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African American acculturation and neuropsychological test performance following traumatic brain injury: An exploratory study.

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AFRICAN AMERICAN ACCULTURATION AND NEUROPSYCHOLOGICAL TEST PERFORMANCE FOLLOWING TRAUMATIC BRAIN INJURY: AN EXPLORATORY STUDY

by

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ABSTRACT

The present study examined the influence of cultural factors in the assessment of African Americans (*N* = 45) who had suffered a traumatic brain injury (TBI). Following the administration of a neuropsychological test battery and functional outcome measures, participants completed a self-report measure of African American acculturation (African American Acculturation Scale-Short Form; Landrine & Klonoff, 1995). In the first study, hierarchical regression analyses were conducted to evaluate the possible relationship between acculturation and neuropsychological test performance. After controlling for various injury-related (TBI severity, time since injury) and demographic factors (age, sex, and education/occupation), lower levels of acculturation were associated with poorer overall neuropsychological test performance (Overall Test Battery Mean; Rohling, Langhinrichsen-Rohling, & Miller, in press) and lower scores on three of the administered tests (Grooved Pegs, WAIS-R Block Design, and Wisconsin Card Sorting Test - Categories). In the second study, standard regression analyses were performed to assess whether inclusion of cultural factors could improve the ability of neuropsychological tests to predict functional outcome following TBI. Less acculturation was related to lower ratings of functional independence on cognitive tasks (Functional Independence Measure-Cognition), greater ratings of disability (Disability Rating Scale), and decreased community integration (Community Integration Questionnaire). These findings suggest that differences in cultural experience may be an important factor in the neuropsychological assessment of African Americans following TBI, and provide support for the hypothesis that cultural factors may partially account for differences among various ethnic-cultural groups on neuropsychological tests.

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TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

One of the key difficulties in clinical neuropsychological assessment is distinguishing the effects of neurological dysfunction from those resulting from other "external" (i.e., environmental or cultural) factors. Traditionally, contemporary neuropsychology has been based on the assessment of a relatively limited sample, namely Western, urban, and literate brain-damaged individuals (Matthews, 1992). However, there is accumulating evidence that educational, linguistic, and cultural factors may have a significant influence on neuropsychological test performance (e.g., Manly et al., 1998; Welsh et al., 1995), and might even impact underlying brain organization (Ardila, 1995; Kennepohl, 1999; Wong, Strickland, Fletcher-Janzen, Ardila, & Reynolds, 2000).

Cross-cultural psychologists have long argued that specific learning opportunities and cultural-ecological surroundings can lead to the development of different cognitive abilities (Berry, Poortinga, Segall, & Dasen, 1992; Berry, 1975). Cultural factors "prescribe what shall be learned and at what age; consequently different cultural environments lead to the development of different patterns of ability" (Ferguson, 1956; p.121). Numerous psychological and anthropological studies have investigated cognitive and perceptual abilities in different cultural contexts. These studies have typically involved more "exotic" cultures far removed from mainstream North American society (Berry et al., 1992; Gay & Cole, 1967; Miller, 1973). The formal study of cultural factors within mainstream North American psychology, on the other hand, has remained relatively neglected (Betancourt & Lopez, 1993; Helms, 1992; Vernon, Jackson, & Messick, 1988).

The analysis of cultural differences within multicultural societies such as the United States or Canada entails a host of complexities. These include, among others, the formal identification of distinct ethnic-cultural groups, the difficulties in defining the concept of culture, and the potential inter-relatedness of concepts such as race, culture, and socio-economic status (Helms, 1997; Kaufman, Cooper, & McGee, 1997). Psychological studies assessing ethnic-cultural differences have often inferred group membership from family name, language of use, physical characteristics, or self-report ethnic identity. Many have considered the concepts of race, socio-economic status, ethnicity, and culture as if they were interchangeable (Betancourt & Lopez, 1993; Kaufman & Cooper, 1995).

A key concept in cross-cultural research is that of acculturation, loosely defined as the degree to which an individual espouses the traditional values, beliefs, and practices of a given ethnic group *versus* that of the dominant ethnic-cultural group. Some researchers have expressed the hope that acculturation may emerge as a practical, non-racist means of operationally defining within-group cultural variability (Landrine & Klonoff, 1995). Acculturation measures have been developed that assess the degree of cultural involvement among members of minority groups in the United States (e.g., Acculturation Rating Scale for Mexican Americans, Cuellar, Harris, & Jasso, 1980; African American Acculturation Scale, Landrine & Klonoff, 1994).

Given the increasingly diverse nature of North American society, there is a pressing need for research related to ethnic-cultural minorities in neuropsychology. African Americans, the focal group of the present discussion, currently represent about 12% of the U.S. population (Kottak & Kozaitis, 1999). Some research has also suggested that African Americans may be at increased risk for a number of neurological conditions, including dementia (Tang et al., 1998; Welsh et al., 1995), stroke (Giles, Kittner, Losoncsy, & Sherwin, 1995), spinal cord injury (Devivo, Rutt, Black, Go, & Stover, 1992), as well as traumatic brain injury (Rosenthal et al., 1996).

Unfortunately, current neuropsychological practices appear somewhat inadequate in their assessment and treatment of ethnic minorities in North American society, including African

Americans. Although arguably less susceptible to cultural influence than traditional intelligence or cognitive tests, there is accumulating evidence that current neuropsychological measures may be culturally biased. Studies with medically healthy individuals have suggested that minorities are judged to be cognitively impaired at much higher rates than European Americans (e.g., Manly et. al, 1998; Welsh et al., 1995). The underlying reasons for these differences remain largely unknown, and the possibility that culture-specific factors might be related to these differences has not been sufficiently investigated. Some have suggested that variables such as language and level of acculturation may partially account for the some of the observed discrepancies (Arnold, Montgomery, Castaneda & Longoria, 1994; Manly et. al, 1998). The present study represents a preliminary attempt at assessing the impact of acculturation on neuropsychological test performance in a clinical sample, namely African Americans who have suffered a traumatic brain injury (TBI). A secondary goal was to evaluate whether including an acculturation measure would improve the ability of neuropsychological tests to predict functional outcome in an African American population.

Some Important Definitions

Discussion of potential group differences related to psychological phenomena necessarily requires the operational definition of the various concepts, including race, socio-economic status, culture, ethnicity, and society. As noted above, researchers have sometimes considered these terms as interchangeable (see Betancourt & Lopez, 1993; Helms, 1997). Vague conceptualisations may lead to interpretations that stimulate or reinforce racist conceptions (Zuckerman, 1990), and neglect the possible unique contribution of each of the above constructs to human behaviour (Grubb & Dozier, 1989). In practice, their effects may be confounded in research dealing with certain ethnic-cultural groups such as African Americans. When considering cognitive test performance, certain minorities are more likely to be "multiply disadvantaged" (Helms, 1997).

Race: Race may be defined as an "inbreeding, geographically isolated population that differs in distinguishable physical traits from other members of the same species" (Zuckerman, 1990; p. 1297). Scientific studies using the concept of race appear questionable for a number of reasons. Most modern anthropologists believe that *Homo sapiens* evolved once, and that subsequent variations represent "relatively recent climatic adaptations or mere peculiarities of relatively restricted breeding populations" (Zuckerman, 1990; p.1297). The conditions of geographic isolation and inbreeding no longer apply to the vast majority of human populations, and certainly do not apply in contemporary North America. Estimates of the amount of European American "admixture" in the African American population range anywhere from 2% to 50% (Parra et al., 1998; Reed, 1969). Likewise, "Hispanics" represent such a heterogeneous group as to render genetic classifications essentially meaningless (Culebras, 1995).

Global studies of genetic variability, as measured by different markers (e.g., blood groups), have generally revealed within-group differences to be significantly greater than any differences accounted for by differences between different groups (Latter, 1980). This does not dispute the role of genetic factors as significant contributors to human behaviour (e.g., Plomin, 1989), including the possibility that identifiable genetic groups may differ significantly along a number of behavioural and cognitive traits. However, one may question the extent to which these genetic groupings correspond to current, socially defined "racial" classifications (Landrine & Klonoff, 1996).

Socio-Economic Status: Socio-economic status (SES) may be defined as the amount and quality of economic resources available to an individual. Although a relatively straightforward concept in theory, SES is often extremely difficult to assess in applied research. Typically, SES has been measured using a combination of indicators such as income, occupational status, or educational attainment. An example of this type of multidimensional measurement is the Four Factor Index of Social Status (Hollingshead, 1975), which consists of a composite measure of occupation, education, marital status, and gender.

To the extent that ethnic-cultural groups may be considered "multiply disadvantaged", SES may often be seen as a confounding variable in cross-cultural studies (Helms, 1997). In societies where there is a prolonged history of segregation and discrimination, controlling for SES may erroneously result in removing significant cultural variance. Alternatively, it is possible that phenomena exist that are specific to the lower social class regardless of ethnic-cultural divisions (Betancourt & Lopez, 1993).

Culture: In spite of its accepted importance in most facets of human experience, there remains little in the way of an accepted definition of the concept of culture. Some have argued that culture is nothing more than a set of independent variables that can ultimately never be defined (Segall, 1983; 1986). Others have insisted that an empirically useful definition is necessary to allow for some form of measurement (Betancourt & Lopez, 1993). Following a review of the anthropological literature, Rohner (1984) suggested that culture be defined as "the totality of equivalent and complementary learned meanings maintained by a human population, or by identifiable segments of a population, and transmitted from one generation to another" (p.119-120). Similarly, Helms (1997) defined culture as "the customs, values, traditions, and behavioural practices (including information-processing strategies) that define a group" (p. 520).

Ethnicity: Ethnicity is typically used in reference to groups that share a common nationality, culture, or language. Although ethnicity is often characterized in terms of culture, the distinction between the two concepts is an important one for psychology (Betancourt & Lopez, 1993). Whereas culture represents the actual shared values and meanings of a certain group, ethnicity defines certain issues such as an individual's identity, including the perceived/actual discrimination associated with that group (Phinney, 1990). The distinction may be understood through the use of an example. When two or more ethnic-cultural groups remain in contact for an extended period of time, their interaction may alter the values, beliefs, and behaviours within each group (i.e., resulting in cultural change). This may occur without necessarily affecting key aspects of ethnic identity in either group. An individual may be largely acculturated to the majority culture in terms of their beliefs, attitudes, and behavioural practices without influencing the degree to which they identify themselves as a member of a particular ethnic group.

Society: Society may be defined as the "largest unit of a territorially bounded, multigenerational population recruited largely through sexual reproduction, and typically organized around a common culture and common social system" (Rohner, 1984; p. 131). Unlike culture, a society is considered to have material substance. In a contemporary context, society is often synonymous with the term nation. Within multicultural societies such as the U.S. and Canada, distinct ethnic-cultural minorities may function within the larger society while maintaining many of their cultural and linguistic traditions.

Note that sociocultural descriptors such as ethnicity or culture will be used for the remainder of this text, except in specific cases where underlying biological differences are clearly implied in the original literature. The terms black and African American will be used interchangeably to refer to Americans who share a common ancestral descent with people indigenous to sub-Saharan Africa (Jackson & Sellers, 1996). Likewise, the terms European American and white will be used to identify individuals of European descent who make up the majority of the current U.S. population. These definitions specifically refer to the sociocultural aspects of the potential differences between the identified groups.

Group Differences in Cognitive/Neuropsychological Testing

Many studies have identified differences between ethnic groups on measures of intelligence and general cognitive ability. Typically, African Americans have obtained scores approximately one standard deviation below that of the European American mean (e.g., Jensen, 1980; Reynolds, Chastain, Kaufman, & McClean, 1987). In their re-analysis of the standardization sample of the WAIS-R, for example, Kaufman, McLean, and Reynolds (1988) found significant main effects for sex, education, and ethnicity in each of the age groups assessed. The largest differences between ethnic groups were on the Block Design and Vocabulary subtests, tasks that typically correlate best with Full Scale IQ.

There are reports that black/white differences on tests of general cognitive ability may be decreasing over time. Following a re-analysis of several general cognitive measures, Vincent (1991) reported that although both adult and children tested prior to 1980 demonstrated the typical one standard deviation difference, this had decreased a half standard deviation for groups of children assessed after 1980. Flynn (1999, 1987) has reported that the observed IQ gains over successive generations have been greater among African Americans than other American cultural groups.

Differences in neuropsychological test performance have been especially notable in studies with the elderly, where minorities run a greater risk of being inaccurately labelled as cognitively impaired. In an attempt to develop preliminary normative data, Marcopoulos, McLain, & Giuliano (1997) assessed a group of non-demented rural, community-dwelling elders using a battery of nine common neuropsychological tests. The sample consisted of an equal number of black and white individuals whom had 10 or fewer years of formal education and otherwise appeared to be functioning well in the community. Almost half of all subjects would have been erroneously diagnosed with a dementia using existing norms and cut-offs. This was especially evident in individuals reporting less than 8 years of education. Blacks exhibited lower scores on three of the nine tests (WAIS-R Vocabulary, Block Design, and WMS-R Logical Memory - Delayed Recall), even after controlling for educational attainment. In a neurologically normal elderly urban sample, Lichtenberg, Ross, & Christensen (1994) reported that increasing age and African American ethnicity were significant predictors of decreased performance on a visual naming task (i.e., Boston Naming Test).

Welsh and colleagues (1995) assessed a group of 830 white and 158 black elderly individuals with Alzheimer's disease using the CERAD (Consortium to Establish a Registry for Alzheimer's Disease) neuropsychological battery. After statistically controlling for age, education, and duration/severity of dementia, blacks nevertheless scored lower than whites on a number of tasks, including the Mini-Mental Status Examination (MMSE), the Boston Naming Test, and a measure of constructional praxis. Comparable differences have been reported in studies with both normal and clinical samples of elderly Hispanic Americans (Jacobs et al., 1997; Loewenstein, Arguelles, Barker, & Duara, 1993; Loewenstein, Rubert, Arguelles, & Duara, 1995).

Significant group differences have also been demonstrated among younger individuals. Johnson-Selfridge, Zalewski, & Abourdarham (1998) assessed the relationship between ethnicity and word fluency in a sub-sample of 600 European American, African American, and Hispanic American males (200 in each group; mean age = 37.8). These participants were taken from a larger study ($N = 4462$) assessing the long-term effects of military experience in Vietnam. Multivariate analyses of variance indicated significant main effects for verbal fluency tasks (FAS and Animal Names) after covarying for income, education, and single-word reading scores (WRAT-R Reading). In general, European Americans produced significantly better scores than Hispanic Americans, who in turn scored better than African Americans. Roberts and Hamsher (1984) reported that using the typical cut-off score on a visual naming task (BNT) with neurologically normal blacks would result in 22% of them being classified as "impaired" after adjusting for education. Likewise, Manly et al. (1998) found that when using a standard cut-off (more than one *SD*), at least 25% of a large (*N* = 170) medically healthy African American sample scored in the impaired range on 12 of 16 neuropsychological measures administered. Sixty-five percent would have been classified as impaired on a visual naming task (BNT). Ethnicity has even been shown to be a significant predictive factor on measures of simple and choice reaction times (Miller, Bing, Selnes, Wesch, & Becker, 1993).

In light of the above findings, there has been increased demand for the development of appropriate normative data for use with ethnic minorities, particularly with the elderly (e.g., Marcopoulos, McLain, & Giuliano, 1997; Unverzagt et al., 1996). Although the use of appropriate norms represents a useful first step (Ardila, 1995), there remain several unanswered questions, not the least of which concerns the origin of these differences.

Potential Causal Hypotheses

An overview of the relevant literature quickly reveals three relatively distinct theories of the causal mechanisms underlying group differences on cognitive/neuropsychological tests. These may be summarized as the genetic, environmental deficit, and cultural hypotheses (Helms, 1992). Despite several decades of ongoing research, controversy, and debate, there remains little in the way of a consensus surrounding the issue (see Neisser et al., 1996). Although an exhaustive review is clearly beyond the scope of the present discussion, a review of some of the issues relevant to the neuropsychological assessment of ethnic-cultural minorities appears warranted, with a particular emphasis on studies involving African Americans.

The Genetic Hypothesis: The idea that differential test scores may be due to genetic differences among groups is not new in psychology. Indeed, there is extensive evidence of a significant genetic component related to individual differences in psychometric intelligence, at least in the European American population (Neisser et al., 1996). However, a high degree of heritability in one group does not necessarily have implications as to the source of differences between groups. Proponents of the genetic hypothesis (e.g., Jensen, 1980; Rushton, 1988) typically endorse this view as a default: the lack of direct support for an environmental solution necessarily implies a genetic one.

However, there is little direct empirical support for the contribution of genetic factors to the observed group (as opposed to individual) differences. Studies assessing IQ in African American and interracial adoptees have suggested that there is little or no relationship between the degree of European ancestry and scores on cognitive tests (Loehlin, Vandenberg, & Osbourne, 1975; Scarr, Pakstis, Katz, & Barker, 1977; Scarr, Weinberg, & Waldman, 1993). Similarly, children of black and white American soldiers in post-war Germany have shown no differences in mean scores on tests of general cognitive ability (Eyferth, 1961; cf. Neisser et al., 1996).

Perhaps the most compelling evidence opposing the genetic hypothesis is the observation that IQ scores have been steadily increasing over recent successive generations (Flynn, 1999; 1987). Some industrialized nations have shown absolute IQ gains of almost 18 points over the past 30 years. In sum, there now exists a situation where test score differences between generations are greater or equivalent to those typically seen between African Americans and European Americans. Given the amount of time that has elapsed, it becomes evident that these findings cannot be accounted for by genetic differences.

The Environmental Deficit Hypothesis: The underlying logic of the environmental deficit hypothesis is relatively simple: ethnic-cultural differences in cognitive test scores are the direct result of inequalities in access to environmental and economic resources (i.e., lower SES). Vincent's (1991) statement may be seen as typical of this perspective: "the most obvious explanation for these findings is that the black/white IQ differences are in a very real sense a barometer of educational and economic opportunity" (p.161).

Educational attainment is clearly correlated with better neuropsychological and cognitive test performance (Ceci, 1991; Heaton, Ryan, Grant, & Matthews, 1996). Correspondingly, decreased educational attainment has been reported as a significant risk factor for dementia (Katzman, 1993). Studies with older African Americans, in particular, have underscored the key relationship between education and performance on several neuropsychological measures (Callahan et al., 1996; Unverzagt et al, 1996).

Inequalities in the average quality of education among ethnic groups have been cited as a possible contributor to cognitive test differences (Helms, 1997). Myerson, Rank, Raines, and Shnitzler (1998) compared the test scores of African Americans ($N = 577$) and European Americans ($N = 2149$) who completed the Armed Services Vocational Aptitude Test at different grade levels during high school or college. To account for attrition rates, participants were compared to others who ultimately attained the same educational level (i.e., either high school or college graduates). After covarying for SES and age, European American high school graduates appeared to benefit more from their education than their African American counterparts, as suggested by their relative rates of improvement on cognitive test scores over time. However, African Americans that eventually graduated from college seem to "catch up" much of these differences as a result of post-secondary education. One explanation is that African American college graduates represent a relatively select subset that may be particularly prone to the benefits of education. If this were true, however, one might expect this subgroup to demonstrate similar score increases throughout high school as a function of their select "ability". This was not observed to be the case. The authors proposed that these results were more likely due to differences in the quality of secondary education between the two groups, differences that decrease as a function of more equivalent educational environments in college.

Other social factors have been proposed as possible moderating factors on cognitive ability measures. Grubb and Dozier (1989) compared African American and European

American college students on measures of intelligence (WAIS-R), memory (drum learning tasks) and reasoning (Halstead Category Test). Any differences between groups became non-significant after controlling for the number of siblings, occupation level of the father, and the combined level of parent education and income. Unfavourable SES conditions are often associated with certain environmental deprivations, including malnutrition, poorer health care, and increased exposure to harmful environmental toxins. Prolonged malnutrition during childhood has been demonstrated to have long-term effects on intelligence test scores (Neisser et al., 1996). Katzman (1993) has questioned whether education differences in the elderly might serve as a proxy for other childhood deprivations.

Artiola i Fortuny, Heaton, and Hermosillo (1998) compared groups of participants from the U.S.-Mexico Borderland ($N = 185$) and Spain ($N = 205$) on 16 Spanish-language neuropsychological measures. Significant main effects were found for place of birth as well as interactions between years of education and place of birth. On the whole, Spanish participants exhibited better scores on many of the neuropsychological measures. These effects diminished with increasing educational attainment. In the Borderland group, percentage of life span spent in U.S. and bilingual status were also predictive of performance on several tests. Whereas increased percentage of time in the U.S. was negatively correlated with Spanish word generation tasks and positively correlated with scores on a problem-solving task (Wisconsin Card Sorting Test; WCST), bilingualism was associated with better performance on word list-learning tasks. These authors suggested that the differences in cognitive test performance were most likely the result of the documented regional differences between the U.S.-Mexico Borderland and Spain in SES-related indicators such as nutrition, medical care, quality of educational experiences, and general socio-economic conditions.

There are several reasons to believe that SES might not be the entire solution. First, studies that specifically attempt to control for SES levels have still reported differences between ethnic minorities and the white majority on cognitive and neuropsychological tests (Loehlin, Lindzey, & Spuhler, 1975; Stern et al., 1992; Welsh et al., 1995). Second, as previously mentioned, it may be extremely difficult to dissociate the effects of culture from those resulting from lower SES, particularly if one considers the long history of discrimination and economic hardship of minority groups such as African Americans in North America. Finally, some authors have suggested that certain ethnic-cultural groups such as African Americans may have a different social structure than other groups in American society, and have questioned the applicability of conventional measures of SES (Wyche, 1996). For example, years of education may be a poor indicator for the quality of education, particularly when one considers individuals with less than 12 years of education (Helms, 1997).

Several authors have also voiced strong opposition to the implication that lower scores on current tests necessarily represent cognitive deficits, and have challenged the assumption that majority European American culture defines the most intellectually-rich environment (Helms, 1992; Williams, 1972). Expressions such as "cultural deprivation" or "culturally disadvantaged" have often been used among proponents of the environmental deficit perspective. For example, Amante, Van Houten, Grieve, Bader, & Margules (1977) suggested that the observed results might be due to the "interclass and ethnic group patterns of sociocultural learning involving the acquisition of *maladaptive* [italics added] values, attitudes, perspectives, beliefs, and health- or medically-oriented behavioural phenomena."(p.531). Critics of the environmental deficit hypothesis fear that quality of environment and culture may be used virtually equivalently (Helms, 1992).

The Cultural Hypothesis: Cultural explanations for ethnic-cultural group differences on cognitive measures have been increasing over recent years (e.g., Boykin, 1994; Helms, 1992, 1997; Neisser et al., 1996). In its most general form, the cultural hypothesis argues that limited exposure to majority American culture will deleteriously affect cognitive test performance.

Culture provides us with models of how to think, feel, and interact with others. It influences which aspects of the environment, at any given moment, are considered important. Cultural factors are implicit in everything we do, and have been described as "undulating threads woven throughout a clinical story, rather than as obvious facts that might be explicitly spoken" (Haley, Han, & Henderson, 1998; p. 402). An important characteristic of culture is its inherently adaptive, dynamic nature. Flynn (1999) has proposed that the most plausible explanation for the tremendous IQ gains of the past few decades is the "striking cultural difference between successive generations." Unfortunately, research specifically assessing the effects of cultural factors in cognitive test performance has been lacking.

Evidence for the Role of Culture in Neuropsychology

There is accumulating evidence that certain aspects of culture may not only affect the testing procedure itself, but may also alter the way the brain becomes organized during development. Lecours and colleagues (1988) examined the effects of unilateral stroke in large groups of either educated or illiterate Portuguese speakers using a number of linguistic measures. Lesions in the right hemisphere resulted in a greater incidence of language difficulties in illiterate stroke victims than their literate counterparts. Arguably, these findings may be reflective of early left hemisphere dysfunction in the illiterate group. Such long-standing dysfunction could have promoted increased right-sided language representation and interfered with the acquisition of future reading skills. A more plausible explanation is that literacy is a significant factor in language lateralization. Thus, the degree of language lateralization to the left hemisphere may partly be the product of a literate, or possibly more precisely, alphabetised culture. An important caveat remains. In the same study, left-sided strokes unequivocally produced speech disturbances in both groups, indicating that literacy might have served to maximize left hemisphere dominance for most language functions.

An even more striking example is a report relating clinical observations of unilateral stroke patients among differing ethnic groups in China (Yu-Huan, Ying-Guan, & Gui-Qing, 1990). These authors found a much higher incidence of aphasia following a right-sided lesion in right handers (i.e., "crossed aphasia") in the majority ethnic group (the Han). In contrast, crossed aphasia was much less common among the minority group (the Uighur-Kazaks). The findings among the Han are inconsistent with traditional (Western) models of language lateralization, which typically consider crossed aphasia extremely rare (Geshwind & Calaburda, 1985). Yu-Huan et al. (1990) also reported the almost total absence of pure sensory (i.e., Wernicke's) aphasia in the Han sample, accounting for less than 2% of cases. The authors suggested that the above findings are likely associated with the distinctive nature of the Chinese language. Unlike Uighur-Kazak and most Indo-European languages, which are phonetically based, Chinese language is largely "ideographical" and non-phonetic. In other words, one sound can represent several meanings. Based on the above findings, the authors concluded that for the Han "language function is not localized in the left brain but in the right or both hemispheres" (p. 352).

Other linguistic and cultural-ecological factors have been shown to affect performance in a number of cognitive domains. Significant cross-cultural and educational differences have been demonstrated in the ability to perceive three-dimensional shapes (Miller, 1973). Klich and Davidson (1983) reported that Aboriginal Australian children recalled more natural objects than did European Australian children on a visual memory task. There was no difference between the groups in the recall of manufactured objects.

Education is often ignored as an important mediator of cultural experience. Formal education not only teaches broad-based generalized skills (e.g., reading and writing), but also transmits relevant cultural knowledge and norms (Ardila, Rosselli, & Ostrovsky-Solis, 1992). Literacy and the amount of Western-style education an individual receives can have profound effects on neuropsychological test performance. In two separate studies, Ardila and associates

(Ardila, Rosselli, & Rosas, 1989; Rosselli, Ardila, & Rosas, 1990) compared two extreme educational groups (illiterates and professionals) in Columbia matched for age and sex. In both studies, significant differences were evident between the two groups on tasks assessing visuospatial functioning, visual and verbal memory, receptive and expressive language, and motor praxis.

It is effectively impossible to control for those aspects of culture that are confounded with formal, Western-style schooling. Reviewing the impact of education on cognitive testing, Ceci (1991) described some ways in which education can directly affect test performance:

a) through the direct inculcation of relevant cultural information
b) by teaching modes of thinking assessed by cognitive ability tests
c) by preparing students with appropriate attitudes and values for standardized test performance
d) by teaching specific test-taking skills such as how to attend to questioning, monitor and time their responses, sit still, gain rapport, and try their best
e) by emphasizing the use of hypotheticals and abstract thought as ends in themselves.

The formal study of cultural factors appears to be a critical and necessary step towards a more inclusive view of neuropsychology. This position contrasts somewhat with studies that assume that cultural effects may simply be controlled or minimized through the use of more "culture-fair" testing materials.

<u>Issues in Cross-Cultural Neuropsychological Testing</u>

The use of neuropsychological tests in different cultural contexts involves a number of rather important issues, most notably whether the tests have culturally <u>equivalent</u> meanings. Neuropsychologists often assume the culture fairness of certain tests (particularly nonverbal measures) to be self-evident provided the material appears universally familiar (Heaton et al., 1996). For example, Artiola i Fortuny et al. (1998) presumed it was possible to "exclude material that may bias the tests along dimensions of social, religious, culinary, or other customs that may be specific to a distinct group of people" (p.364). Vincent (1991) considered the Raven's Progressive Matrices essentially culture-free because the test was "remarkably free of anything remotely resembling culturally laden material" (p.267).

Maj and associates (1991), in collaboration with the World Health Organization (WHO), assembled a battery of tests to assess the neuropsychological effects of HIV in various regions of the world, namely Bangkok (Thailand), Kinshasa (Zaire), Los Angeles (United States), Munich (Germany), Nairobi (Kenya), and Sao Paulo (Brazil). In developing their battery, these researchers make a number of important assumptions concerning the cross-cultural applicability of the test battery. The cultural equivalence of a first group of tests, including tests of motor dexterity (timed Gait Test, Grooved Pegboard) and verbal fluency (Word List Generation Test), was considered self-evident. A second group of tests (i.e., the Block Design subtest of the EIWA [Spanish version of the WAIS] and WAIS-R Digit Symbol) was considered appropriate in light of support from available literature. The cross-cultural suitability of a third group of tests was considered more questionable (Rey Auditory Verbal Learning Test & Trail Making Test). A second study (Maj et al., 1993) was specifically conducted to assess some proposed culture-fair counterparts for these latter measures (WHO/UCLA Auditory Verbal Learning Test & Color Trails).

The cross-cultural equivalence of the above test battery may be criticized along a number of lines. First, it appears evident that no test may be considered equivalent across cultural settings without empirical support. Previously reviewed studies have suggested that both motor skills (e.g., Rosselli et al., 1990) and verbal fluency (e.g., Johnson-Selfridge et al., 1998) may be influenced by sociocultural and educational factors under certain circumstances. Second, the available literature quoted as support for the use of EIWA Block Design and Digit Symbol was limited to two studies conducted in Costa Rica (Fletcher, Satz, & Carter, 1978; Satz, Krauskope,

& Fletcher, 1980; cf. Maj et al., 1993). However, tests that are demonstrated to be appropriate for use in Costa Rica may not necessarily be suitable for use in Zaire. Third, increased culture-fairness in the newly developed tests was based exclusively on assessment of the psychometric properties of the new tests when compared to the old ones (Rey Auditory Verbal Learning Test and Trail Making Test). Although this undoubtedly constitutes an improvement over the comparison tests, there is little support for the authors' recommendation for the "wide application of these tests in different geographic and sociocultural contexts and for various purposes" (p. 133).

Most cross-cultural psychologists consider culture-fair tests of cognitive ability to be a myth (e.g., Berry et al., 1992). Helms (1992, 1997) has written extensively on the requirements for a test to be considered culturally equivalent. It is important to distinguish "cultural equivalence" from "cultural bias". Whereas cultural bias refers to whether the use of a test results in disparate treatment, cultural equivalence refers to whether constructs have similar meaning within and across cultural groups. Helms identified seven distinct types of cultural equivalence, each of which must be present for a test to be considered culture-fair (1997, p. 518):

a) Functional equivalence: the extent to which test scores have the same meaning in different cultural groups and measure characteristics that occur with equal frequency within groups
b) Conceptual equivalence: the extent to which members of the groups are familiar with the content of the test items
c) Linguistic equivalence: the extent to which the language is equalized to have the same meaning across cultural groups
d) Psychometric equivalence: the extent to which the tests measure the same things across cultural groups
e) Testing Condition equivalence: the extent to which the idea of testing is equally familiar and acceptable to persons from the cultural group
f) Contextual equivalence: the extent to which the cognitive ability is evaluated similarly in the various environments where a person functions
g) Sampling equivalence: the extent to which samples are comparable at test development, validation, and interpretation stages.

Most efforts to improve cross-cultural applicability have focused on a few of the above examples of equivalence. Studies have assessed aspects of conceptual equivalence such as item familiarity and stimulus identity, linguistic equivalence (e.g., test translation), and especially psychometric equivalence (e.g., similarities in factor structure or regression lines) on a number of cognitive tests. However, studies of cross-cultural applicability of neuropsychological tests are extremely rare, possibly as a function of the some of the assumptions noted above. These efforts have been limited to the development of appropriate normative data (sampling equivalence) in the U.S. (e.g., Marcopoulos et al., 1997; Unverzagt et al., 1996) and isolated studies assessing item familiarity (Maj et al., 1993; Roberts & Hamsher, 1984).

Possible Contributions from Cross-Cultural Psychology

Cross-cultural psychology has been defined as the scientific study of human behaviour and its transmission, taking into account the ways in which behaviours are shaped and influenced by social and cultural forces (Berry et al., 1992). Its central features are the study of diversity in human behaviour and the link between individual behaviour and the cultural context in which it occurs.

One particularly useful approach within cross-cultural psychology is the identification of different "cognitive styles" (Berry, 1975; Witkin & Berry, 1975 cf. Berry et al., 1992). This view attempts to relate different cognitive abilities to a particular ecological-cultural context. As a guiding principle, the "law of cultural differentiation" (Ferguson, 1956) states that "cultural factors prescribe what shall be learned and at what age; consequently different cultural environments lead to the development of different *patterns of ability*...Abilities are behaviours that reach stable levels through the adaptation of *cerebral structures* to ecological demand [italics added]" (p.121).

One of the most important and influential contributions of the cognitive styles approach has been the concept of "field dependence" (Witkin, Dyk, Paterson, Goodenough, & Karp, 1962; cf. Berry et al., 1992). The dimension of field dependence may be described as the degree to which an individual relies on internal frames of reference when dealing with their environment. At one end of the continuum, someone with a field-independent cognitive style relies heavily on internal body cues and is thus more "individualistic" in their approach. On the other hand, the person who depends heavily on the external and social environment is considered more field-dependent (a more "collectivist" approach). Studies in different ecological settings have provided broad guidelines as to the most adaptive cognitive styles given the particular context. Based on these findings, for example, hunter-gatherers have generally been identified as more likely to be field-independent than agriculturists in their cognitive style (Berry, 1975).

The issue of whether members of different ethnic-cultural groups in North America develop distinct cognitive styles remains an empirical question (Vernon, Jackson, & Messick, 1988). In light of the previous discussions concerning cultural equivalence, however, one might question whether current neuropsychological and cognitive tests are appropriate in the identification of cognitive styles in a multicultural society. When considering these issues, it may be important to consider the guideline as put forth by Irvine (1966; cf. Irvine & Berry, 1988):

> if one were using the same test to predict success on a common criterion... the test scores could be held to have finite and common meaning. This *predictive* meaning should be held separate from *descriptive* or environmental meaning. Predictive meaning allows valued judgements when the criterion itself is recognized as a *value judgement* [italics added] (pp. 27-28).

For example, it may be acceptable to use neuropsychological test scores with African Americans, as long as similar patterns of ability are predictive of the same explicitly stated criterion (e.g., functional outcome following brain injury). It is worth noting that Irvine (1966) adds that without documented cultural equivalence "test scores taken by themselves, and group averages based on such scores are not sufficient proof of the superiority or inferiority of one group or another" (pp. 27-28). The balance between general societal norms with culture-specific issues when assessing a certain client (i.e., "cultural sensitivity") remains the ultimate goal (Lopez & Taussig, 1991).

An interesting parallel may be drawn between the ecological-cultural study of cognitive styles and the clinical interpretation of individual neuropsychological test profiles. Both assume the existence of certain basic common cognitive processes. Individuals differ in the degree to which these abilities are developed. In this way, an individual's neuropsychological test profile (i.e., pattern of ability) would reflect the dynamic interaction between an underlying brain structure/organization during development and the "ecological contexts, cultural norms, and social situations encountered both during socialisation and at the time of the performance" (Berry et al., 1992; p. 130).

Issues Specific to African Americans

African American Culture: Although culture has long been cited as a key factor in lowered scores demonstrated by African Americans on tests of cognitive ability (e.g., Williams, 1972), there has been little research on the impact of such cultural factors on test performance. This may be partly due to the myth that African Americans do not have a separate culture from majority American society (Landrine & Klonoff, 1994). It is often assumed that African Americans are equally exposed to majority culture, a position that does not seem defensible in what remains a largely segregated society (Helms, 1997).

Several authors have cited factors that appear somewhat unique to African American culture. These factors could, in theory, have a substantial impact on cognitive test performance. These include, among others: a strong spiritual focus; a deep sense of kinship and identity with the group ("communalism"); a keen awareness of one's place in the world ("holism"); a higher need for active learning environments ("behavioural verve"); an emphasis on emotional expressiveness and individualism; reverence for oral communication; and a socially defined time perspective (Boykin, 1983; Heath, 1989; Nobles, 1972; Willis, 1989). Many of these cultural differences are believed to be rooted in traditional African philosophy (Nobles, 1972).

By and large, majority American cultural values stress an autonomous, field-independent cognitive style in which children are taught to think in an analytical, sequential, and task- or object-oriented manner. Heath (1989) has argued that African Americans as a group are typically socialized to develop spontaneous, creative, interactive, and expansive thinking skills. These skills do not appear consistent with those necessary to perform well on most psychometric tests. Essentially, African Americans may demonstrate a relatively more field-dependent cognitive style (Boykin, 1983). As a result, one could hypothesize that African Americans would perform better on measures that assess contextual interpretation, improvisation and creativity, and memory for essence rather than facts (Willis, 1989).

Impact of Continued Racism: The general mistrust of many African Americans towards institutions may also have an impact on attitudes towards testing (see testing condition equivalency). Many African Americans, particularly those of a certain age, have experienced frank discrimination and segregation for many years of their lives. Fear of Western medicine and mistrust of health care providers have been cited as possible factors in explaining increased delays and avoidance of necessary medical care among African Americans (Haley, Han & Henderson, 1998).

Terrell, Terrell, and Taylor (1981) directly assessed the possible impact of such mistrust on cognitive test performance. One hundred black college students were administered a questionnaire (Cultural Mistrust Inventory) to assess their tendency to mistrust whites in different situations. Participants were then divided into two groups depending on their scores on this scale (high vs. low mistrust). Half of the sample were administered the Wechsler Adult Intelligence Scale (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 who scored highest on the cultural 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). In addition, if examined by a white examiner, those with lower mistrust performed better (white examiner-low mistrust > white examiner-high mistrust). These findings are significant for two reasons. First, examiner ethnicity may be an important factor to consider in interpreting cognitive test performance. Second, and possibly more important, these influences are not moderated by simplistic notions of examiner-examinee match, but are rather moderated by an underlying attitude of cultural mistrust in some black test-takers.

Steele (1997) has suggested that the underlying threat of negative stereotyping may also affect cognitive ability test scores. African American and European American university students were given a test consisting of items from the Graduate Record Examination (GRE). Half were told that it was a measure of "intellectual" ability, while the remaining were told it was an assessment of "problem solving" ability. African American participants who were told it was a measure of intelligence obtained lower scores than their European American counterparts. No such differences were found in the groups told the test was assessing the ability to solve problems. In a follow-up study, simply asking participants to identify their racial background prior to the test negatively impacted the performance of African American participants on the problem-solving task. African Americans who were not asked their ethnic background performed as well as the European American groups (Steele, 1997).

Acculturation

Acculturation has emerged as an important concept in the study of ethnic minorities 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; Negy & Woods, 1992). For psychologists, it is important to make the distinction between "group" and "psychological" acculturation. At the group level, acculturation involves changes in social structure, economic base, and political organization. At the individual level, acculturation implies more subtle changes in cultural identity, values, and attitudes. Obviously, not every member of a given cultural group will necessarily participate in all aspects of social and cultural life. Simple identification of a person's ethnic group (ethnicity) reveals little about the amount or type of culture the person has absorbed (Helms, 1992). Some authors even consider ethnicity and culture as orthogonal constructs (e.g., Landrine & Klonoff, 1996).

Acculturation may be defined as the level at which an individual participates in the values, language, and practices of his or her own ethnic community *versus* those of the dominant culture (Landrine & Klonoff, 1995). This definition is similar to the notion of ethnic involvement (Phinney, 1990), or the degree of immersion in the social life and cultural practices of one's particular ethnic group. According to this definition, blacks with a low degree of acculturation are more likely to have retained the customs, values, traditions, and behavioural practices typical of traditional African American culture. At the other hand, those with a high level of acculturation are more likely to have been assimilated into majority American culture, and are more culturally distant from traditional African American values, beliefs, and attitudes.

The above definition may be criticized for its unidimensional view of acculturation. According to this model, individuals are necessarily assessed along a single continuum depending on the degree to which they participate in their group's cultural practices. Strengthening one set of cultural values would necessarily weaken the influence of others. Other researchers have argued that acculturation is a complex, multidimensional entity that cannot be adequately captured using a bipolar scale (e.g., Artiola i Fortuny et al., 1998; Berry, 1989), and several more complex theoretical models of acculturation have been proposed (Landrine & Klonoff, 1996). Berry (1989) proposed a two-dimensional model that assessed both an individual's relationship with traditional culture and their relationship with the dominant culture. This results in four possible ways of interacting within competing cultural contexts:

a) Integration: the individual accepts both the dominant and minority cultures to some degree (i.e., "bicultural"),
b) Separation: the individual desires to distance themselves from the majority culture,
c) Assimilation: the individual does not maintain their own ethnic culture and seeks regular contact with the dominant society,
d) Marginalization: the individual sees little possibility or interest in relations with either culture (p. 216).

The unidimensional model proposed nevertheless holds a number of practical and conceptual advantages, particularly when studying African Americans. First, many of the typical indicators of acculturation used with recent immigrants and other ethnic-cultural groups (e.g., generation in country, language preference) appear inappropriate for use with African Americans. Second, in order to entertain a complete two-dimensional model such as Berry's, one would require a valid measure of acculturation to European American culture. In the absence of such a measure, certain demographic factors (e.g., years of formal American education) may be considered indirect indicators of acculturation to majority American society. Third, there is little information to indicate how the two dimensions might interact in an African American population. Arguably, these factors are unlikely to be totally independent given the history and evolution of African American culture. For example, some items of the African American Acculturation Scale (Landrine & Klonoff, 1994) measure the degree to which blacks mistrust whites as one of the indicators of acculturation. Finally, assessing level of acculturation along a single dimension allows researchers to operationalize, simply and efficiently, within-group cultural variability.

There is little doubt that acculturation is a highly complex, multidimensional process. However, the lack of a practical measure of the degree to which African Americans accept majority American culture would seem to make the use of a multidimensional model overwhelmingly difficult at the present time. Limiting acculturation to a single dimension allows for more coherent study of the underlying factors, and provides a rudimentary framework to study the influence of African American acculturation on psychological functioning.

Effects of Acculturation on Neuropsychological Testing

Performance on cognitive tests has been reported to become "better" as test-takers become more familiar with the culture of origin of the tests (Berry et al., 1992). However, only two studies have formally assessed the degree to which acculturation may affect performance on neuropsychological tests. These are described in greater detail below.

Arnold, Montgomery, Castaneda, and Longoria (1994) assessed the importance of Mexican American acculturation on neuropsychological test performance. They first classified neurologically normal participants into three acculturation groups (Mexican, Mexican American, and Anglo-American) based on language use and surname. Group membership was then confirmed using the Acculturation Rating Scale for Mexican Americans (ARSMA, Cuellar et al., 1980). Each participant completed five tests from the Halstead-Reitan battery of neuropsychological tests (Reitan & Wolfson, 1993), namely the Halstead Category Test, Tactual Performance Test (TPT), Finger Tapping Test, Seashore Rhythm Test (SRT), and Trail Making Test. Multivariate analysis of variance revealed a significant effect of acculturation on several of these measures after controlling for age, sex, and education. The Anglo-American group performed significantly better than the other groups on the Category test, and better than the

Mexican group on three measures of the TPT (dominant hand time, non-dominant hand time, total time). The Mexican American group obtained significantly better scores than both other groups on the SRT. These authors speculated that differences on the Category test might reflect variations in problem solving styles among cultural groups, and that better SRT performance in the Mexican American group might be associated with their bilingual status.

Manly and colleagues (1998) conducted two studies assessing the impact of African American acculturation on neuropsychological test performance. In the first study, 170 neurologically normal African American participants (mean age = 37.7 years; 53% female) were asked to complete several measures as part of the Neuropsychological Test Normative Project in San Diego. These tasks included the African American Acculturation Scale-Short Form (AAAS-33), the Halstead-Reitan Neuropsychological Test Battery (including the Wechsler Adult Intelligence Scale-Revised [WAIS-R]), and additional measures of attention, speed of information processing, learning, memory, and verbal skills. A language sample was taken from a subset of these participants (*N* = 25) and coded for the number of black English variants (black English use). Level of acculturation predicted a significant amount of variance on many of the administered neuropsychological tasks (Category Test, Trails A & B, the Information, Block Design, and Digit Symbol subtests of the WAIS-R, Boston Naming Test, the learning components of the Figure and Story Memory Tests, and Grooved Pegs). After statistically controlling for the influence of age, sex, and education, acculturation effects remained significant on WAIS-R Information and the Boston Naming Test. Black English use was generally associated with poorer scores on Trails B, WAIS-R Information, and a verbal memory test (Story Learning).

In a second study, equal numbers of HIV-positive African American and European American participants were matched for age, education, sex, and HIV disease stage. All 40 participants were recruited from the HIV Neurobehavioral Research Center (HNRC) and completed the same test battery as in the first study. HIV-positive African Americans 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 and visual memory tests. Covariance for acculturation scores resulted in all but one score (Story Learning) becoming non-significant.

In light of these findings, Manly et al. (1998) suggested that cultural differences within the African American population might account for some of the group differences observed on specific neuropsychological tests. They also suggested that the use of acculturation scales might serve to decrease these effects and help improve the diagnostic accuracy of the more susceptible neuropsychological tests.

Nature and Epidemiology of Traumatic Brain Injury

According to the researchers involved in the Traumatic Brain Injury Model Systems National Database (Harrison-Felix, Newton, Hall, & Kreutzer, 1996), traumatic brain injury (TBI) may be defined as follows:

> damage to brain tissue caused by an external mechanical force, as evidenced by loss of consciousness due to brain trauma, post-traumatic amnesia, skull fracture, or objective neurological findings that can be reasonably be attributed to TBI on physical examination or mental status examination (p.2).

This definition has important implications for subject inclusion/exclusion in research protocols. Most important, it excludes many of the milder head injuries resulting in questionable loss of consciousness or subtle findings immediately post-injury. Milder forms of head injury and post-concussion syndrome will not be considered in this review, and are adequately reviewed elsewhere (e.g., Binder, 1997; Binder, Rohling, & Larabee, 1997; Cullum & Thompson, 1997).

Although the overall incidence has decreased in recent years (Kraus & McArthur, 1999), TBI remains one of the most important causes of chronic health problems in North America. In the U.S., current estimates of incidence range from approximately 100-392/100 000 (Kraus & McArthur, 1999). It has long been known that individuals who suffer a TBI are often not representative of the general population. The typical individual suffering from a TBI may be characterized as follows: either between 15-24 or over 60-65 years of age, male (male to female ratio: approximately 2.0 to 2.8), of lower SES, and having a high school education or lower. Some studies have suggested a greater incidence of TBI in ethnic minority populations (Collins, 1990; Rosenthal et al., 1996), although some concerns have been raised about the accuracy of these estimates (Kraus & McArthur, 1999). The incidence of positive blood alcohol and illicit drug findings at the time of injury is high (Rosenthal & Ricker, 2000), and in some samples exceeds 50% (Dikmen, Donovan, Loberg, Machamer, & Temkin, 1993). Pre-injury alcohol abuse is common, with some reports of more than one third being diagnosed as alcohol dependent prior to injury (Hibbard, Usysal, Kepler, Bogdany, & Silver, 1998). Some authors have also suggested a high incidence of individuals with a criminal history, sometimes representing 50-91 % of the studied sample (Brooks, Campsie, Symington, Beattie, & McKinlay, 1986; Thomsen, 1987).

Although older studies of brain injury often involved soldiers or other war-related casualties, more recent TBI studies have primarily involved motor vehicle accidents (MVA), falls, assaults, or sports/recreation-related injuries (Rosenthal & Ricker, 2000). It is important to note that these characterisations can often be misleading, as there are often interactions between demographic and etiological factors. For example, there is considerable evidence that whereas MVAs account for the vast majority of injuries among younger individuals, falls account for a substantial proportion of injuries in the elderly (Goldstein & Levin, 1995; Reeder, Rosenthal, Lichtenberg, & Wood, 1996).

Most brain injuries can be characterized as either "primary" or "secondary". Primary injuries consist of either focal and/or diffuse damage as a direct result of acute mechanical trauma. Focal injuries are typically seen as following a penetrating wound, skull fracture, or abrupt contact with bone structures, usually resulting from orbito-frontal and temporal regions colliding with the anterior surface of the skull (Levin, 1993). Although initially less fatal (Zafonte, Mann, Millis, & Wood, 1997), diffuse injuries may well cause the most devastating and debilitating long-term sequelae of TBI. Significant rotational forces during impact are believed to result in damage to axonal pathways throughout the brain, often affecting major commissural (e.g., corpus callosum) and other fibre tracts (e.g., fornix).

Secondary injuries occur within hours or days of the event, and often result in further damage and resulting impairment. Such factors are particularly important as they relate to the determinants of long-term outcome. Etiological factors that have been identified to affect cerebral integrity at this stage include: edema and increased intracranial pressure, deterioration of the blood-brain barrier and increased blood-neuron contact; cardiac and respiratory changes; infection from septic skull penetrations; hyper-release of catecholamines (norepinephrine and epinephrine); and increased seizure vulnerability (Rosenthal & Ricker, 2000).

Pattern of Neuropsychological Recovery

Most research involving TBI suggests that the more striking early cognitive and behavioural effects (e.g., significant retrograde/post-traumatic amnesia, agitation, and restlessness) typically resolve within the first few months following injury (Levin, 1993; McKinlay & Watkiss, 1999). The clinical picture becomes considerably more complex in the post-acute phase (i.e., several months to years), and it has been immensely difficult to consistently describe the "prototypical" neuropsychological profile following TBI. In spite of these complications, certain neuropsychological tests appear to be more sensitive to the effects of

TBI. These include tasks assessing manual dexterity, complex attention, executive control, and auditory-verbal learning (Putnam & Fichtenberg, 1999). In contrast, measures of psychomotor speed, immediate memory span, language functioning, and general cognitive abilities are considered somewhat more resilient. Particularly notable is the relative insensitivity of certain tests in the face of considerable injury (e.g., WAIS-R Digit Span).

Dikmen, Machamer, Winn, and Temkin (1995) conducted one of the most comprehensive studies assessing neuropsychological functioning following TBI involving large groups of head-injured (*N* = 436) and general-trauma controls (*N* = 121). As might be predicted, they found that the head-injured group performed significantly worse than the control group on most of the neuropsychological measures at one year post-injury. Severely injured individuals, in particular, consistently performed worse than trauma controls. However, the authors also reported that there was considerable variability in the scores obtained by the control, mildly head-injured, and moderately head-injured individuals, and cautioned that at one year post-injury neuropsychological test scores may not always be sufficient to conclusively distinguish individuals who have suffered a mild or moderate TBI.

The Utility of Neuropsychological Testing in Predicting Functional Outcome

Outcome following a head injury depends on several variables, most notably pre-injury characteristics, factors related to the injury itself, and their interaction (Dikmen & Machamer, 1995). The neuropsychologist's predominant interest may be seen as the interaction of premorbid and injury-related variables, as this represents the specific impact a head injury will have on a particular individual.

Early neuropsychological status is often considered one of the best indicators of future outcome (Dikmen & Machamer, 1995; Teasdale, Skovdahl, Gade, & Christensen, 1997; Tellier, 1990). According to Dikmen & Machamer (1995) the success of neuropsychological testing may be related to its ability to serve as an objective composite measure that is affected both by pre-injury and injury-related factors. There are several studies suggesting that neuropsychological testing may also predict different aspects of psychosocial functioning. Either alone or in combination with other factors, objective cognitive indicators have often been reported to successfully predict employment following TBI (e.g., Dikmen et al., 1994; Ip, Dornan, & Schentag, 1995). In a study by Tellier (1990), a composite neuropsychological measure (Halstead-Reitan Average Impairment Rating; Russell, Neuringer, & Goldstein, 1970) surpassed all others in its ability to predict psychosocial outcome at 2.5 years post-injury. Ross, Millis, & Rosenthal (1997) reported that a composite consisting of the Trail-Making Test, Rey Auditory Verbal Learning Test (RAVLT), and age significantly predicted community integration (as measured by the Community Integration Questionnaire; CIQ) at one year post-injury. Hanks, Rapport, Millis & Deshpande (1998) studied the general association between neuropsychological impairment and rehabilitation outcome. Using a canonical correlation, they found that measures of executive function (Letter-Number Span, Controlled Oral Word Association Test [COWAT], Trails B, and Wisconsin Card Sorting Test [WCST]), verbal memory (Wechsler Memory Scale-Revised [WMS-R] Logical Memory - percent retained), and reading skills (Wide Range Achievement Test - Revised [WRAT-R] - Reading) were strongly related to level of overall disability (Disability Rating Scale; DRS) and community integration (CIQ) at six months post-rehabilitation.

However, not all studies have found neuropsychological test scores to be predictive of outcome (e.g., Cifu et al., 1997), and further research is needed to specify to what extent neuropsychological testing can independently contribute to the prediction of outcome measures. This need is particularly pressing given the increased demand for clinical neuropsychology to document the usefulness of its services and interventions (Vanderploeg, 1998).

Other Factors Affecting Outcome in Traumatic Brain Injury

Injury-Related Factors: Head injury severity is the most obvious determinant of outcome following TBI. Prolonged impairments in consciousness and orientation are common following severe TBI (Rosenthal & Ricker, 2000), and the mortality rate in such cases may be as high as 30-50% (Levati, Farina, Vecchi, Rosanda, & Marrubini, 1982). Of those who survive a severe injury, 20% remain unresponsive for at least 30 days post-injury (Zafonte et al., 1997). Moderate and mild injuries show a much greater degree of variability (Dikmen, Machamer, Winn, & Temkin, 1995). Some reviewers have suggested that outcomes following a mild TBI are characterized by complete or nearly complete recovery (Binder, Rohling, & Larabee, 1997), with few neurobehavioural phenomena attributable to brain damage beyond two years post-injury (Levin, 1993). For an opposing viewpoint see Parker and Rosenblum (1996).

Although there is general accord concerning the importance of severity in predicting outcome, there is some disagreement as to its measurement. By far the most popular measure is the Glasgow Coma Scale (GCS). The GCS is a brief, simple, and practical scale that assesses a patient's behavioural responses within three distinct domains: eye movements, motor functions, and vocalisations (Teasdale & Jennett, 1974). Scores range from 3 to 15, with lowered scores signifying a decreased level of consciousness. For research purposes, level of severity is usually defined by the lowest GCS score assessed within the first 24 hours. GCS scores have been shown to be predictive of neuropsychological functioning at one month and one year, with severe injuries associated with poorer cognitive performance (Dikmen & Machamer, 1995). In spite of its inherent simplicity and predictive validity, the GCS may be relatively insensitive to secondary injuries and may possibly be contaminated by pre-injury alcohol or drug use (Stambrook, Moore, Lubusko, Peters, & Blumenschein, 1993).

The oldest measure of injury severity is post-traumatic amnesia (PTA; Russell & Smith, 1961), defined as both the coma and the period of significant anterograde amnesia that typically follows it. It can be measured somewhat more objectively by using tests such as the Galveston Orientation and Amnesia Test (GOAT; Levin, O'Donnell, & Grossman, 1979). PTA remains a good indicator of neurological damage as evidenced by neuroimaging studies (Wilson, Teasdale, Hadley, Wiedmann, & Lang, 1994), and is somewhat more sensitive than GCS to secondary injuries. When measured using more reliable methods, duration of PTA has been demonstrated to be a significant outcome predictor, particularly when combined with other factors (Katz & Alexander, 1994; Zafonte et al., 1997).

Premorbid Factors: The need for baseline measurements of pre-injury functioning in the evaluation of head injury outcome has been apparent for a long time. However, valid pre-injury information is often difficult to obtain, and clinicians and researchers are restricted to more general indices or characteristics as a means of understanding the effect of the injury on a given individual. These characteristics can then be applied within a greater predictive model and to find suitable control groups.

Age has received the most attention of all the premorbid indicators, both because of its simplicity and its predictive value. Age is certainly a strong early predictor of mortality and morbidity following TBI in those 55 or older (Reeder, Rosenthal, Lichtenberg, & Wood, 1996; Vollmer et al., 1991), particularly in association with a severe injury (Giacino & Zasler, 1995). Age may also serve as a useful predictor when used as a cut-off, typically at age 40 or 55 (e.g., Ponsford, Olver, & Ng, 1995). However, the exact relationship between age and TBI outcome is likely to be complex (Goldstein & Levin, 1995). Arguably, older persons may fare worse because of other injury-related variables, medical co-morbidities, or differing levels of psychosocial support.

In light of the higher prevalence of premorbid alcohol use in the TBI population as a whole (e.g., Hibbard et al., 1998; Rosenthal & Ricker, 2000), there has been significant interest in its possible contribution to outcome. Ruff et al. (1990) reported that a history of pre-injury alcohol use was significantly related to increased risk of mass lesions and mortality following severe head injury. Dikmen, Donovan, Loberg, Machamer, & Temkin (1993) related alcohol use to poorer neuropsychological outcome at one year post-injury. As cognitive deficits associated with head trauma are often similar to those associated with chronic alcohol dependence, it is unclear how and to what extent TBI may have interacted with premorbid alcohol use to worsen neuropsychological outcome. This issue is further confounded by the observation that individuals in the Dikmen et al. (1993) study with a history of alcohol use also had lower levels of education. In summary, premorbid alcohol use is likely to be associated with poorer absolute outcome following TBI, although the precise causal factors involved remain unclear at this time.

Some studies (e.g., Rosenthal et al., 1996) have suggested that minority status may have a significant impact on functional outcome following TBI, particularly in the period following discharge from the rehabilitation setting. Although no differences between whites and minorities (almost 80% of which were black) were reported on cognitive and functional abilities at rehabilitation admission and discharge, Rosenthal et al. reported that minority status was strongly related to decreased community integration (as measured by the Community Integration Questionnaire) at six months and one year post-injury. These differences in community integration were present even after controlling for etiology, injury severity, age, gender, and functional status at discharge. There were no differences on other functional measures at one-year post-injury (i.e., Disability Rating Scale, Functional Independence Measure). At present, it is unclear whether these findings are due to the relative cultural insensitivity of the outcome measure (see Dijkers, 1997) or to more pervasive environmental differences between ethnic groups such as the decreased availability of health, rehabilitation and social services.

Purpose of the Current Study

The current investigation was divided into two relatively independent studies. Study 1 was conducted to investigate the potential effect of cultural factors (i.e., acculturation) on neuropsychological test performance among African Americans who have suffered a TBI. Study 2 assessed the extent to which level of acculturation might improve the ability of neuropsychological test scores to predict functional outcome following TBI in an African American population. This type of project may be considered important for a number of reasons.

First, this study represents one of very few studies to directly assess the influence of cultural factors on neuropsychological testing. If culture-related factors were shown to make a significant and unique contribution to the prediction of neuropsychological test scores, this would provide support for the cultural hypothesis of group differences on cognitive/neuropsychological tests.

Second, this would be the first known "within-group" (as opposed to between-group) study specifically assessing the impact of African American acculturation in individuals with documented neuropathology. Limiting assessment to an African American sample partially controls for other differences between blacks and other ethnic-cultural groups (e.g., level of SES, systemic racism). It also avoids the considerable complication of attempting to define European American majority culture, as well as deciding who might be considered "white."

Third, there is some tentative evidence that the influence of cultural factors on neuropsychological test scores may become more prominent with increased neurological impairment (Loewenstein et al., 1993). Furthermore, in the only known prior study assessing acculturation effects with a clinical group (Manly et al., 1998), the more convincing findings were apparent when assessing those individuals with documented neuropathology (i.e., HIV-positive individuals).

Fourth, some authors have suggested that minorities may be disproportionately represented in TBI populations, thereby increasing the relevance of minority issues in TBI-related research (Rosenthal et al., 1996). If African American acculturation is found to be a significant predictor of neuropsychological test performance in Study 1, as suggested by some prior research (Manly et al., 1998), this would likely increase the risk of misdiagnosing a significant proportion of individuals with TBI. As assessed in Study 2, inclusion of an acculturation measure might improve the utility of neuropsychological test scores in predicting functional outcome following TBI in African Americans.

Hypotheses

Study 1: Acculturation and Neuropsychological Test Performance

1. It was hypothesized that individuals who espouse more traditional African American cultural values and beliefs (i.e., lower acculturation to majority white culture) would obtain lower scores on the administered neuropsychological tests. These effects would be present when assessing both individual tests and a composite measure of overall neuropsychological test performance.

2. It was expected that level of African American acculturation would independently predict neuropsychological test performance above and beyond what might be expected from other demographic factors such as age, sex, education, and SES.

3. The above reviewed literature comparing ethnic-cultural groups suggested that cultural factors could potentially affect test performance in any neuropsychological domain. However, in light of prior findings (e.g., Arnold et al., 1994; Manly et al., 1998) and descriptions of the characteristics of African American culture (e.g., Willis, 1989), it was hypothesized that the acculturation effects would more likely be found on tests emphasizing more complex cognitive abilities such as problem solving and reasoning.

Study 2: Predicting Functional Outcome in African Americans

4. In keeping with previous findings (e.g., Tellier, 1990), it was hypothesized that a composite neuropsychological test measure would be significantly correlated with measures of functional outcome following TBI in a sample of African Americans.

5. The addition of an acculturation measure was expected to significantly increase the utility of neuropsychological test scores in predicting functional outcome following TBI. Once again, this contribution was expected to be above and beyond what might be predicted from other injury-related (severity, time since injury) and demographic variables (i.e., age, sex, education, SES).

CHAPTER II

METHOD

Procedure

Participants in the study consisted of 45 African American individuals already involved in the South Eastern Michigan Traumatic Brain Injury Model Systems (SEMTBIS) project. The SEMTBIS project is part of a large, multicenter research effort funded by the National Institute on Disability and Rehabilitation Research (NIDRR), and is dedicated to the collection of extensive data on brain-injured individuals (Dahmer et al., 1993). The accepted definition of a traumatic brain injury in the Traumatic Brain Injury Model Systems National Database (Harrison-Felix, Newton, Hall, & Kreutzer, 1996) has already been described in a previous section. Inclusionary criteria for the SEMTBIS study include a) aged 16 years or older, b) presenting alive to a designated mode system hospital emergency department within eight hours of injury, and c) residing and injured in the designated catchment area.

As part of their involvement in the SEMTBIS project, participants complete a rather extensive set of tests, questionnaires, and rating scales at regular intervals following their TBI. This includes the administration of a complete neuropsychological test battery during their inpatient rehabilitation stay if appropriate, and again during outpatient follow-up sessions at one, two, five, and ten years post-injury. A description of the entire SEMTBIS protocol is presented in Appendix A.

Participants for the current acculturation study were recruited at approximately one, two, five, or ten years post-injury. Upon completion of the SEMTBIS tests/questionnaires, prospective participants were asked to take part in the present acculturation study. Following confirmation of their ethnicity through self-report, participants were asked to complete a brief 5-10 minute acculturation questionnaire. Other variables of interest were obtained directly from the SEMTBIS database. These included various injury-related factors (e.g., time since injury, Glasgow Coma Scale scores, duration of PTA, CT findings), demographic variables (e.g., age, sex, level of education, occupational status), results from the neuropsychological test battery, and measures of general functional status (i.e., Disability Rating Scale, Functional Independence Measure, Community Integration Questionnaire). Three of the participants completed the acculturation questionnaire twice (i.e., at one and two years post-injury). In these cases, only the first assessment was used in subsequent statistical analyses.

Participants

Ethnicity: All 45 participants were self-identified as African American from a set of written choices (see Appendix B).

Age: The age of the participants ranged from 16 to 75 years of age at the time of their initial injury (M = 37.5, SD = 14.9). Mean age at the time of assessment was 41.4 years (SD = 13.7). Note that the bimodal age distribution observed in some prior epidemiological studies with TBI (e.g., Kraus & McArthur, 1999) was not observed in the current sample.

Sex: As with most studies involving TBI, the vast majority of the current sample was male (n = 38, 84% of total sample). However, the proportion of males was larger in this sample than in most published reports (over 5 to 1).

Marital Status: Only six of the participants were married at the time of their participation in the study. The remainder were either single (n = 27) or divorced/separated (n = 12).

Education/Occupation: Thirty eight percent of the current sample had not completed high school (n = 17). Of the remainder, 12 (about 27% of the total) had taken at least some degree of post-secondary education (mostly community college courses). General information regarding prior learning/academic history was also available for 34 of the participants (76% of total sample). Of this group, seven reported that they had received some form of special education for learning problems at some point in their academic career.

Seventy-one percent of the sample was unemployed at the time of injury ($n = 32$), whereas eight were employed full-time. There appeared to be considerable stability in the educational/occupational status of individuals when comparing pre- and post-injury data. Of the eight employed at the time of their accident, only one was subsequently unemployed at the time of their post-injury assessment. None of the participants who were unemployed prior to their injuries reported being employed (either full- or part-time) at follow-up.

Educational level is recorded in the SEMTBIS database as a nominal variable, with various educational landmarks serving as indicators of educational attainment (e.g., junior high school graduate, high school graduate, some college courses). As a result, it was not possible to obtain a single continuous educational variable (i.e., years of education). The Hollingshead Two Factor Index of Social Status (Hollingshead, 1975) was therefore used to derive a single numerical composite of educational and occupational status. The Two Factor Index is very similar to the better-known Four Factor Index of Social Status. The Two Factor Index was chosen in light of the limited collateral information regarding the participants' spouses. Educational categories in the SEMTBIS database are quite similar to those used in the calculation of the Hollingshead Index, which allowed for relatively straightforward calculations. Premorbid occupational status was used in the derivation of estimated SES. Given the high rate of unemployment in the current sample, the Two-Factor Index provided an informative indicator of educational attainment. Using this particular measure, more than half ($n = 31$) were in the lowest SES bracket as outlined by Hollingshead (1975). The vast majority ($n = 42$) were in the lowest two social strata ("Lower" and "Lower Middle").

Substance Use: Although questions regarding alcohol/substance use are a routine part of the SEMTBIS protocol, information regarding premorbid alcohol use was only available for 11 of 45 participants. However, almost half of the sample (47%) had an identifiable blood alcohol level at the time of their hospital admission. Information regarding premorbid illicit drug use was available for 35 of the participants. Of these, 17 reported at least one instance of drug use prior to their TBI.

Legal History: Of the 31 participants for whom such information was available, 15 reported having been arrested at least once over their lifetime. Eight had at least one arrest for a substance-related offence.

Medical/Psychiatric History: Of the 30 for whom such records were present, only one reported any significant psychiatric history. A small number reported having suffered some form of head injury in the past (*n* = 5). Statistical analyses did not reveal any significant differences between groups (with vs. without TBI history) on any of the major outcome measures. History of prior TBI was therefore excluded from any further analyses.

Injury Characteristics

Cause of Injury: Almost half of the sample (*n* = 22) incurred their TBI as a result of an accident involving some type of motor vehicle (49% of sample). Of these, six were pedestrians and one was a cyclist. The other causes of TBI were either assaults (40%) or falls (11%).

Time since injury: There was a relatively even distribution of the observed time since injury in the current sample. A little more than half of the participants were evaluated at one (*n* = 14) and two years (*n* = 12) following their original TBI. Eleven individuals were assessed at five years post-injury, and eight at ten years post-injury.

Injury Severity: The SEMTBIS database provides three GCS scores obtained within the first 24 hours following hospital admission (initial, highest, lowest). To account for possible secondary injuries, the lowest available GCS score obtained in the first 24 hours following hospitalization was chosen as the estimate of injury severity. Such information was available for the vast majority (96%) of the current sample (*n* = 43).

Using conventional cut-offs, classification of injury severity of the current sample was as follows:

Severe	(GCS: 3-8)	$n = 23$	(51%)
Moderate	(GCS: 9-12)	$n = 7$	(16%)
Mild	(GCS: 13-15)	$n = 13$	(29%)
Missing GCS score		$n = 2$	(4%)
Total		$N = 45$	(100%)

Although time to emerge from post-traumatic amnesia (PTA) had initially been considered a useful indicator of neuropathology for this study, this information was only present for a limited number of participants (n = 28). Neuroimaging (CT) findings indicating the presence or absence of significant neuropathology at the time of injury was only available for a relatively small subgroup (n = 28). Correlational analyses between the different indicators of injury severity revealed significant relationships between initial GCS and both duration of PTA and the presence of positive CT findings (see Table 1). In light of the above, lowest GCS score within the first 24 hours was chosen as the sole indicator of injury severity in subsequent analyses.

Measures

Individual Neuropsychological Tests: Neuropsychological testing was performed on all but one of the 45 study participants. However, not all participants completed the entire test battery, typically because of residual physical limitations (e.g., inability to complete paper-and-pencil tasks). The complete SEMTBIS neuropsychological test battery, as well as the number of individuals completing each of the neuropsychological tests is provided in Table 2.

Table 1

Correlations among Indicators of Injury Severity

	Initial GCS	*(Log) PTA*	*CT Findings*
Initial GCS	1.00	-.59**	-.49**
(Log) PTA	-.59**	1.00	.21
CT Findings	-.49**	.21	1.00

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

Table 2

List of Tests in the South East Michigan Traumatic Brain Injury Systems Study (SEMTBIS) Test Battery

1. Galveston Orientation and Attention Test (GOAT)		[*N*=44]
2. Wechsler Memory Scale-Revised (WMS-R): Digit Span	- Forward	[*N*=44]
	- Backward	[*N*=43]
3. Multilingual Aphasia Examination (MAE): Tokens Test		[*N*=43]
4. Controlled Oral Word Association Test (COWAT)		[*N*=44]
5. Benton Visual Discrimination Test (BVDT)		[*N*=44]
6. Wechsler Adult Intelligence Scale-Revised (WAIS-R) Block Design		[*N*=42]
7. Wechsler Memory Scale-Revised (WMS-R): Logical Memory	- Immediate	[*N*=44]
	- Delayed	[*N*=44]
8. Rey Auditory Verbal Learning Test (RAVLT)	- Trial 1	[*N*=44]
	- Total Trials 1-5	[*N*=44]
	- Alternate List	[*N*=44]
	- Delayed Recall	[*N*=44]
9. Grooved Pegboard Test (Grooved Pegs) - Dominant Hand		[*N*=40]
10. Symbol Digit Modalities Test (SDMT)	- Oral	[*N*=42]
	- Written	[*N*=39]
11. Trail Making Test	- Part A	[*N*=41]
	- Part B	[*N*=37]
12. Wisconsin Card Sorting Test (WCST)	- Categories	[*N*=41]
	- Perseverative Responses	[*N*=41]

From the above tests, a total of 20 different test scores were obtained. Of the WMS-R scales, Digit Span Forward & Backward were assessed separately, as were the Immediate and Delayed Recall scores for the Logical Memory subtest. The following four scores were used from the RAVLT: Recall Trial 1, Total Recall Trials 1-5, Alternate List Recall, and Delayed Recall (Trial 6). The Oral and Written versions of the SDMT were both administered and scored separately, as were Parts A and B of the Trailmaking Test. Consistent with the SEMTBIS recording protocol, the total number of categories and perseverative responses were obtained for the WCST. Because the exact relationship between acculturation and neuropsychological test performance has not been clearly established, raw scores were used in all analyses.

Composite Measure of Neuropsychological Test Performance: A composite measure of overall neuropsychological test performance was calculated using all but one of the above listed neuropsychological measures. This "Overall Test Battery Mean" (OTBM) is described by Rohling and colleagues in a number of upcoming reports (Miller & Rohling, in press; Rohling, Langhinrichsen-Rohling, & Miller, in press). The OTBM is conceptually similar to other global indices of neuropsychological impairment such as the Global Neuropsychological Deficit Scale (Reitan & Wolfson, 1988), the Halstead Impairment Index (Reitan & Wolfson, 1993), the Halstead-Reitan Average Impairment Rating (Russell, Neuringer, & Goldstein, 1970), and the LNNB Critical Cut-Off Level (Golden, Purisch, & Hammeke, 1981). The OTBM is also part of a broader statistically-based method of clinical interpretation (Rohling's Interpretive Method or RIM), and can be derived from almost any battery of neuropsychological tests. The basis for the RIM is the conversion of all obtained scores to a common metric (*t*-scores). Using the RIM, three estimates of general neuropsychological test performance may be calculated. The first composite measure, the OTBM, is simply defined as the overall mean of all *t*-scores obtained from administered tests. The other two composite measures include the "Domain Test Battery Mean" (DTBM; calculated by averaging the mean scores from each of the cognitive domains assessed) and the "Instrument Test Battery Mean" (ITBM; calculated by averaging a single score from each test administered). The OTBM was selected for the current study for its conceptual simplicity.

The OTBM in this study was defined as the mean of the 19 corrected *t*-scores in the neuropsychological test battery. As there are no norms available for the Galveston Orientation and Amnesia Test (GOAT), it was excluded from any further calculations. A list of the test scores chosen to calculate the composite score, as well as the normative data from which each of the *t*-scores were derived, are included in Appendix C. OTBM scores were calculated for most of the current sample ($n = 42$). Two of the participants completed fewer than 14 of the test measures and were excluded from any calculations involving the OTBM.

An important aspect of the OTBM relates to its use of different sets of normative data. Ideally, all scores would account for the same factors (e.g., age, sex, education) using similar groupings. Unfortunately, norms for tests in the current battery have quite divergent methods of demographic correction. Whereas test scores included in the Heaton et al. (1991) normative data-set are corrected for age, sex, and education, norms for the MAE Tokens Test do not include any corrections. Whenever possible, the choice of normative data was made to maximize their accountability for demographic factors. Calculated OTBM scores represent a "best possible" estimate of overall neuropsychological functioning (in terms of demographic corrections) based on available published norms for each of the tests.

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 represents a shortened version of a measure (African American Acculturation Scale) developed to assess the degree to which an individual espouses the traditions, values, beliefs, assumptions, and practices specific to traditional African American culture (see Appendix D). According to the developers, the shorter AAAS-33 is highly correlated with the original version

($r = 0.94$). The respondents rate their attitudes using a Likert scale ranging from 1 ("I totally disagree, this is not at all true of me") to 7 ("I totally agree, this is absolutely true of me") on each of the 33 items. Total scores on the AAAS-33 have a possible range of 33 to 231. High scores represent a more traditional African American cultural background (lower degree of acculturation); conversely, low scores are assumed to suggest greater acculturation to white majority society (higher degree of acculturation). A description of how to score the AAAS-33 is provided in Appendix E.

The AAAS-33 is divided into ten 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. These factors were empirically derived (using principal components analyses) from the original AAAS, yet are extremely similar to the theoretically based subscales initially proposed in the development of the original acculturation scale (see Landrine & Klonoff, 1995). In the standardization sample, Landrine and Klonoff reported that the Total Score on the AAAS-33 was relatively independent of income, social status of the family of origin, and educational level. In terms of concurrent validity, the developers also provided evidence that the AAAS-33 Total Score (as well as nine of ten subscales) could significantly differentiate between African American and non-African American respondents. Moreover, the AAAS-33 Total Score (and eight subscales) could distinguish between African Americans who live in predominantly black neighbourhoods and those living in mostly integrated ones. A selected set of subscores of the AAAS-33 (Preferences for Things African American, Traditional Foods, Religious Beliefs/Practices, and Traditional Childhood) was used in Manly et al's (1998) study assessing African American acculturation and neuropsychological test performance.

Functional Outcome: Functional Independence Measure (FIM: Keith, Granger, Hamilton, & Sherwin, 1987):

The Functional Independence Measure (FIM) is an 18-item ordinal scale designed to assess functional independence, and is currently used with a wide variety of rehabilitation populations. The FIM is administered by a multidisciplinary team consisting of physiatrists, psychologists, nurses, and physical/occupational therapists. Individuals are assigned a rating from 1 to 7 on each FIM item depending on their current level of independence. A score of 1 represents "total assist" (performs less than 25% of the task), while persons with scores of 6 or 7 require little or no supervision in that particular area of functioning (see Appendix F). Some research using the FIM (Linacre et al., 1994) has suggested that the 18 scales may best be understood as two relatively separate domains assessing motor (FIM - Motor: 13 items) and cognitive functioning (FIM - Cognition: 5 items).

Disability Rating Scale (DRS) (Rappaport, Hall, Hopkins, & Bellaza, 1982): The Disability Rating Scale (DRS) is a brief external rating scale that was specifically devised to assess "disability" following TBI. One critical advantage of the DRS is its ability to track an individual from very early stages to several years post-injury (i.e., from "coma to community"). The eight items are divided into four categories: 1) arousal and awareness (based on the GCS); 2) cognitive ability to handle self-care; 3) physical dependence on others; and 4) psychosocial adaptation to work, school, or home activities (see Appendix G). During the early stages of recovery, it is well correlated with indices of initial injury severity (Hall et al., 1993) and the FIM. The DRS has also been demonstrated to be strongly related to the Community Integration Questionnaire (CIQ; Hanks, Rapport, Millis, & Deshpande, 1998) at 6 months post-injury, and shows good inter-rater reliability (Gouvier, Blanton, Laporte, & Nepomuceno, 1987). Although relatively insensitive to early changes in functioning, the DRS remains one of the better evaluative measures of TBI outcome (at least in the first two years post-injury), and has demonstrated better sensitivity to change than the Glasgow Outcome Scale (GOS; Hall et al., 1985).

The Community Integration Questionnaire (CIQ; Willer, Rosenthal, Kreutzer, Gordon, & Rempel, 1993): The Community Integration Questionnaire was initially developed to assess reintegration into the community after significant medical injury (Willer et al., 1993). The intent was to design a brief (15-minute), behaviour-focused, unbiased, value-neutral measure that was sensitive to a wide variety of living situations (Willer et al., 1993). The CIQ consists of an interview assessing the individual's participation in a number of different activities (see Appendix H). These activities are subdivided into three subscales assessing: 1) Home Integration (e.g., shopping for groceries, preparing meals, doing housework, caring for children), 2) Social Integration (e.g., shopping, leisure activities, visiting friends), and 3) Productive Activities (e.g., extent to which individual gets out of the house to engage in employment, education, or volunteer activities).

There appears to be relative agreement that the CIQ represents an acceptable measure of community integration following TBI, even if "by default" (Dijkers, 1997). The CIQ is brief, simple, and successfully assesses some degree of community integration in all three described areas. However, Dijkers also pointed out some of the CIQ's sizable shortcomings, including its limited scope, the lack of appropriate norms, the possible influence of demographic factors such as age and gender, and the relative independence of the three dimensions. A longitudinal study assessing community integration over four years (Sander, Kreutzer, Rosenthal, Delmonico, & Young, 1996) suggested that the Productive Activities subscale was the only one to be significantly affected over time. Ceiling effects were reported by Hall and colleagues (1996) at one-year post-injury, particularly for the home and social subscales. Rosenthal et al. (1996) suggested that the CIQ may not be culturally sensitive and may wrongly emphasize personal rather than environmental causes for any measured social handicap.

Different versions of the CIQ are available to be completed by the individual (Patient-Report) or a significant other (Relative-Report), and appear to be well-correlated (Sander et al., 1997). However, only the Patient-Report version was included in the following study as the Relative-Report version was available for less than half of the present sample (n = 19).

Ethnicity of Examiner

As the SEMTBIS is a large project involving many different individuals, participants were recruited and assessed by research assistants of different ethnic backgrounds. Almost half (n = 21) of the test protocols used in the current study were administered by black research assistants. The remainder (n = 24) were administered by white research assistants.

Statistical Methods

Study 1: Relationship of Acculturation to Neuropsychological Test Performance: The purpose of Study 1 was essentially two-fold: 1) to establish acculturation as a valid predictor of neuropsychological test performance, and 2) to evaluate the influence of acculturation above and beyond what might be accounted for by other demographic variables. Two separate sets of analyses were thus performed on each of the identified 20 neuropsychological test scores. First, hierarchical multiple regression/correlational (MRC) analyses were used to assess the effect of acculturation on neuropsychological test performance. Factors directly related to the injury (i.e., lowest GCS in the first 24 hours and time since injury) were included as an initial covariate set. Second, to statistically control for any variance that might otherwise be accounted for by other demographic factors, follow-up hierarchical MRC analyses were conducted using age, sex, and education/occupation (SES) as a second covariate set. The prescribed order of entry in these analyses was based on the expected importance of factors to neuropsychological test performance, namely injury-related factors (injury severity, time since injury), followed by demographic factors (age, sex, education/occupation), and finally level of acculturation.

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 (initial GCS, time since injury) as an initial covariate set.

Study 2: Predicting Functional Outcome in an African American sample: Although prior studies have already established a relationship between neuropsychological test scores and measures of functional outcome (e.g., Dikmen & Machamer, 1995; Ross, Millis, & Rosenthal, 1997; Teasdale, Skovdahl, Gade, & Christensen, 1997; Tellier, 1990), the specific contribution of other variables of interest (e.g., age and education) remains unclear (Dijkers, 1997). In order to assess the relationship of each of these variables and functional outcome, simultaneous MRC analyses were performed using the following independent variables: 1) injury-related variables (lowest GCS, time since injury), 2) mean neuropsychological test performance (OTBM), 3) demographic factors (age, sex, education/occupation), and 4) level of acculturation (AAAS-33 Total Score). Total scores on each of the functional outcome measures (FIM, DRS, and CIQ), as well as their subscores (FIM-Motor & FIM-Cognition; CIQ-Home, CIQ-Social, CIQ-Productivity) served as the dependent variables in each of the analyses.

A Note Concerning Statistical Power and Level of Significance: Any large number of regression analyses coupled with a relatively small participant to variable ratio necessarily increases the likelihood of Type I error, and may lead to questions regarding the validity/generalizability of reported findings (i.e., misinterpreting random variation as meaningful relationships). Given the exploratory nature of the current study, however, the large number of analyses appeared warranted to assess for any possible relationships between the key variables of interest. The precise relationship between acculturation and neuropsychological test performance in African Americans remains poorly understood, and has been the subject of only one formal study (Manly et al., 1998). In spite of the risk of decreased statistical power, it seemed preferable to conduct separate analyses for each of the individual neuropsychological test scores. Given the relatively limited sample size, it was also useful to occasionally adopt a more liberal alpha level ($p < 0.1$) to better understand and interpret possible trends/relationships. In an effort to minimize reports of potentially "spurious" statistical findings, singular importance was placed on the correspondence of any observed results with *a priori* hypotheses.

CHAPTER III

RESULTS

Data Screening

A list of all descriptive statistics of the relevant variables is provided in Appendix I. Prior to analyses, all demographic, acculturation, neuropsychological, and functional outcome variables were screened for univariate outliers and normality. Several data transformations were necessary to correct for non-normal distributions, primarily due to the skewness of the obtained distributions for certain neuropsychological tests and functional outcome measures. A list of data transformations is presented in Appendix J. None of the correlations between independent variables exceeded 0.7, a suggested upper limit with regards to multicollinearity in regression analyses (Tabachnick & Fidell, 1989).

Relationship between Demographic Variables and Injury Severity

Consistent with prior epidemiological studies with TBI (e.g., Kraus & McArthur, 1999), a one-way ANOVA revealed a significant relationship between age and cause of injury, $F(2, 42) = 6.64$, $p < 0.01$. Post-hoc analyses indicated that those injured as a result of a fall were significantly older than other groups (at the $p < 0.05$ level). There was also a modest relationship between age and time since injury ($r = -0.33$, $p < 0.05$), with younger individuals generally being tested somewhat later post-injury. There was no significant relationship between injury severity and level of acculturation.

Relationship between Demographic Variables and Level of Acculturation

Consistent with prior reports (Landrine & Klonoff, 1995), there was no significant relationship between AAAS-33 Total Score and demographic variables (age, sex, and education/occupation). Furthermore, there was no significant relationship between any of the

AAAS-33 subscales and age or education/occupation. However, males reported having played significantly more Traditional Games ($R = 0.32$; $p < 0.05$). Pearson product-moment correlations among the AAAS-33 subscales are presented in Table 3. The inter-relationships among AAAS-33 scores in the current sample were generally quite similar to those described by Landrine & Klonoff (1995).

Effect of Examiner Ethnicity

In order to ensure that examiner ethnicity did not unduly affect the results, multiple independent sample t-tests were conducted to assess the difference between measures administered by examiners of differing ethnic backgrounds (i.e., neuropsychological test scores, acculturation measures, self-report questionnaires). Whereas scores on the Family Practices ($t = 5.79$, $p < 0.05$) and Family Values subscales ($t = 3.47$, $p < 0.1$) were higher when administered by an African American examiner, scores on the subscale assessing Preferences for Things African American were significantly lower ($t = 4.56$, $p < 0.05$). Of specific interest, there were no significant differences according to examiner ethnicity on the Cultural Mistrust subscale or AAAS-33 Total Score.

There were also significant differences on the Grooved Pegboard test ($t = 2.07$, $p < 0.05$) and the written version of the Symbol Digit Modalities Test ($t = -2.49$, $p < 0.05$). In both cases, participants' scores were somewhat lower (i.e., slower) when administered by an African American examiner. However, other measures typically considered to measure similar cognitive constructs (e.g., Trails, SDMT-Oral) did not show this effect. In light of a previous study suggesting an interaction between examiner ethnicity and cultural mistrust (Terrell et al., 1981) participants were split into two groups according to their degree of cultural mistrust (i.e., High vs. Low scores on the Cultural Mistrust subscale of the AAAS-33). Subsequent analyses failed to show a significant interaction between Cultural Mistrust and examiner ethnicity. This

Table 3: Correlations among Subscales (Factors) of the African American Acculturation Scale (AAAS-33)

	Cultural Mistrust	*Falling Out*	*Family Practices*	*Family Values*	*Preference for Things African American*	*Religious Practices*	*Superstitions*	*Traditional Childhood*	*Traditional Foods*	*Traditional Games*
Falling Out	.18									
Family Practices	.33*	.22								
Family Values	.15	.51**	.38*							
Preference for Things African American	.01	.07	-.25	-.06						
Religious Practices	-.08	.32*	-.11	.29	.24					
Superstitions	-.04	.38*	.21	.47**	.00	.33*				
Traditional Childhood	.23	.15	.03	.32*	.42**	.30	.18			
Traditional Foods	.27	.23	-.05	.05	.19	.38*	.29	.35*		
Traditional Games	.06	.23	.03	.25	.04	.20	.10	.15	.10	
AAAS-33 Total Score	.37*	.56**	.12	.52**	.46**	.69**	.55**	.66**	.63**	.35

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

suggests that the above findings were unlikely to be the direct result of examiner mistrust. In light of the above, the ethnicity of the examiner was excluded from all subsequent analyses.

STUDY 1: Relationship of Acculturation to Neuropsychological Test Performance

Individual Neuropsychological Tests: Results of the MRC analyses for each of the 20 neuropsychological test scores are presented in Appendix J. Using a more liberal alpha level ($p < 0.1$), these results suggested that level of acculturation was significantly related to raw scores on a number of the neuropsychological tests. Overall, decreased levels of acculturation (i.e., higher AAAS-33 Total Score) were associated with poorer performance on WAIS-R Block Design, WMS-R Logical Memory Delayed Recall, RAVLT Total Recall Trials 1-5, WCST Categories, Written SDMT, and Grooved Pegs. Follow-up regression analyses indicated that level of acculturation remained a significant predictor of scores on WAIS-R Block Design, WCST Categories, and Grooved Pegs after controlling for age, sex, and education/occupation (p's < 0.1). It is worth noting that all significant findings occurred in the predicted direction, with higher AAAS-33 scores (indicating lower acculturation to white majority society) associated with decreased neuropsychological test performance. A summary of the proportions of variance accounted for by acculturation in each of the MRC analyses is provided in Table 4.

Increased TBI severity (lower GCS scores) was associated with poorer performance on the MAE Tokens Test ($p < 0.1$), BVDT ($p < 0.01$), WMS-R Logical Memory Immediate ($p < 0.01$) and Delayed Recall ($p < 0.05$), RAVLT Delayed Recall ($p < 0.1$), Written SDMT ($p < 0.1$), Trails A ($p < 0.05$), WCST-Perseverative Responses ($p < 0.1$), and WCST-Categories ($p < 0.1$). A longer period of time since injury was associated with significantly better recall on RAVLT Trial 1 ($p < 0.001$) and RAVLT Total Recall Trials 1-5 ($p < 0.05$), as well as a better timed performance on Trails A ($p < 0.05$).

Table 4

Proportion of Variance in Neuropsychological Test Performance accounted for by Level of Acculturation

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, Education/Occupation)
- Step 3: Level of Acculturation (AAAS-33 Total Score)

Neuropsychological Test		R^2 Change Analysis 1	R^2 Change Analysis 2
Galveston Orientation and Attention Test	[*N*=42]	.044	.025
WMS-R Digit Span - Forward	[*N*=42]	.061	.032
WMS-R Digit Span - Backward	[*N*=41]	.000	.000
MAE - Tokens Test	[*N*=41]	.031	.001
Controlled Oral Word Association Test	[*N*=42]	.028	.017
Benton Visual Discrimination Test	[*N*=42]	.004	.000
WAIS-R Block Design	[*N*=42]	.078*	.056*
WMS-R Logical Memory-Immediate	[*N*=42]	.026	.001
WMS-R Logical Memory-Delayed	[*N*=41]	.075*	.033
RAVLT -Trial 1	[*N*=42]	.000	.001
RAVLT - Total Trials 1-5	[*N*=42]	.061*	.043
RAVLT - Alternate Trial	[*N*=42]	.062	.063
RAVLT - Trial 6	[*N*=42]	.034	.025
Grooved Pegs	[*N*=39]	.080*	.062*
Symbol Digit Modalities Test-Oral	[*N*=40]	.010	.001
Symbol Digit Modalities Test-Written	[*N*=37]	.086*	.045
Trails A	[*N*=39]	.027	.011
Trails B	[*N*=35]	.021	.006
WCST - Perseverative Responses	[*N*=39]	.005	.004
WCST - Categories	[*N*=39]	.07*	.054*
Overall Test Battery Mean (OTBM)	[*N*=40]	.127**	

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

Older individuals performed significantly worse on Digit Span-Backwards ($p < 0.001$), MAE Tokens Test ($p < 0.05$), BVDT ($p < 0.05$), WAIS-R Block Design ($p < 0.001$), RAVLT Total Trials 1-5 ($p < 0.05$), RAVLT Delayed Recall ($p < 0.05$), Grooved Pegs ($p < 0.05$), Oral SDMT ($p < 0.05$), Written SDMT ($p < 0.05$), Trails B ($p < 0.05$), WCST Perseverative Responses ($p < 0.05$) and WCST Categories ($p < 0.01$). Females appeared to perform better than males on Grooved Pegs, Oral SDMT, and Trails B (all p's < 0.1). Higher educational attainment and/or occupational status (higher SES) was significantly associated with better scores on the MAE Tokens Test ($p < 0.001$), BVDT ($p < 0.01$), Digit Span Forward ($p < 0.05$), as well as better Immediate ($p < 0.01$) and Delayed Recall ($p < 0.1$) on WMS-R Logical Memory.

Composite Neuropsychological Measure (OTBM): These results generally suggested that a less acculturation (higher AAAS-33 score) was associated with lower scores on a composite measure of overall neuropsychological test performance (OTBM). Results of the hierarchical MRC analysis assessing the prediction of the OTBM are presented in Table 5. While covarying for injury-related variables (lowest GCS, time since injury), level of acculturation was significantly associated with the OTBM ($p < 0.05$), uniquely accounting for 12.7% of the total variance. Injury severity (initial GCS) was also a significant predictor of OTBM in the current analysis ($p < 0.1$). Within the current investigation, the proportion of variance associated with level of acculturation appeared greater than that accounted for by injury-related factors (12.7 % vs. 9.8% of the total variance). However, there was no significant difference between any of the predictors upon further statistical analysis.

STUDY 2: Predicting Functional Outcome in an African American sample

Functional Independence Measure (FIM): Selected results using the total FIM score as a dependent variable are presented in Table 6. The combined set of variables was significantly related to FIM-Total ($R = 0.665, p < 0.05$). An overview of the regression weights suggested

Table 5

Summary of Hierarchical Regression Analysis for Variables Predicting the Overall Test Battery Mean (OTBM) [N=41]

Dependent Variable = Overall Test Battery Mean (OTBM)

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: *Injury Related*			
Initial GCS	0.457*	.256	0.257*
(Log) Time since Injury	3.345	2.86	0.173
		[R^2 Change: 0.098]	
Step 2: *Acculturation*			
AAAS-33 Total	-7.99E-02**	.033	-0.358**
		[R^2 Change: 0.127]	

Summary Statistics: F (3, 36) = 3.50 p = 0.25

R = 0.475; R^2 = 0.226** (Adjusted R^2 = .161)

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Table 6

Summary of Standard Regression Analysis for Variables Predicting the Functional Independence Measure-Total (FIM-Total) [N=33]

Dependent Variable = (Reflect & Log) FIM Total

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Injury-Related			
Initial GCS	1.1076E-02	.017	.098
(Log) Time since Injury	-9.78E-02	.198	-.082
Neuropsychological Test Performance			
Overall Test Battery Mean (OTBM)	-3.73E-02***	.011	-.583***
Demographics			
Age	3.048E-03	.006	.088
Sex	.210	.623	.184
(Log) Education/Occupation - SES	.150	.184	.043
Acculturation			
AAAS-33 Total	1.747E-03	.002	.129

Summary Statistics: $F\ (7, 25) = 2.83$ $p = .026$

$R = .665$ $R^2 = .442$** (Adjusted $R^2 = .285$)

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

that this overall effect was largely due to the significant relationship between OTBM and FIM-Total ($p < 0.01$). There was no significant relationship between FIM-Total and any of the other demographic variables (age, sex, education/occupation, or level of acculturation).

As previously mentioned, FIM scores consist of a motor (FIM-Motor: 13 items) and a cognitive domain (FIM-Cognition: 5 items). Table 7 provides an overview of relevant results in predicting FIM-Motor. Although the combined set of variables was not significantly related to FIM-Motor ($R = 0.583, p > 0.1$), OTBM score was a significant predictor of FIM-Motor ($p < 0.01$). In contrast, the combination of predictors was significantly related to FIM-Cognition ($R = 0.713, p < 0.01$). Both the OTBM ($p < 0.01$) and AAAS-33 Total Score ($p < 0.1$) made significant independent contributions to this prediction. Table 8 provides a summary of the relevant results.

Disability Rating Scale: As with the FIM, a linear combination of independent variables was significantly associated with the overall DRS score ($R = 0.760, p < 0.001$). Table 9 provides an overview of these MRC results. Better neuropsychological test scores were associated with lower overall ratings of disability ($p < 0.001$). Lower AAAS-33 scores (higher level of acculturation) were also significantly related to lower ratings of disability ($p < 0.05$). GCS scores, time since injury, age, sex, and education/occupation were not significant predictors of overall disability.

Community Integration Questionnaire: Total CIQ score was significantly related to the overall combination of independent variables ($R = 0.719, p < 0.001$). Once again, OTBM proved to be the single most important contributor ($p < 0.01$) to this equation, as better overall neuropsychological test performance was related to better community integration (see Table 10). However, level of acculturation was also a significant independent contributor to this solution ($p < 0.1$).

Table 7

Summary of Standard Regression Analysis for Variables Predicting the Functional Independence Measure-Motor (FIM-Motor) [*N*=33]

Dependent Variable = (Reflect and Log) FIM Motor

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Injury-Related			
Initial GCS	1.587E-02	.018	.156
(Log) Time since Injury	-7.10E-02	.201	-.063
Neuropsychological Test Performance			
Overall Test Battery Mean (OTBM)	-3.45E-02***	.011	-.579***
Demographics			
Age	2.022E-03	.006	.063
Sex	.204	.632	.192
(Log) Education/Occupation - SES	.416	.186	.128
Acculturation			
AAAS-33 Total	-1.55E-03	.002	-.122

Summary Statistics: $F(7, 25) = 1.84$ $p = .124$

$R = .583$ $R^2 = .340$ (Adjusted $R^2 = .155$)

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

Table 8

Summary of Standard Regression Analysis for Variables Predicting the Functional Independence Measure-Cognitive (FIM-Cognition) [N=39]

Dependent Variable = (Reflect & Square Root) FIM-Cognition

Predictors	Partial Regression Weights: Raw	Std. Error	Standardized
Injury-Related			
Initial GCS	-1.62E-02	.031	-.072
(Log) Time since Injury	-.389	.338	-.153
Neuropsychological Test Performance			
Overall Test Battery Mean (OTBM)	-6.58E-02***	.019	-.507***
Demographics			
Age	8.712E-03	.009	.119
Sex	.360	1.079	.138
(Log) Education/Occupation - SES	.409	.336	.053
Acculturation			
AAAS-33 Total	7.760E-03*	.004	.268*

Summary Statistics: $F(7, 31) = 5.23$ $p = .001$

$R = .736$ $R^2 = .541$*** (Adjusted $R^2 = .438$)

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

Table 9

Summary of Standard Regression Analysis for Variables Predicting the Disability Rating Scale (DRS) [N=39]

Dependent Variable = Disability Rating Scale (DRS)

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Injury-Related			
Initial GCS	7.185E-02	.073	.128
(Log) Time since Injury	-.462	.785	-.075
Neuropsychological Test Performance			
Overall Test Battery Mean (OTBM)	-.219****	.046	-.669****
Demographics			
Age	-1.11E-02	.023	-.061
Sex	-.664	2.563	-.095
(Log) Education/Occupation - SES	.895	.889	.047
Acculturation			
AAAS-33 Total	2.030E-02**	.009	.273**

Summary Statistics: $F\,(7, 31) = 6.06$ $p = .000$

$R = .760$ $R^2 = .578$**** (Adjusted $R^2 = .483$)

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

Table 10

Summary of Standard Regression Analysis for Variables Predicting the Community Integration Questionnaire-Total (CIQ-Total) [N=39]

Dependent Variable = Community Integration Questionnaire - Total Score (CIQ Total)

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Injury-Related			
Initial GCS	-5.34E-02	.180	-.040
(Log) Time since Injury	-1.225	1.98	-.080
Neuropsychological Test Performance			
Overall Test Battery Mean (OTBM)	.412***	.110	.531***
Demographics			
Age	-9.20E-02	.055	-.209
Sex	-2.135	6.323	-.137
(Log) Education/Occupation - SES	2.791	1.971	.061
Acculturation			
AAAS-33 Total	-4.55E-02*	.023	-.263*

Summary Statistics: $F\,(7, 31) = 5.61$ $p = .000$

$R = .748$ $R^2 = .559$**** (Adjusted $R^2 = .459$)

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

Separate analyses were conducted on the three component subscales assessing Home Integration (Table 11), Social Integration (Table 12), and Productive Activities (Table 13). As might be expected, all three subscales were significantly correlated with a linear combination of the independent variables (all *R*s > 0.6; *p*'s < 0.05). Better overall neuropsychological status ($p < 0.001$) and being female ($p < 0.05$) were associated with greater reported involvement in home-related activities (CIQ-Home). Younger individuals ($p < 0.05$) and those with better neuropsychological test scores ($p < 0.1$) reported more involvement in social activities (CIQ-Social). Finally, better neuropsychological status and a greater level of acculturation (both *p*'s < 0.05) were suggestive of increased number of productive activities (CIQ-Productivity).

Table 11

Summary of Standard Regression Analysis for Variables Predicting the Community Integration Questionnaire-Home Integration (CIQ Home) [N=39]

Dependent Variable = Community Integration Questionnaire-Home Integration (CIQ-Home)

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Injury-Related			
Initial GCS	-.122	.086	-.198
(Log) Time since Injury	-.134	.946	-.019
Neuropsychological Test Performance			
Overall Test Battery Mean (OTBM)	.211****	.052	.597****
Demographics			
Age	1.898E-02	.026	.095
Sex	-2.294**	.941	-.322**
(Log) Education/Occupation - SES	-3.531	3.020	-.169
Acculturation			
AAAS-33 Total	-1.48E-02	.011	-.188

Summary Statistics: F (7, 31) = 4.74 p = .001

R = .719 R^2 = .517*** (Adjusted R^2 = .408)

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Table 12

Summary of Standard Regression Analysis of Variables Predicting the Community Integration Questionnaire-Social (CIQ-Social) [N=39]

Dependent Variable = Community Integration Questionnaire (CIQ - Social)

	Partial Regression Weights		
Predictors	Raw	Std. Error	Standardized
Injury-Related			
Initial GCS	2.827E-02	.102	.044
(Log) Time since Injury	-1.103	1.123	-.153
Neuropsychological Test Performance			
Overall Test Battery Mean (OTBM)	.116*	.062	.316*
Demographics			
Age	-7.13E-02**	.031	-.343**
Sex	-.133	3.586	-.018
(Log) Education/Occupation - SES	4.499	1.118	.207
Acculturation			
AAAS-33 Total	-1.44E-02	.013	-.176

Summary Statistics: $F(7, 31) = 2.59$ $p = .032$

$R = .607$ $R^2 = .369$** (Adjusted $R^2 = .226$)

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

Table 13

Summary of Standard Regression Analysis of Variables Predicting the Community Integration Questionnaire-Productivity (CIQ-Prod) [N=39]

Dependent Variable = (Square Root) Community Integration Questionnaire - Productivity (CIQ Prod)

	Partial Regression Weights		
Predictors	Raw	Std. Error	Standardized
Injury-Related			
Initial GCS	-1.01E-02	.026	-.061
Time since Injury (log)	-6.00E-02	.287	-.032
Neuropsychological Test Performance			
Overall Test Battery Mean (OTBM)	3.709E-02**	.016	.389**
Demographics			
Age	-1.26E-02	.008	-.232
Sex	4.365E-02	.917	.023
Education/Occupation - SES (log)	-.333	.286	-.059
Acculturation			
AAAS-33 Total	-6.99E-03**	.003	-.328**

Summary Statistics: $F(7, 31) = 2.81$ $p = .022$

$R = .623$ $R^2 = .388$** (Adjusted $R^2 = .250$)

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

CHAPTER IV

DISCUSSION

Study 1: Acculturation and Neuropsychological Test Performance

The results of the current study were generally supportive of the proposed hypothesis that cultural factors would be related to neuropsychological test scores (Hypothesis 1). Level of African American acculturation was a significant predictor of performance on some (but not all) tasks emphasizing visuomotor/processing speed (SDMT, Grooved Pegs), visuospatial skills (WAIS-R Block Design), memory (RAVLT & Logical Memory), and executive functioning/problem solving (WCST). Although relatively modest in size, these relationships were all in the expected direction, as more traditional African American cultural values/beliefs were invariably associated with lower neuropsychological test scores. Three of these test scores (Grooved Pegs, Block Design, WCST Categories) also exhibited a significant association with level of acculturation after controlling for the effects of age, sex, and education/occupation (Hypothesis 2).

It was also hypothesized that an individual's score on tasks assessing more complex (i.e., "higher-order") cognitive tasks may be more culture-dependent (Hypothesis 3). Accordingly, two of the three measures that demonstrated unique acculturation effects (WAIS-R Block Design & WCST Categories) are tests that emphasize nonverbal reasoning and problem solving. These findings are generally in keeping with prior studies evaluating the relationship between acculturation and neuropsychological testing (i.e., Arnold et al., 1994; Manly et al., 1998). In a sample of HIV-positive individuals, Manly et al. reported significant black/white differences on the WAIS-R Block Design subtest and the Halstead Category Test (another measure requiring nonverbal problem solving/reasoning). These effects became nonsignificant after controlling for level of African American acculturation. Arnold et al. also reported a significant relationship between the degree of Mexican American acculturation and tasks involving nonverbal problem solving (i.e., Halstead Category Test and Tactual Performance Test). In their study assessing the differences between Spanish-speaking groups in the U.S.-Mexico Borderland area, Artiola i Fortuny et al. (1998) found that improved performance on the WCST (Perseverative Responses) was related to a greater period of time spent living in the United States.

The findings involving the WAIS-R Block Design subtest are particularly interesting in the context of prior research looking at differences between ethnic/cultural groups on tests of general psychometric intelligence. In their re-analysis of the WAIS-R standardization sample, Kaufman et al. (1988) reported that the greatest relative black/white differences were on the Block Design and Vocabulary subtests. These subtests also demonstrated the highest correlations with psychometric intelligence (Full-Scale IQ). In conjunction with those reported by Manly and colleagues (1998), these results suggest that Vocabulary & Block Design may also demonstrate some of the largest correlations with level of African American acculturation. Unfortunately, prior studies reporting ethnic/cultural differences on intelligence testing did not specifically account for level of acculturation in their analyses.

The significant relationship between acculturation and timed performance on the Grooved Pegboard test was not predicted by our initial hypotheses. Some researchers have considered the cultural equivalence of tests of manual dexterity and motor speed such as the Grooved Pegboard Test as self-evident (e.g., Maj et al., 1991). Although preliminary, this finding is nevertheless consistent with some prior reports of black/white differences on speeded tasks (e.g., Miller et al., 1993), and serves as a further reminder that no task may be considered culture-free without empirical verification.

Unlike the results presented by Manly et al. (1998), the present study found no significant relation between level of acculturation and performance on language-related tasks. These may well reflect the different measures used in the assessment of verbal skills in the two studies. Language-related measures within the SEMTBIS battery focus on relatively basic skills such as following verbal instructions (Tokens Test) or word generation (COWAT). In contrast, the measures used in the study by Manly et al. involved somewhat higher-level verbal skills (i.e., WAIS-R Information & Vocabulary) or confrontation naming (Boston Naming Test).

Perhaps the most telling evidence for the influence of African American acculturation on neuropsychological test performance is the observed relationship between level of acculturation and a composite score of neuropsychological test performance. Although the overall effect size may be considered moderate (accounting for less than 13% of the total variance), the observation that level of African American acculturation is a significant and unique predictor of overall neuropsychological test performance remains an important finding. Within the current analyses, an individual's level of African American acculturation accounted for a greater proportion of the variance than an estimate of TBI severity. Although there was no statistically significant difference between acculturation level and injury severity in their relative effectiveness in predicting overall neuropsychological test performance, this may well be due to the relatively small sample size (Tabachnick & Fidell, 1989).

The influence of other demographic variables on neuropsychological test performance following TBI was not the primary focus of the current study. Nevertheless, it appears worthwhile to underscore the importance of the observed relationship between demographic variables and neuropsychological test scores in the current study, particularly in light of reports suggesting that demographic corrections may not be necessary in the neuropsychological assessment of clear cases of TBI (e.g., Reitan & Wolfson, 1995). Demographic variables were significant predictors of neuropsychological test performance on the majority of the measures within the SEMTBIS test battery. Age, in particular, appeared to be quite strongly associated with several of the administered neuropsychological tests. It should be also be noted that the rather severe restriction in variability of some of the demographic variables (e.g., sex, education, SES) in the current sample likely limited the observation of further findings. Regardless, these findings appear to provide further evidence for the inclusion of such "external" variables (i.e., those not directly related to the injury itself) in the analysis of neuropsychological test scores following TBI.

Study 2: Predicting Functional Outcome in African Americans

Our hypothesis that neuropsychological test scores would be significantly related with measures of functional outcome was by and large well supported (Hypothesis 4), as the composite neuropsychological test score (OTBM) was significantly related to decreased functional independence (FIM), increased overall disability (DRS), and decreased community integration (CIQ). These results appear quite consistent with much of the research previously conducted in this area (e.g., Bowman, 1996, Ross et al., 1997; Tellier, 1990). Arguably, these effects may partly reflect the use of previous or concurrent neuropsychological test scores by health care professionals when completing their ratings on measures such as the FIM and DRS. However, neuropsychological test scores were also significantly related to a self-report measure of community integration (CIQ), indicating that these types of findings were unlikely to be exclusively associated with external ratings. Taken together, these results provide support for the ecological validity of neuropsychological tests to estimate functional outcome in an African American sample following TBI (i.e., "criterion" validity).

It was also hypothesized that inclusion of an acculturation measure would significantly improve the ability of neuropsychological tests to predict functional outcome (Hypothesis 5). In keeping with this hypothesis, level of acculturation was found to provide a unique contribution to the prediction of measures of overall disability (DRS) and community integration (CIQ). Level of acculturation was not significantly related to a measure of general functional independence (FIM), possibly because of the emphasis on physical/motor skills within the FIM total score. Scores on the AAAS-33 were also found to be a useful predictor of two subscores on the above measures, namely functional independence on cognitive tasks (FIM-Cognition), and involvement in productive activities (CIQ-Productivity).

As noted above, differences in cultural experience were found to provide a significant and unique contribution to the estimation of measures of functional independence on cognitive tasks (FIM-Cognition) and overall disability (DRS). These findings suggest that the FIM and DRS may be culturally biased, as some African Americans might potentially be considered more cognitively impaired or disabled based on their cultural beliefs/attitudes. Unfortunately, the ethnicity of the raters was not available within the current dataset. It was therefore not possible to assess potential interactions between examiner/participant ethnicity and level of acculturation.

Lower acculturation was also significantly related to lower self-reports of community integration. These results are consistent with those of a prior study (Rosenthal et al., 1996) suggesting that minorities (80% of whom were black) were more likely to report lower CIQ-Total scores at one-year post-injury. Rosenthal and colleagues reported that minority status was associated with lower scores on the Social and Productivity subscales of the CIQ. In the current study, CIQ-Productivity (but not Social Integration) was significantly related with level of African American acculturation. In addition, female participants reported higher scores on the Home Integration subscale, a finding that has also been reported in prior studies using the CIQ (Dijkers, 1997). As pointed out by Dijkers, a strong criticism of the CIQ is the lack of adequate normative data. As a result, it was not possible to ascertain whether the observed culture- and gender-based differences on the CIQ would also be present within the general population. For example, it is unclear whether the significant relationship between the CIQ-Productivity subscale and level of acculturation may reflect a broader difficulty for African Americans with lower acculturation to find employment. Development of appropriate norms for each of the above measures (and the CIQ in particular) would represent an important step in addressing many of the above issues.

The specific causes underlying the apparent lack of cultural equivalence when using the above outcome measures with African Americans remain poorly understood. One possible explanation is that the measures themselves may be relatively insensitive to a number of behaviours or attitudes considered normal or adaptive in more traditional African American cultural settings. However, we cannot rule out the possible influence of a more general cultural bias against African Americans within U.S. society. For example, health care professionals unfamiliar with African American cultural practices/attitudes might potentially rate certain aspects of an individual's presentation as maladaptive. Indeed, there is some evidence that individuals with a lower level of acculturation (as measured by the AAAS) may be more prone to increased discrimination/racism (Landrine & Klonoff, 1996). Rosenthal and colleagues (1996) have also argued that observed differences on current outcome measures may reflect differential access to health care or general support for certain minorities beyond the initial inpatient and rehabilitation phases of recovery.

General Discussion/Theoretical Implications

Although caution must be exercised given the exploratory nature of the current study, these results do provide some support for the cultural hypothesis of group differences on cognitive/neuropsychological tests. Helms (1997) has referred to the "triple quandary" when assessing the individual contributions of race, SES, and culture to differences in cognitive tests among ethnic/cultural groups. This study specifically attempted to control for two of these variables (i.e., ethnicity and SES) in an effort to assess the singular contribution of cultural factors to neuropsychological test performance. In multicultural societies, ethnic/cultural minority groups typically differ from the majority group along several social, political, economic, and cultural lines. African Americans, as a group, differ significantly from European Americans (and other ethnic groups) in several ways, including SES, access to health care, as well as exposure to discrimination. When conducting research of this type, it becomes extremely difficult to compare members of different ethnic groups while controlling for potential confounding variables. In the current study, limiting the sample to a group of African Americans emphasized differences *within* the group of interest (e.g., level of acculturation) and minimized the impact of other variables (e.g., general impact of minority status). Control for an individual's socio-economic status was accomplished in two ways. First, the current sample consisted of a rather homogeneous group (i.e., predominantly lower to lower-middle SES), thus limiting the degree of variability attributable to the access to economic resources. Second, in spite of the significant restriction of this variable, residual differences in SES were statistically controlled using a well-established measure of social status (i.e., Hollingshead Index).

There would therefore appear to be a significant association between level of acculturation and neuropsychological test performance, even when controlling for other potentially confounding variables. It should be noted that these findings do not specifically address the directionality of this relationship. It could be argued that individuals with a certain predisposition for lower performance on cognitive tests might be more likely to reject majority European American culture and espouse more traditional African American values/beliefs. However, studies conducted to date using the AAAS would not seem to support such a conclusion (Landrine & Klonoff, 1996). Most findings suggest that African American acculturation is relatively independent of other demographic variables, such as age, education (often considered a marker of "European American acculturation"), and various indicators of SES (e.g., family income). Findings from the current study suggest that there may be a remarkable range of cultural experiences within a given sample that might otherwise be considered quite homogeneous using other sociological measures (e.g., educational attainment and SES). Further research will be necessary to delineate the specific ways in which cultural factors and cognitive/neuropsychological factors interact.

Prior studies assessing the cross-cultural applicability of cognitive and neuropsychological studies have typically focused on the identification of decreased cultural equivalence within specific tests (e.g., Maj et al. 1993). In the present study, cultural differences among African Americans were significantly associated with some measures of nonverbal problem solving and concept formation, as well as a test of fine motor co-ordination and psychomotor speed. These findings are generally consistent with findings from similar studies (Arnold et al., 1994; Manly et al; 1998) and might reflect cultural differences in problem solving techniques or the relative importance of speed or accuracy in different cultural settings. On the other hand, even if certain tests or sets of abilities are related to differences in culture experience among African Americans, the same would not necessarily hold for other ethnic/cultural groups. Performance differences based on cultural experience may not be an attribute of the tests themselves, but might instead reflect the level of dissimilarity between the "cognitive styles" of the respective cultures. Other ethnic/cultural groups (e.g., First Nations people in North America) would appear to share certain sociological characteristics with African Americans (e.g., lower SES and level of education, minority status and discrimination) yet differ significantly in terms of their cultural background. If different patterns of cognitive skills/abilities were noted between ethnic/cultural groups that shared similar SES levels, this would potentially serve as a cogent argument against the environmental deficit hypothesis. On the other hand, if the same neuropsychological tests or domains were consistently demonstrated to be of limited equivalence across a variety of cultural settings, we might then consider the skills/abilities required to perform these measures as somewhat specific to the culture of origin.

One of the more interesting findings of the present study is that level of acculturation appeared to demonstrate a significant relationship with an estimate of overall neuropsychological test performance. This might suggest the presence of a more general "acculturation factor" which could be related to performance on all or the majority of tests, albeit to varying degrees. If the presence of a general culture-related factor is supported with future empirical work, this would imply that the problem of potential bias in neuropsychological testing may not simply be resolved through the use of specific culturally appropriate tests. Rather, any cross-cultural neuropsychological assessment would require a more in-depth knowledge of the culture in question, including an understanding of issues such as the saliency of the particular ability being assessed, familiarity with testing materials and task demands, and overall level of comfort with the testing environment.

Some researchers (e.g., Loewenstein et al., 1993) have proposed that the influence of cultural variables in neuropsychological assessment may become more prominent when assessing individuals with cognitive impairment. The observation that significant findings could be found using such a small sample size might possibly be used in support of such a position. Although the underlying reasons for the potentially increased relevance of cultural factors in clinical samples remain largely unknown, recent findings in cross-cultural psychology provide some interesting possibilities. A report by Hong, Morris, Chiu, & Benet-Martinez (1997) suggested that bicultural individuals may adapt their cognitive style according to their circumstances. In a series of priming experiments, they found evidence that individuals will switch between different "cultural frames" when completing different tasks in response to the initial presentation of culturally laden symbols (Chinese or American). It could be argued that most ethnic/cultural minorities, including African Americans, are at least minimally familiar with European American cultural behaviours/practices and will occasionally be asked to switch between cultural environments. In theory, certain types of neurological injury (including TBI) may affect the individual's ability to efficiently shift between these cultural frames. Such decreased cultural flexibility following TBI might thus exacerbate pre-existing difficulties for those with a lower degree of acculturation to engage in more culturally distant behaviours (e.g., neuropsychological testing).

As previously mentioned, there is some evidence that minorities may be disproportionately represented in TBI populations (Rosenthal et al., 1996). Therefore, any potential for bias in the neuropsychological assessment of African Americans could be particularly important in the study of TBI. Cultural bias in neuropsychological testing has 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). Given the above definition, it would appear from these findings that some of the present neuropsychological assessment procedures might be culturally biased in the evaluation of African Americans following TBI. This would include current methods used in the assessment of functional outcome. Although performance on neuropsychological tests likely remains an important and valid predictor of outcome among African Americans following TBI (see Study 2), these findings suggest that cultural factors could potentially play a moderating role in decisions regarding an individual's level of cognitive impairment or ability to function in the community.

These findings also raise some interesting questions regarding the current conception of cultural bias. The above definition (Reynolds, 2000) asserts that cultural bias is "due to group membership or some other *nominal* [italics added] variable" (p.250). Even if one assumes a relatively simplistic unidimensional model of acculturation, evaluating potential sources of bias solely in terms of group membership (e.g., black vs. white) may not be appropriate. Rather, these findings would suggest that any cultural factors might better be understood as *continuous* variables. Based on an individual's ethnicity, we might inaccurately assume cultural differences in situations where this may not be the case (e.g., individuals with a high degree of acculturation). In the context of TBI, this might lead to the denial of benefits to individuals who have experienced a significant loss of functioning as a result of their injuries.

The preceding findings appear to suggest that cultural factors might affect overall level of performance on certain neuropsychological tests. However, within the context of an individual neuropsychological assessment, these types of findings may not necessarily have similar implications for the inter-relationship of scores *within* an individual's neuropsychological profile. Indeed, interpretation of the relative influence of an individual's test scores (as opposed to the uncritical comparison of obtained test scores to normative data), is the hallmark of any clinical neuropsychological evaluation. For example, group studies have outlined some of the tasks that may be more sensitive to the effects of TBI (e.g., complex attention, executive control, auditory-verbal learning). However, it would be inappropriate to argue that the absence of "deficits" in these areas (based on normative data) rules out the presence of significant TBI-related sequelae. In a similar vein, these findings clearly do not preclude the performance of a valid neuropsychological assessment of African Americans with a lower degree of acculturation, as interpretation of each individual's neuropsychological profile may well provide useful diagnostic/prognostic information. Recall that these findings would appear to support the use of neuropsychological tests as a useful and valid indicator of overall functional status within this population (see Study 2). However, awareness and understanding of this type of research can certainly help the clinician decide which factors might potentially be underlying certain test scores *within* the individual's neuropsychological profile. Based on the current findings, one suggestion might also be the use of an acculturation scale such as the AAAS-33 in the assessment of African Americans. In keeping with the important guidelines outlined by Nabors, Evans, and Strickland (2000), the clinician conducting an assessment with an African American client should be aware of all of the potentially variables of importance when dealing with this population (e.g., level of acculturation, years/quality of education, SES, perceived discrimination) in order to conduct a more culturally-sensitive neuropsychological assessment.

Limitations of Current Study and Directions for Future Research

As might be expected given the complexity of the issues involved, this study has a number of notable limitations. These may be broadly described in the following categories: issues related to the size and nature of the sample, difficulties underlying the concepts of acculturation, and the identification of specific cultural factors underlying the observed findings. Each of these will be discussed in turn, including suggestions for future research.

The above findings are the result of a large number of analyses performed on a relatively small sample, and should be considered exploratory rather than confirmatory in nature. These types of results necessarily require replication, particularly with regards to the relationship between acculturation and specific neuropsychological tests. Furthermore, although the use of a relatively homogeneous sample (i.e., predominantly males of limited education/SES with a TBI from a specific geographic location) does allow for a more controlled study, it also significantly limits the potential generalizability of the current findings. It remains unclear to what extent acculturation might be related to neuropsychological measures in individuals with higher SES or who have experienced different types of neuropathology (e.g., stroke). Further investigation is required using a variety of cognitive/neuropsychological tests and with different clinical groups before any general statements can be made regarding the relationship between cultural factors and neuropsychological tests.

Acculturation measures should only be considered an indirect measure of the underlying factors that make up a particular culture (Betancourt & Lopez, 1993). The use of a brief, unidimensional measure such as the AAAS-33, although practical, has a number of disadvantages. As Landrine & Klonoff (1996) point out, it seems relatively clear that individuals who obtain extreme scores on the AAAS-33 may be characterized as either more traditional or acculturated in terms of their cultural values and beliefs. The precise meaning of scores in the scale's midrange, however, is less evident. As a result, acculturation measures such as the

AAAS-33 likely may not fully describe the experiences of those "bicultural" African Americans who share values/beliefs from both cultures.

The possibility that level of acculturation may still be serving as a surrogate for an underlying educational or SES-related construct cannot be entirely ruled out. For example, estimates of the amount of education (e.g., years of education) do not account for the possibility of significant differences in the quality of the educational experience provided to different ethnic/cultural groups. As previously noted, lower levels of acculturation have been associated with increased discrimination among African Americans, and this may include differential access to educational resources. Differences in the quality of education provided to ethnic/cultural minorities have already been suggested as a potential explanation for black/white differences on cognitive testing among high school and college students (Merrick et al., 1998). The exact nature of the relationship between employment status and African American acculturation is also unclear. The majority of individuals in the current sample were unemployed prior to their TBI. This is unlikely to represent a homogeneous or representative group, however, and there was little collateral information to assess the potential reasons for their initial (or subsequent) unemployment. The current findings suggest a significant relationship between level of acculturation and an individual's involvement in productive community activities (including employment). Once again, the direction of this relationship is open to debate, as one might argue that individuals with a history of difficulties finding employment may progressively espouse more traditional African American cultural beliefs/values.

Level of acculturation may also be confounded with the more general concept of "acculturative stress", which is defined as the more universal difficulty faced by members of an ethnic/cultural minority adapting to the larger society (Berry, 1989). According to Berry, those individuals who reject both minority and majority cultures (i.e., those experiencing "marginalization") would be expected to undergo the greatest degree of acculturative stress. We would not predict that these individuals would necessarily score either very high or very low on the current acculturation measure. Nevertheless, there may still be an identifiable cost for less acculturated African Americans to maintain more traditional cultural values/beliefs, perhaps in the form of increased discrimination. Some studies have suggested a relation between level of acculturation and an increased report of psychiatric symptoms (Landrine & Klonoff, 1996). Given the potential relationship between affective disorders and neuropsychological test performance (e.g., Bowman, 1996; Calev, 1999; Veiel, 1997), it may be postulated that the observed findings actually reflect the tendency for individuals with increased post-TBI affective disturbance to obtain lower scores on neuropsychological and functional outcome measures. The participants' level of emotional distress at the time of assessment was not specifically addressed in the current study. Nonetheless, it seems somewhat unlikely that affective disturbance could fully account for the current findings. There was little evidence suggesting any significant prevalence of premorbid psychiatric difficulties in the current sample. Moreover, at least one recent study (Sherman, Strauss, Slick, & Spellacy, 2000) has reported that although the presence of a mood disturbance (i.e., depressive symptoms) may affect neuropsychological test performance following TBI, this may only be of clinical relevance for individuals with relatively minimal cognitive deficits.

Further complicating the issue is the possibility that an individual's level of acculturation may not be stable across the life span. Landrine and Klonoff (1996) have proposed a model of African American acculturation in which individuals proceed through a number of discrete steps corresponding with stages of development. The measurement and study of acculturation among African Americans, although necessary, is unlikely to lead to a complete understanding of the effect of culture on cognitive and neuropsychological tests (Nabors et al., 2000). Inclusion of an acculturation scale cannot be considered an adequate "correction" for cultural factors within a neuropsychological assessment. This is because there may be several aspects of African

American culture not specifically assessed using the acculturation measure that might potentially affect the findings of a neuropsychological evaluation (e.g., use of black English). It was not the purpose of the current study to identify the specific aspects of African American culture that may account for differences in neuropsychological test performance. Although some authors have outlined some of the potential determinants within African American culture for observed differences on cognitive tests (e.g., Helms, 1997), these constructs have rarely undergone systematic study. Future studies, preferably designed and conducted by researchers familiar with the cultural context, could further clarify the nature of the processes underlying these differences.

In conclusion, the findings of this study provide some preliminary evidence for the importance of assessing and including cultural factors in neuropsychological assessment. The assumption that neuropsychological tests are immune from the influence of environmental/cultural variables can no longer remain unchallenged. Further research in this area is needed to establish whether similar findings may be found in other clinical populations and with different ethnic/cultural groups. More generally, research in this area holds the promise of decreasing possible cultural biases in neuropsychological assessment, resulting in a more complete and inclusive study of brain/behaviour relationships.

APPENDIX A

NATIONAL TRAUMATIC BRAIN INJURY MODEL SYSTEMS DATASET

National TBI Model Systems Dataset Form I (Initial Hospitalisation) Variables

Dates

- Dates (injury, admittance to ER, admittance to and discharge from acute care, admittance to and discharge from rehabilitation, alternate levels of care, death)
- Short-term rehabilitation interruptions

Demographic Data

- Date of Birth
- Sex
- Race
- Marital Status
- Living With
- Residence
- Highest school grade completed
- Employment Status
- Census occupational code
- Monthly employment ratio
- History of TBI

Physical Status Descriptors

- Papillary response
- Physical examination variables (papillary response, auditory function, vision, swallowing, balance, motor co-ordination, muscle tone, muscle strength)
- Associated injuries
- Cause of injury
- Ethanol blood level
- Intracranial computed tomography diagnosis
- Brain injury ICD.9 codes
- Intracranial hemorrhage
- Glasgow Coma Scale score
- Trauma scores at admission at ED
- Duration of unconsciousness
- Date emerged from PTA
- Cause(s) of death
- Cranial complications (cerebrospinal fluid leak, cranial infections, hydrocephalus, seizures, herniation syndrome, intracranial hypertension, other complications)

Physical Status Descriptors (cont.)

- Noncranial complications (respiratory failure, cardiopulmonary arrest, coagulopathy, hemothorax or pneumothorax, pneumonia, renal failure, septic shock, soft tissue infection, urinary tract infection)

Functional Status Descriptors

- Neuropsychological test battery
- Disability Rating Scale
- Functional Independence Measure
- Rancho Los Amigos Scale

Therapeutic Interventions

- Status Operations acute:
- Cranial: hemorrhage evacuation, debridement, re-operation, depressed skull fracture, bone flap, intracranial pressure monitor, other
- Noncranial: peritoneal lavage, laparotomy, open reduction of fracture(s), thoracostomy, tube thoracostomy, tracheostomy, gastrostomy, jejunostomy, ileostomy, surgery, other.

- Service interventions (physical therapy, occupational therapy, speech pathology, therapeutic recreation, psychology, and vocational rehabilitation)
  - Charges
  - Payer source

Emergency Medical Services Data

- Time and date of injury (EMS)
- Glasgow Coma Scale score (EMS)
- Trauma score (EMS)
- EMS fluids and medications
- Mechanism of injury (EMS)
- Pre-hospital care (EMS)
- Transport mode (EMS)

National TBI Model Systems Data-Set Form II (Follow-up) Variables

Administrative data
- Administrative codes (identity of significant other, why patient did not respond, method of data collection, for completion codes)

Dates
- Dates (injury, follow-up interview, death)

Demographic Data
- Marital status
- Living with
- Residence
- Highest school grade completed
- Employment variables
- Census occupational code
- Monthly employment ratio
- Subsequent TBI

Physical status descriptors
- Duration of unconsciousness
- Medical morbidity: Cranial (CSF leak, cranial infections, hydrocephalus, seizures)
- Medical morbidity: Noncranial (heterotopic ossification)

Functional status descriptors
- Neuropsychological test battery
- Neurobehavioral Rating Scale
- Disability Rating Scale
- Functional Independence Measurement

Therapeutic Interventions
- Outpatient rehabilitation interventions (physical therapy, occupational therapy, speech pathology, therapeutic recreation, psychology, and vocational rehabilitation)
- Re-hospitalization
- Neuroactive drugs

Community Integration
- Community Integration Questionnaire: person with brain injury (shopping, meal preparation, housekeeping, personal finances, child care, leisure activities, social arrangements, visiting friends and relatives, travel arrangements, volunteer activities, training programs, school, employment)
- Community Integration Questionnaire: significant other (same as above)
- Additional community integration information: person with brain injury (drugs, alcohol, transportation, income, sexuality, arrests)
- Additional community integration information: significant other (same as above)

APPENDIX B

SELF-IDENTIFICATION OF ETHNICITY

<u>Self-Identification of Ethnicity</u>

Please check one or more of the following in reference to your ethnic background:

___ African American
___ African
___ Caribbean
___ European American
___ Asian American
___ Other (please specify) ________________________________

APPENDIX C

CALCULATION OF THE OVERALL TEST BATTERY MEAN (OTBM)

<u>Tests and Normative Data used in the Derivation of the Overall Test Battery Mean (OTBM)</u>

Variable List - (1-19)	***Source of Normative Data***	***Corrections***	***Groupings***
(1) Multilingual Aphasia Examination - Tokens Test - *Total Correct*	Multilingual Aphasia Examination Manual (Benton, Hamsher, Rey, & Sivan, 1994)	None	
(2,3) Wechsler Memory Scale - Revised (WMS-R) *Logical Memory I & II*	Wechsler Memory Scale - Revised (WMS-R) Manual (Wechsler, 1987)	Age	16-17; 20-24; 25-34; 35-44; 45-54; 55-64; 65-69; 70-74.
(4,5) Wechsler Memory Scale -Revised (WMS-R) Digit Span - *Forward & Backward*	Wechsler Memory Scale - Revised (WMS-R) Manual (Wechsler, 1987)	Age	16-17; 20-24; 25-34; 35-44; 45-54; 55-64; 65-69; 70-74.
(6) Grooved Pegboard - *Total Time*	Heaton, Grant, & Matthews, 1991	Age Education Sex	16-17; 20-24; 25-34; 35-44; 45-54; 55-64; 65-69; 70-74. 1-7; 8; 9-11; 12; 13-15; 16-17;18 M-F
(7) Benton Visual Discrimination Test (BVDT) - *Total Correct*	Benton, Sivan, Hamsher, Varney, & Spreen, 1983	Age Sex	16-54; 55-75 M-F
(8-11). Rey Auditory Verbal Learning Test (RAVLT) - *Trial 1, Total Trials 1-5, Alternate Form, Trial 6.*	Geffen; published in Spreen & Strauss, 1998	Age Sex	16-19; 20-29; 30-39; 40-49; 50-59; 60-69. M-F
(12,13) Symbol Digit Modalities Test (SDMT) - *Oral & Written*	Symbol Digit Modalities Test - Manual (Smith, 1991)	Age Education	18-24; 25-34; 35-44; 45-54; 55-64; 65-78. < 12; 13+
(14,15) Trail Making Test - *Parts A & B.*	Heaton, Grant, & Matthews, 1991	Age Education Sex	16-17; 20-24; 25-34; 35-44; 45-54; 55-64; 65-69; 70-74. 1-7; 8; 9-11; 12; 13-15; 16-17; 18 M-F.
(16) Wechsler Adult Intelligence Scale - Revised (WAIS-R) - Block Design	Heaton, Grant, & Matthews, 1991	Age Education Sex	16-17; 20-24; 25-34; 35-44; 45-54; 55-64; 65-69; 70-74. 1-7; 8; 9-11; 12; 13-15; 16-17; 18 M-F.
(17,18) Wisconsin Card Sorting Test - *Perseverative Responses & Categories Completed*	Heaton et al., 1996	Age Education	20-29; 30-39; 40-49; 50-59; 60-64; 65-69; 70-74; 75-79; 80-84; 85-89 1-7; 8; 9-11; 12; 13-15; 16-17; 18
(19) Controlled Oral Word Association Test (COWAT) - *Total Number of Words*	Ruff, Light, & Parker, 1996	Education Sex	< 12; 13-15; 16+ M-F

APPENDIX D

AFRICAN AMERICAN ACCULTURATION SCALE-SHORT FORM (AAAS-33)

African American Acculturation Scale-Short Form
AAAS-33 Beliefs and Attitudes Survey

Instructions: Please tell us how much you personally agree or disagree with the beliefs and attitudes listed below by circling a number. There is no right or wrong answer. We want your honest opinion.

	I Totally Disagree Not True at All		I Sort of Agree Sort of True			I Strongly Agree Absolutely True	
1. Most of the music I listen to is by Black artists	1	2	3	4	5	6	7
2. I like Black music more than White music	1	2	3	4	5	6	7
3. The person I admire the most is Black	1	2	3	4	5	6	7
4. I listen to Black radio stations	1	2	3	4	5	6	7
5. I try to watch all the Black shows on TV.	1	2	3	4	5	6	7
6. Most of my friends are Black	1	2	3	4	5	6	7
7. I believe in the Holy Ghost	1	2	3	4	5	6	7
8. I believe in heaven and hell	1	2	3	4	5	6	7
9. I like gospel music	1	2	3	4	5	6	7
10. I am currently a member of a Black church	1	2	3	4	5	6	7
11. Prayer can cure disease	1	2	3	4	5	6	7
12. The church is the heart of the Black community.	1	2	3	4	5	6	7
13. I know how to cook chit'lins	1	2	3	4	5	6	7
14. I eat chit'lins once in a while	1	2	3	4	5	6	7
15. Sometimes, I cook ham hocks	1	2	3	4	5	6	7
16. I know how long you're supposed to cook collard greens	1	2	3	4	5	6	7
17. I went to a mostly Black elementary school	1	2	3	4	5	6	7
18. I grew up in a mostly Black neighborhood	1	2	3	4	5	6	7
19. I went (or go to) a mostly Black high school	1	2	3	4	5	6	7
20. I avoid splitting a pole	1	2	3	4	5	6	7

African American Acculturation Scale-Short Form
AAAS-33 Beliefs and Attitudes Survey (continued)

	I Totally Disagree Not True at All		I Sort of Agree Sort of True			I Strongly Agree Absolutely True	
21. When the palm of your hand itches, you'll receive some money	1	2	3	4	5	6	7
22. There's some truth to many old superstitions	1	2	3	4	5	6	7
23. IQ tests were set up purposefully to discriminate against Black people	1	2	3	4	5	6	7
24. Most tests (like the SATs and tests to get a job) are set up to make sure that Blacks don't get high scores on them	1	2	3	4	5	6	7
25. Deep in their hearts, most White people are racists	1	2	3	4	5	6	7
26. I have seen people "fall out"	1	2	3	4	5	6	7
27. I know what "falling out" means	1	2	3	4	5	6	7
28. When I was a child, I used to play tonk	1	2	3	4	5	6	7
29. I know how to play bid whist	1	2	3	4	5	6	7
30. It's better to try to move your whole family ahead in this world that it is to be out for yourself	1	2	3	4	5	6	7
31. Old people are wise	1	2	3	4	5	6	7
32. When I was young, my parent(s) sent me to stay with a relative (aunt, uncle, grand-mother) for a few days or weeks, and then I went back home again	1	2	3	4	5	6	7
33. When I was young, I took a bath with my sister, brother, or some other relative	1	2	3	4	5	6	7

APPENDIX E

SCORING THE AFRICAN AMERICAN ACCULTURATION SCALE-SHORT FORM

Scoring the AAAS-33

Item Scores

A subject's sore on each item is the number she or he circled for that item. The range of these scores is 1-7.

Factor Scores

Scores on the factors should be computed as follows:

Factor 1: *Preference for Things African American* = sum of the scores on items 1-6 inclusive

Factor 2: *Religious Beliefs/Practices* = sum of the scores on items 7-12 inclusive

Factor 3: *Traditional Foods* = sum of the scores on items 13-16 inclusive

Factor 4: *Traditional Childhood* = sum of the scores on items 13-16 inclusive

Factor 5: *Superstitions* = sum of scores on items 17, 18, and 19.

Factor 6: *Interracial Attitudes/Cultural Mistrust* = sum of scores on items 23-25 inclusive

Factor 7: *Falling Out* = sum of the scores on items 26 and 27.

Factor 8: *Traditional Games* = sum of the scores on items 28 and 29.

Factor 9: *Traditional Family Values* = sum of the scores on items 30 and 31.

Factor 10: *Family Practices* = sum of the scores on items 32 and 33.

AAAS-33 Total Score = sum of the scores on each of the 33 items

APPENDIX F

FUNCTIONAL INDEPENDENCE MEASURE (FIM)

Functional Independence Measure (FIM)

Motor Items

- Self-Care
    1. Feeding
    2. Grooming
    3. Bathing
    4. Dressing Upper Body
    5. Dressing Lower Body
    6. Toileting

- Sphincter Control
    7. Bladder Management
    8. Bowel Management

- Mobility
    - Transfers
        9. Bed, Chair, Wheelchair
        10. Toilet
        11. Tub or Shower
    - Locomotion
        12. Walk/Wheelchair
        13. Stairs

Cognitive Items

- Communications
    14. Comprehension
    15. Expression

- Psychosocial Adjustment
    16. Social Interaction

- Cognitive Function
    17. Problem Solving
    18. Memory

Ratings:
7 = Complete Independence (timely, safely)
6 = Modified Independence (Extra time, device)
5 = Supervision
4 = Minimal Assistance (pt. > 75% of task)
3 = Moderate Assistance (pt. 50-74% of task)
2 = Maximum Assistance (pt. 25-49% of task)
1 = Total Assistance (pt. < 25% of task)

APPENDIX G

DISABILITY RATING SCALE (DRS)

Disability Rating Scale (DRS)

1. Eye Opening

0 = Spontaneous	1= To Speech	2 = To Pain	3 = None

2. Communication Ability

0 = Oriented	1= Confused	2 = Inappropriate	3 = Incomprehensible	4 = None

3. Motor Response

0 = Obeying	1= Localizing	2 = Withdrawing	3 = Flexing	4 = Extending	5 = None

4. Feeding
5. Toileting
6. Grooming

0 = Complete	0.5 = Between Complete/Partial	1 = Partial	1.5 = Between Partial/Minimal
2 = Minimal	2.5 = Between Minimal/None	3 = None	

7. Level of Functioning

0 = Completely Independent	0.5 = Between Completely Independent/Special Environment
1 = Special Environment	1.5 = Between Special Environment/Mildly Dependent
2 = Mildly Dependent	2.5 = Between Mildly/Moderately Dependent
3 = Moderately Dependent	3.5 = Between Moderately/Markedly Dependent
4 = Markedly Dependent	4.5 = Between Markedly/Totally Dependent
5 = Totally Dependent	

8. "Employability"

0 = Not Restricted	0.5 = Between Not Restricted/Select Jobs
1 = Selected Jobs/Competitive	1.5 = Between Selected Jobs/Sheltered Workshop
2 = Sheltered Workshop/Non-Competitive	2.5 = Between Sheltered Workshop/Not Employable
3 = Not Employable	

APPENDIX H

COMMUNITY INTEGRATION QUESTIONNAIRE (CIQ)

Community Integration Questionnaire (CIQ)

Home Integration

1. Shopping for Necessities
2. Meal Preparation
3. Everyday Housework
4. Caring for Children
5. Plan Social Arrangements

2 = Patient Alone	1 = Patient & Someone Else	0 = Someone Else Not Patient

Social Integration

6. Personal Finances

2 = Patient Alone	1 = Patient & Someone Else	0 = Someone Else Not Patient

7. Frequency of Shopping
8. Frequency of Leisure
9. Frequency of Visiting

2 = 5 or more times/month	1 = 1-4 times/month	0 = Never

10. Leisure Activities

2 = With Family/Friends	2 = Friends without Head Injuries	1 = Family
1 = Friends with Head Injuries	0 = Alone	

11. Best Friend/Confidant

2 = Yes	0 = No

Productivity

12. Travel Outside Home

2 = Almost Every Day	1 = Almost Every Week	0 = Seldom/Never

13. Work Situation

3 = Full-Time	2 = Part-Time	1 = Not Working/Actively Seeking
0 = Not Working/Not Seeking		

14. School Situation

2 = Full-Time	1 = Part-Time	0 = Not Attending

15. Volunteer Situation

2 = 5 or more times/month	1 = 1-4 times	0 = Never

APPENDIX I

DESCRIPTIVE STATISTICS

Descriptive Statistics

Variable	M	SD	n
Injury-Related			
Initial GCS	9.0	4.2	43
Time since Injury	3.8	3.3	45
Demographics			
Age	41.4	13.7	45
Hollingshead SES	18.3	5.7	45
Acculturation			
AAAS-33 Total Score	136.5	31.8	45
Raw Neuropsychological Test Scores			
GOAT (# errors)	9.4	7.7	44
WMS-R Digit Span – Forward	7.1	2.1	44
WMS-R Digit Span – Backward	5.2	2.3	43
MAE Tokens Test	38.2	6.1	43
COWAT	24.5	12.1	44
BVDT	26.1	5.7	44
WAIS-R Block Design	18.1	9.4	42
WMS-R Logical Memory – Immediate	14.4	7.8	44
WMS-R Logical Memory – Delayed	9.6	7.7	44
RAVLT – Trial 1	4.1	1.9	44
RAVLT – Total Trials 1-5	32.1	10.1	44
RAVLT – Alternate List	3.4	1.8	44
RAVLT – Trial 6 (Delayed Recall)	5.2	3.1	44
Grooved Pegboard (seconds)	110.7	55.1	40
Oral SDMT	35	16.1	42
Written SDMT	35.1	15.8	39
Trails A (seconds)	56.8	48.3	41
Trails B (seconds)	155.1	93	37
WCST – Perseverative Responses	30.6	20.4	41
WCST – Categories	3.8	2.0	41
Overall Test Battery Mean (*t*-score)	36.3	7.7	42
Functional Outcome			
FIM – Total	118.6	9.7	36
FIM – Motor	87.3	7.3	36
FIM – Cognition	30.7	4.8	43
DRS	2.7	2.4	43
CIQ-Total	12.4	5.9	43
CIQ-Home	3.8	2.7	43
CIQ-Social	6.6	2.8	43
CIQ-Productivity	2.0	1.8	43

APPENDIX J

DATA TRANSFORMATIONS

Data Transformations

Demographic Variables:

- *Logarithm*
  - Time since Injury (Years)
  - Hollingshead SES Index

Individual Neuropsychological Tests:

- *Square Root*
  - Logical Memory - Delayed Recall

- *Logarithm*
  - Grooved Pegboard
  - Rey Auditory Verbal Learning Test - Alternate List (RAVLT-Alt)
  - Trail Making Test - Part A (Trails A)

- *Reflect and Square Root*
  - MAE-Tokens Test

- *Reflect and Logarithm*
  - Benton Visual Discrimination Test (BVDT)

Functional Outcome Measures:

- *Square Root*
  - Community Integration Questionnaire - Productivity (CIQ-Prod)

- *Reflect and Square Root*
  - Functional Independence Measure - Cognition (FIM-Cognition)

- *Reflect and Log*
  - Functional Independence Measure - Total (FIM)
  - Functional Independence Measure - Motor (FIM-Motor)

APPENDIX K

PREDICTING INDIVIDUAL NEUROPSYCHOLOGICAL TESTS

Summary of Hierarchical Regression Analyses of Variables Predicting Performance on the Galveston Orientation Amnesia Test [N=42]

Analysis 1

Dependent Variable = Total Number of Errors GOAT

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	80.2E-02	.290	.044
Time since Injury (log)	-1.743	3.214	-.086
Step 2: Acculturation			
AAAS-33 Total	4.981E-02	.038	.209
	[Change in R^2 = .044]		

Summary Statistics: $F(3, 38) = .745$ $p = .532$
$R = .236$; $R^2 = .056$ (Adjusted $R^2 = -.019$)

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

Analysis 2

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	2.303E-02	.313	.013
(Log) Time since Injury	-1.325	3.586	-.066
Step 2: Demographic Factors			
Age	7.02E-02	.094	.127
Sex	1.634	3.955	.080
(Log) Education/Occupation-SES	-16.835	14.131	-.265
	[Change in R^2 = .095]		
Step 3: Acculturation			
AAAS-33 Total	3.901E-02	.040	.164
	[Change in R^2 = .025]		

Summary Statistics: $F(7, 34) = .736$ $p = .643$
$R = .363$; $R^2 = .132$ (Adjusted $R^2 = -.0479$)

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

Summary of Hierarchical Regression Analyses of Variables Predicting Performance on WMS-R Digit Span - Forward [*N*=42]

Analysis 1

Dependent Variable = WMS-R Digit Span-Forward Total

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	-3.284E-02	.076	-.068
Time since Injury (log)	-4.305E-02	.838	-.008
Step 2: Acculturation			
AAAS-33 Total	-1.542E-02	.010	-.247
	[Change in R^2 = .061]		

Summary Statistics: F (3, 38) = .889 p = .456
R = .256 R^2 = .066 (Adjusted R^2 = -.008)

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

Analysis 2

Dependent Variable = WMS-R Digit Span-Forward Total

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	2.435E-02	.077	.051
Time since Injury (log)	-.507	.874	-.096
Step 2: Demographic Factors			
Age	-3.648E-02	.023	.253
Sex	.525	.853	.098
(Log) Education/Occupation-SES	5.682**	2.757	.341**
	[Change in R^2 = .168*]		
Step 3: Acculturation			
AAAS-33 Total	-1.156E-02	.010	-.185
	[Change in R^2 = .032]		

Summary Statistics: F (6, 35) = 1.498 p = .208
R = .452 R^2 = .204 (Adjusted R^2 = .068)

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

Summary of Hierarchical Regression Analyses of Variables Predicting Performance on WMS-R Digit Span - Backward [N=41]

Analysis 1

Dependent Variable = WMS-R Digit Span-Backward: Total Score

Predictors	Partial Regression Weights: Raw	St. Error	Standardized
Step 1: Injury-Related			
Initial GCS	-1.280E-02	.086	-.024
Time since Injury (log)	-.278	.951	-.048
Step 2: Acculturation			
AAAS-33 Total	-6.987E-04	.012	-.010
	[Change in R^2 = .000]		

Summary Statistics: F (3, 37) = .034 p = .992
R = .052 R^2 = .003 (Adjusted R^2 = -.078)

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Analysis 2

Dependent Variable = WMS-R Digit Span-Backward: Total Score

Predictors	Partial Regression Weights: Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	2.742E-02	.078	.052
Time since Injury (log)	-1.286	.884	-.224
Step 2: Demographic Factors			
Age	-9.474E-02****	.024	-.603****
Sex	-.330	.935	-.053
Education/Occupation-SES (log)	1.999	2.804	.110
	[Change in R^2 = .323***]		
Step 3: Acculturation			
AAAS-33 Total	-7.854E-05	.010	-.001
	[Change in R^2 = .000]		

Summary Statistics: F (6, 34) = 2.73 p = .028
R = .570 R^2 = .325** (Adjusted R^2 = .206)

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Summary of Hierarchical Regression Analyses of Variables Predicting Performance on the MAE Tokens Test [N=41]

Analysis 1

Dependent Variable = (Reflect Square) MAE Tokens Test Total

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	-1.821E-02	.042	-0.70
Time since Injury (log)	.124	.464	.043
Step 2: Acculturation			
AAAS-33 Total	5.797E-03	.005	.175
	[Change in R^2 = .031]		

Summary Statistics: F (3, 37) = .472 p = .704
R = .192 R^2 = .037 (Adjusted R^2 = -.041)

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Analysis 2

Dependent Variable = (Reflect Square) MAE Tokens Test - Total

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	-6.356E-02*	.035	-.243*
Time since Injury (log)	.299	.394	.104
Step 2: Demographic Factors			
Age	2.311E-02**	.011	.295**
Sex	-.224	.408	-.074
Education/Occupation-SES (log)	-5.954****	1.265	-.666****
	[Change in R^2 = .437***]		
Step 3: Acculturation			
AAAS-33 Total	8.117E-04	.004	.024
	[Change in R^2 = .001]		

Summary Statistics: F (6, 34) = 4.52 p = .002
R = .666 R^2 = .444*** (Adjusted R^2 = .346)

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Summary of Hierarchical Regression Analyses of Variables Predicting Performance on the Controlled Oral Word Association Test (COWAT) [N=42]

Analysis 1

Dependent Variable = COWAT Total Number of Words

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	.513	.458	.178
Time since Injury (log)	-2.502E-02	5.068	-.001
Step 2: Acculturation			
AAAS-33 Total	-6.273E-02	.059	-.167
	[Change in R^2 = .028]		

Summary Statistics: F (3, 38) = .799 p = .502
R = .244 R^2 = .059 (Adjusted R^2 = -.015)

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

Analysis 2

Dependent Variable = COWAT Total Number of Words

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	.704	.483	.244
Time since Injury (log)	-2.073	5.477	-.065
Step 2: Demographic Factors			
Age	-.215	.146	-.247
Sex	-.713	5.349	-.022
Education/Occupation-SES (log)	19.393	17.284	.193
	[Change in R^2 = .091]		
Step 3: Acculturation			
AAAS-33 Total	-5.078E-02	.061	-.135
	[Change in R^2 = .017]		

Summary Statistics: F (6, 35) = .941 p = .479
R = .373 R^2 = .139 (Adjusted R^2 = .-.009)

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

<u>Summary of Hierarchical Regression Analyses of Variables Predicting Performance on the Benton Visual Discrimination Test (BVDT) [N=42]</u>

<u>Analysis 1</u>

Dependent Variable = (Reflect and Log) BVDT Total Score

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	-2.403E-02*	.014	.272*
Time since Injury (log)	-.217	.151	-.222
Step 2: Acculturation			
AAAS-33 Total	6.905E-04	.002	.060
	[Change in R^2 = .004]		

Summary Statistics: F (3, 38) = 1.62 p = .201
R = .337 R^2 = .113 (Adjusted R^2 = .043)

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

<u>Analysis 2</u>

Dependent Variable = (Reflect and Log) BVDT Total Score

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	-3.755E-02***	.013	-.425***
Time since Injury (log)	-9.486E-02	.146	-.097
Step 2: Demographic Factors			
Age	9.350E-03**	.143	.351**
Sex	-.138	.461	-.140
Education/Occupation-SES (log)	-1.298***	.004	-.422***
	[Change in R^2 = .237**]		
Step 3: Acculturation			
AAAS-33 Total	-1.430E-04	.002	-.012
	[Change in R^2 = .000]		

Summary Statistics: F (6, 35) = 3.10 p = ..015
R = .589 R^2 = .347** (Adjusted R^2 = .235)

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

Summary of Hierarchical Regression Analyses of Variables Predicting Performance on the WAIS-R Block Design [N=42]

Analysis 1

Dependent Variable = WAIS-R Block Design Raw Score

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	.193	.317	.091
Time since Injury (log)	7.758**	3.451	.336**
Step 2: Acculturation			
AAAS-33 Total	-7.79E-02*	.042	-.279*
	[Change in R^2 = .078*]		

Summary Statistics: F (3, 36) = 3.03 p = .041
R = .449 R^2 = .202** (Adjusted R^2 = .135)

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Analysis 2

Dependent Variable = WAIS-R Block Design Raw Score

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	.335	.298	.158
Time since Injury (log)	5.135	3.343	.222
Step 2: Demographic Factors			
Age	-.283***	.091	-.446***
Sex	-1.19	3.824	-.045
Education/Occupation-SES (log)	13.110	10.841	.180
	[Change in R^2 = .220**]		
Step 3: Acculturation			
AAAS-33 Total	-6.86E-02*	.039	-.246*
	[Change in R^2 = .056*]		

Summary Statistics: F (6, 33) = 3.67 p = .007
R = .632 R^2 = .400*** (Adjusted R^2 = .291)

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Summary of Hierarchical Regression Analyses of Variables Predicting Performance on WMS-R Logical Memory - Immediate Recall [N=42]

Analysis 1

Dependent Variable = Logical Memory - Immediate Recall Score

Predictors	Raw	Std. Error	Standardized
	Partial Regression Weights		
Step 1: Injury-Related			
Initial GCS	.634**	.275	.348**
Time since Injury (log)	1.513	3.044	.075
Step 2: Acculturation			
AAAS-33 Total	-3.798E-02	.036	-.160
	[Change in R^2 = .026]		

Summary Statistics: F (3, 38) = 2.18 p = .106
R = .383 R^2 = .147 (Adjusted R^2 = .079)

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Analysis 2

Dependent Variable = Logical Memory - Immediate Recall Score

Predictors	Raw	Std. Error	Standardized
	Partial Regression Weights		
Step 1: Injury-Related			
Initial GCS	.794***	.268	.436***
Time since Injury (log)	3.040	3.035	.151
Step 2: Demographic Factors			
Age	6.164E-02	2.963	.112
Sex	-1.858	9.577	-.092
Education/Occupation-SES (log)	26.329***	.081	.416***
	[Change in R^2 = .213**]		
Step 3: Acculturation			
AAAS-33 Total	-8.897E-03	.034	-.038
	[Change in R^2 = .001]		

Summary Statistics: F (6, 35) = 2.95 p = ..020
R = .579 R^2 = .336** (Adjusted R^2 = .222)

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Summary of Hierarchical Regression Analyses of Variables Predicting Performance on WMS-R Logical Memory - Delayed Recall [N=41]

Analysis 1

Dependent Variable = (Square Root) Logical Memory-Delayed Recall

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	7.740E-02*	.045	.265*
(Log) Time since Injury	.258	.487	.081
Step 2: Acculturation			
AAAS-33 Total	-1.028E-02*	.006	-.274*
	[Change in R^2 = .075*]		

Summary Statistics: F (3, 37) = 2.19 p = .106
R = .388 R^2 = .151 (Adjusted R^2 = .082)

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Analysis 2

Dependent Variable = (Square Root) Logical Memory-Delayed Recall

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	9.926E-02**	.047	.340**
Time since Injury (log)	.369	.529	.115
Step 2: Demographic Factors			
Age	5.687E-03	.015	.063
Sex	4.321E-03	.506	.001
Education/Occupation-SES (log)	3.132*	1.645	.314*
	[Change in R^2 = .135]		
Step 3: Acculturation			
AAAS-33 Total	-7.047E-03	.006	-.188
	[Change in R^2 = .033]		

Summary Statistics: F (6, 34) = 1.82 p = .124
R = .493 R^2 = .244 (Adjusted R^2 = .110)

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Summary of Hierarchical Regression Analyses of Variables Predicting Performance on the Rey Auditory Verbal Learning Test - Trial 1 [N=42]

Analysis 1

Dependent Variable = RAVLT - Recall Trial 1

Predictors	Partial Regression Weights Raw	 Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	-5.644E-02	.058	-.125
Time since Injury (log)	2.948****	.639	.592****
Step 2: Acculturation			
AAAS-33 Total	-7.236E-04	.007	-.012
	[Change in R^2 = .000]		

Summary Statistics: F (3, 38) = 7.91 p = .000
R = .620 R^2 = .384**** (Adjusted R^2 = .336)

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Analysis 2

Dependent Variable = RAVLT - Recall Trial 1

Predictors	Partial Regression Weights Raw	 Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	-5.563E-02	.063	-.124
Time since Injury (log)	2.741****	.711	.550****
Step 2: Demographic Factors			
Age	-1.856E-02	.019	-.137
Sex	-6.332E-02	.695	-.013
Education/Occupation-SES (log)	-.426	2.244	-.027
	[Change in R^2 = .017]		
Step 3: Acculturation			
AAAS-33 Total	-1.728E-03	.008	-.029
	[Change in R^2 = .001]		

Summary Statistics: F (6, 35) = 3.93 p = .004
R = .634 R^2 = .402*** (Adjusted R^2 = .300)

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Summary of Hierarchical Regression Analyses of Variables Predicting Performance on the Rey Auditory Verbal Learning Test - Total Trials 1-5 [*N*=42]

Analysis 1

Dependent Variable = RAVLT - Recall Total Trials 1-5

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	.306	.332	.130
Time since Injury (log)	11.096***	3.672	.426***
Step 2: Acculturation			
AAAS-33 Total	-7.557E-02*	.043	-.247*
	[Change in R^2 = .061*]		

Summary Statistics: $F(3, 38) = 4.34$ $p = .010$
$R = .505$ $R^2 = .255$** (Adjusted $R^2 = .196$)

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

Analysis 2

Dependent Variable = RAVLT - Recall Total Trials 1-5

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	.413	.328	.176
Time since Injury (log)	9.806**	3.714	.377**
Step 2: Demographic Factors			
Age	-.225**	.099	-.318**
Sex	-4.815	3.627	-.184
Education/Occupation-SES (log)	13.815	11.722	.169
	[Change in R^2 = .165**]		
Step 3: Acculturation			
AAAS-33 Total	-6.628E-02	.042	-.217
	[Change in R^2 = .043]		

Summary Statistics: $F(6, 35) = 3.93$ $p = .004$
$R = .635$ $R^2 = .403$*** (Adjusted $R^2 = .300$)

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

Summary of Hierarchical Regression Analyses of Variables Predicting Performance on the Rey Auditory Verbal Learning Test - Alternate Trial [N=42]

Analysis 1

Dependent Variable = (Log) RAVLT - Recall Alternate Trial

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	2.338E-03	.009	.047
Time since Injury (log)	.132	.097	.210
Step 2: Acculturation			
AAAS-33 Total	-1.848E-03	.001	-.250
	[Change in R^2 = .062]		

Summary Statistics: F (3, 38) = 1.58 p = .211
R = .333 R^2 = .111 (Adjusted R^2 = .040)

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

Analysis 2

Dependent Variable = (Log) RAVLT - Recall Alternate Trial

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	2.120E-03	.009	.037
Time since Injury (log)	.117	.106	.186
Step 2: Demographic Factors			
Age	-3.122E-03	.003	-.182
Sex	-9.259E-02	.104	-.146
Education/Occupation-SES (log)	-4.423E-02	.336	-.022
	[Change in R^2 = .050]		
Step 3: Acculturation			
AAAS-33 Total	-1.928E-03	.001	-.261
	[Change in R^2 = .063]		

Summary Statistics: F (6, 35) = 1.12 p = .371
R = .401 R^2 = .161 (Adjusted R^2 = .017)

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

Summary of Hierarchical Regression Analyses of Variables Predicting Performance on the Rey Auditory Verbal Learning Test - Trial 6 [N=42]

Analysis 1

Dependent Variable = RAVLT - Delayed Recall

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	.181	.114	.244
Time since Injury (log)	1.381	1.261	.169
Step 2: Acculturation			
AAAS-33 Total	-1.784E-02	.015	-.185
	[Change in R^2 = .034]		
Summary Statistics:	F (3, 38) = 1.643 p = .196		
	R = .339 R^2 = .115 (Adjusted R^2 = .045)		

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Analysis 2

Dependent Variable = RAVLT - Delayed Recall

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	.208*	.114	.280*
Time since Injury (log)	.928	1.292	.113
Step 2: Demographic Factors			
Age	-7.622E-02**	.034	-.341**
Sex	-1.630	1.262	-.197
Education/Occupation-SES (log)	3.449	4.077	.134
	[Change in R^2 = .166*]		
Step 3: Acculturation			
AAAS-33 Total	-1.589E-02	.014	-.165
	[Change in R^2 = .025]		
Summary Statistics:	F (6, 35) = 2.18 p = ..069		
	R = .521 R^2 = .272* (Adjusted R^2 = .147)		

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Summary of Hierarchical Regression Analyses of Variables Predicting Performance on Grooved Pegboard Test [N=39]

Analysis 1

Dependent Variable = Grooved Pegs: (log) Timed Score

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	1.863E-03	.007	.042
Time since Injury (log)	-8.416E-02	.079	-.170
Step 2: Acculturation			
AAAS-33 Total	1.602E-03*	.001	.285*
	[Change in R^2 = .080*]		

Summary Statistics: $F(3, 35) = 1.64$ p = ..199
$R = .351$ $R^2 = .123$ (Adjusted $R^2 = .048$)

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

Analysis 2

Dependent Variable = Grooved Pegs: (log) Timed Score

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	1.195E-03	.007	.027
Time since Injury (log)	-6.715E-02	.077	-.135
Step 2: Demographic Factors			
Age	5.395E-03**	.002	.374**
Sex	.141*	.077	.279*
Education/Occupation-SES (log)	-6.303E-03	.239	-.042
	[Change in R^2 = .232**]		
Step 3: Acculturation			
AAAS-33 Total	1.470E-03*	.001	.261*
	[Change in R^2 = .062*]		

Summary Statistics: $F(6, 32) = 2.70$ $p = .031$
$R = .580$ $R^2 = .336$** (Adjusted $R^2 = .212$)

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

Summary of Hierarchical Regression Analyses of Variables Predicting Performance on the Symbol Digit Modalities Test - Oral Version [N=40]

Analysis 1

Dependent Variable = SDMT - Oral: Total Correct

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	.687	.618	.178
Time since Injury (log)	8.489	6.729	.202
Step 2: Acculturation			
AAAS-33 Total	-5.00E-02	.081	-.099
	[Change in R^2 = .100]		

Summary Statistics: F (3, 36) = 1.04 p = .388
R = .282 R^2 = .079 (Adjusted R^2 = .003)

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Analysis 2

Dependent Variable = SDMT - Oral: Total Correct

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	.831	.585	.216
Time since Injury (log)	6.520	6.573	.115
Step 2: Demographic Factors			
Age	-.420**	.179	-.365**
Sex	-14.069*	7.518	-.294*
Education/Occupation-SES (log)	10.881	21.312	.082
	[Change in R^2 = .225**]		
Step 3: Acculturation			
AAAS-33 Total	-2.02E-02	.077	-.040
	[Change in R^2 = .001]		

Summary Statistics: F (6, 33) = 2.32 p = .056
R = .545 R^2 = .297* (Adjusted R^2 = .169)

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Summary of Hierarchical Regression Analyses of Variables Predicting Performance on the Symbol Digit Modalities Test - Written Version [N=37]

Analysis 1

Dependent Variable = SDMT - Written: Total Correct

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	.809	.590	.217
Time since Injury (log)	7.466	6.657	.178
Step 2: Acculturation			
AAAS-33 Total	-.143*	.077	-.294*
		[Change in R^2 = .086*]	

Summary Statistics: F (3, 33) = 2.34 p = .091
R =.419 R^2 = .176* (Adjusted R^2 = .101)

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Analysis 2

Dependent Variable = SDMT - Written: Total Correct

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	1.060*	.582	.284*
Time since Injury (log)	5.032	6.673	.120
Step 2: Demographic Factors			
Age	-.417**	.188	-.353**
Sex	-1.749	8.367	-.035
Education/Occupation-SES (log)	23.309	21.184	.185
		[Change in R^2 = .172*]	
Step 3: Acculturation			
AAAS-33 Total	-.110	.078	-.226
		[Change in R^2 = .045]	

Summary Statistics: F (6, 30) = 2.22 p = .069
R =.554 R^2 = .307* (Adjusted R^2 = .169)

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Summary of Hierarchical Regression Analyses of Variables Predicting Performance on the Trail Making Test - Part A [N=39]

Analysis 1

Dependent Variable = (Log) Trails A Total Time

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	-1.94E-02*	.010	-.303*
Time since Injury (log)	-.248	.109	-.342
Step 2: Acculturation			
AAAS-33 Total	1.348E-03	.001	.164
	[Change in R^2 = .027]		

Summary Statistics: F (3, 35) = 3.37 p = .029
R =.473 R^2 = .224** (Adjusted R^2 = .157)

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Analysis 2

Dependent Variable = (Log) Trails A Total Time

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	-2.21E-02**	.010	-.344**
Time since Injury (log)	-.242**	.113	-.333**
Step 2: Demographic Factors			
Age	5.208E-03	.003	.247
Sex	.144	.113	.194
Education/Occupation-SES (log)	-.341	.348	-.157
	[Change in R^2 = .133]		
Step 3: Acculturation			
AAAS-33 Total	9.141E-04	.001	.111
	[Change in R^2 = .011]		

Summary Statistics: F (6, 32) = 2.77 p = .028
R = .585 R^2 = .342** (Adjusted R^2 = .219)

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Summary of Hierarchical Regression Analyses of Variables Predicting Performance on the Trail Making Test - Part B [N=35]

Analysis 1

Dependent Variable = Trails B Total Time

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	-1.599	3.975	-.072
Time since Injury (log)	-8.425	45.276	-.033
Step 2: Acculturation			
AAAS-33 Total	.418	.512	.145
	[Change in R^2 = .021]		
Summary Statistics:	F (3, 31) = .280 p = .840		
	R = .162 R^2 = .026 (Adjusted R^2 = -.068)		

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Analysis 2

Dependent Variable = Trails B Total Time

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	-2.511	3.650	-.113
Time since Injury (log)	-6.928	42.975	-.027
Step 2: Demographic Factors			
Age	2.966**	1.200	.409**
Sex	75.675*	41.662	.306*
Education/Occupation-SES (log)	-124.530	129.683	-.170
	[Change in R^2 = .294**]		
Step 3: Acculturation			
AAAS-33 Total	.242	.479	.084
	[Change in R^2 = .006]		
Summary Statistics:	F (6, 28) = 2.05 p = .091		
	R = .553 R^2 =.306* (Adjusted R^2 = .157)		

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Summary of Hierarchical Regression Analyses of Variables Predicting Performance on the Wisconsin Card Sorting Task - Perseverative Responses [N=39]

Analysis 1

Dependent Variable = WCST Total Number of Perseverative Responses

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	-1.441	.758	-.298
Time since Injury (log)	-13.501	8.440	-.252
Step 2: Acculturation			
AAAS-33 Total	4.493E-02	.097	.072
	[Change in R^2 = .005]		

Summary Statistics: F (3, 35) = 1.98 p = ..135
R = .381 R^2 = .145 (Adjusted R^2 = .072)

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Analysis 2

Dependent Variable = WCST Total Perseverative Responses

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	-1.423*	.740	-.295*
Time since Injury (log)	-10.309	8.404	-.192
Step 2: Demographic Factors			
Age	.593**	.248	..371**
Sex	9.978	8.631	.179
Education/Occupation-SES (log)	8.810	26.792	.050
	[Change in R^2 = .169*]		
Step 3: Acculturation			
AAAS-33 Total	4.305E-02	.095	.069
	[Change in R^2 = .004]		

Summary Statistics: F (6, 32) = 2.43 p = ..048
R = .559 R^2 = .313** (Adjusted R^2 = .184)

Note: *p < .10 **p < .05 ***p < .01 ****p < .001

Summary of Hierarchical Regression Analyses of Variables Predicting Performance on the Wisconsin Card Sorting Task - Categories [*N*=39]

Analysis 1

Dependent Variable = WCST Total Number of Categories

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	.127*	.073	.268*
Time since Injury (log)	.952	.813	.182
Step 2: Acculturation			
AAAS-33 Total	-1.62E-02*	.009	-.266*
	[Change in R^2 = .070*]		

Summary Statistics: $F(3, 35) = 2.40$ $p = .084$
$R = .413$ $R^2 = .171$* (Adjusted $R^2 = .100$)

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

Analysis 2

Dependent Variable = WCST Total Number of Categories

Predictors	Partial Regression Weights Raw	Std. Error	Standardized
Step 1: Injury-Related			
Initial GCS	.131*	.067	.277*
Time since Injury (log)	.638	.764	.122
Step 2: Demographic Factors			
Age	-6.80E-02**	.023	-.434**
Sex	-1.272	.785	-.233
Education/Occupation-SES (log)	5.087E-02	2.436	.003
	[Change in R^2 = .251**]		
Step 3: Acculturation			
AAAS-33 Total	-1.48E-02*	.009	-.244*
	[Change in R^2 = .054*]		

Summary Statistics: $F(6, 32) = 3.64$ $p = .007$
$R = .637$ $R^2 = .406$*** (Adjusted $R^2 = .295$)

Note: *$p < .10$ **$p < .05$ ***$p < .01$ ****$p < .001$

REFERENCES

Amante, D. Van Houten, V. W., Grieve, J. H., Bader, C. A., & Margules, P. H. (1977). Neuropsychological deficit, ethnicity and socioeconomic status. Journal of Consulting and Clinical Psychology, 45, 524-535.

Ardila, A. (1995). Directions of research in cross-cultural neuropsychology. Journal of Clinical and Experimental Neuropsychology, 17, 143-150.

Ardila, A., Rosselli, M., & Ostrovsky-Solis, F. (1992). Socioeducational. In A. E. Puente & R. J. McCaffrey (Eds.), Handbook of neuropsychological assessment: A biopsychosocial perspective (pp. 181-192). New York: Plenum Press.

Ardila, A., Rosselli, M., & Rosa, P. (1989). Neuropsychological assessment in illiterates: Visuospatial and memory abilities. Brain and Cognition, 11, 147-166.

Arnold, B. R., Montgomery, G. T., Casteneda, I., & Longoria, R. (1994). Acculturation and performance of Hispanics on selected Halstead-Reitan neuropsychological tests. Assessment, 1, 239-248.

Artiola i Fortuny, L., Heaton, R. K., & Hermosillo, D. (1998). Neuropsychological comparisons of Spanish-speaking participants from the U.S.-Mexico border region *versus* Spain. Journal of International Neuropsychological Society, 4, 363-379.

Benton, A. L., Hamsher, K. deS., Rey, G. J., & Sivan, A. B. (1994). Multilingual aphasia examination (3rd ed.). Iowa City, IA: AJA Associates.

Benton, A. L., Sivan, A. B., Hamsher, K. deS., Varney, N. R., & Spreen, O. (1983). Contributions to neuropsychological assessment (2nd ed.). New York: Oxford University Press.

Berry, J. W. (1975). Human ecology and cognitive style: Comparative studies in cultural and psychological adaptation. New York: John Wiley & Sons.

Berry, J. (1989). Psychology of acculturation. In J. J. Berman (Ed.), Nebraska Symposium on motivation, 1989: Cross-cultural perspectives (Vol. 37, pp. 201-234). Lincoln: University of Nebraska Press.

Berry, J. W., Poortinga, Y. H., Segall, M. H., & Dasen, P. R. (1992). Cross-cultural psychology: Research and applications. New York: Cambridge University Press.

Betancourt, H., & Lopez, S. R. (1993). The study of culture, ethnicity, and race in American psychology. American Psychologist, 48(6), 629-637.

Binder, L. M. (1997). A review of mild head trauma. Part II: Clinical Implications. Journal of Clinical and Experimental Neuropsychology, 19(3), 432-457.

Binder, L. M., Rohling, M. L., & Larabee, G. J. (1997). A review of mild head trauma. Part I: Meta-analytic review of neuropsychological studies. Journal of Clinical and Experimental Neuropsychology, 19(3), 421-431.

Bowman, M. L. (1996). Ecological validity of neuropsychological and other predictors following head injury. The Clinical Neuropsychologist, 10 (4), 382-396.

Boykin, A. W. (1983). On academic performance and Afro-American children. In J. R. Spencer (Ed.), Achievement and achievement motives (pp. 324-371). Boston, MA: Freeman.

Boykin, A. W. (1994). Harvesting talent and culture: African-American children and educational reform. In R. Rossi (Ed.), Schools and students at risk (pp. 116-138). New York: Teachers College Press.

Brooks, N., Campsie, L., Symington, C., Beattie, A., McKinlay, W. (1986). The five-year outcome of severe blunt head injury: A relative's view. Journal of Neurology, Neurosurgery, and Psychiatry, 49, 764-770.

Calev, A. (Ed.) (1999). Assessment of neuropsychological functions in psychiatric disorders. Washington, DC: American Press, Inc.

Callahan, C. M., Hall, K. S., Hui, S. L., Musick, B. S., Unverzagt, F. W., & Hendric, H. C. (1996). Relationship of age, education, and occupation with dementia among a community-based sample of African Americans. Archives of Neurology, 53, 134-146.

Ceci, S. J. (1991). How much does schooling influence general intelligence and its cognitive components? A reassessment of the evidence. Developmental Psychology, 27, 703-722.

Cifu, D. X., Keser-Marcus, L., Lopez, E., Wehman, P., Kreutzer, J. S., Englander, J., & High, W. (1997). Acute predictors of successful return to work 1 year after traumatic brain injury: A multicenter analysis. Archives of Physical Medicine and Rehabilitation, 78, 125-131.

Collins, J. G. (1990). Types of injuries by selected characteristics: United States. 1985-1987, National Center for Health Statistics. Vital Health Statistics, 10 (175).

Cuellar, I., Harris, L. C., & Jasso, R. (1980). An acculturation scale for Mexican American normal and clinical populations. Hispanic Journal of Behavioral Sciences, 2, 199-217.

Culebras, A. (1995). Hispanic: An epidemiologically meaningless term. Archives of Neurology, 52, 533-534.

Cullum, C. M., & Thompson, L. L. (1997). Neuropsychological diagnosis and outcome in mild traumatic brain injury. Applied Neuropsychology, 4(1), 6-15

Dahmer, E. R., Shilling, M. A., Hamilton, B. B., Bontke, C. F., Englander, J., Kreutzer, J. S., Ragnarsson, K. T., Rosenthal, M. (1993). A model systems database for traumatic brain injury. Journal of Head Trauma Rehabilitation, 8(2), 12-25.

Devivo, M. J., Rutt, R. D., Black, K. J., Go, B. K., & Stover, S. L. (1992). Trends in spinal cord injury demographics and treatment outcomes between 1973 and 1986. Archives of Physical Medicine and Rehabilitation, 73, 424-430.

Dijkers, M. (1997). Measuring the long-term outcomes of traumatic brain injury: a review of the Community Integration Questionnaire. Journal of Head Trauma Rehabilitation, 12(6), 74-91.

Dikmen, S. S., Donovan, D. M., Loberg, T., Machamer, J. E., & Temkin, N. R. (1993). Alcohol use and its effects on neuropsychological outcome in head injury. Neuropsychology, 7(3), 296-305.

Dikmen, S. S., & Machamer, J. E. (1995). Neurobehavioral outcomes and their determinants. Journal-of-Head-Trauma-Rehabilitation, 10(1), 74-86.

Dikmen, S. S., Machamer, J. E., Winn, H. R., & Temkin, N. R. (1995). Neuropsychological outcome at 1-year post head injury. Neuropsychology, 9(1), 80-90.

Dikmen, S. S., Temkin, N. R., Machamer, J. E., Holubkov, A. L., Fraser, R. T., & Winn, R. (1994). Employment following traumatic head injuries. Archives of Neurology, 51, 177-186.

Eyferth, K. (1961). Leistungen versheidener Gruppen von Besatzungskindern in Hamburg-Wechsler Intelligentztest fur Kinder (HAWIK) [The performance of different groups of occupation children in the Hamburg-Wechsler Intelligence Test for Children]. Archive fur die gesamte Psychologie, 113, 222-241.

Ferguson, G. A. (1956). On transfer and the abilities of man. Canadian Journal of Psychology, 10, 121-131.

Fletcher, J., Satz, P., & Carter, W. (1978). Neuropsychological and socio-cultural correlates of chronic cannabis use: Recent cross-cultural evidence from Costa Rica and other countries. Contemporary Drug Problems, 7, 3-30.

Flynn, J. R. (1987). Massive IQ gains in 14 gains: What IQ tests really measure. Psychological Bulletin, 101, 171-191.

Flynn, J. R. (1999). Searching for justice. American Psychologist, 54(1), 5-20.

Gay, J., & Cole, M. (1967). The new mathematics and an old culture: A study of learning among the Kpelle of Liberia. New York: Holt, Rhinehart & Winston.

Geshwind, N. & Calaburda, A. M. (1985). Cerebral lateralization, biological mechanism, associations, and pathology: 1. A hypothesis and a program for research. Archives of Neurology, 42, 428-450.

Giacino, J. T., & Zasler, N. D. (1995). Outcome after traumatic brain injury: Coma, the vegetative state and the minimally responsive state. Journal of Head Trauma Rehabilitation, 10(1), 40-55.

Giles, W. H., Kittner, S. J., Hebel, J. R., Losonczy, K. G., & Sherwin, R. W. (1995). Determinants of Black-White differences in the risk of cerebral infarction. Archives of Internal Medicine, 155, 1319-1324.

Golden, C. J., Purisch, A. D., & Hammeke, T. A., (1981). Luria-Nebraska Neuropsychological Battery: Manual. Los Angeles, CA: Western Psychological Services.

Goldstein, F. C., & Levin, H. S. (1995). Neurobehavioral outcome of traumatic brain injury in older adults: Initial findings. Journal of Head Trauma Rehabilitation, 10(1), 57-73.

Gouvier, W. D., Blanton, P. Laporte, K., & Nepomuceno, C., (1987). Reliability and validity of the Disability Rating Scale and the levels of Cognitive Functioning Scale in monitoring recovery from severe head injury. Archives of Physical Medicine and Rehabilitation, 68, 94-97.

Grubb, H. J. & Dozier, A. (1989). Too busy to learn: A "competing behaviors" explanation of cross-cultural differences in academic ascendancy based on the cultural distance hypothesis. Journal of Black Psychology, 16(1), 23-45.

Haley, W. E., Han, B., & Henderson, J. N. (1998). Aging and ethnicity: Issues for clinical practice. Journal of Clinical Psychology in Medical Settings, 5(3), 393-409.

Hall, K., Cope, N., & Rappaport, M. (1985). Glasgow outcome scale and disability rating scale: Comparative usefulness in following recovery in traumatic brain injury. Archives of Physical Medicine and Rehabilitation, 66, 35-37.

Hall, K. M., Hamilton, B. B., Gordon, W. A., & Zasler, N. D. (1993). Characteristics and comparisons of functional assessment indices: Disability Rating Scale, Functional Independence Measure and Functional Assessment Measure. Journal of Head Trauma Rehabilitation, 8, 60-74.

Hanks, R. A., Rapport, L. J., Millis, S. R., Deshpande, S. A. (1998). Ecological validity of measures of executive functioning in a rehabilitation sample. Unpublished manuscript.

Harrison-Felix, C., Newton, N., Hall, K. M., and Kreutzer, J. S. (1996). Descriptive findings from the traumatic brain injury model systems database. Journal of Head Trauma Rehabilitation, 11 (5), 1-14.

Heath, S. B. (1989). Oral and literate traditions among Black Americans living in poverty. American Psychologist, 44, 367-373.

Heaton, R. K., Chelune, G. J., Talley, J. L., Kay, G. G., & Curtis, G. (1993). Wisconsin Card Sorting Test (WCST) manual - revised and expanded. Odessa, FL: Psychological Assessment Resources.

Heaton, R. K., Grant, I. & Matthews, C. G. (1991). Comprehensive norms for an expanded Halstead-Reitan battery. Odessa: FL: Psychological Assessment Resources.

Heaton, R. K., Ryan, L., Grant, I., & Matthews, C. G. (1996). Demographic influences on neuropsychological test performance. In I. Grant & K. M. Adams (Eds.), Neuropsychological assessment of neuropsychiatric disorders (2nd ed., pp. 141-163). New York: Oxford University Press.

Heinemann, A. W., & Whiteneck. G.G. (1995). Relationships among impairment, disability, handicap, and life satisfaction in persons with traumatic brain injury. Journal of Head Trauma Rehabilitation, 10, 54-63.

Helms, J. E. (1992). Why is there no study of cultural equivalence in standardized cognitive ability testing? American Psychologist, 47 (9), 1083-1101.

Helms, J. E. (1997). The triple quandary of race, culture and social class in standardized cognitive ability testing. In D. P. Flanagan, J. L. Genshaft, & P. L. Harrison (Eds.), Contemporary intellectual assessment: Theories, tests, and issues (pp. 517-532). New York: Guilford Press.

Hibbard, M. R., Usysal, S., Kepler, K., Bogdany, J., & Silver, J. (1998). Axis I psychopathology in traumatic brain injury. Journal of Head Trauma Rehabilitation, 13(4), 24-39.

Hollingshead, A. B. (1975). Four Factor Index of Social Status. Unpublished manuscript, Yale University.

Hong, Y., Morris, M. W., Chiu, C., Benet-Martinez, V. (1997). Multicultural minds: A dynamic constructivist approach to culture and cognition. American Psychologist, 55(7), 709-720.

Ip, R. Y., Dornan, J., & Schentag, C. (1995). Traumatic brain injury: Factors predicting return to work or school. Brain Injury, 9, 517-532.

Irvine, S.H. (1966). Towards a rationale for testing abilities and attainments in Africa. British Journal of Educational Psychology, 36, 24-32.

Irvine, S. H., & Berry, J. W. (1988). The abilities of mankind: A revaluation. In S. H. Irvine & J. W. Berry (Eds.), Human abilities in cultural context (pp. 3-59). New York: Cambridge University Press.

Jackson, J. S., & Sellers, S. L. (1996). African-American health over the life course: A multidimensional framework. In P. M. Kato, & T. Mann (Eds.), Handbook of diversity issues in health psychology (pp. 301-317). New York: Plenum Press.

Jacobs, D. M., Sano, M., Albert, S., Schofield, P., Dooneief, G., & Stern, Y. (1997). Cross-cultural neuropsychological assessment: A comparison of randomly selected, demographically matched cohorts of English and Spanish-speaking older adults. Journal of Clinical and Experimental Neuropsychology, 19, 331-339.

Jensen, A. R. (1980). Bias in mental testing. New York: Free Press.

Johnson-Selfridge, M. T., Zalewski, C., Abourdarham, J. F., (1998). The relationship between ethnicity and word fluency. Archives of Clinical Neuropsychology, 13, 319-325.

Katz, K.I., & Alexander, M. P. (1994). Traumatic brain injury: Predicting outcome of recovery and outcome for patients admitted to rehabilitation. Archives of Neurology, 51, 661-670.

Katzman, R. (1993). Education and the prevalence of dementia and Alzheimer's disease. Neurology, 43, 13-20.

Kaufman, A. S., McLean J. E., & Reynolds, C. R. (1988). Sex, race, residence, region and education differences on the 11 WAIS-R subtests. Journal of Clinical Psychology, 44, 231-248.

Kaufman, J. S., & Cooper, R. S. (1995). Epidemiologic research on minority health: in search of the hypothesis. Public Health Reports, 110, 662-666.

Kaufman, J. S., Cooper, R. S., & McGee, D. L. (1997). Socioeconomic status and health in blacks and whites: the problem of residual confounding and the resilience of race. Epidemiology, 8, 621-628.

Keith, R. A., Granger, C. V., Hamilton, B. B., & Sherwin, F. S. (1987). The Functional Independence Measure: A new tool for rehabilitation. In M. G. Eisenberg, & R.G. Grzesiak (Eds.), Advances in clinical rehabilitation. New York: Springer.

Kennepohl, S. (1999). Toward a cultural neuropsychology: An alternative view and a preliminary model. Brain and Cognition, 41, 365-380.

Klich, E. Z., & Davidson, G. R. (1983). A cultural difference in visual memory: on le voit, on le voit plus. International Journal of Psychology, 18, 189-201.

Kottak, C. P. & Kozaitis, K. A. (1999). On being different: Diversity and multiculturalism in the North American mainstream. New York: McGraw Hill Companies, Inc.

Kraus, J.S., & McArthur, D. L. (1999). The epidemiology of traumatic brain injury. In M. Rosenthal, E. Griffith, J. Kreutzer, & B. Pentland (Eds.), Rehabilitation of the adult and child with traumatic brain injury (3rd ed., pp. 3-18). Philadelphia, PA: F. A. Davis.

Landrine, H., Klonoff, E. A. (1994). The African American Acculturation Scale: Development, reliability and validity. Journal of Black Psychology, 20, 104-127.

Landrine, H. & Klonoff, E.A. (1995). The African American Acculturation Scale II: Cross-validation and short form. Journal of Black Psychology, 21, 124-152.

Landrine, H., & Klonoff, E.A. (1996). African American acculturation: Deconstructing race and reviving culture. Thousand Oaks, CA: Sage Publications.

Latter, B. (1980). Genetic differences within and between populations of the major human subgroups. The American Naturalist, 116, 220-237.

Lecours, A. R., Mehler, J., Parente, M. A., Beltrami, M. C. Canossa de Tolipan, L., Castro, M. J., Carrono, V., Chagastelles, L., Dehaut, F., Delgado, R., Evangelista, A., Fajgenbaum, S., Fontourna, C., de Fraga Karmann, D., Gurd, J., Hierro Torne, C., Jakubovicz, R., Kac, R., Lefevre, B., Lima, C., Maciel, J., Mansur, L., Martinez, R., Nobrega, M. C., Osorio, A., Paciornik, J., Papaterra, F., Jourdan Penedo, M. A., Saboya, B., Scheuer, C., Batista da Silva, A., Spinardi, M., & Texeira, M. (1988). Illiteracy and brain damage 3: A contribution to the study of speech and language disorders in illiterates with unilateral brain damage (initial testing). Neuropsychologia, 26, 575-589.

Levati, A., Farina, M. A., Vecchi, G., Rossanda, M., & Marrubini, M. B. (1982). Prognosis of severe head injuries. Journal of Neurosurgery, 57, 779-783.

Levin, H. S. (1993). Neurobehavioral sequelae of closed head injury. In P. R. Cooper (Ed.), Head injury (pp. 525-551). Baltimore, MD: Willliams & Wilkin.

Levin, H. S., O'Donnell, V. M., Grossman, R. G. (1979). The Galveston orientation and amnesia test: A practical scale to assess cognition after head injury. Journal of Nervous and Mental Disorders, 167, 675-684.

Lichtenberg, P. A., Ross, T., & Christensen, B. (1994). Preliminary normative data on the Boston Naming Test for an older urban population. The Clinical Neuropsychologist, 891, 109-111.

Linacre, J. M., Heinemann, A. W., Wright, B. D., Granger, C. V., Hamilton, B. B. (1994). The structure and stability of the Functional Independence Measure. Archives of Physical Medicine and Rehabilitation, 75, 127-132.

Loehlin, J. C., Lindzey, G., & Spuhler, J. N. (1975). Race Differences in Intelligence. New York: Freeman.

Loewenstein, D. A., Arguelles, T., Barker, W. W., & Duara, R. (1993). A comparative analysis of neuropsychological test performance of Spanish-speaking and English-speaking patients with Alzheimer's disease. Journal of Gerontology, 48, 389-394.

Loewenstein, D. A. Rubert, M. P., Arguelles, R., & Duara, R. (1995). Neuropsychological test performance and prediction of functional capacities among Spanish-speaking and English-speaking patients with dementia. Archives of Clinical Neuropsychology, 10, 75-88.

Lopez, S. R., & Taussig, F. M. (1991). Cognitive-intellectual functioning of Spanish-speaking impaired and non-impaired elderly: Implications for cultural sensitive assessment. Psychological Assessment: A Journal of Consulting and Clinical Psychology, 3, 448-454.

Maj, M., D'Elia, L., Satz, P., Janssen, R., Zaudig, M., Uchiyama, C., Starace, F., Galderisi, S., & Chervinsky, A. (1993). Evaluation of two new neuropsychological tests designed to minimize cultural bias in the assessment of HIV-1 seropositive persons: A WHO study. Archives of Clinical Neuropsychology, 8, 123-135.

Maj, M. Janssen, R. A. S., Satz, P., Zaudig, M., Starace, F. Boor, D. Sughondhabirom, B., Bing, E. G., Luabeya, M. K., Ndetei, D., Riedel, R., Schulte, G., Sartorius, N. (1991). WHO cross-cultural study of neuropsychiatric function in HIV-1 infection: Preparation and pilot phase. British Journal of Psychiatry, 159, 351-356.

Manly, J. J., Miller, S. W., Heaton, R. K., Byrd, D., Reilly, J. Velasquez, R. J., Saccuzzo, D. P., Grant, I., and the HIV Neurobehavioral Research Center (HNRC) Group. (1998). The effect of African-American acculturation on neuropsychological test performance in normal and HIV-positive individuals. Journal of International Neuropsychological Society, 4, 291-302.

Marcopoulos, B. A., McLain, C. A., & Giuliano, A. J. (1997). Cognitive impairment or inadequate norms? A study of healthy, rural, older adults with limited education. Journal of Clinical and Experimental Neuropsychology, 112-131.

Matthews, C. G., (1992). Truth in labeling: Are we really an international society? Journal of Clinical and Experimental Neuropsychology, 14, 418-426.

McKinlay, W. W., & Watkiss, A. J. (1999). Cognitive and behavioral effects of brain injury. In M. Rosenthal, E. Griffith, J. Kreutzer, & B. Pentland (Eds.), Rehabilitation of the adult and child with traumatic brain injury (3rd ed., pp. 74-86). Philadelphia, PA: F. A. Davis.

Miller, E. N., Bing, E. G., Selnes, O. A., Wesch, J., & Becker, J. T. (1993). The effects of sociodemographic factors on reaction time and speed of information processing. Journal of Clinical and Experimental Neuropsychology, 15, 66.

Miller, L. S., & Rohling, M. (in press). A statistical interpretive method for neuropsychological test data. Neuropsychological Review.

Miller, R. J. (1973). Cross-cultural research in the perception of pictorial materials. Psychological Bulletin, 80, 135-150.

Myerson, J., Rank, M. R., Raines, F. Q. & Shnitzler, M. A. (1998). Race and cognitive ability: The myth of diminishing returns to education. Psychological Science, 9(2), 139-142.

Nabors, N.A., Evans, J.D., & Strickland, T. L. (2000). Assessment and Intervention with African Americans. In E. Fletcher-Janzen, T. L. Strickland, & C. R. Reynolds (Eds.), Handbook of cross-cultural neuropsychology (pp. 31-42). New York: Kluwer Academic/Plenum Publishers.

Negy, C., & Woods, D. J. (1992). The importance of acculturation in understanding research with Hispanic Americans. Hispanic Journal of Behavioral Sciences, 14, 224-247.

Neisser, U., Boodoo, G., Bouchard, T. J. Jr., Boykin, A. W., Brody, N., Ceci, S. J., Halpern, D. F., Loehlin, J. C., Perloff, R., Sternberg, R. J., Urbina, S. (1996). Intelligence: Knowns and Unknowns. American Psychologist, 51(2), 77-101.

Nobles, W. W. (1972). African philosophy: Foundations for Black psychology. In R. L. Jones (Ed.), Black psychology (pp. 18-32). New York: Harper & Row, Publishers.

Parker, R. S., & Rosenblum, A. (1996). IQ loss and emotional dysfunction after mild head injury in a motor vehicle accident. Journal of Clinical Psychology, 52(1), 32-43.

Parra, E. J., Marcini, A., Akey, J., Martinson, J., Batzer, M. A., Cooper, R., Forrester, T., Allison, D. B., Deka, R., Ferrell, R. E., & Shriver, M. (1998). Estimating African American admixture proportions by use of population-specific alleles. American Journal of Human Genetics, 63, 1839-1851.

Phinney, J. (1990). Ethnic identity in adolescence and adulthood: A review of research. Psychological Bulletin, 108, 499-514.

Plomin, R. (1989). Environment and genes: Determinants of behavior. American Psychologist, 44(2), 105-111.

Ponsford, J. L., Olver, J. H., & Curran, C. (1995). A profile of outcome: 2 years after traumatic brain injury. Brain Injury, 9(1), 1-10.

Putnam, S. H., & Fichtenberg, N. L. (1999). Neuropsychological examination of the patient with traumatic brain injury. In M. Rosenthal, E. Griffith, J. Kreutzer, & B. Pentland (Eds.), Rehabilitation of the adult and child with traumatic brain injury (3rd ed., pp. 147-166). Philadelphia, PA: F. A. Davis.

Rappaport, M., Hall, K., Hopkins, K., Belleza, T. (1982). Disability Rating Scale for severe head trauma: coma to community. Archives of Physical Medicine Rehabilitation, 63, 118-123.

Reed, T. (1969). Caucasian genes in American Negroes. Science, 165, 762-768.

Reeder, K. P., Rosenthal, M., Lichtenberg, P., Wood, M. S. (1996). Impact of age on functional outcome following traumatic brain injury. Journal of Head Trauma Rehabilitation, 11, 22-31.

Reitan, R. M., & Wolfson, D. (1988). Traumatic Brain Injury Volume II: Recovery and Rehabilitation. Tucson, AZ: Neuropsychological Press.

Reitan, R. M., & Wolfson, D. (1993). The Halstead-Reitan Neuropsychological Test Battery: Theory and Clinical Interpretation (2nd ed.). Tucson, AZ: Neuropsychology Press.

Reitan, R. M., & Wolfson, D. (1995). Influence of age and education on neuropsychological test results. The Clinical Neuropsychologist, 9, 151-158.

Reynolds, C. E. (2000). Methods for detecting and evaluating cultural bias in neuropsychological tests. In E. Fletcher-Janzen, T. L. Strickland, & C. R. Reynolds (Eds.), Handbook of cross-cultural neuropsychology (pp. 249-286). New York: Kluwer Academic/Plenum Publishers.

Reynolds, C. R., Chastain, R. L., Kaufman, A. S., & McClean, J. E. (1987). Demographic characteristics and IQ among adults: Analysis of the WAIS-R standardization sample as a function of the stratification variables. Journal of School Psychology, 23, 323-342.

Roberts, R. J., & Hamsher, K. DeS. (1984). Effects of minority status on facial recognition and naming performance. Journal of Clinical Psychology, 40, 539-545.

Rohner, R. P. (1984). Towards a conception of culture for cross-cultural psychology. Journal of Cross-Cultural Psychology, 15, 111-138

Rohling, M. L., Langhinrichsen-Rohling, J., & Miller, L. S. (in press). Actuarial Assessment of Malingering: The RIM. In R. Franklin (Ed.) Prediction in Forensic and Neuropsychology: Psychometrically Sound Methods of Analysis. NJ: Lawrence Erlbaum Associates.

Rosselli, M., Ardila, A & Rosas, C. (1990). Neuropsychological assessment in illiterates II: Language and praxic abilities. Brain and Cognition, 12, 281-296.

Rosenthal, M., Dijkers, M., Harrison-Felix, C., Nabors, N., Witol, A. D., Young, M. E., & Englander, J. S. (1996). Impact of minority status on functional outcome and community integration following traumatic brain injury. Journal of Head Trauma Rehabilitation, 11, 41-58.

Rosenthal, M., & Ricker, J. H. (2000). Traumatic brain injury. In R. Frank & T. Elliott (Eds.), Handbook of rehabilitation psychology (pp. 49-74). Washington, DC: American Psychological Association.

Ross, S. R., Millis, S. R., & Rosenthal, M. (1997). Neuropsychological prediction of psychosocial outcome after traumatic brain injury. Applied Neuropsychology, 4(3), 165-170.

Ruff, R. M., Marshall, L. F., Klauber, M. R., et al., (1990). Alcohol abuse and neurological outcome for the severely head injured. Journal of Head Trauma Rehabilitation, 5(3), 21-31.

Rushton, J. P. (1988). Race differences in behaviour: a review and evolutionary analysis. Personality and Individual Differences, 9, 1009-1024.

Russell, E. W., Neuringer, C., & Goldstein, G. (1970). Assessment of brain damage: A neuropsychological key approach. New York: Wiley-Interscience.

Russell, W. R., & Smith, A. (1961). Post-traumatic amnesia in closed head injury, Archives of Neurology, 5, 4-17.

Sander, A. M., Kreutzer, J. S., Rosenthal, M., Delmonico, R. & Young, M. E. (1996). A multicenter longitudinal investigation of return to work and community integration following traumatic brain injury. Journal of Head Trauma Rehabilitation, 11(5), 70-84.

Sander, A. M., Seel, R. T., Kreutzer, J. S., Hall, K. M., High, M., & Rosenthal, M. (1997). Agreement between person with traumatic brain injury and their relatives regarding psychosocial outcome using the Community Integration Questionnaire. Archives of Physical Medicine and Rehabilitation, 78, 353-357.

Satz, P., Krauskope, D., & Fletcher, J. (1980). Neuropsychological correlates of chronic cannabis use. In W. Carter, W. Coggins, & P. Doughty (Eds.), Chronic cannabis use in Costa Rica. New York: Institute for the Study of Social Issues.

Scarr, S., Pakstis, A. J., Katz, S. H., & Barker, W. B. (1977). Absence of a relationship between degree of White ancestry and intellectual skills within a Black population. Human Genetics, 39, 69-86.

Scarr, S., Weinberg, R. A., & Waldman, I. D. (1993). IQ correlations in transracial adoptive families. Intelligence, 17, 541-555.

Segall, M. H. (1983). On the search for the independent variable in cross-cultural psychology. In S. H. Irvine & J. W. Berry (Eds.), Human assessment and cultural factors (pp. 122-137). New York: Plenum Press.

Segall, M. H. (1986). Culture and behavior: Psychology in global perspective. Annual Review of Psychology, 37, 523-564.

Sherman, E. M. S., Strauss, E., Slick, D. J., Spellacy, F. (2000). Effect of depression on neuropsychological functioning in head injury: Measurable but minimal. Brain Injury, 14(7), 621-632.

Smith, A. (1991). Symbol Digit Modalities Test. Los Angeles: Western Psychological Services.

Spreen, O., & Strauss, E. (1998). A compendium of neuropsychological tests: Administration, norms and commentary (2nd ed.). New York: Oxford University Press.

Stambrook, M., Moore, A. D., Lubusko, A. A., Peters, L. C., & Blumenschein, S. (1993). Alternatives to the Glasgow Coma Scale as a quality of life predictor following traumatic brain injury. Archives of Clinical Neuropsychology, 8(2), 95-103.

Steele, C. M. (1997). A threat in the air: How stereotypes shape intellectual identity and performance. American Psychologist, 52, 613-629.

Stern, Y., Andrews, H., Pittman, J., Sano, M., Tatemichi, T., Alntigua, R., & Mayeux, R. (1992). Diagnosis of dementia in a heterogeneous population: Development of a neuropsychological paradigm-based diagnosis of dementia and quantified correction for the effects of education. Archives of Neurology, 49, 453-460.

Tabachnick, B. G. & Fidell, L. S. (1989). Using multivariate statistics (2nd ed.). New York: HarperCollins Publishers, Inc.

Tang, M. X-., Stern, Y., Marder, K., Bell., K., Gurland, B., Lantigua, R., Andrews, H., Tycko, B., & Mayeux, R. (1998). The APOE-e4 allele and the risk of Alzheimer's disease among African Americans, whites, and Hispanics. Journal of the American Medical Association, 279, 751-755.

Teasdale, G., & Jennett, B. (1974). Assessment of coma and impaired consciousness. Lancet, 2, 81-84.

Teasdale, T. W., Skovdahl, H. H., Gade, A., Christensen, A. L. (1997). Neuropsychological test scores before and after brain-injury rehabilitation in relation to return to employment. Neuropsychological Rehabilitation, 7(1), 23-42.

Tellier, A. (1990). Predicting the psychosocial outcome of traumatic brain-injured adults. Unpublished doctoral dissertation, University of Windsor, Ontario.

Terrell, F., Terrell, S. L., & Taylor, J. (1981). Effects of race of examiner and cultural mistrust on the WAIS performance of Black students. Journal of Consulting and Clinical Psychology, 49, 750-751.

Thomsen, I. V. (1987). Late psychosocial outcome in severe blunt head trauma. Brain Injury, 1(2), 131-143

Unverzagt, F. W., Hall, K. S., Torke, A. M., Rediger, J. D., Mercado, N., Gureje, O., Osuntokun, B. O., Hendrie, H. C. (1996). Effects of age, education, and sex on CERAD neuropsychological test performance in an African American sample. Clinical Neuropsychologist, 10, 180-190.

Vanderploeg, R. D. (1998). Neuropsychological outcomes research: A necessity and an opportunity. Applied Neuropsychology, 5(4), 169-171.

Veiel, H. O. F. (1997). A preliminary profile of neuropsychological deficits associated with major depression. Journal of Clinical and Experimental Neuropsychology, 19(4), 587-603.

Vernon, P. A., Jackson, D. N., & Messick, S. (1988). Cultural influences on patterns of abilities in North America. In S. H. Irvine & J. W. Berry (Eds.), Human abilities in cultural context (pp. 208-231). New York: Cambridge University Press.

Vincent, K. R. (1991). Black/White IQ differences: Does age make the difference? Journal of Clinical Psychology, 46, 266-270.

Vollmer, D. G., Torner, J. C., Jane, J. A., et al. (1991). Age and outcome following traumatic coma: why do older patients fare worse? Journal of Neurosurgery, 75, S37- S49.

Wechsler, D. (1981). Wechsler Adult Intelligence Scale-Revised. New York: The Psychological Corporation.

Wechsler, D. (1987). Wechsler Memory Scale-Revised. San Antonio, Texas: The Psychological Corporation.

Welsh, K. A., Fillenbaum, G., Wilkinson, W., Heyman, A, Mochs, R. C., Stern, Y., Harrel, L., Edland, S. D., & Beekly, D. (1995). Neuropsychological test performance in African American and white patients with Alzheimer's disease. Neurology, 45, 2207-2211.

Willer, B., Rosenthal, M., Kreutzer, J. S., Gordon, W. A., & Rempel, (1993). Assessment of community integration following rehabilitation for traumatic brain injury. Journal of Head Trauma Rehabilitation, 8(2), 75-87.

Williams, R. L. (1972). Abuse and misuses in testing Black children. In R. L. Jones (Ed.), Black Psychology (pp. 77-91). New York: Harper & Row, Publishers.

Willis, M. G. (1989). Learning styles of African-American children: A review of the literature and interventions. Journal of Black Psychology, 16(1), 47-61.

Wilson, J. T. L., Teasdale, G. M., Hadley, D. M., Wiedmann, K. D., & Lang, D. (1994). Post-traumatic amnesia: still a valuable yardstick. Journal of Neurology, Neurosurgery and Psychiatry, 57, 198-201.

Witkin, H., & Berry, J. W. (1975). Psychological differentiation in cross-cultural perspective. Journal of Cross-Cultural Psychology, 6, 4-87.

Witkin, H., A., Dyk, R. B., Paterson, H. F., Goodenough, D. R., Karp, S. (1962). Psychological differentiation. New York: Wiley.

Wong, T. M., Strickland, T. L., Fletcher-Janzen, E., Ardila, A., & Reynolds, C. (2000). Theoretical and practical issues in the neuropsychological assessment and treatment of culturally dissimilar patients. In E. Fletcher-Janzen, T. L. Strickland, & C. R. Reynolds (Eds.), Handbook of Cross-Cultural Neuropsychology (pp. 3-18). New York: Kluwer Academic/Plenum Publishers.

Wyche, K. F. (1996). Conceptualization of social class in African American women: Congruence of client and therapist definitions. In M. Hill & E. D. Rothblum (Eds.), Classism and feminist therapy: Counting costs (pp. 35-43). New York: Haworth Press, Inc.

Yu-Huan, H., Ying-Guan, Q., & Gui-Qing, Z. (1990). Crossed aphasia in Chinese: A clinical survey. Brain and Language, 39, 347-356.

Zafonte, R. D., Mann, N. R., Millis, S. R., Black, K. L., Wood, D. L. Hammond, F. H. (1997). Posttraumatic amnesia: Its relation to functional outcome Archives of Physical Medicine and Rehabilitation, 78, 1103-1106.

Zuckerman, M. (1990). Some dubious premises in research and theory on racial differences: Scientific, social, and ethical issues. American Psychologist, 45, 1297-1303.

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