and beliefs (i.e., *lower* level of acculturation) would obtain lower scores on many of the administered tests. Cultural factors were also expected to predict test performance above and beyond what might be anticipated from other demographic factors such as age, sex, education, and socioeconomic status (SES). On the basis of prior findings, it was also hypothesized that acculturation effects would more likely be found on tests assessing language-related skills and/or complex cognitive abilities such as problem solving and reasoning. Finally, we expected that examiner ethnicity might affect test performance among participants that report some degree of cultural mistrust of majority White culture.

METHODS

Research Participants

All participants in the current study were already involved in the South Eastern Michigan Traumatic Brain Injury Systems (SEMTBIS) project at the time of their recruitment. The SEMTBIS project is part of a large, multicenter research effort dedicated to the collection of data on brain-injured individuals (Dahmer et al., 1993) and is funded by the National Institute on Disability and Rehabilitation Research. As part of the SEMTBIS project, participants complete a battery of neuropsychological tests, questionnaires, and rating scales at regular intervals post-TBI. Participants were recruited for the current study at approximately 1, 2, 5, or 10 years post injury. Following their completion of the SEMTBIS measures, participants were asked to complete a brief 5 to 10 min questionnaire. Participants typically filled out the questionnaire in written form; however, in cases where this proved too difficult (e.g., because of reading difficulties), participants were read items aloud. All participants were self-identified as "African American" from a set of written choices. Other variables of interest were obtained from the SEMTBIS database.

A total of 71 individuals between the ages of 21 to 76 years at the time of their participation (M = 42.2 years, SD = 13.1) were recruited over a 2-year period (1999–2001). As with most studies involving TBI, the proportion of males was greater (81.7% of the sample, n = 58). Mean years of education was about that of a high school graduate (M = 11.8, SD = 2.0). Approximately 45% of the sample was employed at least part-time (n = 32) prior to injury. As might be expected, there was a considerable drop-off in employment when comparing pre- and post-injury data. Of the 32 participants working at the time of their accident, only 9 were employed at the time of their post-injury assessment. The Hollingshead Two Factor Index of Social Status (Hollingshead, 1957, cf. Hollingshead, 1975) was used to derive a numerical estimate of SES. Premorbid occupational status was used in the derivation of SES. Using this measure, more than half of the sample (n = 31) was in the lowest SES bracket, and the vast majority (n = 42) were in the lowest two social strata ("Lower" and "Lower Middle").

Injury Characteristics

Almost half of the current sample (n = 33) incurred their TBI as a result of an assault. Of these, ten were the result of a gunshot wound. The other major cause of injury involved some type of motor vehicle accident (41%), either as occupants of a motor vehicle (n =20) or as pedestrians (n = 9). Other causes included falls (n = 9) and a cycling accident (n = 1). Time since injury was relatively evenly distributed. A little more than half were evaluated at 1 (n = 23) or 2 years (n = 15) following their TBI. Fifteen were assessed at 5 years post injury, and 18 at 10 years post injury. Lowest Glasgow Coma Scale (GCS) score within the first 24 hr of

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hospital admission was used as the indicator of injury severity (Teasdale & Jennett, 1974). Within the current sample, 33 individuals (46.5%) incurred a severe TBI (GCS = 3–8), 15 (21.1%) had a moderate injury (GCS = 9–12), while 23 participants (32.4%) were considered to have sustained a mild TBI (GCS = 13–15). It should be noted that mild TBI cases consisted of more complicated injuries that required inpatient rehabilitation. A number of the participants reported having suffered some form of head injury or concussion prior to their TBI ($n = 7$).

Measures

Individual neuropsychological tests

The complete test battery, as well as the number of individuals completing each of the tests, is provided in Table 1. Some participants could not complete the entire battery, often because of residual physical limitations (e.g., inability to complete paper-and-pencil tasks). A total of 20 test scores were obtained from the above list of measures. Raw test scores were used in all analyses.

Composite measure of neuropsychological test performance

A composite measure of overall neuropsychological test performance, the "Overall Test Battery Mean" (OTBM), was calculated using all but one of the above listed neuropsychological measures (i.e., excluding the Galveston Orientation and Amnesia Test). The OTBM is derived by converting all obtained scores to a common metric (T-scores) and subsequently calculating the mean of the obtained T-scores (see Miller & Rohling, 2002). Unfortunately, available norms often employ different methods for the correction of demographic factors. Calculated OTBM scores thus represent an attempt at a "best corrected" estimate based on available norms. Norms used in the derivation of the individual OTBM scores are provided in the Appendix. An OTBM score was obtained for most of the participants ($n = 69$), and a composite measure was not calculated if participants had fewer than 14 test scores.

Level of acculturation

Each participant's level of acculturation was assessed using the African American Acculturation Scale–Short Form (AAAS–33; Landrine & Klonoff, 1995). The AAAS–33 is a shortened version of the African American Acculturation Scale (Landrine & Klonoff, 1994), a measure developed to assess the degree to which an individual espouses the traditions, values, beliefs, assumptions, and practices specific to traditional African American culture. According to the developers, the short form is highly correlated with the original version ($r = .94$). A Likert-type scale ranging from

Table 1. List of tests in the South East Michigan Traumatic Brain Injury Systems Study (SEMTBIS) Neuropsychological test battery

Measure	*N*
Galveston Orientation and Attention Test (GOAT)	[*N* = 71]
Wechsler Memory Scale–Revised (WMS–R): Digit Span	
Forward	[*N* = 70]
Backward	[*N* = 70]
Multilingual Aphasia Examination (MAE): Tokens Test	[*N* = 69]
Controlled Oral Word Association Test (COWAT)	[*N* = 71]
Benton Visual Discrimination Test (BVDT)	[*N* = 71]
Wechsler Adult Intelligence Scale–Revised (WAIS–R) Block Design	[*N* = 68]
Wechsler Memory Scale–Revised (WMS–R): Logical Memory	
Immediate Recall	[*N* = 71]
Delayed Recall	[*N* = 71]
Rey Auditory Verbal Learning Test (RAVLT)	
Trial 1	[*N* = 68]
Total Trials 1–5	[*N* = 68]
Alternate List	[*N* = 68]
Delayed Recall	[*N* = 68]
Grooved Pegboard Test (Grooved Pegs) (Dominant Hand)	[*N* = 64]
Symbol Digit Modalities Test (SDMT)	
Oral	[*N* = 68]
Written	[*N* = 66]
Trail Making Test	
Part A	[*N* = 69]
Part B	[*N* = 63]
Wisconsin Card Sorting Test (WCST)	
Categories	[*N* = 66]
Perseverative Responses	[*N* = 66]

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1 (*I totally disagree, this is not at all true of me*) to 7 (*I totally agree, this is absolutely true of me*) is used to rank attitudes/opinions in response to each of the 33 statements. High scores represent a more traditional African American cultural background (lower degree of acculturation); conversely, low scores suggest greater acculturation to majority American society (higher degree of acculturation).

The AAAS–33 is divided into 10 subscales assessing different aspects of African American culture; namely (1) *Preference for African American Music, Arts, and People*; (2) *Religious Beliefs/Practices*; (3) *Traditional Foods*; (4) *Traditional Childhood Experiences*; (5) *Superstitions*; (6) *Interracial Attitudes/Cultural Mistrust*; (7) *Falling Out*; (8) *Traditional Games*; (9) *Family Values*; and (10) *Family Practices*. In the standardization sample, total scores on the AAAS–33 were found to be relatively independent of income, social status of the family of origin, and educational level (Landrine & Klonoff, 1995). Concurrent validity was demonstrated by establishing that the scale could differentiate between African American and non-African American respondents. Moreover, the scale distinguished between those African Americans who lived in predominantly Black neighborhoods from those living in mostly integrated ones. A set of subscores of the AAAS–33 was used in another study assessing African American acculturation and neuropsychological test performance (Manly et al., 1998a).

Examiner Ethnicity

As the SEMTBIS is a large project, participants were recruited and assessed by research assistants of different ethnic backgrounds. More than half ($n = 40$) of the test protocols were administered by a Black examiner; the remainder ($n = 31$) by a White examiner.

Statistical Methods

Relationship of acculturation to neuropsychological test performance

The purpose of the study was essentially twofold: (1) to establish level of acculturation as a valid predictor of neuropsychological test performance, and (2) to assess the influence of acculturation after controlling for other demographic variables. Two sets of analyses were thus performed on each of the 20 neuropsychological test scores. First, hierarchical multiple regression/correlational (MRC) analyses were used to assess the effect of acculturation on neuropsychological test performance. Factors related to the injury (i.e., lowest GCS in the first 24 hr and time since injury) were included as an initial covariate set, followed by level of acculturation. Second, follow-up hierarchical MRC analyses were conducted using demographic factors as a second covariate set (i.e., after the injury-related factors and before the acculturation factor). A hierarchical MRC analysis was also used to assess the relationship between acculturation and the composite measure of overall neuropsychological test performance (OTBM). Unlike other neuropsychological measures, the OTBM already accounts for demographic factors through its use of corrected T-scores. Hierarchical MRC analysis was conducted using injury-related factors as an initial covariate set.

RESULTS

Data Screening

Descriptive statistics are provided in Table 2. Prior to analyses, all demographic, acculturation, and neuropsychological variables were screened for univariate outliers and normality. Although some of the observed distributions were judged to be non-normal (i.e., some degree of skewness), raw scores were retained in light of the chosen statistic's (MRC) relative robustness to violations of normality. None of the inter-correlations between independent variables exceeded 0.7, a suggested upper limit with regards to multicollinearity in regression analyses (Tabachnick & Fidell, 1989). Unless otherwise specified, an alpha level of .05 was used for all statistical tests.

Relationship Between Demographic and Injury-Related Variables

Consistent with prior studies with TBI (e.g., Kraus & McArthur, 1999), a one-way ANOVA revealed a significant relationship between age and cause of injury [$F(4,66) = 9.37$, $p < .001$]. *Post-hoc* analyses using the studentized Newman-Keuls test suggested that older individuals were more likely to be injured as a result of a fall or as pedestrians, whereas younger participants were more likely to be injured as a result of a motor vehicle accident ($p < .05$). There was no significant relationship between injury-related variables (i.e., injury severity or mechanism of injury) and demographic variables (i.e., sex, years of education, SES) or level of acculturation.

Relationship Between Demographic Variables and Level of Acculturation

There was no significant correlation between AAAS–33 Total Score and demographic variables (age, sex, years of education, or SES). Furthermore, there was no significant relationship between any of the AAAS–33 subscales and age, years of education or SES. However, males reported having played significantly more traditional games [$t(69) = -2.351$, $p < .05$], and females reported eating/preparing more traditional foods [$t(69) = 2.037$, $p < .05$].

Effect of Examiner Ethnicity

We first assessed the relationship between examiner ethnicity and acculturation measures using multiple independent sample *t* tests. There were no significant differences accord-

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Table 2. Descriptive statistics for injury-related, demographic and acculturation variables for the entire sample

Variable	*M*	*SD*	*T* score	*N*
Injury-related				
Initial GCS	9.2	4.1		71
Time since injury	4.3	3.6		71
Demographics				
Age at time of assessment	42.2	13.1		71
Years of education	11.8	2.0		71
Hollingshead Two-Factor SES	19.9	8.2		71
Acculturation				
AAAS–33 Total Score	140.5	29.4		71
Raw neuropsychological test scores				
GOAT (# errors)	9.0	8.7		71
WMS–R Digit Span–Forward	7.2	2.2	−0.8	70
WMS–R Digit Span–Backward	5.0	2.2	−0.8	70
MAE Tokens Test	38.0	7.4	−1.0	70
COWAT	25.1	11.9	−1.3	71
BVDT	26.8	5.2	−0.8	71
WAIS–R Block Design	18.5	10.2	−0.8	68
WMS–R Logical Memory–Immediate	15.5	8.0	−1.2	71
WMS–R Logical Memory–Delayed	11.3	8.2	−1.1	71
RAVLT–Trial 1	4.3	1.9	−1.3	68
RAVLT–Total Trials 1–5	33.2	10.3	−1.8	68
RAVLT–Alternate List	3.5	1.8	−1.3	67
RAVLT–Trial 6 (Delayed Recall)	5.8	3.3	−1.5	67
Grooved Pegboard (seconds)	105.8	52.2	−2.0	64
Oral SDMT	32.9	14.9	−2.5	68
Written SDMT	39.5	17.9	−1.4	66
Trails A (seconds)	57.7	49.6	−1.5	69
Trails B (seconds)	143.9	85.8	−1.4	63
WCST–Perseverative Responses	35.1	26.8	−1.1	67
WCST–Categories	3.6	2.0	−1.2	67
Overall Test Battery Mean (T score)	37.0	7.7		69

ing to examiner ethnicity on the AAAS–33 or any of its subtests. We divided participants into groups according to their degree of mistrust on the basis of an individual's score (i.e., above or below the median) on the Cultural Mistrust subscale of the AAAS–33. Subsequent 2×2 ANOVAs were conducted for each of the neuropsychological test scores, as well as for the OTBM. Our results revealed a significant main effect of examiner ethnicity for Block Design [$F(1,64) = 6.98$, $p < .05$] and Trails A [$F(1,65) = 4.09$, $p < .05$]. In each case, participants performed better when administered by a Black examiner. There were no significant main effects for cultural mistrust. There was, however, a significant examiner Ethnicity $\times$ Cultural Mistrust interaction for both Trails A [$F(1,65) = 5.54$, $p < .05$] and Trails B [$F(1,59) = 4.06$, $p < .05$]. *Post-hoc* analyses using the Newman-Keuls test ($p < .05$) revealed that these interactions were largely due to poorer performance on the Trail Making test by participants who were assessed by a White examiner *and* who reported a greater distrust towards Whites (high mistrust). There were no significant effects of examiner ethnicity or cultural mistrust relative to overall test performance (OTBM).

Relationship of Acculturation to Neuropsychological Test Performance

Individual neuropsychological tests

In the first set of regression analyses, decreased level of acculturation was significantly associated with poorer performance on the GOAT, MAE Tokens, WAIS–R Block Design, RAVLT Total Trials 1–5, RAVLT delayed recall, and written SDMT after controlling for injury-related variables (lowest GCS, time since injury). Level of acculturation remained a significant predictor of scores on all of the above tests except for RAVLT delayed recall after controlling for injury-related and demographic factors. A summary of the proportions of variance accounted for by acculturation in each of the MRC analyses is provided in Table 3. It is worth noting that all significant findings occurred in the *a priori*

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Table 3. Proportion of variance in neuropsychological test performance accounted for by level of acculturation

Neuropsychological test	*N*	R^2 Change	
		Analysis 1	Analysis 2
Galveston Orientation and Attention Test	[*N* = 71]	.089*	.071*
WMS–R Digit Span–Forward	[*N* = 70]	.022	.015
WMS–R Digit Span–Backward	[*N* = 70]	.005	.003
MAE–Tokens Test	[*N* = 69]	.082*	.083*
Controlled Oral Word Association Test	[*N* = 71]	.028	.019
Benton Visual Discrimination Test	[*N* = 71]	.009	.005
WAIS–R Block Design	[*N* = 68]	.064*	.045*
WMS–R Logical Memory-Immediate	[*N* = 71]	.027	.013
WMS–R Logical Memory-Delayed	[*N* = 71]	.030	.017
RAVLT–Trial 1	[*N* = 68]	.014	.008
RAVLT–Total Trials 1–5	[*N* = 68]	.073*	.057*
RAVLT–Alternate Trial	[*N* = 68]	.055	.049
RAVLT–Trial 6	[*N* = 68]	.062*	.043
Grooved Pegs	[*N* = 71]	.016	.006
Symbol Digit Modalities Test-Oral	[*N* = 68]	.025	.016
Symbol Digit Modalities Test-Written	[*N* = 66]	.065*	.048*
Trails A	[*N* = 69]	.027	.019
Trails B	[*N* = 63]	.018	.006
WCST–Perseverative Responses	[*N* = 66]	.010	.007
WCST–Categories	[*N* = 66]	.038	.042
Overall Test Battery Mean (OTBM)	[*N* = 69]	.119**	

Note. *$p < .05$. **$p < .01$.
Analysis 1: Hierarchical Regression: Step 1: injury-related variables (lowest GCS, time since injury); Step 2: level of acculturation (AAAS–33 Total Score). Analysis 2: Hierarchical Regression: Step 1: injury-related variables (lowest GCS, time since injury); Step 2: demographic variables (age, sex, and years of education, SES); Step 3: level of acculturation (AAAS–33 total score)

predicted direction, with lower acculturation associated with decreased test performance.

Composite neuropsychological measure (OTBM)

A lower degree of acculturation was associated with lower scores on a composite measure of overall neuropsychological test performance (OTBM). Results of the hierarchical MRC analysis are presented in Table 4. While covarying for injury-related variables, level of acculturation was significantly associated with the OTBM ($\beta = -.351$, $p < .01$), uniquely accounting for 11.9% of the total variance. Initial GCS score was also a significant predictor of OTBM ($\beta = .262$, $p < .05$). Although the proportion of variance associated with level of acculturation appeared greater than that accounted for by injury-related factors (11.9% *vs.* 4.7% of the total variance), there was no significant difference (using Fisher's transformation r to r') in terms of their relative predictive ability.

DISCUSSION

Overall, our findings suggest a significant association between level of African American acculturation and neuropsychological test performance, even after controlling for other potentially confounding variables such as injury severity, time since injury, age, sex, years of formal education, and socioeconomic status. Within the current study, level of acculturation was a significant and unique predictor of test performance across a wide variety of neuropsychological domains, including attention/orientation, language, visuomotor/processing speed, visuospatial/constructional skills, and memory. These findings were all

Table 4. Summary of hierarchical regression analysis for variables predicting the Overall Test Battery Mean (OTBM) ($N = 69$)

Predictors	Partial regression weights			R^2 change
	B	*SE B*	β	
Step 1: Injury-related				.047
Initial GCS	.490*	.218	.262*	
Time since injury	.351	.246	.166	
Step 2: Acculturation				.119**
AAAS–33 total	−.092**	.030	−.351**	

Note. *$p < .05$. **$p < .01$.
Summary statistics: $F(3,65) = 4.316$, $p = .008$. $R = .408$; $R^2 = .166$** (adjusted $R^2 = .128$).

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in the expected direction, as more traditional African American cultural values/beliefs were associated with lower test performance. Perhaps the most telling evidence was the significant relationship between level of acculturation and a composite score of overall neuropsychological test performance (OTBM), even after covarying for injury severity and time since injury.

These results appear to provide additional support for the cultural hypothesis of group differences on cognitive/neuropsychological tests. Helms (1997) has referred to the difficulties in assessing the contributions of race, SES, and culture in the interpretation of ethnic/cultural group differences on cognitive tests. Within the current study, limiting the sample to African Americans emphasized cultural differences *within* a single ethnic/cultural group while avoiding other potential confounding factors increasing *between*-group variability (e.g., impact of minority status). In addition, the current sample was relatively homogeneous in terms of socioeconomic status (i.e., predominantly lower to lower-middle SES), minimizing the variability attributable to an individual's access to economic resources. Residual differences in SES were also statistically controlled using a well-established measure (Hollingshead Index).

It was initially hypothesized that an individual's score on tasks assessing verbal ability would be more culture-dependent. Accordingly, scores on a test assessing receptive language (Tokens Test) demonstrated a significant and unique acculturation effect. This finding seems consistent with previous findings linking African American acculturation with language-related measures such as the Boston Naming Test (Manly et al., 1998a). In that same study, use of Black English was also associated with lower scores on certain neuropsychological tasks, including some verbal measures (i.e., WAIS–R Information). At this stage, however, it remains unclear whether such findings represent a specific language-related difference between cultural groups, or if the use of Black English might serve as another indicator of a more general acculturation factor.

The hypothesis that executive functioning measures would specifically be associated with cultural factors was generally not borne out in this study. However, acculturation level accounted for a significant amount of variance on the Block Design subtest, a measure often considered to be a test of nonverbal reasoning. In their investigation of acculturation effects among HIV-positive individuals, Manly et al. (1998a) reported significant Black–White differences on Block Design and the Halstead Category Test (another nonverbal measure of problem solving/reasoning). These findings are interesting in the context of research involving psychometric intelligence. Kaufman et al. (1988) reported that the greatest relative Black–White differences were on the WAIS–R Block Design and Vocabulary subtests. These subtests also consistently demonstrate the highest correlations with overall psychometric intelligence (Full-Scale IQ). In conjunction with other studies (Manly et al., 1998a), these results suggest that ethnic/cultural group differences in performance on these particular subtests (i.e., Vocabulary and Block Design) may be partly attributable to differences in cultural experience. Unfortunately, prior studies reporting ethnic/cultural differences on intelligence testing did not account for level of acculturation in their analyses.

Our findings also suggest that level of acculturation may be significantly and uniquely related to a measure of verbal learning (Rey Auditory Verbal Learning Test). Other studies have reported ethnic group differences on memory measures after controlling for various demographic factors (e.g., Manly et al., 1998b, Marcopoulos et al., 1997). Some prior research has suggested that some Blacks categorize items differently than Whites when trying to remember information (e.g., focusing on holistic aspects rather than details), which may partly account for our current findings (Shade, 1991). Cultural differences in language-related skills may also have mediated an individual's encoding of the word list. Supporting this position is the observation that although initial learning of the verbal list (total recall for Trials 1–5) was significantly related to cultural experience, this acculturation effect was not observed for the delayed recall trial after correcting for other demographic factors. Previous research has also indicated an association between Black English use and the learning component of a verbal memory test (Manly et al., 1998a).

We did not expect the significant relationship between level of acculturation and performance on a measure of divided attention and visuomotor speed (Symbol Digit Modalities Test). Although preliminary, this finding is nevertheless consistent with other reports of Black–White differences on speeded tasks (e.g., Miller et al., 1993), and serves as a reminder that no task may be considered culture-free without empirical verification. Potentially the most unexpected finding, however, was the significant relationship between scores on a measure of basic attention/orientation (Galveston Orientation and Amnesia Test) and level of acculturation. Some authors have cited that traditional African American culture adheres to a more socially defined time perspective, contrasting with mainstream American "clock time" (Nobles, 1972; Willis, 1989), and it could be that an individual's relative time perspective might have affected the overall score. It is interesting to note that this measure is often used in the determination of post-traumatic amnesia (PTA) following acute TBI (Levin et al., 1979). Although these findings were obtained at least 1 year post injury (when most effects of TBI on basic attention/orientation are considered to have resolved), future research will be necessary to determine if level of acculturation should be taken into account when using the GOAT in more acute settings.

Prior studies assessing cross-cultural applicability of neuropsychological tests have typically focused on the assessment of the equivalence of specific tests across cultures (e.g., Maj et al. 1993). In contrast, our findings indicate that cultural experience may influence a wide variety of neuropsychological tests and domains, at least with African Americans. Arguably, our findings might be reflective of a single more general acculturation factor mediating performance

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on all or the majority of the tests, albeit to varying degrees. If such findings are replicated, this would imply that current difficulties in cross-cultural assessment will not simply be resolved through the use of specific "culturally-appropriate" tests. Rather, more in-depth knowledge of each of the respective cultures would be necessary, including an understanding of issues such as the cultural saliency of the ability being assessed, familiarity with materials and task demands, and overall level of comfort and motivation within the testing environment.

Our findings also raise interesting questions regarding the current conception and definition of cultural bias in neuropsychological assessment. Cultural bias has sometimes been defined as the "constant or systematic error, as opposed to chance or random error, in the estimation of some value . . . this constant or systematic error is alleged to be due to group membership or some other nominal variable" (Reynolds, 2000, p. 250). Even if one assumes a unidimensional model of acculturation, evaluating potential sources of bias solely in terms of a nominal variable (e.g., Black *vs.* White) would appear misleading. Our findings suggest that many variables potentially underlying such group differences (including cultural factors) might be better understood as *continuous* rather than nominal variables.

Some of our results suggest that the ethnicity of the examiner may also have an effect on certain test scores when assessing African Americans (i.e., Block Design, Trail Making Test). In keeping with prior research (Terrell et al., 1981), this effect seems to be largely moderated by the participant's underlying mistrust of the majority cultural group. It is important to note that these findings were limited to specific tests and were not found when evaluating the majority of neuropsychological measures or overall test performance. Such findings nevertheless suggest that in situations involving cross-cultural testing, factors underlying examiner/examinee relationships and their impact on performance are likely to highly complex and deserving of more detailed study.

The current study has a number of notable limitations. It remains possible that level of acculturation might be serving as a surrogate for other underlying demographic variables. For example, gross estimates of educational attainment do not fully account for the quality of the educational experience. Qualitative differences in education have already been suggested as a potential explanation for Black–White differences on cognitive testing among high school and college students (Myerson et al., 1998). Recent studies have also reported that other indices of academic achievement (e.g., single-word reading level) may partially account for ethnic group differences in neuropsychological test performance (Manly et al., 2000).

It remains difficult to evaluate the possible influence of stereotype threat on test performance within the current study. It should be noted that all participants were intentionally and specifically approached *after* completing the testing in order to minimize the influence of any such underlying anxiety regarding performance. Moreover, it could be argued that any decrease in scores would more likely be interpreted as a direct consequence of their head injury and not as a result of being a member of a particular ethnic group. However, it certainly remains possible that pre-existing negative stereotypes (i.e., that African Americans do poorly on standardized tests) could have affected the performance of some of the participants.

Similarly, level of acculturation might also be confounded with the more general concept of *acculturative stress*, defined as the universal difficulty faced by members of minority groups when adapting to the larger society (Berry, 1989). There may well be an identifiable cost in maintaining more traditional cultural values/beliefs, perhaps in the form of increased discrimination (Landrine & Klonoff, 1996). Given the potential relationship between affect and neuropsychological test performance (e.g., Bowman, 1996; Veiel, 1997), our findings might reflect the tendency for individuals with increased acculturative stress to obtain lower test scores. According to Berry (1989), however, individuals most vulnerable to acculturative stress are expected to be those who reject *both* minority and majority cultures. We would not expect an individual that rejects both cultures to demonstrate a high score on a scale such as the African American Acculturation Scale (suggesting a lower level of acculturation). One could also readily envision a relationship between the concepts of stereotype threat and acculturation, potentially in the form of acculturative stress. A potentially interesting area of future research would be the investigation of the relationship between level of acculturation, stereotype threat and even examiner ethnicity on testing among ethnic/cultural minorities.

The use of a brief unidimensional acculturation measure, although practical, has a number of shortcomings. Measures such as the AAAS–33 can only be considered an indirect measure of the complex factors that make up a culture (Betancourt & Lopez, 1993). As Landrine and Klonoff (1996) point out, although scores in the more extreme ranges may more readily be characterized as representative of either more traditional or acculturated individuals, the precise meaning of scores in the scale's midrange is less clear. Current acculturation measures do not wholly describe the cultural experience of those "bicultural" individuals who share values/beliefs from both cultures. Other aspects of African American culture that might also affect neuropsychological findings (e.g., Black English) were not assessed. Future studies, preferably designed and conducted by researchers familiar with the culture in question, may eventually clarify the nature of the processes underlying such differences.

As a final limitation, it should be pointed out that the above findings are the result of a large number of analyses and should be considered exploratory rather than confirmatory in nature. These results require replication, particularly with regards to the relationship between level of acculturation and specific neuropsychological tests. Although the use of a relatively homogeneous sample (i.e., primarily males of limited education/lower SES with a TBI from a single geographic location) does allow for a more

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controlled study, it also limits the generalizability of the current findings. It remains unclear to what extent acculturation might affect neuropsychological testing among African Americans of higher socioeconomic status, of different geographic regions, or with other types of neuropathology.

In conclusion, the findings of this study provide evidence for the importance of cultural factors in the neuropsychological assessment of African Americans following a traumatic brain injury. More generally, the clinician conducting an assessment with an African American client should be aware of the many variables of potential importance (e.g., level of acculturation, years/quality of education, SES, perceived discrimination) in order to conduct a more culturally sensitive neuropsychological evaluation (see also Nabors et al., 2000). On the basis of such findings, the use of acculturation scales in the neuropsychological assessment of African Americans would certainly seem advisable. However, it is important to emphasize, given the complexity of the issues involved, that inclusion of an acculturation scale cannot be considered an adequate "correction" for the influence of cultural factors within the context of a clinical neuropsychological assessment. Further research in this area will be required to better understand the relationships between the various cultural/environmental factors and test performance.

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APPENDIX

NORMATIVE DATA USED IN THE DERIVATION OF THE OVERALL TEST BATTERY MEAN (OTBM)

Neuropsychological test	Source of normative data	Demographic corrections
Multilingual Aphasia Examination (MAE) Tokens Test	MAE Manual (Benton et al., 1994)	None
Wechsler Memory Scale–Revised (WMS–R)	WMS–R Manual (Wechsler, 1987)	Age
Logical Memory I and II	WMS– R Manual (Wechsler, 1987)	Age
Digit Span–Forward and Backward	WMS–R Manual (Wechsler, 1987)	Age
Benton Visual Discrimination Test (BVDT)	Benton et al., 1983	Age
Rey Auditory Verbal Learning Test (RAVLT)	Geffen; published in Spreen & Strauss, 1998	Age, Sex
Symbol Digit Modalities Test (SDMT)	SDMT manual (Smith, 1991)	Age, Education
Trail Making Test (A & B)	Heaton et al., 1991	Age, Sex, Education
Grooved Pegboard	Heaton et al., 1991	Age, Sex, Education
Wechsler Adult Intelligence Scale–Revised (WAIS–R)–Block Design	Heaton et al., 1991	Age, Sex, Education
Wisconsin Card Sorting Test (WCST)	Heaton et al., 1993	Age, Education
Controlled Oral Word Association Test (COWAT)	Ruff et al., 1996	Sex, Education

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