THE EFFECTS OF BILINGUALISM AND ACCULTURATION ON NEUROPSYCHOLOGICAL TEST PERFORMANCE: A STUDY WITH ARMENIAN AMERICANS

by

SETA KAZANDJIAN

A dissertation submitted to the Graduate Faculty in Psychology
in partial fulfillment of the requirements for the degree of
Doctor of Philosophy, The City University of New York

2006

UMI Number: 3231945

ProQuest Information and Learning Company
300 North Zeeb Road
P.O. Box 1346
Ann Arbor, MI 48106-1346

This manuscript has been read and accepted for the

Graduate Faculty in Psychology in satisfaction of the

dissertation requirement for the degree of Doctor of Philosophy.

Date

Joan C. Borod, Ph.D.

Chair of Examining Committee

Date

Joseph Glick, Ph.D.

Executive Officer

Alan Kluger, Ph.D.
Jennifer J. Manly, Ph.D.
Alizah Brozgold, Ph.D.
Yaakov Stern, Ph.D.

Supervisory Committee

Abstract

THE EFFECTS OF BILINGUALISM AND ACCULTURATION ON NEUROPSYCHOLOGICAL TEST PERFORMANCE: A STUDY WITH ARMENIAN AMERICANS

by

SETA KAZANDJIAN

Advisor: Professor Joan C. Borod

Given the extensive immigration into the United States from various countries and the strong ethnic communities that exist within the major cities of the United States, the effects of bilingualism and acculturation on neuropsychological test performance of non-Hispanic ethnic Americans are crucial. This study examined differences in neuropsychological test performance between non-Armenian, monolingual, Caucasian-American adults (NA) and Americans of Armenian descent (AA), with varying levels of bilingual fluency and several immigration-related factors. Forty bilingual AA (62.5% female) and 43 NA (57.5% female) participants were administered a comprehensive battery of neuropsychological tests. AAs were subdivided into groups based on their performance on the Wide Range Achievement Test-3 (WRAT-3) reading measure (Wilkinson, 1993; creating low- and high-English Fluency groups), an experimental Armenian version of a word-reading test (creating low- and high-Armenian Fluency groups), and the Marin and Marin Acculturation scales (1991) for Language Preference (creating low- and high-language acculturated groups) and Social Relations (creating low- and high-socially acculturated groups). AAs were also grouped by years of Armenian education, immigration age, and origin of immigration. A factor analysis on the 30 test variables yielded 10 meaningful neuropsychological factors (i.e., Learning, Narrative Memory, Nonverbal Processing, Language, Fluency, Conceptualization, Mental Control, Set-Shifting, Attention, and Processing Speed). The data were analyzed using analysis of covariance for each factor, controlling for age, education, and English Fluency. The Language factor emerged as particularly vulnerable, with poorer performance seen by low-English, low-Armenian, low-language acculturated, low-socially acculturated, late immigrating AAs, as well as AAs with more than six years of Armenian education, compared to NAs. Similar results were seen for Narrative Memory with these groups, though the differences were not as striking as for Language. Poorer performance on Learning was seen by Low Language Acculturated AAs compared to High Language Acculturated AAs and NAs. Three variables emerged as strong predictors of performance on Language, Narrative Memory and Learning factors: English Fluency, Language Acculturation, and Immigration Age. These results suggest that differences can be seen on neuropsychological tests with strong verbal components (e.g., vocabulary, naming, story-memory, and verbal list-learning) in bilingual Caucasian immigrants as compared to monolingual, US-born Caucasian-Americans.

Acknowledgements

I would like to thank the most supportive and involved committee ever: my chair and advisor, Joan C. Borod, Ph.D.; for all her help through my graduate school years, Alan Kluger, Ph.D., for his patience and kindness; and Jennifer Manly, Ph.D., for her mentorship and helping me see the light at the end of the long tunnel. I thank my enthusiastic outside readers Alizah Brozgold, Ph.D. and Yaakov Stern, Ph.D..

My utmost appreciation goes to Jill Razani, Ph.D., and her Neuropsychology Lab at California State University, Northridge; Joaquin Burciaga; Jennifer Wong; Lilia Magdelena; and Michelle Madore, without whom I would still be collecting data to this day.

I thank the many neuropsychologists, speech pathologists, linguists, and psychologists, such as Marcel Ponton, Ph.D., Michel Paradis, Ph.D., and Jean Phinney, Ph.D., who graciously gave me their time and their valuable advice that made my dissertation so much better.

To Adam Brickman, Ph.D. and Shelley Peery, Ph.D., for all their help, input, and patience with this project; and for helping me find alternative avenues with all the obstacles I faced along the way. They have been good friends over the graduate school years, and I hope we will remain good friends for a very long time.

This dissertation would not have been possible without the amazing support I received from the Armenian American community of Los Angeles, California. I owe a great debt of gratitude to the ladies of the Armenian Relief Society in Glendale, teachers at Ferrahian Armenian School and Chamlian Armenian School, the students of Glendale Community College, and the staff at Asbarez Armenian Daily News, as well as the staff at Nor Gyank Armenian Daily News. I thank the Armenian Prelacy of New York for helping with the translation of documents to Armenian, as well as Vatche Proodian, Sarkis Mahseredjian, and Anny Bakalian for the education they provided me on Armenian issues and the Armenian language.

Most importantly, I am grateful to my friends and family who gave their time, support, and love throughout my perpetual studies and especially toward this dissertation project. I dedicate this dissertation to Taline and Andres for providing me with a loving home, to little Lori for getting me out of bed every morning with her laughter, to my parents for their understanding even when they didn't quite get the point of it all, and to my wonderful husband, Armen, who pushed me to always do my best, even from thousands of miles away.

Table of Contents

CHAPTER ONE

Introduction

The United States is rapidly becoming increasingly multicultural and multilingual. Widely used neuropsychological tests or their norms are no longer valid for many of its major cities' inhabitants. Language proficiency, bilingualism, acculturation, and quality of education are factors that can affect performance on most verbal tests and even on some non-verbal ones. An increased awareness and interest in ethnic minority issues have resulted in a number of studies comparing African Americans and Hispanic Americans to White Americans on a handful of commonly used neuropsychological measures. These studies have found inconsistent but significant differences. However, a large part of the country's immigrants do not fit in either of these racial or ethnic groups and are considered Caucasian or White, yet speak different languages and have different cultural systems. These are the Eastern European, Middle Eastern, and Near Eastern immigrants. The Armenians are an example of these ethnic groups.

Especially in urban areas, the rise in immigration is leading to an increasingly bilingual, if not multilingual, population. According to the 2000 U.S. Census, 18.7% of Americans speak another language other than English at home. Of these, 45% report not being able to speak English "very well." The definition of bilingualism is rather broad. In most studies, bilinguals include fluent individuals, referred to as "balanced bilinguals" or "strong bilinguals," to those who can understand the second language but are not competent enough to communicate effectively with it ("weak bilinguals"). Age of second-language acquisition, the manner in which it was learned, and the stage of bilingualism are all important factors in the study of bilingualism, neuropsychologically, and cognitively.

This study examined the differences in performance between adults of Armenian descent with varying levels of bilingual proficiency in Armenian and English, varying education histories (e.g., U.S. education, Middle Eastern education, or U.S. Armenian school education), and varying acculturation levels (e.g., extent of involvement in Armenian communities and social interaction, and extent of language use), *and* White, non-Armenian, English-speaking monolingual controls on cognitive functioning, using a battery of neuropsychological tests.

The results are aimed to help clarify whether there are differences in cognitive functioning due to bilingualism and/or acculturation (the extent an individual is immersed into and identifies with the new dominant culture). In addition, the variability in type of education will help clarify whether effects of bilingualism and/or acculturation are due to formal versus informal language education or to level of language proficiency.

This study examines various factors underlying bilingualism, as well as the understudied factor of acculturation, on cognitive functioning as assessed through neuropsychological test performance.

Literature Review

To familiarize the reader with the current state of the bilingualism and acculturation literature, a review of influential and relevant findings is presented. First, a review of the bilingualism literature is presented covering the early theories of bilingual aphasics' language recovery from the time of Ribot and Pitres, the differential organization of the bilingual brain based on electrical cortical stimulation research, lateralization hypotheses, theories of functional organization based on language acquisition factors, neuroimaging findings based on language production and language comprehension, and cognitive neural network theories. Although much of this research is based on recovery data with aphasics, they were included in the current study to provide a frame of reference for the state of the normal bilingual brain. Next, a review of current neuropsychological studies with bilinguals is presented, which served as a base for the current study. Following the review of the bilingualism literature, a brief discussion of the various definitions of culture is presented along with a discussion of its role in education, which leads to an explanation of the term acculturation and a review of neuropsychological findings on acculturation. Finally, the interplay between language, culture, and cognition is explored.

Bilingualism

Classical Theories of Bilingualism

Bilingual aphasics have been studied since the time of Broca in the 1860s. By comparing the recovery patterns of bilingual (and in some cases multilingual) aphasics with monolingual aphasics, several contrasting theories have been produced in reference to the localization and lateralization of two (or more) languages in one brain (for an in-depth review, see Albert and Obler, 1978). Initially, influenced by the recent findings of Broca's area for speech production and presented with a bilingual aphasic who had recovered only one language after a specific injury, Scoresby-Jackson (1867) put forth the view that each language is represented by its own center in the brain. However, as more bilingual aphasics were described in the literature with varying patterns of recovery, Scoresby-Jackson's view quickly became replaced by a set of "rules" regarding recovery in bilingual aphasics. Ribot's rule (1881) states that, regardless of proficiency, the earlier-learned language should be less impaired and should recover before the second language. Pitres (1895), however, believed that the more familiar and proficient language would recover first, regardless of order learned. Minkowski (1927) noted that affective factors also play a role in recovery. Selective recovery for the language spoken by the patient's friends and family, before or after the injury, was seen in a number of patients. Affective variables, such as the desire to communicate in one language rather than the other, have been thought to be consistent with motivational factors noted in second-language acquisition (Gardner & Lambert, 1972). According to Vaid and Genesee (1980), however, affective variables are present to some degree in all cases and cannot be considered a separate determining factor in the recovery of language.

Differential Organization of Bilingualism

The bilingualism recovery literature remained stagnant until electrical cortical stimulation data, reported by Ojemann and Whitaker (1978), brought a new avenue to explore the bilingual's brain. Within the dominant (left) hemisphere of bilinguals, a differential organization was revealed, where along with common language sites for naming, specific cortical areas were discovered that were activated only when naming in one language and not in another. Presented with varying cases of bilingual individuals who, after a cerebral injury, had become completely or partially aphasic in one or both of their languages and encouraged by Ojemann and Whitaker's findings, Paradis rejected the earlier theories of Pitres (1895) and Ribot (1865) as too simplistic (in Marrero et al., 2002), supporting a differential neural functional organization of the two languages in a bilingual's brain. Paradis (1987) identified six patterns of recovery in bilingual aphasics

– parallel, differential, selective, successive, antagonistic, and mixed. The presence of six differing patterns of recovery in bilingual aphasics not only indicates a differential neural functional organization of the two languages in the brain, but also different organizations among individuals.

Several hypotheses have been formulated to explain the differential neural functional organization of bilingual aphasics (for reviews, see de Groot & Kroll, 1997; Paradis, 1997). Paradis, himself, used a cognitive neuropsychological approach and formulated several hypotheses to explain localization in bilinguals, such as the extended system, dual system, and tripartite. Taking the six patterns of recovery into consideration, Paradis's (1997) subset hypothesis is best supported by the cognitive studies and neuropsychological findings thus far. The subset hypothesis states that an implicit linguistic competence language system exists in all individuals. Implicit linguistic competence refers to the unconscious rule-governed aspects of language (e.g., "-ed" as suffix to indicate past tense). Under this larger system, subsystems exist for each of the bilingual's languages. These subsystems are similar to each other to the extent that they are both language systems (thus explaining the mixed and parallel recovery patterns), yet each can be independently inhibited or activated (thus explaining the selective, successive, antagonistic, and differential recovery patterns).

Lateralization Hypotheses of Bilingualism

In addition to views of differential organization within the left hemisphere, a handful of studies have reported crossed aphasia, which is an aphasia resulting from right-hemisphere damage (e.g., Albert & Obler, 1978; Galloway & Scarcella, 1982; Gloning & Gloning, 1965/1983; Ocharova, Raichev, & Geliva, 1980; Vildomec, 1963).

This led to the right-hemisphere hypothesis of bilingualism, which simply states that the bilingual brain is more symmetrical with respect to function than is the monolingual brain. Paradis (1987), however, warned that due to the tendency to over-report crossed aphasia compared to the commonly seen aphasia, the right-hemisphere hypothesis might be premature. A review of the literature by Karanth and Rangamani (1988) came to the conclusion that crossed aphasia was as common in monolinguals as in bilinguals.

Given that the right hemisphere processes information in a gestalt, simultaneous manner, whereas the left hemisphere is an analytical and serial processor (e.g., Borod, 1992; Lezak, 1995), the hypotheses regarding lateralization of language function have been revised to take into account the linguistic aspects of language. Speech content and context comprehension, pragmatics, and prosody are considered right-hemisphere functions (Millar & Whitaker, 1983; Zaidel, 1985). Researchers have looked at appositional versus propositional languages (Rogers, TenHouten, Kaplan, & Gardiner, 1977; Scott, Hynd, Hunt, & Weed, 1979) and direction of script (Gaziel, Obler, & Albert, 1978; Mishkin & Forgays, 1952; Orbach, 1953; Orbach, 1967, as cited in Vaid & Genesee, 1980). However, the results have been inconsistent. Closer inspection of the findings revealed other factors, such as proficiency and age of acquisition of the second language, as mediators for the effects seen.

Language Acquisition Factors

A review of the literature reveals that functional organization of the two languages in a bilingual's brain varies across individuals and depends on several key language acquisition factors – age of second-language acquisition (SLA), manner of SLA, proficiency of SLA, and exposure to SLA after the injury (Vaid, 1983; Vaid &

Genesee, 1980). Earlier studies evaluating proficiency of the second language in crossed aphasics (Albert & Obler, 1978; Krashen & Galloway, 1978; Silverberg, Benton, Gaziel, Obler, & Albert, 1979) and normal bilinguals (Hynd, Tweeter, & Stewart, 1980) refined the right-hemisphere hypothesis to conclude that symmetrical organization of languages in bilinguals is more evident during the initial stages of SLA (less proficient bilinguals) than during the final stages of SLA (more proficient bilinguals). As discussed in Vaid and Genesee (1983), the speech production and comprehension of initial stage language learners consists of more right-hemisphere related linguistic skills than left-hemisphere related skills. This supports the hypothesis of more right-hemisphere involvement in non-proficient bilinguals for the second language.

In terms of age of acquisition, the earlier literature has led to the idea of a critical age of language acquisition for asymmetrical organization of language. Hyltenstam and Stroud (1989) found that the earlier the second language is learned, the more similar the organization to the first language and the more similar to the organization of monolinguals. Experimental evidence using ERPs and dichotic listening tasks have further supported the conclusions that the functional organization of languages for balanced bilinguals (equally proficient) resembling that of monolinguals the earlier the second language is acquired (Vaid & Genesee, 1983). These findings support Ribot's rule from 1865 in that the first language learned is more resilient to cortical damage.

The third factor found to play a significant role in the functional organization of the bilingual brain is the manner in which the languages have been acquired. Formal acquisition involves rule-based learning and error correction, such as processes learned in a classroom. These processes are analytical and involve serial processing. Informal acquisition involves language learning through natural exposure at home or other naturalistic communication settings. Informal acquisition relies on gestalt, contextual, and pragmatic language processing. In informal acquisition, the rules of the language are internalized and can be referred to as implicit linguistic skills. Based on the skills learned and the manner in which the languages were learned, Carroll (1980) associated formal acquisition with greater left-hemisphere involvement and informal acquisition with right-hemisphere involvement. Referring to cognitive development in infants, language areas are more symmetrical until around age 5. It is at this age that children begin to learn language more formally, in terms of grammar and spelling (Segalowitz, 1983). These findings led to the proposal that bilinguals who learned their native language informally, never received formal training later in life, and used it only in naturalistic settings will have greater right-hemisphere involvement for their native language and greater left-hemisphere involvement for their second language, which they might have learned in school.

Neuroimaging Findings

The recent literature using neuroimaging techniques (PET and fMRI) has clarified some of these issues of lateralization and localization of languages in the bilingual brain, particularly in terms of language acquisition factors. Briefly, based on an extensive review by Abultalebi, Cappa, and Perani (2001), fMRI and PET data led to the following conclusions. In terms of language production, early bilinguals demonstrated no activation differences between the first and second languages. In addition, late bilinguals showed common neural networks for their languages if they were highly proficient in both.

In terms of language comprehension, early bilinguals demonstrated a common neural network for both their languages within the dominant (left) hemisphere, if equal exposure had been provided from birth. For late bilinguals, the less proficient language showed a different neural network than the more proficient language, regardless of age of acquisition. Furthermore, late, low-proficiency participants were found to have large inter-subject variability in the organization of the second language, suggesting that a common neural functional organization of newly acquired language does not exist. Mechelli et al. (2004) found grey-matter density in the inferior parietal cortex greater in bilinguals than in monolinguals with the density in the region increasing with second-language proficiency, but decreasing as the age of second-language acquisition increased. Overall, based on the neuroimaging data reviewed by Abultalebi, Cappa, and Perani (2001), as well as Fabbro (2001), and taking into account the clinical evidence reported by earlier researchers, the neural functional organization of the languages of a bilingual depends on language-acquisition factors. Most importantly, the level of proficiency is implicated. Proficiency is confounded with age of acquisition, as most early bilinguals become more proficient in their second language than late bilinguals. The importance of evaluating the proficiency of the bilingual in both the second and first language is highlighted by these findings.

Cognitive Implications – Neural Networks

Cognitive psychologists have studied memory and numeric cognition in relation to bilingualism. Numeric cognition involves calculations, arithmetic problem-solving, and working with numbers. Several hypotheses have been formulated regarding the semantic memory stores of bilinguals. The independence hypothesis states that bilinguals have two distinct memory stores (Macnamura & Kushnir, 1971; Tulving & Colotta, 1970), whereas the interdependence hypothesis states that bilinguals share a semantic store accessing it with two representational lexical systems (Glanzer & Duarte, 1971). Paradis's three-store hypothesis (1978, 1980) is similar to the interdependence hypothesis in that two subsystems exist under a larger system. In the three-store hypothesis, the larger system is a conceptual store, which is independent of language, and the two subsystems are a lexical store for word meaning and a store of phonological and syntactic properties for each language. If the interdependence or three-store hypotheses are operative, the choice of which language and which representation to use will result in differences in the performance of bilinguals on memory tasks as compared to monolinguals.

Some researchers suggest different networks exist based on the type of memory involved. In terms of episodic versus semantic memory tasks, Snodgrass (1984) suggests an independent network for episodic memory but an interdependent network for semantic memory. Also, in line with Paradis's three-store model, which consists of a conceptual store, Paivio and Desrochers (1980) suggest that memory tasks involving concrete words would result in a difference in performance between bilinguals and monolinguals, while abstract words would not result in a significant difference between the two groups. Paivio and Lambert (1981) suggested that the method of encoding information can affect later retrieval, in that bilingual encoding, which involves translation, would be better retained than monolingual encoding. Kolers (1978, 1979) considered memory to be reliant on the specific factors present at initial learning, which are not only external but also internal, such as cultural aspects, affective values, the method in which the material was presented and acquired, and most importantly, spoken language.

Ardila et al. (2000) evaluated the performance of Spanish-English bilinguals on a series of verbal memory tests (WMS Logical Memory, WMS Associate Learning, Digit Span, and Serial Verbal Learning) in both English and Spanish. Results supported a couple of theoretical models of bilingual cognition and memory described above. Specifically, the overall finding of better performance on delayed memory tests in the Spanish condition than in the English condition lends support to Harris, Cullum, and Puente's (1995) findings of better performance in list-learning for the dominant language in unbalanced bilinguals. Taken together, the two studies support Kolers (1978, 1979) in that knowledge and memory are organized and dependent upon factors, such as language and method of learning. However, given that Ardila et al.'s (2000) participants were proficient in both languages, the issues of language, cognition, and culture are raised, which we will discuss later in this paper. A more important finding reported by the Ardila et al. study was that the preferred language (the language in which the participants preferred to communicate daily) was a stronger predictor of performance on verbal memory tests than age of second-language acquisition.

In terms of numerical operations, Magiste (1980) compared high and low proficient bilinguals on an arithmetical operations task finding that highly proficient bilinguals demonstrated a slower response time. This increase in response time was thought to be due to the interdependence hypothesis. Geary, Cormier, Goggin, Estrada, and Lunn (1993) have found a similar, yet non-significant, trend in carry-over numerical operations, where highly proficient bilinguals demonstrated a slower response time compared to low proficient bilinguals and monolinguals. This effect was thought to imply greater interference in working memory due to the interdependent or three-store hypothesis. Ardila et al (2000) evaluated the performance of Spanish-English bilinguals on four calculation tasks (successive subtractions, multiplication, division, and numerical problems). Significant differences were found between the two languages in all but the successive subtractions tests. Furthermore, preferred language was found to be a significant variable in solving numerical problems. The authors suggest this finding to imply that better reasoning abilities are dependent upon the preferred language. These overall language effects for native language in calculations support the theory that numerical operations are highly correlated with the language individuals were initially taught (Kolers, 1968; Noel & Fias, 1998; Shannon, 1984).

Neuropsychological Findings

A number of studies have been conducted that compare bilinguals and monolinguals on neuropsychological tests. Unfortunately, the majority of these studies have methodological constraints. Many did not evaluate degree of proficiency of both languages, but rather created subgroups based on age of second-language acquisition. Furthermore, many of the earlier studies did not control for SES or they tested the bilingual participants in their weaker language (Centeno & Obler, 2001). However, an important study by Peal and Lambert (1962), which controlled for degree of proficiency and SES, found that bilingual children performed better than age-matched monolingual children in Canada in both verbal and nonverbal intelligence, particularly in mental flexibility and reorganization of visual patterns (Centeno & Obler, 2001). Ponton and Ardila (1999) evaluated the differential performance of Spanish-English bilinguals on the

Neuropsychological Screening Battery for Hispanics (NeSBHIS; Ponton et al., 2000) based on preferred language. Results suggested that testing in the preferred language can enhance test scores in mental flexibility and attention (Digit Span, Digit Symbol, and Color Trails I and II) and abstract nonverbal reasoning (Block Design and Ravens Standard Progressive Matrices). Overall, based on the limited studies with bilinguals on tests of intelligence, it is held that bilingualism offers enhanced cognitive functioning in attention, mental flexibility, nonverbal reasoning, and visual patterning due to the advantage bilinguals have of being exposed to the symbolic nature of language and understanding that language is a tool of cognition in and of itself (Bialystok, 1992; Perez-Arce, 1999; Ponton & Ardila, 1999).

A handful of studies have looked at specific neuropsychological functions that are frequently examined in assessments due to their sensitivity to brain damage and ease of administration, such as verbal fluency (semantic and phonemic) and confrontation naming (via the Boston Naming Test,). These tests are particularly important to evaluate in bilinguals given their high linguistic content. Furthermore, while normative data exist for Hispanic populations, these are not appropriate for other bilinguals. As described earlier, bilinguals are a heterogeneous group, and it is understandably a nearly impossible task to create a set of norms for each group of bilinguals for even one test, let alone an entire battery. Aside from age, method, and stage of acquisition, the languages that bilinguals speak and understand play a major role in test differences between the groups due to the variability in the grammatical and morphological nature of language. However, a select group of researchers has studied Spanish-English bilinguals in the United States on some of these verbal tests.

Rosselli, Ardila, Salvatierra, et al. (2002) looked at differences in performance and strategy use of Spanish-English bilinguals on Spanish and English semantic and phonemic fluency tests, as well as the performance and strategies of Spanish and English monolinguals on these tests. The groups were controlled for age with an overall mean age of 61.8 (SD = 9.3) and an overall mean education of 14.8 years (SD=3.6). Bilinguals had poorer semantic fluency in their second language compared to their first language and to both monolingual groups. The findings supported the theories of Snodgrass (1984) and Paivio and Desrochers (1980) in that semantic and concrete words could be located in a separate lexical store in the interdependent or three-store model (Paradis, 1980), resulting in an interference in accessing the information and translating to the appropriate language. The difference in fluency was not seen for the phonemic category because it is not restricted to concrete words and, therefore, more conceptual words can be produced from the shared conceptual linguistic store. Closer inspection of the subcategories generated by the bilinguals compared to the monolinguals revealed fewer subcategories in the animal category. This was thought to signify the more elaborate lexical framework available in the native language compared to the second language of bilinguals.

The same group of healthy, educated elderly participants was evaluated on sentence repetition and an oral description of a picture (Cookie Theft – Boston Diagnostic Aphasia Exam; Goodglass & Kaplan, 1983). No significant differences were found on these tasks for the bilinguals. Although this study contained a very thorough questionnaire of language use, along with a naming test in both languages to assess bilingualism, the participants were not grouped according to bilingual proficiency, but rather by age of acquisition. Furthermore, the age of acquisition cut-off was rather high (age 12). In addition, the group was educated and had been exposed to English for an average of 35.95 years.

Gollan, Montoya, and Werner (2002) examined semantic and phonemic fluency in Spanish-English bilingual college students. Their findings were consistent with those of Rosselli et al. (2002). The bilinguals produced significantly fewer semantic items than English-speaking monolinguals. These bilinguals also generated significantly fewer phonemic items and proper names than English-speaking monolinguals. These findings again support the cross-language interference hypothesis that results from the three-store model. Unfortunately, this study's bilingualism assessment techniques were not ideal. The bilinguals were identified by self-ratings on a language-history questionnaire. Actual proficiency in the native or second language was not assessed. Furthermore, the age of English acquisition (second language) was at a mean of 3.4 years (SD=2.7). Although the bilingual group in this study differed significantly in their responses to the language history questions from the monolingual group, it is highly likely that the bilingual group was highly acculturated to the dominant U.S. culture and considered English their preferred language (this question was not asked). Results might have differed had these factors been taken into consideration.

Kohnert, Hernandez, and Bates (1998) conducted a study with young, educated Spanish-English bilinguals with the Boston Naming Test. Results indicated a significant difference in performance between the first and second language, with better performance in English. As the authors note, such a result suggests the subject group to be English dominant. However, only self-ratings were used to assess bilingual proficiency.

Furthermore, acculturation was not assessed – a critical variable that affects the familiarity of the items (e.g., a beaver, pelican, acorn, etc.)

Finally, the Stroop effect was evaluated in bilinguals. No differences were found on any of the conditions of the test, although bilinguals were 5-10% slower than monolinguals on the color-word condition. However, bilinguals assessed as "unbalanced" (i.e., unequal proficiency in the two languages) showed better performance in their dominant language (Rosselli et al., 2002).

In all of the above-mentioned studies, bilingualism was assessed through a series of self-rating questions, which ranged from rating their level of proficiency in each of their languages to more detailed questions that involved self-assessments of daily usage and exposure to the languages. Although self-ratings have been found to be accurate predictors of performance on several language tasks (Delgado, Gerrero, Goggin, & Ellis, 1999), when attempting to gather normative data on such a heterogeneous and poorly defined group, better assessment measures should be used that later can be correlated with appropriate self-rating questions. It is a well-known psychological phenomenon that individuals are not good evaluators of their own performance and abilities. Inaccurate estimation of one's native or second-language proficiency can be due to loyalty to one's native language or shame associated with the lack of mastery in English (Harris et al., 2001). In many cases of early bilinguals who have been exposed to their native language primarily in the home and social environment, their vocabulary and syntax often consists of "Hispanisized" English terms and phrases (i.e., laundromat is called "el londri"). Often this hybrid version of Spanish is modeled and considered accurate Spanish by individuals who have not received formal Spanish training (Ponton & Ardila, 1999).

Harris et al. (2001) point out other problems with bilingual proficiency assessments used thus far in studies and in clinical settings, including the assumption that individuals presenting with good conversational skills in either language are also proficient in other aspects of language (e.g., reading and writing).

Culture and Cognition

Culture

D'Andrade defines culture 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" (1988, p.116). Rohner (1984) defines culture in terms of "highly variable systems of meanings," which are "learned" and "shared by a people or an identifiable segment of a population." Culture, therefore, consists of ideas, tools, values, beliefs, and knowledge, which are all transmitted genetically and/or through language, modeling, and imitation (Wertsch, 1985).

Culture plays a major part in the outcome of cognitive and neuropsychological tests. Studies in cross-cultural neuropsychology and cognitive psychology have found differences among cultural groups in strategies for classifying and solving problems, memory strategies, and cognitive styles. Bruner, Oliver, and Greenfield (1966) found cross-cultural differences in categorization by color, shape, and function. Choi, Nisbett, and Smith (1997) reported cross-cultural differences on category-based induction, which is the willingness to generalize a rule across categories. Koreans were found to use categories less often than Americans for inductive inferences.

Cross-cultural findings in terms of memory structure have found that cultures with oral tradition have better memory for stories (Ross & Millsom, 1970). Wagner

(1981) proposed that the structure of memory is universal (i.e., STM capacity), whereas control processes (encoding and retrieval strategies) are culturally influenced. Luria's Uzbek expedition in the 1930's revealed cultural differences in logical reasoning. Comparing five groups of women who varied in education and exposure to major towns versus villages, Luria (1976) reported two types of reasoning. The illiterate villagers, who had had very little exposure outside of their small towns, habitually used concrete reasoning, which was termed "graphico-functional." These women's reasoning was limited to real life experiences and situational constraints. The literate group that lived in collectivistic communities showed abstract or "hypothetico-deductive" reasoning.

Greenfield (1997) identified three reasons for the cross cultural differences seen in psychological testing. These are values and meanings, modes of knowing, and conventions of communication. In a review paper by Ardila (2005), eight different culture-dependent values are explained, which are thought to be related to the cross-cultural differences seen in cognitive testing. These are 1) one-to-one relationship, 2) background authority, 3) best performance, 4) isolated environment, 5) special type of communication, 6) speed, 7) internal or subjective issues, and 8) use of specific testing elements and testing strategies. These are values that involve the testing environment and can affect the test performance, as well as the interpretation. In summary, the cultural view that the examinee holds regarding sharing personal information, working in a private room with a stranger who may be of a different culture, the level of importance placed on these tests, and the speed of performance requested can differ from culture to culture and can confound the test results.

Culture or Formal Education?

These findings have been reevaluated by other researchers, and the differences seen were considered to be due to an effect of formal education. Cole et al. (1971) and Mistry and Rogoff (1985), have attributed these differences in logical reasoning and memory strategy use to schooling.

Formal schooling does play a major role in cognitive test performance. Kendall et al. (1988) identified skills taught in schools that have been formulated by members of the Western culture and are appreciated, rewarded, and directly assessed in cognitive tests. These skills include simple practice with writing utensils, booklets, books, and letters and numbers, as well as learning the importance of attention, obeying instructions, and responding to questions quickly and accurately.

In response to the cross-cultural findings and the formal education effects, neuropsychologists and cognitive psychologists have pushed for the assessment of "cognitive competence" in lieu of "intelligence" (Berry, 1984; Verster, 1986). Intelligence is defined differently across cultures (Berry, 1974) and composed of various characteristics outside of the Western world's academic view of intelligence. The most commonly held difference from the Western view of intelligent behavior, which includes speed and accuracy, is a slow and careful response style. Sternberg, Conway, Ketron, and Bernstein (1981) found that a "social competence" factor emerged consistently when intelligence was defined outside of the academic and scientific population. Unfortunately, the tests that have been used to assess cognitive competence have been the culture-laden executive functioning tests, which are only one component of intelligence (Nell, 2000).

Furthermore, the studies comparing cultural groups tend to include uneducated, isolated cultural groups that drastically differ from the cultural groups living in the Western and Eastern worlds. These traditional peoples vary in a number of variables from those living in urban or rural modern societies that make it difficult to attribute differences to culture, language, education, SES, socialization practices, or ecological forces of the environment. The existence of multiple cultures within a major culture must also be recognized. Political and economic differences across periods of time can also cause differences within cultures. Another issue to be aware of is the individual outside of his original culture and now living within a new dominant culture.

Acculturation

This brings us to the issue of acculturation. Bilingualism is highly correlated with acculturation (Artiola i Fortuny, Heaton, & Hermosillo, 1998 in Gasquoine, 2001). However, it has been ignored in the bilingualism literature and the neuropsychology literature in general. Acculturation has also only recently been discussed in the cross-cultural literature. In order for proper assessment of an individual's true abilities, the examiner must be aware of not only the language proficiency and preference of the individual, but also his/her cultural preference and identification, or acculturative level.

Acculturation has been defined in the literature as the "phenomena resulting from the direct and continuous first-hand contact of different cultures that produces change in the cultural patterns of one or more of the corresponding groups" (Ponton & Ardila, 1999). Four major types of acculturation strategies discussed in cross-cultural psychology are assimilation (relinquish indigenous cultural identity and adapt new dominant culture), integration (maintain own identity, while becoming part of the larger societal framework), separation (a desire to relate to the host society), and marginalization (loss of contact with both the dominant group and indigenous cultures). Cultural identity (the complex set of beliefs and attitudes about oneself in relation to their cultural group membership) plays a role in the acculturation strategy taken by the individual (Berry, 2001).

Acculturation is a multidimensional process, because it involves a cultural change taken by the individual. As described earlier, culture consists of several learned systems of meaning, which involve tools, ideas, and values. As Berry (2001) noted, the level or acculturative strategy taken by the individual can vary based on the situation. For instance, an individual may speak their native language at home, but English outside of the home. They may hold on to their native culture's foods and music, but choose to watch, listen to, and read American or English language media sources. According to Ponton and Leon-Carrion (2001), a clinically meaningful assessment of an individual's acculturation level must objectively ascertain the cultural change at several dimensions.

Neuropsychology and Acculturation

Does acculturation - - the extent an individual is immersed into and identifies with the new dominant culture - -affect neuropsychological test performance? Only a few studies have attempted to answer this question, thus far, either directly or indirectly. In a review of studies conducted with Hispanic Americans (Gasquoine, 2001), only 11 out of 21 studies reported information on acculturation. Of these, only two used acculturation scales (Arnold et al., 1994; Ponton et al., 2000). Seven of these studies used length of United States residency as a measure of acculturation. Several studies stratified the groups based on a minimum of years in United States residency (Jacobs, Sano, Albert, et al., 1997; Jacobs, Winston, & Polanco, 1997) or provided minimal information (Lowenstein et al., 1992; Olazaran et al, 1996). Artiola i Fortuny, Heaton, & Hermosillo (1998) found a negative effect of length of residency on letter fluency in Spanish, such that participants provided fewer items in Spanish as the number of years in the U.S. increased. They also found a positive effect on the Wisconsin Card Sorting Test, such that performance on the test improved as years of residence in the U.S. increased. All other studies did not report any differences as a function of acculturation. Touradji, Manly, Jacobs, and Stern (2001) reported a significant effect of years of residence in the United States among foreign-born non-Hispanic, White elderly on tests of verbal fluency (semantic and phonemic) and abstract reasoning (WAIS-R Similarities). These results were found after controlling for age and years of education, as well as English-reading proficiency (assessed by the Wide Range Achievement Tests Reading subtest; Wilkinson, 1993). Taken together, the few studies suggest acculturation effects on fluency, abstract reasoning, categorization, and set-shifting. Unfortunately, these studies looked at acculturation as secondary analyses or post-hoc. Other factors, such as years and quality of education, SES pre- and post-immigration, and bilingual proficiency were not appropriately assessed in most of these studies.

Several researchers have looked into the role of literacy among ethnic minorities. These studies have found performance on reading tests, specifically the Wide Range Achievement Test's Reading test, as a better predictor of neuropsychological performance than years of education (Byrd, Jacobs, Hilton, Stern and Manly, 2005; Byrd, Sanchez, and Manly, 2005; Manly, Schupf, Tang, and Stern, 2005; O'Bryant, Schrimsher, and O'Jile, 2005). Quality of education among ethnic minorities was found to be an important predictor, which is not adequately measured by self-reported years of educational attainment.

Language, Culture, and Cognition

Language and reasoning are considered culturally determined cognitive tools by cognitive psychologists (Perez-Arce, 1999). According to Whorf (cited in Shweder, 1999), the cognitive framework through which we interpret, classify, and organize perceptions and information is determined by language (Perez-Arce, 1999). Knowledge is based on social interaction. It is a combination of cultural, historical, and biological tools. Thought is structured by the environment, which, in turn, is structured by social interaction. Hence, thinking is a product of the material conditions in which it develops (Marx cited in Nell, 2000). In Western culture, thought is linguistically based. Therefore, the language in which the child interacts with the society and the cultural boundaries the child is exposed to create the cognitive framework of the individual (Kolers, 1978).

Universal aspects of cognition exist, such as perception, categorization, retention, reasoning, and problem-solving (Segall, 1979). However, this functional universality does not suggest that cultural differences do not exist within them. The process, content, and contexts in which these basic cognitive abilities are conducted, as well as the complex abilities that arise from the combination of these basic cognitive processes can vary between and across cultures. According to Ratner (1991), "cultural schemas and social contexts are postulated to develop, focus, and shape the interpretive processes for which the individual has capacity, that is, they are an integral part of the cognitive activity" (in Perez-Arce, 1999, p. 584).

Inclusion of Armenian Americans

Armenian Americans were selected as the target population for several reasons. The variability of this immigrant group's educational and language history, the strong cultural community that is readily available for newly arrived immigrants and the significant difference in the Armenian language as compared to the English language (e.g., different alphabet, syntax, and style) makes this group an ideal source. In addition, the absence of neuropsychological data on Armenians and a lack of data on most Middle and Eastern cultural groups, such as Afghani, Arab, Assyrian, Iranian, Israeli, Kurdish, Turkish, provide an opportunity to investigate an understudied group.

The number of Armenians living in the United States is unclear. According to the 2000 U.S. Census (2000), 385,488 individuals of Armenian descent live in the United States, with 204,631 living in California, 28,595 in Massachusetts, 24,460 in New York, and 17,094 in New Jersey. According to the Armenian religious and cultural organizations, however, this is an underestimate. Often misidentified as members of their countries of emigration, or not included due to illegal immigration, these organizations feel the true number of Armenians in California is closer to 600,000. In the city of Glendale, an estimated 40% of the residents are Armenian. According to the 2000 U.S. Census, 78,000 Armenians live in Glendale.

As described in Sabagh, Bozorgmehr, and Der-Martirosian (1990), political circumstances have led to most of the Armenian immigration into the United States. There have been several waves of Armenian immigration to the United States. The first wave consisted of Armenian refugees who fled the Ottoman Empire in the late 19^{th} and early 20^{th} centuries. A significant wave occurred in the late 1970's and through the

1980's as Armenians living in Egypt, Lebanon, Iran, and Turkey escaped the political turmoil in these countries. Finally, a wave of Armenians began to emigrate from the Republic of Armenia following the collapse of the Soviet Union in 1991. This last wave is continuing with over 1,000 Armenians legally or illegally immigrating to Southern California every year. Over 10,000 Armenians have immigrated to the United States since 1999.

This immigration pattern creates a unique pool of participants to study acculturation and bilingualism. The pool consists of one cohort, which included survivors of the first wave of immigrants and their descendants who are now a middle-aged second generation, and young or very young third and fourth generations. A second cohort consists of first-generation immigrants that vary widely in age. The multiple waves of emigration out of Armenia and Eastern Turkey to countries in Europe, Middle East, Australia, Asia, and North America have resulted in a significantly large Diaspora in relation to the number of Armenians living in present-day Armenia. A series of historical events led to a strong sense of cultural and ethnic identity despite the fact that many Armenians were born outside of the Republic of Armenia in the Middle East or the United States. The Republic of Armenia declared independence in 1991, after 70 years of Soviet rule. Over the years Armenians not only maintained their unique language, history, and cultural traditions, but they held on to it very tightly. There is a strong ethnocentrism in the Armenian community, with little tolerance for inter-group marriage. The Armenian language and traditions are deemed extremely important for most Armenians living outside of Armenia (Bakalian, 1993).

Armenian Language

The Armenian language is a separate branch of the Indo-European languages with a unique alphabet consisting of 36 characters. The language is similar to the Latin languages in many ways, but with important differences (Sakayan, 2000). Some examples of the contrasts between English and Armenian are the following:

1. Gender in Armenian is unmarked. There is no expressed grammatical distinction for masculine, feminine, or neutral gender. Gender must be discerned by the linguistic context or situation.

2. English mainly uses prepositions, while Armenian has a lot more postpositions.

3. Whereas, English uses two distinctions for proximity (this/that and here/there), Armenian has three distinctions indicating a) immediate proximity, b) moderate distance, and c) greater distance.

4. Unlike English (but similar to Spanish and French), Armenian finite forms do not require personal pronouns as the personal endings in the conjugation. To indicate I, you, they, etc., an *m, s, a, nk, k*, or *n* are added to the end of the conjugated verbs.

5. The Armenian vocabulary consists of a large number of compound words formed by joining two words together with a conjunctive "a", such as the word for perfume, which is composed of the word for sweet added on to the word for scent.

Below is a table depicting the Armenian alphabet, with the names of the letters written in phonetically in English.

THE ARMENIAN ALPHABET

Ա	ա	aip	Մ	մ	men
Բ	բ	pen	Յ	յ	he
Գ	գ	kim	Ն	ն	noo
Դ	դ	tah	Շ	շ	shah
Ե	ե	yech	Ո	ո	vo
Զ	զ	zah	Չ	չ	chah
Է	է	ai	Պ	պ	bay
Ը	ը	yet	Ջ	ջ	chay
Թ	թ	to	Ռ	ռ	rrah
Ժ	ժ	zhay	Ս	ս	say
Ի	ի	ini	Վ	վ	vev
Լ	լ	lune	Տ	տ	dune
Խ	խ	kh	Ր	ր	ray
Ծ	ծ	dzah	Ց	ց	tso
Կ	կ	ghen	Ւ	ւ	hune
Հ	հ	ho	Փ	փ	pure
Ձ	ձ	tsah	Ք	ք	kay
Ղ	ղ	ghad	Օ	օ	o
Ճ	ճ	jay	Ֆ	ֆ	fay

Armenian Culture

In terms of acculturation, the Armenian Americans serve as an ideal population group. As a result of their history of genocide, deportation, and years of foreign rule, the Armenians have formed a "tough skin" in terms of acculturation. They have many cultural organizations, ethnic organizations, compatriotic unions with ancestral villages, community centers, stores, churches, and Armenian language schools. Waves of immigration into the Los Angeles area have resulted in the formation of strong communities in neighborhoods in cities such as Hollywood, Glendale, and North Hollywood. In these neighborhoods, an Armenian can live a very active social and occupational life and receive many services without speaking a word of English and interacting only with Armenians. Armenian-speaking food vendors, pharmacists, physicians, dentists, lawyers, tailors, hair stylists, shop owners, and mechanics are all available. Up to three different 24-hour Armenian language television and radio channels are available. There are various social activities to attend for the Armenian community every day. Therefore, individuals exist who are not acculturated at all to the dominant

American culture, as well as those who have chosen to separate from the Armenian community and acculturate completely, and many who are in the middle of the acculturation spectrum.

Education in Armenian American Community

The Armenian American community in Los Angeles also provides a pool of educational variability. Due to the immigration patterns of Armenian Americans, there is access to immigrants who arrived in the United States at varying ages and who have received an American public education from early on, only a secondary American education, or only an American college education. Access is also available to immigrants who never received any American education, but were self-taught in the English language or had taken English as Second Language courses privately. Evaluation of recent immigrants allows for an investigation of the effect of foreign education (Lebanese, Iranian, or Soviet) on neuropsychological test performance. A third valuable variable found in this subject group is the availability of participants who attended private Armenian language schools in the United States. There are currently 5 major elementary to secondary level Armenian-language private schools in the Los Angeles area. These schools offer formal education in English and all major academic subjects, as well as formal Armenian language and Armenian history courses on a daily basis.

In terms of educational achievement, there is a high level of educational achievement among Armenian men and women. A large number of the children of immigrated Armenians have college educations. However, among the older age groups, the number of Armenian men with post-graduate college education is far fewer than those with limited elementary education. There is also a tendency among Armenian women in

Los Angeles to have higher educational achievements than Armenian men (Sabagh, Bozorgmehr, & Der-Martirosian, 1990).

Summary and Hypotheses

Empirically, clinical studies with bilingual aphasics, experimental studies using neuroimaging, and normative studies using neuropsychological tests have revealed a differential neural functional network for bilinguals dependent upon a number of variables, such as age, type of task, and stage of second language acquisition. The younger the individual learned the second language and the greater the exposure to the second language, the less neural differentiation is seen. Neuropsychological studies with Spanish-speakers and immigrants from Central and South America have found differences in semantic and phonemic fluency, auditory comprehension, and confrontation naming, which are all verbal functions. These differences can clearly be a factor of language proficiency. However, differences have also been found in nonverbal tasks (BVRT matching, Identities and Oddities, and BVRT recognition memory) among Spanish-English bilingual immigrants (Jacobs, Sano, et al., 1997). The differences seen here may be due to cultural factors, as they do not involve verbal content.

The more acculturated the individual is to the dominant culture, the less functional differentiation in performance is seen. Jacobs, Sano, et al. (1997) pointed out that the differences they reported in their bilingualism study were related to the number of years in U.S. residence. Bilingualism appears to play a role in neuropsychological test performance, but in many instances, the bilingual's level of acculturation is limited. These differences were noted with elderly individuals who tend to hold on to their original culture, even many years after emigration. A review of the bilingualism and acculturation studies reveals that the findings were minimal, occurred only in a few tests, and were variable. The differences are very sensitive to education, socioeconomic status, and other factors. Nevertheless, differences do exist among low acculturated and low-proficiency bilinguals.

Based on this research, and the literature reviewed, the following hypotheses will be tested in the current study:

1. Armenian American participants (AAs), in general, will not perform as well as Non-Armenian monolingual participants (NAs) on verbal and language tests, such as confrontation naming, vocabulary, phonemic and semantic fluency, verbal list memory, and story memory. Whereas, AAs are expected to perform as well as, or better than, NAs on nonverbal tests and tests of conceptual reasoning.
2. AAs with a higher level of English proficiency will perform better than those with a lower level of English proficiency on the overall battery. Alternatively, AAs with a higher level of Armenian proficiency will have lower scores than those with a lower level of Armenian proficiency on the battery, especially on tasks with high language content.
3. Greater Armenian proficiency (despite level of English proficiency) will result in higher ethnocentric scores and lower acculturation scores.
4. It is expected that on the neuropsychological tests, participants with higher levels of acculturation to the dominant U.S. culture will perform similarly to the English-speaking monolingual White, non-Armenian controls and better than those who are not acculturated.

5. It is expected that participants born in the US or arriving before age 10 will perform better than those arriving after age 10. These participants will also perform similarly to the monolingual, Caucasian-American participants.
6. AAs with formal Armenian language education are expected to perform worse than those with the majority of their education in American schools on the neuropsychological tests, especially tests measuring language functioning.
7. Due to the lack of preexisting studies on country of origin (US, Western, and Eastern), an exploratory analysis will be conducted. It is expected that US and Western participants will perform better than Eastern participants, due to the similarities in educational and economic culture.

CHAPTER TWO

Methods

Participants

Armenian American participants were solicited through advertisements in community and ethnic newspapers, community centers, and ethnic stores. Non-Armenian, non-Hispanic, White American monolingual participants were solicited through advertisements placed in area community centers, stores, and newspapers, as well as through the student subject pool at California State University, Northridge. Respondents were screened by telephone for the following selection criteria: age (must be between ages 18-45), education (country and type of school; years of education: 12-18), socioeconomic status (Hollingshead SES score between 4 and 7; Hollingshead, 1977), and year of immigration. Respondents were requested to complete a questionnaire to screen for medical, psychological / psychiatric, neurological, learning disability and substance abuse history. It is important to recruit participants who do not have a history of medical, psychiatric, and neurological disorders or learning disability that may affect cognitive functioning. Similarly, respondents with significant substance use or alcohol use were screened out.

Respondents whose demographic information agreed with the criteria were asked to participate in the study. Participants received either $25 for their participation or credit toward their course requirements at California State University, Northridge for experimental participation. Ninety-five participants were recruited in total. 50 of the participants were Armenian Americans living in the Los Angeles area. Forty-five of the participants were monolingual, Caucasian, non-Armenian Americans from the Los

Angeles area to serve as a comparison group. Data cleaning for outliers and incomplete data resulted in a final sample of 83 participants. Eight Armenian participants from the early data collection group were omitted due to incomplete data, one Armenian and one non-Armenian subject were omitted for better distribution of age and education between the two subject groups, and one Armenian subject was omitted due to a possible undiagnosed learning disorder.

Forty bilingual Armenian Americans (AAs) and 43 monolingual, non-Armenian, Caucasian-Americans (NAs) were included in the final sample. Independent samples t-tests found that the groups were not significantly different for age ($F = 2.15$ (1,81), $p = .147$) or education ($F = 2.31(1,81)$, $p=.132$). Cross-tabulation for gender found the groups did not significantly differ (Pearson's chi square = .406). Non-parametric analysis found the groups did not differ significantly based on socioeconomic status (Mann-Whitney U = 744.500, $p = .263$). Table 1 provides the means and standard deviations by subject group for these core demographic variables.

Within the AA group, participants were further categorized by age of immigration to the United States (before the age of 10 and after age 10), years of formal Armenian education (less than 6 years and 6-12 years), and country of emigration. Country of emigration was broken down by those who were born in the United States or immigrated to the US before the age of 2, those who emigrated from the Western-dialect speaking countries (e.g., Lebanon, Iraq, Turkey, and Syria), and those who emigrated from the Eastern-dialect speaking countries (e.g., Armenia and Iran). The origin of emigration was identified as differences exist between the two Armenian dialects in structure, as well as in political, economical, and cultural environments in the countries of emigration.

Table 2 offers a distribution of the three categories, including the results of independent sample t-tests for age and years of education, Kruskal Wallis non-parametric tests for socioeconomic status, and cross-tabulations for gender were conducted to test for significant variance on the core demographic variables. A significant distribution of age was noted for US Age ($F = 5.896$, $p = .020$). US Age of Immigration groups also were different, though not significantly ($p = .064$), in years of education. In analyses with US Age of Immigration, age and education will be held as covariates to control for any influence these demographic variables may have on the dependent variables.

Procedure

Acculturation Scale

Selected participants were given an acculturation scale specific to the Armenian and American cultures, which is a modified form of the Marin and Marin Acculturation Scale (Marin & Marin, 1991). There are several acculturation scales available that have been used in the literature. The Marin and Marin Acculturation Scale, however, consists of cultural dimensions that are related to cognitive functioning or test performance. This scale has also been endorsed as a psychometrically sound and objective scale of acculturation and is recommended and used by Ponton and Leon-Carrion (2001) in studies of cross-cultural neuropsychology with Hispanics.

The subject is presented with 12 statements from the Marin and Marin Acculturation Scale, which was modified by replacing the word “Hispanic” with “Armenian”. Although the Marin and Marin Acculturation Scale was originally created and standardized for Hispanic populations, the content of the scale items are not specialized for any particular ethnic or cultural group. One item from the scale in the media preferences section was changed to be consistent with actual media choices available in Los Angeles. Item number 7 of the scale refers to radio program preferences. The question was changed with newspaper preferences, as there are no Armenian-language radio stations available in Los Angeles, while there are at least four major Armenian-language newspapers. The scale can be divided into three sections: language preference (items 1-5), media preference (items 6-8), and ethnic social relations (items 9-12). For items 1-12, the participants are asked to respond to the statement on a Likert type scale with "1" indicating "Only Armenian", "2" indicating "More Armenian than American/English", "3" indicating "Both Equally", "4" indicating "More American/English than Armenian", and "5" indicating "Only American/English." An example of a media preference statement is "In general, what language are the programs you watch on television?" The responses for each section of the 12 items are tabulated and compared with the different scale ranges for each section. Table 3 provides an interpretation key of the Marin and Marin Acculturation Scale along with the percentage of Armenian participants in each category.

The score on each section will provide a multidimensional evaluation of the participants' acculturation levels, which will be analyzed separately to determine which dimension plays a greater role in neuropsychological test performance. Due to the significant non-normal distribution of the Media Preferences category, this section was omitted from the analyses. In addition, the "high" and "moderate" participants on Language Preference and Ethnic Social Relations Scale were combined in an attempt to minimize a non-normal distribution in these subscales. The scale has been translated into

Armenian for participants who are low in English proficiency. This was done to ensure accurate placement of acculturation level groups.

Language Proficiency

Bilingual proficiency was assessed through the use of a combination of measures.

Armenian Proficiency

For Armenian proficiency, listening comprehension, reading (words, sentences, and paragraph), and dictation (words and sentences) sections from the Bilingual Aphasia Exam (Part B: Western and Eastern Armenian; Paradis, 2000) was used. Normative data are available for unimpaired participants on these measures (Paradis, 1987). The average range for the combined subtests on the BAT, Part B, is 37 out of 41. High Armenian proficiency is defined as a combined score above 37 (90^{th} percentile). Sixty-two and a half percent of the Armenian participants scored in the high proficiency group. Thirty-seven and a half percent were in the low proficiency group.

In addition, Armenian participants were administered the Bilingual Aphasia Test Part C (Western and Eastern Armenian; Paradis, 2000), which involves the translation of words and sentences and involves making grammatical judgments of sentences to and from English and Armenian. For example, participants will be asked to translate "Yesterday, I decided to walk" into Armenian, or given the word for "wall" in Armenian and asked to provide the English word. The aim of this subtest is to identify bilingual proficiency in English and Armenian. As detailed in Paradis's The Assessment of Bilingual Aphasia (1997), the BAT is a criterion-based test, such that 100% identifies fluency in the unimpaired range. For the purposes of this study, any score below 78 out of a possible 86 (90^{th} percentile) is considered a low-bilingual. Forty-two and a half percent of the Armenian participants scored in the high bilingual group, whereas 57.5 % scored in the low bilingual group.

English Proficiency

For English proficiency, the Boston Diagnostic Aphasia Exam, Third Edition (BDAE; Goodglass, Kaplan, & Barresi, 2000) Complex Ideational Material subtest (for listening comprehension) was used. More subtests from the BDAE were originally administered. However, due to a large number of missing data on these subtests, only the Complex Ideational Material subtest was included in the final analysis. Given that this subtest has a strong ceiling effect, any score below 11 (90^{th} percentile) will be labeled as low English proficiency. According to this criterion, 67.5 % of the Armenian participants scored in the high proficiency group, whereas 32.5 % scored in the low proficiency group.

Word Reading Tests

In addition to the subtests taken from the aphasia tests described above, an experimental Armenian word reading test modeled after the Reading subtest of the Wide Range Achievement Test (WRAT; Wilkinson, 1993) will be administered along with the Tan version of the WRAT Reading in English. The WRAT Reading test has been regularly used by neuropsychologists as a measure of premorbid intelligence, literacy, and basic English proficiency.

An experimental Armenian version of this test was created. The test consists of 42 Armenian words that increase in phonetic complexity and decrease in frequency. Words were selected from an Armenian dictionary and rated for level of difficulty and frequency by editors of an Armenian language newspaper. The participants will be administered both the English WRAT Reading subtest and the experimental Armenian Word Reading Test (AWRT). The English WRAT can be used to determine English proficiency, however, the AWRT will strictly be used as an experimental measure for which normative data will be collected. Setting the criterion for high proficiency on the mean of the current sample (mean = 44 [SD = 11.12]), 70 % of the Armenian participants were identified as high proficiency in Armenian reading.

For English proficiency, normative data published in the WRAT testing manual were used. Based on the normative data, a raw score of 58 is at the 50^{th} percentile for ages 20-45. A raw score of 55 is at the 50^{th} percentile for ages 18-19. Given the range of ages in the study, the raw scores were converted into standard scores with a mean of 100 and a standard deviation of 15. Given that the scores of AA participants in the current study will be compared with the scores of the NA participants, the cut-off for high-reading proficiency was identified as the mean standard score of the NA subject group (e.g., SS = 90). Based on this criterion, 56.6% of the participants were identified as high-English reading proficiency. Among the AAs, 19 participants were identified as low-English reading proficiency and 21 with high-English reading proficiency.

The non-Armenian, Caucasian participants (NAs) were identified as monolingual and made up 51.8% of all participants. However, among the NAs, 17 were identified with scores in the low-English reading proficiency range and 26 had scores in the high-English reading proficiency range. Given this variability, performances will be compared based on literacy level for NAs.

Neuropsychological Battery

A battery of neuropsychological tests will be administered to all participants in English. The battery of tests was selected based on several criteria. First, the tests are commonly used in clinical research settings and are known to be reasonably reliable and valid measures of the cognitive domain that they are designed to measure. Second, the tests were selected based on past cross-cultural and bilingualism studies in neuropsychology which found differences in reaction time, fluency, naming, and abstract reasoning, but did not control for acculturation, type of education, and/or specific bilingualism factors. The tests included in this study are either identical to the ones used in past studies or were selected because they add valuable information on the cognitive domain investigated. Third, the tests selected vary in their level of culturally loaded content. Most tests, particularly the language-based tests like the Boston Naming Test and the California Verbal Learning Test, have been considered to be culturally unfair for non-Western, non-English-speaking test-takers. However, other tests, such as the Color Trails Test, have been created with the intent to correct for the cultural load, or have rarely been questioned for their "cultural-loadedness" (i.e., Rey-Osterreith Complex Figure Test).

The battery will be administered in English only to all participants, regardless of level of proficiency in English for two reasons. First, there are no Armenian versions of these tests available and normative data have not been collected on Armenians for fair comparison. Second, the purpose of the study is to investigate differences in performance among bilingual individuals of varying proficiency in English and varying levels of acculturation. Therefore, the testing materials and environment must be identical for accurate comparison.

The following is a description and purpose of each of the tests included in the battery. The battery is designed to take 90 – 120 minutes to administer.

Animal Naming. Animal naming is a type of category or semantic fluency task (Spreen & Strauss, 1998). This test evaluates word-list generation abilities with semantic cues. Participants are asked to provide as many words as they can think of belonging to a particular semantic category (e.g., animals) within 60 seconds. The similarity between this test and the test of phonemic word fluency (COWAT – FAS; Tombaugh, Kozak, & Rees, 1999) described below, leads to the inclusion of both measures in bilingualism and acculturation studies. Differences have been seen in semantic fluency between bilinguals and monolinguals, such that bilinguals do not produce as many category words as monolinguals (Gollan, Montoya, & Werner, 2002).

Boston Naming Test (BNT). The purpose of the Boston Naming Test (Kaplan, Goodglass, & Weintraub, 1983) is to assess the ability to name pictured objects. Confrontation naming tests, especially the Boston Naming Test, are frequently used in neuropsychological assessment. The sixty items of the full BNT range from simple, high-frequency vocabulary ("house") to rare words ("sphinx") that are presented one at a time on cards, and two prompting cues (a stimulus cue followed by a phonemic cue) are provided if the subject does not produce the word spontaneously within 20 seconds. Participants were initially presented with item 30. If at least eight consecutive items are not correctly identified, the items are presented in reverse order from Item 30 until at least six consecutive items are correctly named. Based on results found in Kohnert et al. (1998) and Roberts et al. (2002) with bilingual adults, it is expected that this subtest will be affected by the predictor variables of bilingualism and acculturation, such that lower English proficiency AAs will not perform as well as NAs.

California Verbal Learning Test (CVLT). This CVLT (Delis, Kramer, Kaplan, & Ober, 1983) test assesses verbal memory via immediate and delayed recall with and without cues, and via recognition. The examiner reads the subject a shopping list of 16 items composed of four semantic categories with four items per category in random-blocked order. The list is read over five trials. Following each trial, the examiner asks the subject to recall as many of the shopping items as possible, in any order, for a maximum possible score of 80 points. After the fifth trial is completed, the examiner presents the subject a different shopping list to remember, which is similarly constructed with four semantic categories and four items per category. This interference trial is followed by an evaluation of the subject's free recall of the original list without any cueing. Subsequently, the examiner solicits only the items contained within each of the four categories, one by one. After a 20-minute delay, during which other nonverbal tests are administered, free recall is re-evaluated, followed by another evaluation of cued recall. Finally, 48 words, 16 from the shopping list and 32 foils, are read to the subject who must identify by recognition the words that were from the shopping list. This is not a timed task.

Scores used for the present study are total raw score on Trials 1-5, short delay free recall raw score, long delay free recall raw score, and discriminability percentage. The total raw score on Trials 1-5 is the sum of the number of words the subject recalled on the first five presentations of the 16-item list. The range of possible scores is 0 to 80. The short delay free recall raw score is the number of words recalled without any cues immediately following the distracter trial (i.e., Tuesday's list) out of a maximum possible score of 16. The long delay free recall raw score is the number of words recalled without any cues after the 20-minute delay out of the maximum possible of 16. The discriminability score is calculated by dividing the number of false positives and misses on the recognition trial by the total number of items presented on the recognition trial (n = 44). The quotient is then subtracted from the number 1.00 and multiplied by one hundred. These scores were selected to obtain a score for immediate recall, delayed recall, and the ability to discriminate the task-presented verbal stimuli from distracters. The CVLT provides other scores, however, for the purpose of limiting the data points, only these four scores will be used. This test was selected because of its widespread use with clinical populations, despite having been implicated as culturally-loaded.

Color Trails Test. The Color Trails Test (CTT; D'Elia at al., 1989) requires the connection, by making pencil lines, between 25 encircled numbers, randomly arranged on a page, in the proper sequence (Part 1). All odd-numbered circles have a pink background and all even-numbered circles have a yellow background. The CTT is designed to minimize the influence of language. Part 1 is a test of speed for attention, sequencing, visual search, and motor function. Part 2 is a test of speed for divided attention, sequencing, and mental flexibility, along with visual search and motor function. Part 2 of the Color Trails Test shows all the numbers from 1 to 25 twice, once with a pink and once with a yellow background. The subject is required to connect the numbers from 1 to 25 alternating between pink and yellow circles. Both parts of the CTT are timed, and the speed of completion is recorded as the participant's score. The CTT was chosen over the Trail Making Test to minimize the issue of language in comparing bilinguals' performances. It will also provide valuable information in terms of acculturation, since the language component has been removed.

Phonemic Fluency (FAS). The phonemic fluency test, also known as the Controlled Oral Word Association Test – FAS (Tombaugh, Kozak, & Rees, 1999), evaluates word-list generation ability with phonemic cues. Participants are asked to provide as many words as they can think of beginning with a particular letter of the alphabet (e.g., F, A, and S) in 60 seconds. Test instructions do not permit responses that are proper names of people or places, numbers, or the same word with different suffixes or prefixes. The phonemic fluency test is a commonly used test in many neuropsychological batteries. It not only assesses word-generation ability, which is helpful in diagnosing aphasia, but also set-shifting and perseveration, which can indicate executive functioning disabilities. Past bilingualism and acculturation studies have found mild differences in performance between subject groups on this test (Gollan, Montoya, & Werner, 2002; Rosselli et al., 2002). Phonemic fluency was included in the current study in an attempt to replicate these findings. Its strong verbal component is also expected to result in significant differences as a function of bilingualism and/or acculturation.

Digit Span. The Digit Span subtest of the WAIS-III (Wechsler, 1997) consists of two components: Digit Span Forward and Digit Span Backward. Digit Span Forward assesses basic attention span, while Digit Span Backward tests for mental tracking and flexibility. Beginning with two digits, participants are presented with a series of digit sequences that increase in length by one digit every other trial. Up to nine digits are presented for the forward trials and up to eight digits for the backward trials. For the backward trials, participants are asked to repeat the sequence of digits in reverse order.

The Digit Forward trials are administered first, followed by a practice and administration of the Digit Span Backward trials. A maximum score of 18 and 16 points are possible per subtest, respectively. This test was included in the battery in part due to its common use in most neuropsychological batteries, but also to assess for any differences between the participant groups based on proficiency in the English language.

Digit Symbol. The Digit Symbol subtest of the WAIS-R (Wechsler, 1981) consists of nine pairs of digits and symbols. Participants are requested to draw symbols corresponding to 93 digits as quickly as they can in 90 seconds. Their score is the number of symbols correctly drawn within the time limit. This test was included in the battery to provide a comparative measure on psychomotor speed. The WAIS-R version of this subtest was used as opposed to the WAIS-III version in order to be consistent with the battery used by the California State University at Northridge team's battery.

Rey-Osterreith Complex Figure (RCFT). The RCFT (Meyers and Meyers, 1995) has three components. The *copy* portion of this test aims to assess visuospatial constructional ability, which includes attention to detail, organization of visual space, and planning, as well as perceptual and motor abilities. The subject is presented with a black-and-white line drawing of a complex geometric figure and asked to copy the figure to the best of his/her ability on an 8 ½ " x 11" page of blank paper placed in front of them. There is no time limit. The examiner notes the copying strategy and later scores the drawing according to criteria detailed by Taylor (1991). Eighteen elements of the drawing are scored from 0–2 points, for a maximum possible score of 36 points.

The second and third components of the RCFT assess visual memory. Participants are asked to recall and redraw the figure they had initially copied three minutes following the copy trial (Immediate Recall) and then on a 30-minute delayed recall (Delayed Recall). Similar to the copy trial, the examiner notes the strategy of the drawings and scores each reproduction according to the Taylor (1991) criteria. Eighteen elements of the drawings are scored from 0–2 points, for a maximum possible score of 36 points for each of the recall trials. As participants are never told to remember the drawing, this is a test of incidental learning.

Inclusion of these visuospatial and visual memory tasks in the battery allows for an assessment of neuropsychological test performance on tasks that have limited verbal content. Therefore, differences may be related to acculturation and education, as opposed to purely linguistic factors.

Ruff Figural Fluency. The Ruff Figural Fluency Test Part I (Ruff, Light, & Evans, 1987) is designed to measure nonverbal design fluency. The participant is asked to create different designs in 60 seconds on identical 5-point diagrams by connecting at least two dots and using only straight lines. The total number of unique designs completed within 60 seconds is the total score. This task was included in the battery to provide a measure of nonverbal fluency in comparison to phonemic and semantic (i.e., animal) fluency.

Stroop Test. The Stroop Color-Word Test (SCWT; Stroop, 1935) has three parts. Parts 1 (Word) and 2 (Color) measure the speed at which the subject reads or names printed color names and color Xs, respectively. The test consists of three white cards, each containing 30 rows of five items. In Part 1, the subject reads randomized color names (red, blue, and green) printed in black ink. This part measures reading speed and attention. In Part 2, the subject has to name the color of the Xs (red, blue, and green).

This part measures speed of color name generation, detection, and attention. Given that the Stroop test measures basic reading and color-naming speed, it is considered a good measure of response time differences due to bilingual proficiency. In Part 3 (Interference), the subject has to name the color of the ink in which incongruent color words (red, blue, and green) are printed (e.g., the word "blue" is printed in red ink). The subject must disregard the verbal content and name the colors. This part of the Stroop Test is a test of selective attention and cognitive flexibility. It measures the ease with which a person can shift his or her perceptual set to conform to changing demands and suppress a habitual response in favor of an unusual one. The total score for each part of the Stroop Test is the total number of items read within 45 seconds. All errors are subtracted from the total score. Therefore, three scores are provided: Stroop-Reading, Stroop-Color, and Stroop Color-Word.

WASI Block Design. This subtest of the WASI is designed to assess visuospatial skills and nonverbal organization and was included in the battery to provide a nonverbal processing and conceptualization measure. The block design subtest is a timed task. Participants are asked to arrange 4 – 9 blocks to duplicate a design from a stimulus book. Scoring is based on speed of completion and accuracy. Up to 13 designs are presented for a maximum score is 71. The Block Design subtest was included in the current study as a nonverbal task to counteract the verbal tests.

WASI Matrix Reasoning. This subtest of the WASI is designed to assess nonverbal abstract reasoning. Participants are asked to complete a puzzle with one of five choices provided. Up to 35 puzzles are presented for a maximum score of 35. The task is discontinued after four consecutive errors, and there are no time limits.

WASI Similarities. The WASI Similarities subtest asks participants to tell how two objects are similar (i.e., an orange and a banana). This is a verbal abstract reasoning task. Responses are scored based on abstract reasoning (2 points), concrete reasoning (1 point), and incorrect information (0 points), with a maximum score of 48. Up to 26 word pairs are presented. There are not time limits.

WASI Vocabulary. The WASI Vocabulary subtest requires participants to provide definitions of words that increase in difficulty. Up to 42 words are presented for a maximum score of 80. It is not a timed task. This subtest is commonly used in neuropsychological assessment as a measure of pre-morbid intelligence. Several studies have encouraged the use of the Wechsler Intelligence Scales' Vocabulary subtests because it is considered to be resilient to neurological impairment and aging (McFie, 1975, Vanderploeg, 1994; Yates, 1956). The subtest itself is highly correlated with the Full-Scale Intelligence Quotient on the WAIS (Wechsler, 1997). Due to its high language and cultural content, however, any factors bilingualism and/or acculturation play are expected to manifest in this particular subtest.

Wechsler Memory Scale-III Logical Memory Immediate and Delayed Recall (WMS-III Logical Memory). The WMS-III Logical Memory subtest (Wechsler, 1997) is a narrative memory task. Participants are read two brief stories and asked to recall as much of the story as they can immediately after each reading. Story A is read and recalled only once, whereas Story B is read and recalled twice. In this task, participants are informed that they will be asked to retell the story later. Following a 30-minute delay, the participants are asked to recall both stories. A cue is provided if the participant is unable to recall any aspects of the story. The delayed free recall trials are followed by a recognition trial, which consists of 15 yes/no response questions for each story.

For the free recall trials, a total immediate recall score is compiled based on the number of phrases or key terms recalled from Story A and both trials of Story B, with a maximum score of 75. A total delayed recall score is compiled based on the number of phrases and key terms recalled from each story (25 for each per story) following the 30-minute delay with a maximum score of 50. A recognition score is made up of the number of correctly answered items on the recognition trial with a maximum score of 30. This method is the standard scoring method as described in the WMS-III manual (Wechsler, 1997).

<u>Wisconsin Card Sorting Test (WCST)</u>. The Wisconsin Card Sorting Test (Heaton, Chelune, Talley, Kay, & Curtis, 1993) 128-card version is used as a test of abstract reasoning and set-shifting ability. Participants are given a deck of 128 cards containing colored symbols and asked to place each card from the deck under one of the three key cards placed before him. Minimal directions and feedback are provided. After placement of a card under a key card, a “correct” or “incorrect” response is provided. The cards can be categorized by color, form, or number. The examiner shifts the category following 10 consecutive correct responses without informing the participant. Testing is discontinued when six categories have been completed (i.e., each category - color, form, and number - completed twice) or all 128 cards have been used. The WCST computerized scoring system was used and the raw scores for number of categories completed, number of perseverative errors, and the percentage for level of conceptual responses were selected from the ten available scores. These three scores were selected

to provide measures of concept formation, perseveration, and set-shifting. This test was included in this battery in order to have a measure of conceptual thinking and set-shifting ability. Acculturation has been implicated in a study with a Mexican-American population on the WCST, such that low acculturated Mexican-Americans did not perform as well on the WCST as high acculturated Mexican-Americans (Coffey et al., 2005).

CHAPTER THREE

Results

Data Reduction

A total of 30 dependent variables were selected from the neuropsychological data, as described above. For preparation of the data, the raw scores were converted to z-scores based on the variable means and standard deviations generated for each of the 30 neuropsychological variables from the entire dataset.

In order to reduce the number of dependent variables and have greater power in the analyses, a principal components analysis with varimax rotation was conducted. This method allows for smaller more interpretable clusters (Field, 2000). A cut-off of .40 was used to load the variables into components. The cut-off score of .40 was selected based on the better interpretability of the factors at this level. According to Tabachnick and Fidell (2001), cut-off scores between .32 and .60 are acceptable.

The analysis yielded 10 factors having initial eigenvalues greater than 1.00, which are named and described in Table 4. The factor loadings are presented in parentheses following each measure. Each of the 10 output variables was inspected for functional relationships among the contributing dependent variables. Each factor was labeled based on these functional values or skills that the contributing measures hold. Several factors are made up of only the specific neuropsychological tests, subtests, or measures (e.g., CVLT, Logical Memory, Rey-Osterreith Figure Test, and Wisconsin Card Sorting Test). Others are a composed of various cognitive measures that were found to co-load on the same factor. The strongest relationship among the contributing measures was identified and used to name the factor. Tables 5-9 and Figure 1 provide the statistical results of the principal components analysis (e.g., Total Variance Explained, Component Matrix [Initial Solution], Rotated Component Matrix following Varimax Rotation, Component Transformation Matrix, and Scree Plot of Eigenvalues).

Composite scores were tabulated from the resulting factor scores to form Weighted z-score Composite Scores. Weighted z-score Composite Scores were tabulated by multiplying the z-score of each contributing variable in a factor by its factor loading score (greater than .40) and then averaging the results for a total factor score. For example,

> CVLT Weighted z-score Factor Score = [(CVLT Recall 1-5 z-score) (CVLT Recall 1-5 factor loading) + (CVLT Short Delay z-score) (CVLT Short Delay factor loading) +(CVLT Long Delay z-score)(CVLT Long Delay factor loading) + (CVLT Discriminability z-score)(CVLT Discriminabilty factor loading)]/4

The 10 output variables resulting from the factor analysis were assessed for the presence of normal distributions. Skewness was examined by dividing the skewness statistic for each output variable by its standard error (Tabachnick & Fidell, 2001). The Processing Speed, Narrative Memory, Nonverbal Processing, Language, Fluency, and Attention factors were found to be normally distributed. The Learning, Set-Shifting, Conceptualization, Mental Control, and Fluency output variables were examined for outliers, as no standard transformation techniques were able to normalize their distributions. Both the Learning and Mental Control output variables were found to have one outlier each that was negatively affecting the mean of the sample. Removal of these outliers was successful in producing normal distributions for the remaining sample. Normality plots are available from the author. The Set-Shifting and Conceptualization output variables were found to have several outliers in both directions, but removal of the outliers was not sufficient to correct the skewness of either sample. Given that no standard technique was found to properly adjust for these variables' skewness, non-parametric approaches were used to analyze the Set-Shifting and Conceptualization variables.

Statistical Analyses

Power Analysis/Effect Size

A formal power analysis was not conducted, as there were not enough studies in the published literature similar to the current study for a valid power analysis. Cohen (1992) recommends a minimum of 45 participants in a one-way analysis of variance (ANOVA), with four comparison groups for a medium effect size of .25 at the .05 p level. A minimum of 18 participants is recommended for a large effect size (.40) at the .05 p level for a one-way ANOVA with four comparison groups. Effect sizes are listed in the tables provided for each analysis.

Non-Parametric Analyses

Mann-Whitney U and Kruskal-Wallis non-parametric tests were used to analyze the Set-Shifting and Conceptualization factors. There were no significant results found for either of these variables for any of the hypotheses (Tables 9 and 10). Therefore, these factors will not be discussed in the results below. Mann-Whitney U and Kruskal-Wallis non-parametric tests were also conducted for all other neuropsychological factors for each hypothesis in light of the variability in the shape of the factor distributions as a function of the various predictor variables. There were no differences in the findings between non-parametric tests and the analyses of covariance (ANCOVAs), with age and education controlled, reported below (Table 43), despite the inability to control for age and education on these nonparametric analyses.

Analyses of Covariance.

The neuropsychological factors resulting from the principal components analysis were found to have low correlations with each other (see Table 11). Therefore, one-way between-subjects ANCOVAs were conducted for the neuropsychological factors of Learning, Narrative Memory, Language, Nonverbal Processing, Mental Control, Fluency, Processing Speed, and Attention. Although Age and Education were found to significantly differ only for the groups divided by Immigration Age, Age and Education were held as covariates for each of the analyses to control for any effects they may have had on the variables in addition to the one being directly tested. Both age and educational attainment have been found to have strong relationships to measures of cognitive functioning (Heaton, Ryan, Grant, & Matthews, 1996).

Controlling for English Fluency

In an attempt to extrapolate the influence of English fluency on the predictor variables (i.e., Armenian Fluency, Language and Social Acculturation, Immigration Age, Armenian Education, and Origin), ANCOVAs were repeated by controlling for English Fluency in addition to Age and Education. This was done to help clarify whether the significant differences seen on these predictor variables were due to English Fluency or the predictor variable in question. Only the dependent factors of Language, Narrative Memory, Learning, and Nonverbal Processing were reanalyzed.

<u>Hypothesis 1: Bilingual Armenians vs. Monolingual Non-Armenians</u>

AAs, in general, will not perform as well as NAs on verbal and language tests, such as the factors Verbal Narrative Memory, Learning, and Language. Whereas, AAs are expected to perform as well as, or better than, NAs on nonverbal tests and tests of conceptual reasoning.

To examine whether differences existed between the two main subject groups (AA and NA) on the neuropsychological variables, a one-way between-subjects ANCOVA was conducted for each of the six neuropsychological factors. Age and Education were held as covariates for each of the analyses to control for any effects they may have had on the variables in addition to the one being directly tested. The six neuropsychological variables selected were Learning, Narrative Memory, Language, Mental Control, Fluency, and Nonverbal Processing. The distribution for each factor was examined for normality, separately for each of the two subject groups.

<u>Tests of Normality</u>. Table 12 provides the results of the Shapiro-Wilk test of normality (Shapiro & Wilk, 1965). The Narrative Memory, Language, and Fluency factors were found to be normally-distributed for both subject groups. The Learning factor was not normally-distributed for the AA group. Nonverbal Processing and Mental Control factors were not normally-distributed for the NAs. Histograms are provided for each factor for AAs and NAs (Figure Set 2)

<u>ANCOVAs</u>. Table 13 and Figure 8 provide the means and standard deviations for each subject group, as well as the results of the separate ANCOVAs conducted with the Weighted z-score Composite Scores. AAs had significantly lower scores than NAs on

the Narrative Memory, F (1, 78) = 5.93, p = .017, and Language, F (1, 78) = 13.10, p = .001, factors. A trend was seen showing that the AAs had higher scores than the NAs on the Nonverbal Processing factor, F *(1, 78) = 3.34*, p = *.071*. It is important to note that significant positive correlations were found for Age, F (1, 78) = 4.08, p = .047, and Education, F (1, 78) = 5.14, p = .026, for the Language factor, such that with increasing age and education, higher scores were seen. A significant negative correlation was found for Age for the Nonverbal Processing factor, F (1, 78) = 10.17, p = .002, such that with increasing age, scores on this factor decreased.

Hypothesis 2: English Fluency and Performance on Neuropsychological Measures

AAs with a higher level of English fluency will perform better than AAs with a lower level of English fluency on the battery overall.

Low-English Fluency AAs and High-English Fluency AAs were identified. The two groups were formed by dividing the AAs into High and Low English Fluency, using WRAT-3 Reading scores with a cut-off at the mean standard score of 90 seen in the NA group (*M* = 90.3, *S.D.* = 5.96). Those with standard scores less than or equal to 89 were identified as Low-English Fluency AAs (n=19), and those with standard scores above 90 on the WRAT-3 were identified as High-English Fluency AAs (n = 21).

One-way between-subject ANCOVAs were performed on each of the eight neuropsychological factors (i.e., Learning, Narrative Memory, Language, Nonverbal Processing, Processing Speed, Mental Control, Fluency, and Attention). The predictor variable was level of English Fluency, and consisted of Low-English Fluency AAs, High-English Fluency AAs, and NAs. Covariates were Age and Education.

Tests of Normality. Table 14 provides the results of the Shapiro-Wilk test of normality. Nonverbal Processing and Mental Control had non-normal distributions for the NA group. Learning had a non-normal distribution for the High-English Fluency AAs. All other factors showed normal distributions for all groups. Histograms are provided for each factor for Low-English Fluency AAs, High-English Fluency AAs and NAs (Figures Set 3).

ANCOVAs. Table 15 provides the means and standard deviations for each group on the eight neuropsychological factors, and the results of the one-way between-subject ANCOVAs with Age and Education covaried conducted with the Weighted z-score Composite Scores. Significant main effects were found for Language, F (1, 79) = 10.57, p = .000, and Narrative Memory, F (1, 79) = 6.52, p = .002. Pairwise post-hoc comparisons (were conducted for the significant main effects (Table 16). For the Language factor, Low-English AAs performed significantly worse than NAs (p=.000) and High-English AAs (p=.029). For the Narrative Memory factor, post-hoc comparisons found Low-English AAs performed significantly worse than High-English AAs (p=.035) and NAs (p=.002). A significant positive correlation (r = .299) for age was found for Language, F (1, 79) = 4.52, p = .037, and a significant negative correlation (r = -.299) for Nonverbal Processing, F (1, 79) = 10.34, p = .002, such that with increasing age, Language scores increased while Nonverbal Processing scores decreased.

Armenian Fluency. On an exploratory analysis, Armenian Fluency (AWRT scores) was examined as a predictor variable (i.e., Low-Armenian Fluency AAs, High-Armenian Fluency AAs, and NAs). One-way between-subjects ANCOVAs were performed with the Weighted z-score Composite Scores on each of the eight neuropsychological factors. Age, Education, and English Fluency (measured by WRAT-3 Reading Score) were held as covariates. Table 17 provides the means and standard deviations for each subject group, as well as the results of the ANCOVAs. Significant main effects were found for Language, F (2, 77) = 5.09, p = .008, and Narrative Memory, F (2, 77) = 3.34, p = .040. A trend was seen on Nonverbal Processing, F (2, 77) = 2.48, p = .091. Pairwise post-hoc comparisons were conducted for the significant main effects (Table 18). For the Narrative Memory factor, post-hoc comparisons found Low-Armenian Fluency AAs had significantly lower scores than NAs. (p=.046). For the Language factor, High-Armenian Fluency AAs (p = .027) and Low-Armenian Fluency AAs (p = .048) had significantly lower scores than NAs. A trend was seen for Nonverbal Processing with High-Armenian Fluency AAs performing better than NAs (p = .087). A significant negative correlation was found between Age and Nonverbal Processing, (r = -.280, p = .001). Significant positive correlations were found for English Fluency for both Verbal List Learning (r = .354, p = .006), and Language (r = .527, p = .000).

Hypothesis 3: Bilingual Proficiency and Acculturation

Greater Armenian proficiency (despite level of English fluency) is related to higher ethnocentric scores and lower acculturation scores.

Armenian Proficiency and Acculturation. Partial correlations were performed for Armenian proficiency (scores on the BAT-C and BAT-B) and the acculturation subscales (Language and Social Acculturation) to determine the size and direction of the relationship between Armenian proficiency and acculturation. The correlation analyses were performed with English fluency (as measured by the WRAT-3 score) controlled.

On an exploratory basis, partial correlations were also performed using the Armenian version of the WRAT reading test (AWRT) as our Armenian fluency measure.

Results of the partial correlations are listed in Table 19. The Armenian proficiency measures, BAT-B and BAT-C, were found to significantly, and positively correlate with each other, such that high scores on one measure of Armenian language were related to high scores on the other measure ($r = .483$, $p = .002$). The experimental Armenian version of the WRAT-3 Reading Test, the AWRT, was found to significantly and positively correlate with the BAT-B ($r = .682$, $p = .000$) and BAT-C ($r = .471$, $p = .002$). Language Acculturation was found to have a significant negative correlation with the AWRT ($r = -.317$, $p = .050$). Social Acculturation was not found to significantly correlate with any of the Armenian proficiency measures or with Language Acculturation.

English Fluency and Acculturation. Bivariate correlations were performed for English Fluency (WRAT-3 Reading Score) and the acculturation subscales (Language and Social Acculturation) to determine the size and direction of the relationship between WRAT-3 Reading scores and acculturation (Table 20).

WRAT-3 scores were found to significantly and positively correlate with both Language Acculturation (r = .379, p = .016) and Social Acculturation (r = .375, p = .017), such that high English Reading Fluency scores were related to high acculturation scores on these measures.

Hypothesis 4: Acculturation

On the neuropsychological factors, we expect that AAs with higher levels of acculturation to the dominant U.S. culture will perform similarly to the NAs and better than AAs with lower levels of acculturation.

Two types of acculturation were examined: Language Acculturation and Social Acculturation (based on subscales of the Marin and Marin Acculturation Scale [1991] described earlier in the text).

Language Acculturation

Tests of Normality. Table 21 provides the results of the Shapiro-Wilk tests of normality. All factors were found to be normally-distributed for the three groups, except for the Mental Control and the Nonverbal Processing factors, which were not normally-distributed for the NA group. Histograms are provided for each Weighted z-score Composite Score for Low Language Acculturation AAs, High Language Acculturation AAs, and NAs (Figure Set 4).

ANCOVAs. One-way between-subjects ANCOVAs were performed on each of the eight neuropsychological factors. The comparison groups were identified as High-Language Acculturated AAs (n = 22), Low-Language Acculturated AAs (n = 18), and NAs (n = 43). Age and Education were held as covariates.

Table 22 provides the means and standard deviations for each comparison group, as well as the results of the ANCOVAs for Language Acculturation. Significant main effects were found for Learning, F (2, 77) = 6.04, p = .004; Narrative Memory, F (2, 77) = 6.30, p = .003; and Language, F (2, 77) = 8.67, p = .000. Pairwise post-hoc comparisons were conducted for the significant main effects (Table 23). For Learning, Low-Language Acculturated AAs had significantly lower scores than High-Language

Acculturated AAs (*p*=.003). For Narrative Memory, post-hoc comparisons found that Low-Language Acculturated AAs performed significantly worse than NAs (*p*=.003) and High-Language Acculturated AAs (*p*=.043). Low-Language Acculturated AAs performed significantly worse than NAs (*p*=.000) for Language, as well. For Language, there were significant positive correlations for Age (r = .257, p = .044), and Education (r = .282, p = .039). A significant negative correlation was found between Age and Nonverbal Processing (r = -.295, p = .002).

To screen out the effect of English Fluency on the neuropsychological factors, Learning, Narrative Memory, Language, and Nonverbal Processing were reanalyzed with Age, Education, and English Fluency held as covariates. By controlling for English Fluency, small changes are seen in the findings (Table 24). Although the p-values increase slightly along with decreased effect sizes, the significant differences seen for Learning, F (2, 76) = 4.42, p = .015; Narrative Memory, F (2, 76) = 5.30, p = .007; and Language, F (2, 76) = 5.74, p = .005, persisted. No other significant findings occurred by controlling for English Fluency on the Language Acculturation measure. Pairwise comparisons found that Low-Language Acculturated AAs performed significantly worse than High-Acculturated AAs on Learning (p = .012). On Narrative Memory, Low-Language Acculturated AAs had significantly lower scores than NAs (p = .006), and a trend was seen such that the Low-Language Acculturated AAs also had lower scores compared to High-Language Acculturated AAs (p = .069). Finally, on the Language measure, Low-Language Acculturated AAs had significantly lower scores than NAs (p = .005).

Social Acculturation

Tests of Normality. Table 25 provides the results of the Shapiro-Wilk tests of normality. Non-normal distributions were found for the High-Social Acculturated AAs group on Learning and for the NA group on Nonverbal Processing and Mental Control factors. Histograms are provided for each factor for Low-Social Acculturated AAs, High Social Acculturated AAs, and NAs (Figure Set 5)

ANCOVAs. One-way between-subjects ANCOVAs were performed on each of the eight neuropsychological factors. The comparison groups were identified as High-Socially Acculturated AAs (n = 25), Low-Socially Acculturated AAs (n = 15), and NAs (n = 43). Age and Education were held as covariates. Table 26 provides the means and standard deviations for each comparison group, as well as the results of the ANCOVAs for Social Acculturation. A significant main effect was found for Language, F (2, 77) = 7.33, p = .001. A trend was seen for Narrative Memory, F (2, 77) = 2.99, p = .056. Pairwise post-hoc comparisons were conducted for the significant main effects and trends (Table 27). For Narrative Memory, there were no significant pairwise differences. Low-Socially Acculturated AAs performed significantly worse than NAs (p=.001) for Language. Language and Education were found to have a significant positive correlation (r = .293), F (1, 77) = 4.20, p = .044.

When English Fluency was also held as a covariate (Table 28), Language remained a significant finding, F (2, 76) = 5.65, p = .005. Pairwise comparisons show that Low-Socially Acculturated AAs had significantly lower scores than NAs on Language (p = .004). Narrative Memory, F (2, 76) = 2.53, p = .086, remained a trend, but no pairwise differences were seen. No other significant findings occurred by controlling for English Fluency on the Social Acculturation measure.

<u>Hypothesis 5: Immigration Age</u>

It is expected that AAs born in the United States or who immigrated before age 10 will perform better than AAs who immigrated after age 10. These early immigrated participants will also perform similar to NAs.

AAs were subdivided into two groups – those who immigrated to the United States at age 10 or older (Late AAs) and those who were born in the United States or immigrated before the age of 10 (Early AAs). This age group cut-off of 10 was selected based on studies tying some neuropsychological measures to school-based knowledge. Kendall et al. (1988) identified crystallized information, testing style, and language learning as the skills directly assessed in some cognitive tests, such that these cognitive measures are essentially measuring skills learned in the Western or American education system more than cognitive functioning. On an exploratory basis, it was hypothesized that immigrating to the United States at or after the age of 10, would have a greater impact on the attainment of those skills considered inherent to the Western and American educational system. This age was selected to coincide with the peak age of language acquisition (age 7) and curricula taught during elementary school years.

<u>Tests of Normality</u>. Table 29 provides the results of the Shapiro-Wilk tests of normality. Non-normal distributions were found for the NA group on Mental Control and Nonverbal Processing. Histograms are provided for each factor for Early AAs, Late AAs, and NAs (Figure Set 6).

Partial Correlations. Partial correlations were initially performed to assess the size and direction of the relationship between immigration age and neuropsychological test performance for the AAs (Table 30). Age and Education were controlled.

Negative correlations were seen between Immigration Age and both Learning (r = -.346, p = .033) and Language (r = -.473, p = .003), indicating that the later AAs immigrated into the United States, the lower were their scores on Learning and Language. A trend in the negative direction was also seen for Mental Control (r = -.288, p = .080). A positive correlation was seen for Nonverbal Processing (r = .329, p = .044), such that as an individual's immigration age increased, performance improved on this factor.

ANCOVAs. Table 31 provides the means and standard deviations for each comparison group, as well as the results of the ANCOVAs for Immigration Age. Significant main effects were found for Language, F (2, 77) = 12.95, p = .000, and Narrative Memory, F (2, 77) = 3.04, p = .053. Trends were seen for Learning, F (2, 77) = 2.92, p = .06, and Nonverbal Processing, F (2, 77) = 2.62, p = .079. Pairwise post-hoc comparisons were conducted for the significant main effects and trends (Table 32). There were significant differences between Late AAs and both Early AAs (p = .004) and NAs (p = .000) on Language. Late AAs had significantly lower scores on Language than did the other two groups. For the Narrative Memory factor, there were no significant pairwise differences. For Learning, a trend was seen where Late AAs had lower scores than Early AAs (p = .056). For Nonverbal Processing, however, a trend was found showing that Late AAs performed better than NAs (p = .074).

Significant effects of Age were found for Language (*r* = .236, p = *.009)* and Learning (*r* = .201, p = *.041)* such that as an individual's age at time of testing increased, scores on these tasks were higher. A significant effect of Education for Language was also found (*r* = .254, p = *.004)*, such that greater educational attainment was related to better performance on the Language factor. A significant effect of Age was found for Nonverbal Processing (*r* = -.274, p = *.001),* such that increasing age at testing was related to poorer performance on this factor.

To screen out the effect of English Fluency on the neuropsychological factors, Learning, Narrative Memory, Language, and Nonverbal Processing were reanalyzed with Age, Education, and English Fluency entered as covariates. When English Fluency was controlled, Language remained as a significant finding, *F* (2, 76) = 8.42, *p* = .000 (Table 33). Pairwise comparisons showed that Late AAs had significantly lower scores than NAs (*p* = .000) and Early AAs (*p* = .048) on Language. Narrative Memory, F *(2, 76)* = *2.46*, p = *.092*, remained a trend with no significant pairwise differences noted. Nonverbal Processing, however, emerged as significant, *F* (2, 76) = 3.71, *p* = .029. Pairwise comparisons showed that Late AAs had significantly higher scores than NAs (*p* = .024) on Nonverbal Processing.

Hypothesis 6: Armenian Education

AAs with formal Armenian language education will have lower scores on the battery of tests than AAs who have had the majority of their education in American schools. This difference will especially be evident on tests measuring language functioning. AAs who received at least six years (elementary education) of Armenian private school education *in or out of the United States (Majority Armenian-Educated AAs) will have significantly lower scores than AAs with six years or more of American public school education (Minimal Armenian-Educated AAs) and NAs with American public school education on verbal and language-based tests, whereas these Majority Armenian-Educated AAs will have higher scores on nonverbal and conceptual tasks than NAs and Minimal Armenian-Educated AAs.*

Tests of Normality. Table 34 provides the results of the Shapiro-Wilk tests of normality. For the Minimal Armenian-Educated AAs, Processing Speed was not normally distributed (p = .026). For the Majority Armenian-Educated AAs, there were non-normal distributions for Learning (p = .006) and Language (p = .041). The NA group was found to have non-normal distributions on Nonverbal Processing (p = .034) and Mental Control (p = .001). Histograms are provided for each factor for Minimal Armenian-Educated AAs, Majority Armenian-Educated AAs, and NAs (Figure Set 7).

ANCOVAs. One-way between-subjects ANCOVAs were conducted comparing Minimal Armenian-Educated AAs (n = 11), Majority Armenian-Educated (n = 29), and NAs (n = 43) on each of the eight neuropsychological variables. Age at testing and years of total education were entered as covariates. Table 35 provides the means and standard deviations for each comparison group, as well as the results of the ANCOVAs for Armenian Education.

Significant main effects were found for Narrative Memory, F (2, 77) = 3.23, p = .045, and Language, F (2, 77) = 6.54, p = .002. Pairwise post-hoc comparisons were conducted for the significant main effects (Table 36). A significant difference was seen between Majority Armenian-Educated AAs and NAs (p = .003) on Language. Majority

Armenian-Educated AAs had significantly lower scores on the Language factor than NAs.

Significant effects of Education (r = .293, p = .028), and Age (r = .271, p = .048), were found for the Language factor, such that higher scores were seen on the Language factor with increasing age and educational attainment. A significant effect of Age was found for Nonverbal Processing (r = -.295, p = .002), such that increasing age was related to lower scores on Nonverbal Processing.

To screen out the effect of English Fluency on the neuropsychological factors, Learning, Narrative Memory, Language, and Nonverbal Processing were reanalyzed with Age, Education, and English Fluency entered as covariates. When English Fluency was controlled, Language remained as a significant finding, F (2, 77) = 5.10, p = .008 (Table 37). Pairwise comparisons showed that Majority Armenian-Educated AAs had significantly lower scores than NAs (p = .009) on Language. A trend was seen for Narrative Memory, F (2, 77) = 2.43, p = .072, with no significant pairwise differences.

Hypothesis 7: Country of Origin

Due to the lack of preexisting studies on country of origin (US, Western, and Eastern), an exploratory analysis was undertaken. Due to the similarities in educational and economic culture, it was expected that US and Western participants would perform similarly and better than Eastern participants on these "Western" cognitive measures.

Four groups were created for this analysis: US-born AAs (n = 11), Western Armenian dialect-speaking AAs (n = 16), AAs from Eastern Armenian dialect-speaking countries (n = 13), and NAs (n = 43).

<u>*Tests of Normality*</u>. Table 38 provides the results of the Shapiro-Wilk tests of normality. The Eastern Armenian and Western Armenian groups had normal distributions for all eight factors. The NA group was found to have a non-normal distribution on Mental Control ($p = .001$). Histograms are provided for each factor by origin (Figure Set 8).

<u>*ANCOVAs*</u>. Table 39 provides the means and standard deviations for each comparison group, as well as the results of the ANCOVAs for Origin. Age and Education were used as covariates for each of the analyses to control for any effects they may have had on the variables. Significant main effects were found for Learning, F (2, 77) = 4.02, $p = .010$; Narrative Memory, F (2, 77) = 3.20, $p = .028$; and Language, F (2, 77) = 7.882, $p = .000$. Pairwise post-hoc comparisons were conducted for the significant main effects (Table 40). The Eastern Armenian group had significantly lower scores on Learning than both the US-born ($p = .007$) and Western Armenian ($p = .040$) participants. A trend was also found on Learning, such that Eastern Armenians had lower scores than NAs ($p = .066$). Eastern AAs performed significantly worse than NAs on Narrative Memory ($p = .022$) and Language ($p = .000$).

Significant effects of Age ($r = .253$, p = *.040),* and Education ($r = .252$, p = *.000),* were found for the Language factor, such that increasing age and educational attainment was related to higher scores on Language.

To screen out the effect of English Fluency on the neuropsychological factors, Learning, Narrative Memory, Language, and Nonverbal Processing were reanalyzed with Age, Education, and English Fluency entered as covariates. When English Fluency was controlled, Language remained a significant finding, F (2, 75) = 4.74, $p = .004$, although the strength of the finding was reduced (Table 41). Pairwise comparisons show Eastern AAs had significantly lower scores than NAs (p = .004) on Language. Both the Narrative Memory, F (2, 75) = 2.61, p = .057, and Learning, F (2, 75) = 2.55, p = .062, factors became trends when English Fluency was controlled. Pairwise comparisons show trends, such that Eastern AAs had lower scores than NAs on Narrative Memory (p = .063) and than US-born AAs on Learning (p = .075).

As an exploratory analysis, Origin was reanalyzed by controlling for English Fluency and Immigration Age, along with Age (at testing). This step was taken in an attempt to clarify whether the significant findings and trends seen were due to an underlying variable of the origin country or rather due to immigration age, given the variability in the waves of immigration described earlier. Education was removed as a covariate because it was not found to have a significant effect on any of the neuropsychological factors for these subject groups.

Controlling for Immigration Age and English Fluency, the significant findings seen in the previous analyses were not maintained (Table 42). A trend was seen for Learning, F (2, 75) = 2.63, p = .087. Pairwise comparisons showed Western AAs with higher scores on Learning than Eastern AAs (p = .036).

CHAPTER FOUR

Discussion

Results from this preliminary study of the effects of bilingualism and acculturation on neuropsychological test performance among Caucasian bilingual immigrants suggest that verbally-loaded cognitive tests, particularly those that assess language functioning, are vulnerable in non-Hispanic, Caucasian bilingual immigrants.

On initial comparison of participants based on ethnicity alone, scores on measures of language functioning (i.e., WASI Vocabulary and Boston Naming Test) and narrative memory (i.e., WMS-III Logical Memory Immediate Total Recall, Delayed Total Recall, and Recognition) were found to be lower for the Armenian American bilingual participants compared to the non-Armenian, Caucasian monolingual participants (Figure 8). In addition, higher performance by AAs compared to NAs on measures of nonverbal processing (i.e., Rey-Osterreith Complex Figure Copy, Immediate Recall, and Delayed Recall) was a trend.

Bilingual Fluency

In an attempt to understand the underlying factors that led to these differences, this study addressed the issue of bilingual fluency. Proficiency has been implicated as the main factor leading to differences in cortical organization and neuropsychological test performance in bilinguals (Abultalebi, Cappa, & Perani, 2001; Fabbro, 2001; Magiste, 1980; Ponton & Ardila, 1999). In this study, English Fluency was measured via the WRAT-3 Reading Test. A differentiation was made between AA participants who scored lower than the 90th %ile on the WRAT-3 Reading Test and those with higher

English reading scores. Armenian Fluency was measured via an experimental Armenian reading test, the AWRT, that was modeled after the WRAT-3 Reading test and was found to highly correlate with other measures of Armenian proficiency (i.e., Bilingual Aphasia Exam Armenian Test Parts B and C). AAs that were identified as Low-English fluent performed worse than NAs and AAs who were identified as High-English fluent on the Language and Narrative Memory factors (Figure 9). This finding underscores the importance of assessing English reading ability on tasks that rely heavily on verbal skills, such as vocabulary, naming, and story memory. It also supports findings that emphasize the assessment of reading ability as a better predictor of test performance than years of education (Byrd, Jacobs, Hilton, Stern & Manly, 2005; Byrd, Sanchez, & Manly, 2005; Manly, Schupf, Tang, & Stern, 2005; O'Bryant, Schrimsher, & O'Jile, 2005).

Is Armenian reading fluency a reliable predictor? Apparently, its predictor strength emerges only when English Fluency is controlled (Figure 11). AAs, overall, regardless of level of Armenian fluency, had lower scores on Language compared to NAs. However, AAs with a low-level of Armenian fluency performed worse than NAs on Narrative Memory. Although High-Armenian Fluency AAs had lower scores than NAs, as well, this difference was not a significant one. We can only speculate on an explanation for the poorer performance of Low-Armenian Fluency AAs on story memory compared to High-Armenian Fluency AAs. Perhaps, this group of Low-Armenian Fluency AAs has difficulty with verbally-loaded tasks, thus, also explaining their poor performance on the Language factor. These individuals may have difficulty with language, in general, thus, possibly also explaining their poor Armenian reading scores. Interestingly, High-Armenian Fluency AAs had better performance on Nonverbal

Processing than did NAs. This better performance on a nonverbal task compared to poorer performance on verbal tasks suggests that fluency in a second language may offer better ability to verbally mediate nonverbal tasks for better encoding. It is also possible that these individuals with higher Armenian fluency may have put greater effort into tasks that were not verbally-loaded to make up for their shortcomings during the evaluation.

Acculturation

The Language acculturation measure was found to negatively correlate with the AWRT. Therefore, AAs who had higher scores on the Armenian word reading test tended to also had a lower preference to speak English. In the same vein, AAs who had higher scores on the English word reading test had a greater preference to speak English. High WRAT-3 scores were also correlated with high social acculturation, thus, those with higher English fluency had greater preference to socialize with Americans. Given these relationships between Armenian and English reading tests *and* Acculturation measures, similar differences in performance should occur with acculturation measures as with fluency measures.

Participants who identified themselves as having a preference to speak, read, and think in Armenian, more often than in English, made up 55 % of our Armenian American sample. These Low-Language Acculturated AAs showed poorer performance on the Language, Narrative Memory, and Learning factors, even after controlling for Age, Education, and English Fluency (Figure 12). Compared to the other predictor variables, Language Acculturation was the most sensitive to the differential performance on tasks with high verbal content, more so than English Fluency or Armenian Fluency. Language

Acculturation also appeared to differentiate between low and high language-acculturated AAs on the Learning factor (i.e., CVLT measures) and on the Narrative Memory factor, such that AAs with less preference to speak English had lower scores on these measures than AAs who had a greater preference to speak English. For Social Acculturation, we see a difference between Low-Socially-Acculturated AAs and NAs on Language, such that those who prefer and tend to socialize with Armenians more than with non-Armenians had lower scores than NAs (Figure 13). Although the two acculturation subscales were not found to correlate, it is likely that AAs with a greater preference to speak Armenian (Low-Language Acculturated AAs) would also prefer to socialize with Armenians more than with non-Armenians.

These findings suggest that language acculturation may have a greater impact on neuropsychological test performance than English fluency on its own. Measuring preference and frequency of English language use, compared to another language, may serve as a more sensitive tool for clinicians in considering whether findings are valid or confounded by a language bias. The greater utility of language acculturation versus language fluency measures lies in its ability to better differentiate between high and low language-acculturated individuals. Bilinguals may have good reading ability in both languages, but the bias for another language other than English may have a greater impact on cognitive measures of verbal functioning than on language fluency per se. Language acculturation, therefore, should be taken into consideration even when bilingual immigrants perform above the 90th percentile on the WRAT Reading subtest.

Immigration Age

Greater years of residency in the United States have been found to be associated with higher performance on neuropsychological tests among Hispanic and Caucasian immigrants (Artiola i Fortuny, Heaton, & Hermosillo, 1998; Touradji, Manly, Jacobs, & Stern, 2001). In the current study, as opposed to years of residency, age of immigration was investigated. This was done to also ascertain the age of language acquisition, or in this case, culture acquisition. Age of immigration was also selected to obtain a measure of when participants entered the educational system in the United States. As described earlier, it is hypothesized that performance on commonly used cognitive measures is highly correlated with the American elementary educational curriculum. Skills and knowledge learned in the first years of formal schooling are tapped on some of the tests included in commonly used neuropsychological batteries, such as naming, vocabulary, and the idea of performing quickly but accurately. By setting a cut-off age of 10, it is assumed that AAs who immigrated after the age of 10 would have received their primary language education and test-taking skills outside of the United States.

Even after controlling for age, educational attainment, and English fluency, we found that Late AAs showed significantly lower scores on the Language factor compared to NAs and Early AAs (Figure 14). One obvious explanation for this finding can be the later language acquisition of these participants, which can support our hypothesis that aspects of the Vocabulary subtest of the WASI and the Boston Naming Test are learned in the initial years of elementary education.

These Late AAs also showed stronger performance on the Nonverbal Processing factor when compared to NAs. This finding on Nonverbal Processing is consistent with the results of the correlation analysis, which showed that as immigration age increased, performance on the Nonverbal Processing factor improved. We can only speculate as to the underlying factors that lead to better nonverbal processing with increasing age of immigration. Given that many of our Late AAs were exposed to more than one language in their country of origin (e.g., Arabic, French, Russian, and Farsi) to some extent, the better nonverbal processing performance seen by these participants may be due to greater reliance placed on visual skills when compared to AAs, who learned English at a younger age, and monolingual NAs. Another explanation may be the fact that greater importance was given to nonverbal memory and visuospatial skills in their countries of origin than in the United States. It is also possible that these individuals who immigrated at a later age, much like those who had higher Armenian fluency, may have put greater effort into tasks that were not verbally-loaded to make up for their shortcomings during our evaluation.

Armenian Education

The effect of education has been a question for many studies. In this study, having more than six years of Armenian education was related to poorer scores on the Language factor compared to NAs (Figure 15). The Armenian education, in many cases, was received in the Los Angeles area, where the participants received the majority of their courses in English, but had daily Armenian language and history courses and interaction with Armenian-speakers. Often these individuals also identified themselves as less acculturated, especially in terms of social relations. This effect, therefore, may be confounded by language or social acculturation. Furthermore, greater formal Armenian education may also be tapping those individuals who had immigrated at a later age. Regardless if there is an underlying factor related to this finding of poorer scores on the

Language factor when compared to NAs, or not, the Language factor continues to emerge as a sensitive cognitive measure.

<u>Origin of Immigration</u>

Finally, our study looked at origin of immigration. Given that Armenian Americans emigrated from several countries and speak different dialects, it was an interesting question to see how dialect or origin country's culture affected performance on neuropsychological tests. The Western Armenian dialect-speaking countries include Lebanon, Iraq and other Middle Eastern nations (such as Syria, Jordan, and Israel), as well as Turkey and Europe. The Eastern Armenian dialect-speaking countries include Armenia and Iran. As described earlier, Armenians immigrated to the United States in waves. The most recent wave was from Armenia, an Eastern Armenian dialect-speaking country. In this study, even when English Fluency was controlled, Eastern Armenian dialect-speaking AAs, when compared to NAs, were found to have significantly lower scores on Language and they tended to have lower scores on Narrative Memory and Learning factors (Figure 16). It can be speculated that Armenia and Iran are less Westernized and are distanced from Western European and American values and educational systems than Western dialect-speaking countries (i.e., Lebanon and Turkey). The political climate in the Eastern-speaking countries was one that denounced Westernized and American values, such as the Soviet government and the Iranian post-revolutionary climate in the 1980s and 1990s. At some level, the cultural climate of the origin countries may have had an influence on the educational curriculum which these participants may have experienced. Due to this greater difference in cultures, the values that underlie cognitive test performance, described by Ardila (2005), such as that of best performance, internal or subjective issues, and testing strategies, may be playing a role in the differences seen between the Eastern AAs and the NAs. Less exposure to the English language (e.g., through radio and television) may also have led to the current results of lower performance on the Language and Narrative Memory factors.

Given that the Eastern Armenian dialect-speaking AAs were also most likely to have immigrated at a later age, the difference may be a factor of immigration age more than the culture of the origin country. Controlling for Age, English Fluency, and Immigration Age, the differences seen initially on the Language, Narrative Memory, and Learning factors disappeared (Figure 17). Therefore, the influence of the origin country's cultural influence is negated, and the influence of Immigration Age is strengthened.

Clinical Implications

Clinical implications of this study within the field of clinical neuropsychology lie in the assessment of bilingual immigrants. The current findings consistently found our bilingual immigrants' performance on a combined measure of expressive vocabulary and confrontation naming as significantly poorer than that of non-Armenian, Caucasian-American monolinguals. In some instances, poorer performance was also seen on story memory and verbal list learning by bilingual immigrants when compared to the Caucasian monolinguals. These differences were seen in a neurologically healthy, adult sample.

When testing bilingual immigrants who have sustained a neurological insult, such as a stroke, tumor, epilepsy, or dementia, the results of this study are important to keep in mind when evaluating the extent of deficit, particularly within the verbal domain. Furthermore, language lateralization continues to be unclear among bilinguals. Deficits seen in verbally-loaded English tests may not be an indication of lesion focus or decline in this population, and care must be taken to not over-diagnose deficits in this population. However, clinicians must also take care to not under-diagnose language deficits in the bilingual, immigrant population, and careful histories must be taken, including English reading fluency, language acculturation, and, if possible, testing should be carried out in the patient's native language. Per Ardila's suggestions based on his review of cultural values on cognitive test performance (2005), care must be taken to narrow the gap between the dominant American culture and that of the examinee's culture by providing opportunity to explain the testing situation, the purpose of the testing, and clarifying the test instructions to ensure better understanding and comfort with such evaluations.

Methodological Considerations

In this study, composite scores were tabulated from the factor scores using weighted z-scores, where the z-scores for each contributing measure having a cut-off factor score of .40 were multiplied by their factor loading. Composite scores could also have been tabulated by combining the un-weighted contributing z-scores for each factor, combining the raw scores of the contributing measures over .40 without weighting them by their factor loadings, or by combining the weighted raw scores of the contributing measures.

On an exploratory basis, one factor (e.g., Language) was reanalyzed by forming the three other composite scores described above. One-way between-subjects ANCOVAs were performed for the Language factor with each of the predictor variables (i.e., Ethnicity, English Fluency, Armenian Fluency, Language Acculturation, Social Acculturation, Immigration Age, Armenian Education, and Origin). The ANCOVAs were repeated with the same covariates as the original analyses interpreted with the weighted z-scores. Table 44 provides the *F* and *p* values resulting from each composite score tabulation method (i.e, raw score, weighted raw score, z-score, and weighted z-score). No notable differences were observed across the composite scores on any of the predictor variables.

A second methodological issue to consider is that of the significance criterion used to interpret the results of the current study. Given the exploratory nature of this dissertation project, results were interpreted based on a .05 significance criteria. It was also possible to use a more conservative significance criterion, which would be corrected for the multiple analyses conducted with this dataset. For a Bonferroni-adjusted significance criterion, the .05 criterion is divided by the number of dependent variables which were evaluated in the analyses of covariance. There were eight dependent variables evaluated in this study, therefore, a Bonferroni-adjusted significance criterion equals .00625. Inspecting the results of the study with the more conservative significance criterion further supports the vulnerability of the Language factor for all predictor variables described above, except for Armenian Fluency and Armenian Education. For these two predictors, the main effect came close to the conservative level (p = .008). Specifically, we continue to see that immigrants with low English Fluency and low language acculturation, who have immigrated to the United States after the age of 10, show lower scores on a combined factor of the WASI Vocabulary test and the Boston Naming Test.

Future Directions

The current study's aim was to investigate differences in neuropsychological test performance among Caucasian immigrants living in the United States who do not fall into the minority category. Given the differences in language and culture, it was predicted that these Armenian American participants would present with a different neuropsychological profile compared to their monolingual Caucasian-American peers. Furthermore, it was expected that the differences in performance style would be dependent upon variables, such as English fluency, Armenian fluency, Acculturation, Immigration Age, Armenian Education, and Origin.

Although differences were seen among Armenian Americans and monolingual non-Armenians, they appear to be limited to the Language factor. Due to a small sample size, limitations had to be placed in terms of the number of variables that could be analyzed as part of this study. Therefore, it was difficult to ascertain which individual subtests were most sensitive to English fluency. Although a clearer picture was provided when English Fluency was held as a covariate, the small numbers make it difficult to generalize.

The main direction the results of this study lead us to is that of investigating the differential performance of immigrants of various ethnic groups on neuropsychological tests. It would be interesting to see which individual tests are most sensitive to cultural differences (including language and education) and which are most resistant. This study highlighted the vulnerability of language tests. Even when controlling for English fluency, our immigrant groups consistently scored lower on the language tests, which were comprised of vocabulary and confrontation naming. Although significant differences were not seen for the Mental Control factor, which is comprised of the Color

Trailmaking Test and Phonemic Fluency, it would be interesting to analyze Phonemic Fluency on its own, given its highly verbal and/or language component.

Another interesting question is that of age of immigration. As an experimental hypothesis, we compared our immigrant participants based on the age of 10 as the time of immigration. This age was selected to insure that early language and reading education would have been completed in school. This age was also selected because of the hypothesis that early elementary curricula coincide with some of the underlying concepts tapped by many of the neuropsychological tests. It would be interesting to see how much curriculum taps into these tests, and which age is most sensitive to the effect of early education. The results of this study strongly suggest careful consideration of immigration age, especially if the majority of the elementary school years were received outside of the United States.

In terms of Armenian Fluency, this study used an experimental Armenian version of the WRAT-3 Word Reading Test along with subtests of the Bilingual Aphasia Exam in Armenian. Although interesting results were seen when English fluency was held as a covariate, these measures were not found to be robust measures of Armenian fluency. Poor differentiation was seen between high and low fluency. There are two possible explanations for this lack of differentiation. One explanation is that since the testing was conducted in English and measured cognitive functioning using the English language, fluency in Armenian or any other language, did not make a significant impact on participants' performance. Another explanation is that the measures of Armenian fluency may not have been adequate for this group. The Bilingual Aphasia Test Parts B and C, though found to be adequate for assessing language functioning loss in aphasic patients, were not found to be as sensitive for assessing language fluency in normal participants. The experimental Armenian reading test created for this study did identify differences between both high and low Armenian Fluency Armenian Americans and non-Armenians on Language, but these differences are difficult to interpret. Given the phonetic quality of the Armenian language, most AA participants who were comfortable with the Armenian alphabet were able to read the majority of the words, despite not having ever heard of the words before. This suggests that a better test for Armenian fluency may be a brief vocabulary test. Reading rate was also seen to be a helpful discriminator between high fluency Armenians and low fluency Armenians. More testing for an appropriate and valid measure of Armenian fluency is needed.

This study would have benefited from more participants to better identify the influential predictor variables. Furthermore, the variability in the shape of the distributions of this sample requires careful interpretation of the results. Using a factor analysis, the strength of the results is also limited, as some important individual variables may have become obscured by forming composite scores. Taken together, the interpretations from the results of this study should be limited to the Armenian American immigrant group from Los Angeles, and should not be generalized to all non-Hispanic, Caucasion, immigrant groups.

Although a neuroimaging study was not possible with this sample due to limited resources, an interesting future direction with such a diverse bilingual immigrant group would be to look at functional neuroimaging data. Past studies with neuroimaging data found that early bilinguals demonstrated no activation differences between the first and second languages during language production, whereas late bilinguals showed common neural networks for their languages if they were highly proficient in both languages (Abultalebi, Cappa, & Perani, 2001). In terms of *language comprehension*, early bilinguals demonstrated a common neural network for both their languages within the dominant (left) hemisphere, if equal exposure had been provided from birth. For late bilinguals, the less proficient language showed a different neural network than the more proficient language, regardless of age of acquisition. Furthermore, late, low-proficiency participants were found to have large inter-subject variability in the organization of the second language, suggesting that a common neural functional organization of newly acquired language does not exist. A future study, looking at vocabulary, verbal list learning, narrative memory, or confrontation naming with a sample that has the diversity of the current one, would be very illustrative of any differences in neural organization of language functioning as a factor of age of acquisition, level of proficiency, or method of acquisition.

The current study served as a good preliminary analysis of the effects of bilingualism and acculturation on neuropsychological test performance for immigrants. It resulted in interesting findings that encourage further investigation into the performance of immigrants on these tests and a better investigation into the core underlying factors that best predict performance for these groups. Currently, results suggest the careful consideration of English reading level and immigration age. More studies are needed with a larger sample that encompasses a variety of ethnic origins, languages, immigration ages, bilingual levels, acculturation levels, and educations, to better identify the predictors and form guidelines to aid clinicians in the interpretation of test results.

Appendix: Tables and Figures

TABLES

Table 1. AAs vs. NAs on Core Demographic Variables

Type of Subject	N	Age of Subject	Years of Education	Gender	Socioeconomic Status
Armenian	40	Mean = 28.3 SD = 6.80	Mean = 15.23 SD = 2.62	Male = 15 Female = 25	Mean = 5.23 SD = .97
Non-Armenian	43	Mean = 25.9 SD = 8.37	Mean = 14.44 SD = 2.06	Male = 20 Female= 23	Mean = 5.00 SD = .65
Total	83	Mean = 27.05 SD = 7.71	Mean = 14.82 SD = 2.36	Male = 35 Female = 48	Mean = 5.11 SD = .83
		F = 2.15(1,81), p=.147	F = 2.31(1,81), p=.132	Pearson chi square = .690, p = .406	Mann-Whitney U = 744.500, p = .263

Table 2. Armenian American Subgroups on Core Demographic Variables

AGE	**Immigration Age**		**Region of Origin**			**Armenian Education**	
	0-9	**10-17**	**US**	**Western**	**Eastern**	**< 6 years**	**6 + years**
Mean	25.7	30.7	25.6	30.5	27.9	28.5	28.24
Standard Dev	7.33	5.46	7.86	6.16	6.17	6.88	6.89
N	19	21	11	16	13	11	29
F	5.896		2.976			.016	
p value	.020		.093			.901	
Years of Education	**Immigration Age**		**Region of Origin**			**Armenian Education**	
	0-9	**10-17**	**US**	**Western**	**Eastern**	**< 6 years**	**6 + years**
Mean	14.4	15.9	14.0	15.75	15.62	15.45	15.14
Standard Dev	2.29	2.73	2.19	2.91	2.40	2.42	2.72
N	19	21	11	16	13	11	29
F	3.649		1.289			.114	
p value	.064		.264			.737	

SES	**Immigration Age**		**Region of Origin**			**Armenian Education**	
	0-9	**10-17**	**US**	**Western**	**Eastern**	**< 6 years**	**6 + years**
Mean	5.05	5.38	4.91	5.31	5.38	5.36	5.17
Standard Dev	1.08	.865	1.04	.946	.961	1.12	.93
N	19	21	11	16	13	11	29
Chi square	1.265		1.786			.213	
p value	.261		.409			.644	
Gender	**Immigration Age**		**Region of Origin**			**Armenian Education**	
	0-9	**10-17**	**US**	**Western**	**Eastern**	**< 6 years**	**6 + years**
N	19	21	11	16	13	11	29
Male:Female	8 : 11	7: 14	5:6	6:10	4:9	5:6	10:19
Pearson Chi-Square	.327		.548			.410	
p value	.567		.760			.522	

Table 3. Interpreting the Marin and Marin (1991) Acculturation Scale

Domain	*Items*	*Score*	*Classification*	*Percentage*
Language Preference	1-5	≤14	Low	55.0 %
		15-19	Moderate	40.0 %
		≥20	High	5.0 %
Media Preference	6-8	≤8	Low	5.0 %
		9-11	Moderate	7.5 %
		≥12	High	87.5 %
Ethnic Social Relations Scale	9-12	≤11	Low	62.5 %
		12-15	Moderate	32.5 %
		≥16	High	5.0 %

Table 4. Principal Components Extraction Results

1. Verbal List-Learning (“Learning”) a. CVLT Total 1-5 (.872) b. CVLT Short-Delayed Free Recall (.911) c. CVLT Long Delay Free Recall (.915) d. CVLT Discriminability (.782)	6. WASI – Conceptualization (“Conceptualization”) a. Similarities (.829) b. Matrix Reasoning (.840) c. Block Design (.452)
2. Narrative Memory (“Narrative Memory”) a. Logical Memory Immediate Total Recall (.890) b. Logical Memory Delayed Total Recall (.859) c. Logical Memory Recognition (.717)	7. Mental Control and Speed (“Mental Control”) a. Color Trails A (-.858) b. Color Trails B (-.741) c. Phonemic Fluency- FAS (.522)
3. Non-Verbal Memory / Visuospatial Functioning (“Nonverbal Processing’) a. RCFT Copy (.684) b. RCFT Immediate Recall (.934) c. RCFT Delayed Recall (.917)	8. Set-Shifting (“Set-Shifting”) a. WCST Categories Completed (.853) b. WCST Perseveration Percentage (-.890) c. WCST Conceptualization (.891)
4. Language (“Language”) a. WASI Vocabulary (.795) b. Boston Naming Test (.799)	9. Attention (“Attention”) a. Digit Span – Forward (.805) b. Digit Span – Backward (.741)
5. Semantic and Design Fluency (“Fluency”) a. Animal Naming (.732) b. Ruff Figural Fluency (.467) c. Stroop Reading (-.603)	10. Psychomotor Speed and Cognitive Flexibility (“Processing Speed”) a. Digit Symbol (.710) b. Stroop Reading (.516) c. Stroop Color (.763) d. Stroop Color-Word (.859)

Table 5. Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.479	18.891	18.891	5.479	18.891	18.891	3.423	11.804	11.804
2	3.578	12.337	31.229	3.578	12.337	31.229	2.685	9.258	21.061
3	2.748	9.476	40.705	2.748	9.476	40.705	2.574	8.877	29.938
4	2.256	7.780	48.485	2.256	7.780	48.485	2.534	8.738	38.677
5	1.908	6.581	55.066	1.908	6.581	55.066	2.403	8.287	46.963
6	1.745	6.018	61.083	1.745	6.018	61.083	2.159	7.445	54.409
7	1.367	4.714	65.797	1.367	4.714	65.797	2.006	6.916	61.325
8	1.270	4.379	70.176	1.270	4.379	70.176	1.736	5.986	67.311
9	1.120	3.862	74.038	1.120	3.862	74.038	1.547	5.335	72.646
10	1.068	3.684	77.722	1.068	3.684	77.722	1.472	5.076	77.722
11	.924	3.187	80.909						
12	.835	2.879	83.788						
13	.679	2.342	86.130						
14	.569	1.963	88.094						
15	.545	1.880	89.973						
16	.414	1.429	91.402						
17	.397	1.370	92.772						
18	.344	1.188	93.959						
19	.290	.998	94.958						
20	.274	.946	95.904						
21	.241	.831	96.735						
22	.187	.644	97.380						
23	.180	.622	98.002						
24	.167	.577	98.578						
25	.130	.450	99.028						
26	.104	.358	99.386						
27	.081	.279	99.666						
28	.063	.217	99.883						

Table 6. Component Matrix

	Component									
	1	2	3	4	5	6	7	8	9	10
CVLT Total Recall 1-5	.647	-.384	.367	.183	.066	-.070	.237	-.045	.156	.002
LM Recognition	.643	-.046	.033	-.121	-.106	.372	-.165	.016	-.279	-.057
LM-II Total Recall	.631	.014	.006	.042	-.110	.585	.028	-.138	-.258	.006
CVLT Short Delay Recall	.616	-.471	.404	.152	.052	-.058	.231	.071	.135	-.091
LM-I Total Recall	.592	.051	-.073	.132	-.262	.556	-.054	-.066	-.313	.023
CVLT Long Delay Recall	.590	-.455	.469	.208	.048	-.137	.156	.101	.104	-.081
Stroop-C	-.555	.267	.341	.409	.292	.004	.075	.066	-.246	.005
Digit Symbol	.538	.193	-.385	-.422	-.085	-.075	.022	.108	.096	-.122
Stroop- CW	-.528	.029	.205	.444	.140	-.102	.139	-.330	-.233	.327
Color Trails B	-.514	-.406	.229	-.091	-.157	.309	-.036	-.064	.276	.301
Animal Naming	.489	.034	-.134	-.132	.487	-.013	.096	-.481	.214	.204
WASI Block Design	.392	.575	.098	.171	.392	.070	.011	.114	-.009	-.041
REY-0 Copy	.143	.548	-.049	.329	-.153	-.122	-.221	.111	.248	-.176
WASI Similarities	-.158	.519	.356	-.099	.279	.404	-.020	-.091	.303	-.020
CVLT Discriminability	.488	-.497	.330	.269	-.092	-.072	.065	-.163	.002	-.107
WASI Matrix Reasoning	-.141	.493	.467	-.171	.181	.357	.189	-.240	.212	-.172
WCST Categories	.298	.435	.401	-.314	-.246	-.403	.072	-.050	-.046	.124
WCST Conceptualization %	.340	.489	.532	-.271	-.269	-.192	-.051	.094	-.077	.120
WCST Perseverative Errors	-.330	-.487	-.517	.292	.163	.247	.098	-.046	.144	-.141
Stroop-R	-.413	.221	.423	.333	.229	.097	-.093	.202	-.228	-.326
REY-O 3 Minute	.325	.406	-.266	.673	-.263	-.070	-.028	-.003	.193	.053
REY-O 30 Minute	.334	.379	-.249	.643	-.319	-.054	.023	-.077	.224	.067
FAS MEAN	.426	.119	-.294	-.156	.537	-.062	-.224	-.150	.134	-.188
WASI Vocabulary	.357	-.209	.006	.179	.360	.003	-.524	.329	.019	.088
BNT	.333	-.189	.217	.062	.365	-.110	-.496	.085	-.048	.407
Digit Span-BW Digits	.179	.206	-.113	-.025	.202	.169	.462	.485	.083	.053
Digit Span-FW Digits	.103	.036	-.251	-.038	.247	.066	.442	.476	-.065	.350
Color Trails A	-.298	-.102	.306	-.041	-.318	.416	-.249	.261	.416	.224
Ruff Figural Fluency	.286	.402	-.235	.081	.015	.050	.089	-.152	-.082	.418

Extraction Method: Principal Component Analysis.

a 10 components extracted.

Table 7. Rotated Component Matrix[a]

	Component									
	1	2	3	4	5	6	7	8	9	10
CVLT Long Delay	.915	.106	-.013	-.043	.073	-.063	.016	.167	-.058	.042
CVLT Short Delay	.911	.047	-.044	-.109	.118	-.031	.014	.099	.001	.085
CVLT Total Recall 1-5	.872	.075	.032	-.069	.131	-.005	.039	.093	.150	.064
CVLT Discriminability	.782	-.022	.018	.028	.190	-.161	.019	.048	.020	-.212
WCST Conceptualization %	.075	.891	.082	-.076	.110	.156	-.030	.018	-.056	.002
WCST Perseverative Errors	-.038	-.890	-.022	.031	-.087	-.146	-.064	-.092	.011	.028
WCST Categories	.080	.853	.056	-.095	-.069	.044	.099	-.108	.102	-.034
REY-O 3 Minute	.036	-.011	.934	.036	.119	-.074	.079	-.002	.074	.050
REY-O 30 Minute	.073	-.002	.917	.022	.133	-.070	.040	-.082	.135	.016
REY-0 Copy	-.125	.182	.684	-.112	-.071	.190	.090	.082	-.181	-.067
Stroop CW	-.099	-.079	.013	.859	-.184	-.024	-.040	-.095	.166	-.101
Stroop-C	-.174	-.012	.023	.763	-.192	.261	.062	.023	-.298	.086
Digit Symbol	-.067	.186	.080	-.710	.154	-.064	.270	-.021	.153	.167
LM-I Total Recall	.120	.016	.193	-.111	.890	-.030	.004	.011	.044	.028
LM-II Total Recall	.216	.003	.065	-.126	.859	.109	.052	.010	.130	.050
LM Recognition	.191	.133	-.041	-.279	.717	-.014	.092	.179	-.009	-.016
WASI Matrix Reasoning	-.051	.212	-.074	.125	.035	.840	-.046	-.244	.008	-.030
WASI Similarities	-.180	.130	.029	.099	.006	.829	-.147	.031	.028	.044
WASI Block Design	.014	.225	.328	.034	.160	.452	.390	.268	.017	.288
Color Trails A	-.059	-.005	.008	-.039	-.006	.193	-.858	.101	-.179	-.033
Color Trails B	-.014	-.225	-.314	.188	-.137	.049	-.741	-.073	.076	-.127
FAS MEAN	-.001	-.144	.020	-.393	.007	.252	.522	.380	.257	-.045
BNT with Semantic Cues	.199	.145	-.081	.091	.056	-.079	-.028	.799	.197	-.051
WASI Vocabulary	.180	-.116	.066	-.115	.092	-.066	.046	.795	-.105	.040
Animal Naming	.217	-.056	-.029	-.165	.054	.272	.341	.180	.732	.002
Stroop-R	-.076	-.010	-.001	.516	-.075	.348	.090	.086	-.603	-.031
Ruff Figural Fluency	-.197	.188	.311	.063	.249	-.009	.126	.038	.467	.220
Digit Span-FW Digits	-.037	-.056	-.052	-.003	.005	-.120	.035	.049	.127	.805
Digit Span-BW Digits	.049	-.009	.071	-.132	.039	.167	.068	-.061	-.059	.741

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.
a Rotation converged in 9 iterations.

Table 8. Component Transformation Matrix

Component	1	2	3	4	5	6	7	8	9	10
1	.521	.250	.235	-.429	.465	-.048	.292	.237	.234	.109
2	-.509	.479	.461	.049	.035	.456	.238	-.096	.004	.147
3	.479	.521	-.227	.374	-.030	.383	-.259	.074	-.246	-.163
4	.264	-.342	.682	.552	.043	-.091	.035	.105	-.145	-.011
5	.038	-.294	-.298	.183	-.217	.425	.468	.496	.178	.256
6	-.125	-.374	-.098	-.006	.685	.447	-.380	-.047	-.042	.132
7	.301	-.032	-.090	.143	-.079	.047	.134	-.705	.166	.573
8	-.029	.079	.036	-.190	-.102	-.166	-.196	.298	-.598	.658
9	.207	-.179	.328	-.427	-.496	.399	-.427	.007	.219	-.017
10	-.141	.233	.000	.311	.029	-.255	-.433	.289	.630	.309

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

Table 9. Non-Parametric Test Results: Conceptualization

Mann-Whitney	Ethnicity
Mann-Whitney U	671.000
Wilcoxon W	1491.000
Z	-1.722
Asymp. Sig. (2-tailed)	.085

Kruskal Wallis Test	English Fluency	Armenian Fluency	Language Acculturation	Social Acculturation	Immigration Age	Years of Armenian Education	Origin by Dialect
Chi-Square	3.024	2.968	5.386	3.156	3.095	3.964	4.494
Df	2	2	2	2	2	2	3
Asymp. Sig.	.220	.227	.068	.206	.213	.138	.213

Table 10. Non-Parametric Test Results: Set-Shifting

Mann-Whitney	Ethnicity
Mann-Whitney U	701.500
Wilcoxon W	1521.500
Z	-1.285
Asymp. Sig. (2-tailed)	.199

Kruskal Wallis Test	English Fluency	Armenian Fluency	Language Acculturation	Social Acculturation	Immigration Age	Years of Armenian Education	Origin by Dialect
Chi-Square	2.190	2.030	1.655	2.189	1.824	1.863	4.079
Df	2	2	2	2	2	2	3
Asymp. Sig.	.334	.362	.437	.335	.402	.394	.253

Table 11. Correlation Matrix of Composite Scores

		Learning	Set-Shifting	Nonverbal Processing	Processing Speed	Narrative Memory	Concept-uallization	Mental Control	Language	Fluency	Attention
Learning	Pearson Correlation	1	.124	-.009	-.226(*)	.314(**)	-.172	.092	.318(**)	.213	-.001
	Sig. (2-tailed)	.	.271	.933	.041	.004	.123	.410	.004	.054	.994
	N	82	81	82	82	82	82	82	82	82	82
Set-Shifting	Pearson Correlation	.124	1	.128	-.079	.151	.281(*)	.100	.002	.028	-.052
	Sig. (2-tailed)	.271	.	.251	.482	.176	.010	.370	.988	.803	.644
	N	81	82	82	82	82	82	82	82	82	82
Nonverbal Processing	Pearson Correlation	-.009	.128	1	-.025	.166	.023	.220(*)	.036	.047	.012
	Sig. (2-tailed)	.933	.251	.	.819	.133	.834	.045	.750	.676	.916
	N	82	82	83	83	83	83	83	83	83	83
Processing Speed	Pearson Correlation	-.226(*)	-.079	-.025	1	-.330(**)	.236(*)	-.202	-.138	.592(**)	-.110
	Sig. (2-tailed)	.041	.482	.819	.	.002	.032	.067	.214	.000	.322
	N	82	82	83	83	83	83	83	83	83	83
Narrative Memory	Pearson Correlation	.314(**)	.151	.166	-.330(**)	1	.029	.162	.171	.270(*)	.089
	Sig. (2-tailed)	.004	.176	.133	.002	.	.796	.143	.122	.014	.426
	N	82	82	83	83	83	83	83	83	83	83
Conceptualization	Pearson Correlation	-.172	.281(*)	.023	.236(*)	.029	1	-.077	-.125	-.080	.037
	Sig. (2-tailed)	.123	.010	.834	.032	.796	.	.490	.259	.472	.740
	N	82	82	83	83	83	83	83	83	83	83
Mental Control	Pearson Correlation	.092	.100	.220(*)	-.202	.162	-.077	1	.128	.336(**)	.181
	Sig. (2-tailed)	.410	.370	.045	.067	.143	.490	.	.248	.002	.101
	N	82	82	83	83	83	83	83	83	83	83
Language	Pearson Correlation	.318(**)	.002	.036	-.138	.171	-.125	.128	1	.159	.047
	Sig. (2-tailed)	.004	.988	.750	.214	.122	.259	.248	.	.151	.672
	N	82	82	83	83	83	83	83	83	83	83
Fluency	Pearson Correlation	.213	.028	.047	-.592(**)	.270(*)	-.080	.336(**)	.159	1	.132
	Sig. (2-tailed)	.054	.803	.676	.000	.014	.472	.002	.151	.	.236
	N	82	82	83	83	83	83	83	83	83	83
Attention	Pearson Correlation	-.001	-.052	.012	-.110	.089	.037	.181	.047	.132	1
	Sig. (2-tailed)	.994	.644	.916	.322	.426	.740	.101	.672	.236	.
	N	82	82	83	83	83	83	83	83	83	83

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table 12. Tests of Normality: Ethnicity

Cognitive Factor	Type of Subject	Shapiro-Wilk		
		Statistic	df	Sig.
Learning	Armenian	.931	40	.017
	Caucasian	.983	42	.767
Narrative Memory	Armenian	.981	40	.728
	Caucasian	.984	42	.833
Language	Armenian	.975	40	.512
	Caucasian	.961	42	.171
Nonverbal Processing	Armenian	.986	40	.905
	Caucasian	.941	42	.034
Mental Control	Armenian	.972	40	.406
	Caucasian	.898	42	.001
Fluency	Armenian	.984	40	.822
	Caucasian	.949	42	.064

Table 13. ANCOVA Results for Ethnicity (Age and Education Controlled)

	Means[a] (SD[b])		AGE		EDUCATION		ETHNICITY		Effect Size
	AAs	NAs	F^c	p	F^c	p	F^c	p	
Learning	.10 (0.76)	.09 (0.61)	2.659	.107	.308	.581	.053	.818	.000
Narrative Memory	-.42 (1.66)	.57 (1.65)	1.359	.247	.019	.892	5.93	.017	.073
Language	-.18 (.94)	.33 (.72)	4.078	.047	5.135	.026	13.10	.001	.155
Mental Control	.06 (.88)	.23 (.34)	2.367	.128	1.476	.228	.392	.533	.000
Fluency	-.01 (.96)	.09 (1.25)	1.161	.284	.050	.824	.366	.547	.000
Nonverbal Processing	.33 (1.25)	-.19 (1.81)	10.17	.002	2.56	.113	3.338	.071	.047

[a]: = Unadjusted Composite Score Means [b]: = Standard Deviation [c]: df = (1, 79)

Table 14. Tests of Normality: English Fluency

Cognitive Factor	English Fluency	Shapiro-Wilk		
		Statistic	df	Sig.
Learning	Low	.947	19	.344
	High	.898	21	.032
	NA	.983	41	.767
Narrative Memory	Low	.970	19	.768
	High	.956	21	.446
	NA	.984	41	.833
Language	Low	.979	19	.925
	High	.929	21	.133
	NA	.961	41	.171
Nonverbal Processing	Low	.976	19	.883
	High	.949	21	.321
	NA	.941	41	.034
Processing Speed	Low	.958	19	.531
	High	.928	21	.128
	NA	.978	41	.618
Mental Control	Low	.960	19	.574
	High	.964	21	.592
	NA	.898	41	.001
Fluency	Low	.964	19	.651
	High	.977	21	.881
	NA	.949	41	.064
Attention	Low	.946	19	.337
	High	.924	21	.102
	NA	.973	41	.434

Table 15. ANCOVA Results for English Fluency (Age and Education Controlled)

	Means[a] (SD[b])			Age		Education		English Fluency		Effect Size
	LoAA [d]	**Hi AA[e]**	**NA**	**F[c]**	**p**	**F[c]**	**p**	**F[c]**	**p**	
Learning	-.11 (.83)	.30 (.64)	.09 (.60)	2.793	.099	.023	.880	1.584	.212	.040
Narrative Memory	-1.07 (1.69)	.16 (1.43)	.57 (1.65)	1.382	.243	.513	.476	6.522	.002	.143
Language	-.58 (.85)	.19 (.87)	.33 (.72)	4.525	.037	2.88/	.094	10.57	.000	.213
Nonverbal Processing	.58 (1.24)	.11 (1.24)	-.19 (1.81)	10.34	.002	3.407	.069	2.460	.092	.059
Mental Control	-.15 (.88)	.25 (.85)	.23 (1.34)	2.329	.131	.946	.334	.638	.531	.016
Fluency	-.12 (.98)	.09 (.95)	.09 (1.25)	1.164	.284	.010	.920	.314	.732	.008
Processing Speed	.49 (2.13)	-.58 (1.51)	-.15 (1.72)	.590	.445	.323	.572	2.018	.140	.049
Attention	.10 (1.06)	.00 (1.00)	.06 (.91)	1.071	.304	.429	.515	.028	.973	.001

[a]: = Unadjusted Composite Score Means [b]: = Standard Deviation [c]: df = (1, 79) [d]: LoAA = Low-English Fluency

[e]: High-English Fluency

Table 16. Pairwise Comparisons: English Fluency (Age and Education Controlled)

Dependent Variable: Narrative Memory

(I) English Fluency	(J) English Fluency	Mean Difference (I-J)	Std. Error	Sig.(a)
Low	High	-1.352(*)	.523	.035
	NA	-1.584(*)	.445	.002
High	Low	1.352(*)	.523	.035
	NA	-.233	.446	1.000
NA	Low	1.584(*)	.445	.002
	High	.233	.446	1.000

Dependent Variable: Language

(I) English Fluency	(J) English Fluency	Mean Difference (I-J)	Std. Error	Sig.(a)
Low	High	-.650(*)	.245	.029
	NA	-.958(*)	.208	.000
High	Low	.650(*)	.245	.029
	NA	-.309	.209	.429
NA	Low	.958(*)	.208	.000
	High	.309	.209	.429

Based on estimated marginal means * The mean difference is significant at the .05 level.

Table 17. ANCOVA Results: Armenian Fluency (Age, Education, and English Fluency Controlled)

	Means[a] (SD[b])			Age		Education		English Fluency		Armenian Fluency		Effect Size
	LoAA [d]	**Hi AA[e]**	**NA**	**F[c]**	**p**	**F[c]**	**p**	**F[c]**	**p**	**F[c]**	**p**	
Learning	.06 (.85)	.12 (.73)	.09 (.61)	1.03	.314	.016	.901	8.11	.006	.063	.939	.002
Narrative Memory	-.89 (1.97)	-.22 (1.50)	.57 (1.66)	2.28	.135	.164	.687	.822	.367	3.34	.040	.080
Language	-.39 (1.02)	-.09 (.90)	.33 (.72)	1.11	.294	1.74	.191	20.52	.000	5.089	.008	.117
Nonverbal Processing	1.00 (1.26)	.43 (1.27)	-.19 (1.81)	12.15	.001	1.51	.223	1.41	.238	2.48	.091	.060

[a]: =Unadjusted Composite Score [b]: = Standard Deviation [c]: df = (1, 79) [d]: LoAA = Low Armenian Fluency

[e]: High Armenian Fluency

Table 18. Armenian Fluency: Pairwise Comparisons (Age, Education, and English Fluency Controlled)

Dependent Variable: Language

(I) Armenian Fluency (cut-off 44)	(J) Armenian Fluency (cut-off 44)	Mean Difference (I-J)	Std. Error	Sig.(a)
Low	High	-.099	.245	1.000
	NA	-.574(*)	.233	.048
High	Low	.099	.245	1.000
	NA	-.475(*)	.177	.027
NA	Low	.574(*)	.233	.048
	High	.475(*)	.177	.027

Dependent Variable: Narrative Memory

(I) Armenian Fluency (cut-off 44)	(J) Armenian Fluency (cut-off 44)	Mean Difference (I-J)	Std. Error	Sig.(a)
Low	High	-.757	.580	.586
	NA	-1.365(*)	.550	.046
High	Low	.757	.580	.586
	NA	-.608	.418	.450
NA	Low	1.365(*)	.550	.046
	High	.608	.418	.450

Dependent Variable: Nonverbal Processing

(I) Armenian Fluency (cut-off 44)	(J) Armenian Fluency (cut-off 44)	Mean Difference (I-J)	Std. Error	Sig.(a)
Low	High	-.481	.520	1.000
	NA	.354	.493	1.000
High	Low	.481	.520	1.000
	NA	.835	.375	.087
NA	Low	-.354	.493	1.000
	High	-.835	.375	.087

Table 19. Partial Correlations: Acculturation Scale and Language Proficiency (English Fluency Controlled)

	AWRT	BAT-B	BAT-C	Language Acculturation	Social Acculturation
AWRT		r = .682 p = .000	r = .471 p = .002	r = -.317 p = .050	r = .106 p = .519
BAT-B	r = .682 p = .000		r = .483 p = .002	r = -.207 p = .206	r = .214 p = .192
BAT-C	r = .471 p = .002	r = .483 p = .002		r = -.190 p = .246	r = .152 p = .354
Language Acculturation	r = -.317 p = .050	r = -.207 p = .206	r = -.190 p = .246		r = .057 p = .733
Social Acculturation	r = .106 p = .519	r = .214 p = .192	r = .152 p = .354	r = .057 p = .733	

*df = 1, 37

Table 20. Correlations: English Fluency and Acculturation

	WRAT-3 Reading	Language Acculturation	Social Acculturation
WRAT-3 Reading		r = .379 p = .016	r = .375 p = .017
Language Acculturation	r = .379 p = .016		r = .190 p = .239
Social Acculturation	r = .375 p = .017	r = .190 p = .239	

r = Pearson Correlation; $p < .05$

Table 21. Tests of Normality: Language Acculturation

	Groups by Language Acculturation	Shapiro-Wilk		
Learning	high acculturation	.912	18	.094
	Low acculturation	.963	22	.542
	Caucasian	.983	41	.786
Nonverbal Processing	high acculturation	.969	18	.775
	Low acculturation	.955	22	.401
	Caucasian	.941	41	.034
Processing Speed	high acculturation	.929	18	.186
	Low acculturation	.958	22	.457
	Caucasian	.978	41	.618
Narrative Memory	high acculturation	.976	18	.900
	Low acculturation	.966	22	.611
	Caucasian	.984	41	.833
Mental Control	high acculturation	.944	18	.335
	Low acculturation	.975	22	.832
	Caucasian	.898	41	.001
Language	high acculturation	.942	18	.319
	Low acculturation	.944	22	.241
	Caucasian	.961	41	.171
Fluency	high acculturation	.954	18	.499
	Low acculturation	.988	22	.992
	Caucasian	.949	41	.064
Attention	high acculturation	.946	18	.372
	Low acculturation	.939	22	.191
	Caucasian	.973	41	.434

Table 22. ANCOVA Results: Language Acculturation (Age and Education Controlled)

	Means[a] (SD[b])			**Age**		**Education**		**Language Acculturation**		**Effect Size**
	LoAA[d]	**Hi AA[e]**	**NA**	**F[c]**	**p**	**F[c]**	**p**	**F[c]**	**p**	
Learning	-.22 (.80)	.50 (.47)	.09 (.60)	2.971	.089	.060	.808	6.036	.004	.136
Narrative Memory	-.98 (1.61)	.26 (1.49)	.57 (1.66)	1.477	.228	.151	.698	6.298	.003	.139
Language	-.42 (.94)	.12 (.86)	.33 (.72)	4.185	.044	4.413	.039	8.670	.000	.182
Nonverbal Processing	.39 (1.30)	.25 (1.22)	-.19 (1.81)	10.05	.002	2.628	.109	1.717	.186	.042
Mental Control	-.22 (.86)	.39 (.80)	.23 (1.34)	2.440	.122	1.123	.293	1.529	.223	.038
Fluency	-.14 (1.03)	.16 (.88)	.09 (1.26)	1.148	.287	.020	.887	.489	.615	.012
Processing Speed	.22 (2.05)	-.43 (1.64)	-.15 (1.72)	.616	.435	.056	.814	.700	.499	.018
Attention	.11 (1.13)	-.02 (.90)	.06 (.91)	1.082	.302	.464	.498	.077	.926	.002

[a]: = Unadjusted Composite Score [b]: = Standard Deviation [c]: df = (2, 76) [d]: LoAA = Low Language Acculturation AA
[e]: High Language Acculturation AA

Table 23. Pairwise Comparisons: Language Acculturation (Age and Education Controlled)

Dependent Variable: Learning

Groups by Language Acculturation	Groups by Language Acculturation	Mean Difference	Std. Error	Sig
high acculturation	low acculturation	.701(*)	.202	.003
	Caucasian	.359	.182	.158
low acculturation	high acculturation	-.701(*)	.202	.003
	Caucasian	-.342	.168	.135
Caucasian	high acculturation	-.359	.182	.158
	low acculturation	.342	.168	.135

Dependent Variable: Narrative Memory

Groups by Language Acculturation	Groups by Language Acculturation	Mean Difference	Std. Error	Sig
high acculturation	low acculturation	1.289(*)	.515	.043
	Caucasian	-.184	.463	1.000
low acculturation	high acculturation	-1.289(*)	.515	.043
	Caucasian	-1.473(*)	.426	.003
Caucasian	high acculturation	.184	.463	1.000
	low acculturation	1.473(*)	.426	.003

Dependent Variable: Language

Groups by Language Acculturation	Groups by Language Acculturation	Mean Difference	Std. Error	Sig
high acculturation	low acculturation	.477	.245	.167
	Caucasian	-.366	.221	.304
low acculturation	high acculturation	-.477	.245	.167
	Caucasian	-.842(*)	.203	.000
Caucasian	high acculturation	.366	.221	.304
	low acculturation	.842(*)	.203	.000

Table 24. ANCOVA Results: Language Acculturation (Age, Education, and English Fluency Controlled)

	Means[a] (SD[b])			**Age**		**Education**		**English Fluency**		**Language Acculturation**		**Effect Size**
	LoAA[d]	**Hi AA[e]**	**NA**	**F[c]**	**p**	**F[c]**	**p**	**F[c]**	**p**	**F[c]**	**p**	
Learning	-.22 (.80)	.50 (.47)	.09 (.60)	1.42	.237	.07	.791	5.09	.027	4.42	.015	.104
Narrative Memory	-.98 (1.61)	.26 (1.49)	.57 (1.66)	1.66	.201	.24	.628	.231	.632	5.301	.007	.121
Language	-.42 (.94)	.12 (.86)	.33 (.72)	1.37	.245	1.7	.202	17.91	.000	5.74	.005	.130

[a]: = Unadjusted Composite Score [b]: = Standard Deviation [c]: df = (2, 76)
[d]: LoAA = Low Language Acculturation AA [e]: High Language Acculturation AA

Table 25. Tests of Normality: Social Acculturation

Cognitive Factor	Groups by Social Acculturation	Shapiro-Wilk		
		Statistic	df	Sig.
Learning	high acculturation	.871	15	.035
	low acculturation	.954	25	.310
	Caucasian	.983	41	.786
Narrative Memory	high acculturation	.964	15	.756
	low acculturation	.974	25	.757
	Caucasian	.984	41	.833
Language	high acculturation	.970	15	.858
	low acculturation	.977	25	.827
	Caucasian	.961	41	.171
Nonverbal Processing	high acculturation	.974	15	.907
	low acculturation	.973	25	.714
	Caucasian	.941	41	.034
Processing Speed	high acculturation	.943	15	.416
	low acculturation	.957	25	.360
	Caucasian	.978	41	.618
Mental Control	high acculturation	.959	15	.678
	low acculturation	.973	25	.733
	Caucasian	.898	41	.001
Fluency	high acculturation	.931	15	.286
	low acculturation	.968	25	.605
	Caucasian	.949	41	.064
Attention	high acculturation	.969	15	.849
	low acculturation	.962	25	.456
	Caucasian	.973	41	.434

Table 26. ANCOVA Results: Social Acculturation (Age and Education Controlled)

	Means[a] (SD[b])			Age		Education		Social Acculturation		Estimated Effect Size
	LoAA[d]	Hi AA[e]	NA	F[c]	p	F[c]	p	F[c]	p	
Learning	-.04 (.76)	.34 .(69)	.09 (.60)	1.903	.172	.116	.734	.874	.421	.022
Narrative Memory	-.29 (1.72)	-.64 (1.60)	.57 (1.65)	1.164	.284	.006	.938	2.996	.056	.071
Language	-.38 (1.00)	.16 (.73)	.33 (.72)	3.166	.079	4.200	.044	7.333	.001	.158
Nonverbal Processing	.48 (1.17)	.08 (1.37)	-.19 1.81	9.271	.003	2.705	.104	1.753	.180	.043
Mental Control	-.04 (.89)	.22 (.86)	.23 (1.34)	2.744	.102	1.136	.290	.533	.589	.013
Fluency	.02 (.91)	-.06 (1.08)	.09 (1.25)	1.318	.254	.091	.763	.318	.729	.008
Processing Speed	-.34 (1.68)	.38 (2.17)	-.15 (1.72)	.335	.564	.003	.959	.564	.571	.014
Attention	.02 (1.11)	.09 (.89)	.06 (.91)	.991	.323	.543	.464	.014	.986	.000

[a]: = Unadjusted Composite Score [b]: = Standard Deviation [c]: df = (2, 76)
[d]: LoAA = Low Social Acculturation AA [e]: High Social Acculturation AA

Table 27. Pairwise Comparisons: Social Acculturation (Age and Education Controlled)

Dependent Variable: Narrative Memory

Groups by Social Acculturation	Groups by Social Acculturation	Mean Difference	Std. Error	Sig
high acculturation	low acculturation	-.200	.568	1.000
	Caucasian	-1.042	.532	.161
low acculturation	high acculturation	.200	.568	1.000
	Caucasian	-.842	.421	.148
Caucasian	high acculturation	1.042	.532	.161
	low acculturation	.842	.421	.148

Dependent Variable: Language

Groups by Social Acculturation	Groups by Social Acculturation	Mean Difference	Std. Error	Sig
high acculturation	low acculturation	.322	.264	.681
	Caucasian	-.421	.247	.279
low acculturation	high acculturation	-.322	.264	.681
	Caucasian	-.742(*)	.196	.001
Caucasian	high acculturation	.421	.247	.279
	low acculturation	.742(*)	.196	.001

Table 28. ANCOVA Results: Social Acculturation (Age, Education, and English Fluency Controlled)

	Means[a] (SD[b])			**Age**		**Education**		**English Fluency**		**Social Acculturation**		**Effect Size**
	LoAA[d]	**Hi AA[e]**	**NA**	**F[c]**	**p**	**F[c]**	**p**	**F[c]**	**p**	**F[c]**	**p**	
Learning	-.04 (.76)	.34 (.69)	.09 (.60)	.647	.424	.087	.769	7.74	.007	.728	.486	.019
Narrative Memory	-.29 (1.72)	-.64 (1.60)	.57 (1.65)	1.63	.205	.097	.756	1.03	.313	2.53	.086	.062
Language	-.38 (1.00)	.16 (.73)	.33 (.72)	.866	.355	1.37	.244	20.45	.000	5.65	.005	.128

[a]: = Unadjusted Composite Score [b]: = Standard Deviation [c]: df = (2, 77)
[d]: LoAA = Low Social Acculturation AA [e]: High Social Acculturation AA

Table 29. Tests of Normality: Immigration Age

Cognitive Factors	Immigration Age	Shapiro-Wilk		
		Statistic	df	Sig.
Learning	Early: 0-9	.925	19	.139
	Late: 10+	.929	21	.129
	NA	.983	41	.786
Narrative Memory	Early: 0-9	.965	19	.665
	Late: 10+	.966	21	.634
	NA	.984	41	.833
Language	Early: 0-9	.954	19	.468
	Late: 10+	.927	21	.120
	NA	.961	41	.171
Nonverbal Processing	Early: 0-9	.983	19	.968
	Late: 10+	.976	21	.858
	NA	.941	41	.034
Processing Speed	Early: 0-9	.931	19	.183
	Late: 10+	.951	21	.359
	NA	.978	41	.618
Mental Control	Early: 0-9	.915	19	.093
	Late: 10+	.975	21	.839
	NA	.898	41	.001
Fluency	Early: 0-9	.977	19	.898
	Late: 10+	.933	21	.161
	NA	.949	41	.064
Attention	Early: 0-9	.924	19	.136
	Late: 10+	.941	21	.223
	NA	.973	41	.434

Table 30. Partial Correlations: Immigration Age by Neuropsychological Factors (Age and Education Controlled)

	Learning	Narrative Memory	Language	Nonverbal Processing	Mental Control	Fluency	Processing Speed	Attention
Pearson Correlation	-.346	-.038	-..473	.329	-.288	-.209	.092	-.080
Sig. (2-tailed)	.033	.822	.003	.044	.080	.206	.583	.633

df = 1, 36

Table 31. ANCOVA Results: Immigration Age (Age and Education Controlled)

	Means[a] (SD[b])			Age		Education		Immigration Age		Estimated Effect Size
	Early[d]	Late[e]	NA	F[c]	p	F[c]	p	F[c]	p	
Learning	.30 (.63)	-.07 (.83)	.09 (.61)	4.317	.041	.989	.323	2.918	.060	.070
Narrative Memory	-.22 (1.76)	-.61 (1.58)	.57 (1.66)	1.127	.292	.003	.959	3.044	.053	.072
Language	.08 (.96)	-.41 (.87)	.33 (.72)	7.255	.009	8.782	.004	12.948	.000	.249
Nonverbal Processing	.10 (1.26)	.54 (1.24)	-.19 (1.81)	11.537	.001	1.796	.184	2.622	.079	.063
Mental Control	.26 (1.06)	-.13 (.65)	.23 (4.34)	1.774	.187	1.918	.170	.753	.475	.019
Fluency	.03 (.94)	-.05 (1.00)	.09 (1.26)	1.330	.252	.100	.752	.335	.716	.009
Processing Speed	-.33 (1.79)	.16 (1.98)	-.15 (1.72)	.420	.519	.000	.999	.219	.804	.006
Attention	.09 (1.04)	.01 (1.03)	.06 (.91)	1.165	.284	.426	.516	.057	.944	.001

[a]: = Unadjusted Composite Score [b]: = Standard Deviation [c]: df = (2, 77) [d]: Early = Immigration Age 0-9 AAs
[e]: Late = Immigration Age 10 + AAs

Table 32. Pairwise Comparisons: Immigration Age (Age and Education Controlled)

Dependent Variable: Language

Immigration Age	Immigration Age	Mean Difference	Std. Error	Sig.
Early	Late	.810(*)	.243	.004
	Non-Armenian	-.242	.202	.705
Late	Early	-.810(*)	.243	.004
	Non-Armenian	-1.052(*)	.207	.000
Non-Armenian	Early	.242	.202	.705
	Late	1.052(*)	.207	.000

Dependent Variable: Narrative Memory

Immigration Age	Immigration Age	Mean Difference	Std. Error	Sig.
Early	Late	.255	.553	1.000
	Non-Armenian	-.786	.461	.276
Late	Early	-.255	.553	1.000
	Non-Armenian	-1.041	.471	.090
Non-Armenian	Early	.786	.461	.276
	Late	1.041	.471	.090

Dependent Variable: Learning

Immigration Age	Immigration Age	Mean Difference	Std. Error	Sig.
Early	Late	.521	.217	.056
	Non-Armenian	.218	.181	.699
Late	Early	-.521	.217	.056
	Non-Armenian	-.303	.185	.316
Non-Armenian	Early	-.218	.181	.699
	Late	.303	.185	.316

Dependent Variable: Nonverbal Processing

Immigration Age	Immigration Age	Mean Difference	Std. Error	Sig.
Early	Late	-.669	.490	.527
	Non-Armenian	.287	.408	1.000
Late	Early	.669	.490	.527
	Non-Armenian	.956	.418	.074
Non-Armenian	Early	-.287	.408	1.000
	Late	-.956	.418	.074

Based on estimated marginal means

Table 33. ANCOVA Results: Immigration Age (Age, Education, and English Fluency Controlled)

	Means[a] (SD[b])			Age		Education		English Fluency		Immigration Age		Effect Size
	Early[d]	Late[e]	NA	F[c]	p	F[c]	p	F[c]	p	F[c]	p	
Learning	.30 (.63)	-.07 (.83)	.09 (.61)	1.98	.164	.091	.764	5.42	.023	1.61	.206	.041
Narrative Memory	-.22 (1.76)	-.61 (1.58)	.57 (1.66)	1.62	.207	.098	.755	3811	.371	2.46	.092	.060
Language	.08 (.96)	-.41 (.87)	.33 (.72)	2.88	.094	3.74	.057	15.4	.000	8.42	.000	.179
Nonverbal Processing	.10 (1.26)	.54 (1.24)	-.19 (1.81)	14.3	.000	.636	.428	2.90	.093	3.71	.029	.088

[a]:Unadjusted Composite Means [b]:Standard Deviation [c]: df = (2, 77) [d]: Early = Immigration Age 0-9 AAs
[e]: Late = Immigration Age 10 + AAs

Table 34. Tests of Normality: Armenian Education

Cognitive Factor	Armenian Education	Shapiro-Wilk		
		Statistic	df	Sig.
Learning	Minimal Armenian Ed (<6)	.985	11	.987
	Majority Armenian Ed (6+)	.892	29	.006
	Non-Armenian	.983	41	.786
Narrative Memory	Minimal Armenian Ed (<6)	.929	11	.400
	Majority Armenian Ed (6+)	.975	29	.690
	Non-Armenian	.984	41	.833
Language	Minimal Armenian Ed (<6)	.909	11	.234
	Majority Armenian Ed (6+)	.925	29	.041
	Non-Armenian	.961	41	.171
Nonverbal Processing	Minimal Armenian Ed (<6)	.956	11	.716
	Majority Armenian Ed (6+)	.984	29	.930
	Non-Armenian	.941	41	.034
Mental Control	Minimal Armenian Ed (<6)	.869	11	.075
	Majority Armenian Ed (6+)	.986	29	.958
	Non-Armenian	.898	41	.001
Fluency	Minimal Armenian Ed (<6)	.941	11	.527
	Majority Armenian Ed (6+)	.977	29	.764
	Non-Armenian	.949	41	.064
Processing Speed	Minimal Armenian Ed (<6)	.833	11	.026
	Majority Armenian Ed (6+)	.931	29	.057
	Non-Armenian	.978	41	.618
Attention	Minimal Armenian Ed (<6)	.979	11	.960
	Majority Armenian Ed (6+)	.951	29	.196
	Non-Armenian	.973	41	.434

Table 35. ANCOVA Results: Armenian Education (Age and Education Controlled)

	Means[a] (SD[b])			Age		Education		Armenian Education		Estimated Effect Size
	<6[d]	6 +[e]	NA	F[c]	p	F[c]	p	F[c]	p	
Learning	-.21 (.80)	.22 (.71)	.09 (.60)	2.75	.101	.410	.524	1.83	.167	.045
Narrative Memory	-.75 (1.91)	-.30 (1.57)	.57 (1.66)	1.35	.249	.011	.916	3.2	.045	.077
Language	-.08 (1.12)	-.21 (.87)	.33 (.72)	4.03	.048	5.01	.028	6.54	.002	.144
Nonverbal Processing	.29 (1.20)	.34 (1.29)	-.19 (1.81)	10.04	.002	2.54	.115	1.66	.197	.041
Mental Control	.34 (1.10)	-.05 (.77)	.23 (1.34)	2.37	.128	1.38	.243	.628	.536	.016
Fluency	-.24 (.92)	.08 (.98)	.09 (1.26)	1.16	.285	.065	.800	.508	.604	.013
Processing Speed	.40 (2.06)	-.25 (1.82)	-.15 (1.72)	.604	.440	.006	.938	.504	.606	.013
Attention	-.20 (1.04)	.15 (1.02)	.06 (.96)	1.09	.299	.470	.495	.503	.606	.013

[a]: = Unadjusted Composite Score [b]: = Standard Deviation [c]: df = (2, 77) [d]: Armenian Education = <6 years
[e]: Armenian Education = 6+ years

Table 36. Pairwise Comparisons: Armenian Education (Age and Education Controlled)

Dependent Variable: Narrative Memory

Armenian Education	Armenian Education	Mean Difference	Std. Error	Sig.
Minimal Armenian Ed (<6)	Majority Armenian Ed (6+)	-.444	.591	1.000
	Non-Armenian	-1.233	.571	.102
Majority Armenian Ed (6+)	Minimal Armenian Ed (<6)	.444	.591	1.000
	Non-Armenian	-.790	.407	.168
Non-Armenian	<6 Armenian Ed	1.233	.571	.102
	Majority Armenian Ed (6+)	.790	.407	.168

Dependent Variable: Language

Armenian Education	Armenian Education	Mean Difference	Std. Error	Sig.
Minimal Armenian Ed (<6)	Majority Armenian Ed (6+)	.095	.278	1.000
	Non-Armenian	-.564	.269	.117
Majority Armenian Ed (6+)	Minimal Armenian Ed (<6)	-.095	.278	1.000
	Non-Armenian	-.660(*)	.192	.003
Non-Armenian	<6 Armenian Ed	.564	.269	.117
	Majority Armenian Ed (6+)	.660(*)	.192	.003

Table 37. ANCOVA Results: Armenian Education (Age, Education, and English Fluency Controlled)

	Means[a] (SD[b])			Age		Education		English Fluency		Armenian Education		Effect Size
	<6[d]	6 +[e]	NA	F[c]	p	F[c]	p	F[c]	p	F[c]	p	
Learning	-.21 (.80)	.22 (.71)	.09 (.60)	1.05	.308	.003	.960	8.36	.005	1.97	.147	.049
Narrative Memory	-.75 (1.91)	-.30 (1.57)	.57 (1.66)	1.85	.177	.118	.732	.974	.327	2.73	.072	.066
Language	-.08 (1.12)	-.21 (.87)	.33 (.72)	1.22	.272	1.72	.194	20.92	.000	5.10	.008	.117
Nonverbal Processing	.29 (1.20)	.34 (1.29)	-.19 (1.81)	11.47	.001	1.55	.217	1.56	.215	2.04	.138	.050

[a]: = Unadjusted Composite Score [b]: = Standard Deviation [c]: df = (2, 77) [d]: Armenian Education = <6 years
[e]: Armenian Education = 6+ years

Table 38. Tests of Normality: Origin by Dialect

Cognitive Factor	Origin by Dialect	Shapiro-Wilk		
		Statistic	df	Sig.
Learning	US-Born	.858	11	.054
	Western Armenian	.887	16	.051
	Eastern Armenian	.968	13	.875
	Non-Armenian	.983	42	.767
Narrative Memory	US-Born	.951	11	.659
	Western Armenian	.989	16	.998
	Eastern Armenian	.917	13	.229
	Non-Armenian	.987	42	.895
Language	US-Born	.982	11	.976
	Western Armenian	.957	16	.614
	Eastern Armenian	.956	13	.692
	Non-Armenian	.960	42	.144
Nonverbal Processing	US-Born	.954	11	.690
	Western Armenian	.958	16	.632
	Eastern Armenian	.947	13	.551
	Non-Armenian	.948	42	.055
Mental Control	US-Born	.970	11	.890
	Western Armenian	.941	16	.367
	Eastern Armenian	.957	13	.705
	Non-Armenian	.895	42	.001
Processing Speed	US-Born	.880	11	.105
	Western Armenian	.951	16	.506
	Eastern Armenian	.930	13	.342
	Non-Armenian	.978	42	.593
Fluency	US-Born	.974	11	.924
	Western Armenian	.958	16	.632
	Eastern Armenian	.908	13	.174
	Non-Armenian	.949	42	.058
Attention	US-Born	.920	11	.318
	Western Armenian	.940	16	.354
	Eastern Armenian	.940	13	.456
	Non-Armenian	.975	42	.482

* This is a lower bound of the true significance. a Lilliefors Significance Correction

Table 39. ANCOVA Results: Origin (Age and Education Controlled)

	Means[a] (SD[b])				Age		Education		Origin		Estimated Effect Size
	US[d]	W[e]	E[f]	NA[g]	F[c]	p	F[c]	p	F[c]	p	
Learning	.40 (.51)	.29 (.71)	-.38 (.79)	.09 (.68)	2.80	.098	1.08	.301	4.023	.010	.137
Narrative Memory	-.19 (2.01)	-.04 (1.56)	-1.10 (1.35)	.57 (1.66)	1.74	.192	.003	.958	3.20	.028	.111
Language	.06 (.78)	.04 (.62)	-.64 (1.23)	.33 (.72)	4.34	.040	7.63	.007	7.88	.000	.235
Nonverbal Processing	-.01 (1.21)	.60 (1.22)	.29 (1.36)	-.19 (1.81)	11.18	.001	1.87	.174	1.73	.168	.063
Mental Control	.11 (.95)	.10 (.71)	-.04 (1.05)	.23 (1.34)	2.34	.130	1.51	.223	.218	.884	.008
Fluency	.07 (1.13)	-.14 (.96)	.08 (.88)	.09 (1.26)	1.37	.245	.096	.757	.340	.796	.013
Processing Speed	-.70 (1.94)	.33 (2.01)	-.04 (1.68)	-.15 (1.72)	.365	.547	.014	.906	.578	.631	.022
Attention	.23 (1.02)	.06 (.98)	-.11 (1.13)	.06 (.91)	1.12	.293	.320	.573	.211	.888	.008

[a]: = Unadjusted Composite Score [b]: = Standard Deviation [c]: df = (2, 77) [d]: Origin = US born [e]: Western Armenian
[f]: Eastern Armenian [g]: Non-Armenian

Table 40. Pairwise Comparisons: Origin (Age and Education Controlled)

Dependent Variable: Learning

Origin by Dialect	Origin by Dialect	Mean Difference	Std. Error	Sig.(a)
US-Born	Western Armenian	.798	.893	1.000
	Eastern Armenian	3.112(*)	.922	.007
	Non-Armenian	1.257	.750	.587
Western Armenian	US-Born	-.798	.893	1.000
	Eastern Armenian	2.314(*)	.829	.040
	Non-Armenian	.459	.673	1.000
Eastern Armenian	US-Born	-3.112(*)	.922	.007
	Western Armenian	-2.314(*)	.829	.040
	Non-Armenian	-1.855	.712	.066
Non-Armenian	US-Born	-1.257	.750	.587
	Western Armenian	-.459	.673	1.000
	Eastern Armenian	1.855	.712	.066

Dependent Variable: Narrative Memory

Origin by Dialect	Origin by Dialect	Mean Difference	Std. Error	Sig.
US-Born	Western Armenian	-.318	.666	1.000
	Eastern Armenian	.827	.688	1.000
	Non-Armenian	-.764	.558	1.000
Western Armenian	US-Born	.318	.666	1.000
	Eastern Armenian	1.145	.619	.408
	Non-Armenian	-.446	.502	1.000
Eastern Armenian	US-Born	-.827	.688	1.000
	Western Armenian	-1.145	.619	.408
	Non-Armenian	-1.591(*)	.531	.022
Non-Armenian	US-Born	.764	.558	1.000
	Western Armenian	.446	.502	1.000
	Eastern Armenian	1.591(*)	.531	.022

Dependent Variable: Language

Origin by Dialect	Origin by Dialect	Mean Difference	Std. Error	Sig.
US-Born	Western Armenian	.315	.302	1.000
	Eastern Armenian	.916(*)	.312	.026
	Non-Armenian	-.223	.253	1.000
Western Armenian	US-Born	-.315	.302	1.000
	Eastern Armenian	.601	.280	.211
	Non-Armenian	-.538	.227	.123
Eastern Armenian	US-Born	-.916(*)	.312	.026
	Western Armenian	-.601	.280	.211
	Non-Armenian	-1.139(*)	.241	.000
Non-Armenian	US-Born	.223	.253	1.000
	Western Armenian	.538	.227	.123
	Eastern Armenian	1.139(*)	.241	.000

Table 41. ANCOVA Results: Origin (Age, Education, and English Fluency Controlled)

	Means[a] (SD[b])				**Age**		**Education**	
	US[d]	**W[e]**	**E[f]**	**NA[g]**	**F[c]**	**p**	**F[c]**	**p**
Learning	.40 (.51)	.29 (.71)	-.38 (.79)	.09 (.68)	1.39	.241	.190	.664
Narrative Memory	-.19 (2.01)	-.04 (1.56)	-1.10 (1.35)	.57 (1.66)	1.99	.162	.048	.827
Language	.06 (.78)	.04 (.62)	-.64 (1.23)	.33 (.72)	1.55	.217	2.99	.088
Nonverbal Processing	-.01 (1.21)	.60 (1.22)	.29 (1.36)	-.19 (1.81)	13.01	.001	.817	.369

	English Fluency		**Origin**		**Effect Size**
	F[c]	**p**	**F[c]**	**p**	
Learning	3.87	.053	2.55	.062	.093
Narrative Memory	.328	.569	2.61	.057	.093
Language	14.51	.000	4.74	.004	.158
Nonverbal Processing	1.96	.165	2.12	.104	.077

[a]: = Unadjusted Composite Score [b]: = Standard Deviation [c]: df = (2, 75) [d]: Origin = US born [e]: Western Armenian
[f]: Eastern Armenian [g]: Non-Armenian

Table 42. ANCOVA Results: Origin (Age, English Fluency, and Immigration Age Controlled)

	Means[a] (SD[b])				Age		English Fluency	
	US[d]	W[e]	E[f]	NA[g]	F[c]	p	F[c]	p
Learning	.40 (.51)	.29 (.71)	-.38 (.79)	.09 (.68)	1.96	.171	.198	.659
Narrative Memory	-.19 (2.01)	-.04 (1.56)	-1.10 (1.35)	.57 (1.66)	2.01	.165	2.08	.158
Language	.06 (.78)	.04 (.62)	-.64 (1.23)	.33 (.72)	12.00	.001	3.24	.081
Nonverbal Processing	-.01 (1.21)	.60 (1.22)	.29 (1.36)	-.19 (1.81)	1.28	.266	.038	.847

	Immigration Age		Origin		Effect Size
	F[c]	p	F[c]	p	
Learning	1.79	.190	2.63	.087	.134
Narrative Memory	.077	.783	.822	.448	.046
Language	4.40	.043	.801	.457	.115
Nonverbal Processing	2.46	.126	.142	.868	.008

[a]: = Unadjusted Composite Score [b]: = Standard Deviation [c]: df = (2, 75)
[d]: Origin = US born [e]: Western Armenian [f]: Eastern Armenian [g]: Non-Armenian

Table 43. Non-Parametric Test Results: Neuropsychological Factors

Grouping Variable: Ethnicity

Mann-Whitney	Learning	Narrative Memory	Language	Nonverbal Processing	Mental Control	Fluency	Processing Speed	Attention
Mann-Whitney U	779.5	589	563	734.5	721	821	855	850.5
Wilcoxon W	1682.5	1409	1383	1680.5	1541	1641	1801	1796.5
Z	-.561	-2.470	-2.707	-1.144	-1.267	-.355	-.046	-.087
Asymp. Sig. (2-tailed)	.575	.014	.007	.253	.205	.722	.964	.931

Grouping Variable: English Fluency (WRAT)

Kruskal Wallis Test	Learning	Narrative Memory	Language	Nonverbal Processing	Mental Control	Fluency	Processing Speed	Attention
Chi-Square	3.429	11.191	14.824	2.069	3.329	.438	2.725	.477
Df	2	2	2	2	2	2	2	2
Asymp. Sig.	.180	.004	.001	.355	.189	.803	.256	.788

Grouping Variable: Armenian Fluency (AWRT)

Kruskal Wallis Test	Learning	Narrative Memory	Language	Nonverbal Processing	Mental Control	Fluency	Processing Speed	Attention
Chi-Square	.413	7.183	8.603	1.576	1.605	.847	.355	.191
Df	2	2	2	2	2	2	2	2
Asymp. Sig.	.813	.028	.014	.455	.448	.655	.837	.909

Grouping Variable: Groups by Language Acculturation

Kruskal Wallis Test	Learning	Narrative Memory	Language	Nonverbal Processing	Mental Control	Fluency	Processing Speed	Attention
Chi-Square	10.597	11.033	10.841	1.449	5.704	1.369	.765	.343
Df	2	2	2	2	2	2	2	2
Asymp. Sig.	.005	.004	.004	.485	.058	.504	.682	.843

Grouping Variable: Groups by Social Acculturation

Kruskal Wallis Test	Learning	Narrative Memory	Language	Nonverbal Processing	Mental Control	Fluency	Processing Speed	Attention
Chi-Square	3.991	6.694	10.054	2.197	2.123	.140	1.210	.105
Df	2	2	2	2	2	2	2	2
Asymp. Sig.	.136	.035	.007	.333	.346	.932	.546	.949

Grouping Variable: Immigration Age

Kruskal Wallis Test	Learning	Narrative Memory	Language	Nonverbal Processing	Mental Control	Fluency	Processing Speed	Attention
Chi-Square	2.543	7.025	10.092	2.282	4.433	.136	.695	.070
Df	2	2	2	2	2	2	2	2
Asymp. Sig.	.280	.030	.006	.320	.109	.934	.706	.966

Grouping Variable: Years of Armenian Education

Kruskal Wallis Test	Learning	Narrative Memory	Language	Nonverbal Processing	Mental Control	Fluency	Processing Speed	Attention
Chi-Square	3.973	6.672	7.419	1.316	3.440	.716	.600	1.332
Df	2	2	2	2	2	2	2	2
Asymp. Sig.	.137	.036	.024	.518	.179	.699	.741	.514

Grouping Variable: Origin by Dialect

Kruskal Wallis Test	Learning	Narrative Memory	Language	Nonverbal Processing	Mental Control	Fluency	Processing Speed	Attention
Chi-Square	9.693	9.464	9.923	2.317	1.689	.342	2.626	.489
Df	3	3	3	3	3	3	3	3
Asymp. Sig.	.021	.024	.019	.509	.639	.952	.453	.921

Table 44. Composite Score Tabulation Comparison for the Language Factor

	Raw Scores		Weighted Raw Score		z-score		Weighted z-score	
	F	**p**	**F**	**p**	**F**	**p**	**F**	**p**
Type	14.448	.000	14.451	.000	14.395	.000	13.103	.001
English Fluency	9.887	.000	9.879	.000	9.983	.000	10.577	.000
Armenian Fluency	5.628	.005	5.630	.005	5.603	.005	5.089	.008
Language Acculturation	7.010	.002	7.016	.002	6.930	.002	5.738	.005
Social Acculturation	6.670	.002	6.674	.002	6.613	.002	5.648	.005
Armenian Education	5.849	.004	5.852	.004	5.813	.004	5.099	.008
Immigration Age	9.619	.000	9.623	.000	6.613	.002	8.418	.000
Origin	1.251	.299	1.255	.298	1.204	.312	.801	.457

FIGURES

Figure 1. Scree Plot: Eigenvalues of Components in Principal Component Analysis

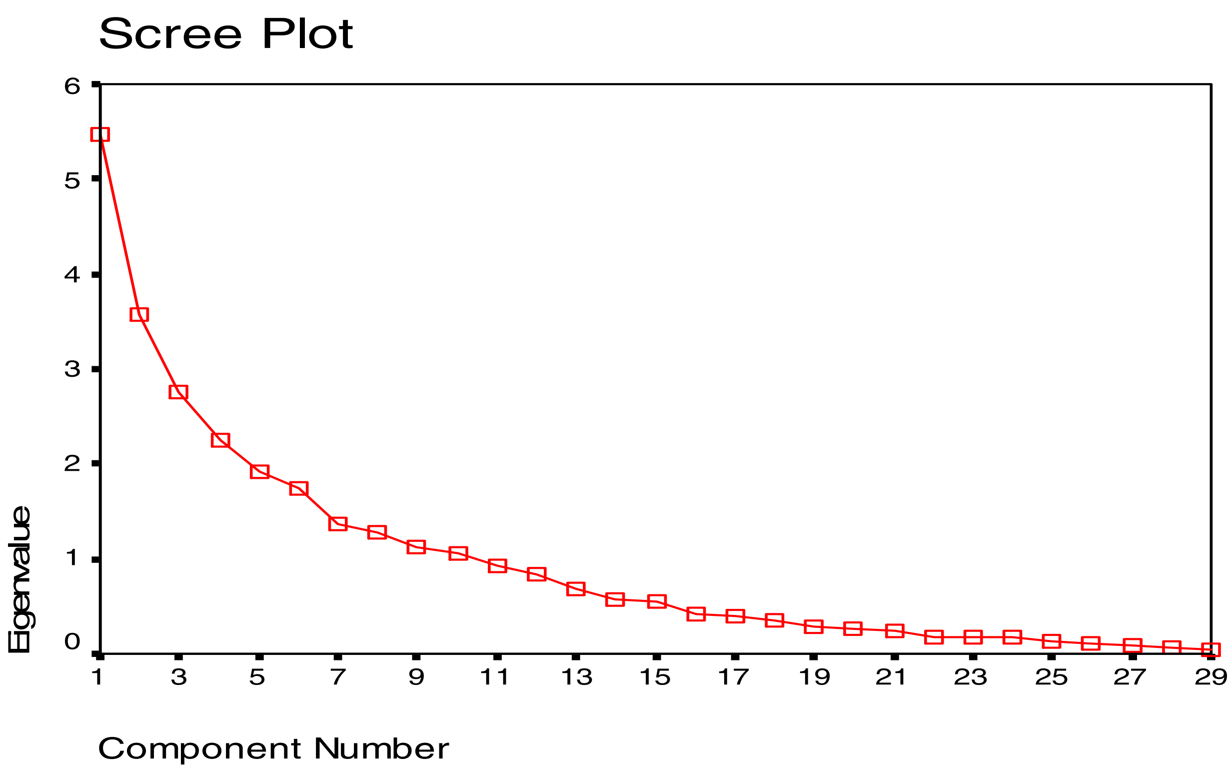
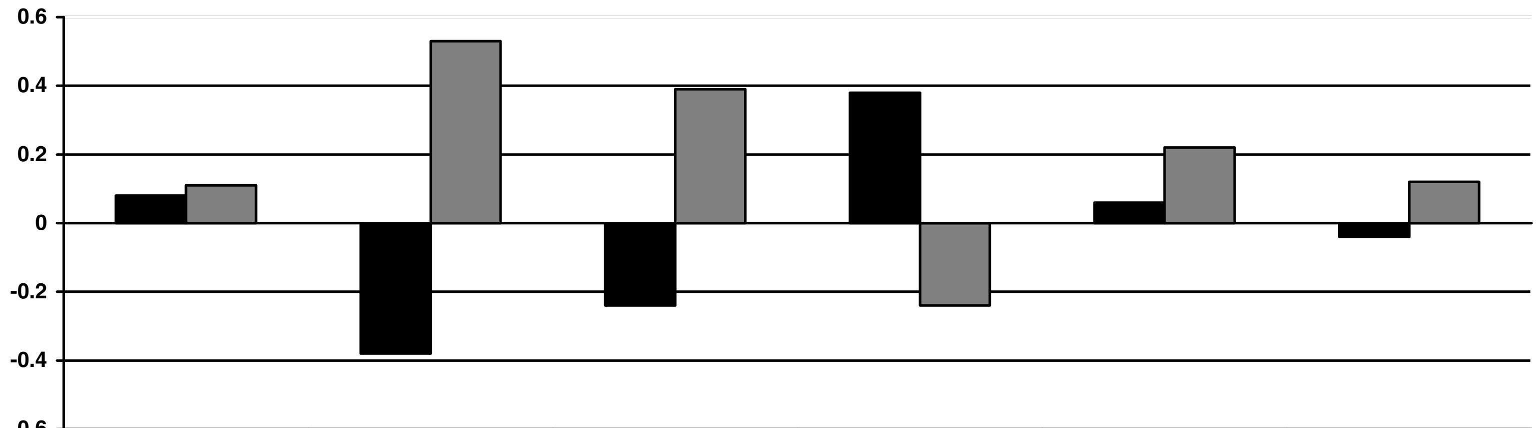


Figure 2. Armenian Americans vs. Non-Armenians:
Adjusted Mean z-scores and Standard Deviations of AAs and NAs on Neuropsychological Factors with Age and Education Controlled

Armenian-Americans vs. Non-Armenians on Cognitive Factors

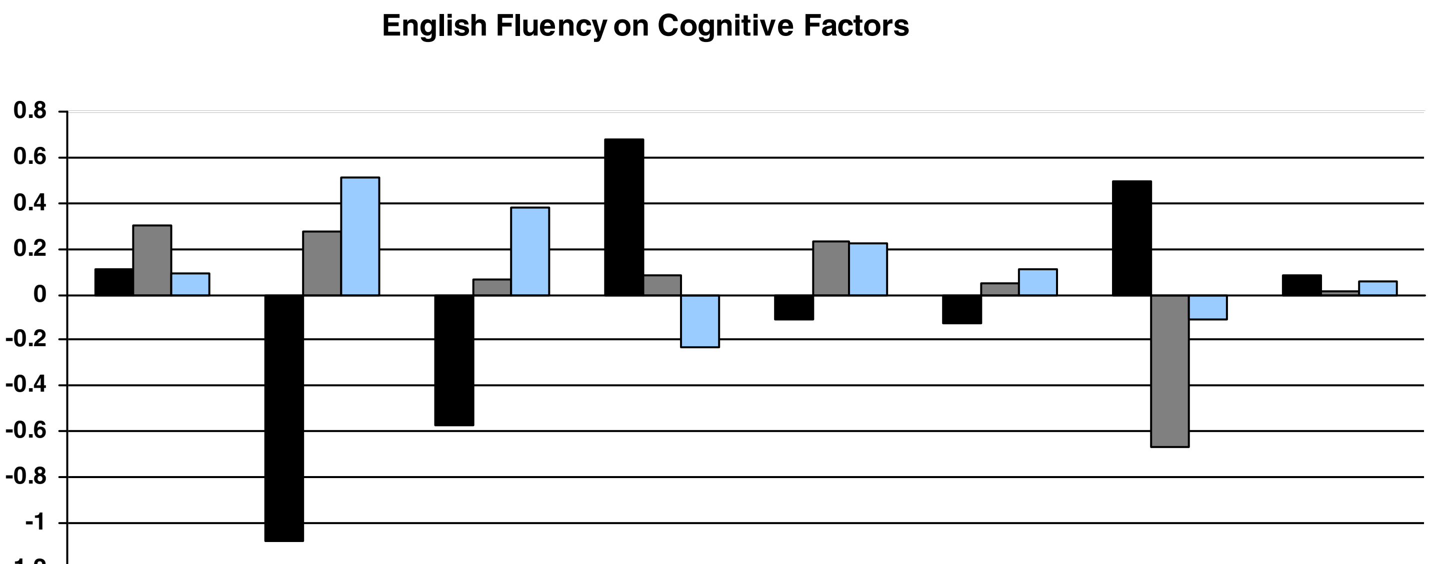


	Learning	Narrative Memory	Language	Nonverbal Processing	Mental Control	Fluency
■ AAs	0.08	-0.38	-0.24	0.38	0.06	-0.04
□ NAs	0.11	0.53	0.39	-0.24	0.22	0.12

ANCOVA Results (Age and Education Controlled)

	Learning	Narrative Memory	Language	Nonverbal Processing	Mental Control	Fluency
F	1.58	5.93	13.10	3.34	.392	.366
p	.212	.017*	.001**	.071	.533	.547

Figure 3. English Fluency
Adjusted Means and Standard Deviations of High-English Fluent, Low-English Fluent, and NAs on Neuropsychological Factors with Age and Education Controlled



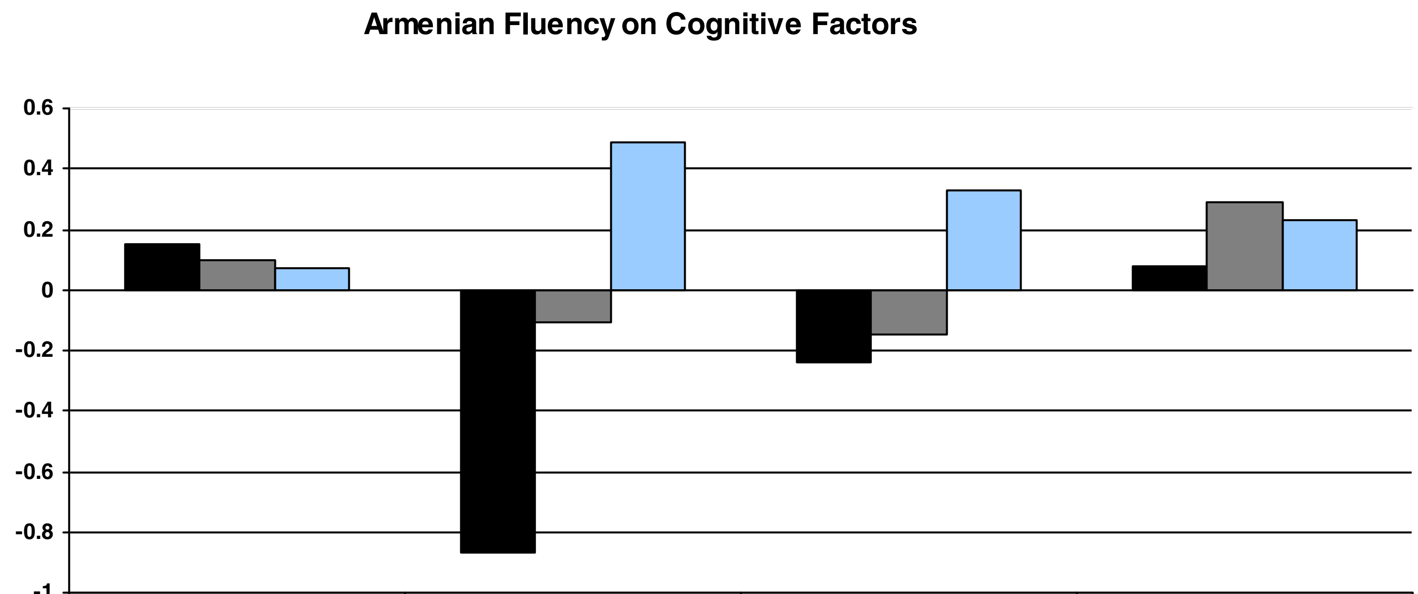
	Learning	Narrative Memory	Language	Nonverbal Processing	Mental Control	Fluency	Processing Speed	Attention
■ Low-English	0.11	-1.08	-0.57	0.68	-0.11	-0.13	0.49	0.08
■ High-English	0.3	0.28	0.07	0.08	0.23	0.05	-0.67	0.01
□ NAs	0.09	0.51	0.38	-0.23	0.22	0.11	-0.11	0.06

ANCOVA Results (Age and Education Controlled)

	Learning	Narrative Memory	Language	Nonverbal Processing	Mental Control	Fluency	Processing Speed	Attention
F	1.58	6.52	10.57	2.46	.638	.314	2.02	.028
P	.212	.002**	.000**	.092	.531	.732	.140	.973

Figure 4. Armenian Fluency:

Adjusted Means and Standard Deviations of High-Armenian Fluent, Low-Armenian Fluent, and NAs on Neuropsychological Factors with Age, Education, and English Fluency Controlled



	Learning	Narrative Memory	Language	Nonverbal Processing
Low-Armenian	0.15	-0.87	-0.24	0.08
High-Armenian	0.1	-0.11	-0.15	0.29
NAs	0.07	0.49	0.33	0.23

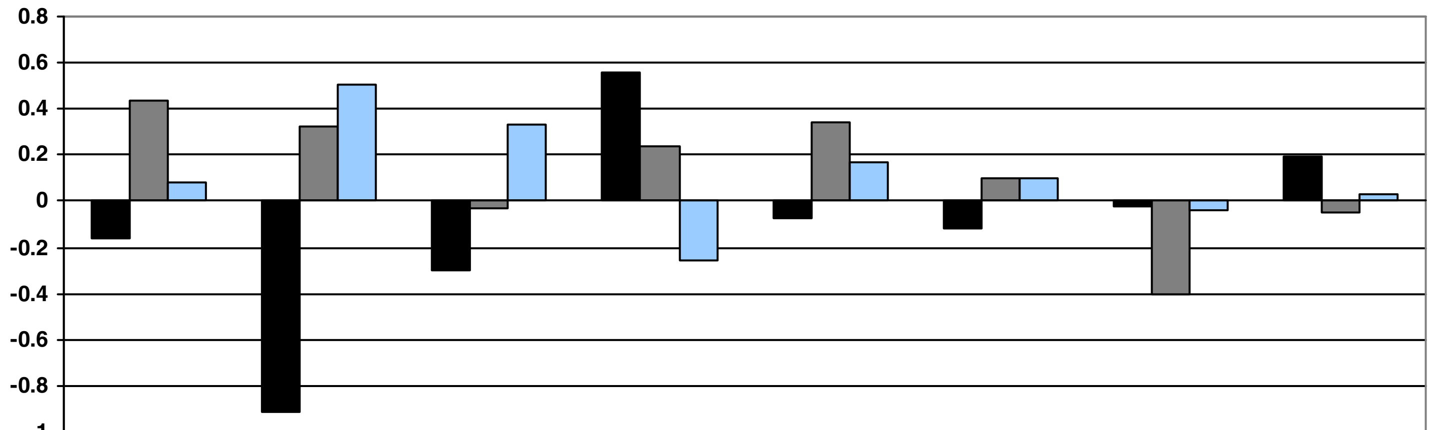
ANCOVA Results (Age, Education and English Fluency Controlled)

	Learning	Narrative Memory	Language	Nonverbal Processing
F	.063	3.34	5.09	2.48
P	.939	.040*	.008*	.091

Figure 5. Language Acculturation:

Adjusted Means and Standard Deviations of High-Language Acculturated, Low-Language Acculturated, and NAs on Neuropsychological Factors with Age, Education, and English Fluency Controlled

Language Acculturation on Cognitive Factors



	Learning	Narrative Memory	Language	Nonverbal Processing	Mental Control	Fluency	Processing Speed	Attention
■ Low L.A.	-0.16	-0.91	-0.3	0.56	-0.07	-0.12	-0.02	0.19
□ High L.A.	0.44	0.32	-0.03	0.24	0.34	0.1	-0.4	-0.05
□ NAs	0.08	0.51	0.33	-0.26	0.17	0.1	-0.04	0.03

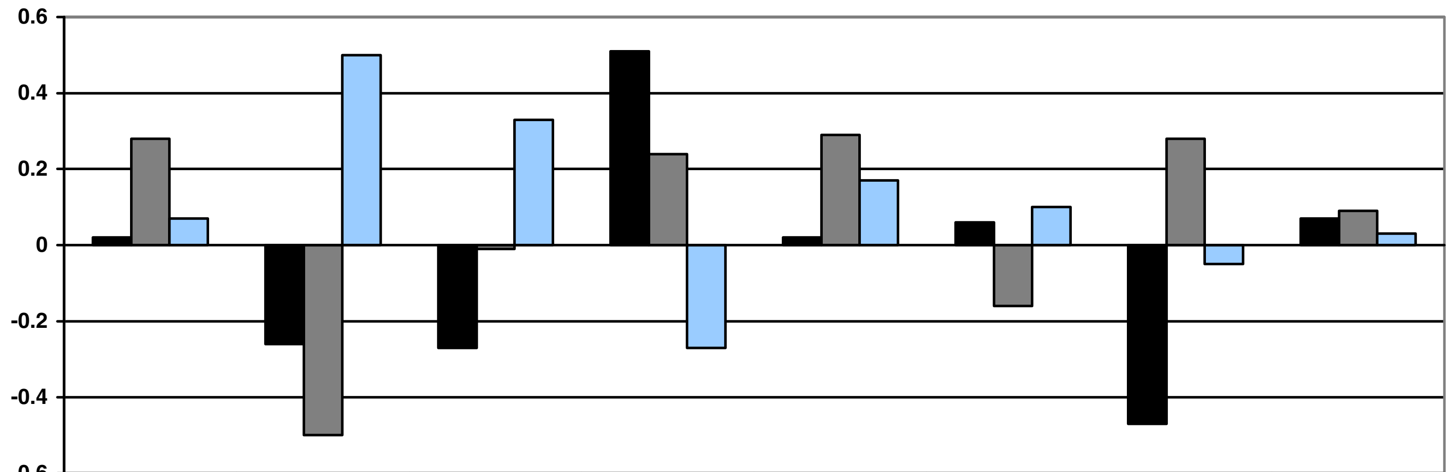
ANCOVA Results (Age, Education and English Fluency Controlled)

	Learning	Narrative Memory	Language	Nonverbal Processing	Mental Control	Fluency	Processing Speed	Attention
F	4.42	5.30	5.74	1.72	1.53	.489	.700	.077
P	.015*	.007*	.005**	.186	.223	.615	.499	.926

Figure 6. Social Acculturation:

Adjusted Means and Standard Deviations of High-Social Acculturated, Low-Social Acculturated, and NAs on Neuropsychological Factors with Age, Education and English Fluency Controlled

Social Acculturation on Cognitive Factors



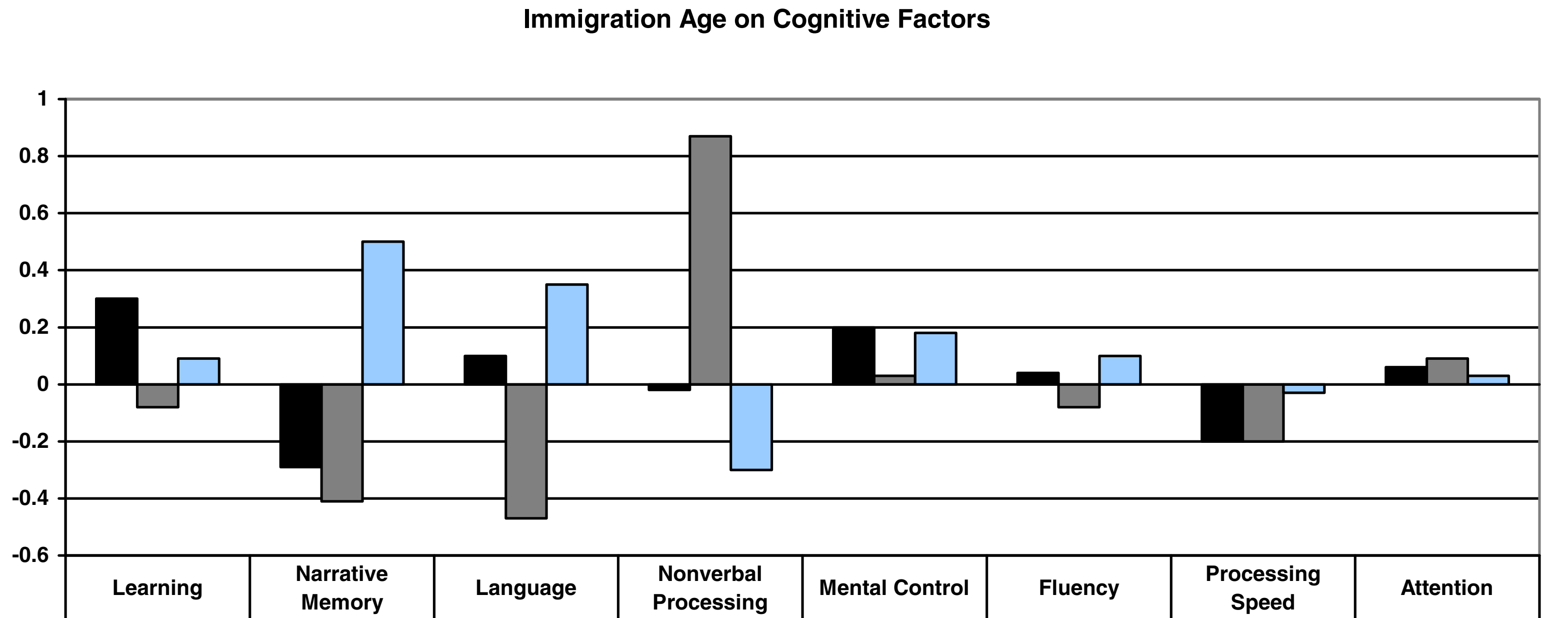
	Learning	Narrative Memory	Language	Nonverbal Processing	Mental Control	Fluency	Processing Speed	Attention
Low S.A.	0.02	-0.26	-0.27	0.51	0.02	0.06	-0.47	0.07
High S.A.	0.28	-0.5	-0.01	0.24	0.29	-0.16	0.28	0.09
NAs	0.07	0.5	0.33	-0.27	0.17	0.1	-0.05	0.03

ANCOVA Results (Age, Education and English Fluency Controlled)

	Learning	Narrative Memory	Language	Nonverbal Processing	Mental Control	Fluency	Processing Speed	Attention
F	.874	2.97	7.33	1.75	.533	.318	.564	.014
P	.421	.056	.001	.180	.589	.729	.571	.986

Figure 7. Immigration Age:

Adjusted Means and Standard Deviations of Late Immigrated AAs, Early Immigrated AAs, and NAs on Neuropsychological Factors with Age, Education, and English Fluency Controlled



	Learning	Narrative Memory	Language	Nonverbal Processing	Mental Control	Fluency	Processing Speed	Attention
Early	0.3	-0.29	0.1	-0.02	0.2	0.04	-0.2	0.06
Late	-0.08	-0.41	-0.47	0.87	0.03	-0.08	-0.2	0.09
NAs	0.09	0.5	0.35	-0.3	0.18	0.1	-0.03	0.03

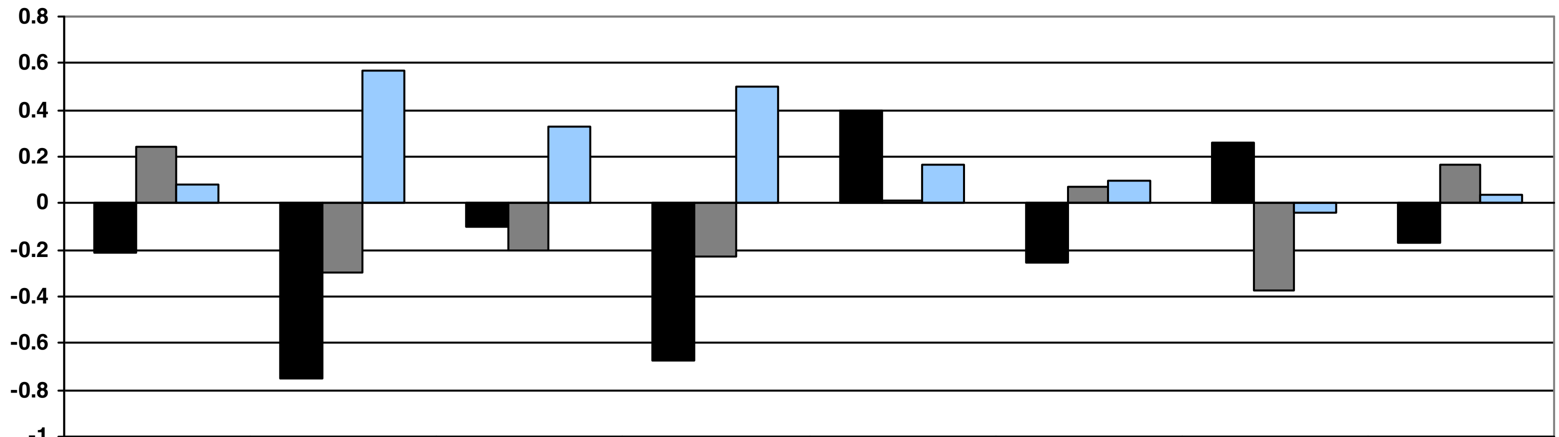
ANCOVA Results (Age, Education and English Fluency Controlled)

	Learning	Narrative Memory	Language	Nonverbal Processing	Mental Control	Fluency	Processing Speed	Attention
F	1.61	2.46	8.42	3.71	.753	.335	.219	.057
p	.206	.092	.000**	.029*	.475	.716	.804	.944

Figure 8. Armenian Education:

Adjusted Means and Standard Deviations of Less than Six Years of Armenian Education, More than Six Years of Armenian Education, and NAs on Neuropsychological Factors with Age, Education and English Fluency Controlled

Years of Armenian Education on Cognitive Test Factors



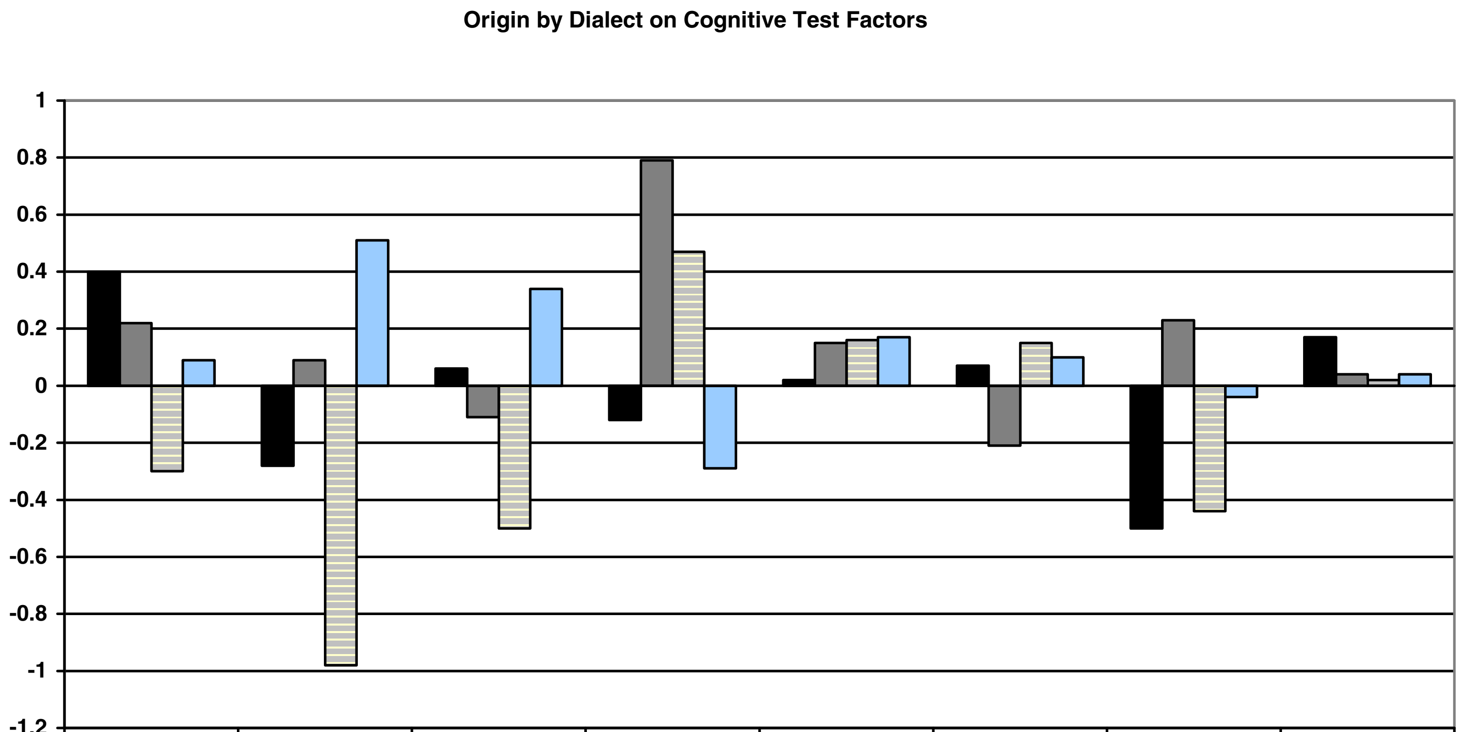
	Learning	Narrative Memory	Language	Nonverbal Processing	Mental Control	Fluency	Processing Speed	Attention
■ < 6	-0.21	-0.75	-0.1	-0.67	0.4	-0.25	0.26	-0.17
□ > 6	0.24	-0.3	-0.2	-0.23	0.01	0.07	-0.37	0.17
□ NAs	0.08	0.57	0.33	0.5	0.17	0.1	-0.04	0.04

ANCOVA Results (Age, Education and English Fluency Controlled)

	Learning	Narrative Memory	Language	Nonverbal Processing	Mental Control	Fluency	Processing Speed	Attention
F	1.97	2.73	5.10	2.04	.628	.508	.504	.503
P	.147	.072	.008*	.138	.536	.604	.606	.606

Figure 9. Origin:

Adjusted Means and Standard Deviations of US-Born AAs, Western Armenian AAs, Eastern AAs, and NAs on Neuropsychological Factors with Age, Education and English Fluency Controlled

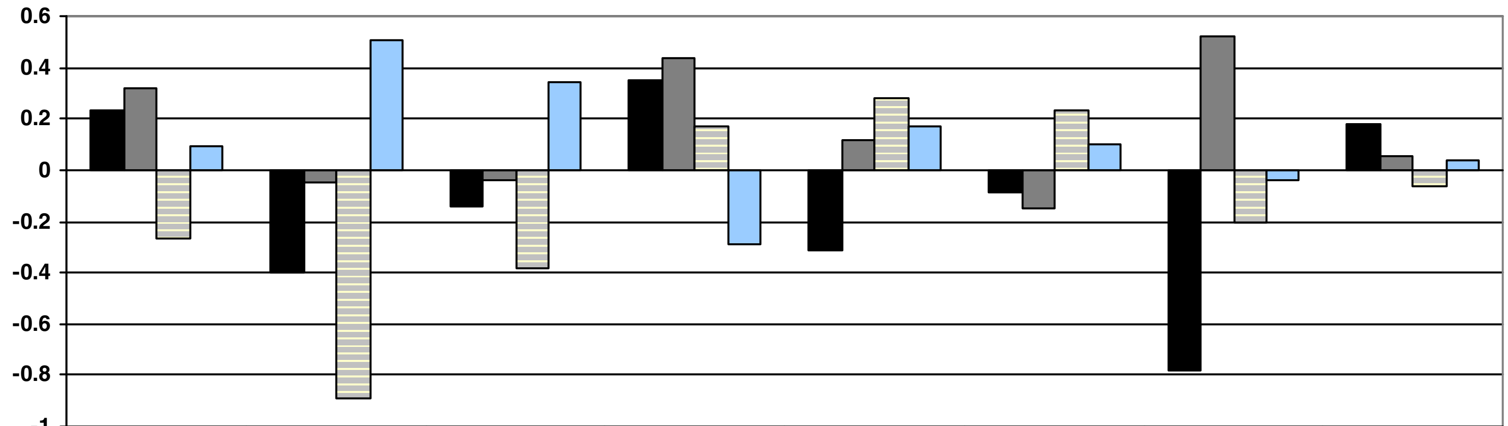


	Learning	Narrative Memory	Language	Nonverbal Processing	Mental Control	Fluency	Processing Speed	Attention
US Born	0.4	-0.28	0.06	-0.12	0.02	0.07	-0.5	0.17
Western	0.22	0.09	-0.11	0.79	0.15	-0.21	0.23	0.04
Eastern	-0.3	-0.98	-0.5	0.47	0.16	0.15	-0.44	0.02
NAs	0.09	0.51	0.34	-0.29	0.17	0.1	-0.04	0.04

Figure 10. Origin

Adjusted Means and Standard Deviations of US-Born AAs, Western Armenian AAs, Eastern AAs, and NAs on Neuropsychological Factors with Age, English Fluency and Immigration Age Controlled

Origin by Dialect on Cognitive Test Factors



	Learning	Narrative Memory	Language	Nonverbal Processing	Mental Control	Fluency	Processing Speed	Attention
US Born	0.23	-0.4	-0.14	0.35	-0.31	-0.09	-0.78	0.18
Western	0.32	-0.05	-0.04	0.44	0.12	-0.15	0.52	0.05
Eastern	-0.27	-0.89	-0.38	0.17	0.28	0.23	-0.2	-0.06
NAs	0.09	0.51	0.34	-0.29	0.17	0.1	-0.04	0.04

ANCOVA Results (Age, English Fluency, and Immigration Age Controlled)

	Learning	Narrative Memory	Language	Nonverbal Processing	Mental Control	Fluency	Processing Speed	Attention
F	2.63	.822	.801	.142	.218	.340	.578	.211
P	.087	.448	.457	.868	.884	.796	.631	.888

References

Abutalebi, J., Cappa, S.F., & Perani, D. (2001). The bilingual brain as revealed by functional neuroimaging. *Bilingualism: Language and Cognition*, *4*, 179-190.

Albert, M., & Obler, L. (1978). *The bilingual brain.* New York: Academy Press.

Ardila, A. (2005). Cultural values underlying psychometric cognitive testing. *Neuropsychology Review, 15,* 185 – 195.

Ardila, A., Rosselli, M., Ostrosky-Solis, F., Marcos, J., Granda, G., & Soto, M. (2000). Syntactic comprehension, verbal memory, and calculation abilities in Spanish-English bilinguals. *Applied Neuropsychology, 7,* 3-16.

Arnold, B. R., Montgomery, G. T., Castaneda, I., & Longorida, R. (1994). Acculturation and performance of Hispanics on selected Halstead-Reitan Neuropsychological Tests. *Assessment, 1,* 239-248.

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

Artiola i Fortuny, L. & Mullaney, H. (1997). Neuropsychology with Spanish speakers: Language use and proficiency issues for test development. *Journal of Clinical and Experimental Neuropsychology, 19,* 615-622.

Bakalian, A. (1993). *Armenian-Americans: From Being to Feeling Armenian*. New Brunswick (NJ): Transaction.

Berry, J. W. (1974). Ecology, cultural adaptation, and psychological differentiation: Traditional patterning and acculturative stress. In R. W. Brislin, S. Bockner, & W. J. Lonner (Eds.), *Cross-cultural perspectives on learning.* Beverly Hills, CA: Sage.

Berry, J. W. (1984). Towards a universal psychology of cognitive competence. *International Journal of Psychology, 19,* 335-361.

Berry, J. W. (2001). A psychology of immigration. *Journal of Social Issues, 57,* 615-631.

Bialystok, E. (1992). Selective attention in cognitive processing: The bilingual edge. In R. J. Harris (Ed.), *Cognitive processing in bilinguals: Advances in Psychology, 83,* 501-513.

Borod, J. C. (1992). Interhemispheric control of emotion: A focus on unilateral brain damage. *Journal of Consulting and Clinical Psychology, 60,* 339–348.

Bruner, J.S., Olver, R.R., Greenfield, P. M. (Eds.). (1966). *Studies in cognitive growth.* New York: John Wiley.

Byrd, D., Sanchez, D., & Manly, J. (2005). Neuropsychological test performance among Caribbean-born and U.S.-born African American elderly: The role of age, education and reading level. *Journal of Clinical and Experimental Neuropsychology*, *27*(8), 1056-1069.

Byrd, D., Jacobs, D., Hilton, H., Stern, Y., & Manly, J. (2005). Sources of errors on visuoperceptual tasks: Role of education, literacy, and search strategy. *Brain and Cognition*, *58*(3), 251-257.

Carroll, F. (1980). Neurolinguistic processing of a second language: Experimental evidence. In R. Scarcella and S. Krashen (Eds.), *Research in second-language acquisition.* Rowley, Mass.: Newbury House.

Centeno, J. G., & Obler, L. K. (2001). Principles of bilingualism. In M. O. Ponton & J. Leon-Carrion (Eds.), *Neuropsychology and the Hispanic Patient: A clinical handbook* (pp. 75-86). Mahwah, NJ: Lawrence Erlbaum Associates.

Choi, I., Nisbett, R.E., Smith, E. E. (1997). Culture, category salience, and inductive reasoning. *Cognition*, *65*, 15-32.

Coffey, D. M., Marmol, L., Schock, L., & Adams, W. (2005). The influence of acculturation on the Wisconsin Card Sorting Test by Mexican-Americans. *Archives of Clinical Neuropsychology, 20,* 795-803.

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112,* 155-159.

Cole, M., Gay, J., Glick, J., & Sharp, D. (1971). *The cultural context of learning and thinking.* New York: Basic Books.

D'Andrade, R. G. (1988). Cultural meaning systems. In R. A. Shweder & R.A. LeVine (Eds.), *Culture theory: Essays on mind, self, and emotion (pp. 88-122).* Cambridge: Cambridge University Press.

D'Elia, L., Satz, P., & Schretlen, D. (1989). Wechsler Memory Scale: A critical appraisal of the normative studies. *Journal of Clinical & Experimental Neuropsychology*, *11,* 551-568.

de Groot, A.M.B. & Kroll*,* J. F. (1997). *Tutorials in bilingualism: Psycholinguistic perspectives.* Mahwah, NJ: Lawrence Erlbaum.

Delgado, P., Gerrero, G., Goggin, J. P., & Ellis, B. B. (1999). Self-assessment of linguistic skills by bilingual Hispanics. *Hispanic Journal of Behavioral Science, 21,* 31-46.

Delis, D. C., Kramer, J. H., Kaplan, E., & Ober, B. A. (1983). The California Verbal Learning Test—Adult Version. San Antonio, TX: Psychological Corporation.

Fabbro, F. (2001). The bilingual brain: Cerebral representation of languages. *Brain and Language, 79,* 211-222.

Field, A. (2000). *Discovering statistics using SPSS for Windows.* London, UK: Sage.

Galloway, L. M., & Scarcella, R. (1982). Cerebral organization in adult second-language acquisition: Is the right hemisphere more involved? *Brain and Language, 16,* 56-60.

Gardner, R. C., & Lambert, W. E. (1972). *Attitudes and motivation in second-language learning.* Rowley, MA: Newbury House.

Gasquoine, P. G. (2001). Research in clinical neuropsychology with Hispanic American participants : A review. *The Clinical Neuropsychologist, 15,* 2-12.

Gaziel, T., Obler, L. K., & Albert, M. (1978). A tachistoscopic study of Hebrew-English bilinguals. In M. Albert, & L. K. Obler (Eds.) *The bilingual brain* (pp. 167-193). NewYork: Academic Press.

Geary, D. C., Cormier, P., Goggin, J. P., Estrada, P., & Lunn, M. C. E. (1993). Mental arithmetic: A componential analysis of speed-of-processing across monolingual, weak bilingual, and strong bilingual adults. *International Journal of Psychology, 28,* 185-201.

Glanzer, M., & Duarte, A. (1971). Repetition between two languages in free recall. *Journal of Verbal Learning and Verbal Behavior, 10,* 625-630.

Gloning, I., & Gloning, K. (1965/1983). Aphasia in polyglots: Contribution to the dynamics of language disintegration as well as to the question of the localization of these impairments. In M. Paradis (Ed.), *Readings in aphasia in bilinguals and polyglots.* Montreal: Didier.

Gollan, T. H., Montaya, R. I., & Werner, G. A. (2002). Semantic and letter fluency in Spanish-English bilinguals. *Neuropsychology, 16,* 562-576.

Goodglass, H., & Kaplan, E. (1983). *The assessment of aphasia and related disorders* (2nd ed.). Philadelphia: Lea & Febiger.

Harris, J. G., Cullum, C. M., & Puente, A. E. (1995). Effects of bilingualism on verbal learning and memory in Hispanic adults. *Journal of the International Neuropsychological Society, 1,* 10-16.

Harris, J. G., Echemendia, R., Ardila, A., & Rosselli, M. (2001). Cross-cultural cognitive and neuropsychological assessment. In J. J. Andrews, & D. H. Saklofske (Eds.) *Handbook of Psychoeducational Assessment,* 391-413.

Heaton, R.K., Chelune, G.J., Talley, J.L., Kay, G.G., & Curtis, G. (1993). *Wisconsin Card Sorting Test (WCST) Manual Revised and Expanded.* Odessa, FL: Psychological Assessment Resources.

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

Hollingshead, A. (1977). *A four factor index of social status.* Unpublished manuscript, Yale University, New Haven, CT.

Hyltenstam, K., & Stround, C. (1989). Bilingualism in Alzheimer's dementia: Two case studies. In K. Hyltenstam, & L. K. Obler (Eds.), *Bilingualism across the lifespan: aspects of acquisition, maturity, and loss* (pp. 202-226). New York: Cambridge University Press.

Hynd, G. W., Teeter, A., & Stewart, A. (1980). Acculturation and the lateralized speech in the bilingual Native American. *International Journal of Neuroscience, 11,* 1-7.

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

Jacobs, D. M., Winston, T. D., & Polanco, C. L. (1997). Assessment of verbal memory in Spanish-speaking elders: Development of two frequency-matched list learning tests. *Journal of Clinical and Experimental Neuropsychology, 19,* 119-125.

Kaplan, E. G., Goodglass, H., & Weintraub, S. (1983). *The Boston naming test*, 2nd ed. Philadelphia: Lea and Febiger.

Karanth, P., & Rangamani, G. N. (1988). Crossed aphasia in multilinguals. *Brain and Language, 34,* 169-180.

Kendall, I. M., Verster, M., & Von Mollendorf, J. W. (1988). Test performance of Blacks in Southern Africa. *In:* Irvine, S. H. (Ed); Berry, J. W. (Ed). *Human abilities in cultural context*. New York: Cambridge University Press. pp. 299-339.

Kohnert, K.J., Hernandez, A. E., & Bates, E. (1998). Bilingual performance on the Boston Naming Test: Preliminary norms in Spanish and English. *Brain and Language, 65,* 422-440.

Kolers, P. A. (1968). Bilingualism and information processing. *Scientific American, 218,* 78-86.

Kolers, P. A. (1978). *On the representations of experience: Language interpretation and communication.* New York: Plenum.

Kolers, P.A. (1979). Reading and knowing. *Canadian Journal of Psychology, 33,* 106-117.

Krashen, S., & Galloway, L. (1978). The neurological correlates of language acquisition: Current research. *SPEAQ Journal, 2,* 21-35.

Lezak, M. (1995). *Neuropsychological assessment (Third Edition).* London: Oxford University Press.

Loewenstein, D. A., Ardila, A., Rosselli, M., Hayden, S., Duara, R., Berkowitz, N., Linn-Fuentes, P., Mintzer, J., Norville, M., & Eisendorfer, C. (1992). A comparative analysis of functional status among Spanish- and English-speaking patients with dementia. *Journal of Gerontology: Psychological Sciences, 47,* P389-P394.

Luria, A. R. (1976). *Cognitive development : Its cultural and social foundations.* Cambridge, Mass.: Harvard University Press.

Macnamura, J., & Kushner, S. L. (1971). The linguistic independence of bilinguals: The input switch. *Journal of Verbal Learning and Verbal Behavior, 10,* 480-487.

Magiste, E. (1980). Memory for numbers in monolinguals and bilinguals. *Acta Psychologica, 46,* 63-68.

Manly, J., Byrd, D., Touradji, P., Sanchez, D., & Stern, Y. (2004). Literacy and cognitive change among ethnically diverse elders. *International Journal of Psychology*, *39*, 47-60.

Manly, J., Byrd, D., Touradji, P., & Stern, Y. (2004). Acculturation, reading level, and neuropsychological test performance among African American elders. *Applied Neuropsychology*, *11*, 37-46.

Manly, J. J., Miller, S. W., Heaton, R. K., Byrd, D., Reilly, J., Velasquez, R. J., Saccuzzo, D. P., Grant, I., and The HIV Neurobehavioral Research Center Group (1998).

The effect of African American acculturation on neuropsychological test performance in normal and HIV-positive individuals. *Journal of the International Neuropsychological Society*, *4,* 291-302.

Manly, J., Schupf, N., Tang, M., & Stern, Y. (2005). Cognitive Decline and Literacy Among Ethnically Diverse Elders. *Journal of Geriatric Psychiatry and Neurology*, *18*, 213-217.

Marin, G. & Marin, B. V. (1991). Research with Hispanic populations. Thousand Oaks, CA: Sage Publications, Inc., 130 pp.

Marrero, M. Z., Golden, C. J., & Espe-Pfeifer, P. (2002). Bilingualism, brain injury, and recovery: Implications for understanding for bilingual and for therapy. *Clinical Psychology Review, 22,* 463-478.

McFie, J. (1975). *Assessment of organic intellectual impairment*. Oxford, England: Academic Press, 164 pp.

Mechelli, A., Crinion, J. T., Noppeney, U., O'Doherty, J., Ashburner, J., Frackowiak, R.S., & Price, C. J. (2004). Neurolinguistics: Structural plasticity in the bilingual brain. *Nature, 431,* 757.

Meyers, J. E. & Meyers, K. R. (1995). Rey Complex Figure Test under four different administration procedures. *Clinical Neuropsychologist*, *9*, 63-67.

Millar, J. M., & Whitaker, H.A. (1983). The right hemisphere's contribution to language: A review of the evidence from brain-damaged participants. In S. J. Segalowitz (Ed.), *Language functions and brain organization* (pp. 87-114). New York: Academic Press.

Mishkin, M., & Forgays, D. G. (1952). Word recognition as a function of retinal locus. *Journal of Experimental Psychology, 43,* 43-48.

Mistry, J., & Rogoff, B. (1985). A cultural perspective on the development of talent. In F.D. Horowitz, & M. O'Brien (Eds.), *The gifted and talented: Developmental perspectives*, (pp. 125-144).

Nell, V. (2000). *Cross-cultural neuropsychological assessment: Theory and practice.* Mahwah, NJ: Lawrence Erlbaum Associates.

Noel, M. & Fias, W. (1998). Bilingualism and numeric cognition. *Psychological Belgica, 38,* 231-250.

Ojemann, G. A., & Whitaker, H. A. (1978). The bilingual brain. *Archives of Neurology, 35,* 409-412.

Olazaran, J., Jacobs, D. M., & Stern, Y. (1996). Comparative study of visual and verbal short-term memory in English and Spanish speakers: Testing a linguistic hypothesis. *Journal of the International Neuropsychological Society, 2,* 105-110.

Orbach, J. (1953). Retinal locus as a factor in the recognition of visually perceived words. *American Journal of Psychology, 65,* 555-562.

Orbach, J. (1967). Differential recognition of Hebrew and English wordsin right and left visual fields as function of cerebral dominance and reading habits. *Neuropsychologia, 50,* 127-134.

Ovcharova, P., Raichev, R., & Geleva, T. (1968/1983). Aphasia in polyglots. In M. Paradis (Ed.), *Readings in aphasia in bilinguals and polyglots.* Montreal: Didier.

Paivio, A., & Desrochers, A. (1980). A dual-coding approach to bilingual memory. *Canadian Journal of Psychology, 34,* 390-401.

Paivio, A., & Lambert, W. (1981). Dual coding and bilingual memory. *Journal of Verbal Learning and Verbal Behavior, 20,* 532-539.

Paradis, M. (1980). Language and thought in bilinguals. In W. C. McCormack & H. J. Izzo (Eds.), *The Sixth LACUS Forum* (pp. 420-431). Columbia, SC: Hombeam Press.

Paradis, M. (1987). Neurolinguistic perspectives on bilingualism. In M. Paradis & G. Libben (Eds.), *The assessment of bilingual aphasia* (pp-1-17). Hillsdale, NJ: Lawrence Erlbaum Associates.

Paradis M. (1997). The cognitive neuropsychology of bilingualism. In A. M. B. DeGroot & J. F. Kroll (Eds.), *Tuturials in bilingualism: Psycholinguistic perspectives* (pp. 331-354). Mahwah, NJ: Lawrence Erlbaum Associates.

Paradis,, M. (2000). Cerebral representation of bilingual concepts. *Bilingualism: Language and Cognition, 3,* 22-24.

Peal, E., & Lambert, W. E. (1962). Relation of bilingualism to intelligence. *Psychological Monographs, 76,* 1-23.

Perez-Arce, P. (1999). The influence of culture on cognition. *Archives of Clinical Neuropsychology, 14,* 581-592.

Pitres, A. (1895/1983) A study of aphasia in polyglots. In M. Paradis (Ed.), *Readings in aphasia in bilinguals and polyglots.* Montreal: Didier.

Ponton, M.O. & Leon-Carrion, J. (2001). *Neuropsychology and the Hispanic patient: A clinical handbook.* Mahwah, NJ: Lawrence Erlbaum.

Ponton, M. O. & Ardila, A. (1999). The future of neuropsychology with Hispanic populations in the United States. *Archives of Clinical Neuropsychology, 14,* 565-580.

Ponton, M. O., Gonzalez, J. J., Hernandez, I., Herrara, L., & Higerada, I. (2000). Factor analysis of the Neuropsychological Screening Battery for Hispanics (NeSBHIS). Applied Neuropsychology, 7, 32-39.

Ratner, C. (1991). *Vygotsky's sociohistorical psychology and its contemporary applications.* New York: Plenum Press.

Ribot, T. (1881). *Diseases of memory: An essay in the positive psychology.* London: Paul Roberts, P. M., Garcia, L. J., Desrochers, A., & Hernandez, D. (2002). English performance of proficient bilingual adults on the Boston Naming Test. *Aphasiology, 16,* 635.

Rogers, L., TenHouten, W., Kaplan, C. D., & Gardiner, M. (1977). Hemispheric specialization of language: An EEG study of bilingual Hopi Indian children. *International Journal of Neuroscience, 8,* 1-6.

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

Ross, B. M., & Millsom, C. (1970). Repeated memory of oral prose in Ghana and New York. *International Journal of Psychology, 5,* 173-181.

Rosselli, M., Ardila, A., Salvatierra, J., Marquez, M., Matos, L., & Weekes, V. A. (2002). A cross-linguistic comparison of verbal fluency tests. *International Journal of Neuroscience, 112,* 759-776.

Ruff, R. M., Light, R. H., & Evans, R. W. (1987). The Ruff Figural Fluency Test: A normative study with adult. *Developmental Neuropsychology*, *3*, 37-51.

Sabagh, G., Bozorgmehr, M., and Der-Martirosian, C. (1990). Subethnicity: Armenians in Los Angeles. *Institute for Social Science Research – California Immigrants in World Perspective: The Conference Papers, 5.*

Sakayan, D. (2000). *Modern Western Armenian*. Montreal, Canada: Arod Books.

Scoresby-Jackson, R. E. (1867). Case of aphasia with right hemiplegia. *Edinburgh Medical Journal, 12,* 696-706.

Scott, S., Hynd, G. W., Hunt, L., & Weed, W. (1979). Cerebral speech lateralization in the Native American Navajo. *Neuropsychologia, 17,* 89-92.

Segall, M. H. (1979). Cognition: Information-processing in various cultures. In *Cross-cultural psychology: Human behavior in global perspective* (pp. 96-131). Monterey, CA: Brooks/Cole.

Segalowitz, S. J. (1983). Cerebral asymmetries for speech in infancy. In S. J. Segalowitz (Ed.), *Language functions and brain organization* (pp. 221-230). New York: Academic Press.

Shannon, B. (1984). The polyglot mismatch and the monolingual tie. Observations regarding the meaning of numbers and the meaning of words. *New ideas in Psychology, 2,* 75-79.

Shapiro, S. S. & Wilk, M. B. (1965). An analysis of variance test for normality (complete samples). *Biometrika*, *52*, 591-611.

Shweder, R.A. (1999). Why cultural psychology? *Ethos, 27*, 62-73.

Silverberg, R., Bentin, S., Gaziel, T., Obler, L.K., & Albert, M. L. (1979). Shift in visual field preference for English words in native Hebrew speakers. *Brain and Language, 8,* 184-190.

Snodgrass, J. G. (1984). Concepts and their surface representations. *Journal of Verbal Learning and Verbal Behavior, 23,* 3-22.

Spreen, O. & Strauss, E. (1998). *A compendium of neuropsychological tests* (2nd ed.). NewYork, NY: Oxford University Press.

Sternberg, R., Conway, B., Ketron, J., & Bernstein, M. (1981). People's conceptions of intelligence. *Journal of Personality and Social Psychology, 41,* 37-55.

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology, 18,* 643-662.

Tabachnick, B. G. & Fidell, L.S. (2001). *Using multivariate statistics* (4th ed.). Boston: Allyn and Bacon.

Taylor, L.B. (1991). Scoring Criteria for the ROCF. In Spreen, O., & Strauss, E. *A Compendium of Neuropsychological Tests: Administration, Norms, and Commentary.* New York: Oxford.

Tombaugh, T. N., Kozak, I., & Rees, L. (1999). Normative data stratified by age and education for two measures of verbal fluency: FAS and animal naming. *Archives of Clinical Neuropsychology*, *14*, 167-77.

Touradji, P., Manly, J. J., Jacobs, D. M., & Stern, Y. (2001). Neuropsychological test performance: A study of Non-Hispanic White elderly. *Journal of Clinical and*

Experimental Neuropsychology, 23, 643-649.

Tulving, E., & Colotta, V. (1970). Free recall in trilingual lists. *Cognitive Psychology, 1,* 86-98.

United States Bureau of the Census. (2000) Public Use Micro-Sample 2000 Census: Bureau of the Census, US Department of Commerce.

Vaid, J. (1983). Bilingualism and brain lateralization. In S. J. Segalowitz (Ed.), *Language functions and brain organization* (pp. 315-340). New York: Academic Press.

Vaid, J. & Genesee, F. (1980). Neuropsychological approaches to bilingualism: A critical review. *Canadian Journal of Psychology, 34,* 417-445.

Yuspeh, R. L., Vanderploeg, R. D., & Kershaw, D. A. (1998). Normative data on a measure of estimated premorbid abilities as part of a dementia evaluation. *Applied Neuropsychology, 5,* 149-153.

Verster, J. M. (1986). *Cognitive competence in Africa and models of information processing: A research prospectus* (Report No. Pers-411). Pretoria: Human Sciences Research Council.

Vildomec, V. (1963). *Mulitlingualism.* (pp. 58-67). Leyden: A.W. Sythoff.

Wagner, W. (1981). A fuzzy model of concept representation in memory. *Journal of Fuzzy Sets & Systems, 6,* 11-26.

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

Wechsler, D. (1997). *Wechsler Adult Intelligence Scale- Third Edition*. New York, Psychological Corporation.

Wechsler, D. (1997). *Wechsler Memory Scale-Third Edition*. New York, Psychological Corporation.

Wechsler, D. (1999). *Wechlser Abbreviated Scale of Intelligence.* New York, Psychological Corporation.

Wertsch, J. V. (1985). *Vygotsky and the social formation of the mind.* Cambridge, MA: Harvard University Press.

Wilkinson, G. S. (1993). The Wide Range Achievement Test Third Edition. Wilmington, DE: Wide Range, Inc.

Yates, A. J. (1956). The use of vocabulary in the measurement of intellectual deterioration: A review. *Journal of Mental Science, 102,* 409-440.

Zaidel, E. (1985). Language in the right hemisphere. In D. F. Benson, & E. Zaidel (Eds.), *The dual brain: Hemispheric specialization in humans* (pp. 205-232). New York: Guilford Press.