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Pepperdine University  
Graduate School of Education and Psychology

INITIAL CONSTRUCT VALIDATION OF THE COLOR FIGURE MAZES TEST

A clinical dissertation submitted in partial satisfaction  
of the requirements for the degree of  
Doctor of Psychology

by

Kimberly Lee Smith

October, 2012

Shelly Harrell, Ph.D. – Dissertation Chairperson

This clinical dissertation, written by

Kimberly Lee Smith

under the guidance of a Faculty Committee and approved by its members, has been submitted to and accepted by the Graduate Faculty in partial fulfillment of the requirements for the degree of

DOCTOR OF PSYCHOLOGY

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## DEDICATION

This dissertation is dedicated to the three people who have made my life worth living—My husband, Big Fred, and my babies, Little Fred, and London. You are my sun, moon and stars. Thank you for loving me and walking beside me through this life goal. Big Fred, I am truly blessed to have a husband who supports my dreams and uplifts me in all of my endeavors. Thank you for loving me and taking care of me; now it is my turn to take care of you. Fred and London, you are my greatest gifts to the world! Seeing each of your beautiful faces and feeling your hugs after a long day is what life is all about. I love my family deeply and endlessly. I am, because you are.



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Mona, L.R., & Smith, K. (in press). Sexuality and Disability. Psychologists Desk Reference, 3<sup>rd</sup> Edition.

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## ABSTRACT

Measurement of cognitive abilities across diverse ethnocultural and racial groups has a contentious history, with broad politico-legal, economic, and ethical impact. There is an abundance of literature on attention, concentration, and executive functioning. However, specific literature pertaining to traditionally under-served populations, linguistic minorities and those with low education and literacy levels are limited. This study reports data gathered in an attempt to validate a Spanish language instrument of frontal lobe functioning, called the Color Figure Mazes Test, on monolingual Spanish speaking male day laborers. The instrument was originally developed by the World Health Organization (WHO) and the University of California, Los Angeles (UCLA) to study neurocognitive disorders cross-culturally. Correlations were run to assess convergent and divergent validity of intellectual, achievement, and neuropsychological measures with each of the six subtests of the CFM. Additionally, an independent sample t-test was run to assess performance on the CFM test based upon level of education (0-6 years and 7-10 years). Results indicated all subtests of the CFM significantly correlated with education. Additionally, CFM had significantly convergent validity with measures of attention, nonverbal reasoning, motor skills, complex nonverbal reasoning, verbal memory, executive functioning and working memory. The CFM had significant divergent validity with verbal reasoning, verbal fluency, and visual memory. Results will serve to bridge the gap between research and clinical practice for underserved and under-represented populations globally.

## Introduction

Clinical neuropsychology is not exempt from the concerns related to ethnocultural diversity that exists in the broader field of professional psychology. As the U.S. is becoming increasingly global and diverse, clinical neuropsychologists are routinely asked to assess individuals from backgrounds that are traditionally underserved and under-represented. Such individuals represent a breadth of ethnocultural and linguistic diversity that still poses unique challenges for the field (Ardila, Rosselli, & Rosas, 1989; Pérez-Arce, 1999). However, as the field of clinical neuropsychology develops, practitioners are increasingly acknowledging numerous factors not directly related to brain functioning may influence individual's performance on neuropsychological tests.

Some of these factors include effort (Tombaugh, 1996), fatigue (van der Liden, Frese, & Meijman, 2003), and pain (Grigsby, Rosenberg, & Busenbark, 1995). It should be noted cultural experience is a significant correlate of performance on neuropsychological tests (Brickman, Cabo, & Manly, 2006). However, there remains continuous debate surrounding the presence of cultural influences and the appropriate use of eurocentrically developed assessment measures with traditionally underserved and under-represented groups continues (Armour-Thomas, 2003; Neisser et al., 1996; Suzuki, Meller, & Ponterotto, 1996; Suzuki & Valencia, 1997; Valencia & Suzuki, 2001). Consequently, the need for further research on the role of cultural influence in testing and the development of more culture-fair assessment tools persists (Suzuki & Valencia, 1997; Valencia & Suzuki, 2001). As testing outcomes from neuropsychological measures can

potentially impact educational, career, and social paths valid assessment with diverse populations requires tools that are least influenced by cultural elements (Verney, Granholm, Marshall, Malcarne, & Saccuzzo, 2005). The Color Figure Mazes Test attempts to fill this gap.

Although translated batteries are administered to non-English speakers under the assumption the battery has the same meaning across language groups, research has indicated that test scores often result in the over diagnosis of cognitive disorders in non-English speakers (Colzato, Bajo, van den Wildenberg, & Paolieri, 2008; Siedlecki, et al., 2010). This problem is particularly true among elderly Spanish-speaking Latinos, who are a growing demographic group in the United States (Ardila, Rosselli, & Ostrosky, 1992). Even on measures of gross cognitive functioning, such as a translated version of the Folstein Mini-Mental State Exam (MMSE), monolingual Spanish-speaking subjects are more likely to be categorized as impaired, despite a clinical evaluation within normal limits (Bird, Canino, Stipeck, & Shrout, 1987).

### **Focus of the Proposed Study**

The impetus for the proposed study is rooted in the increasing ethnocultural diversity in the U.S. integrated with clinical neuropsychology's struggle to provide culturally responsive, relevant, and ethical assessment to traditionally underserved and under-represented populations. In particular, literacy is significantly associated with virtually all neuropsychological measures, even though the correlation between education and neuropsychological test scores depends on the specific test. The influence of literacy is reflected in

different domains of cognitive functioning. Learning to read reinforces and modifies certain fundamental abilities, such as verbal and visual memory, phonological awareness, and visuospatial and visuomotor skills. Functional imaging studies are now demonstrating that literacy and education influence the pathways used by the brain for problem solving. The existence of partially specific neuronal networks as a probable consequence of the literacy level supports the hypothesis that education impacts not only the individual's day-to-day strategies, but also the brain networks.

Accordingly, this study will analyze data gathered from a larger investigation to inform the validation of a Spanish language instrument of attention, concentration and executive functioning called the Color Figure Mazes Test on monolingual Spanish speakers. This study not only has relevance for monolingual Spanish speakers, but also for individuals who are illiterate and/or have low educational attainment.

### **Research Questions and Hypotheses**

Question 1. What is the correlation between the Color Figure Mazes (CFM) Test and select subtests of the WAIS-III, Color Trails 1 and 2, the Stroop Test, the Woodcock Johnson Test, Verbal Fluency Test, Rey Osterrieth Test, and Wisconsin Card Sorting Test?

Hypothesis 1a. It is expected the CFM Test will significantly correlate with select subtests of the WAIS-III.

Hypothesis 1b. It is expected the CFM Test will significantly correlate with Color Trails 1 and 2.

Hypothesis 1c. It is expected the CFM Test will significantly correlate with the Stroop Test.

Hypothesis 1d. It is expected the CFM Test will significantly correlate with the Woodcock Johnson Test.

Hypothesis 1e. It is expected the CFM Test will significantly correlated with the Verbal Fluency Test.

Hypothesis 1f. It is expected the CFM Test will significantly correlate with the Rey Osterrieth Test.

Hypothesis 1g. It is expected the CFM Test will significantly correlate with the Wisconsin Card Sorting Test.

Hypothesis 1h. It is expected that the CFM Test will not significantly correlate with the Beck Depression Inventory.

Hypothesis 1i. It is expected that the CFM Test will not significantly correlate with the Beck Anxiety Inventory.

Question 2. Will individuals' performance on the CFM and CPT differ according to level of education?

Hypothesis 2a. It is expected that individuals with 7-10 years of education will perform higher than individuals with 0-6 years of education on the CFM Test.

### **Definition of Key Terms**

*Attention:* Attention is a cognitive process that refers to the various ways an individual becomes receptive to stimuli and begins processing incoming data.

*Concentration:* Focused or selective attention sustained over time.



*Culture Fair:* Designed to be free of cultural bias, as best as possible, so no one culture has an advantage over another. Also, culture fair tests are not meant to be influenced by verbal ability, cultural climate, or education attainment.

*Executive (frontal lobe) Functioning:* Higher ordered mental functions that include planning, reasoning, judgment, impulse control, memory and motor functioning.

*Latino:* Americans with origins in the Hispanic countries of Latin America or Spain, and in general all persons in the United States who self identify as Hispanic or Latino.

*Standardization:* To be defined as a “test”, an instrument must be “standardized”, which means that a procedure for administering and scoring the test needs to be specified.

*Validity:* The accuracy and/or appropriateness of interpretations assigned to tests scores and the uses made of test scores.

*Construct Validity:* The ability of a test to identify or assess the variables or constructs in a measure. The decision is based on a pattern of correlations with instruments that theoretically would be expected to correlate (convergent validity), and not correlate (discriminant validity) with the target measure.

## **Method**

The current study focuses on validation of the Color Figure Mazes (CFM) instrument that was originally developed by the World Health Organization (WHO) and the University of California, Los Angeles (UCLA) to study neurocognitive disorders cross-culturally. The data for this study was accessed

from a larger investigation of the neuropsychological functioning of Latino, monolingual Spanish speaking, male day laborers in the greater Los Angeles area and Guadalajara, Mexico. The original study was developed to (a) gather additional comprehensive normative data for the monolingual Spanish-speaking Latino population on standard cognitive test batteries and (b) assess the test performance of monolingual Spanish-speaking groups in order to learn about the similarities and differences in test performance, and learn about factors that may contribute to these results.

The two hypotheses tested with the original study were as follows: (a) it was hypothesized the norms obtained for the neuropsychological test performance of the monolingual Spanish-speaking Latino group would differ most significantly than the bilingual group for the language based tests relative to the other cognitive domains; and (b) it was hypothesized that acculturation, education, and language factors would account for a significant portion of the variation in neuropsychological test scores between the bilingual and monolingual Spanish-speaking groups. The study utilized the same cross-sectional non-experimental design approach as the larger study.

### **Subjects**

The overall *N* for study participants was 115. The all male sample was comprised of individuals whose ages ranged from 18 (71%) to 49 (44%), with a mean age of 28 as outlined in Table 1 and Table 2. Over 99% (*N*=114) identified Spanish as their primary language and 1% (*N*=1) identified English as their primary language. Their country of origin included Mexico (81.7%, *N*=94),

El Salvador (.9%,  $N=1$ ), Honduras (8.7%,  $N=10$ ), The United States (1.7%,  $N=2$ ), Guatemala (5.2%,  $N=6$ ), Venezuela (.9%,  $N=1$ ), and Cuba (.9%,  $N=1$ ). Table 3 outlines the participant's country of origin. Additionally, participant's level of education ranged from 0-10 years. Specifically, 48.7% ( $N=56$ ) reported having 0-6 years of education and 51.3% ( $N=7-10$ ) reported having 7-10 years of education. In terms of their primary language, 99% ( $N=114$ ) reported Spanish as their primary language and 1% ( $N=1$ ) indicated English as a primary language. Ninety percent ( $N=104$ ) of the participants indicated they did not speak another language at all besides Spanish, while 3.5% ( $N=4$ ) reported speaking one other language. Thus, the sample can be described as predominantly monolingual Spanish-speaking. The participants reported their level of English fluency as follows: 41.7% ( $N=48$ ) reported speaking "very little" English, 6.1% ( $N=7$ ) reported "yes" as having English language fluency, and 52.2% ( $N=60$ ) indicated "no" to English language fluency.

## **Procedures**

Institutional Review Board approval was obtained from California State University, Northridge. Participants were recruited from churches and by way of Spanish language newspapers. Principal Investigators extensively trained graduate and undergraduate student to administer the measures. Once informed consent was obtained and participants were described the nature of the testing, participants were explained that the tests range in difficulty, which served to reduce test anxiety. Participants were also given the option of speaking directly to the project investigators if they wished to discuss issues related to anxiety

and/or desired a referral for treatment. Given that participants could possibly be contacted in the future to clarify information provided during testing or to be invited to participate in future projects, participants were not anonymous. Of note, the actual test scores were entered into the database in an anonymous fashion using identification numbers.

Participants were administered a three hour neuropsychological battery and an acculturation questionnaire. Participants were instructed to do the best they could on the testing. To avoid fatigue due to lengthy testing, participants were offered frequent breaks. All evaluations took place on a one-to-one basis. The measures were selected to assess specific cognitive domain such as overall intellectual ability, memory, attention, concentration, abstract reasoning, visual-spatial ability, information processing speed, language, and motivational/effort/emotional measures. Four of the measures were experimental cognitive measures. Of note, the following were administered to participants in the original study and are grouped according to domain assessed as outlined in Table 4.

### **Instruments**

For the current study, the variables included the six subtests of the Color Figure Mazes test (CFM A, B, C, and 1, 2, 3), including select subtests of the WAIS-III (Picture Completion, Vocabulary, Digit Symbol Coding, Block Design, Similarities, Arithmetic, Matrix Reasoning, Digit Span, Information, Comprehension, Symbol Search, and Letter-Number Sequencing), Color Trails 1 and 2, the Stroop Tests, the Wisconsin Card Sorting Test, the Beck Depression

Inventory-II, the Beck Anxiety Inventory, the verbal fluency test (PMR and Animals), and the Rey Osterrieth Test.

**Color Figure Mazes Test (A, B, C, 1, 2, 3).** The Color Figures Mazes Test, also referred to as the CFM (D'Elia, Satz, & Lopez, 2002) is a nonverbal measure of attention, concentration, working memory and executive functioning that is a combination of the Stroop Test and the Color Trails 1 and 2 tests. It requires respondents to respond to progressively difficult non-verbal tasks that measure immediate attention, concentration and the ability to consciously inhibit over-learned responses. There is also a working memory component, as participants must remember and accurately execute provided instructions.

**Wechsler Adult Intelligence Scale-III.** The WAIS III (Wechsler, 1997) is an intelligence test for adults from ages 16-90 years. Four index scores representing various domains of intelligence are generated: Verbal Comprehension Index (VCI), Perceptual Reasoning Index (PRI), Working Memory Index (WMI) and Processing Speed Index (PSI). Additionally, two scores are generated that serve to summarize overall intellectual abilities: Full Scale IQ (FSIQ), which combines performance of the VCI, PRI, WMI, and PSI; and General Ability Index (GAI), primarily comprised of the six subtest, VCI and PRI. Each Index is comprised of subtests as follows: the Verbal Comprehension Index includes Similarities, Vocabulary, Information, and Comprehension (Supplemental subtest); the Perceptual Reasoning Index includes Block Design, Matrix Reasoning, Visual Puzzles, Picture Completion (Supplemental Subtest) and Figure Weights (Supplemental Subtest); the Working Memory Index includes

Digit Span, Arithmetic, and Letter-Number Sequencing (Supplemental Subtest); and the Processing Speed Index includes Symbol Search, Coding, and Cancellation (Supplemental Subtest).

**Color Trails Test 1 and 2.** The Color Trails Test (D'Elia, Satz, Uchiyama, & White, 1996) is often described as a culture-fair measure of visual attention, graphomotor speed and sequencing, as well as executive functioning as compared to the TMT (Dugbartey, Townes, & Mahurin, 2000; Tombaugh, 2004). Familiarity of the Arabic numeral and the English alphabet is mandatory for examinees, therefore individuals unable to count and whose written language does not include the English alphabet are precluded from taking the test. There are two parts to the CTT called Color Trails 1 and 2 (CT1, CT2).

In CT1 examinees are provided a page with scattered numbered circles from 1 to 25, with even-numbered circles colored yellow and odd-numbered circles colored a vivid pink. The examinee is required to connect the numbers as quickly as they can. During CT2, examinees are again provided a page with scattered numbered circles from 1 to 25 twice, with one sequence in yellow and the other in pink. The examinee is required to connect the numbered circles from 1 to 25 alternating between pink and yellow circles, while disregarding the numbers in circles of the alternate color. Limitations of the CTT include susceptibility to practice effects (Lezak, 1982).

**Stroop A, B, C.** The Stroop Color and Word Test (Stroop, 1935) is based on the observation that individuals can read words with greater speed than they can identify and name colors. The cognitive dimension tapped by the Stroop is

associated with cognitive flexibility, resistance to interference from outside stimuli, creativity, and psychopathology-- all of which influence the individual's ability to cope with cognitive stress and process complex input. The Stroop can be used as a screener or as part of a general battery, as it is quick and easy to administer. Further the Stroop's validity, and reliability make it a highly useful instrument.

The Stroop Color and Word Test consists of a Word Page (Part A) with the name of color words printed in black ink, a Color Page with 'Xs' printed in color, and a Color-Word Page with words from the first page printed in colors from the second page (the color and the word do not match). The examinee looks at each sheet and moves down the columns, reading words or naming the ink colors as quickly as possible. The test yields three scores based on the number of items completed on each of the three stimulus sheets. In addition, an Interference score, which is useful in determining the individual's cognitive flexibility, creativity, and reaction to cognitive pressure, can also be calculated.

**Woodcock-Johnson (Picture Vocabulary).** The Woodcock-Johnson Test-Third Edition is an intelligence test first developed in 1977 by Woodcock and Johnson. It was revised in 1989 and again in 2001; this last version is commonly referred to as WJ-III. They may be administered to children from age two to adults in their 90s. The WJ-III is covers a wide variety of cognitive skills including oral expression, Listening Comprehension, Written Expression, Basic Reading Skills, Mathematics Calculation Skills and Math Reasoning. The Picture Memory subtest measures language ability and visual memory.

**Verbal Fluency (P, M, R, and Verbal Fluency).** The Verbal Fluency subtest assesses a person's ability to make verbal associations to specified letters (e.g., P, M, and R). It is a useful component of a neuropsychological battery as it is able to detect changes in word association fluency often found in various disorders. This measure involves asking an individual to name as many letters they can think of that begin with a specific letter for one minute. The animal naming portion asks the individual to name a list of animals in one minute.

**Rey-Osterrieth Complex Figure Test.** This is a commonly used neuropsychological measure for assessing visuospatial perception and memory, executive function, and graphomotor skills. The patient is presented with a copy of the ROCF and is instructed to copy the figure to the best of their ability. Then, depending on the administration method used, the patient is presented the ROCF again at either immediately or 30 minutes after their initial copying of the figure. The order and accuracy in which the ROCF is copied and then drawn from memory is used to provide information concerning the location and extent of brain damage, if any.

**Wisconsin Card Sorting Test.** The Wisconsin Card Sorting Test (WCST) is a measure of frontal lobe functioning. It requires subjects to discover the principle according to which a deck of cards must be sorted. The tests consist of cards with geometric figures (triangle, star, cross, circle), various colors (red, green, blue or yellow) and numbers (1, 2, 3, or 4 items). Four reference cards are presented to the subject throughout the test. Another deck serves as the response cards. The goal of the subject is to get as many right as possible.



## **Results**

Descriptive statistics for the total sample performance on all measures utilized in this research study are presented in Table 6. Variations in test performance is evidenced by the large standard deviations for certain measures that assess frontal lobe functioning that also have a time component (e.g., CFM, Stroop, Color Trails). Additionally, the breadth of performance on the various measures is also demonstrated by the minimum and maximum scores obtained by participants. Of note, the participants engaged in neuropsychological testing that covered a range of mental processes from simple motor performance to complex reasoning and problem solving. The scores reflected in the preliminary analysis highlight the overall relative strengths and weaknesses among all participants. Overall, participants tended to perform better on tasks that measured frontal lobe functioning (e.g., CFM, Stroop, Color Trails) and nonverbal reasoning (e.g., Block Design), with a weaker performance on tasks requiring verbal reasoning (e.g., Similarities, Information, Vocabulary).

### **Convergent Validity**

A series of bivariate correlations were conducted to evaluate the relationship between CFM A, B, C, and 1, 2, 3 and select subtests of the WAIS-III, Color Trails 1 and 2, Stroop ABC, Woodcock Johnson-Picture Vocabulary Subtest, PRM Total Score (verbal fluency), Animals Total Score, the Rey-O, and Wisconsin Card Sorting Test. This analysis found both nonsignificant and significant negative correlations between the CFM and the selected subtests of the WAIS-III. Positive correlations were found between all the components of the

CFM test and Color Trails 1 and 2. There were also positive correlations between some of the subtests CFM Test and Stroop A, B, and C as well as with the Wisconsin Card Sorting Test Total Score, including the number of categories achieved. Negative correlations were noted between the CFM Test and PRM Total, Rey-O Total Copy and Rey-O 30 minute delay. Correlations between the CFM and Animals were nonsignificant. Overall, it can be observed that there was a pattern of insignificant correlations of the validity scales with CFM A and CFM B and a more consistent pattern of correlations between the validity scales and CFM 1, CFM 2, and CFM 3. The hypotheses were partially supported. Results of these analyses are presented in Table 8.

### **Discriminant Validity**

Bivariate correlations were performed to test the relationship between the Beck scales (BDI and BAI) and the CFM test. It was hypothesized that these measures of depression and anxiety should not be significantly correlated with the CFM test. This hypothesis was supported. There were no significant correlations between the CFM Test and the BDI and BAI. Results are presented in Table 9.

### **Educational Differences**

Hypothesis two was tested using an independent samples t-test to compare the performance of individuals with varying levels of education on the CFM Test. Significant differences on the CFM Test were found between individuals with 0-6 and 7-10 years of education thus providing support for the hypothesis. Additionally, there were significant correlations between educational

level and all subtests of the CFM. Results of these analyses are presented in Table 10.

## **Discussion**

This initial construct validity study of the Color Figure Mazes Test examined both convergent and discriminant validity utilizing measures of intellectual functioning, academic achievement, executive functioning, attention, concentration and visual memory. The validity instruments included the WAIS-III (selected subtests), Color Trails 1 and 2, Stroop ABC, Woodcock Johnson Picture Vocabulary Subtest (Spanish and English), PRM and Animals (verbal fluency), Rey-O and WCST. Correlations were computed to determine the convergent or divergent validity amongst the various tests and subtests. It should be noted that the Color Trails 1 and 2, the Stroop Test and the CFM are all speeded tests. The faster a participant performs, the lower their score and the better they performed. For interpretation purposes, the significant correlations that appear negative for these scores are, in fact, interpreted as correlations that are convergent, rather divergent. Finally, there appears to be a plateau effect between CFM 2 and 3, which raises the question as to the utility of keeping CFM 3 as a part of the measure.

### **Convergent Validity**

The CFM had a significant positive correlation with measures of attention, concentration and executive functioning. These results supported the study's hypothesis. Specifically, the CFM and the Stroop test were significantly correlated. Specifically, Color Figure Mazes A and C correlated with Stroop B

and C. Additionally, CFM1, CFM 2 and CFM 3 positively correlated with Color Trails 1 and 2. CFM 1, CFM 2, and CFM 3 correlated with Stroop A. Finally, CFM 1 and CFM 2 positively correlated with Stroop B and C. Concerning Color Trails 1 and 2, there was a moderate correlation between CFM A, CFM C, and CFM 1 with CT1. In addition, a moderately positive correlation was demonstrated between the CFM C, CFM1 and CT. There were also moderately significant correlations in the positive direction between CFM 1 and CFM2 and the WCST total cards used, and the number of categories achieved on the WCST.

Results further indicate the CFM Test was not significantly correlated with select intellectual and achievement measure subtests among an all male, day laborer, monolingual Spanish speaking population. This is not consistent with the hypothesis generated for this research study, which predicted a positive correlation between select WAIS subtests and CFM.

### **Discriminant Validity**

Discriminant validity was established by exploring the relationship between CFM A, CFM B, CFM C, CFM 1, CFM 2, CFM 3 and measures of visual memory, verbal memory, verbal fluency and mood. Overall, the CFM test did not significantly correlate with measures of visual memory and verbal fluency, as hypothesized in the research questions. There were relatively weak correlations between CFM 2 and CFM 3 with the Rey-O total copy score. Additionally, weak negative correlations were noted between CFM 2 and CFM 3 and the Rey-O 30 minute delay. As predicted, the CFM had negative correlations with the verbal

fluency measure of P, R, M total score and animal naming total score.

Concerning correlations with achievement tests, the CFM significantly correlated with the Woodcock-Johnson achievement measure in a negative direction.

There were significant correlations between CFM C, CFM 1 and CFM 2 and the Woodcock-Johnson Picture Memory subtest in Spanish, and two significant correlations on the English version of the Picture Memory subtest. The CFM is a nonverbal measure and these results were anticipated.

### **Differences Between Educational Level**

Separate analyses of participants with 0-6 and 7-10 years of education was computed. A significant difference between these groups was found.

Specifically, a significant difference was found between participants with 0-6 years of education and those with 7-10 years of education on CFM A, B, C and 3. This suggests that among this monolingual Spanish speaking Latino population, nonverbal measures of cognitive functioning are impacted by education. As educational level increased, the better participants performed on the CFM Test.

### **Interpretation of Results**

In general, the CFM has significant areas of overlap between the subtests. This suggests similar cognitive process (e.g., attention, concentration, executive functioning and working memory) are cohesively functioning to complete a specific subtest, rather than working independently. The CFM test progressively takes participants through the various mazes and adds an extra element, with each subtest building upon the other. This accounts for the correlations between subtests that consecutively follow each other in the sequence. To illustrate, CFM

C and CFM 1 have a moderately strong correlation, which can be attributed to the need to continue with the square-circle sequence, but adding the requirement of having a pink-yellow-blue sequence. Additionally, education may be a factor that contributes the performance results. Of note, educational level is an important factor to take into consideration, as one learns methods to quickly solve problems in the context of schooling.

The cognitive abilities of attention and concentration are measured, with the added component of an increased working memory demand through the introduction of the additional instructions. The specific results seen may be attributed to the added cognitive demand of working memory and the ability to navigate visual spatial relationships. The similar processes of attention, motor skills, and nonverbal complex problem solving also appear to overlap as similar abilities that are measured by the CFM test.

Color Figure Mazes A and B did not perform similarly to the other subtests, as there is less cognitive demand placed on these two tasks. Specifically, these two subtests are relatively simple and require participants to pay attention and connect a clear pattern of shapes through the maze, without additional instructions. The other subtests (CFM C, CFM 1, CFM 2 and CFM 3) are more complex in terms of cognitive demands, as participants are required to follow increasing complex instructions that require integration of attention, concentration, executive function and working memory.

Measures of visual memory, verbal fluency and WAIS III subtests significantly correlated with the CFM Test in a divergent nature, as the CFM is

was not necessarily designed to measure these variables. However, the brain is complex and does not function in isolation. This suggests an inverse relationship, where as one performs better with the CFM, they are not utilizing verbal or visual memory and their scores decrease in these areas. There were significant correlations between all subtests of the CFM Test and Block Design, which indicate higher scores on the CFM are related to non-verbal problem solving. Similarly, the significant divergent correlations between select subtests of the CFM and WAIS III measures of verbal reasoning (Similarities, Arithmetic, Comprehension, and Information), and Symbol Search (visuo-perceptual analysis and visual scanning) indicate related cognitive processes are being utilized, but in an inverse relationship. Of note, these scores were more significant between CFM 1, 2, and 3, which indicate more complex cognitive processes are underway as the tasks become progressively more difficult. There are no components of the CFM that requires participants to engage in activities measuring visual memory, verbal fluency or have a strong educational component. Additionally, it is not surprising that the CFM did not positively correlate with the WAIS II Matrix Reasoning (MR) subtest, as the MR requires independent non-verbal problem solving, whereas participants are explicitly provided instructions on what to do, but are required to execute the instructions in a quick manner.

The CFM Test significantly correlated with the Stroop Test. The Stroop Test has a large verbal component that requires participants to state colors seen, read the color of words and inhibit the over-learned ability to read. It specifically

measures selective attention and cognitive flexibility (Spreen & Strauss, 1998). The inability to read could be a major factor contributing to the lack of a significant positive correlation between the CFM and Stroop Test. The reading component inherent in the Stroop Test necessarily accesses lexical access and the phonological loop that is not required in the CFM Test (Kulaif & Valle, 2008). Finally, even general cognitive has been shown to be less efficient in the absence of reading ability, which further may account for the lack of a positive correlation. However, there was a significant correlation nonetheless, and educational factors may play a role in the performance of participants on these measures.

The CFM significantly correlated with the Wisconsin Card Sorting Test (WCST). A measure of frontal lobe functioning, the correlation between the CFM and WCST indicate set shifting may be a central cognitive mechanism that influences performance (Barceló, 2001; Braver, Reynolds, & Donaldson, 2003; Nyhus & Barcelo, 2009). This may account for the negative correlation between CFM and the WCST.

### **Assumptions and Limitations**

There are several limitations to this study including involvement of women, bilingual individuals and the inclusion of a geriatric population. Women did not participate in the present study, which limits the ability to apply research findings to them. In particular, the inclusion of women can help abate the inconclusive and oftentimes contradictory neuropsychological findings for females, since many tests are norm referenced on Caucasian males. Additionally, bilingual individuals



were not included in the study. As such, performance on the CFM, as correlated with the above mentioned measures might be different between individuals' scores because of their fluency in English and Spanish. Additionally, participants self-selected to participate in the study, and there is likely to be a degree of self-selection bias. For example, the decision to participate in the study may reflect some inherent bias in the characteristics/traits of the participants (e.g., a participant who believes they have cognitive difficulties wanting to be tested). Additionally, there is a risk of the sample not being representative of the population being studied, or exaggerating some particular finding from the study. Finally, older individuals were not included in the study. For various reasons, elderly individuals may experience difficulty with cognitive processes directly measure by the CFM. Inclusion of the elderly population could have provided valuable information regarding their performance on a nonverbal measure that is not educationally loaded. Additionally, the sample is geographically limited as recruitment only occurred in Los Angeles (LA) County. Overall, these limitations suggest the construct validity data will not be generalizable beyond monolingual Spanish speaking men in LA County. It should also be noted neuropsychological test performance may be impacted by various personal, interpersonal and clinical characteristics such as a low self-esteem, personality traits, and psychological difficulties (e.g., anxiety, depression, severe mental illness).

### **Clinical Implications**

For various reasons, including socioeconomic and political, Latinos have not achieved the level of educational attainment typically seen in the U.S. even

when compared to other traditionally under-served and under-represented groups (Kim, Jang, Chiriboga, Ma, & Schonfeld, 2010). Test performance in monolingual Spanish-speakers and individuals with low educational attainment can have various clinical manifestations, depending on the developmental history and quality of education. These clinical manifestations may also be compounded by traumatic brain injury (TBI), as this is a true possibility with day laborers. Individuals may develop isolated or associated disorders of language, reading, writing, calculation, memory, attention, visuoconstruction, behavior, and movement difficulties when workplace injuries are added to the equation. However, identifying many of these disorders is sometimes difficult as there are still very few neuropsychological tools created for, standardized, and normed on individuals with limited to no English language proficiency and low educational attainment.

Given the heterogeneity of Latinos and marked class differences in Latin America, educational attainment and socioeconomic status may be quite diverse and impact performance on cognitive measures. Of note, there is an expanding neuropsychological literature base, with the Latino population in particular, that suggests educational attainment plays a role in the expression in brain functioning. Accordingly, the use of homogenous regional groups can be utilized when developing norms (i.e., sample groups from California, El Paso, etc). Targeting region of origin, as opposed to country of origin, in the sampling process can also assist in controlling for this variable. Alternatively, targeting country of origin instead of ethnicity as a variable may be also be useful when

assessing Latinos and other heterogeneous ethnic groups. Finally, possibly ignoring ethnicity and using education as a variable of interest is another route to access the range of performance on cognitive measures for Latinos.

This study highlights the responsibility of clinicians to fully understand and appreciate the whole person in context. Clinicians often lack comprehensive training in the assessment of traditionally under-served and under-represented populations. Consequently, the application to neuropsychology at the individual level may include:

1. Awareness of one's own assumptions, values, and stereotypes about traditionally underserved populations, including how such beliefs and attitudes can negatively impact the provision of neuropsychological services. This may enhance the ecological validity of interpretations in neuropsychological evaluations, as neuropsychologists become aware of and appreciate the effects of these cultural variables.
2. Knowledge of and understanding of one's own worldview and that of the client's who may undergo a neuropsychological evaluation.
3. Obtain training in culturally appropriate assessment and accompanying interventions to work effectively with various ethnic groups.
4. Develop a core set of competencies that integrate new theories, practices and policies that are more responsive to all groups.

There is a component to cognitive functioning that is connected to the values and demands of a culture (Perlman & Kaufman, 1990). Future research can address modalities of assessment that are reflective of culture, in particular,

the way information is sent or received. For example, in Western society, information is routinely shared via the computer. This is reflected in an increase in computerized neuropsychological testing. Additionally, future studies may also direct attention to the role of practice effects and the extent to which performance on the CFM Test exerts a transfer of training influence upon similar measures (e.g., Stroop Test, Color Trails 1 and 2) or vice versa.

Future research involving the CFM is needed. Research studies replicating this study are encouraged, as it would be beneficial to know if new studies obtained the same results. The inclusion of a larger sample of participants, including a broader age range, educational attainment, literacy levels, and varying levels of English proficiency would be helpful to generalize results among different populations and to better eliminate the restricted range of scores when comparing participants' scores with other measures. Additionally, further research studies on the CFM are needed with Latinos from different socioeconomic and demographic backgrounds, including different clinical samples of patients with various psychiatric disorders.

In the civil and criminal forensic setting, the CFM can be utilized as a cognitive measure to assess motivation or cognitive malingering. There are few tests to inform clinical psychologists how to detect cognitive malingering (Leng & Parkin, 1995). The CFM is a speeded measure, as such; future studies with clinical populations and individuals involved in a civil or forensic court case may help develop a comparative normative base. Individuals who are significantly slower than a defined cutoff rate could be considered as possible feigning or

exaggerating cognitive difficulties, or exhibiting low motivation towards testing. Finally, individuals can be assessed in a test-retest format to further assess for motivational factors as part of a larger forensic battery.

### **Contributions**

The most valuable contribution of this study is that it is an addition to the growing field of cultural neuropsychology and provides data on the construct validity of an instrument developed for culturally, linguistically and educationally diverse populations. The inclusion of individuals with broad diverse characteristics is in line not only with the growing trend of clinical neuropsychology, but in clinical psychology as a field. Second, this study may contribute data that can inform a more accurate cognitive assessment for monolingual Spanish speakers and individuals with low levels of education, both of whom are underrepresented in the field of clinical neuropsychology. Specifically, the results of this study suggest a nonverbal assessment that measures frontal lobe functioning and removes the need to speak the English language and literacy can be used in clinical settings to evaluate individuals from diverse settings.

Neuropsychological assessment of individuals with low educational levels, and accompanying low literacy levels, may benefit from emphasizing the clinical interview (e.g., history), incorporate effort to understand individual's functioning within their sociocultural context, and explore areas in which cognitive functioning differs from that of peers and/or their own pre-morbid functioning (Judd et al., 2009; Ciborowski, 1979).

Neuropsychological tests require a reference value, which typically occurs in the form of a normative table. Many neuropsychological tests do not have norms for Spanish speakers and people with low educational attainment. Development of a normative base for individuals who are monolingual Spanish speakers, have limited English proficiency, or have limited education can further the field of clinical neuropsychology by including traditionally underserved and under-represented populations in clinical research (Judd et al., 2009).

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Table 1.

*Sample Demographics: Age*

<b>Variable</b>	<b>Range</b>	<b><i>M</i></b>	<b>SD</b>
Age (total years)	18-49	28.23	8.74

  

Variable	Frequency	Percent	Cumulative %
Age (18-29)	71	61.7	61.7
Age (30-49)	44	38.3	100.0

Table 2.

*Sample Demographics: Gender*

<b>Variable</b>	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative %</b>
Gender			
Male	115	100	100

Table 3.

*Sample Demographics: Nationality*

<b>Variable</b>	<b>Frequency</b>	<b>Percent</b>	<b>Cumulative %</b>
Nationality			
Mexico	94	81.7	81.7
El Salvador	1	.9	82.6
Honduras	10	8.7	91.3
United States	2	1.7	93.0
Guatemala	6	5.2	98.3
Venezuela	1	.9	99.1
Cuba	1	.9	100.0

Table 4.

*Measures administered in the original study*

<b>Domain Assessed</b>	<b>Measure</b>	<b>Brief Description</b>	<b>Estimated Administration Time</b>
Overall Cognitive Functioning (Screening)	Cognistat	Briefly screens general cognitive functioning including language, memory and executive functioning.	10 minutes
Overall Intellectual/Academic Functioning	Wechsler Adult Intelligence Scale-Version Preliminaria (WAIS-III; Spanish translation)	A translation of the WAIS-III, which assesses verbal and nonverbal intellectual ability.	60-90 minutes
	Quick Verbal Intelligence for Spanish Speakers (QVITSS)	An experimental measure designed to quickly estimate a participant's Verbal IQ by having him/her identify related words from a list.	15 minutes
Information Processing/Mental Speed	Escala Intelligencia Wechsler para Adultos (EIWA)—Digit Symbol Subtest	A psychomotor subtest measuring the ability to process nonverbal information quickly and accurately by copying symbols that match to digits as quickly as possible.	2 minutes
	Color Trails A & B	A test of psychomotor speed assessing attention (Part A) and cognitive flexibility (Part B).	5 minutes
	Stroop A, B, C	Measures verbal processing speed, word reading (Part A), naming (Part B) , and response inhibition (Part C).	3 minutes

(Continued)



<b>Domain Assessed</b>	<b>Measure</b>	<b>Brief Description</b>	<b>Estimated Administration Time</b>
Attention/Concentration	EIWA- Digit Span Subtest	Measures basic attention skills by having the participant repeat digits.	5 minutes
	Continuous Performance Test	A computerized test measuring sustained attention by having the participant press a space bar to all but one predetermined letter from a series that is individually flashed on the screen at variable intervals.	15 minutes
Language Skills	Rapid Naming Test	An experimental test of naming ability that requires the ability to rapidly name objects.	5 minutes
	Woodcock Johnson-Picture Vocabulary Subtest	Measures participants' ability to name sequentially presented drawings of objects.	5 minutes
	Verbal Fluency (P, M, R; Animals)	A subtest of La Bateria Neuropsicologica en Espanol measures verbal fluency by asking participants to produce as many words as possible that begin with the letters P, M, and R in three minutes. Participants are also asked to name as many animals as they can in 60 seconds.	4 minutes
Visual Spatial Skills	Rey-Osterrieth Figure Copy and Memory	A test of spatial and visual memory that assesses the ability to copy (draw) a complex design.	10 minutes

(Continued)

<b>Domain Assessed</b>	<b>Measure</b>	<b>Brief Description</b>	<b>Estimated Administration Time</b>
	EIWA-Block Design Subtest	A visual-spatial reasoning test that requires participants to accurately assemble a set of blocks based upon a picture provided.	0 minutes
Verbal Memory	Word List Memory Test	Measures verbal and learning memory by assessing participants' ability to learn a list of 16 common words over 5 different trials, and then recalling the words after a short delay.	15-20 minutes
	Spanish Logical Memory Test	An experimental test that assesses participants' ability to learn details and themes of a story and recall them after a short delay.	10 minutes
Visual Memory	Picture Memory Interference Test	Assesses participants' ability to sequentially recognize 5 lists of pictures after exposure to an interference list and later to identify the list from which the individual items originated.	15 minutes
Frontal/Executive Skills	Wisconsin Card Sorting Test-64	Assesses participants' nonverbal, abstract reasoning ability as they determine whether to sort individual cards by color, form, or number based on presented stimuli cards.	15 minutes

(Continued)

<b>Domain Assessed</b>	<b>Measure</b>	<b>Brief Description</b>	<b>Estimated Administration Time</b>
	Color Figure Mazes	An experimental measure that assesses cognitive flexibility as the participants have to rapidly sequence and alternate between color, shape and size.	4 minutes
Effort/Motivation	Rey-15 Item Memorization Test	A measure of effort/motivation where participants reproduce 15 over learned items (letters, numbers, shapes) immediately after a 10 second exposure to the item.	2 minutes
	Dot Counting Test	A measure of effort/motivation where participants rapidly count randomly arranged and grouped dots on a card.	5 minutes
Acculturation Measure		Self-administered questionnaire assesses acculturation level (language skills and cultural self-identity) of Latino participants.	10 minutes
Mood (Screening)	Beck Depression Inventory-II	Inventory used to measure depression.	3 minutes
	Beck Anxiety Inventory	Inventory used to measure anxiety.	3 minutes

Table 5.

*Overview of neuropsychological tests used with participant sample and associated validation on Spanish speaking population*

<b>Domain(s) Measured</b>	<b>Test</b>	<b>Type(s) of Validity Established</b>	<b>Support for use with Latinos</b>	<b>Description of Sample</b>
Intellectual functioning	Wechsler Adult Intelligence III (WAIS III)	Face, Criterion, convergent and discriminant validity	NeSBHIS norms by Ponton-Harbor UCLA	Mexico City Workers
Both A & B: Psychomotor speed, cognitive flexibility, visual scanning	Color Trails A & B	Face, convergent, criterion, discriminant	NeSBHIS norms by Ponton-Harbor UCLA	Mexican Americans in Los Angeles
A: Visual attention/word reading B: Visual attention/task switching/color naming C: inhibition	Stroop A, B, & C	Face, convergent, construct, criterion, discriminant	NeSBHIS norms by Ponton-Harbor UCLA	Hispanic Americans from south Texas and Los Angeles (Ponton)
Visual language skills, oral expression, lexical knowledge; Vocabulary	Woodcock-Johnson Picture	Face, Test validity, internal structure validity, construct, concurrent		Latinos in Mexico (n=118), United States (n=89), Cuba (25) and Columbia (14), (8 or less in certain Latin countries) N=1, not reported
Verbal fluency: PMR—phonemic fluency; Animals: Category fluency	Verbal Fluency Subtest (P,M,R, Animals)	Face, construct, criterion	NeSBHIS norms by Ponton-Harbor UCLA	Mexican Americans in Los Angeles
Paper-pencil and visuo-spatial-constructive skills	Rey Osterrieth	Face, construct	NeSBHIS norms by Ponton-Harbor UCLA	Mexican Americans in Los Angeles
Frontal/executive functioning (abstract reasoning, cognitive flexibility)	Wisconsin Card Sorting Test-64	Face, construct, criterion	Gustavo, et al. (1999)	234 Spanish-speaking adults
Frontal/executive functions	Color Figure Mazes	Not validated—		

Table 6.

*Performance of total sample on all measures in the research study*

<b>Variable</b>	<b><i>M</i></b>	<b><i>SD</i></b>	<b>Minimum</b>	<b>Maximum</b>
CMF A	4.89	3.79	1	31
CFM B	14.50	5.86	5	35
CFM C	34.58	13.49	7	100
CFM 1	55.30	31.72	19	188
CFM 2	104.00	47.65	32	300
CFM 3	133.44	54.77	28	336
WAIS III Vocabulary	17.83	9.79	1	48
WAIS III Digit Symbol	46.18	16.28	13	101
WAIS III Similarities	11.20	4.38	0	23
WAIS III Block Design	29.36	11.01	8	53
WAIS III Arithmetic	8.92	2.24	4	15
WAIS III Figure Matrices	8.30	3.80	3	19
WAIS III Digit Span	10.83	2.63	6	19
WAIS III Information	8.01	3.81	2	19
WAIS III Comprehension	12.17	5.24	3	27
WAIS III Symbol Search	21.22	8.31	2	40
WAIS III L-N Sequencing	5.62	2.55	0	12
W-J: English (Pic Vocab)	4.44	5.62	0	29
W-J: Spanish (Pic Vocab)	31.01	5.48	8	43
Color Trails 1	44.55	28.55	12	240

(Continued)

<b>Variable</b>	<b><i>M</i></b>	<b><i>SD</i></b>	<b>Minimum</b>	<b>Maximum</b>
Color Trails 2	96.64	43.06	25	226
Stroop A	103.00	22.57	32	160
Stroop B	66.54	17.65	23	104
Stroop C	38.62	13.44	11	82
PRM: Total Score	32.41	11.07	9	72
Animals: Total Score	17.74	4.97	3	35
Rey-O: Total Copy Score	26.38	8.52	1	36
Rey-O: 30 Min Delay	16.21	7.93	0	34
WCST: Total Cards	35	10.46	11	55
WCST: Total Categories	1.77	1.19	0	5
BDI-II	12.92	8.94	0	48
BAI	6.60	6.02	0	27

Table 7.

*Intercorrelations Among CFM Subtests (123 and ABC)*

	<b>Motor</b>		<b>Choice/Sequence</b>		<b>Divided Attention</b>	
	CFM A	CFM B	CFM C	CFM 1	CFM 2	CFM 3
CFM A	1.00	.482**	.385**	.299**	-.032	.051
CFM B	—	1.00	.420**	.383**	.150	.196*
CFM C	.385**	—	1.00	.604**	.372**	.347**
CFM 1	.299**	.383**	—	1.00	.547**	.542**
CFM 2	-.032	.150	.372**	—	1.00	.640**
CFM 3	.051	.196*	.347**	.542**	—	1.00

\* $p < .05$ , two-tailed. \*\* $p < .01$ , two-tailed

Table 8.

*CFM Convergent Validity Coefficients with Select WAIS-III Subtests, Color Trails 1 and 2, Stroop ABC, Woodcock Johnson, PRM Total Score, Animals Total Score, Rey-O, and Wisconsin Card Sorting Test*

	CFM A	CFM B	CFM C	CFM 1	CFM 2	CFM 3
WAIS III Picture Completion	-.040	-.031	-.238*	-.266**	-.385**	-.168
WAIS III Vocabulary	-.096	-.016	-.187*	-.240*	-.271**	-.212*
WAIS III Digit Symbol Coding	-.173	-.181	-.246**	-.425**	-.415**	-.372**
WAIS III Block Design	-.262**	-.206*	-.289**	-.369**	-.338**	-.273**
WAIS III Similarities	-.269**	-.204*	-.272**	-.403**	-.250**	-.331**
WAIS III Arithmetic	-.122	-.017	-.141	-.222*	-.212*	-.202*
WAIS III Matrix Reasoning	-.161	-.140	-.315**	-.375**	-.341**	-.357**
WAIS III Digit Span	-.126	-.076	-.292**	-.329**	-.384**	-.353**
WAIS III Information	-.033	-.089	-.174	-.219	-.301**	-.213**
WAIS III Comprehension	-.158	-.233*	-.245**	-.321**	-.221*	-.320**

(Continued)



	CFM A	CFM B	CFM C	CFM 1	CFM 2	CFM 3
WAIS III Symbol Search	-.209*	-.220*	-.460**	-.511**	-.525**	-.429**
WAIS III Letter-Number Sequencing	-.184	-.280**	-.400**	-.454**	-.437**	-.332*
Color Trails 1 Total Time	.427**	.226*	.467**	.443**	.214*	.274**
Color Trails 2 Total Time	.202*	.228*	.449*	.534**	.386**	.366**
Stroop A	.014	-.137	-.183	-.409*	-.338**	-.249**
Stroop B	-.119	-.157	-.131	-.328**	-.201*	-.179
Stroop C	-.202*	-.185	-.220*	-.312**	-.277**	-.220*
Woodcock Johnson – Picture Vocabulary (Spanish)	-.208*	-.077	-.247**	-.245**	-.271*	-.155
Woodcock Johnson – Picture Vocabulary (English)	-.038	-.098	-.212*	-.136	-.198*	-.089

(Continued)

	CFM A	CFM B	CFM C	CFM 1	CFM 2	CFM 3
PRM Total Score	-.261**	-.238*	-.310**	-.386**	-.289**	-.228*
Animals Total Score	-.135	-.050	-.061	-.081	-.157	-.099
Rey-O Total Copy Score	-.151	-.060	-.209*	-.261**	-.405**	-.318**
Rey-O 30 Minute Delay Total Score	-.167	-.045	-.189*	-.199*	-.289**	-.240*
WCST Total Cards	-.256*	-.339**	-.229	-.453**	-.361**	-.314*
WCST Total Categories	-.264*	-.395**	-.223	-.483**	-.445**	-.410**

\* $p < .05$ , two-tailed. \*\* $p < .01$ , two-tailed

Table 9.

*Pearson r Correlations Between CFM Test (123 and ABC), BDI and BAI Total Scores*

	BDI	BAI
CFM-A	-.075	-.084
CFM-B	-.099	-.148
CFM-C	.171	.056
CFM-1	.127	.067
CFM-2	.122	.057
CFM3	.044	.095

\* $p < .05$ , two-tailed. \*\* $p < .01$ , two-tailed.

Table 10.

*Education Level Differences for Dependent Variable (CFM-ABC and CFM- 123)*

<b>Variable</b>	<b><i>M</i></b>	<b><i>SD</i></b>	<b><i>t</i></b>	<b><i>p</i></b>
CFM A				
0-6	5.36	4.83	2.222	.139
7-10	4.41	2.23		
CFM B				
0-6	14.82	5.60	.013	.909
7-10	14.18	6.15		
CFM C				
0-6	35.50	14.02	2.56	.614
7-10	33.67	13.02		
CFM 1				
0-6	61.14	34.67	3.529	.063
7-10	49.56	27.67		
CFM 2				
0-6	116.31	55.16	9.183	.003
7-10	92.12	35.70		
CFM 3				
0-6	141.10	55.84	.025	.875
7-10	126.46	53.31		

## APPENDIX

### Review of the Literature

## APPENDIX

### Review of the Literature

Psychology in Northern America evolved out of a theory of knowledge that offered unsurpassed regard to empiricism (positivism) and linear formal logic. Such scientific values were infused in the training of social scientists and formed the path for psychological researchers to develop empirically based pragmatic models of behavior rather than considering broad theories (Leong, 1996; Nell, 2000; Pérez-Arce, 1999; Slife & Williams, 1997). Accordingly, neuropsychologists in America searched for universals in cognitive behavior across individuals that espoused a direct linkage between the neurobiological brain, cognitive processes, and behavior (Vygotsky, 1978). Consequently, neuropsychological test results obtained in a seemingly context-free office using “culture free” tests have been considered the most valid and reliable for evaluating patients’ cognitive capacities and predicting optimal behavior in their home and community (Ostrosky-Solís & Oberg, 2006).

Intergroup differences are increasingly recognized in some neuropsychological measures by the inclusion of norms divided by demographic indices that include age, gender, educational level, and in some instances race and ethnicity (Heaton, Grant, & Matthews, 1986, 1991). Of note, the influence of sociocultural development and life experiences on cognitions is only recently being considered and studied systematically (Fletcher-Janzen, Strickland, & Reynolds, 2000).

It is argued sociocultural and historical experiences influence the development of the nervous system, including cognition; and the brains, minds, and behaviors of individuals from different cultures are both similar and different (Helms, 1997; Luria, 1976; ; Ostroski-Solis & Oberg, 2006). As Luria (1976) observed and published extensively, tests developed and validated for use in one culture often resulted in experimental failures and were invalid for use with different cultural groups. This research essentially conveyed that neuropsychological instruments intended to measure constructs in one culture may not be applicable to individuals of other cultures with the expectation they equally measure the same construct.

The description and understanding of sociocultural, ethnic and historical influences in the development of cognition, as well as the similarities and differences among groups is a key theme of the emerging field of transcultural neuropsychology, which encourages pluralism and acknowledges cultural differences in the clinical application and research on brain-behavior relationships. As society becomes increasingly globalized, neuropsychologists engaged in the clinical, research and theoretical domains will be expected to fully consider and integrate cultural factors into account, not as “interfering nuisance variables,” but as matters of basic neurobiological significance with wide ranging behavioral effects and outcomes (Ostroski-Solis & Oberg, 2006). Admittedly, clinical neuropsychology has not adequately responded to the increasing need of an ever-evolving and diverse society (Rivera-Mindt, Byrd, Saez, & Manly, 2010).

Although there is significant neuropsychological literature in Latin America and Spain, there is little research of neuropsychological studies addressing Latinos who live in the United States (U.S.) (Ardila, Rosselli, & Puente, 1994). There is a dire need for neuropsychological literature and instruments that are designed for and norm referenced with Latinos living in the U.S. Additionally, it should be noted Latinos are more likely than Caucasians to suffer from cognitive disorders and brain injury, which highlights the importance of culturally congruent assessment measures (Bruns & Hauser, 2003; Kraus & McArthur, 1996).

**Latinos in the United States.** There is an explosion of ethnocultural diversity in the United States. In the past century, U.S. demographics have transformed from a country where one in eight people held ethnic minority status to one in three. According to the 2010 U.S. Census, approximately 30% of the population currently belongs to a racial or ethnic minority group and it is projected by the year 2010, non-Latino whites will make up only 40% of the U.S. population. In 2010, there were 50.5 million Latinos in the United States, composing 16 percent of the total population. Between 2000 and 2010, the Latin population grew by 43%—rising from 35.3 million in 2000, when this group made up 13% of the total population. The Latino population increased by 15.2 million between 2000 and 2010, accounting for over half of the 27.3 million increase in the total population of the United States (U.S. Census Bureau, 2011).

In California, Latinos comprise 36.6% of the population and are projected to be the largest ethnic group in California by 2021 (U.S. Census Bureau, 2010). The Latino population in the United States (U.S.) has increased exponentially in



the past decades. The average age of Hispanic males and female born in the U.S. is 17 and 18 years, respectively. The average age of foreign-born Hispanic males and females who presently live in the U.S. is ages 36 and 39, respectively (Pew Hispanic Center, 2010).

In the past 10 years, the Latino impact on the demographics of the U.S. has changed drastically from Latino subgroups living in select states including California, Texas, New York, and Florida, to thriving Latino communities in mid-Atlantic and mid-Western states. In California, the District of Columbia, Hawaii, New Mexico, and Texas, the population was majority-minority (i.e., over 50% of the population was minority) in 2010. Hawaii had the highest proportion minority (77%), followed by California and New Mexico, each with 60%. Latinos across the country now constitute approximately 15% of the U.S. population and in some states now account for the majority of new births (Hayes-Bautista, 2004).

In California and Los Angeles County, individuals identifying as Hispanic or of Latino origin account for 37% and 48% of the population, respectively (U.S. Census Bureau, 2009). In terms of sociodemographics, approximately half of the Latino adults in California had less than a high school diploma; over half of Latino immigrants do not speak English well and, overall, are more likely to be medically uninsured than other racial/ethnic groups (Pew Hispanic Center, 2010). To illustrate, approximately 29% of Latinos ages 0-64 lacked medical insurance in 2007, as compared to 18 % for non-Hispanic whites and 15% for African Americans (University of California Los Angeles, 2007).

**Mental health disparities.** Mental Health disparities are generally

described as the persistent gaps between the mental health status of people from traditionally underrepresented and underserved populations who are generally members of ethnic minority groups and non-minorities in the United States (Carter-Pokras & Baquet, 2002; Gustavo, Crockett, Carranza, & Martinez, 2011). Despite continued advances in health care and technology, individual racially, culturally underserved and under-represented populations continue to have higher rates of disease, disability and premature death than non-Hispanic whites. Regarding health in general, African Americans, Latinos/Latinos, American Indians and Alaska Natives, Asian Americans, Native Hawaiians and Pacific Islanders, have higher rates of infant mortality, cardiovascular disease, diabetes, HIV infection/AIDS, cancer and lower rates of immunizations and cancer screening (Sondik, Huang, Klein, & Satcher, 2010).

Although the causes for such health disparities are numerous, two major contributing factors include: (a) inadequate access to care which involves barriers to medical and mental health care results from economic, geographic, linguistic, cultural and health care economic issues; and (b) substandard quality of care such that even in instances where traditionally underserved populations have similar levels of access to care, health insurance and education, the quality and intensity of health care they receive is often substandard). Lower quality care has many causes, including patient-provider miscommunication, provider discrimination, stereotyping or prejudice. Quality of care is generally rated on effectiveness, patient safety, timeliness and patient centeredness. These measures are all critical to building a trusting, empathic and effective relationship

between provider and patient (LêCook, McGuire, Lock, & Zaslavsky, 2010). Kim, Aguado Loi, Chiriboga, Jang, Parmelee, and Allen (2011) Limited English Proficiency (LEP) was a barrier to seeking out mental health care services for Latinos, which confirms prior studies documenting that individuals who do not speak English fluently are less likely to receive mental and medical health care (DuBard & Gizice, 2008). Additionally, stressors involved in leaving their original country and adjusting to another may also pose barriers to older Latinos seeking mental health care (Kim, Jang, Chiriboga, Ma, & Schonfeld, 2010). Of note, both inadequate access to and substandard quality of care extends to neuropsychological evaluations, as well as in the form of lack of access to culturally appropriate measures, norms, and clinicians who offer culturally responsive cognitive evaluations.

**Brain injury in the workplace.** Traumatic brain injury (TBI) is a leading cause of mortality and disability in the United States. Each year in the U.S., approximately 1.4 million people sustain a TBI. Of these people, more than 1.36 million people are treated and released from emergency departments, nearly 275,000 are hospitalized, and 52,000 die as a result of their injury (Faul, Xu, Wald, & Coronado, 2010; National Center for Injury Prevention and Control, 2006). Traumatic brain injuries are often associated with a slow recovery pattern (Wrona, 2006) and significant claim costs (Wei, Liu, Fergenbaum, Comper, & Colantonio, 2010). The annual economic burden in the United States for TBI was approximately \$37.8 billion in 1985 and rose dramatically to 76.3 billion in 2010. Of note, for TBI survivors and their families, the financial cost is only part

of the burden. The long-term impairments and disabilities associated with TBI are severe and the full human cost is incalculable. Yet, because these disabilities are not readily apparent to the public unlike a broken leg, for example, TBI is commonly referred to as an invisible epidemic. These disabilities, arising from cognitive, emotional, sensory, and motor impairments, often permanently alter a person's vocational goals and have profound effects on personal, social and family relationships.

**Immigrant workers employed in the United States.** Immigrants have become a growing segment of the U.S. work force playing “an increasingly important role in the U.S. economy” (Mosisa, 2002, p. 14). During the 1996-2000 labor force expansion, “foreign-born workers 16 years and older constituted 48.61 percent of the total labor force for an increase of 6.7 million” (Mosisa, 2002, p. 10). By 2008, The U.S. Bureau of Labor Statistics (BLS) estimated foreign-born workers comprised 15.6% of the total civilian labor force, an increase of 14% from the estimates for 2003 (Bureau of Labor Statistics, 2009). Labor force participation for foreign-born men had also increased from 80.6% in 2003 to 81.4% in 2008. Foreign-born workers are generally younger, poorer, less educated, and less proficient in English than native-born laborers (Mosisa, 2002). Due to these characteristics, and in conjunction with limited occupational skills and unfamiliarity with the U.S. job market, many immigrants find unskilled or entry-level jobs in low-paying, higher-risk industries such as agriculture, construction, manufacturing, landscaping and domestic service.

Annual averaged data for 2008 showed immigrants were more likely than their native-born counterparts to be employed in service occupations (23.2% vs. 15.6%, respectively); in production, transportation, and material moving occupations (16.4% vs. 11.5%, respectively); and in natural resources, construction, and maintenance occupations (15.1% vs. 9.3%, respectively). Of the immigrants employed in the labor force, Hispanics accounted for the biggest group with 49.4%, followed by Asians with 22.4%.

**Immigrant workers and occupational injuries.** Although the high incidences of immigrant workers' occupational injuries and deaths have been highlighted by some studies and organizations, there is a paucity of research literature addressing immigrant workers and occupational injury. A report by the American Federation of Labor & Congress of Industrial Organizations (AFL-CIO), 2005, stated immigrant workers are at far greater risk of being killed or injured on the job than native-born workers. Of note, estimates of Latino workers' deaths from 1992 to 2006 showed that except for the year 1995, the work-related injury death rate for Latino workers exceeded the rate for all U.S. workers for every year during that period. Workplace fatalities for all immigrant workers increased 46% from 1992 to 2002 while Latino workers' fatalities specifically increased by 58%. In 2002, Hispanics accounted for 62% of the fatally injured foreign-born workers. For the period of 2003-2006, foreign-born Hispanic workers also had higher work fatality rates (5.9 per 100,000 Hispanic workers) than U.S.-born Hispanic workers (3.5 per 100,000 Hispanic workers).

The leading causes of these fatal injuries were also different between foreign-born and native-born workers. For the time period of 1996 through 2001 workplace homicide was the leading cause of fatal injury for foreign-born workers, accounting for one-quarter of all fatal injuries. Falls to another level (15 percent) and highway incidents (14%) completed the three leading causes of fatal injuries for foreign-born workers, while native-born workers were most likely to be killed in highway incidents (23%) than homicides (12%) or falls to lower level (11%). It should also be noted that 40% of fatally injured immigrant workers were 35 years of age or younger compared to 30% of the native-born workers (Tiesman, Konda, & Bell, 2011).

A literature review by McCauley (2002) reported fatality rates of 13% among immigrant farm workers, a thousand of those deaths related to pesticide toxicity. It also reported from 1992 to 2002 the largest proportion (27%) of occupational deaths among Latino workers was in construction. Rates of non-fatal work injuries were also high among immigrant workers. Non-agricultural immigrant Latino workers reported an injury rate of 12/100 FTE, higher than the 7.1/100 FTE of the 1997 US population. Twenty eight % of Latino poultry workers interviewed also had at least one occupational injury or illness in the last year (Tiesman, Konda, & Bell, 2011). Nearly 60% of these workers also reported symptoms of an occupational injury or illness in the past 30 days. Another portion of these immigrants, mostly undocumented, sought employment as day laborers at street corners or informal hiring sites (Hiott, Grzywacz, Davis, Quandt, & Acrcury, 2008). Many of these laborers frequently found temporary work in

dangerous industrial and agricultural occupations, without health or worker's compensation benefits, and often without personal protection equipment (PPE) or safety training (Tiesman, Konda, & Bell, 2011). Studies focusing on day laborers have also found high rates of non-fatal occupational injuries among these workers. For example, eleven of twenty one (52.4%) day laborers interviewed in Chicago had been injured in the previous year, with only two of them seeking medical attention. Another study of day laborers that included some U.S. born workers reported an estimated injury rate of 31 recordable injuries per 100 FTE workers, a higher rate than the Bureau of Labor Statistics' 2004 recordable injury rate for construction and warehousing and storage of 6.2 and 9.3 injuries per 100 FTE, respectively.

**Day laborers.** Estimates of the number of day laborers nationally are between 115,000 and 120,000. Day laborers are predominantly Latino men, immigrants, mostly recent arrivals (less than five years) and most have undocumented immigration status (Valenzuela, Theodore, Melendez, & Gonzalez, 2006). Despite a high labor participation rate, day laborers are largely uninsured. In California, immigrants make up 29% of employees in the workforce but represent 53.6% of working adults without health insurance. Immigrants have limited access to health services due to their high levels of uninsurance, low levels of employment-based coverage, poverty, and language and cultural differences. These disparities are similar to those faced by low-income U.S.-born individuals, but immigrants, and in particular day laborers (who for the most part are undocumented), also face additional barriers to qualify for government-

sponsored health services. These additional barriers make day laborers the least likely among all subgroups of the workforce to access health services. Access to health services is a pressing issue for day laborers. The state of being unauthorized restricts day laborers to seek employment in the informal sector of the economy, which does not provide health insurance or adequate protection for occupational hazards. Day laborers cannot afford to purchase coverage privately given their limited financial resources. The sporadic nature of day labor employment results in extreme poverty conditions that jeopardize their ability to support their families. Lacking health coverage, the means to afford private care and facing occupational risks, leads day laborers to forego health services until it becomes an emergency. This formidable barrier to access to health care has important consequences for the health status of day laborers. Despite these unfavorable conditions, day laborers endure their role in the US workforce.

Their presence is found from Washington, DC to Los Angeles in both urban and suburban settings. Day labor is characterized by men who congregate in visible "open air," curbside locations such as empty lots, street corners, parking lots, or store fronts of home improvement establishments to solicit temporary daily work (Valenzuela, 2000). Soliciting work in this manner is an increasingly visible part of the urban landscape (Valenzuela, 1999). Data from the National Day Labor Study confirms day laborers are present throughout the states and that they are an intricate part of the nation's economy. Day laborers meet the need of flexible labor in the United States. Since the 1980s, there has been a trend towards part-time and short-term employment and a decline in full-time jobs



with benefits (Sverke, Hellgren, & Naswell, 2002). This economic restructuring favors day laborers. Other reasons for their demand are the irregular labor needs of the construction industry and an increase in the "do-it-yourself" home improvement market.

Day laborers are a vulnerable population in the United States. They often perform dangerous work and are exposed to occupational hazards with little regard to their safety (Layne & Pollack, 1998). Day laborers are prone to workplace abuses and are not adequately protected by existing labor laws. They are often hired to do the most physically demanding and potentially hazardous parts of a job (Magana & Hovey, 2003).

If they become injured they are less likely to receive medical attention and workers compensation benefits. There are few studies addressing the health status and access to health care for day laborers. The studies available are usually unpublished, exploratory, and pay particular attention to the daily mechanisms of work and occupational risk factors. Most of the research is comprised of pilot studies that include small samples located in small community or hiring site settings (Layne & Pollack, 1998). Only one national survey of this population exists, the National Day Labor Survey, and two regional surveys - Los Angeles and New York - each undertaken by Valenzuela (2006).

The literature indicates that Latino immigrants, including day laborers, are affected by the following predisposing factors: age, immigration status, country of birth, area of settlement in the US, cultural beliefs, enabling, and linguistic barriers (Moua, Guerra, Moore, & Valdiserri, 2002). As previously described, day

laborers tend to have undocumented immigration status. Day laborers' undocumented status predisposes them to workplace abuse and occupational injury. Valenzuela (2000) found that over 50 percent of day laborers reported being cheated or defrauded by employers at least once. Other studies similarly report frequent instances of employer abuse ranging from verbal to physical attacks, refusal of work breaks, denial of access to food and/or water, non-payment of wages, or shorting of wages. As a result, work injury, violence, suffering, and occupational health risks occupy a central place in the lives of day laborers.

Other predisposing factors described in the literature are language barriers and culture. Culture refers to health beliefs, attitudes, values, and knowledge that can influence individuals' perceptions of health need and their use of health services (Andersen & Davidson, 2001). Cultural factors can be powerful enough to deter immigrants from using health care services even when they have access and coverage (Siegrist & Marmot, 2004). For instance, Latinos are more likely than non-Latino Whites to believe that there is little one can do to prevent cancer and that once you get it, that it is a death sentence. These beliefs deter immigrants from participating in health screenings, preventive medicine, and possibly treatment of a suspected TBI.

Language barriers include limited English proficiency (LEP) as well as complete lack of English language skills. Immigrants, particularly those with LEP, are less likely to report having knowledge about the availability of care and are more likely to experience problems communicating with their providers

(Buchanan, 2004). Of note, immigrants coming from indigenous tribal backgrounds are doubly challenged: many speak little or no English and may also have limited Spanish proficiency. They experience the most severe linguistic barriers in health care settings because there are few interpreters fluent in their dialects, and they frequently are assigned a Spanish-speaker to interpret for them. This is just one example of the numerous cultural and linguistic factors that predispose immigrants to need health services but also make it difficult for them to obtain appropriate health care.

The literature indicates Latino immigrants are likely to be uninsured. In fact, Latinos have the highest rates of uninsurance (58%) among immigrants. One of the reasons is that they are less likely to have employment-based coverage than native-born citizens. Moreover, noncitizen-Latinos have even higher rates of uninsurance than their citizen counterparts. Among low-income Latinos, the percentage of noncitizen adults who are uninsured is 70 percent. This is twice as high as the 34% of similar citizens who lack insurance (Walter, Bourgois, Loinaz, & Schillinger, 2002). These alarming rates are likely to apply to day laborers, almost all of who are low-income noncitizens. These disparities raise concerns because the lack of coverage leads to less access to preventive care, which translates into inability to receive detection and treatment at an early stage. This high level of uninsurance among day laborers has important consequences for their physical and mental health status. Uninsured individuals are less likely to have any physician visit within a year, and are less likely to have a regular source of care (Siegrist & Marmot, 2004), which impacts day laborers and their families.

Day laborers like other Latino immigrants have to evaluate their own symptoms of illness, pain, and severity of their health condition through their cultural beliefs (Agnew & Suruda, 1993). For instance, day laborers tend to minimize pain or injuries at work because the prospect of a serious injury conflicts with their self-concept of manhood as providers for their families (Walter, Bourgois, Loinaz, & Schillinger, 2002). Similarly, migrant workers often believe that their bodies have superior stamina for physical labor and therefore it is part of their identity to ignore pain (Bureau of Labor Statistics, 2009). These beliefs can affect day laborers' assessment of their need for seeking health care.

There is a confounding association with health need and limited access to health services for day laborers, particularly for noncitizens due to their highest rates of uninsurance and practices of traditional medicine. Lack of health coverage can influence both perceived and evaluated need. Perceived need can be influenced by a combination of cultural beliefs and limited access to health services. For instance, uninsured immigrants can utilize traditional remedies to ameliorate their symptoms in order to delay needed health care because they cannot afford paying their own medical bills and do not have health coverage. Perceived need can also be affected by the fact that noncitizens have less contact with or have greater problems communicating with health care providers; this may make them less aware of their medical needs than people with better access to care (Bureau of Labor Statistics, 2009).

Immigrants' evaluated health needs can be also improperly assessed because of language barriers, particularly for LEP immigrants who do not have

access to medical interpreter services (Hovey & Seligman, 2006). In addition, the literature suggests uninsured immigrants may have more conditions that go undiagnosed because they lack access to preventive health services that assess their health problems. Other areas of health need stem from the fact that day labor is occupationally dangerous. Many laborers work in the construction or home-refurbishing industry where they face frequent illness and injury, lack of safety equipment and lack of best-practice instructions for performing toxic or dangerous tasks. Roofing and sheet metal work are considered the most hazardous trades in the construction industry, with one in five workers suffering injuries or illnesses in a given year.

Latino factory and industrial workers get hurt or killed on the job more often, and their injuries are more serious, than non-Latino White and African American workers in similar jobs, Spanish-surnamed factory workers were killed in Los Angeles County at higher rates than anywhere else in the United States and sixty percent of Latinos who die on the job are immigrants. These workplace hazards are common in the lives of day laborers and contribute to their need for health services.

Day laborers experience inadequate living conditions that increase their need for health services. They are isolated from their families and their social support. Many are living in cramped or overcrowded rooms, homeless shelters, or on the streets where violence and other hardships take a daily toll on their physical and mental health (Valenzuela, 2000). It is common for day laborers to have informal living arrangements in which they share a single room with four to

six men. When conflict arises it can force them to live in the streets. Living and working in the street exposes day laborers to violence and hardship that is endemic in low-income neighborhoods. Day laborers who are recent immigrants are targeted for robbery and assault because they lack the urban street skills to place and store their savings. These hardships are extremely taxing to their health, particularly for those who are recovering from injuries.

Day laborers' undocumented status negatively affects their mental health. Undocumented immigrant day laborers are restricted to a niche at the margins of society, excluded from social services, and considered fugitives of the law. They must keep a low profile to avoid being deported by the authorities and they need to recover from the trauma of having crossed the border through unauthorized means (Walter, Bourgois, Loinaz, & Schillinger, 2002). Unauthorized entry to the US is often violent and exhausting. Due to increasing border security, immigrants cross through remote areas that are less intensively patrolled, walking for days through the mountains and the desert. Some immigrants are fleeing political persecution, as well as economic and military crises, which add a troubling background to their everyday lives. Thus, economic pressures, exposure to violence, and the worker's anxiety over finding work or being deported, further increases their risk for work injury and their need for health and mental health services (Garcia, 2004).

**Attention and concentration.** Attention is a cognitive process that refers to the various ways an individual becomes receptive to stimuli and begins processing incoming data (whether internal or external) (Parasuraman, 1998).

There are various views as to what constitutes attentional processes. For example, Mirsky (1989) defines attention more broadly as “information processing” whereas Gazzaniga, Holtzman, and Smylie (1987) describes the attention structure as functioning “independently of information processing activities” and not as a developing property of a continuing processing system. Researchers are generally in agreement that the definition of attention should include the aspects of the voluntary and reflex processes (Leclercq, 2002; Parasuraman, 1998) and that the defining characteristics of attention are its limited resources and capacity for detachment to shift focus, as well respond to sensory or semantic stimuli.

Most researchers think of attention as a system in which processing occurs sequentially in a series of phases within the different brain systems required for attention (Jeannerod, 1994; Luck & Hillyard, 2000; Vogt, De Houwer & Crombez, 2011). Specifically, the phases include the ability to integrate the earliest entries that are modality specific, while late processing is conscious and is supramodal (Jeannerod, 1994; Posner, 1990). Generally, most daily activity is dependent on intact attentional mechanisms for focusing attention, dividing attention when needed, and sustaining attention until the activity is finished.

There is a finite amount of processing that can occur at one time, because the attentional system is limited in its capacity (Lavie, 2001; Pashler, 1998; Posner, 1978; van Zomeran & Brouwer, 1994). Attentional capacity varies between individuals and also within each person at different times and can be circumstance dependent (American Educational Research Association, American

Psychological Association, & National Council of Measurement in Education, 1999). Depression, anxiety, fatigue, or medication can reduce attention capacity in adults who are otherwise cognitively intact (Zimmerman & Leclercq, 2002), as can old age (Parasuraman & Greenwood, 1998; Van der Linden & Collette, 2002), and brain injury. Finally, immediate attention span, the amount of retained information at one time, is an effortless process that tends to be fairly resistant to the effects of aging and of many brain disorders (Albert & Heaton, 1988).

Though sometimes considered a form of working memory, the immediate attention span is also an integral component of attentional functioning (Lezak, Howieson, & Loring, 2004). Even though a person may experience attentional deficits, other cognitive functions can remain intact. Therefore, this person might be capable of some high level functioning and yet their overall cognitive productivity can suffer from inattentiveness, flawed concentration, and resulting fatigue (Stuss et al., 1985; Stuss et al., 1989).

Focused or selective attention, better known as concentration, is one of the most researched aspects of frontal lobe functioning (Lezak et al., 2004).

Concentration is the capacity to cognitively highlight ideas being presented (focused attention) or focusing on multiple stimuli while actively inhibiting competing distractions (selective attention). Of note, difficulties with attention and concentration are amongst the most common psychological problems associated with brain damage (Lezak, 1989).

### **Education and Neuropsychological Testing**

Without careful consideration of educational variables, neuropsychology



runs the risk of finding brain pathology where there are only educational differences (Ostrosky-Solís, Ardila, Rosselli, Lopez-Arango, & Uriel-Mendoza, 1998). It is generally agreed that literacy and educational levels may be reflected in psychoeducational and neuropsychological testing. Significant cognitive transformations of learning to read and to write have been addressed in the literature, for example, changes in visual perception, logical reasoning, and memory strategies (Laboratory of Comparative Human Cognition, 1983) have been reported. It should also be noted the influence of schooling on formal operational thinking has also been highlighted (Laurendeau-Bendavid, 1977). Educational level represents a crucial variable in psychoeducational and neuropsychological test performance, as educational attainment significantly correlates with scores on standard tests of intelligence, including norms. This correlation ranges from about 0.57 to 0.75 (Matarazzo, 1979). Correlations with verbal intelligence subtests are usually higher (from about 0.66 to 0.75) than correlations with performance intelligence subtests (from about 0.57 to 0.61). Based on this, it can reasonably be assumed that psychometric measures of intelligence are strongly biased by education (Ardila, Rosselli, & Rosas, 1989).

Educational attainment is a major factor in the interpretation of cognitive test scores but years of education are not necessarily synonymous with educational quality among racial and ethnic minority populations. For example, although culture and education are two factors that significantly affect cognitive performance, it is often difficult to distinguish between the effects of education and the effects of culture, since educational level influences the sociocultural

status of an individual. Ostrosky-Solis (2004) and Ostrosky-Solis, Ramirez, Lozano, Picasso, and Velez (2004) investigated the influence of education and culture on the neuropsychological profile of an indigenous and non-indigenous population in Mexico. They studied the Maya group, who live in the state of Yucatan in the Mexican Republic. Results showed that indigenous subjects showed higher scores in visuospatial tasks and that level of education had significant effects on working and verbal memory. No significant differences were found in other cognitive processes (e.g., orientation, comprehension, and some executive functions). The researchers concluded that culture dictates what is important for survival and that education could be considered a subculture that facilitates the development of certain skills over others. Further, they highlighted the idea that culture and education affect cognitive skills, so that valid measurement of cognitive dysfunction is dependent on both educational and cultural domains.

**Validity.** Validity has been assigned different meanings over the years. Likewise, different forms or aspects of validity have been proposed and developed in an effort to help define and guide test validation. Typically, two basic categories, which Cronbach (1949) termed logical and empirical forms of validity are recognized. Although the concept of validity has historically been described in numerous ways, there is a general consensus that validity is not an inherent characteristic of tests and what researchers and clinicians seek to validate are inferences derived from test scores (Lissitz, 2009). Validity is traditionally defined as the accuracy and/or appropriateness of interpretations

assigned to tests scores and the uses made of test scores (Sireci, 1998, 2008). Essentially, validity is commonly defined as a question (Kerlinger, 1986, p. 417): “to what extent does a measurement provide the correct answer?” (Kirk & Miller, p. 19), While Boorsboom, Mellengbergh, & van Heerden (2004) conceptualize validity as a property of a test, they define validity in terms of a causal relationship between the attribute being measured and performance on the test’s tasks. Lissitz and Samuelson (2007) also treat validity as a property of the test, but associate it with the representativeness of its content relative to some domain (e.g., history). In testing the validity of neuropsychological measures, it is important to look at the relationship between the purpose and context of the assessment to an individual’s test performance.

There are numerous types of validity, however face validity, content validity, construct validity, and ecological validity are commonly used in cognitive measurements. Face validity is concerned with how a measure or procedure appears. Unlike content validity, face validity does not depend upon established theories for support (Fink, 1995). Content validity reflects the extent to which the behaviors sampled by a test are representative of the domain to be measured. Construct validity generally determines how well observable behaviors measured by the test represent a particular underlying theoretical construct (Mitrushina, Boone, & D’Elia, 1999). Cronbach’s (1949) idea of ecological validity is a loosely organized, broadly defined set of approaches, including content analyses, and examination of operational issues and test processes. Much of what has become known as content validity is found within this broad category. Cronbach

and Meehl (1955) organized their seminal paper on validity on construct validity around interpretations and noted validity was not about the property of a test, but about a property of test interpretations. Further, Cronbach and Meehl (1955) noted they were not simply aligned with the factual question of whether a test measures an attribute; they were invested in the complex question of whether test score interpretations were consistent with a nomological network involving theoretical and observational terms, or with a more complex system of theoretical rationales, empirical data, and social consequences of testing (Messick, 1989).

It is generally accepted that the most common use of neuropsychological tests of frontal lobe functioning is where performance on the test is viewed as representing the state of some brain process/es that are used in situations outside the controlled testing environment (Burgess, Alderman, Evans, Emslie, & Wilson, 1998; Gioia, 2009). This is frequently referred to as ecological validity and is defined as the extent to which research results can be applied to real life situations outside of research settings. This issue is closely related to external validity but covers the question of to what degree experimental findings mirror what can be observed in the real world. To be ecologically valid, the methods, materials and setting of a study must approximate the real-life situation that is under investigation (Gioia, 2009).

**Reliability.** Reliability is a fundamental psychometric property that should be determined in the measurement of any theoretically important empirical construct. Of note, when researchers are developing scales, reliability is of the utmost importance. The issue of reliability of measures used in mainstream

cognitive psychology, however, is typically neglected. As related to clinical neuropsychology, reliability refers to the degree to which test scores are free from errors of measurement, and is often defined as an indication of a test's consistency between two or more administrations or ratings of that test (Spreen & Strauss, 1998). To the extent that a test is unreliable it cannot be valid, because a test's reliability establishes the upper limit for that test's validity: clinical neuropsychologists who use tests may benefit from being familiar to what extent differences between forms or administrations of a test reflect simply errors of measurement as opposed to signifying actual differences in underlying abilities (Kirk & Miller, 1986).

**Cultural equivalence.** Clinical neuropsychologists have sought to address the influence of culture and ethnicity in neuropsychological assessment through various means, including creating putatively “culture free,” “culture fair,” and “nonverbal measures” (Helms, 1992). Ideally, a neuropsychological measure or item used in cross-cultural applications would be “culture fair” or “culturally equivalent.” Cultural equivalence is generally defined as the equivalence of scores across national, cultural boundaries, or ethnically non-discriminatory use within a society (Helms, 1992, p.72). Early attempts based on non-verbal and performance tests (Anastasi, 1988) did not prove to be as “culture fair” as hoped for. Unfortunately, it appears that non-verbal testing does not necessarily reduce cultural bias, and many non-verbal activities are educationally dependent. Consequently, it is probably more realistic to consider the concept of

“culturally reduced tasks” rather than “culturally loaded tasks” (Helms, 1992, pp.105).

In order to analyze test items and gain additional understanding of test taking behavior, Perry, Satiani, Henze, Mascher, and Helms (2008) recommend researchers utilize qualitative methods to better understand how individuals from different cultural groups generate and assign meaning. One example the authors' suggested was to conduct focus groups composed of test takers and have researchers code the meaning of test items from the test takers' own cultural perspective.

**Assessment measures in Spanish.** Latino Americans are the largest foreign language speaking racial/ethnocultural minority within the United States comprising approximately 12% of the population. As of the 2010 census 78% of Latino Americans over the age of five reported speaking Spanish at home (U.S. Bureau of the Census, 2000). There are numerous Spanish language neuropsychological test instruments that have been published for use with Latino American adults ranging in ages from 18-65 years old (see Table 5). Ardila, Rosselli, and Puente (1994) described tests of orientation and attention, language, memory, and spatial and praxic abilities, that included translations of commonly used English measures such as the Boston Diagnostic Aphasia Exam, Mini-Mental State Examination, and the Wechsler Memory Scale. The Neuropsychological Screening Battery for Latinos (Ponton, 2001) is an 80-minute screening battery assessing language, memory, visual-perceptual functioning, mental control, psychomotor functioning, and reasoning. The NEUROPSI

(Ostrosky-Solis, Ardila, & Rosselli, 1999) is a 30-minute screening battery designed to assess orientation, attention, memory, language, visuoperceptual, and executive functions. The Bateria Neuropsicologica en Espanol (Artiola i Fortuny, Hermosillo, Heaton, & Pardee, 1999) contains eight tests of attention, memory, and executive functions that are adaptations of widely utilized English language measures (e.g., Wisconsin Card Sorting Test). The Bateria-R (Woodcock & Munoz-Sandoval, 1996), the Spanish version of the Woodcock-Johnson Psychoeducational Battery-Revised, has been described as “. . . the most comprehensive, properly validated and normed intelligence test available for use with Spanish-speaking immigrants” (Schrauf, Weintraub, & Navarro, 2006, p. 393). This measure is comprised of 39 subtests (e.g., processing speed, long-term retrieval) covering cognitive abilities, oral language, and academic achievement.

These tests were all intended for use with monolingual Spanish-speaking adults and, except for the NeSBHIS that was normed in Los Angeles on a group that was 30% bilingual, mostly have norms collected from foreign countries: in Colombia; Mexico, Spain and the United States-Mexico border region (19% were United States residents; 17% of the total was bilingual); and the Bateria-R mostly from Mexico, Puerto Rico, Costa Rica, Spain, and Peru, (34% were United States residents). This raises the issue of how suitable these norms are for Hispanic American adults, many of who are better characterized as bilingual. Based on the age breakdown of participants in neuropsychological studies

reviewed by Gasquoine (2001), Hispanic Americans who are monolingual Spanish speakers are more frequently found amongst the elderly.

Within the adult age range, Spanish monolinguals tend to be foreign born, recent immigrants, and poorly educated. Artiola i Fortuny, Heaton, and Hermosillo (1998) argued that Hispanic Americans “. . . do not maintain bilingual status and tend to lose proficiency in their language of origin to a significant degree” (p. 365), but this observation is probably less applicable to Hispanic Americans who reside in certain enclaves within the United States where Spanish and English languages are both widely used. One such enclave is the Rio Grande Valley region of Texas, a collection of small communities and towns on the Mexican border stretching from Laredo, south of San Antonio to Brownsville, on the Gulf of Mexico. Over 90% of area residents’ are Hispanic American, many of whom are subjectively fluent in both languages. Likewise, Hispanic American residents in certain areas of Los Angeles County are also subjectively fluent in both English and Spanish, and able to switch easily between languages, and have little accent in either language. Participants in this study were all residents from this area (Casas & Ryan, 2010).

The most popular and widely utilized psychological test with Hispanic Americans is the Escala de Inteligencia Wechsler para Adultos also referred to as EIWA (Wechsler, Green, & Martinez, 1968), which is the WAIS Spanish translation. The majority of items in the EIWA were translated and adapted for use with an exclusively Puerto Rican sample. Differences in conversions from



raw scores to scaled scores between the two tests (English and Spanish versions), predicated upon assumptions of the need to adjust such conversion calculations for use with Spanish speaking participants, resulted in an overestimation of IQ of Hispanic examinees by as much as 20 points compared to the U.S. English-speaking normative samples. As a result, clinicians have been cautioned that it may be unethical to utilize this instrument with U.S. Latino populations and to take this into consideration when interpreting test results (Glymour, & Manly, 2008).

Normative data have also been published for multiple measures from the Benton Laboratory and for the Wisconsin Card Sorting Test. This research provided normative data and statistical comparisons between linguistic/cultural groups on the Multilingual Aphasia Examinations, English and Spanish (Rey & Benton, 1991). It also provided normative data for the Wisconsin Card Sorting Test in a Spanish-speaking sample, along with statistical comparisons of the English-speaking and Spanish-speaking normative data samples.

Another screening battery of Spanish-language neuropsychological tests, the NEUROPSI (Ostrosky-Solis, Ardila, & Roselli, 1999) has been developed, standardized and psychometrically investigated. This brief battery assesses various cognitive functions, including orientation, attention, memory, language, visuoperceptual abilities, and executive functions. Strengths of this battery include its brevity, normative base of over 800 monolingual Spanish-speaking participants, its inclusion of normative data for individuals with very low levels of formal education, and its normative stratification by age and educational level for

all measures. Although most measures included in the NEUROPSI are adaptations of English-language instruments, all were designed to provide culturally relevant content for Spanish-speaking individuals.

Other measures for use with special segments of the Latino population have been developed and investigated. To illustrate, neuropsychological assessment procedures to evaluate dementia or other common neurocognitive dysfunctions of older Latino adults have been developed (Ardila & Rosselli, 1989). Additionally, the use of the Mini-Mental State Examination (MMSE), a commonly used, brief screening measure for gross mental status with monolingual Spanish speakers has translations in Spanish and has been investigated (Ostrosky-Solis, Lopez-Arango, & Ardila, 2000).