DISSERTATION

NEUROPSYCHOLOGICAL ASSESSMENT OF SPANISH-SPEAKING POPULATIONS: TRANSLATIONS AND NORMS FOR THREE TESTS

Submitted by

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WE HEREBY RECOMMEND THAT THE DISSERTATION PREPARED UNDER OUR SUPERVISION BY THOMAS A. CUMMINGS ENTITLED NEUROPSYCHOLOGICAL ASSESSMENT OF SPANISH-SPEAKING POPULATIONS: CULTURALLY RELEVANT TRANSLATIONS AND NORMATIVE DATA FOR THREE MEASURES OF COGNITIVE FUNCTIONING BE ACCEPTED AS FULFILLING IN PART REQUIRMENTS FOR THE DEGREE OF DOCTORATE OF PHILOSOPHY.

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ABSTRACT OF DISSERTATION

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Increasing demand for neuropsychological assessment of the growing population of Spanish-speakers in the United States has necessitated the development of culturally appropriate measures of cognitive functioning. Previously, the use of literal translations, untrained interpreters, and English-speaking norms has resulted in culturally-biased and unreliable evaluations. The present study addresses the lack of appropriate measures by developing culturally-relevant translations of a word list memory task, a test of visuoconstruction, and a test of non-verbal reasoning. Normative data on a sample of 148 Spanish-speaking participants stratified by age and education are provided. Current results reveal age effects on both memory and nonverbal measures. Generally, performance declines with increasing age. There were no effects of education on the memory measures. Education effects were present on the nonverbal measures; performance improved with higher levels of education. No effects of gender, occupation, or acculturation were found on any of the measures. For the validation of these measures further research is needed involving clinical populations and expanded normative data collection.

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Introduction

Clinical Neuropsychology

The field of clinical neuropsychology has grown over the past half century at a rapid rate. From Ralph Reitan's first version of the Halstead-Reitan Neuropsychological Test Battery in 1951 (unpublished, in Golden, Osmon, Moses, & Berg, 1981) to the current plethora of batteries and process approaches, the field has gained many converts and a position of prominence and respect (Snyder & Nussbaum, 1998).

Neuropsychologists are staff members in many departments of neurology, neurosurgery, and psychiatry at major teaching hospitals across the country. Many primary care facilities consult with neuropsychologists on a regular basis: Emergency departments regarding patients with traumatic brain injury; cardiology departments on behalf of patients who have suffered strokes, multiple infarcts, or anoxic episodes; oncology departments for patients with central nervous system (CNS) tumors; and geriatric departments for assessment of patients with suspected dementia. Neuropsychologists are considered an integral part of multidisciplinary teams in rehabilitation hospitals. Consequently, the membership roles of related national and international scientific and professional organizations are swelling as are the number of neuropsychological training programs.

In short, neuropsychology came of age in the nineties. Two examples of formal recognition of the discipline are: 1) The inclusion of American Medical Association-approved neuropsychology CPT codes within the neurological domain (Pérez-Arce, 1999). 2) The specific recognition in the *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition (DSM-IV; American Psychiatric Association, 1994) that neuropsychological assessment is a valid method of differentiating and diagnosing cognitive disorders.

With the recognition and expansion of neuropsychological services there has been a concomitant burgeoning of neuropsychological tests and measures. Widely held to be the definitive compendium of such tests, Muriel Lezak's *Neuropsychological Assessment* (1995) lists more than 600 tests and assessment measures for the evaluation of function and dysfunction in various cognitive domains. These include general intelligence, sensory/perception, attention, memory, speech/language, visuoperception, visuoconstruction, motor, conceptual, and executive capacity. The vast majority of these measures were developed in the English language and normed on samples that were primarily Caucasian, middle class European Americans.

Over time, psychological assessment of what is deemed as appropriate behavior has shifted from a reliance on subjective, qualitative approaches to a reliance on objective, quantitative protocols based on normative data. In contrast, neuropsychology has always relied on the norm-referenced approach to interpret assessment results (Lezak, 1995). Normative data serve as a reference against which the performance of the referred individual is compared. With this information, statistical and clinical inferences are made about behavior as it relates to brain functioning. It has been stressed that the performance of the individual being assessed be compared to that of the *relevant* norm group. Primarily, the variables considered important in norm-based referencing have been simple demographic factors such as age, gender, and years of education (Heaton, Grant,

& Matthews, 1991). Recently however, the factors that determine the relevancy of the norm group to the individual case are being reexamined.

Culture Shapes Cognition

From its inception, neuropsychology has been framed as an atheoretical and decontextualized science that studies the "brain as an organ whose processes proceed independent of fundamental socioenvironmental variables" (Pérez-Arce, 1999, p. 582). Under the banner of scientific positivism and reductionism, the search has focused on the 'holy grail' equivalents of universals in cognitive processes that mediate behaviors ordained by the neurobiological brain. This view is epitomized by Matarazzo's (1992, p. 1011) prediction that future tests of cognition and intelligence will focus on the "neuromolecular, neurophysiological, and neurochemical levels." The assumption was as follows: If the testing situation is held fairly constant with the use of appropriate instruments and well-trained professionals, then the dependent measure, brain function, will be accurately measured (Ardila, Rosselli, & Puente, 1994). Consequently, testing results obtained in the 'context-free' office by unbiased examiners using 'culture-free' tests have been considered sufficiently valid and reliable to predict behavior in the referred individual's home and community.

This position downplays, or altogether discounts, the existence of cognitive dimensions that are permeated by cultural, social, and socioeconomic influences. Several investigators from the fields of anthropology, cognitive psychology, and sociology have emphasized a fundamental role for the influence of culture on cognition.

Culture is explained by D'Andrade (1988, p.116) as consisting of:

> "learned systems of meaning, communicated by means of natural language and other symbol systems, having representational, directive and affective functions, and capable of creating cultural entities and particular senses of reality."

Thus, culture is not only evidenced by language and customs, but also by a set of cognitive propositions about the world at large. Fan (1984) postulates that cognition is not only structural but also functional. Environmental factors, which are relative and transient, shape the development of cognitive structures. Shore (1996) refers to the "construction of meanings" to describe the process through which culture shapes cognition. The ambient culture induces internal symbolic processes that, through their effect on the biological brain, shape a person's perception and behavior in everyday life. A given culture's propositions about nature and humankind are both descriptive and normative (Spiro, 1988). The normative aspect of a culturally determined cognitive framework is encompassed by the term *socially shared cognition* (Pérez-Arce, 1999). Resnick and colleagues (1991) describe thinking as a *sociocognitive* activity. They coined the term *situated cognition* to describe how knowledge is constructed through a dynamic interaction of objective (consensually validated physical) characteristics *and* the individual's self-referring information such as culturally determined values, beliefs, and social roles. An individual's cultural knowledge and social experience grind the interpretive lenses through which one makes sense of the world. Cultural relevancy, through a process of consensual validation and social reinforcement, cultivates each individual's percepts, reasoning, and problem solving strategies. In short then, important aspects of cognition are *culturally bound* (Derry, 1996).

Language is the primary medium of culture. Benjamin Lee Whorff's seminal work, Language, Thought and Reality (1956) crystallized the theory that language determines the way we perceive, interpret, classify, and react to so-called objective stimuli. Although this position is considered extreme, most ethnolinguists and many cognitive psychologists agree that language plays a critical role in the development of higher cognitive functions (Pérez-Arce, 1999).

These revelations have generated an increasing awareness of the importance of incorporating the individual's ecological context into the interpretation of neuropsychological data (Ardila et al., 1994; Pérez-Arce & Puente, 1996; Pontón, Melendez, & Monguio, 1997; Puente, 1993). If assessment is to be accurate and rehabilitation efforts successful, the patient's culture, language, and socioeconomic status, as well as their gender, age, and educational level must be taken into account. The DSM-IV (American Psychiatric Association, 1994) addresses the importance of cultural competency in the assessment and treatment of mental disorders and has provided an outline for the cultural formulation of cases. Moreover, the American Psychological Association Task Force on the delivery of services to minority populations has developed specific guidelines for the providers of psychological services to culturally diverse populations (American Psychological Association, 1990).

Hispanic Populations

Terminology and Heterogeneity. The term Hispanic came into acceptance in the 1940s when the U.S. Census Bureau used it to refer to people who emigrated from countries south of the border (Ruiz, 1982). According to Webster (McKechnie, 1983) the term refers to the people, speech, or culture of Spain, Portugal, and Latin America. The

Diccionario de la Lengua Española, Vigesima Edición (Real Academia Española, 1984) defines Hispano as referring to Spain or the nations of Hispanic America. This is confusing, however, as there are many nations in Latin America where Spanish is not the primary language. Portuguese is spoken in Brazil, French in Haiti, and English in Belize. Latino is used in the U.S. to refer to people who are born in Latin America (Pontón & Ardila, 1999). This would exclude those born in Spain and those who were born in the U.S., unless we consider the U.S. to be a part of Latin America. The United States is the fifth largest Spanish-speaking country in the world. In some respects this too would make the U.S. part of Latin America. For purposes of convenience this study will use Hispanic to refer to individuals living in the U.S. and who were born in, or can trace their family background to, one of the Spanish-speaking Latin American nations or Spain (Marin &_Marin, 1991). The more specific term Mexican American will refer to the subgroup of Hispanics who were born in or trace the family background to Mexico.

As of June 1997, Hispanics, 29.2 million strong, comprise 10.9 percent of the total population of the United States (US Census Bureau, 1997). The Hispanic population is the fastest growing minority and by the year 2025 they will constitute the largest minority group in the United States (Statistical Abstract, 1990). Moreover, by 2050 they will outnumber all other major ethnic minorities combined and will comprise one fourth of the U.S. population (New York Times, 1997). However, the Hispanic population is not one race nor one culture, but many (Shorris, 1992; Pontón & Ardila, 1999; Llorente, Pontón, Taussig, & Satz, 1999). Factors contributing to this heterogeneity include ethnicity, language, acculturation, education, age, and socioeconomic status. Given what we've learned of the influence of culture on cognition, these factors are worthy of incorporation into the research and development of a relevant Hispanic neuropsychology.

Ethnicity. Even the U.S. Census Bureau concedes that "Hispanics may be of any race" (1997, p. 1). Race refers to the biological divisions of humankind whereas culture is delineated by language and customs (McKechnie, 1983). In the sociological definition, ethnicity refers to shared race/nationality, culture, and language. The Hispanic population represents a multitude of ethnic groups (Shorris, 1992). Two concepts that explain the diverse ethnicity of Hispanics are *mulataje*, the ethnic mixture of the Spanish with African peoples, and *mestizaje*, the ethnic mixture of the Spanish with the indigenous peoples at the time of the *conquista* (Pontón & Ardila, 1999).

Country of origin, regional differences, and patterns of immigration are more immediate variables that determine ethnic identity (Llorente et al, 1999). For example Argentineans, Cubans, and Mexicans are generally considered to be ethnically distinct, as well as linguistically and culturally. The largest immigrant population is represented by Mexican Americans who comprise 63.6 percent (greater than 14 million persons) of the total Hispanic population of the United States (U.S. Census, 1992a). Mexican Americans are currently the largest minority in the southwestern states (Rogler, Malgady, Costantino, & Blumenthal, 1987; Malgady, Rogler, & Costantino, 1987), and in many counties in the southwest they represent a majority of the total population (U.S. Census, 1992b). Much of the focus of this work will be with Mexican American populations.

Language. Worldwide there are more than 500 million Spanish speakers compared to 360 million English speakers (World Population Data Sheet, 1990). The United States is the fifth largest Spanish-speaking country in the world, with over 20 million speakers (Ardila et al., 1994). Yet Spanish is a heterogeneous language group of regional dialects, pidgins, and creoles (Shorris, 1992). The primary dialect of Spain is referred to as *Castillian*, and it is considerably different than the Puerto Rican dialect, which in turn is quite different from the Mexican American dialect (Shorris, 1992). In fact, the dialects of Mexican Americans in Texas and southern California are noticeably different (Cobos, 1983).

The continuous creolization of Spanish further complicates the assessment process. In a culture where bilingualism is misperceived as a political threat, minorities whose mother tongue is not English tend to lose vocabulary and grammatical mastery (Pontón & Ardila, 1999). As they acquire new concepts and vocabulary in English, they do so more laboriously because they have to back-translate into Spanish (Artiola i Fortuny & Mullaney, 1997). When there are no direct translations, a variety of transliterations develop. These 'Hispanicized' English terms like *guinchil* (windshield) and *renche* (wrench) are numerous and regionally specific (Cobos, 1983). Further complicating the language is the ubiquitous influence of the Hispanic media that popularize transliterations and hybrid neologisms. The borrowing from English, the application of English syntax to Spanish phrases, the diversity of regionally-specific idiomatic expressions, and the transliterations all converge to forge a language that is evolving so rapidly that it defies cataloging.

Bilingualism presents a confound in the assessment of cognitive abilities that proves to be difficult to clarify. Depending on the age of emigration, the degree of acculturation, and the level of educational attainment, the linguistic capabilities of a Hispanic individual can be categorized along a continuum that includes five linguistic categories: Monolingual, Spanish only; Bilingual, Spanish dominant; Balanced Bilingual; Bilingual, English dominant; or Monolingual, English only. True bilingualism implies an equal mastery of both languages in all domains of cognitive functioning. Kuhl (1993) suggests that, because languages have specific phonemic patterns, the perceptual maps for one language constrain the acquisition of a second. This view questions the notion of a true bilingual except in cases where there is simultaneous and similar degree of exposure to both languages before age ten (Kuhl, 1993). Many self-reported bilinguals usually have a preference for one of the two languages. Further, that preference may differ depending on whether they are speaking, reading, or writing. Generally, if the age of emigration was ten or older, the individual's mother tongue would likely be Spanish (Harris, Cullum, & Puente, 1995). Emigration at an earlier age would allow any possible category placement depending on the degree of acculturation (Shorris, 1992).

Typically, the Hispanic whose mother tongue is English tends to be younger and native to the United States. On the other end of the continuum, 50 to 70 percent of Hispanics over the age of 60 speak only Spanish (Kemp, Staples, & Lopez-Aqueres, 1987). Cubrillo and Prieto (1987, in Taussig, Henderson, & Mack, 1992) estimate that nearly ninety percent of the elderly Hispanic population speak Spanish at home. The bilingual categories are complex because many, though not the majority, of Hispanic Americans are differentially competent at both languages. Often a bilingual Hispanic American will speak Spanish in the home, but speak English at work and in the world of commerce. In cases where patients were given a choice between Spanish or English language testing, those who chose Spanish tended to be foreign born, less educated, and older (Roberts, 1981).

In the assessment of a bilingual patient the clinician should refrain from automatically relying on the parsimonious choice of interviewing in English. First, a preliminary assessment should be conducted to determine language proficiency, dominance, and preference (Rogler, Malgady, & Rodriguez, 1989). Taking this into account, the clinician can proceed accordingly, using interview language and tests that are congruent with those findings. Pitta, Marcos, and Alpert (1978) suggest that, when English is the language of treatment chosen by the patient, it may be helpful to switch to Spanish long enough to clarify emotional descriptions. In their estimation, emotional expression is more spontaneous in the patient's native tongue because the use of a second language fosters intellectual defenses and control. Obviously, under ideal circumstances, the dyadic structure would involve as close a match as possible between the language abilities of the clinician and the patient.

The impact of bilingualism on neuropsychological test performance depends on the nature of the balance of proficiency between the two languages. Harris, Cullum, and Puente (1995) found that the memory performance of unbalanced bilinguals was significantly worse than that of monolinguals or balanced bilinguals. For unbalanced bilinguals the process of communication is less proficient because of the laborious process of back translation into Spanish (Artiola i Fortuny & Mullaney, 1997). For balanced bilinguals in the Neuropsychological Screening Battery for Hispanics (NeSBHIS) sample there was a positive correlation with many measures even when matched on education (Pontón & Ardila, 1999). The investigators suggest that the improved performance may be due to metacognitive strategies which, in balanced bilinguals, are highly developed through the process of learning two languages simultaneously.

Acculturation. Acculturation refers to the complex process whereby the values, behaviors, and attitudes of the dominant culture are adopted by the immigrants as they become more immersed in that culture (Rogler et al., 1987). This process varies widely for individuals and groups. It is multidimensional and will vary in degree and in context. It is reflected in immigrants' media preferences, social relations, and in the degree to which they use Spanish or English, with one study showing language contributing to 40% of the variance in acculturation (Marin, Sabogal, Marin, Otero-Sabogal, Perez-Stable, 1987). Ruiz (1982) refers to a continuum for each dimension ranging from most traditional ('completely Hispanic') to most acculturated ('completely Anglo'). However, others have proposed that the degree of orientation toward the host culture need not conflict with that toward the mother culture. This accounts for a bicultural orientation, with varying degrees along each axis and with a situational specificity. For example, a given Mexican-American may assimilate the host culture at work, but retain traditional cultural values at home.

Acculturation has been demonstrated to have an impact on the perception of illness (Epstein, Duxenbury, Borvin, & Diaz, 1994). It also influences the degree to which immigrants access mental health services (Becerra, Karno, & Escobar, 1982), and assert themselves in that process (Sue, 1981). More specifically, Herrera, Pontón, Corona, Gonzalez and Higareda (1998) using the NeSBHIS demonstrated that acculturation directly influences neuropsychyological test performance in a Hispanic population.

Due to the wide range of acculturation present in the Hispanic population, and because of the strong impact that cultural factors can have on the assessment outcome, several researchers have recommended an initial assessment of the patient's acculturation level prior to conducting any psychological assessment (Ardila et al., 1994; Malgady et al., 1987; Pérez-Arce & Puente, 1996; Pontón & Ardila, 1999; Rogler et al., 1987; Rogler et al., 1989). To assist clinicians in determining the degree of acculturation a Mexican American may have experienced, Cuellar and colleagues have developed and revised an Acculturation Rating Scale for Mexican Americans (ARSMA-II)(Cuellar, Arnold, & Maldonado, 1995; Cuellar, Harris, & Jasso, 1980). The ARSMA-II assesses acculturation through an orthogonal, multidimensional approach that uses two subscales to measure orientation toward the Anglo culture and the Mexican culture independently. It's authors report good internal reliability and the construct validity was demonstrated using 370 Mexican American normal and clinical populations representing the first to the fifth generations. It has English and Spanish versions, is a 'paper and pencil' type of test, and can be administered in 10-20 minutes. Pontón and Ardila (1999) recommend an acculturation scale developed by Marín and Marín (1991); however, they report that it requires about 80 minutes to complete (Pontón & Ardila, 1999). These acculturation measures notwithstanding, many investigators rely on self-report of language proficiency as a measure of acculturation given that language loyalty appears to be the dominant factor in acculturation (Peréz-Arce, 1999).

Interestingly, several studies have demonstrated that the socioeconomic status of the immigrant prior to migration is the strongest predictor (a positive correlation)of the degree of acculturation to the U.S. (Golding & Burnam, 1990; Neidert & Farley, 1985).

Further study in this area will be helpful in teasing apart the relative contributions of socioeconomic status and acculturation.

Age. With Hispanic populations, there is greater likelihood for interaction effects between age and other variables such as acculturation, language, education, and socioeconomic status. In contrast to their younger counterparts, older Hispanics are less likely to be acculturated to the mainstream American culture (Ruiz, 1982; Cuellar et al., 1995). They are also more likely to be monolingual Spanish speakers (50-70 percent) or, if bilingual, they are likely to be Spanish dominant (Cubrillo & Prieto, 1987, in Taussig et al., 1992). Additionally, this population is also more likely to be poor and disadvantaged educationally (Taussig et al., 1992). This translates into inadequate retirement benefits and a greater incidence of poor health or functional status when compared to the general elderly population (Andrews, Lyons, & Rowland, 1992). A report by the Commonwealth Fund Commission on Elderly People Living Alone (1989, in Taussig et al., 1992) revealed that a disproportionate number of elderly Mexican Americans face a daily struggle, living on limited incomes and coping with poor health. Andrews and colleagues (1992) observed that this translates into a greater incidence of depression related to loneliness and a lower life satisfaction, as well as a higher incidence of anxiety related to health problems and financial difficulties. All of the other mediating factors presented above, language, acculturation toward the culture of origin, low educational attainment, and low SES, appear to converge on the elderly Hispanic population. Therefore, it is imperative that the clinician be aware of the dynamic interplay that all of these factors can have on cognitive performance outcome.

Developmental factors have long been known to impact heavily upon neuropsychological test performance in English-speaking populations (Craik, 1984; Heaton et al., 1991; Salthouse, 1985). The age effect, a negative correlation with measures of cognitive functioning, is being replicated with nearly every neuropsychological study done with Hispanic populations (Adila, Rosselli, & Rosas, 1989; Taussig et al., 1992; Taussig, Mack, & Henderson, 1996). In the Neuropsychological Screening Battery for Hispanics (NeSBHIS), a sample of 300 Hispanics in southern California, Pontón and colleagues (1996) found that age was negatively correlated with nearly every measure. The strongest correlations were observed in the areas of delayed memory, abstract reasoning, and motor processing speed. Ostrosky-Solis, Ardila, Rosselli, Lopez-Arango, and Uriel-Mendoza (1998) found a strong age effect in all areas of memory and in visuoperceptual functioning. On a semantically categorized word list memory task, Jacobs, Winston, and Polanco (1997) found an age effect in an elderly population of Spanish speakers that was strongest with delayed free recall.

Education. This variable has been operationalized in terms of the total number of years of formal schooling. Formal education may occur in public, parochial, or private schools, and continue in community colleges, universities and trade schools. Many consider a GED to be equivalent to the twelfth grade. However, there are two assumptions at play here.

The first assumption is that a given year at one school is both qualitatively and quantitatively equivalent to the same year at any other school. Manly (2000) reported observing significant differences between neuropsychological test performances of older

African Americans and European Americans with the same years of education. Analysis of the types of schools the subjects attended revealed that many of the African Americans attended segregated schools with poor supplies and facilities maintenance. When reading level was analyzed they found these subjects had the lowest reading rate when compared to African American and European American subjects who attended integrated or 'whites-only' schools that were typically better supplied and in good repair. Thus, 'years of education' may not be a sensitive discriminator in determining appropriate norm groups for referencing. In response, some have recommended using standardized reading tests to assist in estimating the appropriate reference group (Johnstone, Callahan, Kapila, & Bouman, 1996).

The second assumption is that an informal education is so qualitatively different from formal education that it need not be factored into the norm-referencing process. Informal education can occur via general reading, apprenticing, mentoring, and over the internet. There are many anecdotal cases of people with little formal education yet functioning at fairly high levels. Take for example the immigrant who starts a small business that grows into a franchise because of shrewd management skills and what Gardner (1993) termed *social intelligence*. To illustrate the point, Pontón and Ardila (1999) provide a hypothetical case whereby a given patient incurs a head injury. Although he had only four years of formal education in Mexico, he has become a very successful businessman in the restaurant business. In the assessment of this patient, the same scores on the Rey-Osterrieth Complex Figure (ROCF; Osterrieth, 1944) could result in two very different outcomes depending on the norm group referenced. When compared to current normative data for this test, he appears impaired in his visuoconstructional skills. However, when compared to the lowest (0-6 years) education group for a Hispanic sample, his visuoconstructional abilities appear to be within normal limits. Clearly the criterion of *formality* is significant here. However, because it is difficult to operationalize or measure quantitatively, *informal* education has been largely disregarded.

Education as a norm-referencing variable is important for Hispanics because in many Latin American countries the quality and quantity of schooling varies dramatically depending on the financial resources of the family. The group median for years of education among Mexican Americans is 11.5 years compared to 12.7 for European Americans (US Census, 1992a). Age, socioeconomic status, and age of immigration have a strong impact on the extent of education a given Mexican American patient may attain. Generally, age is inversely related to educational level. In the adult population under 35 years of age, 7.4 percent have less than a 5th grade education and 51 percent are high school graduates. In those over 35 years, 20.3 percent have less than a 5th grade education and only 40 percent have a high school education. Generally, socioeconomic status is directly correlated with educational attainment. The dropout rate for poor Mexican American children is extremely high when compared to European American or Asian American children (Pérez-Arce & Puente, 1996). The parents of many of these children are migrant field workers with very little formal education. The children are often called on to help in the fields, and the parents do not provide the critical support needed for scholastic success because the value of a formal education has little salience in their view of a successful life.

About 10 percent of the U.S. population are functionally illiterate, with Mexican Americans representing an unusually large proportion thereof (Ardila et al., 1994). This is even more likely among segments of the Mexican American population that have recently immigrated, those who are elderly, and those of low socioeconomic status.

Education Effects on Neuropsychological Performance. Educational level has long been appreciated as a moderating variable in psychological test performance (Heaton et al., 1991; Wechsler, 1981). On standardized tests of intelligence, correlations between educational level and verbal intelligence are higher, (ranging from 0.57 to 0.75), than those between education and performance intelligence (ranging from 0.57 to 0.61; Matarazzo, 1979). Controlling for other variables, the effect of education in Hispanic populations has a similarly strong effect on neuropsychological performance in many areas of cognitive functioning (Ardila, Rosselli, & Ostrosky, 1992; Ardila et al., 1994; Finlayson, Johnson, & Reitan, 1977; Heaton, Grant, & Mathews, 1991). Generally, the correlation is positive, but research on which areas are specifically affected is mixed; the education effect is strong in some areas, moderate in others, and absent in a few areas of cognitive functioning. Cornelious and Caspi (1987) found a positive correlation between education and tests of verbal meaning, but not with tests of everyday problem solving. With the NeSBHIS sample, Pontón and colleagues (1996) found that education was positively correlated with nearly every area of functioning. The effect was most dramatic in the lowest range of years of education (0-6). In tests of visuospatial functioning and nonverbal reasoning like Block Design (Escala Inteligencia de Wechsler para Adultos, EIWA; Wechsler, 1968) and Raven's Controlled Progressive Matrices (Raven, Raven, & Court, 1993) there was a moderately strong ($r > 0.50$) and positive correlation with education. Their norms also show that education correlated positively with measures of language fluency and naming, attention and concentration, and psychomotor functioning. Though there was a positive correlation with verbal memory tasks, it was fairly weak relative to the domains mentioned above. In the auditory verbal list learning task, the immediate recall correlation was .27, short-delay recall correlation was .18, and the long-delayed recall correlation was .34. On a verbal list learning task, Query and Megran (1983) observed a positive effect of education at all levels of educational attainment. In contrast, other investigators have found an education effect on verbal memory only at the extremes of educational level, i.e. less than 5 years and more than 16 years (Wiens & Crossen, 1988; Ardila & Roselli, 1989).

Ostrosky-Solis and colleagues (1998) found that education had the strongest effect on phonological verbal fluency, constructional abilities, and conceptual functions, with lesser effects on visuoperceptual and memory functioning. Further, they found that in an illiterate subject group with a wide age range, education had a stronger effect than age. In an older Hispanic sample, Manly, Jacobs, Sano, and Bell (1999) found a significant overall effect for literacy level, even when matched for age and years of education, on many but not all areas of cognitive functioning. The illiterate subjects performed significantly lower on measures of naming, comprehension, verbal abstraction, orientation, and figure matching and recognition. However, they found no effect of literacy status on measures of verbal list delayed recall, category fluency, and nonverbal abstraction. Perri, Naplin, and Carpenter (1995), on Spanish verbal list learning measure with Hispanic subjects, found an effect of education only at both extremes of educational levels. For less than 6 years and more than 17 years of education, there were significant differences in learning trials 1-3, the interference list, and delayed recognition. However, there were no differences in short- or long-delayed recall, or in cued, delayed recall.

When evaluating patients who have little or no formal education certain precautions must be considered. In the norms used for neuropsychological evaluation, there are low numbers of subjects, or none at all, in the cells that correspond to the low range of educational achievement (Heaton et al., 1991). Thus, there is a lack of normative data for lower educational levels in the European American population let alone for the Hispanic population. Ardila and colleagues (1989, 1994) have begun to develop such norms using Spanish-speaking illiterate populations and those of low educational attainment in Columbia. Though this is a different Hispanic subculture, it is fairly safe to assume that it may be a better norm group than the small sample size of the European American normative data that some may have heretofore utilized. This valuable source notwithstanding, further development of a normative sample that is representative of the lower end of educational attainment is desperately needed as more of this population seeks neuropsychological assessment.

Socioeconomic Status. Although Hispanics span the range of socioeconomic status (SES) levels, a disproportionate number, 29.5 percent, live in poverty (US Census, 1992). Because they have larger families, their mean income per family member is far below that for all families (Arredondo, 1991). Hispanics (65 percent) are more likely than European Americans (50 percent) to be employed in blue-collar service or farm occupations. Additionally, the unemployment rate for Hispanics is 3 to 5 percent higher than that for the entire population (Becerra et al., 1982). Thus, the psychosocial stress that accompanies low SES may contribute to, or exacerbate mental illness in this population (Peréz-Arce, 1999). Puente (1990) reports that increasing numbers of this population are seeking Social Security Disability benefits due to incapacitation resulting from organic brain disorders. Thus, there is further need for outreach to this population to provide neuropsychological services for the purpose of determining competency and/or disability eligibility.

Generally, the effects of SES on neuropsychological test performance are mediated through education, health care, and acculturation and are discussed above. However, the inextricable link between SES and ethnicity is of critical importance and worth mentioning here. In the United States, people of color have limited access to safe neighborhoods, quality education, satisfying jobs, quality health care, and mental health services. As a result, some have confused the effects of SES on cognitive abilities with the sequelae of racial discrimination (Herrnstein & Murray, 1994; Rushton, 1994), often with deleterious consequences for targeted minorities and for society as a whole.

Neuropsychological Test Development and Normative Data for Hispanic Populations

The Need for Culturally Relevant Tests and Normative Data. Since the 1940s (Cattell, 1940) there have been attempts at developing culture-free tests. The very concept of culture-free or culture-fair measures has been challenged, and it is questionable whether any unbiased measures exist (Scarr, 1978). Arvey (1972) has argued that every assessment instrument developed for members of the dominant culture is likely to have some measure of cultural bias that may negatively influence the performance of minority groups. Given the inevitability of cultural bias, the focus of assessment research should be to measure the effect of cultural variables, not to control for these factors through so-called culture-free tests and non-biased interpretations.

Head injury among Hispanic populations appears to have a high incidence (Pontón et al., 1997). Likewise, Alzheimer's disease and other types of dementia are likely to rise with the aging of the Hispanic population in the U.S. (Taussig et al., 1992). Concomitantly, there is a rising need for culturally appropriate neuropsychological assessment of this population because important legal, medical, and vocational decisions are based on such assessment.

Unfortunately, much of the psychodiagnostic research on this population remains scant and unsystematic (Malgady et al., 1987; Rey, Feldman, Rivas-Vazquez, Levin, & Benton, 1999), and the provision of inadequate neuropsychological services to Hispanic populations is pervasive (Echemendia, Congett, Harris, Diaz, & Puente, 1994; Peréz-Arce, 1999). A review of materials used with Spanish-speakers in North America found much of the material to be of poor quality (Artiola i Fortuny & Mullaney, 1997). Clinicians who are called upon to assess this population may be improvising and adapting existing neuropsychological measures to provide a critically needed service. However, in the process they may be using untrained interpreters, invalid tests, and inappropriate norms that misrepresent the actual abilities of the referred patient. As a result, the clinical utility of these evaluations has been ineffectual, if not unethical.

Four Challenges to Validity in the Development of Neuropsychological Assessment Instruments for Hispanic Populations

The pitfalls to the cross-cultural validity of neuropsychological testing can be classified into four categories (Artiola i Fortuny & Mullaney, 1997; Pérez-Arce, 1999). The first, construct bias, has been alluded to in the above section on culture and cognition. Bias is suspected when there are significant differences in the measurement of a given construct across cultures. This occurs when assumptions are made regarding the cultural equivalence of a construct a test purportedly measures (Helms, 1992; Teng, 1996). Because cultural conditioning determines what constructs are relevant, the question arises as to whether a given construct has similar meaning across cultures. For example, anxiety as measured by the Beck Anxiety Inventory (Beck, 1990) may not be conceptualized in the target culture in the same manner as it is in the mainstream culture.

The second challenge is in the area of ecological validity. This arises out of assumptions about the functional equivalence of tests across diverse cultures. The ecological relevance of a given cognitive ability, as interpreted by European American investigators, may not operate in the same manner within Hispanic populations (Pérez-Arce, 1999).

The third source of bias is at the level of individual items on a test. Frequently, literal translations are subject to this type of error. A review of Spanish translations of test materials used in North America revealed that many were of poor quality (Artiola i Fortuny & Mullaney, 1997). Many of the errors were not minor; they were so unmistakable that even poorly educated Spanish-speakers would notice them. These included errors of syntax, spelling, and grammar. For example on a Spanish version of the Beck Anxiety Inventory (Beck, 1990), the symptom "dizzy or light-headed" was translated as "*mareado o ligero de cascos*" which reads "dizzy or light on hooves". The phrase "light on hooves" is meaningless in Mexico. Worse yet, in Spain or Puerto Rico it refers to someone of easy virtue. Items that are nonsensical, offensive, or contain errors of syntax would obviously interfere with the validity of the test. A different type of item bias is seen in translated tests of verbal fluency that use the letters *f*, *a*, and *s* typically used in English versions (Ardila et al., 1994; Pontón et al., 1996). The frequency of Spanish words beginning with these letters is not equivalent to those in English.

The fourth challenge to validity in cross-cultural assessment, method bias, involves the conditions of test administration (Artiola i Fortuny & Mullaney, 1997; Pérez-Arce, 1999). Sources of bias include, but are not limited to: Poor rapport between subject and examiner; failure to clarify with the patient the reason for the interview; failure to inform the patient of the types of behaviors that are expected in the interview; failure to follow culturally defined rules of proper etiquette and role expectations; failure to recognize cultural differences in social desirability; and lack of awareness of cultural response patterns (e.g., rural Hispanics exhibit acquiescent response tendencies, Pérez-Arce, 1999). In the development of neuropsychological measures for Spanish speakers, these validity risks are worthy of consideration.

Strengths and Shortcomings of Current Approaches to Neuropsychological Assessment with Hispanic Populations

Until recently, for Spanish-speaking individuals there was not a valid measure of the intellectual capacity represented by an IQ score. The Spanish translation of the WAIS, the *Escala Inteligencia Wechsler para Adultos* (EIWA; Wechsler, 1968) renders scores that are inflated by 1 to 2 standard deviations (Melendez, 1994). Some clinicians have resorted to using the verbal subtests of the experimental Spanish translation of the Wechsler Intelligence Scale for Children-Revised (WISC-R; Wechsler, 1974). However, the norms are limited both in number and in age range. Fortunately the *Woodcock-Munoz Bateria-R* (Woodcock & Munoz-Sandoval, 1996) has begun to supplant these practices. It was developed with normative baseline data on Hispanics living in the U.S.

and classified according to age and educational attainment level. It is considered to have reasonable construct and ecological validity (Pérez-Arce, 1999).

The assumption that nonverbal tests are immune to cross-cultural validity problems is being seriously challenged by several investigations. As discussed above, the findings of Pontón and colleagues with the NeSBHIS battery (1996) show that education, a variable that is undeniably culturally determined, is highly correlated with nonverbal measures as well as verbal measures. Above and beyond the effect of education, there may be other culturally specific variables that influence performance on nonverbal measures. Jacobs and colleagues (1997) found that when matched on age and education, the performance of Spanish-speaking and English-speaking elders was comparable on many language-based measures of cognitive functioning. However, the Spanish-speaking elders performed significantly lower than English-speaking elders on almost all of the nonverbal measures administered. Though there are some studies that show little effect of cultural bias in nonverbal measures (e.g., Cornelious & Caspi, 1987, discussed above), these data suggest that many, if not all, nonverbal measures are subject to the influence of cultural variables.

Analysis of a Spanish translation of the McCarthy Scales of Children's Abilities (1972) revealed content bias against the Spanish-speaking group of children when compared to the standard version with English-speaking children (Valencia & Rankin, 1985). The biased items were observed to cluster in two subtests, *Verbal Memory I* and *Numerical Memory I*. The authors attributed the bias to between-language differences in word length. Other investigators have found that word length, which for many simple nouns and numbers is longer in Spanish, negatively impacts working memory capacity

(Baddeley, Thompson, & Buchanan, 1975; Harris, 2000). This explains why Spanish-speakers routinely have scored lower in tasks of attention/concentration such as digit span and letter number sequencing (Lopez & Taussig, 1991; Naveh-Benjamin & Ayres, 1986). When investigators controlled for the number of syllables, differences persisted (Olazaran, Jacobs, & Stern, 1995). However, preliminary data (Harris, 2000) suggests that the determining factor is length of *articulatory time*, as opposed to the number of syllables, which is longer for many Spanish words and numbers. This diminished capacity of working memory in turn limits resources for the encoding of that information and compromises immediate recall (Harris, 2000; Naveh-Benjamin & Ayres, 1986).

To control for the language barrier in the evaluation process, some clinicians have used an interpreter. Often a family member is recruited in this role. There are many obvious pitfalls to this approach. First, objectivity is compromised with the involvement of a family member. The interpreter's self-imposed role and attitude toward the patient or clinician can lead to distortions (Marcos, 1980). Second, there are many concepts and words that are unknown to the untrained interpreter. Third, many tests or test items cannot be simply translated. There are many phonological and cultural variables that are not amenable to direct translation (Ardila et al., 1994). For example, the Luria-Nebraska neuropsychological battery is heavily language-based and has two scales devoted to measuring language abilities. Many of the items assume knowledge of culturally based concepts (i.e. proverbs) and culturally based sounds. Thereby, an ignorant clinician could confound a culturally based variable with the intended neuropsychologically based variable.

Literal translations of neuropsychological tests and their use with Spanish-speaking individuals can lead to the same problems mentioned above with interpreters. Additionally, the construct validity and the ecological validity are questionable. The Luria-Nebraska and the Halstead Neuropsychological Batteries have been translated; however they were translated into *Castillian* Spanish and so would be inappropriate for Mexican Americans (Ardila et al., 1994). Furthermore, to test for accuracy the translated tests should be translated back into English by linguistically competent psychometricians. To test for validity, the translated versions should be normed on Hispanic populations. The translations of these two batteries were not authorized, were not back translated, and were not normed on the appropriate populations.

All too frequently, some clinicians have resorted to using translations, formal or otherwise, and comparing the Hispanic patient's performance to the standard English-speaking norms (Artiola i Fortuny & Mullaney, 1997; Demsky, Mittenberg, Quintar, Katell, & Golden 1998; Pontón & Ardila, 1999). A case in point is the widespread use of on-the-fly translations of the Performance subtests of the WAIS-R (Wechsler, 1981) and subsequent referencing of the Hispanic patient's performance to the published English-speaking norms (Pérez-Arce, 1999). The assumption is that these tests, being nonverbal in nature, are not subject to cross-cultural relevancy issues. For reasons described above, cross-cultural referencing can easily invalidate the interpretation of the results. To test this hypothesis, Demsky and colleagues (1998) administered a detailed Spanish translation of the Wechsler Memory Scale – Revised (WMS-R; Wechsler, 1987) to 50 normal Spanish-speaking Hispanics and compared the results to the published WMS-R norms. They found that using English-language standard norms resulted in Spanish-speaking normal individuals scoring an average of one standard deviation below the average range. This was true for both verbal and nonverbal subtests. This is strong evidence against the clinical practice of using Spanish translations of English language tests without renorming and running validity checks.

Ardila and colleagues (1994) have been developing a neuropsychological battery for Spanish speakers that is being normed on monolingual Spanish-speaking subjects in Columbia. They have been careful to include elderly (65-85 years) and illiterate populations as these are frequently missing in the validation of other neuropsychological tests (in any language). They have used large sample sizes of 180-300 subjects, allowing for 10-20 subjects per cell, and have matched subjects in age, educational level, and gender. Their battery of 19 tests includes appropriate translations of some of the classic neuropsychological tests, for example, the Mini Mental Status Exam (Folstein, Folstein, & McHugh 1975), Wechsler Memory Scale-Revised, (Wechsler, 1987), Boston Diagnostic Aphasia Examination (Goodglass & Kaplan, 1983), and the Rey-Osterrieth Complex Figure (Osterrieth, 1944). More importantly, they have developed seven tests in Spanish that directly assess various aspects of speech and language functioning, as well as three other tests that assess attention and memory. However, this normative sample is quite distinct culturally from Hispanic populations in the U.S.; the factors of acculturation, language, SES, and education are all markedly different in these two populations.

Taussig and colleagues (1992, 1996) developed Spanish translations of several measures used to differentiate between normal and demented older individuals. Translations were done by bilingual psychologists from Argentina, Mexico, Columbia, Cuba, and Puerto Rico and care was taken to avoid words that have regional variations in meaning or offensiveness. The Spanish versions were administered to Spanish-speaking monolingual Mexican Americans from the Los Angeles area, half of whom were diagnosed with Alzheimer's Disease (AD), and half were without known neurological disease. Employing Brislin's (1980) method for translation in cross-cultural research, back-translations of the tests were administered to English-speaking matched controls. The Spanish-language versions discriminated between normals and AD patients as did the back-translated English versions. However, there were significant differences between the two language groups on four tests, two of which directly assess language ability. The authors suspect that the translation of the Boston naming test included items that lacked cultural relevance for the Hispanic population, whereas the translated Controlled Oral Word Association Test suffered from phonological confounds (discussed above). Nonetheless, this represents a good start in providing linguistically relevant neuropsychological tests to clinicians assessing Mexican American populations.

Rey and colleagues (1999) developed normative data for the Multilingual Aphasia Examination-Spanish. They used 234 normal subjects who were primarily Spanish-speaking and classified them according to age, education, and gender. They also compared the results of Puerto Rican subjects with that of Mexican American subjects and found no significant differences when matched on age and education. Rey and colleagues have also been developing normative data on several measures of executive functioning (1999). In both studies they have found no significant differences between their samples and the English-speaking samples with which the instruments were originally developed. One criticism is that the normative sample was drawn from Dade

County Florida, a sample that is enriched with Cuban Americans relative to Hispanic populations in the western U.S. where Mexican Americans predominate. As a group, Cuban Americans are more educated, more acculturated, and of higher SES than Mexican Americans. Controlling for education notwithstanding, the influences of acculturation and SES may confound interpretation when making inferences regarding a Mexican American patient based on these norms.

Development of an Hispanic Neuropsychology

Given the problems inherent in the translation of tests from Spanish to English, some investigators have called for the development of entirely new measures that are sensitive to the cultural variables relevant to this population (Pérez-Arce, 1999; Pontón & Ardila, 1999; Teng, 1996). A case in point is the example provided by Mungas (1996), who has pioneered a new battery developed to specifically address the cognitive abilities of older Hispanic individuals. Others argue that this extreme position is unwarranted, if not simply impractical. With rigorous test development standards, possible translation confounds can be minimized (Artiola i Fortuny & Mullaney, 1997). Additionally, much valuable data in cross-cultural neuropsychology may be lost with the secession of a separate Hispanic neuropsychology from the field of mainstream neuropsychology. Furthermore, caution is warranted as *separate but equal* solutions have historically resulted in the institutionalization of discrimination.

Taking into account the myriad problems that can occur in the development of neuropsychological measures for Hispanic populations, the following guidelines may be helpful (adapted from Artiola i Fortuny & Mullaney, 1997; Pontón & Ardila, 1999; and Pérez-Arce, 1999).

1) During the test construction phase, test authors should consult a bilingual neuropsychologist or linguist whose native fluency is advanced in the full range of linguistic skills.
2) Test authors and consultants should maintain current awareness of relevant cultural issues.
3) Translations should convey the intended meaning of each item, such that it continues to measure the target construct. Literal translations should be avoided, as these are fraught with syntactical or grammatical errors that misconstrue the meaning of the item, which in turn, can confound the measurement of the intended construct.
4) Translated versions should be back translated and/or piloted on Spanish dominant bilingual individuals who have considerable formal education in their native language as well as the English language.
5) Given the regional specificity of Spanish dialects;
   a) Selection of items should exclude terms or stories that do not generalize to different geographical areas, or
   b) Tests should be developed for specific regional populations and items should be selected based on their relevance to their particular subculture.
6) Normative data should be developed specifically for the newly developed/translated test. These data should be based on samples that have sufficient numbers and broad ranges of age and educational attainment level.
7) The factor of race/ethnicity should be coded with regard to country or region of origin.

8) The factor of acculturation should be coded with regard to age of immigration, time spent in the host culture, and language loyalty.

9) The factor of language should address the presence and degree of bilingualism. To minimize the impact of bilingualism on test performance, the response criteria should:

   a) Be developed in consultation with publications of Spanish terms used in the U.S. (e.g. Galvan's Chicano Dictionary, 1995).

   b) Be developed in consultation with formal resources that provide definitions of colloquial terms by country or region in Latin America (e.g., *Diccionario de la Lengua Espanola*, Real Academia Espanola, 1984)

   c) Accept as many possible responses to an item as are semantically permissible.

10) The factor of education should be coded in a manner that addresses both the quality and number of years of education.

Nature and Objectives of this Investigation

The assessment of episodic memory, visuoconstructional skills, and nonverbal reasoning are integral to a thorough evaluation of cognitive functioning following brain injury and in the diagnosis of neurological illness.

Memory and learning difficulties are by far the most frequent presenting complaints in neuropsychological referrals (Snyder & Nussbaum, 1998). In the common vernacular, memory is the most familiar domain of cognitive functioning. Further, memory impairment is particularly disabling in people's everyday lives. Years of investigation have revealed that memory is a complex domain with a variety of functional systems, modes of stimulus presentation, and perceptual input channels (see Appendix I). Episodic memory refers to the capacity to recall contextually specific events and is impaired in amnesic patients (Tulving, 1983) and in demented patients (Butters, Salmon, & Butters, 1994). Tests of episodic memory assess different aspects of memory and learning: Immediate versus delayed recall, free recall versus cued recall, recall versus recognition, interference effects, visual versus auditory (mode of presentation), and working memory (actually a measure of attention and concentration). The third edition of the Wechsler Memory Scale (WMS–III; Wechsler, 1997c) is a widely used and well normed test of episodic memory. It was conormed with the WAIS-III and has 16 subtests that tap into all of the areas of memory mentioned above. Although the WMS-R (Wechsler, 1987) has been translated into Spanish, critical evaluation has revealed content bias in one version (Pérez-Arce, 1999), and in another the normative sample is not representative of Hispanics living in the United States (Ardila et al., 1994). To date, no Spanish translation of the third edition has been published. A new addition to the WMS-III is a list learning task with 12 items covered in *Word Lists I* and *II*. Because it refers to the same items in the *Word Lists I*, the second subtest is actually a continuation of the first following a 25-35 minute delay. For purposes of simplicity it will be referred to henceforth as *Word Lists*. It is similar to other list learning tests such as the Rey Auditory Verbal Learning Test (RAVLT; Rey, 1964) and the California Verbal Learning Test (CVLT; Dellis, Kramer, Kaplan, & Ober, 1987). However, the RAVLT consists of 15 items, and the CVLT consists of 16 items that are semantically clustered into four categories. The WHO-UCLA Auditory Verbal Learning Test (Maj et al., 1993) is a Spanish list learning test of 15 items semantically clustered into five categories. It was developed with HIV-1 seropositive patients and was later normed on Hispanics in southwestern California (Pontón et al., 1996). Perri and colleagues (1995) developed a

Spanish Auditory Verbal Learning and Memory Test that mimics the CVLT in construction. However, the norms are quite limited in age range with relatively few subjects over the age of 35. The advantages of the Word Lists subtests of the WMS-III are its brevity, its large norm base, and the ability to relate actual performance to expected performance based on the WAIS-III.

One of the most widely used tests of visuoconstructional ability is the Block Design subtest from all editions of the WISC (Wechsler, 1949, 1974, 1991) and WAIS (Wechsler, 1955, 1981, 1997b), and more recently from the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999). Constructional ability or *praxis* refers to the ability to draw or assemble an object from component parts (Snyder & Nussbaum, 1998). It relies on visuoperceptual skills, which involve pattern discrimination, and visuospatial ability, which involves the processing of orientation or location in space. Block Design involves analysis and synthesis and is considered a nonverbal, abstract concept formation task.

Matrix Reasoning, introduced on the third edition of the WAIS and again on the WASI, is a measure of nonverbal reasoning. It subsumes four types of tasks: pattern completion, classification, analogy, and serial reasoning (Wechsler, 1999). Examinees look at a pattern or matrix, from which a part is missing, at the top of the page. They then select the missing piece from among five options at the bottom of the page.

Block Design and Matrix Reasoning are both measures of *nonverbal* or *performance* intelligence. Among the WAIS-III performance subtests they have the highest correlation with the Full Scale IQ (Wechsler, 1999), and represent the fourth and fifth best measures of *g* (general intelligence)among all 14 subtests (Sattler, 1992). The

WASI versions of these subtests correlate fairly highly with those of the WAIS-III; 0.83 for Block Design and 0.66 for Matrix Reasoning (Wechsler, 1999, p. 136). With the WASI, the two subtests generate a Performance Intelligence Quotient (PIQ) that correlates strongly (0.84) with the PIQ of the WAIS-III.

Like the WAIS-III, the WASI was constructed under the same high standards and was normed very recently on a large sample that was stratified according to demographic variables representative of the populations from all regions of the U.S. except Hawaii and North Dakota. Advantages to the WASI over the WAIS-III include the following. The WASI requires considerably less time to administer; its authors claim that it can be done in less than 30 minutes. However, this author has not been able to administer it in less than 40 minutes at best. Nonetheless, it undoubtedly requires less time than the full WAIS-III. Additionally, the WASI was developed for use with a wider age range, from six years old to 89 years old. Additionally, a Performance IQ is generated, with high correlation to the PIQ of the WAIS-III, in just 15-30 minutes using only two subtests.

The incidence of traumatic brain injury and dementia Hispanic populations appears to be on the rise (Pontón et al., 1997; Taussig et al., 1992). Concomitantly, there is a rising need for culturally appropriate neuropsychological evaluations of this population because important legal, medical, and vocational decisions are based on such evaluations. The efficiency and utility of the subtests described above, Word Lists from the WMS-III and Block Design and Matrix Reasoning from the WASI, warrant culturally-relevant adaptation to the Hispanic populations of the U.S. If assessment is to be accurate, and rehabilitation efforts successful, the patient's performance on tests measuring these faculties should be compared to that of a demographically appropriate norm group. The patient's culture, language, and socioeconomic status, as well as their gender, age, and educational level must be taken into account (Ardila et al., 1994; Pérez-Arce & Puente, 1996; Pontón, Melendez, & Monguio, 1997). For reasons explained above, scores on translated tests are only valid when compared to normative data developed with Spanish-speaking populations.

To that end the objective of this project is to develop culturally relevant Spanish translations of *Word Lists*, a list learning task from the WMS-III that tests episodic memory. Additionally, culturally relevant translations of the *Block Design* and *Matrix Reasoning* subtests of the WASI are developed and administered to the same subjects during the required interval between *Word Lists I* and *II*, as this period must engage the examinee in nonverbal tasks to prevent rehearsal. These tests measure visuoconstructional skills, and nonverbal reasoning, respectively. Using various scores on the three tests, normative data are developed with a sample of normal Hispanics, most of them Mexican Americans, for whom Spanish is the primary language. The effects of age, gender, education, acculturation, and occupation are evaluated.

Hypotheses to be tested are as follows:

1) There will be no relationship between gender and any of the memory or nonverbal measures.
2) There will be a positive relationship between memory scores and general intelligence (g) as estimated from the scores on the nonverbal subtests.
3) There will be a negative relationship between age and memory measures.
4) There will be a negative relationship between age and performance on the nonverbal measures.

5) There will be a positive relationship between education and memory measures.

6) There will be a positive relationship between education and performance on the nonverbal tests.

7) There will be no relationship between acculturation and memory measures.

8) There will be a positive relationship between acculturation and performance on the nonverbal tests.

9) Potential relationships with occupational status and performance on all measures will be explored.

Method

Participants

The initial sample consisted of 158 native Spanish-speaking adults, ranging in age from 18 to 92 years. Participants were excluded from the study if they reported a history of learning disability, head injury with loss of consciousness, psychiatric disorders, substance abuse, seizures, dementia, or other neurological disorders. Those who could not track the process or had more than eight intrusions on the memory task were also excluded as these response patterns are indicative of deficits in attention or in response discrimination (Delis et al., 1987). This type of memory deficit is suggestive of dementia or Korsakoff's syndrome (Butters & Cermak, 1980; Fuld, Katzman, Davies, & Terry, 1982). Data from participants with these response patterns or with questionable health histories were excluded, yielding a final sample number of 148.

Demographic information was collected on each participant. The factors of age, gender, handedness, years of education, country of origin, profession, years in the U.S., and self-reported proficiency with English were coded as follows.

Age was divided into four groups of roughly equal size, 18-30, 31-45, 46-65, and 66+. These dividing points are often used in many other normative databases (Heaton et al., 1991; Pontón et al., 1996). In fact, this study breaks the older subjects into more groups, because, as reported in various studies, it is among the older groups where the age effect is strongest.

In some analyses, the number of years of formal education was coded as a continuous variable. In other analyses, years of education were divided into two groups. The dividing point, between the 9^{th} and 10^{th} grades, was selected because this was the median grade level of the sample and represents a major step in educational level in many Latin American school systems. *Primaria* and *secundaria* include grades 1-6 and 7-9 respectively, whereas *preparatorio* (the equivalent of preparatory or high school) focuses on preparation for higher education. Additionally, this division has been employed in previous studies (Pontón et al., 1996; Taussig et al., 1992).

Occupation was coded by the participants' report of the type of work they have done over the past three years. If unemployed or retired, the most recent occupation was recorded. The criteria used in the grouping of occupations were adapted from previous studies (Manly, 2000; Manly et al., 1999; Perri et al., 1995). Occupations were grouped into three categories: Category 1 included food service, unskilled labor, fabricator, operator, and agricultural work. Category 2 included administrative support, sales, and skilled labor. Category 3 included professional, technical, executive, administrative, and managerial positions.

The factor of acculturation was coded with regard to age of immigration, time spent in the host culture, and proficiency with the English language. Previous studies have used either English proficiency or years in the U.S. as a rough measure of acculturation (Jacobs et al., 1997; Perri et al., 1995). The current study utilized both factors. Self-reported English proficiency (EP) was recorded along a four-point Likert scale (0 = none, 1= little, 2 = medium, 3 = much). A mainstream cultural immersion quotient (AQ, ranging 0-1) was derived by dividing the total number of years in the U.S.

by the chronological age. An Acculturation Index (AI) was developed by normalizing each the EP and the AQ to a range of 0-1, and adding them together. The AI ranged from 0-2.0.

These demographic factors or their derivatives were entered into the various statistical models as independent variables or covariants. The demographic data of the sample of 148 participants are summarized in Table 1.

Instruments

Test Development. The development of all written and oral Spanish presentations, including consent forms, test instructions, test items, and recruitment posters and speeches, were done under the guidance of three native Spanish speakers who were balanced bilinguals (with English). The first, who was most actively involved, has a Ph.D. in linguistics and has taught upper level Spanish courses for several years, the second was a Ph.D. level psychologist, and the third an experienced instructor of upper level Spanish classes.

All instructions and items were developed for a target audience with an elementary education. Not all components of the consent form met this criterion. The Human Resources Committee required specific inclusions that were complex and legalistic. However, verbal explanations were provided that met this criterion. Further, recruitment speeches and posters, developed with the same target audience in mind, reiterated much of the content of the consent form (see Appendix II).

Vocabulary selection for all components favored words that are common to most Latin Americans, rather than those unique to any country's specific dialect. Two

Table 1. Demographic data of the normative sample (N=148).

Age	*n*	**Education Level**	*n*
18-30	43	0	4
31-45	37	1-5	14
46-65	38	6	26
66-92	30	7-9	34
		10-11	16
		12	23
Gender	*n*	13-14	21
Men	73	15-20	10
Women	75		
		Occupation Level	*n*
Handedness	*n*	1	98
Right	136	2	33
Left	11	3	17
Mixed	1		
		English Spoken	*n*
Country* of Origin	*n*	None	45
Mexico	120	Little	36
Peru	7	Medium	31
Puerto Rico	6	Much	36
Guatemala	5		
El Salvador	4	**Years in U.S.A.**	*n*
New Mexico*	2	0-2	56
Texas*	1	2-5	22
Argentina	1	6-10	27
Cuba	1	11-15	9
Nicaragua	1	15-20	14
*U.S.A.		>20	20

dictionaries were consulted; *Galvan's Chicano Dictionary* (1995) provided information on Spanish terms used in the U.S., and the *Diccionario de la Lengua Española* (Real Academia Española, 1984) provided definitions of colloquial terms specific to different regions in Latin America.

Spanish versions were back translated into English by three Spanish-dominant bilingual individuals who have considerable formal education in their native language as well as in English and administered to seven native English-speaking individuals. The Spanish versions were piloted on seven native Spanish speakers who were also proficient in English. The ethnicity composition of these pilot subjects were two first generation Mexican Americans, two second generation Mexican Americans, one second generation Cuban American, one Peruvian, and one Puerto Rican. Their recommendations were incorporated into the final versions.

Three Spanish-speaking administrators were instructed in test administration. Test administration was twice role-played with two native Spanish speakers. In the first role-play the pilot examinees were instructed to simply follow the examiner's lead. The second time, the pilot examinees were instructed to occasionally act confused about the procedure, to act frustrated, and to ask frequent questions. This served to prepare examiners for any type of participant response.

In addition to the native speakers mentioned above, development of the Spanish Word Lists was done in conjunction with Debra Marmor of the Psychological Corporation who was one of the authors of the original WMS-III Word Lists I and II subtests (Wechsler, 1997). In the original version the following criteria guided item selection: 1) simple words that would be familiar to someone with minimal primary education; 2) nouns representing something concrete or tangible, or something someone could see or picture in their mind; and 3) a mixture of mono-, di-, and tri-syllabic words in mixed presentation order, with a preponderance of di-syllabic words. Item selection and translation into Spanish was guided by the combination of these criteria for the original version and the criterion calling for the use of more universal Latin American words. The syllabic length criterion presented a dilemma and was adjusted after deeper analysis. For simple, tangible nouns, the original syllabic balance was roughly representative of the syllabic length in the common North American English vernacular. However, because the distribution of syllabic length in Spanish is different, with very few monosyllabic and a higher frequency of tri- and quadri-syllabic words (Baddeley et al., 1975; Harris, 2000), the Spanish Word Lists were reflective of this distribution. In some cases there were two or more words that would convey the same meaning of an item. When the most accurate translation of an item was a phrase rather than a single word (e.g., the best translation for 'sunset' is 'puesta del sol'), a substitution within in a similar semantic category was selected. The final *Spanish Word Lists* appear in Table 2.

Because the Block Design and Matrix Reasoning (Wechsler, 1999) subtests are performance oriented rather than verbally mediated, only the instructions and permissible prompts needed translation. Again, words/phrases that are easily understood regardless of education level and words/phrases universal to all Latin Americans were chosen. Likewise, responses to anticipated questions, and brief encouraging statements were employed that are in the common vernacular. As in most test administration protocols, all forms of feedback were non-contingent in nature.

Table 2. Spanish Word Lists*

List A	List B (interference)	Recognition List
Blanco	Diamante	Revista
Dedo	Jardin	Dólar
Árbol	Cancha	Alfombra
Cocodrilo	Héroe	Nido
Dólar	Arena	Tráfico
Patio	Gatito	Doctor
Estudiante	Rama	Blanco
Tráfico	Cocina	Escoba
Escoba	Margarita	Pueblo
Mar	Lago	Dedo
Ala	Gorila	Mercado
Gigante	Cárcel	Gigante
		Sonriza
		Mar
		Casa
		Ala
		Estudiante
		Desayuno
		Pluma
		Cocodrilo
		Patio
		Cordón
		Árbol
		Hotel

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Test Scores. The translated tests yielded the following neuropsychological measures which were entered into statistical analyses as dependent variables.

A. Spanish Word Lists

1. The 1st Recall Score (R1) is the total number of items recalled on the first trial (range 0-12 points).
2. The Recall Total Score (RT) is the sum of items recalled over trials 1-4 (range 0-48 points).
3. The Short Delay Recall Score (SDR) is the number of words from list A recalled immediately after recall of the interference list (List B) (range 0 to 12 points).
4. The Long Delay Recall Score (LDR) is the number of words from list A recalled after the 25-35 minute interlude of performance tests (range 0 to12 points).
5. The Recognition Score (RG) is the number of true positives and true negatives recognized from a 24-item list after the long delay recall task (range 0 to 24).
6. The Retention Quotient (RQ) is the Long Delay Recall Score divided by the Trial 4 Recall Score, expressed as a percentage (range 0 to 100%).
7. The Learning Slope (LS) is the difference between Trial 4 and Trial 1 (range -12 to 12).
8. The Contrast AB Measure (CAB) is the difference between the 1st Recall Score (List A) and the List B Recall Score (range -12 to 12). If positive, it indicates proactive interference is present.

9. The Contrast AA Measure (CAA) is the difference between the 1st Recall Score and the Short-delay Recall Score (-12 to 12). If positive, it indicates retroactive interference is present.
10. The Intrusion Score (INT) represents the total number of response items that were not in the word list.

B. Nonverbal Tasks

1. The Block Design Raw Score (BD) can range from 0 to 71 for all ages.
2. Matrix Reasoning Raw Score (MR) can have a minimum score of 0; however the maximum score will differ depending on the age of the examinee. Because of observed differences among age groups in performance on this measure, the authors have set different ceilings (discontinuation points) for different age groups. This results in different possible maximum scores for the different age groups. For ages 18-44, the maximum is 35, for ages 45-79, the maximum is 32, and for examinees over 80 the maximum is 28.
3. The Performance Total Score (PT) is the sum of the BD score and the MR score.

Procedure

Selection of Sample. Most of the participants were recruited from various communities in Colorado with a smaller subset from Hawaii. The most frequent settings were universities, senior centers, and Catholic churches that celebrated mass in Spanish. Participants were solicited through brief oral presentations and through posted flyers (see Appendix II). Appointments were set in person or by sign-up on a posted schedule.

Test Administration. In a room with minimal distractions, the examiner and participant sat on opposite sides of a small table. The entire session lasted from 35-50 minutes depending on how quickly the participant responded and how many items they were able to answer correctly. Participants were given a consent form in Spanish (see Appendix II) and encouraged to read along as the examiner read the consent form verbatim. Subsequently each paragraph was summarized in simple language. This approach avoided the embarrassing question of whether participants could read, yet ensured that they clearly understood the nature and extent of their involvement before testing began. Via oral interview, non-identifying demographic information was collected, and a history of possible brain injury/illness was ruled out.

The *Spanish Word Lists* test was administered in the following format. The examiner orally presented brief instructions and asked the participant if there were any questions. The examiner proceeded by orally presenting all items from the twelve-word list (List A) and asked the participant to recite as many as possible immediately afterwards. This was repeated three times until a total of four trials of List A were administered. Then one trial of a 12-word interference list (List B) was administered. Immediately following the recall of List B items, the participant was asked to recall as many as possible from List A. Participants were then encouraged to remember List A and told they would be asked to recall it later.

Then participants were administered the Block Design subtest of the WASI (Wechsler, 1999). In the first trial the examiner placed four red and white plastic blocks in a pattern and asked the participant to make an identical pattern with four other blocks. In subsequent trials the participant was shown a picture of a red and white pattern and instructed to arrange the blocks so that their tops looked identical to the pattern in the picture. Participants were instructed to work as quickly as possible. There were time limits of 60 seconds with four-block designs and 120 seconds with nine-block designs. Trials were in order of increasing difficulty. Participants had to get the design correct to receive any credit, and with more complex designs, extra credit was given depending on how quickly they completed them. The test was discontinued after three consecutive scores of zero.

Participants were then administered the Matrix Reasoning subtest of the WASI (Wechsler, 1999). In this test, colored patterns that were missing a piece were presented. Participants were instructed to look carefully at all parts of the presented pattern, and then to choose the 'best-fitting' missing piece from among five options at the bottom of the page. Up to 29 patterns were presented with a 30-second time limit on each one. Each response was either correct or incorrect, and one point was given for each correct response. The subtest was discontinued after four consecutive scores of zero.

Finally, the second portion of *Spanish Word Lists* was administered. This consisted of a delayed free recall task and a delayed recognition task. In the delayed recall task, the participant was asked to recall as many words as possible from the first list of words that was repeated four times (List A). In the delayed recognition task, the participant was read a list of 24 words and instructed to say '*si*' (yes) if the word was part of List A or '*no*' if it was not.

Results

Experimentwise Alpha Level

The current study examined a variety of statistical comparisons including correlations, analysis of variance, and descriptive statistics for groups stratified by age and education. To control for experimentwise error in a consistent fashion, an alpha level was set at $p < .01$. For purposes of this study, only those values that met this alpha level will be interpreted and discussed.

Correlational Analyses

The first step in data analysis involved an examination of the relationships between three sets of variables using Pearson's r. The first set focused on those among the independent variables, the second set, among the dependent variables, and the final set looked at relationships between the independent and dependent variables.

The first set of correlations examined the relationships among the independent variables of gender, age, education, occupation, and acculturation (see Table 3). In the correlations, age, education, and acculturation were treated as continuous variables to assess the direction and valence of their linear relationship with one another. Gender was dichotomous, and occupation was entered at three levels. The rationale for using three occupation categories, unskilled, skilled, and professional, is adapted from previous research (Llorente et al., 1999; Perri et al., 1995), and is further described in the Method section above. The strongest relationship was between education and occupation (r = .68). This is understandable considering that higher levels of education are frequently

Table 3. Intercorrelations among age, gender, education, occupation, and acculturation.

	Age	Gender	Education	Occupation
Age				
Gender	.11			
Education	-.33**	-.04		
Occupation	-.13	-.08	.68**	
Acculturation	.23*	.15	.43**	.35**

*$p < .01$; ** $p < .001$

prerequisites to the more skilled and professional occupations. There were moderate correlations between acculturation and education (r = .43), and between acculturation and occupation (r = .35). This suggests that those who were more educated or had more professionally oriented occupations were more acculturated to the mainstream culture. Age and education were negatively correlated (r = -.33), revealing that the older subjects were less educated as a group. Gender was not correlated with any of the other variables.

The second set of correlations (Table 4) examined the relationships among the dependent variables. Because of the nature of the constructs tapped by the different types of measures, moderate to strong relationships were expected within the memory test measures, and within the nonverbal measures. The various measures of the *Spanish Word Lists* task are related in that all are measures of episodic memory functioning and, more specifically, auditory verbal learning and memory functioning (see Appendix I). However, each measure evaluates a specific expression of that functioning. Though they are all expected to correlate fairly highly, a profile of the various scores gives the clinician a more detailed understanding of the strengths and weaknesses a given patient exhibits in this domain. They are also related in that certain measures are mathematically derived from other measures (see Method section). Generally, the correlations among the *Spanish Word Lists* measures fell into two groups. The first group, consisting of recall, recognition, and retention measures (R1, RT, SDR, LDR, RG, and RQ), can be referred to as *primary* memory measures because they directly measure performance in a graded manner. They provide useful information independent of the other memory measures. These primary measures exhibited moderate to strong positive intercorrelations. The strongest were those between LDR and RQ (r = .86), SDR and LDR (r = .81), RT and

Table 4. Intercorrelations among all test measures.

	R1	RT	SDR	LDR	RG	RQ	LS	CAB	CAA	INT	BD	MR
R1												
RT	.72**											
SDR	.61**	.74**										
LDR	.60**	.77**	.81**									
RG	.51**	.65**	.67**	.69**								
RQ	.33**	.54**	.59**	.86**	.55**							
LS	-.51**	-.08	.12	.13	.07	-.01						
CAB	.55**	.30*	.12	.18	.12	.04	-.42**					
CAA	.06	-.10	-.44**	-.14	-.15	-.39**	.18	.20				
INT	-.17	-.18	-.19*	-.22*	-.06	-.26*	.11	-.04	.15			
BD	.38**	.53**	.45**	.43**	.40**	.30**	.03	.06	-.06	-.13		
MR	.38**	.60**	.48**	.44**	.38**	.32**	.03	.06	-.11	-.17	.86**	
PT	.39**	.57**	.47**	.45**	.41**	.32**	.03	.06	-.08	-.14	.91**	.93**

*$p < .01$; ** $p < .001$

Note. Spanish Word Lists Measures, Primary: R1 = First Recall Score; RT = Recall Total Score; SDR = Short Delay Recall Score; LDR = Long Delay Recall Score; Rg = Recognition Total Score; RQ = Retention Quotient; **Spanish Word Lists Measures, Auxiliary:** LS = Learning Slope; CAB = Contrast AB; CAA = Contrast AA; INT = Intrusion Score. **Performance Test Measures (WASI):** BD = Block Design; MR = Matrix Reasoning; PT = Performance Total.

LDR (r = .77), RT and SDR (r = .74), and R1 and RT (r = .72). Many of the strongly correlated pairs are mathematically related. Furthermore, as mentioned above, all measures in this group tap into different aspects of the same construct, namely auditory verbal learning and memory.

The second group, consisting of the two contrast measures, learning slope, and intrusions, can be referred to as *auxiliary* measures in that their interpretation is dependent upon an understanding of performance on the primary memory measures. These auxiliary measures exhibited only one significant correlation amongst themselves and generally negative correlations with the primary memory measures. The correlation between LS and CAB (r = -.42) is likely an artifact of the construction of the LS measure. If an examinee does poorly on the first trial (R1) and recovers on subsequent trials, their LS will be inflated and their CAB will be negative. The moderate negative correlations between CAA and LDR and RQ are likely due to their mathematical relationship. However, the weak correlations between Intrusions (INT) and the primary measures of LDR and RQ are worth noting because there is no mathematical relationship, and both are important in assessing memory problems in elderly populations.

The two nonverbal tests are related in that they tap into overlapping constructs; Block Design and Matrix Reasoning are both measures of nonverbal or performance intelligence. More specifically, they have been thought to tap into aspects of fluid intelligence, which purportedly is culture-free and less influenced by education (Cattell, 1963). Among the WAIS-III performance subtests, they have the highest correlation with the Full Scale IQ (Wechsler, 1999), and represent the fourth and fifth best measures of *g* among all 14 subtests (Sattler, 1992). Further, with English-speaking norms, the two tests have been shown to be strongly correlated (Wechsler, 1999). Thus, the strong positive correlation here (r = .86) was expected.

The Performance Total Score is used to generate a Performance IQ in the WASI, and the two tests that contribute to this score, Block Design and Matrix Reasoning, correlate fairly strongly with the Full Scale IQ. The Full Scale IQ is purported to be a good measure of *g*, a general factor underlying all expressions of intellectual ability (Spearman, 1923). To test the hypothesis that the memory scores are directly correlated with *g*, a review of the correlations presented in Table 4 is warranted. The correlations between the Performance Total (PT) and the *Spanish Word Lists* primary memory measures are moderate, ranging from r = .32 (between PT and RQ) to r = .57 (between PT and Total Recall), with the remaining correlations ranging from .39 to .45. However, performance on the nonverbal tests was not related to the auxiliary memory measures consisting of the learning slope, contrast (interference), and intrusion measures.

The third set of correlations (Table 5) examined the relationships between test performance and the independent variables of age, education, occupation, and acculturation. An overview reveals four major patterns. 1) There were few significant correlations between occupation, acculturation and all memory measures. 2) There were virtually no meaningful correlations between any of the independent variables and the auxiliary memory measures, except for two weak correlations between age and the contrast measures, CAB (r = -.24) and CAA (r = -.24). 3) Age and education exhibited moderate to strong relationships with nearly every measure of test performance, except the auxiliary memory measures. Generally, age was negatively correlated, and education was positively correlated. 4) The strongest relationships were observed between age and

Table 5. Correlations for all test variables with age, years of education, occupation level, and acculturation.

	Age	Gender	Education	Occupation	Acculturation
R1	-.61**	-.06	.29**	.12	-.19
RT	-.86**	-.04	.38**	.22*	-.18
SDR	-.73**	-.11	.33**	.20	-.08
LDR	-.77**	-.06	.26*	.14	-.19
RG	-.62**	-.10	.27**	.16	-.17
RQ	-.62**	-.04	.18	.10	-.10
LS	.04	.01	-.08	.03	.03
CAB	-.24*	-.07	.06	-.11	-.12
CAA	-.20*	.09	-.13	-.09	-.16
INT	.17	.18	-.15	-.18	-.01
BD	-.56**	-.07	.71**	.60**	-.20
MR	-.58**	-.03	.73**	.58**	.26*
PT	-.58**	-.06	.74**	.61**	.23*

*$p < .01$; ** $p < .001$

Note. Spanish Word Lists Measures, Primary: R1 = First Recall Score; RT = Recall Total Score; SDR = Short Delay Recall Score; LDR = Long Delay Recall Score; Rg = Recognition Total Score; RQ = Retention Quotient; **Spanish Word Lists Measures, Auxiliary:** LS = Learning Slope; CAB = Contrast AB; CAA = Contrast AA; INT = Intrusion Score. **Performance Test Measures (WASI):** BD = Block Design; MR = Matrix Reasoning; PT = Performance Total.

the primary memory measures and between education and the nonverbal measures. Age explained 74% of the variance in the total number of recalled items across trials 1-4 (RT), 59% of the variance in Long-Delay Recall (LDR), 53% of the variance in Short Delay Recall (SDR), and 38% of the variance in the retention quotient (RQ). Education explained 53% of the variance on the Matrix Reasoning (MR) test and 50% of the variance on the Block Design (BD) test. Although occupation did not correlate highly with any of the memory measures, it did correlate positively with the performance measures. Occupation explained 36% of the variance on Block Design and 34% of the variance on Matrix Reasoning.

The correlations between test performance and the demographic factors of age and education were fairly strong. The negative correlation between age and test performance was expected; however, the valence of the positive correlation between education and the nonverbal measures in this study is noteworthy. Occupation also correlated fairly strongly with some of the measures as well. However, there was a strong positive correlation ($r = .68$) between occupation and education that explained 46% of the variance therein. Further, there were positive correlations between acculturation and age ($r = .23$), and between acculturation and education ($r = .43$). Thus, further analysis was warranted to scrutinize the main effects of age, education, and occupation on test performance, the interaction effects of education and occupation, and the interaction effects of acculturation with age and education.

Multivariate and Univariate Analyses of Variance (MANOVA and ANOVA) with Post Hoc Analyses: The Effects of Age, Gender, and Education.

In order to look at the effects of the various independent factors, the second step in data analysis involved the examination of the main and interaction effects of age, gender, education, occupation, and acculturation on the outcome measures as a group. The initial general linear model employed a MANOVA. This model tests whether or not the independent variables are related to at least one or more of the test measures. Because of the different nature of the constructs measured by the memory tasks and the performance tasks, a separate MANOVA was employed for each of these domains of outcome measures. The models used a 2 (Gender) x 4 (Age) x 2 (Education) design and investigated all main effects, 2-way, and 3-way interactions.

Memory measures. The three-way MANOVA with the memory measures revealed a significant multivariate main effect for age, $F(27, 363) = 10.58$, $p < .0005$, $\eta^2 = .43$), but not for education, $F(9, 124) = 1.10$, or gender $F(9, 124) = .98$. The triple interaction was not significant, $F(27, 363) = .54$. Neither were the gender x education, $F(9, 124) = .59$, the gender x age, $F(27, 363) = .49$, or age x education $F(27, 363) = 1.01$, interactions. Given the multivariate effect of age on the memory measures, the next step involved an examination of the univariate effects of age on each of the memory measures, employing a series of univariate ANOVAs. These analyses revealed a significant main effect of age on all of the primary memory measures, but not on the auxiliary memory measures (see Table 6). Age had a significant inverse relationship with the level of performance on immediate and delayed recall, total recall, recognition, and retention. The older the individual, the lower the scores were on these measures. The

Table 6. Univariate age effects from the gender x age x education MANOVA along with the means, standard deviations, and post hoc tests for the age effect on the memory measures.

Memory Measure		Age Groups				Univariate Age F (3, 144)	Age Effect Size (η^2)
		18-30	31-45	46-65	65+		
R1	M	5.98_a	5.86_a	5.37_a	3.80_b	31.84**	.40
	SD	1.22	.92	.97	.85		
RT	M	35.86_a	34.35_a	30.11_b	23.10_c	121.04**	.72
	SD	3.47	2.69	2.46	3.33		
SDR	M	9.63_a	9.24_{ab}	8.74_b	7.13_c	51.67**	.52
	SD	.72	.64	.86	1.28		
LDR	M	9.35_a	9.08_a	8.13_b	5.93_c	67.96**	.57
	SD	1.07	.86	1.12	1.28		
RG	M	23.63_a	23.41_a	22.97_a	21.30_b	33.95**	.42
	SD	.54	.64	.75	1.91		
RQ	M	89.35_a	87.46_{ab}	81.31_b	70.02_c	30.41**	.39
	SD	9.19	8.45	8.61	10.47		
LS	M	4.51	4.54	4.63	4.63	0.16	.03
	SD	1.03	.99	.97	.81		
CAB	M	.70	.43	.39	.27	3.16	.06
	SD	1.04	1.01	.92	.79		
CAA	M	.86	1.06	1.48	2.30	2.57	.05
	SD	.74	.76	.83	.79		
INT	M	.33	.39	.54	.71	2.93	.06
	SD	.57	.40	.58	.72		

*$p < .01$; ** $p < .001$

Note: Memory Measures (Spanish Word Lists): Primary: R1 = First Recall Score; RT = Recall Total Score; SDR = Short Delay Recall Score; LDR = Long Delay Recall Score; RG = Recognition Score; RQ = Retention Quotient. Auxiliary: LS = Learning Slope; CAB = Contrast 1; CAA = Contrast 2; INT = Intrusions. Within each outcome measure, any means that do not have a common subscript are significantly different at $p < .01$.

effect sizes were large for significant variables, ranging from $\eta^2 = .40$ to .72. Effect size was particularly strong for the recall total and delayed recall measures.

To pinpoint where among the different groups the age effect was strongest, post hoc analyses using Tukey's Honestly Significant Differences Tests (HSD) were employed. For R1 and RG, the effect of age was concentrated in the oldest age group. That is, the oldest group performed at a significantly lower level than each of the three younger groups, which did not differ significantly from one another. For the other primary memory measures, the age effect was spread over a broader range of age groups. For RT and LDR (the two measures with the strongest size effects), the two younger groups did not differ significantly, but did significantly better than the two older groups. Moreover, the 46-65 year-old group performed significantly better than the oldest group. For SDR and RQ, the youngest group significantly outperformed the 46-65 year-old group, which, in turn significantly outperformed the oldest group. The performance of the 31-45 year-old group was not significantly different from the youngest group or the 46-65 year-old group, but was significantly better than the oldest group.

Again, there were no significant effects of age on the auxiliary memory measures. These include the contrast measures, which assess proactive and retroactive interference, the learning slope, and the intrusions score.

Performance measures. The three-way MANOVA with the performance measures (Table 7) revealed a significant multivariate main effect for age, $F(6, 262) = 14.91, p < .0005, \eta^2 = .26$), and for education $F(2, 131) = 54.72, p < .0005, \eta^2 = .46$. However, once again there was no effect of gender, $F(2, 131) = .49$. The triple interaction was not significant, $F(6, 262) = .18$. Neither were the gender x education,

Table 7. Univariate age effects from the gender x age x education MANOVA along with the means, standard deviations, and post hoc tests for the age effect on the nonverbal measures.

Performance Measure		Age Groups				Univariate Age F (3, 144)	Age Effect Size (η^2)
		18-30	31-45	46-65	65+		
BD	M	33.14_a	30.41_{ab}	22.47_b	12.97_c	20.98**	.30
	SD	12.68	13.43	10.45	8.44		
MR	M	19.35_a	17.59_{ab}	14.18_b	10.00_c	22.38**	.32
	SD	5.38	5.95	4.86	3.83		
PT	M	52.49_a	48.00_{ab}	36.66_b	22.97_c	23.46**	.33
	SD	17.12	18.47	14.74	11.88		

*$p < .01$; ** $p < .001$

Note: Performance Measures (WASI): BD = Block Design Raw Score; MR = Matrix Reasoning Raw Score; PT = Performance Total Score. Within each outcome measure, any means that do not have a common subscript are significantly different at $p < .01$.

$F(2, 131) = .09$, the gender x age, $F(6, 262) = .42$, or age x education $F(6, 262) = 1.59$, interactions. Given the multivariate effect of age and education on the performance measures as a group, the next step involved an examination of the univariate effects of age on each of the performance measures. As with the memory measures, univariate analyses revealed a significant main effect of age on all of the performance measures. As in the above analyses with the memory measures, post hoc analyses allowed us to focus in on where the age effects were strongest (see Table 7). However, in addition to age, education exhibited a main effect on all of the performance measures and these data are summarized in Table 8. Both age and education effects on the performance tests were fairly strong, with effect sizes in the .30 range. Post hoc analyses revealed a clear pattern of between-group differences for age. Those over 65 performed significantly poorer than the other three groups on all performance measures. The youngest group significantly outperformed the 46-65 year-old group, which, in turn significantly outperformed the oldest group. The performance of the 31-45 year-old group was not significantly different from the youngest group or the 46-65 year-old group, but was significantly better than the oldest group.

Since the two performance tests were so strongly correlated, it is likely that education and age each have an effect on a factor underlying the constructs of visuoconstruction (Block Design) and abstract reasoning (Matrix Reasoning). Visuospatial abilities are common to both tests, and this may contribute to this underlying factor. However, as discussed above, there is likely a general intelligence factor akin to Spearman's *g* that contributes more significantly to these measures. Thus, those who are

Table 8. Univariate education effects on the performance measures from the gender x age x education MANOVA along with the means and standard deviations.

Perform -ance Measure		Education Groups		Univariate Education F (1, 146)	Age Effect Size (η^2)
		Grades 0-9	Grades 10+		
BD	M	17.79	34.36	83.55**	.36
	SD	8.42	13.31		
MR	M	12.14	19.64	87.01**	.37
	SD	4.19	5.55		
PT	M	29.94	54.00	93.65**	.39
	SD	11.64	18.21		

*$p < .01$; ** $p < .001$

Note: Performance Measures (WASI): BD = Block Design Raw Score; MR = Matrix Reasoning Raw Score; PT = Performance Total Score.

either older or have a lower level of education tended to perform more poorly on these measures.

The Effects of Occupation and Acculturation.

Age and education were associated with the outcome measures more strongly than other variables. However, with the nonverbal measures, the correlations with occupation were nearly as strong as with education. However, because of the strong correlation observed between education and occupation ($r = .68$), the next step was to employ a MANCOVA where education could be controlled by entering it as a covariant. Acculturation was also entered as a covariant because it too correlated with occupation, though not as strongly ($r = .35$). Occupation and age were entered as fixed effects. In this approach, the effects of occupation could be teased out separately from other independent variables. Within this model, no effect of occupation was found, $F(22, 248) = 1.36$, yet age maintained a significant main effect, $F(33, 366) = 4.34$, $p < .0005$, $\eta^2 = .62$.

Acculturation only correlated with two of the test measures, MR and PT, the latter being a derivative of the former. However, it also correlated with age and education, so it appeared worthy of further analysis. The next step involved looking at the effect of acculturation employing a MANCOVA where age and education could be controlled by entering them as covariants. Two levels of acculturation were entered as a fixed effect. With this model acculturation did not exhibit a significant main effect on the group of test measures, $F(11, 134) = 2.07$.

Normative Data Stratified by Age and Education

Norms stratified by age and education will permit the current population to serve as a reference group against which to compare the performance of other Spanish-speaking participants for clinical or research purposes. However, because the current sample of 148 subjects is relatively small and yields unequal ns in a 30-cell design, modifications were required to allow more participants per cell. Since the general linear models employed revealed no significant effects of gender or occupation, data were collapsed across these factors thereby increasing cell size while still maintaining differentiation in education and age. Age was divided into four groups of roughly equal size, 18-30, 31-45, 46-65, and 66+. Education was divided into two groups, between 9th and 10th grades. Data are summarized in Tables 9, 10, and 11.

Table 9. Means and standard deviations for Spanish Word Lists, Primary Memory Measures, stratified by age and education.

Age Group	Years of Education		R1	RT	SDR	LDR	RG	RQ
18-30	<10	M	6.00	35.58	10.32	9.79	23.68	90.71
	(n = 19)	SD	1.15	2.85	1.21	1.23	0.48	9.89
	10+	M	6.21	36.83	10.00	9.71	23.58	86.71
	(n = 24)	SD	1.14	3.73	0.88	1.20	0.58	9.61
31-45	<10	M	5.74	34.05	9.58	9.53	23.32	91.16
	(n =19)	SD	1.05	2.09	0.77	0.96	0.67	9.44
	10+	M	5.61	34.50	9.56	9.11	23.50	86.59
	(n =18)	SD	0.78	2.98	0.86	0.83	0.62	8.13
46-65	<10	M	5.00	29.57	8.19	7.67	23.00	79.03
	(n = 21)	SD	0.84	2.18	1.12	1.28	0.84	9.63
	10+	M	5.47	30.12	8.47	7.82	22.94	80.72
	(n = 17)	SD	0.72	2.09	0.94	1.09	0.66	7.61
66+	<10	M	3.42	21.47	5.79	4.89	23.00	65.23
	(n = 19)	SD	1.02	3.31	0.71	1.33	0.88	11.60
	10+	M	3.73	23.45	6.27	5.27	22.94	62.47
	(n = 11)	SD	0.65	3.86	1.27	1.27	0.76	9.73

Note. Spanish Word Lists, Primary Measures: R1 = First Recall Score; RT = Recall Total Score; SDR = Short Delay Recall Score; LDR = Long Delay Recall Score; RG = Recognition Score; RQ = Retention Quotient.

Table 10. Means and standard deviations for Spanish Word Lists, Auxiliary Memory Measures, stratified by age and education.

Age Group	Years of Education		LS	CAB	CAA	INT
18-30	<10	M	4.79	0.21	1.11	0.42
	(n = 19)	SD	1.23	1.21	0.81	0.69
	10+	M	5.00	0.25	0.93	0.25
	(n = 24)	SD	0.98	0.09	0.70	0.44
31-45	<10	M	4.74	0.44	1.53	0.41
	(n =19)	SD	1.37	1.24	0.81	0.42
	10+	M	4.94	0.41	1.42	0.38
	(n =18)	SD	1.11	0.58	0.73	0.46
46-65	<10	M	4.67	0.59	1.91	0.55
	(n = 21)	SD	0.86	0.90	0.83	0.52
	10+	M	4.24	0.53	1.69	0.53
	(n = 17)	SD	0.90	0.94	0.85	0.83
66+	<10	M	4.11	0.78	2.42	0.78
	(n = 19)	SD	0.94	0.82	0.90	0.89
	10+	M	4.64	0.63	2.19	0.63
	(n = 11)	SD	0.67	1.66	0.54	0.69

Note. Spanish Word Lists, Auxiliary Measures: LS = Learning Slope; CAB = Contrast AB; CAA = Contrast AA; INT = Intrusion Score.

Table 11. Means and standard deviations for the Spanish translations of the WASI Performance Measures, stratified by age and education.

Age Group	Years of Education		BD	MR	PT
18-30	<10	M	24.42	15.11	39.53
	(n = 19)	SD	9.66	3.87	12.06
	10+	M	40.04	22.71	62.75
	(n = 24)	SD	10.40	3.79	13.15
31-45	<10	M	20.47	13.37	33.84
	(n =19)	SD	6.35	4.17	8.88
	10+	M	40.89	22.06	62.94
	(n =18)	SD	10.60	3.95	13.34
46-65	<10	M	16.76	11.52	28.29
	(n = 21)	SD	4.28	3.27	6.57
	10+	M	29.53	17.47	47.00
	(n = 17)	SD	11.57	4.54	15.58
66+	<10	M	9.63	8.63	18.26
	(n = 19)	SD	4.89	2.59	6.83
	10+	M	18.73	12.36	31.09
	(n = 11)	SD	10.29	4.57	14.52

Note: Performance Measures (WASI): BD = Block Design Raw Score; MR = Matrix Reasoning Raw Score; PT = Performance Total Score.

Discussion

Demographic and cultural variables such as age, education, language, and acculturation can dramatically effect the outcome of neuropsychological assessment (Bleecker, Bolla-Wilson, Agnew, & Meyers, 1988; Heaton et al., 1991; Heaton et al., 1993; Query & Megran, 1983; Wechsler, 1997b, 1997c, 1999). Therefore it is important to consider the influence of these factors when interpreting results. The Hispanic population is the fastest growing minority group in the U.S. and comprises the largest minority group in the southwestern part of the nation. Over the course of the past decade, several studies have been conducted that involve translating neuropsychological tests and developing culturally relevant normative data for Spanish-speaking individuals. This study contributes to that process in order to provide clinicians with much needed tools and preliminary standards for the neuropsychological evaluation of Spanish-speaking populations.

Culturally relevant Spanish translations and normative data are presented for three widely used subtests in neuropsychological assessment. Translation was conducted in consultation with a neuropsychologist, a linguist, and Spanish language instructors, all of whom were all native Spanish speakers. The translated Word Lists I and II from the WMS-III, and Block Design and Matrix Reasoning from the WASI were administered to 148 native Spanish-speaking persons in various communities in Colorado and Hawaii. The effects of various factors were examined, including age, gender, education, acculturation, and occupation.

Strengths and Limitations

The sample used in this study is fairly representative of the Hispanic population in the western United States (U.S. Census, 1992a), with the vast majority being of Mexican origin (81%). While the samples of several previous studies have been primarily of Mexican origin (Mungas, 1996; Ostroski-Solis et al., 1998; Perri et al., 1995; Pontón et al., 1996; Taussig et al., 1996), others have been predominantly Cuban (Ardila et al., 2000; Rey et al., 1999), Dominican (Jacobs, Winston, et al., 1997; Olazaran et al., 1996), Puerto Rican (Jacobs, Sano, et al., 1997), or Columbian (Ardila et al., 1994). The differences in the two groups of samples are reflective of the immigration patterns of Hispanics (Llorente et al., 1999). Whereas those of Mexican origin tended to migrate to the western U.S., those of Cuban, Dominican, and Puerto Rican origin migrated to the eastern U.S.

While previous studies have included segments of the Hispanic population that typically are underrepresented, few have included a broad range of individuals with regard to age, education, acculturation, and SES. The most notable exception is the NeSBHIS project (Pontón et al., 1996), with 300 participants ranging in age from 16 to 75, and in education from grade 1 to postgraduate levels. In the present study, there is a fairly balanced sample with respect to age, education, acculturation, and SES. The caveat must be added that our measure of acculturation, while based on years in the U.S. and English proficiency, is not as precise as the acculturation scale used in the NeSBHIS study. Additionally, our measure of SES, based on occupation, is a relatively general measure. Those of lower SES were actually oversampled; more than 50% were from the least skilled professional group. However, except for one (Perri et al., 1995), the other studies reviewed did not include the SES of their participants in their analyses. Deeper analysis of acculturation and SES were beyond the scope of this study, yet these variables warrant analysis in future studies.

In this study, older individuals, those with less education, and those who were recent immigrants were well represented. In several previous studies younger individuals were excluded and older persons were targeted because the focus was on dementia, an illness of the aged (Jacobs, Sano, et al., 1997; Jacobs, Winston, et al., 1997; Mungas, 1996; Olazaran et al., 1996; Taussig et al., 1996). In other studies, older subjects were lacking (Perri et al., 1995; Rey et al., 1999; Wiens & Crossen, 1988) due to sampling limitations. In the present study, the age ranged from 18 to 92, with 40% over the age of 50. A fair proportion were recent immigrants; 21% had lived in the U.S. less than one year, 38% less than two years, and 49% less than four years. The English proficiency of the present sample is balanced, with 21-30% in each of four categories. Older subjects who were more highly educated made up the smallest group (n = 11). This appears to be a common problem in many studies, both with Spanish-speaking populations (Jacobs, Sano, et al., 1997; Rey et al., 1999; Rosselli et al., 2000) and English-speaking Hispanic populations (Wechsler, 1999). Aside from this limitation and limitations in SES sampling, a broad range of Spanish-speaking individuals was included in this study. With such representation, these data may serve as a reference group for more relevant comparisons with individuals in underrepresented Spanish-speaking populations.

Intercorrelations Among the Demographic Variables

The intercorrelations among the demographic variables revealed that education and occupation were highly correlated. This was not unexpected considering that a higher level of education is frequently a prerequisite to the more skilled and professional occupations. Further, both correlated with various test measures; education correlated with the memory measures and the nonverbal measures, whereas occupation correlated only with the nonverbal measures. With the exception of one study (Perri et al., 1995), convention has favored looking only at education. This history, along with the finding in this study that education correlated with more test measures than did occupation, would obviously lead one to favor education as a moderator and put less emphasis on occupation. However, it could be that there is a factor underlying both variables that may better explain the variance seen in test measures. SES is a likely candidate for such a factor because it has been shown to determine the quality, as well as the quantity, of education, and the type of occupation to which one gravitates, among other factors (Pérez-Arce, 1999; Sattler, 1992). In this study, age correlated negatively with education. As discussed above, older Spanish-speaking individuals, as a group, are more likely to be poor and disadvantaged educationally (Taussig et al., 1992). Taken together then, it is likely that SES is a composite variable moderating everything from prenatal care and early childhood stimulation to the quantity and quality of education. However, SES has been difficult to operationalize, because it influences so many other factors that are more quantifiable. Further analysis, perhaps involving a structural equation that accounts for all of these types of variables, is warranted.

Interestingly, education and occupation were moderately correlated with acculturation, suggesting that those who were more educated or had more professionally oriented occupations were more acculturated to the mainstream culture. Previous studies have demonstrated that the socioeconomic status of the immigrant prior to migration is the strongest predictor of the degree of acculturation to the U.S. (Golding & Burnam, 1990; Neidert & Farley, 1985). Though age and acculturation are typically negatively correlated (Ruiz, 1982; Cuellar et al., 1995), there was a weak correlation in this study. Further analysis involving a breakdown of acculturation into its two components, revealed that the number of years in the U.S. accounted for the correlation, whereas English proficiency did not. Thus, either the cohort in this sample is different from those in previous studies, or the acculturation index employed in this study lacks specificity. Acculturation, like SES, is worthy of further analysis in future studies of this type.

Correlations Among the Memory Measures

The correlations among the memory measures revealed that the primary memory measures are highly related. This is likely due to two processes. First, some measures are mathematically derived from others. Secondly, all measures tap into different aspects of the same construct, namely auditory verbal learning and memory. Both processes are at play in the high correlation between First Recall (R1) and Recall Total (RT). Since RT is a summation of all four trials, an elevated or low R1 score would contribute 25% toward a similar RT score. Further, both are measures of working memory.

The high correlations observed among some of the memory test measures that are not mathematically related are worth noting here. The fact that SDR and LDR were so strongly correlated would suggest that, despite the nature of the interference (verbal in the SDR and nonverbal in the LDR), if information is retained after a short delay, it will be retained after a longer delay. The strong correlation between the Recall Total and both the Delayed Recall measures suggests that working memory and long term memory are related processes. Perhaps, like intelligence, there is a general memory capacity, *gm*, that underlies all types of memory constructs.

The auxiliary memory measures did not correlate with one another, and for the most part did not correlate with the primary measures unless they were mathematically related. Moreover, with the exception of weak, negative correlations between the contrast measures and age, these measures did not correlate with any of the independent variables. As outlined in the results section, these measures can only be interpreted in the context of the primary memory measures. They do not yield any useful clinical information, unless the primary measures deviate significantly from the normal range. The Intrusion measure is worth noting however, because it is not mathematically related to any of the primary measures, yet it is negatively correlated with three of these measures. In some cases of dementia and amnesia, the patient may make up items they cannot remember. The Intrusions measure was added to the *Spanish Word Lists* because a similar measure in the CVLT, a widely used word list learning measure, is sensitive to such confabulation (Delis et al., 1987).

Correlations Among the Nonverbal Measures

The intercorrelations among the nonverbal measures were quite strong. This is consistent with that observed in English-speaking populations (Wechsler, 1997a, 1999). The two nonverbal tests are related in that they tap into overlapping constructs; Block Design measures visuoconstructional skills and Matrix Reasoning measures nonverbal reasoning. Both rely on visuoperceptual discrimination skills. Among the WAIS-III performance subtests, these subtests have the highest correlation with the Full Scale IQ

(Wechsler, 1999), and represent the fourth and fifth best measures of *g* among all 14 subtests (Sattler, 1992).

Correlations Between the Memory Measures and the Nonverbal Measures

It is important to note that, other than working memory, long term memory skills are not required to perform well on the nonverbal tests. Although the items progressively become more difficult, each item can be solved without knowledge of the previous item. Performance on these two tests is not typically affected by pure memory deficits (Snyder & Nussbaum, 1998), and the author has witnessed above average, even stellar performance on these measures by patients with pure amnesic disorders. However, an intact working memory *is* required to perform these tasks (Goldman-Rakic & Friedman, 1991). Working memory is more accurately a measure of attention that is mediated by the dorsolateral frontal lobes among other cortical and subcortical regions. It remains intact in pure amnesic disorders (Goldman-Rakic & Friedman, 1991). For this reason, many neuropsychologists will rely on these measures, among others, for an estimate of premorbid functioning in amnesic patients, provided it is known there are no deficits in attention, visuospatial, or executive functioning.

The examination of the relationship between the nonverbal tests and the memory measures is important because it helps clarify the constructs purportedly measured by these tests. The cognitive domains measured by the two types of tests are distinct (Kyllonen & Christal, 1990; Snyder & Nussbaum, 1998). The nonverbal measures tap into visuoconstruction and nonverbal reasoning, and the stimuli are visually presented. In contrast, the memory measures tap into working memory, recall, and recognition of auditory, verbal material. Yet, a look at the definitions of the constructs of intelligence and memory would suggest that the two are quite related. Although there have been many definitions of intelligence (Sattler, 1992), most of these refer to the capacity for knowledge, to learn from experience, and to deal effectively with the environment. Memory is described as "the persistence of learning in a state that can be revealed at a later time" (Squire, 1987, p. 3). It follows then, that a good memory would be a major contributor to intelligence. In fact, the two global concepts, as measured by some of the most widely used tests of intelligence and memory, correlate positively (Wechsler, 1997a, p. 124). The relationship between the WAIS-III FSIQ and the WMS-R measures is in the .67 to .77 range. The FSIQ and CVLT are not as highly correlated, ranging from .28 to .43. The CVLT, a word list learning task, is more akin to the Spanish Word Lists than the WMS-R measures. In the present study there was a moderate relationship between performance on the nonverbal measures and the primary memory measures. The correlations between the Performance Total (PT) and the *Word Lists* primary memory measures were moderate, ranging from $r = .32$ (between PT and RQ) to $r = .57$ (between PT and RT), with the remaining correlations ranging from .39 to .45. Though a bit more highly correlated in this study, the range is close to that between the WAIS-III FSIQ and the CVLT. The moderately strong correlation between PT and RT, the best measure of working memory in this study, corroborates the hypotheses of cognitive psychologists that working memory is an important predictor of individual differences in learning, intellectual ability, and nonverbal reasoning (Kyllonen, 1987; Kyllonen & Christal, 1990; Sternberg, 1980). The present study corroborates the findings of previous studies with English-speaking populations, extends these findings to Spanish-speaking populations, and lends weight to the hypothesis that intelligence and memory are positively correlated.

The Absence of Gender Effects

The initial MANOVA failed to reveal a significant effect of gender on any of the test measures. Although some previous normative studies have suggested an overall effect of gender on test performance (e.g., Bornstein, 1985), a meta-analysis by Hyde and Linn (1988) failed to show gender differences in many tests of verbal ability. Several other normative studies revealed a similar lack of gender differences in neuropsychological test outcomes in both English-speaking (e.g., Wechsler, 1997a, 1997b, 1997c, 1999) and Spanish-speaking individuals (Jacobs, Sano, et al., 1997; Jacobs, Winston, et al., 1997; Pontón et al., 1996). The failure to find effects of gender on these measures is consistent with these studies.

The Effects of Age and Education on Memory Measures and Nonverbal Measures

The most salient finding of this study is that age is strongly related to test performance in both the memory tasks and the nonverbal tasks. Another important finding is that education had a significant effect on the nonverbal measures but not on the memory measures.

Memory Measures. Age effects were found for all of the primary memory measures, but not for the auxiliary memory measures. This is consistent with previous results with both Spanish-speaking (Ardila, et al., 1994; Jacobs, Winston, et al., 1997; Ostrosky-Solis et al., 1998; Taussig et al., 1992, 1996) and English-speaking populations (Bleecker et al., 1988; Heaton et al., 1991; Query & Megran, 1983). With the original WMS-III *Word Lists I* and *II* (Wechsler, 1997c), there was a significant effect of age. In contrast, however, the NeSBHIS study (Pontón et al., 1996) failed to reveal a significant effect of age on measures of short and long delay recall of items from a word list learning task.

In the present study age had a significant inverse relationship with the level of performance on immediate and delayed recall, recall total, recognition, and retention. The older the individual, the lower the scores were on these measures. The effect of age tended to be concentrated in the oldest age group (65 years and older). The measure where the age effect was strongest was on the Long Delay Recall (LDR) task of the *Spanish Word Lists*. The analyses revealed that subjects over the age of 65 could perform up to four standard deviations below subjects in the 18-30 age group on the LDR task. The effect of age was also seen in the Short Delay Recall (SDR) task. Both SDR and LDR are examples of delayed auditory recall, the only difference being the length of delay. Given that this capacity, delayed auditory recall, is subject to a natural decline in elderly populations (Butters et al., 1994; Delis et al., 1987; Salmon, 2000), it is important to distinguish between performance that is representative of normal aging versus amnesic dysfunction. Delayed recall tasks have been shown to be pivotal in the assessment of dementia (Butters et al., 1994; Morgan et al., 2000) and Korsakoff's Syndrome (Cermak, Butters, & Goodglass, 1971). These data provide a preliminary normative sample against which the performance of older Spanish-speaking patients can be compared.

The age effect also influenced the First Recall (R1) and Recall Total (RT) tasks, both measures of working memory. On the RT task individuals who were over 65 could perform up to three standard deviations below those in the 18-30 age range. This is consistent with the findings of other researchers that working memory declines with age (Butters et al., 1994; Taussig et al., 1992, 1996; Wechsler, 1997a, 1997c).

The age effect was present on the recognition task, though not as strong as it was on the delayed recall tasks or the working memory tasks. This was expected in that several researchers have noted that though recognition ability declines with age, the decline is not nearly as strong as that seen in delayed recall (Butters et al., 1994; Cummings & Benson, 1983). The distinction between delayed free recall and recognition tasks is critical in the differential diagnosis between a cortical dementia, such as Alzheimer's Disease, and a frontal-subcortical dementia, such as Huntington's Chorea (Butters et al., 1994; Salmon, 2000). In a cortical dementia, characterized by an abnormal rate of forgetting, both recall and recognition are compromised. In contrast, in a frontal-subcortical dementia, characterized by a compromised capacity for retrieval, recognition is spared relative to recall capacity (Damasio & Anderson, 1993). These normative data suggest that, for the two older cohorts, there is greater variability in delayed recall that is still within the normal range of functioning (SD = 1.09 - 1.33), whereas there is less variability in recognition that would be considered normal (SD = .66 - .88).

Multivariate analysis on the memory measures failed to reveal a significant effect of education. The absence of an education effect on the memory measures is consistent with the findings of most of the previous studies with this population (Ardila et al., 1994; Jacobs, Winston, et al., 1997; Ostrosky-Solis et al., 1998; Taussig et al., 1992, 1996) and with English-speaking populations. In the original English version of *Word Lists I and II* (Wechsler, 1997c), education effects were not observed. However, there are some notable exceptions to the absence of an education effect on memory in Spanish-speaking populations. In the NeSBHIS study, Pontón and colleagues (1996) found that education significantly affected performance on a long delay recall task, though not on immediate recall or short delay recall tasks. Further, some researchers have found significant education effects on memory only in the extreme ranges of education. Ardila and Rosselli (1989) found significant differences between illiterate and highly educated Colombians across a variety of memory tasks including delayed memory for words. Additionally, the study by Perri and colleagues (1995) revealed education effects on memory measures only at the extreme levels of education. However, their sample contained very few subjects in these education categories; their recommendation for caution in interpretation mitigates this finding. Likewise, small *n*s in the extreme ranges of education precluded such analysis in the present study. The differences in memory performance, between the extremes of education level, may be due to an underlying factor. As discussed above, education is a correlate SES, particularly in the extreme ranges of education. Thus, SES may better clarify the differences seen in the extreme ranges of education. Further research into the effects of education on memory performance is necessary. The role of SES in that relationship may also be an important moderator.

Nonverbal Measures. Effects of age were found on the performance on the nonverbal tests. Age effects were found on Block Design and on Matrix Reasoning. The effect of age on the performance tests corroborates the findings of previous normative data studies with English-speaking populations (Heaton et al., 1991; Wechsler, 1997a; 1999) and with Spanish-speaking populations (Ardila et al., 1992; Ardila et al., 1994;

Jacobs, Winston, et al., 1997; Ostrosky-Solis et al., 1998; Pontón et al., 1996; Taussig et al., 1992, 1996). Both visuoconstructional abilities, as measured by the Block Design test, and nonverbal reasoning skills, as measured by the Matrix Reasoning test, tend to decline with age, particularly past the age of 60 (Snyder & Nussbaum, 1998). Because of the timed nature of these tests, processing speed may also be a factor contributing to this decline. This capacity has long been observed to decline in the later years (Butters et al., 1994; Cummings & Benson, 1983). Working memory, thought to be a critical component of intellectual ability and nonverbal reasoning (Kyllonen, 1987; Kyllonen & Christal, 1990; Sternberg, 1980), is also believed to decline with age (Cummings & Benson, 1983; Salmon, 2000). In the present study, the strongest age effect on the memory measures was observed on RT, a measure of working memory. Further, the Block Design test relies on some degree of psychomotor speed, which is also compromised with increasing age (Salmon, 2000). This may be yet another factor contributing to the decline in performance on these types of tests. It is conceivable then, that the age related declines in working memory, processing speed, and psychomotor speed better explain the decline in performance on tasks of visuoconstruction and nonverbal reasoning. Further research in this area that accounts for each of these factors may further clarify the commonly observed effect of age on tests of visuoconstruction and nonverbal reasoning.

In the present study, education had a significant effect on performance on the nonverbal measures (i.e., Block Design and Matrix Reasoning). The education effect on nonverbal measures is consistent with the majority of the research on Spanish-speaking populations (Ardila, et al., 1994; Jacobs, Winston, et al., 1997; Ostrosky-Solis et al., 1998; Pontón et al., 1996; Taussig et al., 1992, 1996). With English-speaking populations, the education effect on a variety of neuropsychological tests was considered strong enough by some investigators to break down norms by education level (Heaton et al., 1991; Heaton et al., 1993). Yet, with the WAIS-III and WMS-III (Wechsler, 1997a), education effects on both memory and nonverbal measures were considered negligible when developing the norms tables. In the NeSHBIS study (Pontón et al., 1996), education was the strongest factor in test performance across a variety of tasks including Block Design (from the EIWA, Wechsler et al., 1968) and Raven's Progressive Matrices (Raven et al., 1993), which is very similar to the WASI Matrix Reasoning test.

Although these are nonverbal measures that tap into aspects of *fluid intelligence*, which purportedly is culture-free and less influenced by education (Cattell, 1963; Rosselli, 1993), the more highly educated participants outperformed those with less education. Some have suggested that familiarity with geometric shapes, fostered by educational experience, mediates performance on these measures (Jacobs, Sano, et al., 1997). This is a plausible explanation, however, the implications may be far more reaching than this. Education may have a pivotal influence on formal operational thinking (Laurendeau-Bendavid, 1977), which in turn determines a wide variety of problem solving strategies. Ostrosky-Solis and colleagues (1998) have shown that for some tests, just the first one or two years of education result in significant differences in performance. Their study also revealed that as educational level increases, the differences in test performance between levels of education disappear. From another angle, the above discussion of the relationship between working memory and nonverbal test performance suggests that working memory itself may be affected by education, perhaps through the routine exercise of the conceptual workspace that schooling provides. Thus, the education effect may be mediated by the practice and familiarity with the manipulation of geometric shapes, opportunities to develop visuoperceptual discrimination, guidance in problem solving, and the 'fitness' of the individual's working memory.

From another viewpoint, education and the measurement of intelligence have been confounded since the inception of intelligence testing (Sattler, 1992) when Edwin Boring challenged the circularity of the of the argument by stating, "Intelligence is whatever it is that the intelligence tests measure." (p. 44). Thus, tests like the nonverbal measures used in this study merely repeat what has been done in most school settings. Further, people without much education may lack the cognitive skills required to acquire academic knowledge. Because of a lack of reinforcement, they are likely to find schooling unappealing and eventually drop out. Individuals with this background are likely to score in the lower ranges on most measures of cognitive functioning, regardless of their ethnicity.

Whatever the explanation for the effect of education on neuropsychological test performance, the possibility of intervening variables, in particular SES, should continue to be evaluated. As discussed above, SES and educational quantity and quality are correlated. Various other factors associated with low SES undoubtedly compound the problem of poor education to affect test performance in a number of areas. These include but are not limited to poor prenatal and neonatal health care, diminished quantity and quality of stimulation in critical developmental periods, and stable living conditions.

Further research on the effect of education on neuropsychological test performance should involve an examination of the relationship between SES and education.

The effect of education on nonverbal test performance in this study is fairly strong. It corroborates the findings of the vast majority of other studies on neuropsychological test performance with Spanish-speaking populations. These data challenge the idea held in some clinical circles that nonverbal tests yield a reliable estimate of true ability in non-English-speaking populations. These data, though preliminary, may also contribute to the growing body of normative data regarding the performance of Spanish-speaking individuals on nonverbal tests of visuoconstruction and nonverbal reasoning.

The Absence of Effects for Acculturation and Occupation

MANCOVA analyses controlling for age and education failed to reveal a significant effect of acculturation or occupation on any of the test measures. The role of occupation was discussed above, thus the discussion here will focus on acculturation effects. Our measure of acculturation was based on English proficiency and number of years residence in the U.S. It is by no means a comprehensive measure of acculturation, so caution in interpretation is warranted. Jacobs, Sano, and colleagues (1997), using the same measures of acculturation, likewise found no effect of acculturation on a variety of neuropsychological test measures including a word list learning task and measures of visuoperceptual discrimination and nonverbal reasoning. The lack of an acculturation effect on the *Spanish Word Lists* measures suggests that our translation was culturally relevant for the sample tested. Anecdotally, the three participants who did not understand all items were raised in the U.S. and were not familiar with the words *cocodrilo* (crocodile) or *cancha* (court). Their data were not included in this study. The absence of an effect of acculturation on the nonverbal tests may be interpreted in a variety of ways. For further discussion of this topic the reader is referred to the above section on education effects on the nonverbal measures.

Normative Data

Means and standard deviations stratified by four levels of age and two levels of education are provided. Though comparisons with the original English-speaking normative sample may yield interesting information, caution in their interpretation is warranted. The original norms are stratified only by age and not by education. Additionally, this Spanish-speaking sample is slightly skewed toward the less educated. Finally, once translated, any assumptions that the two tests are equivalent must be abandoned for reasons discussed at length in the introduction.

The Spanish Word Lists uses ten measures, adding a measure of short delay recall (SDR) and number of intrusions (INT) to the eight measures of the original WMS-III *Word Lists I and II* (Wechsler, 1997c). The auxiliary measures for the two samples were comparable. The scores on the primary measures were roughly comparable to the English-speaking norms with two exceptions. One, on the two working memory measures, R1 and RT, the two older groups in the Spanish-speaking sample performed at a slightly lower level than that of the English-speaking sample. Two, on the Long Delay Recall (LDR) and Retention Quotient (RQ) measures, all age groups of the Spanish-speaking sample performed at a higher level than the English-speaking sample. One plausible explanation for the first difference is that the Spanish-speaking sample was, as a group, less educated than the English-speaking sample. Since education itself was not observed to affect working memory, it may be that education is a proxy for some underlying factor such as SES that impacted the performance on the working memory measures in the older cohorts. Again, this is only speculative, but it may be worthy of exploration in future studies. The differences seen in the LDR and RQ, which are mathematically and construct-related, may be due to the differences in administration protocol. In the original version, *Word Lists I and II* are given in the midst of at least ten other memory tasks, one of which is a paired word list. The interference parameters in this type of protocol are very challenging compared to the protocol used in the Spanish Word Lists administration.

The scores on the nonverbal tests were roughly comparable to the WASI (Wechsler, 1999) English-speaking norms with one exception. As was the case with the working memory measures, the two older cohorts performed at a lower level than did those cohorts in the English-speaking sample. Given the strong effect of education on these measures, this difference is likely due to the oversampling of individuals with less education in the Spanish-speaking sample.

Current findings show that translations or adaptations of tests are not a substitute for stratified norms with the target population (Artiola i Fortuny & Mullaney, 1997; Peréz-Arce, 1999; Pontón & Ardila, 1999). The differences in the two sets of normative data in this study provide another example of why separate norms are needed when tests are translated.

Despite recent research in the development of normative data, neuropsychological assessment of Spanish-speaking subjects remains underdeveloped because it still lacks instruments that are adequately normed and culturally appropriate. These data are but an initial step in the development of such instruments. Further stratification in age and education is needed for more precise comparisons to be made between the individual in question and the relevant norm group. Additionally, administration of these tests to clinical populations with known memory, visuoconstructional, and reasoning deficits would provide important information regarding the sensitivity and specificity of these tests in clinical application.

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Appendix I. The Measurement of Learning and Memory

Much of what we know about memory functioning derives from the study of amnesic patients. Patterns of dissociation were observed where certain memory functions were spared while others were impaired. This led investigators to postulate three orthogonal axes along which distinct memory systems can be described. The first axis encompasses the distinction between *implicit* memory versus *explicit* memory (Sherry & Schacter, 1987, H&V, p. 546). Implicit memory refers to learning and remembering something, with no intention to do so, while having no conscious recollection of the learning event itself. In contrast, explicit memory requires a deliberate intention to remember target information. In amnesic patients implicit memory is often spared whereas explicit memory is impaired (Squire, 1987, H&Vp.538). The second axis involves a distinction between *declarative* memory versus *procedural* (or more recently, nondeclarative) memory (Cohen & Squire, 1980, in H&V, p546). Declarative memory refers to knowing *that* something was learned, whereas procedural memory refers to knowing *how to do* something that was learned. Declarative memory includes facts, lists, events, and everyday remembering. Procedural memory includes motor skill sequences and personal preferences. In amnesic patients, procedural memory is spared, whereas certain aspects of declarative memory are impaired (Cohen & Squire, 1980). The third axis further breaks down declarative memory; it makes a distinction between *semantic* versus *episodic* memory (Tulving, 1972, 1983 in H&Vp.544). Semantic memory includes facts, language, and social skills and remains intact in most amnesic patients (Cermak, 1984, H&Vp545). Episodic memory (sometimes called *autobiographical*) refers to the capacity to recall contextually specific events such as a list of words or a social engagement. Episodic memory is impaired in amnesic patients (Tulving, 1983). Both semantic and episodic memory can be subsumed under declarative memory. The finer distinction helps explain the dissociation seen in amnesic patients.

Further distinctions can be made in the evaluation of memory functioning that focus on the interface between the domain of memory with language. One involves the mode of target material. Material to be remembered can be presented verbally or nonverbally. The second distinction involves the sensory pathways, visual versus auditory, that mediate the encoding process.

The act of remembering involves four basic processes, and the failure of any one of these can interfere with it (Snyder & Nussbaum, 1998). First, *attention* is required for the entry of information into the system. Attention itself can be broken down further into four processes. *Selective attention* involves choosing goal-relevant information from the array of diverse environmental stimuli. One then has to *focus* attention on the relevant information, while *inhibiting* irrelevant information, and one must *sustain* attention until all relevant information has been processed. The second step in remembering, the *encoding* process, involves the intention to remember and the organization of material into a meaningful memory trace. The third step in memory, the *storage* process, requires consolidation and retention of the encoded information. Finally, the *retrieval* process entails accessing the information in storage and bringing it to mind. This process may be conscious, which puts it in the realm of explicit memory, or it may be unconscious and in the realm of implicit memory.

Another distinction is that between working memory and long term memory. Working memory involves a combination of attention, encoding, and immediate retrieval. It encompasses all material that is held in memory while still rehearsing it. It is measured by tasks of immediate recall and/or recognition. Long term memory refers to any material that is "stored" when not actively rehearsing the material. The distinction between the two is not one of time, but whether there was a break in time between the original acquisition of the material and the subsequent recall or recognition of it.

Yet another important distinction in memory testing involves the nature of retrieval. If the individual is required to retrieve the material without any cues, this is engaging in free recall. If the individual is given cues, such as a category for the item in question, this is engaging in cued recall. If the individual is given the item among a list of items, and asked to simply say whether it was a target item or not, this is engaging in the process of recognition.

Most tests of memory assess the functioning of episodic memory, that is, memory for contextually specific events. This includes memory for a list of words, a drawing, names, faces, and social engagements, and other events that occurred in a specific place at a specific time. The WMS-III contains tests that allow the examiner to gain information in the functioning in all of these areas, provided the optional tests of Word Lists and Visual Reproduction are administered.

In this study, the Spanish Word Lists consist of several measures that tap into the following memory domains. The first group, consisting of recall, recognition, and retention measures (R1, RT, SDR, LDR, RG, and RQ), can be referred to as *primary* memory measures because they directly measure performance in a graded manner. They provide useful information independent of the other memory measures. Because items are presented orally and the response is mediated verbally, all measures fall in the domain of *auditory verbal memory*. First Recall and Total Recall, because they assess free recall immediately after stimulus presentation, measure auditory immediate memory, which is a function of working memory. Short Delay Recall and Long Delay Recall measure auditory delayed memory which is a function of long term memory. The Recognition task, which measures auditory delayed recognition, is also a function of long term memory. The Retention Quotient, is a measure of delayed auditory recall that compares it to the working memory from the fourth trial of the word list.

The second group of memory measures on the Spanish Word Lists consists of the two contrast measures (CAB and CAA), Learning Slope (LS), and Intrusions (INT). These measures can be referred to as *auxiliary* memory measures in that their interpretation is dependent upon an understanding of performance on the primary memory measures. The interpretation of these measures can only be meaningful when looking at the pattern of scores on the *primary* measures. Contrast AB (CAB) and Contrast AA (CAA), are measures of auditory free recall following interference. CAB is a working memory measure in that it measures the difference between the first recall of List A and that of List B. It is expected that some interference will occur in normal subjects. A positive score indicates that proactive interference has occurred, because the learning of List A over four trials has resulted in a drop in the first recall of List B compared to the first recall of List A (Delis, Kramer, Kaplan, & Ober, 1987; Postman, 1971). CAA measures the difference in List A fourth trial immediate recall and LDR. It compares the long term memory (albeit very short LTM) with the working memory for the same material. A positive score is expected in normal subjects indicating that some degree of *retraoactive interference* has occurred; That is, there was a decremental effect of subsequent learning (List B) on the retention (SDR) of previously learned information (Postman, 1971). The LS measures the incremental learning of material over a series of trials. A very low LS is indicative of an inability to learn or remember material beyond the working memory capacity. However, LS is subject to artifacts. It is difficult to interpret a moderate to high LS, as it takes into account both the first and last recall. If LS is high because of a low first recall, does the individual have a low working memory capacity yet a high capacity for reiterated material? If LS is low because of a high first recall and the ceiling effect of a 12 item list, then this score is not very informative. Again, the LS score is of little value unless examined in the context of the other scores. The number of intrusions (INT) is not originally part of the WMS-III Word Lists test. It is added here because it has been shown to be useful in other word list tests (Delis, Kramer, Kaplan, & Ober, 1987; Rey, 1964). It is a measure of *confabulation*, which is the process whereby a person will simply make up a reasonable substitute when faced with the task of recalling something they cannot remember. This is more typical of cases of basal forebrain amnesia, Korsakoff's Syndrome, and frontal-subcortical dementias than it is of cortically based amnesia or dementia (Butters, Salmon, & Butters, 1994; Cummings & Benson, 1983; Bauer, Tobias, & Valenstein, 1993).

Appendix II. Recruitment Speeches, Consent Forms, and Test Instructions (Spanish/English)

Recruitment Speech – Spanish

Buenas tardes feligréses (estudiantes) me llamo Tomás Cummings. Quisiera pedirles ayuda con un proyecto que podrá ayudar muchos hispanohablantes de nuestra comunidad. Necesito que ustedes me ayuden con un estudio de la universidad del estado de Colorado. Actualmente, no hay pruebas para evaluar problemas de pérdida de memoria con hispanohablantes. Hay bastante pruebas para personas que hablan inglés, pero en español no hay. Por eso, hemos desarrollado una prueba para evaluar la memoria en español, y necesitamos administrarla con personas normales que hablan español. Por personas normales quiero decir, personas en buena salud sin lesiones cerebrales, como la mayoría de nosotros. Cuando hemos determinado el rendimiento de personas normales, entonces los doctores van a poder dar esta prueba a pacientes hispanohablantes que tienen problemas con la memoria, y pueden comparar el rendimiento de estos con el rendimiento de los normales. Entonces, los pacientes que se han hecho daño en el cerebro, o se han enfermado con algo como Alzheimers o un ataque de apoplejía, van a recibir el tratamiento adecuado. Pues, con su ayuda, si toma esta prueba, ayudará a estos pacientes hispanohablantes, ...y también me ayudará a ganar mi titulo de doctorado.

Padre Flynn (Cliff, o maestra Lorraine) me ha dado permiso para administrar la prueba, que es oral y breve, de uno en uno, en un cuarto de la iglesia (en una oficina de una maestra de este colegio). Dura 20-30 minutos. No es difícil, de hecho, mucha gente lo encuentra divertida e interesante. Al terminar le pagaré $5 en efectivo por su ayuda, o si prefiere puedo donar $5, en su nombre, a esta iglesia. Después de la misa (clase) podríamos reunir brevamente afuera, y podríamos hacer una cita para tomar la prueba. Tal vez pueda tomarla después de la misa hoy o antes de la misa el próximo domingo. (Tal vez pueda tomarla después de esta clase hoy, o antes de la próxima clase, o después de la clase el jueves.) Muchas gracias por esta oportunidad y espero que hablemos después de la misa.

Recruitment Speech - English

Good afternoon, parishioners (students), my name is Tomás Cummings. I would like to ask for your help with a project that could help the Spanish speakers of our community. I need your help with a study for Colorado State University. Currently, there are no tests to evaluate memory problems in Spanish speakers. There are plenty of such tests for English speakers, but few in Spanish. Therefore, we have developed a memory test in Spanish and we need to administer it to normal persons who speak Spanish. By normal persons I mean persons in good health, without brain injuries, like the majority of us. When we have determined the performance of normal persons, then doctors can give this test to Spanish-speaking patients with memory problems. They can then compare the performance with that of normal people. So, patients that have had a brain injury or illness, such as Alzheimer's, or a stroke, can receive adequate treatment. So, with your help, if you take this test, you will help Spanish-speaking patients, ...and also help me get my doctoral degree.

Father Flynn (Cliff or teacher Lorraine) has granted me permission to administer the test, which is oral and short, one on one, in a room of the church (in an office of the teacher). It takes 20-30 minutes. It is not difficult; in fact, many people find it fun and interesting. At the end, I will pay you $5 cash for your trouble, or if you prefer, I can donate the $5 to the church. After the mass (class) we can meet briefly outside and set an appointment to take the test. Perhaps you could take it after the mass today or before the mass next Sunday. Thank you very much for this opportunity, and I look forward to speaking with you after mass.

La universidad del estado de Colorado
Consentimiento informado para participar en una investigación

Título del proyecto: Traducciones al español y data normativa para tres pruebas empleadas en evaluaciones neuropsicológicas.
Investigador principal: Ernest L. Chavez, Ph.D.

Persona encargada y numero de teléfono para preguntas/problemas:
Tomás A. Cummings, (970) 416-7505

Propósito de la investigación: Desarrollar una traducción española de tres pruebas de memoria problemas para evaluar problemas de pérdida de memoria en personas con lesiones en la cabeza o enfermedades que afectan el cerebro. En este proyecto se administrará las tres pruebas a personas en buena salud, como usted, para determinar el nivel de rendimiento de hispanohablantes normales en estas pruebas. Con estas pruebas se podrá comparar el rendimiento de pacientes hispanohablantes con lesiones cerebrales con el rendimiento de los hispanohablantes normales. Actualmente, estas pruebas son empleadas rutinariamente con anglohablantes, pero no están disponibles para pacientes hispanohablantes.

Procedimientos/metodos utilizados: Sólo pueden participar aquellos hispanohablantes que no tengan lesiones o enfermedades del cerebro. Primero, se le preguntará la edad, años de educación, y país de procedencia. Para proteger su privacidad, no se le preguntará su dirección o nombre completo. En la primera prueba, le tomará tres pruebas orales breves en español. En la primera, voy a leer una lista de palabras y le pediré que diga todas las que recuerde. En la segunda, le pediré que haga diseños con cubos de colores. En la última, le enseñaré dibujos en que falta una parte y usted escogerá de cinco opciones la parte que falta . Tarda 25-35 minutos. Al terminar le pagaré en efectivo por su participación, o si prefiere podemos donar $5 la iglesia o organización donde tiene lugar esta prueba.

Riesgos del procedimiento: No hay riesgos conocidos. No es posible anticipar todos los riesgos posibles en un procedimiento de investigación, sin embargo los investigadores han tomado todas las precauciones posibles parea minimizar posibles riesgos.

Beneficios: Usted recibirá $5 en efectivo por participar en algo que mucha gente encuentra divertido e interesante. Este proyecto ayudará a la comunidad hispanohablante ya que resultará en una prueba diagnóstica que ayudará a identificar problemas de memoria debidos a lesiones o enfermedades cerebrales en pacientes hispanohablantes. Esto hará posible que estos pacientes reciban tratamiento adecuado.

Pagina 1 de 2: Iniciales del participante________ Fecha:________

Confidencialidad: Para proteger la confidencialidad, las hojas de consentimiento y las hojas de rendimientos serán guardado por separado y bajo llave. Toda la información obtenida será utilizada sólo para este investigación. Solamente los investigadores de este proyecto podrán ver estas hojas.

Responsabilidad: El acta de inmunidad gubernamental de Colorado determina, y podría limita, la responsabilidad legal de la universidad estatal de Colorado en caso de daños causados por este estudio. Demandas en contra de la universidad deben ser presentadas menos de 180 días de haber sufrido un daño. Si tienes preguntas sobre los derechos de los participantes, dirijase a Celia S. Walker a (970) 491-1563.

Participación: Su participación es voluntaria. Si decide participar en el estudio, puede retirar su consentimiento y dejar de participar en cualquier momento sin perder los beneficios que le corresponden.

Su firma certifica que ha leido/oido la información y afirmado voluntariamente esta hoja de consentimiento. Con su firma también certifica que ha recibido, en la fecha de la firma, una copia de esta documento que tiene dos páginas.

____
Nombre de participante (letra imprenta)

______________________________ ___________
Firma de participante Fecha

______________________________ ___________
Firma de investigador o co-investigador Fecha

Página 2 de 2: Iniciales de participante __________ Fecha________

COLORADO STATE UNIVERSITY

INFORMED CONSENT TO PARTICIPATE IN A RESEARCH PROJECT

Project Title: Culturally Relevant Spanish Translations and Normative Data For Three Tests Used in Neuropsychological Assessment

Principal Investigator: Ernest L. Chavez, Ph.D.

Co-Investigator: Tomás A. Cummings, M.S.

Contact Person and phone number for questions/problems: Tomás A. Cummings (970) -416-7505

Purpose of the Research: To develop a Spanish version of three subtests that are used to evaluate memory problems in people with head injuries or illnesses that affect the brain. This project involves testing healthy people like you to determine the performance of normal Spanish-speaking. Then doctors can use these tests on Spanish-speaking people with memory problems and compare their performance with that of normal Spanish-speaking people. Currently, these tests are used routinely with English-speaking people, but they are lacking for Spanish-speaking people.

Procedures/Methods to be Used: Only Spanish-speaking persons without a history of brain injury/illness can participate. First, you will be asked for your age, years of education, and country of origin. To protect your privacy, you will **not** be asked to give your full name or your address. Then you will take three short, oral tests in Spanish. The examiner will read a short list of words and you will be asked to recite as many as you can remember. Then you will be asked to make some designs with colored blocks. Finally you will be shown a series of different drawings, each with a piece missing. You will choose the missing piece from five options at the bottom of the page. The total time will be 25-35 minutes. At the end you will be paid $5 cash for your participation, or you may choose to donate that $5 to the organization where this testing takes place.

Risks Inherent in the Procedures: There are no known risks. It is not possible to identify all potential risks in research procedures, but the researchers have taken reasonable safeguards to minimize any known and potential, but unknown, risks.

Benefits: As a participant you will receive $5 cash for doing something that many people find fun and interesting. This project will help Spanish speaking people as a group as it will provide a useful diagnostic tool that will help doctors correctly identify memory problems due to a head injury or brain illness. This will help these people receive the best treatment they deserve.

Confidentiality: In order to protect confidentiality the consent forms and score sheets will be kept separately in locked filing cabinets. Although you will be asked to sign this consent form, it will be kept separately from the test score sheets, which will **not** contain your name. All information collected will be used for this research project only. Only the investigators involved in the project may see the score sheets and consent forms.

Liability: The Colorado Governmental Immunity Act determines and may limit Colorado State University's legal responsibility if an injury happens because of this study. Claims against the University must be filed within 180 days of the injury. Questions about subjects' rights may be directed to Celia S. Walker at (970) 491-1563.

Page 1 of 2: Participant initials ________ Date _________

Participation: Your participation in the research is voluntary. If you decide to participate in the study, you may withdraw your consent and stop participating at any time without penalty of loss of benefits to which you are otherwise entitled.
Your signature acknowledges that you have read the information stated and willingly sign this consent form. Your signature also acknowledges that you have received, on the date signed, a copy of this document containing two pages.

____
Participant name (printed)

______________________________ ____________
Participant signature Date

______________________________ ____________
Investigator or co-investigator signature Date

Las instrucciones: Lista de palabras I, Diseños con cubos, Razonamiento con matrices, Lista de palabras II

Lista de palabras I

Recordación libre inmediata, lista A

Prueba 1. Voy a leer una lista de palabras. Escuche con cuidado. Cuando haya acabado, quiero que me repita todas las palabras que recuerde. No hace falta que las repita en el orden original. Sencillamente trate de recordar todo lo que pueda. ¿Está listo/a? (Lea la lista A) Ahora, digame todas las palabras que recuerde.

Prueba 2-4. Voy a leer las mismas palabras otra vez, y como antes, al terminar quiero que me diga todas las palabras que recuerde, incluyendo las palabras que me dijo antes. No hace falta que las diga en el orden original. Sencillamente trate de recordar tantas palabras como pueda.
(Lea la lista A tres veces más) Ahora, digame todas las palabras que pueda recordar.

Recordación libre inmediata, lista B

Ahora, voy a leer una nueva lista de palabras para ver cuántas palabras de esta nueva lista puede recordar. ¿Está listo/a?
(Lea la lista B) Ahora, digame todas las palabras que pueda recordar.

Recordación libre después de una pausa corta, lista A

¿Recuerda la primera lista de palabras que hicimos cuatro veces? Quiero que me diga todas las palabras de esa lista que pueda recordar.

(Después de anotar las respuestas)
Quiero que recuerde la primera lista de palabras que hicimos cuatro veces porque más tarde voy a pedirle que me las diga otra vez.

Diseños con cubos

Diseño 3, Prueba 1

Ahora, voy a pedirle que haga algunos diseños. Aquí tenemos unos cubos. Todos son iguales. Algunos lados son completamente rojos; Otros, completamente blancos; y otros, mitad rojo y mitad blanco.
Voy a combinar estos cubos para hacer un diseño. Mire bien lo que hago. Ahora, haga uno exactamente igual y digame cuando acabe. Puede empezar.
(si no puede hacerlo) Prueba 2
Mire otra vez lo que hago.
Ahora, intentelo otra vez y asegúrese de hacerlo exactamente como el mío.

Diseño 4, Prueba 1

Vamos a hacer uno nuevo diseño. Ahora, vamos a combinarlos de tal manera que se parezcan a este dibujo. Primero mire lo que hago.
Como puede ver, las superficies de los cubos se parecen a este dibujo.
Ahora, mire el dibujo y haga un diseño que sea exactamente igual usando estos cubos. Digame cuando acabe. Puede empezar.
(si no puede hacerlo) *Prueba 2*

Mire otra vez lo que hago.
Ahora, intentelo otra vez y asegúrese de hacerlo exactamente como el que está en la página.

Diseños 5-9
Ahora haga uno exactamente como éste. Trate de hacerlo lo más rápidamente posible. Digame cuando acabe.

Diseños 10-13
Ahora haga uno exactamente como éste usando nueve cubos y digame cuando termine.

<u>Razonamiento con matrices</u>
Ahora vamos a hacer algo diferente. Voy a enseñarle algunos dibujos. En cada dibujo hay una parte que falta.
Mire con cuidado todas las partes de cada dibujo y escoja la parte que falta de las cinco opciones al pie de la página. Por cada problema hay sólo una respuesta correcta . Si cree que hay más de una respuesta correcta, escoja la mejor.

(Ej. A)
Por ejemplo, mire con cuidado los dibujos de esta página y digame cual de estas opciones debe estar aquí.
(Si sea correcto) Correcto.
(Si no) Hay varias maneras de resolver este problema. Por ejemplo, puede mirar al dibujo separandolo en dos columnas. Fijese que las piezas de la columna izquierda son iguales. Las dos tienen la misma forma. Ahora mire la columna derecha. Una de las opciones hará que las partes de la columna derecha sean iguales también. Por ejemplo, esta opción haria que las dos partes de la columna derecha sean triángulos.

Pruebas 1-35
Ahora digame cuál de estas opciones debe estar aquí.

<u>Lista de palabras II</u>
Recordación libre con pausa larga, lista A
¿Recuerda la lista de palabras que repetimos cuatro veces?
Ahora quiero que me diga todas las palabras de esa primera lista que pueda recordar, una vez más.
Reconocimiento con pausa larga, lista A
Ahora voy a leer más palabras. Escuche con cuidado. Después de leer cada palabra diga "si" si la palabra es de la primera lista de palabras que repetimos cuatro veces. Diga "no" si es una nueva palabra y no fue parte de la primera lista.
¿Está listo/a?

Instructions (English) for Word Lists I & II from the Wechsler Memory Scale III

Word Lists I

Free Recall List A

Trial 1

I am going to read a list of words. Listen carefully. When I'm finished I want you to repeat as many of the words as you can remember. You don't have to repeat them in the same order, simply try to remember as many as you can.

Are you ready? (Read list A)

Now, tell me as many as you can remember.

Trials 2-4

I am going to read the same words again, and like before, at the end tell me all that you can remember, including the words you've told me before. They don't have to be in the original order, simply try to remember as many words as you can.

Are you ready? (Read List A)

Now, tell me as many as you can remember.

Free Recall, List B

Now, I am going to read a new list of words to see how many words from this new list you can remember. Are you ready?

(Read list B)

Now, tell me as many as you can remember.

Short Delay Free Recall, List A

Remember the first list of words that we did four times? Tell me as many words from that first list as you can remember

I want you to remember the first list of words that we did four times because later I am going to ask you to tell me them again.

Word Lists II

Long-Delay Free Recall, List A

Remember the list of words that we repeated four times? Now, tell me all the words from that first list that you can remember one more time.

Long-Delay Recognition, List A

Now I am going to read more words. Listen carefully, after reading each word day "yes" if the word was from the first list of words that we did four times. Say "no" if it is a new word and was not part of the first list.

Are you ready?