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Predicting Premorbid Ability in African American Elders using Demographic and Performance Variables

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PREDICTING PREMORBID ABILITY IN AFRICAN AMERICAN ELDERS
USING DEMOGRAPHIC AND PERFORMANCE VARIABLES

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I HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER MY SUPERVISION BY **HAYLEY KRISTINSSON** ENTITLED **PREDICTING PREMORBID ABILITY IN AFRICAN AMERICAN ELDERS USING DEMOGRAPHIC AND PERFORMANCE VARIABLES** BE ACCEPTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PSYCHOLOGY.

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Abstract

Researchers and clinicians require a method of estimating an elderly individual's premorbid ability level in order to determine the amount of cognitive decline that has occurred. This issue has received a great deal of attention within the research literature; however, little attention has been paid to this issue specifically in elderly African American elderly adults. Although researchers have examined the predictive utility of demographic variables, few studies have examined whether including additional demographic variables (i.e., quality of education) improves prediction of premorbid ability. The current sample consisted of 46 African American elderly adults who did not exhibit any cognitive impairment or neurological disorders. Using correlation analysis a number of significant relationships were found between quality and type of education variables and full scale IQ scores. Although, results suggest that including some quality of education variables may slightly improve the ability to predict premorbid ability in African American elders, reading level emerged as the strongest predictor of full-scale IQ. Limitations of the current study and directions for future research are discussed.

Predicting Premorbid Ability in African American Elders Using Demographic

Variables and Performance Variables

Clinical neuropsychological assessment often requires clinicians to make a

comparison between current test performance and some measure of premorbid ability,

particularly when conducting dementia assessments. Significant attention has been paid

to creating objective methods of accomplishing this goal. Clinical judgment, although

useful in some circumstances, is generally considered to be an insufficient method of

estimating premorbid ability. For many years, a popular method was using a single

vocabulary score as an indicator of premorbid intellectual functioning (Lezak, Howieson,

& Loring, 2004). Other methods of estimating premorbid ability include demographic

regression formulae, such as the Barona formula, and the use of scores on

neuropsychological tests. Frequently, word reading ability, as measured by the National

Adult Reading Test (NART; Nelson, 1982), is used as an estimate of premorbid

functioning (Lezak et al., 2004). Although word reading ability does predict premorbid

functioning, this method leaves a significant amount of variance unaccounted for (Lezak

et al., 2004). Thus, researchers began combining demographic formulas with reading

performance in order to predict premorbid ability. Demographic regression formulas,

however, frequently omit several variables (e.g., quality of education variables) that may

be important contributors to the formula.

Including solely years of education into a demographic formula may represent different educational experiences for Caucasian and African American elderly adults. Unequal quality of education may be particularly important for African American elderly adults due to a number of historical issues including segregation (Dotson et al., 2009). These historical factors often resulted in reduced education spending, shorter school years, and higher student-teacher ratios for African American students. Thus, it may be important to include additional quality of education variables into regression formulae, particularly for African American elderly adults. The current study examined whether including quality/type of education variables into regression formulae would predict full-scale IQ above the predictability of cognitive test scores and years of education.

Necessity of Estimating Premorbid Ability

There are a variety of situations in which estimating premorbid ability level is required. Certain diagnoses stipulate that some decline or impairment in cognition be demonstrated. The diagnosis of dementia, for example, requires that a decline in cognitive functioning be present (Franzen, Burgess, & Smith-Seemiller, 1997). In order to determine decline, clinicians must be able to estimate premorbid levels of functioning. As a result of substantial individual differences in cognitive ability, comparing current performance with test norms may be of limited value (Crawford, Millar, & Milne, 2001). Any given test score may be considered normal for one individual and seriously impaired for another. Thus, it is essential to compare current test performance against some individual standard (Lezak et al., 2004). Previous test scores are often not available, so clinicians must find some other method of estimating premorbid performance.

Clinicians often use tests of current cognitive functioning to estimate premorbid ability. These tests have good reliability, are strongly related to IQ within the general population, and are resistant to the effects of both neurological and psychiatric disorders (Crawford et al., 2001). It is, however, questionable whether neuropsychological measures are actually insensitive to the effects of injury, thus clinicians may use demographic variables in addition to or instead of test performance.

The Best Performance Method

For many years, clinicians used the best performance method for estimating premorbid ability. This method was based on observations that elderly adults who showed declining cognitive functioning appeared to retain well-established verbal skills. The best performance method uses the individual's best score or ability on a cognitive test as an indicator of premorbid functioning. Their best performance may be on current testing performance, observable behavior, or premorbid achievements (Lezak et al., 2004). It is generally believed that the highest test score obtained by an individual is a good estimate of premorbid ability and thus becomes the standard against which all other performance is judged.

The best performance method relies on a number of assumptions, including that under relatively normal conditions of development, there is one level of performance that is representative of each person's general cognitive ability (Lezak et al., 2004). Thus, an average individual's scores should group around some hypothetical mean level of performance in the absence of disease or injury. Another related assumption asserts that discrepancies in levels of different cognitive functions provide evidence of disease or

injury that has prevented that individual from performing at his or her optimal level of cognitive functioning. The best performance method also assumes that an individual's cognitive potential can either be enhanced or reduced by external factors and that it is not possible to function at a level higher than is permitted by one's biology (Lezak et al., 2004). For individuals with cognitive impairment, it is believed that the least impaired ability likely represents their premorbid level of functioning.

This method has been useful in predicting premorbid functioning and in taking a variety of factors into account when doing so. A broad range of abilities are considered when evaluating an individual in order to establish which ability best represents premorbid functioning (Lezak et al., 2004). Generally clinicians should not use a single score to predict premorbid functioning unless demographic variables and clinical observations are not available. The estimate should always take into account as much information as possible.

Although useful, this method presents several limitations. Mortenson, Gade, and Reinisch (1991) assert that a general intelligence factor can account for some of the variance in individual performance, but it certainly does not account for all of it. There is often intra-individual scatter within healthy individual test performance. The authors found that the best performance method overestimated premorbid intellectual ability in both healthy adults and adults with cerebral atrophy (Mortenson et al., 1991).

The best performance method has also been criticized based on the psychometric properties of tests. One of the main assumptions of this method is that the tests used are reliable; however, test-retest reliability and the magnitude of the standard error of

measurement add to the scatter that is often seen among individual subtest scores (Franzen et al., 1997). In addition, the error associated with a particular test score is assumed to have a symmetrical distribution and a mean of 0, thus any particular score will be higher than the true score in approximately half of all people (Mortenson et al., 1991). This goes against the assumption that an obtained score is representative of a floor or true level of ability. It has also been pointed out that a reliable difference is not necessarily a meaningful difference, thus a reliable split in scores may not actually be meaningful when evaluating an individual for cognitive decline.

Word Reading Test Performance for Predicting Premorbid Ability

Researchers have used word reading test performance to predict premorbid ability level. Using reading performance is based on four main assumptions: reading is highly correlated with intelligence, reading ability is more resistant to dementia than performance on the WAIS (The Psychological Corporation, 1999) Vocabulary subtest, reading irregular words is more resistant to cognitive deterioration than the reading of regular words, and word reading taps previous knowledge and minimizes the demand on current cognitive capacity (Franzen et al., 1997). This approach follows from the notion that reading test performance is only minimally affected by brain injury when compared to performance on other neuropsychological measures.

It has been suggested that performance on the National Adult Reading Test is a reliable estimate of premorbid ability level (NART; Nelson, 1982; Mortenson et al., 1991). The NART requires individuals to orally read 50 phonetically irregular English words, which vary in their frequency of use (Nelson, 1982). This test essentially provides

an index of vocabulary size. When using the NART to predict WAIS and WAIS-R scores, correlations have ranged from .72 to .89 (Mortenson et al., 1991). Another version of the NART, the North American Adult Reading Test (NAART; Blair & Spreen, 1989) was developed for use with American and Canadian individuals. This test contains 61 words, 35 of which are contained in the original NART. Correlations between the NAART and intelligence scores range from .75 to .83 (Blair & Spreen; 1989). Another version of the NART, the AMNART or the American version of the NART is a 45-word test that appears to be sensitive to semantic deficits in individuals with early Alzheimer-type dementia (Grober & Sliwinski, 1991). Recently, a 50-word version of the NART, the American National Reading Test has been developed and purports to be more appropriate for the ethnically-diverse population in the USA (ANART; Gladsjo, Heaton, et al., 1999). The ANART has been useful in predicting verbal premorbid ability, but does not appear useful in predicting performance abilities (Gladsjo, Heaton, et al., 1999; Strauss, Sherman, & Spreen, 2006). It is assumed that individuals will only be able to pronounce words on the NART if the word was previously in the individual's vocabulary and incorrect responses are believed to demonstrate the limits of an individual's store of vocabulary (Nelson, 1982). NART performance has been linked to IQ scores and it has been suggested that scores on this measure are better predictors of premorbid IQ than scores obtained using demographic equations (Bright, Jaldow, & Kopelman, 2002).

Ryan and Paolo (1992) administered the NART to healthy elderly adults in the United States and created regression equations to predict IQ. They then used the NART scores to predict IQ in elderly adults with various brain impairments. As the researchers expected, NART scores led to an overestimation of IQ in elderly adults with brain

damage. In another study examining NART performance as a predictor of premorbid IQ, Paolo et al. (1997) used both demographic and NART equations to predict WAIS-R IQ scores in healthy adults and adults with suspected Alzheimer's disease (AD). They found that both methods accurately predicted the IQs of the healthy participants and overestimated the IQs of the AD patients. The researchers then divided the AD group into mild, moderately, and severely impaired and found that the severe participants displayed both lower WAIS-R and NART scores, which suggests that the NART is sensitive to the effects of dementia (Paolo et al., 1997). This is an unsurprising finding given the loss of semantic information that is seen in AD. The NART estimates for the mild and moderately impaired participants were larger than the WAIS-R IQs, thus suggesting that the NART should be used with caution with mild and moderately impaired adults as it does appear to overestimate IQ. NART performance has been found to be predictive not only of IQ scores but also of scores on the Rey Auditory Verbal Learning Test (Meyers & Meyers, 1995), the mini-mental state examination (Folstein et al., 2001), the trail making test, semantic fluency measures, the COWA, Raven's matrices, the PASAT, and the Door and People Test (Knight et al., 2006; Lezak, Howieson, & Loring, 2004). Thus, NART performance may be useful in predicting a wide range of test scores.

The Word Reading subtest of the Wide Range Achievement Test-4 (WRAT-4; Wilkinson, 2006) has also been used to estimate premorbid ability. This subtest is similar to the NART and uses more or less frequently appearing English words, but not all of the words are phonetically irregular. Using the word reading subtest of the WRAT-4 to predict premorbid ability has produced similar results as the NART (Mortenson et al., 1991). It has been found that scores on this test are more accurate than the NART in

predicting lower IQ scores, but underestimate average and higher IQ scores even more so than the NART (Strauss et al., 2006). In a study examining the relationship between WRAT-READ and IQ, it was found that performance on this subtest was predictive of performance on the WAIS-R (Kareken, Gur, & Saykin, 1995). These findings are consistent with other research showing that WRAT-READ performance accounts for a significant amount of variance in IQ scores (Mortenson et al., 1991; Orme et al., 2004). In their study, Kareken et al. (1995) found that race and parental education were stronger predictors of IQ than WRAT-READ performance. These results are consistent with finding that the Barona (1984) demographic formula is useful in predicting premorbid IQ.

Researchers have also examined whether performance on other reading measures can be used to predict premorbid functioning. Law and O'Carroll (1998) compared performance on the NART, the Cambridge Contextual Reading Test (CCRT; Beardsall & Huppert, 1994) and the Spot-the-Word Test (STW; Baddeley, Emslie, & Nimmo-Smith, 1993) in both AD patients and healthy controls. The CCRT is a modified version of the NART, in which the stimulus words are placed in a meaningful sentence. The STW is a lexical decision task, in which participants have to indicate from a series of pairs of words which is the word and which is the pseudo word (Law & O'Carroll, 1998). They found that performance on all three measures was relatively unaffected by the presence of cognitive impairments due to AD. Performance on both the NART and the CCRT was related to verbal IQ, as measured by the WAIS-R; however, the relationship between performance on the STW and verbal IQ was extremely low. These results suggest that both NART and CCRT performance may be useful as estimates of premorbid intelligence.

It appears that relationships between word reading test performance and scores on IQ tests are related to education level. Studies examining this relationship often ignore quality of education, which is likely a mitigating factor (Strauss et al., 2006). Overall, using reading measures to predict verbal and full-scale IQ scores results in fairly accurate estimates; however, for people with either extremely high or extremely low IQs, this method may lead to unreliable estimates.

Demographic Variables for Predicting Premorbid Ability

Demographic variables, such as socioeconomic status and level of education, are related to scores on intelligence tests and thus may provide an index of premorbid ability (Mortenson et al., 1991). A major advantage of using demographic variables rather than word reading performance to predict premorbid intelligence is their relative independence from the individual's current neuropsychological status. It has been found that occupational status is the strongest predictor of premorbid IQ when compared to both age and years of education (Crawford & Allan, 1997).

An individual's demographic information is often used informally to estimate their premorbid level of functioning. This has led researchers to question whether using regression equations to estimate premorbid ability is more accurate than informal estimates made by clinicians (Crawford, Millar, & Milne, 2001). In order to investigate this question, Crawford et al. (2001) examined whether clinicians exhibit systematic biases in their estimations of IQ. They found that the relationship between obtained IQ and the regression equation estimate was higher than the relationship between obtained IQ and clinician's estimates. They also found that estimated IQ from the regression

equation was equivalent to obtained IQ; however, the clinician's estimates did differ from obtained IQ. Thus, it appears that regression equations based on demographic information can provide unbiased and useful estimates of premorbid ability.

Barona, Reynolds, and Chastain (1994) created a regression formula using age, sex, race, education, occupation, geographical region, urban-rural residence, and handedness to estimate premorbid ability. They created three formulas, which predicted each of the WAIS-R scores. The authors cautioned that when an individual's premorbid Full Scale IQ was above 120 or below 69, the formula would likely result in either over or under-estimation of premorbid ability. Using the Barona formula, it has been found that IQ tends to be overestimated in healthy individuals, particularly when their IQ is less than 89 (Eppinger, Craig, Adams, & Parsons, 1987). It has also been found that this formula tends to underestimate IQ when it is above 110 (Ryan & Prifitera, 1990).

The first Barona formula (Barona et al., 1984) was based on using regression analysis to predict IQ of the entire WAIS-R standardization sample and the other formula was based on regression analysis using African American and white individuals over 19 years of age from the WAIS-R standardization sample (Barona & Chastain, 1986). Paolo and Ryan (1992) compared both of these formulas and found that the 1984 Barona formula underestimated both VIQ and FSIQ in healthy elderly participants and the Barona 1986 formula underestimated VIQ. For individuals with neurological disease, both formulas resulted in greater predicted IQs than obtained IQs. The authors concluded that the 1984 formula is likely superior to the supposedly improved 1986 formula (Paolo & Ryan, 1992).

Although it is useful to use demographic information to predict premorbid ability, it is often not clear how to use this information to predict a specific IQ score. Actuarial methods have been developed for predicting IQ from demographic information (Franzen et al., 1997). These methods, in addition to the regression formulas that have been developed, are considered superior to clinical judgment and represent an attempt to objectify estimation of premorbid ability.

In addition to examining the predictive ability of education level, researchers have also examined whether achievement test performance can be used to estimate premorbid IQ. These measures are thought to predict academic success and show strong relationships with various measures of intelligence (Baade & Schoenberg, 2004). There has been a great deal of research using the predicted-difference method to predict achievement test scores from IQ scores; however, little attention has been paid to predicting IQ scores from achievement tests (Graves, Carswell, & Snow, 1999). The predicted-difference method involves using the discrepancy between the predicted and actual achievement test scores to determine the probability that the difference occurred by chance. Using existing data, which compares achievement test performance and Wechsler IQ scores, Baade and Schoenberg (2004) found that the predicted-difference method can be used to predict premorbid IQ from achievement test scores. Spinks et al. (2007) also found that school achievement data was predictive of WAIS-III IQ in middle-aged Iowa Adoption Study participants.

Combining Demographic Variables and Test Performance to Predict Premorbid Ability

Efforts to estimate premorbid ability have led to the generation of formulas that combine word reading ability and demographic information. It is generally assumed that combining word reading scores and demographic variables results in a good estimate of premorbid ability (Strauss et al., 2006). Kareken, Gur, and Saykin (1995) used WRAT reading performance to predict WAIS-R IQ in healthy adults and found that including parental education level and race increased the accuracy of prediction.

Vanderploeg and Schinka (1995) examined their BEST-3 method, which combines demographic variables and WAIS-R subtest scores in a regression formula used to predict premorbid IQ. This method includes a decision rule, which involves using the measure with the highest estimate as the predictor. Using brain injured individuals, they found that the Barona and the BEST-3 methods resulted in different IQ values than when the WAIS-R was actually administered; however, the BEST-3 method displayed the stronger relationship to group membership when predicted minus actual IQ discrepancy scores were calculated. This study suggests that using both performance and demographic approaches may be useful in predicting premorbid ability. In a study comparing the BEST-3 method and the Barona approach, it was found that both procedures were equally effective in predicting premorbid ability in elderly adults with diffuse cognitive impairment (Paolo, Ryan, & Troster, 1997).

In an attempt to increase the accuracy of predicting premorbid ability, the Oklahoma Premorbid Intelligence Estimation (OPIE) was created (Strauss et al., 2006).

OPIE includes using Vocabulary and Picture Completion subtest scores from the WAIS-R along with age, education, occupation, and race data. Using these variables, they created formulas for predicting FSIQ, VIQ, and PIQ. The OPIE uses current performance on IQ tests to estimate premorbid IQ and may thus actually be an estimate of current functioning rather than premorbid functioning. This method is also based on the assumption that certain WAIS-R subtests are insensitive to brain injury. This claim is not backed by research, as it has been found that scores on certain subtests are actually susceptible to the effects of neurological injury (Kaufman, 1990). The OPIE also relies on the best performance method, an approach which may ignore regression towards the mean and chance fluctuations in subtest profiles.

Comparing Methods for Estimating Premorbid IQ

As a result of the wide variety of methods available for predicting premorbid IQ, researchers have turned their attention to discovering which method results in the most accurate estimate. Kareken et al. (1995) compared formulas that included parental education level and race with WRAT-READ scores to estimates obtained using the Barona formula. Using healthy adults, they found that the reading and parental education method resulted in a broader range of estimates than did the Barona estimates. Similarly, Griffin et al. (2002) found that the Barona formula was the least useful method of estimating IQ, as it both over and underestimated IQ scores.

Powell, Brossart, and Reynolds (2003) compared the ability of demographic formulas and the OPIE formula in predicting premorbid IQ in brain injured and healthy participants. They found that the demographic information formula was more sensitive to

cognitive decline than the OPIE formula; however, the demographic formula was less

effective than the OPIE in predicting premorbid ability in healthy participants than in

brain injured participants. The OPIE, in contrast, appears to be a good predictor of

premorbid functioning in healthy participants and not in brain injured participants

(Powell et al., 2003).

In a study that compared methods for estimating premorbid IQ, Axelrod,

Vanderploeg, and Schinka (1999) conducted three sets of analyses to compare the

predictive utility of the BEST-3, Barona, and OPIE approaches. Using both healthy and

neurologically impaired patients, they found no difference in ability to distinguish

between patients and controls for all three methods. Thus, it appears that these three

approaches are equally effective methods of premorbid prediction. In another study

comparing methods for estimating premorbid IQ, it was found that the NAART, Barona,

and OPIE formulas all overestimated WAIS-R FSIQ in chronic pain patients and the

WRAT-3 underestimated FSIQ (Griffin et al., 2002). After dividing the sample into three

IQ ranges, they found that the OPIE accurately classified individuals with above average

IQ scores and the WRAT-3 accurately classified individuals with below average

intelligence. The NAART, OPIE, and WRAT-3 provided equal classifications of

individuals who fell in the average IQ range. They also found that the Barona formula

under and over-estimated IQ scores across the IQ continuum (Griffin et al., 2002). These

findings suggest that different estimation methods should be used depending on the

individual's IQ.

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Spinks et al. (2009) wanted to compare IQ proxy measures against WAIS-III scores. They were particularly interested in examining proxy performance at tail ends of the IQ distribution. Participants from the Iowa Adoption Study were administered the NAART, the Shipley Institute of Daily Living Skills (SILS), and the WAIS-III. They also obtained demographic information for each participant in order to complete OPIE and Barona formulas. Spinks et al. (2009) found that the IQ proxy measures performed poorly as estimates of WAIS-III FSIQ at tails ends of the IQ distribution. The OPIE and Barona estimates did not differ from WAIS-III scores for any of the participants. The NAART generally performed quite poorly as an estimate of IQ particularly in individuals with above average IQ scores. This measure is often thought to be a true measure of premorbid ability, but may not be appropriate for use with all individuals. These results suggest that using IQ proxy measures with individuals who have either above or below average IQs may not result in an accurate estimate of premorbid IQ.

Estimating Premorbid Intelligence in Ethnically Diverse Individuals

The vast majority of studies examining prediction of premorbid IQ have been conducted using Caucasian samples. Using prediction methods based on the characteristics of Caucasian participants may make using these formulas with African American individuals problematic (Boekamp, Strauss, & Adams, 1995). It is essential to consider differences in quality of education and other demographic variables between Caucasian and African American individuals when looking at methods of estimating IQ. Researchers have demonstrated differences in quality of education delivered in primarily Caucasian versus primarily African American schools (Constentino, Manly, & Mungas,

2007). Thus, years of education may provide a poor reflection of actual ability. It has been demonstrated that reading ability is a better predictor of IQ performance than years of education (Manly et al., 2005). For example, using years of education for an elderly individual with 6 years of education who is an avid reader will not likely accurately reflect his or her abilities. Similarly, if someone has a high school education but is illiterate, it would be inappropriate to use years of education as an accurate representation of his or her ability (Weinstein & Sachs, 2000).

Test norms are often stratified solely on the basis of age and education, which may lead to poor specificity for non-white individuals. It has been shown that reading performance attenuates racial differences in performance on neuropsychological tests (Manly et al., 2002). Using a sample of elderly African American adults, Johnson, Flicker, and Lichtenberg (2006) examined whether reading ability would be a better predictor of premorbid IQ than years of education. They found that reading ability accounted for a greater amount of variance than years of education in performance on Letter-Number Sequencing, Similarities, COWAT, Trail Making Test, and Colored Progressive Matrices. Thus, more accurate interpretation of norms and ability may be made using reading performance rather than years of education in African American individuals.

Reading scores, which are widely used as estimates of premorbid IQ, are considered representative of educational quality across ethnic groups; however, this has not been directly examined. A number of researchers have demonstrated that African American elderly adults often read at a grade level that is significantly lower than their

total years of education (Dotson et al., 2009). Using Caucasian, African American, and Latino elderly adults, Constentino et al. (2007) examined reading in relation to years of education. They found that reading scores at each particular grade level were lower for ethnic minorities than Caucasian participants. Reading scores increased with years of education regardless of ethnicity, thus suggesting that such scores can be used comparably in multiethnic participants. Dotson et al. (2009) found that literacy, but not years of education, was a significant predictor of performance on a battery of neuropsychological tests. They hypothesized that reading serves as a better predictor of cognitive performance than years of education.

It has also been examined whether the influence of reading ability and education on cognitive performance actually varies as a function of socioeconomic status (SES). It has been demonstrated that SES is related to level of overall cognitive functioning (Dotson et al., 2009). This may be due to the fact that individuals from a higher SES have greater access to high-quality education. Thus the observed discrepancy noted between reading ability and years of education seen in African American elders may actually vary as a function of SES. Dotson et al. (2009) examined this issue in a study using African American and Caucasian elderly adults, who were stratified based on race and SES. They predicted that reading level would be a more accurate predictor of cognitive performance than years of education, particularly for African American and low-SES individuals. Using a battery of cognitive tests, the researchers found that reading scores were a predictor of performance on a number of cognitive tests for both low and high SES African American participants and low SES Caucasian participants. Thus, literacy appears to be a stronger predictor of cognitive functioning in African American elders

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regardless of SES (Dotson et al., 2009). However, they found that their findings varied by SES in the Caucasian group.

The current study focused on determining whether demographic variables versus reading test performance are better predictors of premorbid functioning in African American participants. Particular attention was paid to determining whether more precise information concerning quality of education results in accurate prediction of premorbid ability. Specifically, the following hypotheses were examined: (a) reading test performance will account for a significant amount of variance in cognitive test performance in African American participants (b) quality of education in addition to other demographic variables will account for additional variance in cognitive test performance, above that accounted for by reading ability in African American participants.

Method

Participants

Participants included 46 African American individuals (8 males and 38 females) aged 55 to 83. These participants were recruited for the Allen (2009) study and findings are based on the use of this archival data. The demographic and clinical data for the participants are presented in Table 1. Individuals were recruited primarily through community health centers in and around Dayton, OH. These centers included Cassano's Community Health Center, Charles R. Drew Health Center, St. Leonard's Hospital, and Robert A. Vogel Health Center. Participants with no known neurological impairment were included in the study. Individuals with a previous diagnosis of head trauma, Parkinson's disease, stroke, or primary psychiatric diagnosis were excluded.

Five of the participants were married, 10 were widowed, 26 were separated or divorced, and five were never married. Thirteen participants did not have any type of degree or diploma, 20 had a high school diploma, four had a General Education Degree (GED), two had an associate's degree, four had a Bachelor of Arts or Bachelor of Science degree, one had a master's degree, and one had another type of degree or diploma. Forty-four of the participants attended a public high school, one did not attend high school and one attended another type of high school. In terms of type of curriculum of high school attended, 30 participants attended a general education high school, 10 attended a college

preparation school, 4 went to a vocational school, and one did not attend any type of high school. Twenty-one participants attended college or trade school after high school.

Materials

Wide Range Achievement Test-4 (WRAT-4). The WRAT-4 is used to measure the basic skills of word reading, sentence comprehension, spelling, and math computation. It was standardized on a sample of 3000 individuals aged 5-94 years (Wilkinson, 2006). The WRAT-4 includes four subtests: word reading, sentence comprehension, spelling, and math computation. The word reading subtest is used to measure reading through word and letter recognition. Sentence comprehension examines an individual's ability to understand ideas in sentences. The spelling subtest uses a dictated format to examine an individual's ability to encode sound into written form. Finally, the math computation test measures an individual's ability to complete basic math operations. The WRAT-4 yields individual subtest scores and a reading composite score, which is obtained by combining the word reading and sentence comprehension standard scores (Wilkinson, 2006).

Wechsler Test of Adult Reading (WTAR). The WTAR is thought to be a pre-morbid measure of intellectual functioning for individuals aged 16 to 89 years (The Psychological Corp., 2001). It is a reading test composed of a list of 50 words, which have irregular pronunciations The WTAR was normed with a large sample of US individuals. Clinical validity has been demonstrated with Alzheimer's disease, Huntington's disease, Parkinson's disease, Korsakoff's syndrome and Traumatic Brain Injury. Administration time is less than 10 minutes and involves asking the individual to

read 50 words out loud (The Psychological Corp., 2001). Total score on the WTAR is the number of words read correctly.

Dementia Rating Scale – Second Edition (DRS-2). The DRS-2 measures cognitive status across five subscale domains (Attention, Memory, Conceptualization, Construction, and Initiation/Perseveration; Jurica, Leitten, & Mattis, 2002). The DRS-2 allows for the calculation of age-corrected and education-corrected scores.

Wechsler Abbreviated Scale of Intelligence (WASI). The WASI, a brief measure of intellectual ability, was normed with 2245 individuals aged 6 to 89 years (The Psychological Corp., 1999). This test includes a two and four-subtest format. The four-subtest format results in FSIQ, VIQ, and PIQ scores. The PIQ score includes matrix reasoning for measuring nonverbal fluid ability and reasoning, and block design for measuring visuomotor skills. VIQ is based on vocabulary and similarities, which are both measures of crystallized abilities including general word knowledge and verbal abstract reasoning. The two-subtest form includes vocabulary and matrix reasoning and only yields the FSIQ score. The reliability coefficient for FSIQ is .98, test-retest reliability is .92, and inter-rater reliability is .98 (The Psychological Corp., 1998).

Procedure

The current research used data collected for the Allen (2009) study. Participants in this study completed testing that included measures of cognition, literacy, and adaptive functioning. Testing was conducted over two sessions in order to limit fatigue for participants. Both participants and caregivers were interviewed in order to obtain

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demographic information. All participants filled out a demographic information

questionnaire, which included questions about work, education, and medical history (see

Appendix B).

Design

Statistical Analysis included stepwise multiple regressions, with FSIQ from the

WASI as the dependent variable and quality of education variables, demographic

variables, and cognitive test scores serving as predictors.

Results

Performance on Cognitive Measures

In terms of cognitive performance, average NART estimated VIQ, PIQ, and FSIQ all fell in the average range (M = 90.53, SD = 11.06; M = 101.01, SD = 5.86; M = 94.21, SD = 9.79). The average for WTAR standard score fell in the low average range (M = 85.64, SD = 16.12). Using the Barona formula, estimated VIQ, PIQ, and FSIQ all fell in the average range (M = 93.14, SD = 7. 12; M = 90.57, SD = 5.40; M = 91.93, SD = 7.02). The average Sentence Comprehension, Reading Recognition, and Reading Composite standard scores for the WRAT fell in the low average range (M = 87.09, SD = 13.76; M = 85.80, SD = 13.15; M = 85.14, SD = 12.97). The average WASI estimated FSIQ score fell within the low average range (M = 86.89, SD = 17.73). The average DRS-2 total standard score fell in the average range (M = 8.09, SD = 3.48; M = 7.95, 3.79).

Correlation Analyses

Using Pearson correlation coefficients, initial analyses focused on determining relationships between scores on the various cognitive measures and quality/type of education variables. Elementary school GPA was significantly negatively related to NART, WTAR, WRAT and WASI test scores (r = - .47, r = -.45, r = -.47, r = -.46) respectively. In addition, high school GPA was significantly negatively related to NART,WTAR, Barona, WRAT, and WASI test scores (r = -.40, r = -.37, r = -.44, r = -

.47, *r* = -.47). These findings suggest that as GPA increased, IQ increased (given how GPA was coded)[1]. Quality of high school education was significantly positively related to NART full-scale IQ score (*r* = .31). There was a significant positive relationship between quality of college education and WTAR and Barona scores (*r* = .43, *r* = .47). Years of parental education was positively related to Barona estimated verbal IQ (*r* = .46). Additional Pearson correlation coefficients between quality of education variables and cognitive test performance are presented in Table 3.

In terms of type of education variables, type of degree or diploma was significantly positively related to NART, WTAR, Barona, WRAT, and WASI test scores (*r* =.51, *r* = .50, *r* = .55, *r* = .36, *r* = .47) respectively. There was a significant positive relationship between type of curriculum and NART, WTAR, WRAT, and WASI test scores (*r* =..41, *r* = .42, *r* = .33, *r* = .42). Additional Pearson correlation coefficients using type of education variables and cognitive test performance are presented in Table 4.

Regression Analysis 1

To examine the predictive utility of quality of education variables in accounting for variance in full scale IQ scores, we conducted a stepwise multiple regression analysis. Importantly, this stepwise regression allowed us to determine whether quality of education variables (type of degree or diploma, type of high school, type of curriculum, elementary GPA, high-school GPA, quality of elementary school, quality of high school, and overall quality of education) added to the prediction of life skills functioning above the variance predicted by years of parental education and years of participant education.

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[1] GPA was coded as: 1 = A, 2 = A/B, 3 = B, 4 = B/C, 5 = C, 6 = C/D, 7 = D, 8 = D/F, 9 = F, 10 = N/A

The following predictors were used: years of education, years of mother's education, years of father's education, type of degree or diploma, type of high school, type of curriculum, elementary GPA, high-school GPA, quality of elementary school, quality of high school, and overall quality of education. The dependent variable was WASI full-scale IQ score. Note that additional quality of education variables were excluded from the regression because they were found to be non-contributory and did not meet selection criteria to be included in the regression analysis.

As illustrated in Table 5, the first step of the model, which included high school GPA, accounted for 35.2% of the variance in WASI FSIQ. In the second step of the model, years of education was added into the model and accounted for an additional 12.3% of the variance over the 35.2% explained by high school GPA. The beta coefficient for high school GPA was -.63, which suggests that as full-scale IQ score increased, high school GPA increased (given how GPA was coded, as described previously)[1]. In the second model, the beta coefficient for high school GPA was -.46 and the beta coefficient for years of education was .42. This suggests that as years of education increased, full scale IQ score also increased.

Regression Analysis 2

To examine the extent to which quality of education variables account for a significant amount of variance above that accounted for by cognitive test performance, a second stepwise multiple regression analysis was conducted. The following predictors were used: NART estimated FSIQ, Barona estimated FSIQ, WRAT-4 Reading Recognition score, years of education, years of mother's education, years of father's

education, type of degree or diploma, type of high school, type of curriculum, elementary GPA, high-school GPA, quality of elementary school, quality of high school, and overall quality of education. The dependent variable was again WASI estimated FSIQ. Similar to analysis 1, additional quality of education variables were excluded from the regression because they were found to be non-contributory and did not meet selection criteria to be included in the regression analysis.

As illustrated in Table 6, the first step of the model, which included NART estimated FSIQ, accounted for 71.7% of the variance in WASI FSIQ. In the second step of the model, high school GPA was added into the model and accounted for an additional 10.9% of the variance over the 71.7% explained by NART estimated FSIQ. In the first model, the beta coefficient for NART estimated FSIQ was .87, which suggests that as FSIQ increased, NART estimated FSIQ also increased. In the second model, the beta coefficient for NART estimated FSIQ was .63 and the beta coefficient for high school GPA was -.41. Given how GPA was coded, as described previously, these findings suggest that as both NART estimated FSIQ and high school GPA increased, WASI FSIQ increased.

Discussion

The purpose of the current study was to determine whether the inclusion of quality of education variables would improve the ability to predict full-scale IQ score in African American elderly adults. Results from the correlation analysis revealed that demographic factors, including years of parental education, quality and type of education, and GPA, are related to FSIQ. As expected, scores on cognitive tests are also related to FSIQ.

We hypothesized that quality of education, type of curriculum, and type of education variables would predict full-scale IQ scores above the predictability of cognitive test performance and years of education. It appears that the variance attributed to high school GPA is distinct from that ascribed to cognitive test performance and extends beyond the variance that is attributed to years of education. High school GPA, along with years of education and cognitive test performance, predicts full-scale IQ score. However, it appears that cognitive test performance, specifically word reading ability is the strongest predictor of full-scale IQ score in elderly African American adults, which is consistent with the finding that reading is a better predictor of cognitive performance because it is a better measure of quality of education (Manly, 2002). This finding may also be influenced by economic factors within the current sample that were not examined, which have found to be related to reading level regardless of race or ethnicity

(Consentino, Manly, & Mungas, 2007). In addition, it has been shown that reading scores increase with years of education regardless of ethnicity or language (Consentino, Manly, & Mungas, 2007).

Limitations

The current findings should be considered in light of certain limitations, including the limited sample size, which may have impacted the regression analysis. Based on this sample, the maximum number of predictor variables should have been four; however up to 13 variables were entered into the regression analysis. In general, unless a predictor is adding a considerable amount of explained variance, its inclusion will decrease the F value and decrease the likelihood of obtaining a significant relationship (Cohen, 2008). A Bonferroni adjustment may have been useful, based on the number of predictors at each step. There also may have been multicollinearity of variables within the sample, which was not detected. When there are many predictors, it possible for multicollinearity to occur even when no pair of variables is high correlated (Cohen, 2008). This can occur when one predictor is predicted by a combination of other predictors.

A standardized rating of school quality was not used, which may have led to either over or under-estimations of quality. Participants and their family members were simply asked to rate their perceived quality of education on a scale from 1-10, with 1 representing very poor quality of education and 10 representing excellent quality of education. It is plausible that participants either did not remember or did not remember accurately the quality of their educational experiences. The current findings are also

likely influenced by the error apt to be introduced by using self-report ratings. In addition, the education levels were compressed, which may limit findings.

One of the methods the current study used to estimate full-scale IQ was reading test scores. It is unknown whether these scores actually represent a wide range of educational experiences in African American elderly adults (Manly, Consentino, & Mungas, 2007). Economic factors, such as higher student-teacher ratios, access to health care and community resources, and exposure to educational experiences within the home have all been found to be related to reading achievement. Thus, reading scores in the current study may not actually reflect educational attainment, but rather variations in socioeconomic status (SES), which was not examined in the current study.

The current study may also lack broad generalization. Indeed, African American elderly individuals with no known neurological impairment were sampled. These individuals, however, are all living in Dayton, Ohio and many of them live in residential care facilities, where their activities are likely limited. Consequently, they may not be representative of the general population of elderly African American adults. It is possible that supplementary and/or divergent relationships may be found if sampling is extended to other groups of African American elderly adults living in other regions of the country.

Future Directions

Future research examining predicting premorbid ability level in African American elders will likely need to further examine issues related to SES. As mentioned previously, reading ability has been shown to be a better predictor of cognitive test performance than

years of education because it is a better index of quality of education (Manly, 2002).

Factors related to SES, such as teaching method, special facilities and resources, and per

student expenditure, have a large impact of quality of education, but not years of

education. Thus low SES, regardless of race, may be related to educational quality. This

is a particularly important issue in African American elderly adults, whose educational

opportunities have been impacted by historical factors, such as segregation (Dotson et al.,

2009). Future studies should examine this issue by stratifying samples not only by race,

but also by SES.

Future studies would benefit from less reliance on self-report. It would be

interesting to reproduce the current study using standardized ratings of school quality. In

addition, more accurate and standardized ratings of GPA should be used.

Clinical Implications

As our population becomes increasingly diverse, it is essential that we develop

methods for conducting culturally competent assessment, an issue that is particularly

salient in dementia assessment. Although race itself is likely not a causative factor in the

development of dementia, biological vulnerabilities may place certain minority groups at

particular risk of showing cognitive decline due to some type of dementia. For example,

there is a higher incidence of hypertension in African American individuals (Weinstein &

Sachs, 2000). This places these individuals at an increased risk of developing cognitive

problems due to vascular disease, such as vascular dementia. In addition, severe and

persistent social stress associated with being from a non-majority culture can have

neurotoxic effects (Weinstein & Sachs, 2000). For example, stress can lead to atrophy of

neurons in the hippocampus, which impacts memory functioning. Thus, it is essential that clinicians use an accurate method of estimating premorbid ability level in order to determine the amount and severity of cognitive decline that has occurred.

Current methods of estimating premorbid ability assume that Caucasian and minority elderly adults have had similar educational experiences. Due to factors such as segregation, many elderly African American individuals were not provided with equal educational experiences. Thus, assuming that 12 years of education represents equal experiences for Caucasian and African American elderly individuals is likely inaccurate. This faulty assumption may lead clinicians to over or under estimate the amount of cognitive decline that has occurred for an elderly African American adult. Consequently, clinicians may need to examine additional educational variables related to quality of education when working with African American elders. The current study represents an attempt to examine these unique educational experiences and their impact on cognitive functioning.

Although the results of this study suggest that reading test performance may account for the greatest amount of variability in IQ scores, it is still necessary to continue to examine quality of education variables. Cognitive impairment in minority elderly adults often goes unrecognized because they seek services on a less frequent basis and treatment providers often make assumptions that are based on their knowledge of the majority culture (Weinstein & Sachs, 2000). Although researchers have begun to examine how differences in educational experiences impact the assessment of cognitive decline, it will be important to identify the specific ways in which these experiences

relate to current cognitive test performance. Literacy measures appear to better reflect educational experiences than simply years of education. Therefore, neuropsychological tests scores adjusted for reading level may be able to predict premorbid ability more accurately than if only years of education are used. This approach also helps guard against the assumption that everyone receives the same amount of learning from a particular grade level. In this way, reading level more accurately reflects the quality of education that an individual has received. In summary, it is essential that we find accurate and meaningful methods for examining premorbid experiences in non-majority elderly individuals. Working towards this goal will help clinicians working with elderly adults develop culturally sensitive methods of assessment, treatment, diagnosis, and research.

Appendix A

Table A1

Demographic Data

Variable	N	Mean (SD)	Range	Minimum	Maximum
Age (years)	46	64.96(6.75)	55-83	55	83
Years of Education	46	11.87(2.24)	7-18	7	18
Elementary GPA	46	3.39(1.63)*	1-10	1	10
High School GPA	46	3.76(1.71)*	1-10	1	10
Grad School GPA	46	9.65(1.64)*	2-10	2	10
College GPA	46	8.34(2.89)	2-10	2	10
Mom Schooling Years	27	9.62(3.47)	0-16	0	16
Dad Schooling Years	22	8.95(3.83)	0-16	0	16

Note. *GPA was coded as: 1 = A, 2 = A/B, 3 = B, 4 = B/C, 5 = C, 6 = C/D, 7 = D, 8 = D/F, 9 = F, 10 = N/A

Table A2

Cognitive Tests

Test Name	Subtests	Ability Measured
Wechsler Test of Adult Reading (WTAR)	Reading test composed of 50 words	Reading level; often used as an estimate of premorbid intellectual functioning
Wide Range Achievement Test – Fourth Edition (WRAT – 4)	Word Reading, Sentence Comprehension, Spelling, Math Computation	Achievement Level; Word Reading score is often used as an estimate of premorbid intellectual functioning
Wechsler Abbreviated Scale of Intelligence (WASI)	Matrix Reasoning, Block Design, Vocabulary, Similarities	Brief measure of intellectual functioning; Matrix Reasoning and Block Designs yields PIQ; Vocabulary and Similarities yields VIQ; 2-subtest form uses Vocabulary and Matrix Reasoning to calculate FSIQ; 4-subtest format uses all 4 subtests to calculate FSIQ
Dementia Rating Scale – Second Edition (DRS – 2)	Attention, Memory, Conceptualization, Construction, Initiation/Perseveration	Cognitive status/amount of cognitive decline

Table A3

Correlations among Cognitive Test Scores and Quality of Education Variables

	Years of education	Elementary GPA	High School GPA	College GPA	Grad School GPA	Quality of elementary Education	Quality of High School Education	Quality of College Education	Mom Schooling Years	Dad Schooling Years
NART estimated VIQ	.580**	-.472**	-.401**	-.395**	-.428**	.201	.308*	.347	.272	.329
NART estimated PIQ	.571**	-.441**	-.408**	-.378*	-.395**	.212	.343*	.296	.272	.329
NART estimated FSIQ	.583**	-.472**	-.404**	-.386**	-.427**	.204	.314*	.337	.272	.329
WTAR Standard Score	.532**	-.449**	-.371*	-.315*	-.377*	.197	.242	.433*	.291	.421
Barona estimated VIQ	.885**	-.221	-.442**	-.652**	-.442**	.103	.294	.485*	.285	.462*
Barona estimated PIQ	.901**	-.203	-.430**	-.592**	-.459**	.116	.281	.425*	.277	.371
	.896**	-.203	-	-.643**	-	.087	.285	.468*	.294	.457*

Barona estimated FSIQ			.440**		.448**					
WRAT reading composite standard score	.468**	-.466*	-.381*	-.253	-.313*	.228	.175	.327	.236	.374
WRAT Sentence Comprehension standard score	.410**	-.413**	-.288	-.220	-.263	.195	.105	.373	.194	.346
WRAT Reading Recognition standard score	.478**	-.412**	-.372*	-.266	-.318*	.223	.267	.277	.266	.335
WASI Vocabulary T score	.513**	-.458**	-.400**	-.450**	-.341*	.042	.203	.198	.374	.395
WASI Matrices T score	.487**	-.356*	-.413**	-.396**	-.356*	.127	.101	.191	.194	.207
WASI estimated FSIQ	.564**	-.459**	-.467**	-.462**	-.395**	.070	.152	.193	.292	.297

Note. **p < .01
*p < .

Table A4

Correlations among Cognitive Test Scores and Type of Education Variables

	Type of High School Attended	Type of Degree or Diploma	Type of Curriculum
NART estimated VIQ	-.002	.506**	.411**
NART estimated PIQ	.000	.496**	.393**
NART estimated FSIQ	.001	.512**	.414**
WTAR Standard Score	.041	.497**	.422**
Barona estimated VIQ	-.195	.561**	.202
Barona estimated PIQ	-.175	.528**	.232
Barona estimated FSIQ	-.188	.545**	.207
WRAT reading composite standard score	-.050	.359*	.300
WRAT Sentence Comprehension standard score	-.051	.294	.243
WRAT Reading Recognition standard score	-.032	.385**	.327*

WASI Vocabulary T score	.076	.454**	.431**
WASI Matrices T score	-.056	.425**	.366*
WASI estimated FSIQ	-.007	.472**	.419**

Note. **p < .01
*p < .05

Table A5

Stepwise Regression using Quality of Education Variables to Predict WASI FSIQ

Model	Variables	b^*	$SE\ b$	R^2
1	High School GPA	-.63*	5.02	.35*
2	High School GPA	-.46*	4.99	.48*
	Years of Education	.42*	2.82	

Note. p < .05

Table A6

Stepwise Regression Using Quality of Education Variables and Cognitive Test Performance to Predict WASI FSIQ

Model	Variables	$b*$	$SE\ b$	R^2
1	NART Estimated FSIQ	.87*	.29	.72*
2	NART Estimated FSIQ	.63*	.27	.83*
	High School GPA	-.41*	2.25	

Note. p < .05

Demographic Questionnaire

A. Demographic/Medical
1. Name: _____
2. Telephone contact: (_____) _____ - _____
3. Street Address _____
4. What is your date of birth? _____/_____/_____   Age: _____
5. Gender: _____ male _____ female
6. Marital Status: _____ married _____ widowed _____ separated/divorced _____ never married
7. Are you Hispanic or Latino/Latina: yes _____   no _____
8. What racial/ethnocultural group best represents you:
    _____ American Indian/Alaskan Native
    _____ Asian
    _____ Native Hawaiian/Pacific Islander
    _____ Black/African American
    _____ White
    _____ Other
    _____ More than one race/ethnicity (list): _____ _____ _____
9. Is English your primary language? yes _____   no _____ (specify _____)
10. Do you have any known brain/neurological disorder? yes _____   no _____
    If yes, explain: _____
    _____
11. Have you every been diagnosed with:
    _____ dementia (specify type _____ (date ___/___/___)
    _____ seizure disorder   date ___/___/___   age _____
    _____ traumatic brain injury   date ___/___/___   age _____
    _____ attention deficit disorder date ___/___/___   age _____
    _____ stroke/CVA   date ___/___/___   age _____
    _____ other _____ (date: ___/___/___)
12. Do you have any known:
    _____ visual impairment
    _____ hearing impairment
    _____ motor/physical (arm, leg, etc.) impairment

B. Education
13. How many grades or years of education did you complete?: _____
    What is the highest diploma or degree that you earned?
    _____ none   _____ High School Diploma   _____ G.E.D.   _____ Associate's degree
    _____ Bachelor's of Arts/Science   _____ Masters degree
    _____ Professional degree (M.D.,J.D., etc.)   _____ Doctoral Degree (Ph.D.)
    _____ Other (specify) _____
14. What type of high school did you attend?:
    _____ Public H.S.
    _____ Parochial H.S.
    _____ Private H.S.
    _____ Other (specify) _____
    _____ N/A: No High school

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