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ASSESSING LEARNING STRATEGY USE IN ENGLISH- AND SPANISH-SPEAKING
OLDER ADULTS DURING VERBAL LEARNING TESTS

By

CYNTHIA MARTIN FUNES

Under the Direction of Robin Morris, PhD

ABSTRACT

This study investigated learning and memory performance similarities and differences between healthy, Spanish-speaking older adults of Hispanic/Latino descent and English-speaking Caucasian older adults. It explored the possibility that the novelty of verbal memory tasks, along with cultural and educational differences, may lead to performance differences in Spanish-speaking older adults' effective use of organizational strategies, such as semantic clustering. It was hypothesized that an alternative strategy instruction, which provided explicit detail on how to use the effective semantic clustering strategy, would reduce differences observed between the Hispanic and Caucasian groups. Forty-eight healthy, Spanish-speaking older adults and 55 healthy, English-speaking older adults were administered list-learning tasks in their dominant language. Under standard task instruction, Spanish-speaking older adults with low levels of

formal education learned fewer words on the task than Caucasian and Hispanic participants who had higher levels of education. Hispanic participants, regardless of educational levels, also utilized semantic clustering recall at lower rates than Caucasian participants under standard instruction. When provided with explicit strategy instructions, both groups showed reduced list learning, and Hispanic older adults demonstrated reduced response to strategy manipulation compared to Caucasian participants. Finally, in the Hispanic older adult sample, the quality of their formal education and level of acculturation were identified as important predictors of verbal learning outcomes. These findings highlight the need to continue to examine the complex role of demographic and cultural variables on verbal learning and memory processes, as they may impact the assessment of pathological processes such as dementia, as well as the development of effective cognitive interventions for diverse elders.

INDEX WORDS: Memory assessment; verbal learning; acculturation; aging; older adults; bilingual; dementia assessment; assessment with Spanish-speakers; learning strategies; cognitive rehabilitation; neuropsychological assessment; Hispanic; Latinos/Latinas

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CYNTHIA MARTIN FUNES

A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of

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Georgia State University

2016

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DEDICATION

“A theory which cannot be mortally endangered cannot be alive.” -W. A. H. Rushton

I would like to dedicate this dissertation to my husband, Samuel Funes Martin. He has been with me through this journey every step of the way, and has been my strength, my constant cheerleader, a true partner throughout my often-busy days.

I would also like to dedicate this work to our elders, who are responsible for paving the paths we have the good fortune to walk on today.

This work is also dedicated to my family: my mother, Santos Funes, my father, Armando Funes, my three brothers, Carlos, Jovany and Eric Funes, and my wonderful nieces and nephew, Emilee, Jonathan, Melonie & Ellie Z. Through example, you have taught me that the combination of humility, curiosity, fortitude and good humor will take me far in life. Thank you for your unending support.

Finally, I would like to dedicate this document to the many immigrants who travel around the globe in search of safety, security and the pursuit of dreams. I find my life story strongly connected to yours, and I hope that this work honors your resilience in some small way.

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TABLE OF CONTENTS

ACKNOWLEDGEMENTS	v
List of Figures.....	xi
1 INTRODUCTION.....	1
1.1 Purpose of the Study	1
<i>1.1.1 Theoretical Foundations for Studying Culture and Neurocognition.....</i>	<i>3</i>
<i>1.1.2 Memory Assessment for Spanish-speaking Older Adults.....</i>	<i>5</i>
<i>1.1.3 Spontaneous Semantic Clustering on List-Learning Memory Tasks</i>	<i>6</i>
<i>1.1.4 The Influence of Instruction Sets on Strategy Use</i>	<i>8</i>
<i>1.1.5 Demographic Factors Associated with Hispanic Test Performances</i>	<i>10</i>
1.2 Specific Aims and Hypotheses	13
2 METHODS	15
2.1 Participants.....	15
<i>2.1.1 Special considerations for Hispanic sample.....</i>	<i>17</i>
<i>2.1.2 Special Considerations for Caucasian Sample.....</i>	<i>19</i>
2.2 Screening.....	19
2.3 Procedure.....	22
<i>2.3.1 List Learning Strategy Intervention.....</i>	<i>24</i>
2.4 Measures	27
<i>2.4.1 English Verbal Learning and Memory Task.....</i>	<i>27</i>
<i>2.4.2 Spanish Verbal Learning and Memory Task</i>	<i>29</i>
<i>2.4.3 Scoring of List-learning Measures.....</i>	<i>30</i>
<i>2.4.4 Spanish/English Proficiency and Vocabulary</i>	<i>31</i>
<i>2.4.5 Cognitive Screening Task</i>	<i>32</i>

2.4.6	<i>Demographic Questionnaire</i>	33
2.4.7	<i>Depression Scales</i>	34
2.4.8	<i>Acculturation Measure</i>	34
2.4.9	<i>Physical Activity Measure</i>	36
3	RESULTS	38
3.1	Comparing the Word Lists across Measures	38
3.2	Comparison of Hispanic and Caucasian Groups under Standard Task Administration	41
3.2.1	<i>Aim 1.1. Standard Administration</i>	42
3.2.2	<i>Further Exploratory Analyses for Aim 1.1</i>	44
3.3	Comparison of Hispanic and Caucasian Groups after Explicit Strategy Instruction	47
3.3.1	<i>Analyses for Aim 1.2.</i>	47
3.3.2	<i>Impact of Level of Explicitness of Strategy Instruction</i>	51
3.4	Cultural and Demographic List-Learning Predictors for Spanish-Speakers	53
3.4.1	<i>Preliminary Analyses</i>	53
3.4.2	<i>Correlations with Learning Variables</i>	55
3.4.3	<i>Primary Analyses for Aim 2</i>	55
3.4.4	<i>Exploratory Stepwise Regressions</i>	56
3.4.5	<i>Hierarchical Regressions</i>	58
4	DISCUSSION	62
4.1	Standard List-Learning Task	62
4.2	Performance given Explicit Strategy Instruction	66
4.3	Demographic and Cultural Variables related to Hispanic Learning Outcomes ...	70
4.4	Quality of Education	71

4.5	Acculturation.....	73
4.6	Clinical Implications.....	75
4.7	Limitations.....	77
4.8	Future Direction.....	80
	REFERENCES.....	84
	APPENDICES.....	103
	Appendix A. Bivariate Correlations of Demographic and Cultural Variables.....	103
	Appendix B: Screening Materials	104

LIST OF TABLES

Table 1. Descriptive Statistics of Key Demographic Variables and Four Group ANOVA	16
Table 2. Frequencies, Means and Standard Deviations of Key Demographic Variables of Hispanic Groups.....	20
Table 3. Screening Measures and Measures used to Assess Study Variables	23
Table 4. Percent Word Frequency by Words Across Trials for CVLT-II vs. SVLT	39
Table 5. Percentage of Recall by Category on the CVLT-II and SVLT	40
Table 6. Group Means, Standard Deviations and One-Way ANCOVAs for Standard List- Learning Variables.....	42
Table 7. One-Way ANOVAs for Standard List-Learning Outcome Variables by Education Group	43
Table 8. One-Way ANOVAs for Additional List-Learning Outcome Variables by Education Group	45
Table 9. Mean Learning Outcome Scores by Group and Type of Instruction	49
Table 10. ANCOVA for Main and Interaction Effects of Instruction and Race.....	49
Table 11. Mean Learning Outcome Scores by Group and Explicitness of Instruction.....	52
Table 12. ANCOVA for Main Effects and Interaction Effects of Strategy Instruction on Learning	52
Table 13. Bivariate Correlations of Demographic and Cultural Variables and Learning Outcomes	55
Table 14. Variables Identified by Stepwise Regression Analysis as Predicting the Learning Outcome Variables.....	57
Table 15. Results of Hierarchical Regression Analysis of Cultural Variables on Learning Outcomes	59

LIST OF FIGURES

Figure 1. Recruitment Flowchart	22
Figure 2. Research Design.	26
Figure 3. Reported Strategy for Standard Trial.....	46
Figure 4. Clustering Scatterplot.	48
Figure 5. Total Learning by Instruction Type.....	50
Figure 6. Semantic Clustering by Instruction Type.	50
Figure 7. Total Learning by Explicitness of Strategy Instruction	51

1 INTRODUCTION

1.1 Purpose of the Study

Memory impairment is a marker for several brain pathologies of aging, including frontal lobe impairment and dementia (Razani, Boone, Miller, Lee, & Sherman, 2001; Shimamura, Jurica, Mangels, Gershberg, & Knight, 1995). How well individuals encode newly learned information is affected by the efficiency of their learning strategies (Baldo, Delis, Kramer, & Shimamura, 2002; Razani, Murcia, Tabares, & Wong, 2007). Failure to initiate effective strategies, such as semantic clustering during list learning tasks, has been identified as a specific cognitive deficit in patients with frontal lobe disorders, such as Frontotemporal Dementia (Gershberg & Shimamura, 1995; Hirst & Volpe, 1988).

At the same time, healthy members of some minority populations may not spontaneously use such effective strategies, resulting in poor performances that may be misinterpreted as cognitive impairment. While several normative corrections and assessment adaptations are available, it is not clear how cultural and linguistic differences may impact the use of cognitive strategies and organizational responses during evaluation with historical gold-standard memory assessment measures. The goal of this dissertation was to better understand the cultural, demographic, and possible instructional factors which may underlie response differences in memory performance among minorities, and to evaluate whether there are approaches to their assessment that may improve the evaluation of memory performance and impairment in such groups.

Reliable and valid memory assessment approaches for Spanish-speaking older adults in the United States poses a major dilemma. In recent years, the demand for adequate assessment of older Spanish-speakers has increased due to the steady growth in the number of Hispanic/Latino

older adults. In 2000, the elderly Hispanic/Latino population, a large proportion of whom report speaking English less than "very well," made up 5.9% of individuals above 65 years of age (U.S. Census Bureau, 2012), and it is projected that 19.8% will be of Latin American descent by 2050 (Vincent & Velkoff, 2010). These figures highlight the growing need for adequate memory assessment methods for older Spanish-speakers to assist in the clinical detection of the cognitive impairments associated with pathological aging.

Despite an increasing number of aging Spanish-speaking patients being evaluated, the impact of culture and ethnicity on learning, memory, and strategy use on standard approaches to memory assessment has not been well described. Because ethnic minorities in the U.S. typically perform significantly worse than their Caucasian counterparts on various memory tasks (Boone, Victor, Wen, Razani, & Pontón, 2007; Fernández & Marcopulos, 2008; La Rue, Romero, Ortiz, Liang, & Lindeman, 1999; Manly, Byrd, Touradji, & Stern, 2004; Razani, Murcia, et al., 2007), the need for increased understanding of the linguistic, cultural, and cognitive influences on their memory test performance is critical, as use, or non-use of specific strategies may aid in the differential diagnosis of various neurological illnesses (Pasquier, Grymonprez, Lebert, & Linden, 2001).

Studies have shown that although some spontaneous strategy use occurs in Spanish-speakers, their encoding and retention levels are still depressed (Harris, Cullum, & Puente, 1995). It is not clear why these lower performances occur. It is possible that the novelty of tasks assessing memory may affect both the spontaneity and effectiveness of the strategies used in this group (Ardila, 2005). Because of these findings, this study will: (1) evaluate whether differences in the instructions given prior to learning/memory tasks will increase the effectiveness of strategy use, and thereby reduce the performance discrepancy between older Spanish-speaking

adults with varying levels of acculturation; and (2) determine how demographic (i.e., age, education, socioeconomic status) and cultural (i.e., acculturation) factors may influence strategy use and resulting standard test performance of Spanish-speakers.

1.1.1 Theoretical Foundations for Studying Culture and Neurocognition

Within the last two decades, the field of psychology has refocused on understanding the impact of culture and ethnicity within a variety of theory and practice domains.

Neuropsychology in particular has been exploring the impact of cultural and ethnic differences on assessment results for a number of years. From the early development of instruments such as the Wechsler Intelligence Tests, demographic factors outside of “pure” cognition, such as gender, were linked to observed differences in testing performance (Wechsler, 1950).

Demographically corrected norms have come to be expected and, research efforts focused on the need for such norms are abundant (e.g., Norman, Evans, Miller, & Heaton, 2000 for the CVLT).

Dubbed the “sociological paradigm shift in neuropsychology” by Lawless, Ries, & Llorente (2008), several changes in the field related to these observed differences have begun to occur.

Some of these changes include unparalleled development of new measures and testing procedures specific to various ethnic groups, including Spanish-speaking Hispanics; a large number of research papers and new volumes written to address challenges related to cultural/ethnic differences; changes to ethical guidelines (APA, 2002); and the emergence of special interest groups, such as the Hispanic Neuropsychological Society. These examples highlight the clear inclusion of sociocultural factors in the understanding of brain-behavior relationships within neuropsychology, with a field-wide response that has focused on providing assessment adaptations and accommodations in order to better serve these populations.

To a lesser extent, research on the impact of language and culture has also focused on understanding how cognitive organization and processes are impacted by these sociocultural differences. To this end, some theoretical efforts have been made in addressing the impact of culture on direct brain-behavior processes. One notable theory, similar to the modern biopsychosocial perspective, was proposed by Kennepohl, (1999): the “cultural neuropsychological model” suggests that we should come to understand all brain functions as “culture sensitive.” Kennepohl argues that research has already produced compelling evidence that culture impacts our cognitive functioning from language development, to emotional expression, and even the ways we experience pain. Thus, his model suggests that many other cognitive functions may be modulated in similar ways in order to “display appropriate culturally relevant behaviors.” Kennepohl (1999) suggests that the brain “does not function as an independent variable that singularly dictates or controls behavior, but also acts as a dependent variable that reflects and is systematically influenced by environmental factors.” In proposing this model, Kennepohl challenges the idea of dualism, in which our nervous system is seen as both a producer and modulator of our behaviors, and suggests that behaviors common to a group of individuals will likely impact their cognitive organization in a similar way.

Though Kennepohl does not directly cite it, modern research on the effects of culture on assessment results, and (indirectly) on cognitive functioning, has supported this idea in terms of the impact of formal education and quality of education on assessment outcomes within ethnic minority communities. For example, literacy levels among ethnic minority elders has been found to have a profound effect on their scores on neuropsychological measures across both verbal and nonverbal domains (Manly et al., 2004). Although this research may more clearly highlight a need for more adequate norms for testing individuals with limited education and literacy, the

impact of these factors even on non-verbal tests suggest that something more specific about these cultural/demographic variables may be impacting cognitive organization. The current study has been designed with these theoretical considerations and questions in mind. In this study, an attempt is made to further this theoretical line by investigating the impact of culture on memory and linguistic semantic organization within a list-learning paradigm.

1.1.2 Memory Assessment for Spanish-speaking Older Adults

As previously indicated, one of the main tasks for neuropsychologists working with older adults is to identify normal and abnormal cognitive aging processes. The increase of Spanish-speaking older adults in the US places increased attention on the immediate need for appropriate memory measures and norms for use with this population. In addition, though the phenomenon is not well understood, prevalence studies have demonstrated that Hispanic older adults within the United States tend to experience symptom onset for Alzheimer's disease more than six years earlier than Caucasians (Clark et al., 2005). Various studies in normal populations have shown an effect of culture and ethnicity on memory performance measures, where ethnic minorities tend to perform significantly worse than their Caucasian counterparts despite statistical corrections (Arnold, Montgomery, Castaneda, & Longoria, 1994; Boone et al., 2007; Fernández & Marcopulos, 2008; La Rue et al., 1999; Manly, Touradji, Tang, & Stern, 2003; Mungas, Reed, Haan, & González, 2005; Razani, Burciaga, Madore, & Wong, 2007). For Spanish-speaking older adults, the diagnostic utility of standard memory measures may be further complicated by limited English-language use, often lower socioeconomic status, and lower educational attainment (Angel, Frisco, Angel, & Chiriboga, 2003).

As previously stated, these observed differences have triggered the development of several cultural and language adaptations of memory tests to be used with such ethnic minorities,

as well as the expansion of normative data for interpreting memory test results of Spanish-speaking elders. Developing cultural adaptations of standardized memory tests for Spanish-speaking individuals has not significantly improved our understanding of why such performance differences exist in the first place. Without such population-specific knowledge, the possibility of diagnostic error will continue to be significant. Some studies have cited ethical dilemmas related to the selection of normative data for interpretation of scores of individuals within the dynamic Hispanic community (Fernández & Marcopulos, 2008; López & Taussig, 1991; Suen & Greenspan, 2009). The potential health disparity in misdiagnosis of cognitive impairment, such as dementia, is of particular concern in this population given the reports of systematically lower age of onset and lower normative performances (Clark et al., 2005). This study therefore is also focused on investigating the within-group influences of demographic and cultural predictors on cognitive organization, spontaneous strategy use, and error rates within standard memory assessment in Spanish-speaking older adults. These analyses will serve to further our understanding and, in turn, raise future questions regarding how these cognitive processes are impacted by cultural differences outside of ethnicity alone.

1.1.3 Spontaneous Semantic Clustering on List-Learning Memory Tasks

How individuals encode newly learned information is affected by the efficiency of their learning strategies (Baldo et al., 2002). Patients with frontal lobe abnormalities, such as frontotemporal dementia, have been shown to use inefficient strategies, or no systematic strategy that can be identified. This inefficiency in strategy use may lead to their low levels of new learning and various errors in recall of the learned information (Glosser, Gallo, Clark, & Grossman, 2002). Failure to initiate effective learning strategies, such as semantic clustering, can lead to less effective learning (Savage et al., 2001). Past research has found that semantic

clustering is the most effective strategy for learning lists of related words. Semantic clustering is an active learning strategy where words from the same category are cognitively organized and remembered together (e.g., "peaches, grapes"), and has been identified as a specific, primary memory deficit in patients with frontal lobe disorders, such as Frontotemporal Dementia (Glosser et al., 2002; Hirst & Volpe, 1988). Recently, the semantic clustering learning strategy has also been implicated as a sign of cognitive decline in early amnesic Mild Cognitive Impairment (aMCI; Malek-Ahmadi, Raj, & Small, 2011). Unfortunately, studies have also shown a natural decline in semantic clustering during older adulthood when such beginning dementia processes are more common (Haarmann, Ashling, Davelaar, & Usher, 2005; Wegesin, Jacobs, Zubin, Ventura, & Stern, 2000).

Learning strategies may also systematically differ due to cultural factors such as language fluency, immigration history, and acculturation level (Arnold et al., 1994; Simpaio, Espino, Palmer, Lichtenstein, & Hazuda, 2005). Other experiential factors such as learning background and literacy (Manly et al., 2003) have been demonstrated to influence performance on such memory tasks (Mungas et al., 2005). The literature also describes a positive relationship between years of education and continued efficient strategy use on list-learning memory tasks in the general aging population (Norman et al., 2000). This 'natural' decline in spontaneous, efficient strategy use and its link with educational background has not been systematically investigated as one of the potential underlying basis for Spanish-speaking older adults' often lower performances on such memory measures. This is particularly relevant given that many have limited educational experiences or received their education outside of the U.S., and have different immigration histories and acculturation levels (Arnold et al., 1994; Manly, Jacobs, Touradji, Small, & Stern, 2002) and reading abilities (Manly et al., 2003). In addition, whether

Spanish-speaking older adults even show similar age-related changes or education-related protective impacts as have been observed in the English-speaking U.S. population is unknown.

1.1.4 The Influence of Instruction Sets on Strategy Use

If educational experience has a link to the spontaneous use of efficient strategies during learning and memory tasks, then Spanish-speaking older adults in the U.S. might be systematically disadvantaged. These disadvantages may include different cultural values related to education, having received their primary education outside of the U.S. resulting in different knowledge or skill sets, or lower overall educational attainment in general, resulting in the poor acquisition and practice of learning strategies. Unique and different educational experiences, and culturally-learned strategies, might be more closely related to their differing strategic approach compared to English-speaking peers, or may be a key factor in understanding their weaker performances on such memory tasks.

One study of the relationship between level of education and use of semantic clustering in Spanish-speaking older adults evaluated this phenomenon as is manifested on a category fluency task (Rosselli, Tappen, Williams, Salvatierra, & Zoller, 2009). The study demonstrated that, after controlling for age and gender, educational attainment was associated with higher overall scores and with greater ease of switching between categories, but that this was more significant for particular categories. For example, the category “fruit” was less influenced by educational attainment, possibly highlighting the influence of other cultural factors for the cognitive organization of such semantic categories. It is such findings that raise important questions about ethnic, linguistic, and cultural differences in cognitive and semantic organization, and their influence specifically on learning and memory strategies that have led to the current study.

It is important to bear in mind that there are some studies which have shown that some English-speaking patients with frontal lobe disorders also have an inability to spontaneously use efficient learning strategies on memory measures, but are, at times, able to utilize such strategies when given extremely explicit instructions on specific strategy use. In a study with patients with frontal lobe damage, Hirst & Volpe, (1988) asked patients and normal controls to memorize a list of categorizable words in order to examine their spontaneous semantic clustering of the words on the list during learning trials. These words were presented visually, and patients were able to organize the list physically. As frontal lobe patients were unable to do this task effectively, they were then given explicit instructions to categorize the words. The additional instruction improved their performances, but did not lead to 'normal' performance.

Given these findings, learning strategy instruction may provide a useful method for adapting our standard list learning tasks for use with older adults with diverse learning and cultural backgrounds. Given the variability observed in spontaneous semantic clustering and other effective learning strategies based on factors such as years of education (Norman et al., 2000) and acculturation (Arnold et al., 1994), strategy instruction may assist in 'correcting' for differences in educational and cultural backgrounds by generating a more effective learning strategy using a top-down process (i.e., explicit rather than implicit strategy use). Rather than expecting spontaneous semantic clustering to occur in the same way for diverse elders, providing strategy instruction may reduce the variability in performance based on these demographic and environmental factors. Such explicit strategy instruction might change the specificity of memory measures, but should improve its sensitivity to abnormal cognitive changes for diverse elders.

In order to better understand the relationships among cultural factors, language differences, educational experiences, and strategy use and efficiency, a stratified instruction set

with explicit instructions ranging from low-to-high explicitness was designed for this study in order to understand the impact of strategy instruction on the different linguistic populations. For English-speaking Caucasian participants, the impact of strategy instruction is predicted to be smaller than for Hispanic participants for two reasons. First, Caucasian participants are expected to demonstrate less variability in terms of years of education, cultural experience, and language proficiency, which will make their performance more similar. Caucasian participants are believed to be more similar to the standardization sample for commonly-used list-learning measures, both educationally (i.e., most having a high school education), and culturally (i.e., similar quality of education). For these reason, we predict that Caucasian participants will demonstrate higher spontaneous semantic clustering use during the standard test administration, and thus have a reduced range of growth in both performance gains and semantic clustering gains with changes in instruction.

1.1.5 Demographic Factors Associated with Hispanic Test Performances

It is well understood that memory and learning measures are sensitive to many demographic factors outside of brain pathology, such as age, gender, education, immigration history and acculturation level (Anstey & Smith, 1999; Arnold et al., 1994), reading ability (Gladsjo, Heaton, Palmer, Taylor, & Jeste, 1999; Manly et al., 2003), and past and current socioeconomic status (Gold, Johnson, & Powell, 2013). Specific to Hispanic older adults, level of education, as estimated through measures of academic achievement, has been found to be an influential variable on memory and learning test performance not unlike the relationship found in the English-speaking Caucasians in most normative samples in the US (Rosselli, Tappen, Williams, & Salvatierra, 2006). However, because overall educational attainment is often generally lower than that of Caucasian population, it is very difficult to differentiate the effects

of potential cultural and experiential differences from the general effect of lower education level. In addition, because many older Hispanic adults have been educated in various countries outside of the US, comparability of measures such as “years of education” has been questioned.

Manly et al., (2002) have suggested the importance of looking beyond the traditional measures of years of education or degree obtained, and instead directly assess the quality of educational experience and occupation-related indices of ability. These techniques have demonstrated some promise as explicatory factors for memory and learning performance differences within this population. As an example, Manly et al (2002) used single-word reading accuracy as a proxy indicator of education quality and found that education quality accounted for test discrepancies between African American and Caucasian elders even after the groups had been matched for years of education. A similar measure has been developed for use with Spanish-speaking older adults; the Word Accentuation Test (WAT; Del Ser, González-Montalvo, Martínez-Espinosa, Delgado-Villapalos, & Bermejo, A) is a Spanish-language measure of reading level that was designed to assess knowledge of infrequent, irregularly-stressed words written in capital letters without their accents. This test, and its US adaptation (Schrauf, Weintraub, & Navarro, 2006), has shown promise as a measure of premorbid functioning in Spanish-speakers but may not be as sensitive in expanding our understanding of education quality in diverse Spanish-speakers.

Studies have suggested that there are additional issues related to immigration history and experiences (i.e., English as a second language, assimilation into a new culture) that are significant factors in accounting for observed memory test score variations and differences with other comparison groups (Arnold et al., 1994; Artiola i Fortuny, Heaton, & Hermsillo, 1998). Various studies (Anstey & Smith, 1999; Arnold et al., 1994; Boone et al., 2007; Coffey, Marmol,

Schock, & Adams, 2005; Razani, Murcia, et al., 2007) have indicated that there are specific aspects of the acculturation process, such as language usage and preference, ethnic identity and generation, broad ethnic interaction, and cultural exposures through media, that might account for important additional variance in cognitive performances, including on memory and learning tasks.

Acculturation itself has been defined in the literature as “a phenomenon resulting in direct and continuous first hand contact of different cultures that produces change in the cultural patterns of one or more groups” (Ardila, 2005). This definition has been the product of several studies (Marín & Marín, 1991; Mena, Padilla, & Maldonado, 1987; Sanchez & Fernandez, 1993) and is a potential key component for understanding similarities and differences among Spanish-speaking older adults with different levels of acculturation, how this might impact their cognitive strategies and frameworks, and how similar or different they may be to the majority population’s approach to similar challenges. It has been suggested that all valid memory and learning measures of Hispanic clients should include an index of acculturation, regardless of whether the individual has been in the U.S. for a number of years (Razani, Burciaga, Madore, & Wong, 2007; Harris, Cullum, & Puente, 1995), since it may mark changes in cognitive frameworks and strategies.

Measures of acculturation have been important predictors of test performances in several studies (Arnold et al., 1994; Boone et al., 2007; Manly, Byrd, Touradji, & Stern, 2004; Simpao et al., 2005), but rarely have they been used to better understand cognitive organization, memory and learning strategies. Unfortunately, the broad nature of the acculturation process makes it difficult to distinguish from other embedded factors, such as educational attainment (Mungas et al., 2005). Thus, its evaluation is complex. The confounds of education and differing language

proficiency all need to be assessed in conjunction with acculturation in order to consider the unique impact of acculturation on verbal learning outcomes. By providing participants with both an assessment of acculturation through a gold-standard acculturation measure, as well as attempting to quantify educational attainment, via language proficiency and vocabulary measures, this study makes it possible to explore the unique influence of acculturation on verbal learning and strategy use.

1.2 Specific Aims and Hypotheses

Research Aim One is to identify group differences in performance, particularly their learning strategy use during verbal list learning tests, between Spanish- and English-speaking elderly groups when standard manual instructions are employed, and to observe whether those differences are reduced when more explicit strategy instructions are provided to these groups.

- *Hypothesis 1.1:* When a memory task is introduced with standard administration instructions, Spanish-speaking older adults will perform more poorly and employ less effective learning strategies (i.e. higher serial vs. lower semantic clustering) than English-speaking older adults.
- *Hypothesis 1.2:* When the strategy instructions are more explicit, performance differences between the Spanish- and English-speaking older adults will change in two ways: (1) the performance of both groups will increase with explicit instruction on effective strategy use, and (2) the Spanish-speaking participants will have greater gains in performance than the English-speaking participants, leading to smaller differences between the Caucasian and Hispanic/Latino groups.

- *Hypothesis 1.3:* The number of Spanish-speaking older adults who newly employ the semantic clustering strategy will increase at a significantly greater rate than the number of English-speaking older adults.

Research Aim Two is to examine the role of demographic (i.e. age, education, socioeconomic status) and cultural (i.e. acculturation, years lived in US, quality of formal education) factors on memory test performance and strategy use in the standard administration within the Spanish-speaking group.

- *Hypothesis 2.1:* There will be significant associations between demographic/cultural factors and list-learning performance and strategy use in the Spanish-speaking group, such that higher levels of education, socioeconomic status, acculturation, and quality of education will be associated with increased performance and strategy use.
- *Hypothesis 2.2:* Cultural factors will predict list-learning outcome scores above and beyond demographic scores, such that when controlling for standard demographic variables, cultural variables will predict a significant proportion of the variance in total learning, semantic clustering, and serial clustering.

2 METHODS

2.1 Participants

A total of 103 older adults participated in this study. Participants were divided into two groups: (1) 48 neurologically intact, primarily Spanish-speaking older adults of Hispanic descent, and (2) 55 neurologically intact monolingual English-speaking, Euro-American older adults (referred to as Caucasian for the purpose of this study). Enrollment of participants was limited to participants age 60 and above because cross-sectional data indicates that age-associated episodic memory decline begins a precipitous decline at about age 60 (Brickman & Stern, 2010). Within the Hispanic group, a total of 24 participants comprised the Low Explicit (LE) strategy instruction group and 24 received the High Explicit (HE) strategy instruction (see descriptions below). Within the Caucasian group, 28 received the LE condition and 27 received the HE condition. The groups did not differ in regard to age, sex, years since retirement, or depression symptoms. *Between* the Hispanic and Caucasian groups, significant differences were observed in years of education and frequency of aerobic exercise. None of these differences were noted across strategy intervention groups (LE vs. HE) *within* each ethnic group (see Table 1).

Participants were recruited from the greater Atlanta community. Caucasian participants were recruited from various local organizations including the Emory Alzheimer's Disease Research Center volunteer pool, community churches, independent living facilities, and local senior centers. Hispanic participants were recruited from CETPA's Latino Community Mental Health Clinic, the Latin American Association of Atlanta, local consulates (Mexico, Guatemala, El Salvador), as well as various community churches and businesses. While there are no Hispanic-serving independent living facilities and senior centers in the area, a small number of Hispanic participants were recruited from these locations in Gwinnett and Dekalb counties.

Table 1 Descriptive Statistics of Key Demographic Variables and Four Group ANOVA

	Hispanic		Caucasian		F	P
	LE	HE	LE	HE		
Age						
Mean	66.67	70.08	70.54	69.26	1.41	.22
SD	7.14	6.85	7.40	6.66		
Sex						
M	9	10	7	9	.58	.63
F	18	14	21	18		
Education ⁺						
Mean	11.02	11.83	15.04	15.56	7.99	<.01*
SD	5.33	5.39	2.49	2.33		
Retired						
Yes	15	14	15	15	.84	.48
No	12	10	13	12		
Exercise ^{++†}						
Mean	5.04	3.96	5.04	5.38	2.78	.05*
SD	1.46	2.44	1.84	1.50		
Depression Symptoms ^{††}						
Mean	6.92	7.67	4.14	5.41	2.48	.07
SD	5.07	5.79	3.93	5.47		

No significant differences noted *within* Hispanic and Caucasian intervention groups for any variable.

Significant differences were observed *between* the Hispanic and Caucasian group using pairwise comparisons for two variables: ⁺ Hispanic groups had significantly fewer years of education than the Caucasian group.

⁺⁺Hispanic HE group had significantly lower frequency of aerobic exercise than the Caucasian HE group.

[†] Aerobic exercise practices were measured using the Rapid Assessment of Physical Activity (RAPA).

^{††}Depression symptoms were measured using the Geriatric Depression Scale (GDS) long form.

Participants were also recruited by several other methods: recruitment flyers were placed in community businesses, including local grocery stores, restaurants, laundromats, and other Latino-serving businesses. Community liaisons were established with local senior and Latino-serving health organizations including the *Lideres* of Caminar Latino, Grady Hospital's *Latino Diabetes Education Program* (ELDEP), *Club de la tercer edad*--the senior group of the Latin American Association, and the Health Ministry of the Catholic Archdiocese of Atlanta. These liaisons served to promote and refer participants to the study. A large portion of our Hispanic sample (20%) were also recruited at local health fairs organized by churches and community leaders. These health fairs provided an opportunity for the study research staff to speak directly

to older adults and their families about the research project, and offer information about senior services for Latinos in Atlanta to potential participants. Participants were also recruited through word of mouth (37%), where participants were asked to spread the word about the study to friends and family and given flyers to share with their eligible contacts. The investigator also conducted four educational workshops at 2 churches (1 Spanish, 1 English) and with two local senior groups in the community (1 Spanish, 1 English), providing information about healthy aging and memory improving techniques. While these workshops provided an opportunity to network with elders, they were less effective for recruitment purposes (n=2). See Figure 1 for a summary of recruitment outcomes.

2.1.1 Special considerations for Hispanic sample

Individuals from Hispanic descent were defined as participants who have immigrated to the United States from South America, Central America, Mexico, and the Spanish Caribbean. In the literature, this population has been referred to as Hispanic, Latino, Chicano, Spanish-American and Latin-American. For the purposes of this study, the term “Hispanic” has been selected because it is believed to have a broader reference to all Spanish-speaking individuals whom are the population of interest for this project. However, participants self-identifying by the previous denoted terms were also included in this study, provided that Spanish was their primary and dominant spoken language. Since almost all measures were administered in Spanish for the Hispanic sample, participants were required to self-identify as either monolingual or primarily Spanish-speaking. Hispanic participants were asked to qualitatively describe their Spanish-language proficiency using the following categories: “poor,” “fair,” “good,” or “excellent,” and only participants with “good” or “excellent” Spanish language proficiency were invited to participate. Because some participants in this study have limited formal education, in addition to

self-identification of language ability, Spanish language proficiency was assessed with the Woodcock-Munoz Language Survey-Revised (see below). English vocabulary in the Hispanic sample (for participants who reported any English language abilities) was also assessed using the English version of the WMLS-R picture vocabulary test. The current Hispanic sample includes representatives of 11 countries of origin, with the largest percent of participants originating from South America (47%), followed by Mexico and Central America (36%) and the Spanish Caribbean (21%).

With regard to cultural differences within the Hispanic Sample, demographic analyses were conducted across these three geographic groups to assess potential differences across multiple demographic and ability factors, including: years of education, SES (subjective measure and income level), years living within the United States, level of acculturation, English picture vocabulary (number of words), and Spanish language proficiency (WMLS-R score). Significant differences were observed among the Hispanic subgroups on years of education, subjective ratings of current SES (ladder) and native language proficiency. In terms of years of education, participants from North and Central America had significantly fewer years of formal education than the participants from both the South Americas and Caribbean groups. Participants from North and Central America also had lower subjective ratings of SES and Spanish language proficiency than the South American group, but not the Caribbean group. No other significant differences were noted across other key demographic, performance, and cultural factors (see Table 2). These differences parallel overall immigration patterns among Hispanic communities in the United States. According to a report on Hispanic national trends from the Pew Research Center (Motel & Patten, 2012), South American groups such as those from Colombia and Peru have large concentrations in the South, along with those from Cuba. In addition, Mexican and

Central American immigrants make up the group with the lowest educational attainment, with only about a quarter (22-26%) of persons over the age of 25 having at least a high school degree (Motel & Patten, 2012).

2.1.2 Special Considerations for Caucasian Sample

Caucasian older adults were defined as non-Hispanic, monolingual English-speaking, Euro-American individuals who were born and raised in the United States. Caucasian participants were required to originate from families with at least two generations born in the United States, and participants with immigrant parents were excluded from this study. Both English fluency and Spanish vocabulary (for those Caucasian participants who reported any Spanish-language abilities) were assessed. A minimal amount of participants reported Spanish-language abilities (n=2), so this variable was not evaluated during data analysis.

2.2 Screening

(See figure 1)

All participants were community-dwelling older adults who self-reported independence in their activities of daily living. All participants received a telephone screening prior to scheduling for the study which took approximately 5-10 minutes. During this telephone screening, participants received a brief word memory test (3 words with recall requested after 5 minutes), and were asked basic screening questions to rule out participants who did not meet eligibility criteria (see Appendix B). On the day of testing, all participants were administered the Montreal Cognitive Assessment, which provides both English- and Spanish-language versions (MoCA; Nasreddine et al., 2005). This measure was utilized to screen for possible cognitive impairment (see below). In addition, participants were asked health-related questions, designed

Table 2 *Frequencies, Means and Standard Deviations of Key Demographic Variables of Hispanic Groups*

	Hispanic Groups by Region of Origin			F	P
	North and Central America (N=18)	South America (N=20)	Spanish Caribbean (N=10)		
Country of Origin	Mexico (n=11) El Salvador (n=6) Nicaragua (n=1)	Colombia (n=9) Peru (n=6) Ecuador (n=2) Venezuela (n=2) Argentina (n=1)	Cuba (n=7) Dominican Republic (n=2) Puerto Rico (n=1)		
Years of Education+					
Mean	7.56	14.15	12.95	11.18	<.001*
SD	4.52	4.22	4.75		
Current Income ^a					
Mean	2.83	3.15	3.50	.85	.43
SD	1.15	1.39	1.43		
SES Ladder ^{b ++}					
Mean	5.06	6.55	5.60	3.42	.04*
SD	1.93	1.70	1.65		
Years in US					
Mean	23.86	26.56	32.80	1.12	.34
SD	12.11	15.63	19.03		
Acculturation (raw) ^c					
Mean	-1.89	-1.39	-1.95	2.75	.07
SD	.54	.89	.83		
English Picture Vocabulary (raw) ^d					
Mean	12.17	18.63	20.60	2.46	.10
SD	11.06	9.76	11.99		
Native Language Proficiency ^{e+++}					
Mean	86.61	101.47	100.89	5.70	.01*
SD	15.23	14.64	11.73		

⁺ The North/Central American group had significantly fewer years of education than the South American and Caribbean group.

⁺⁺ The North/Central group had lower subjective ratings of SES than the South American group, but not the Caribbean group.

⁺⁺⁺ The North/Central group had significantly lower native language proficiency than the South American group, but not the Caribbean group.

^a Income measured with 1-5 scale (1=0-10k, 2=>10k-20k, 3=>20k-30k, 4=>30k-40k, 5=50k+), ^b Subjective ladder of SES (score range: 1-10), ^c Acculturation Rating Scale for Mexican Americans, adapted for use with all Hispanic groups, ^d Total words (raw) measured with the Woodcock-Munoz Language Survey-Revised (WMLS-R),

^e WMLS-R Spanish Language Proficiency Cluster scores (SS).

to screen for major health problems that are known affect cognitive functioning (Uchiyama, Mitrushina, Satz, & Schall, 1996). Participants were asked about their history of head injuries, neurological disorders (e.g. seizures, strokes, dementia), chronic medical problems (e.g. diabetes, heart problems, thyroid conditions, lung disease), major psychiatric illnesses (e.g., major depression, psychosis, bipolar disorder), substance abuse (e.g., extensive alcohol/illicit drug use,) and current medications they were taking. Individuals also reported on whether their medical conditions were receiving treatment and whether they were well-managed by the treatment. Individuals who reported poorly managed chronic health problems in these areas, or those who were taking medications known to significantly affect cognition (Moore & O'keeffe, 1999), were excluded from the current study.

Ruling out Major Depressive Disorder (MDD) was of particular concern for this study, given that the literature has strong indications of the link between poor memory test performance and MDD. Although MDD is not as common among older adults as among younger cohorts, depressive symptoms are common among elders (Blazer, 2003). In addition, while little research has examined depression rates among older Hispanic immigrants, research suggests that rates of general depression among Hispanic older adults are higher than for Caucasian elders (Dunlop, Song, Lyons, Manheim, & Chang, 2003; Yang & Jones, 2008). In regards to memory impairment, however, research has indicated that the majority of older adults having only mild symptoms of depression do not have impairments in verbal learning that can be explained by these symptoms (Mesholam-Gately et al., 2012). In addition, a longitudinal study assessing the relationship between cognitive decline and depressive symptoms in Hispanic older adults found that low levels of depressive symptoms were similarly unrelated to cognitive decline (Perrino, Mason, Brown, & Spokane, 2008). Thus, only participants who met diagnostic criteria for MDD

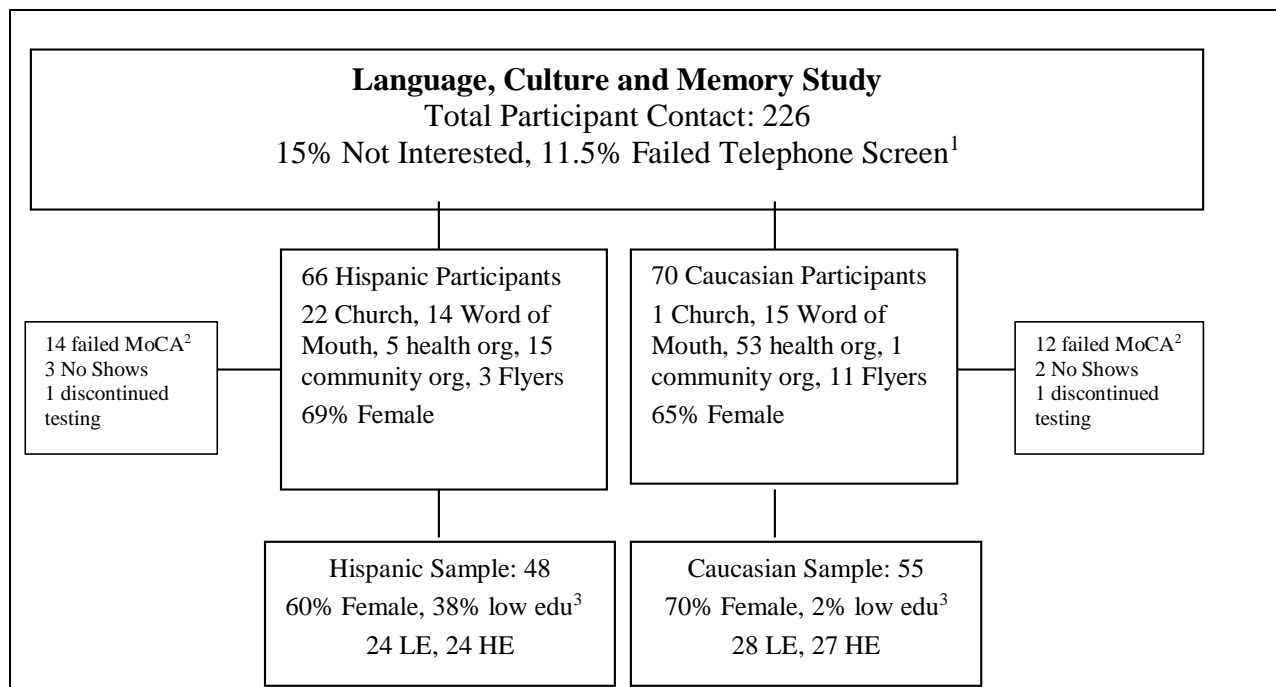


Figure 1 Recruitment Flowchart

Participant screening, selection, and assignment; Final sample completed full testing battery.

MoCA= Montreal Cognitive Assessment screening measure administered in dominant language; Church=recruited at a local church or church event; Word-of-Mouth: referred by other study participants; Health Org= recruited at a local hospital or community health clinic; Community Org= recruited at a local community center including senior centers or cultural centers

¹Telephone screen failed: English not first language, parents were immigrants, severe head injury, race/ethnicity was not Hispanic or Caucasian, failed alcohol screen, significant memory problems

²Hispanic MoCA cutoff score of ≥ 20 ; Caucasian MoCA cutoff score of ≥ 26

³Low education = ≤ 11 years of education

via questionnaire were ruled out of this study (see below for methodology).

2.3 Procedure

During testing sessions, participants completed a battery of measures designed to evaluate their memory, linguistic abilities, cultural and demographic characteristics (see Table 3). The testing sessions took approximately 1 ½ to 2 hours. Participants were consented in both English and Spanish, with an option to sign with an “X” rather than their name. This method of consent was approved by the Georgia State University Institutional Review Board.

Table 3 Screening Measures and Measures used to Assess Study Variables

Measure	Factors Assessed	Subtests /Measure Characteristics	Scores Utilized in Analysis
Montreal Cognitive Assessment (Nasreddine et al., 2005a) English Form, Spanish Form	Cognitive Status	Brief Assessment across multiple cognitive domains: Visuospatial, Naming, List-learning, Attention, Language, Abstract Reasoning & Orientation	Screening measure: Hispanic: Scores < 20 Caucasian: Scores <26
Batería Neuropsicológica en Español (Artiola i Fortuny, L., Romo, D., Heaton, R., & Pardee, 1999)	Verbal Learning and Learning Processes	Spanish Verbal Learning Test (SVLT) List A and B	Total Learning Semantic Clustering Serial Clustering
California Verbal Learning Test-II (Delis, Kramer, Kaplan, & Ober, 2000)	Verbal Learning and Learning Processes	California Verbal Learning Test-II (CVLT-II) List A and B	Total Learning Semantic Clustering Serial Clustering
Woodcock-Munoz Language Survey-Revised (WMLS-R) <i>Spanish Form</i> (Woodcock, 2005)	Native Language Proficiency Bilingualism	Dictation, Passage Comprehension, Understanding Directions, Story Recall, Picture Vocabulary.	Spanish Language Proficiency Spanish Picture Vocabulary
Woodcock-Munoz Language Survey-Revised (WMLS-R) <i>English Form A</i> (Woodcock, Munoz-Sandoval, Ruef, & Alvarado, 2005)	Bilingualism	Dictation, Passage Comprehension, Understanding Directions, Story Recall, Picture Vocabulary	English Picture Vocabulary Raw Score
Scale of Subjective Social Status (Adler, Epel, Castellazzo, & Ickovics, 2000)	Subjective rating of SES	10 point Likert Scale (Low to High)	Childhood SES Score Current SES Score
Alcohol Use Disorder Identification Test (AUDIT-C) (Bush, Kivlahan, McDonell, Fihn, & Bradley, 1998)	Alcohol Abuse	3 questions with 5 response options (12 points possible).	Exclusion Criteria: Women: scores >3 Men: scores >4
Geriatric Depression Scale (GDS) (Greenberg, 2007)	Depression Symptoms	30 yes or no questions relating to symptoms of depression.	Screening Severe Depression: Hispanic: scores >19 Caucasian: scores >20
Rapid Assessment of Physical Activity Questionnaire (RAPA) (Topolski et al., 2006)	Exercise Practices	Aerobic Exercise (1-7 score) Fitness Categories (1-5 score) Strength and Flexibility (1-3 score)	Aerobic Exercise Score
Acculturation Rating Scale for Mexican Americans (ARSM-A-II) (Cuellar, Arnold, & Maldonado, 1995) Adapted for use with all Hispanic/Latino groups	Acculturation	Hispanic Orientation Score Anglo Orientation Score Raw Acculturation Score Level of Acculturation (1-5) Acculturative categories (Traditional, Low Bicultural, High Bicultural, Assimilated)	Hispanic participants only: Raw Acculturation Score Acculturative Categories

2.3.1 List Learning Strategy Intervention

All participants were asked to learn two 16-word lists over five learning trials for each word list. Caucasian participants were presented two word lists taken from the California Verbal Learning Test-II (CVLT-II; Delis, Kramer, Kaplan, & Ober, 2000), word list A and word list B. Word lists presentation was randomly counterbalanced, such that half of the participants received word list A first and half received word list B first. Hispanic participants were administered two word lists taken from the Aprendizaje de Palabras (SVLT), a Spanish verbal learning test from the Bateria Neuropsicológica en Español (*Neuropsychological Battery in Spanish*; Artiola i Fortuny, L., Romo, D., Heaton, R., & Pardee, 1999). The SVLT was designed as an analogue to the CVLT-II, but with cultural adaptations to make it more appropriate for use with Spanish-speakers (see below for description). The Hispanic participants followed the same learning procedure as the Caucasian participants, learning two 16-word lists (List 1 and List 2), with 5 learning trials for each list. These lists were also randomly counterbalanced.

The standard administration for these verbal learning tests was applied for List 1, such that each list of 16 words was orally presented to participants over 18-20 seconds, which was confirmed by the use of a stopwatch. After the words were presented, participants were asked to recall as many words as they could remember from the list of words in any order they chose. All responses were recorded, both correct and incorrect (i.e., repetitions and intrusions), and in the order in which they were recalled. This procedure was repeated 4 times. After the standard administration was completed, participants were asked “what strategy did you use to learn the list of words?” Their responses were recorded verbatim and coded for analysis.

In order to determine the effect of more explicit instruction sets on the participant’s ability to spontaneously use an effective learning strategy (i.e. semantic clustering), two

additional instruction sets were designed: *low explicit (LE)* strategy instructions, in which participants were told that some people find that grouping words into related (i.e. semantic) categories helps them remember the words, and *highly explicit (HE)* strategy instructions, in which examples of semantic clustering were given and participants were asked to practice using the highly explicit strategy prior to learning a list. The highly explicit strategy instructions were adapted from instructions used with frontal lobe patients (Hirst & Volpe, 1988) that was shown to elicit strategy use with this clinical population. The use of two different explicit strategy instruction conditions was employed for methodological purposes, as it is not clear from the literature how much explicitness is needed before individuals employ more effective strategies on such measures. Further, a lower level of explicitness might allow for both an increase in semantic clustering and the preservation of the sensitivity of this task in detecting frontal lobe disorders in diverse populations.

Thus, all participants received the first learned list with standard instructions, which allowed for cross-cultural comparison of performance across all participants. During the second list-learning trial set, half the participants received either low- or highly-explicit instructions. This also allowed for evaluation of within-group performance gains across racial/ethnic groups, and allowed for evaluation of differences in performances between the low- and highly-explicit instruction sets. See Figure 2 for a summary of this research design.

Procedural Fidelity and Testing Environment

Testing batteries were administered by the study research team. The research team consisted of a doctoral student (Principal Investigator; PI) and two advanced undergraduate students (research assistant; RA) trained in the administration of the test battery. Each RA was trained directly by the PI, was required to practice the administration of the battery over a period

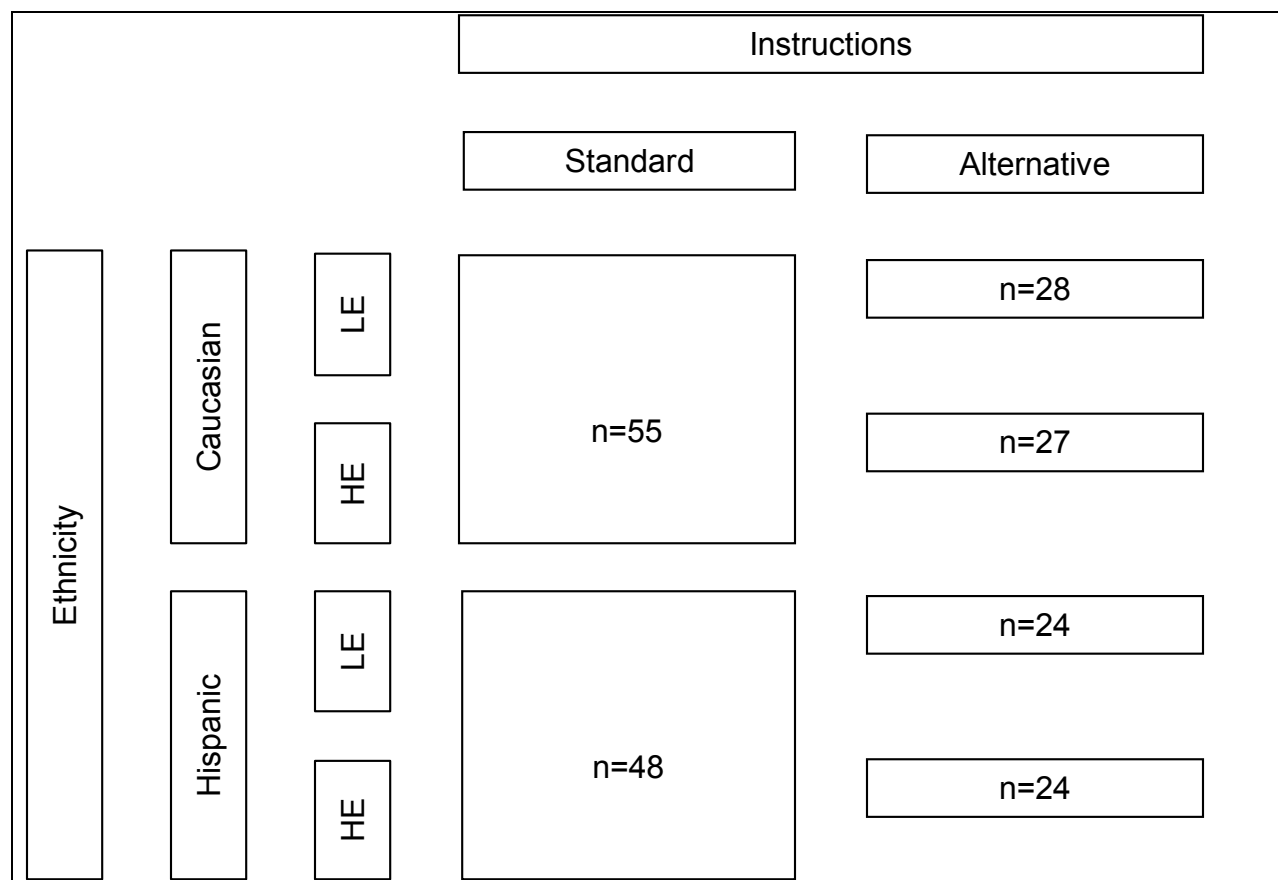


Figure 2. Research Design

All participants learned List 1 using standard task instructions. After a 30-45 minute delay, half of participants received Low Explicit (LE) Strategy instruction, and the other half received High Explicit (HE) strategy instruction.

of two weeks, and was required to administer the full battery to the PI prior to participant contact. During their first scheduled appointment, the PI observed testing and provided feedback to the RA. Both RAs were cleared for independent testing after their initial appointment. For quality assurance, the PI observed several RA testing appointments throughout the course of the study period, which allowed for direct feedback on testing procedure. The PI and one RA are fluent Spanish-speakers and tested all Hispanic participants.

Testing was conducted across multiple settings including Georgia State University, Wesley Woods Geriatric Hospital, Emory Neurology Clinic at Executive Park, the Latin American Association, CETPA community clinic, a local church, and participants' homes. All

testing conditions were comparable: participants were tested individually in a quiet room with as few distractions as possible. Family members were not allowed to be present during testing. With the exception of two measures, all testing prompts were presented orally in the dominant language of the participant. The WMLS-R Understanding Directions and Story Recall subtests were administered via audio recording provided by the measure.

Because the project participants were older adults, testing was conducted at the most convenient and accessible location to the participants, which sometimes required home visits to less ambulatory participants. When home visits were scheduled, two members of the research team (the PI and one RA) were required to attend the testing appointment together, and to follow an IRB approved safety protocol. To avoid fatigue, participants had the option of completing testing in one or two sessions. The majority of participants (98%) chose to complete testing in one visit.

2.4 Measures

2.4.1 English Verbal Learning and Memory Task

The English-language instrument used to assess verbal learning was the California Verbal Learning Test-II (CVLT-II; Delis et al., 2000), the most frequently used list learning task and a gold-standard assessment tool for verbal learning and memory. In fact, it is among the five most commonly used assessment instruments by clinical neuropsychologists in the United States (Rabin, Barr, & Burton, 2005). The normative sample was 53% female, and 76.9% Caucasian, with 10.3% participants of Hispanic origin. This list learning test assesses word recall, as well as use of learning strategies and types of errors committed by participants. While the measure also includes delayed recall, cued recall, and recognition tasks, these were not utilized as part of the current study. The CVLT-II has adequate reliability for use with older adults. Reliability scores

were calculated based on split-half reliability estimates after splitting immediate recall trials ($r=.94$), based on categories ($r= 0.82$), and based on number of times each word was recalled ($r=.79$). Split-half reliability estimates across the older adult age groups (60-89 years of age) ranged from 0.68-0.92. No significant differences were noted across men and women with regard to internal consistency. Validity was assessed through comparisons to the original CVLT and other list learning measures.

The structure of the CVLT-II was based on the test development procedures conducted for the original CVLT (Delis, Kramer, Kaplan, & Ober, 1987). However, more attention was paid to word selection in the development of the CVLT-II (Delis et al., 2000). With regard to the development of the word lists, the test developers conducted a study with 154 subjects in which they provided participants with 36 categories, and then had them generate words under these categories within 30 seconds. The test developers focused on reducing the “prototypicality” of words within their word lists, as intrusions recalled by individuals are often among the most highly prototypical words within a category. In order to avoid confabulations being regarded as correct recalls, they removed the 4 most frequently produced words for each category and built their target lists based on the remaining words.

Test developers also focused on making the words on the list easier to understand than those found on the original list. For example, the word “paprika” was found on the original list, but was difficult to recall due to the low frequency of this word in the English language. In order to avoid this problem, word frequency ratings were taken from the American Heritage Word Frequency Book (Carroll, Davies and Richman, 1971). Based on these analyses, the test developers selected words that were both easy to understand, frequently used, but not so highly prototypical so as to be easily recalled as intrusions.

2.4.2 *Spanish Verbal Learning and Memory Task*

The Spanish language instrument selected for this study is the Spanish Verbal Learning Test from the Bateria Neuropsicológica en Español (*Aprendizaje de palabras*; SVLT; Artiola i Fortuny, L., Romo, D., Heaton, R., & Pardee, 1999), an instrument that parallels the format of the CVLT-II, and was developed and normed completely with Spanish speakers (not translated). It is appropriate for use with Spanish-speaking older adults within the U.S., Spain and Latin America. While no reliability and validity data were provided within the administrative and technical manual, a follow-up study conducted by the authors of this measure assessed the comparability of performance across Spanish-speaking groups from Spain and the U.S.-Mexico Border Region (Artiola i Fortuny et al., 1998). The study observed comparable results across Spanish-speakers from Spain and Mexico across three measured variables (Total learning, Short Delay Free Recall, List A Discriminability) with significant effects of both age and education observed across both groups. The similarity in outcomes obtained by these two Spanish-speaking groups supports the notion that this measure can be applied effectively to participants from different educational and socioeconomic background, regardless of regional language differences.

According to the test manual, the word lists for this measure were generated using the following procedure: the words for each list were derived from a large list of words generated by 45 native Spanish speakers from 10 different countries. Each Spanish-speaker was given a series of categories and asked to generate as many words as they could that fit that category. Of the words generated for each category, the top two most prototypical words were excluded from the lists. The test developers purposefully omitted only the two most prototypical words (rather than four omitted in the CVLT-II) in order to develop “relatively simple word lists, which would be

accessible to persons with lower educational attainment” (Artiola i Fortuny et al., 1999). The final 32 words that made up List A and List B were words that shared a meaning across all sampled countries of origin. Any word that had a different meaning in another Spanish-speaking region was discarded.

2.4.3 Scoring of List-learning Measures

List-learning outcome variables for both the CVLT-II and the SVLT were calculated using an excel spreadsheet designed for this study. Use of our specially designed scoring spreadsheet also allowed the calculation of the learning and process scores for the SVLT, a procedure that was not provided by the publishers of this measure (Artiola i Fortuny et al., 1999). The spreadsheet utilized the formulas provided by the CVLT-II manual to calculate the following scores: total learning (trial 1-5), words learned by trial, semantic clustering, serial clustering, learning slope, serial position effect (i.e., % primacy, middle, recency), and errors (i.e., repetitions, intrusions, intrusion type). Calculated scores using our spreadsheet were confirmed with use of CVLT-II scoring software (Delis et al., 2000).

Participant *total learning* and the *semantic clustering* index served as the primary dependent variables of interest for these analyses. *Total learning* was defined as the sum of words learned across all 5 trials (overall performance). The *semantic clustering index* was computed by adding the number of times a correct word was recalled immediately following another correct word from the same semantic category. For each trial, the number of semantic clusters observed was subtracted from the number of semantic clusters expected by chance. Due to this calculation, it is possible to obtain a negative semantic cluster ratio, as was the case for some of our participants (see results). This difference was then divided by the number of trials (1-5) that had at least two or more correct responses recalled to create the chance-adjusted

Semantic Clustering index utilized for these analyses (Stricker, Brown, Wixted, Baldo, & Delis, 2002). The *Serial Clustering* score, or the recall of words in the same order that they were presented, was also used as a dependent variable to assess participant's rote memory strategy use.

The spreadsheet also calculated word recall frequency scores using the following criteria. Words with *high frequency* were words that were recalled at least 4 times (without repetitions) across all 5 trials. Words with *low frequency* were words recalled only 1 or fewer times across the 5 learning trials. These scores were utilized to assess the comparability of list learning measures as a proxy for cultural familiarity (see results section).

2.4.4 *Spanish/English Proficiency and Vocabulary*

Level of English and Spanish proficiency was assessed using the Woodcock Munoz Language Survey-Revised (WMLS-R) English Form A and the Spanish version (Woodcock, R. W., Munoz-Sandoval, A.F., Ruef, M.L., & Alvarado, 2005a; Woodcock, Richard W., Munoz-Sandoval, A.F., Ruef, M.L., & Alvarado, 2005c). Each version has seven subtests designed to assess language proficiency. This instrument has been standardized for use with older adults (90+). Four of these subtests (Dictation, Story Recall, Understanding Directions, and Passage comprehension) were administered to participants in order to generate a total Applied Language Proficiency cluster (continuous) scale score for each language. In addition, the Picture Vocabulary subtest of this instrument was administered in the participant's dominant language in order to measure basic lexical knowledge and vocabulary level. For Spanish-speaking participants who endorsed English language abilities, the English version of the Picture Vocabulary subtest was also administered. English-speakers who endorsed Spanish language abilities were also administered the Spanish Picture Vocabulary subtest. Those participants who

spoke only one language were administered only one version of the picture vocabulary test, and received a score of “0” for proficiency in the second language. As only two Caucasian participants reported Spanish language abilities, only the English Picture Vocabulary scores were utilized for analysis for aim 2 (see results). Within the Hispanic scores of Spanish Language Proficiency, one outlier (>3 standard deviations from mean) was identified. This outlier was recoded to the next most extreme value for data analysis.

2.4.5 Cognitive Screening Task

In order to screen for possible cognitive impairment, the Montreal Cognitive Assessment (MoCA; (Nasreddine et al., 2005b) was selected for use. The MoCA is a one-page cognitive screening measure that is available in over 35 languages, including Spanish-language versions. It is designed to briefly assess several cognitive domains, including visuospatial/constructional skills, confrontation naming, list learning (5 words, 2 presentations), attention, language, abstract reasoning, and orientation. For English speakers, a sum total of 26 out of 30 points must be scored in order to pass the screening. Participants who have completed 12 years of education or fewer are awarded an additional point. Based on the available research, cognitively intact Spanish-speakers on average score within a range of 16.1 among illiterate subjects to 20.3 among those who had completed primary school (Gómez, Zunzunegui, Lord, Alvarado, & García, 2013), and 23.3 in an ethnically diverse population within the United States with varying educational attainment (Rossetti, Lacritz, Cullum, & Weiner, 2011). For the purposes of this study, a cutoff score of 20 was utilized with Spanish-speaking participants. With participants whose level of education was extremely low (<4 years of formal education), participants were allowed to score fewer than 20 points, provided they remember at least 3 of the 5 words from the

embedded list-learning measure of the MoCA. Scores lower than 20 were observed in only 3 tested participants.

2.4.6 Demographic Questionnaire

Self-reported information about current age, gender, race and ethnicity, years of education, current socioeconomic status, occupational status and immigration history was obtained via a short interview (see Appendix B). The Scale of Subjective Social Status (Adler et al., 2000) was also used to assess socioeconomic status. This is a new measure of SES which uses a self-anchoring scale (Kilpatrick & Cantril, 1960). Participants were shown the stimuli and asked to place themselves and their family on a ladder to represent their current SES. This measure has been found to be a good predictor of outcomes associated with low SES, including poor health outcomes (Adler et al., 2000). For Latino participants, both objective SES and subjective SES measures were collected to further capture predicted variability in SES.

This questionnaire also includes health-related questions that were designed to screen for major health problems known to affect cognitive functioning (Uchiyama, Mitrushina, Satz & Schall, 1996). Participants were asked about their history of head injuries, neurological disorders (e.g. seizures, strokes, dementia), chronic medical problems (e.g. diabetes, heart problems, lung disease), major psychiatric illnesses (e.g., major depression, psychosis, bipolar disorder), substance abuse (e.g., extensive alcohol/illicit drug use) and current medications. Included within these health-related questions were 3 items from the Alcohol Use Disorder Identification Test (AUDIT-C; Bush, Kivlahan, McDonell, Fihn, & Bradley, 1998). This measure was designed by the World Health Organization and was used to screen out potential substance dependence in all participants. Scores range from 0-12, and the recommended cutoff score of 4 for men and 3 for women was utilized for this study. The three-item AUDIT-C has a sensitivity

ranging from 85% in Hispanic women to 95% in white men, and sensitivity was generally comparable across racial/ethnic groups (Frank et al., 2008).

2.4.7 Depression Scales

Symptoms indicating a Major Depressive Episode at the time of testing were assessed using the Geriatric Depression Scale (GDS; (Greenberg, 2007; Yesavage et al., 1983). This measure has been tested and used extensively within the older adult population. In addition, several translations exist in different languages, including Spanish translations. Due to the long-form of the scale's inclusion of somatic symptoms of depression, it has been found to be more sensitive than the short-form version for Spanish-speaking Hispanic older adults (Fernández-San Martín, Andrade-Rosa, Molina, Muñoz, Carretero, Rodríguez, & Silva, 2002). Therefore, the long-form version of this measure was used for this study. The English version of the GDS was found to have 92% sensitivity and 89% specificity when evaluated against other diagnostic methods for depression, while the Spanish version has a sensitivity of 86.7% and specificity 63.1% in community dwelling Hispanic elders (Fernandez- San Martin et al, 2002). The GDS long form consists of 30 yes or no questions. For participants with limited reading abilities, this measure was administered orally (n=2). Scores of 20 and greater were considered an indication of severe depression within the English versions, while a score of 19 is considered sensitive to severe depression in the Spanish version (Reuland et al., 2009).

2.4.8 Acculturation Measure

A fully validated measure for the assessment of the acculturation process in older Hispanic adults does not currently exist. However, the Acculturation Rating Scale for Mexican Americans (ARSMA-II; (Cuellar et al., 1995) was selected for use with our Hispanic participants based on a comprehensive review conducted by Yamada (2006) of the utility of several

acculturation measures with Hispanic older adults. Based on this review, as well as a qualitative comparison of the data provided by standard acculturation measures, the ARSMA-II was selected for use in this study for several reasons: this measure is the most widely-used acculturation measure with Hispanic persons in the United States, and while originally designed for use with Mexicans, it has been adapted for use with various countries of origin, including Mexican, Central- and South-Americans, and Cubans (Alamilla, Kim, & Lam, 2010; Sabina, Cuevas, & Schally, 2015). It has also been successfully used with older adults (Jimenez, Gray, Cucciare, Kumbhani, & Gallagher-Thompson, 2010).

The ARSMA-II is a 30-item Likert scale which measures acculturation along 3 primary factors: language, ethnic identity, and ethnic social relations. It is an orthogonal, multidimensional scale that measures orientation toward the traditional Hispanic culture and the Caucasian (which they refer to as Anglo) culture independently using two subscales, a Hispanic Orientation subscale (HOS) and an Anglo Orientation Subscale (AOS). The HOS is made up of 17 items, with an alpha of .88 while the AOS has 13 items, with an alpha of .83. The overall Acculturation Score represents the difference between the HOS and AOS. The ARSMA-II also provides guidelines for interpreting scores in order to generate both linear acculturation categories (Levels 1-5) and acculturative categories (Traditional, Low Bicultural, High Bicultural, and Assimilated). This allows the overall Acculturation Score to be used both as a continuous measure and as a categorical measure for data analyses. In order to score the measure, a simple excel spreadsheet that generated the HOS, AOS, and provided guidelines for interpreting these scores categorically was developed.

2.4.9 *Physical Activity Measure*

Physical activity has been demonstrated to support healthy cognitive and brain function in older adults, and has been linked to a reduction in risk for the development of neurodegenerative diseases (Kramer & Erickson, 2007). In order to assess physical activity practices among our participants, the Rapid Assessment of Physical Activity questionnaire (RAPA; Topolski et al., 2006) was used. The RAPA was designed to quickly assess the level of physical activity of older adult. Its reliability and validity is comparable to the commonly-used Community Healthy Activities Model Program for Seniors (CHAMPS) questionnaire, with the added benefit of brief administration. The RAPA also provides two Spanish-language versions, one normed with Mexican Spanish-speakers and the second used with European Spanish-speakers. The Mexican version was selected for use in this study. It was developed using focus groups that helped refine the wording of the questions and the examples of exercises provided in the measure (Topolski et al., 2006).

The RAPA is a nine-item questionnaire with response options of yes or no to questions covering a wide range of physical activities, ranging from sedentary to regular vigorous activity. It also has two items that assess strength training and flexibility exercises. Prior to completing the measure, instructions are provided that give a brief description of the three levels of physical activity being evaluated (light, moderate, vigorous) as well as both graphic (cartoons) and written examples of activities that would fall into these categories. The measure provides separate scores for aerobic exercise and strength/flexibility training. The aerobic exercise score ranges from 1-7 and also provides categories for use in interpreting the score: 1 = sedentary, 2 = underactive, 3 = regular underactive (light activities), 4 = regular underactive, and 5 = regular

active. The strength/flexibility training responses range from 1-3, with 1=strength training, 2=flexibility training, and 3=both are regularly practiced.

3 RESULTS

3.1 Comparing the Word Lists across Measures

In order to better understand the structural similarities and/or differences of the two list-learning tasks (CVLT-II, SVLT), we evaluated those characteristics that are known to influence recall (Bock & Klinger, 1986), including the frequency of words recalled and the familiarity or ease of their recall both at the single word level and at the categorical level. In order to estimate these factors, we utilized data from the learning trials (1-5) under standard task administration. For each word on the list, we calculated the number of participants who had successfully recalled that word 4 or 5 times across the 5 learning trials (high frequency), and the number of participants who successfully recalled the word only 0 or 1 time across the 5 learning trials (low frequency). We then calculated a percentage of participants who had recalled the word with high frequency and low frequency for each individual word. These data are presented in Table 4.

As can be observed from these results, the word lists generally display a similar primacy and recency pattern of word frequency recall across both the Spanish and the English lists, with some variability noted across individual words. Due to this variability, we can also begin to gauge the familiarity of a particular word for the samples of participants being evaluated. For example, three words within the English lists (Turnip, Garage, Rabbit), and three Spanish words (Sillón, Mano, Oso), appear to be of lower familiarity for more than 50% of the tested samples. These rates of recall are also consistent with expected reduced recall for words in the middle of the lists across both groups. In addition, more than 70% of participants recalled three words within the English lists (Cabbage, Violin, Radishes) and three words within the Spanish lists (Abuelo, Piano, Tambor). All of these high familiarity words are either the first or last word on the list suggesting that the primary effect is related to their high rate of recall. Overall, this data

Table 4 Percent Word Frequency by Words Across Trials for CVLT-II vs. SVLT

CVLT-II List A ⁺			SVLT List A ⁺		
% recalled	4 or 5 times	0 or 1 time	% recalled	4 or 5 times	0 or 1 time
Truck	57	0	Abuelo/ <i>grandfather</i>	81	7
Spinach	50	25	Jirafa/ <i>giraffe</i>	58	11
Giraffe	29	21	Pierna/ <i>leg</i>	35	26
Bookcase	29	14	Cama/ <i>bed</i>	50	22
Onion	39	14	Hipopótamo/ <i>hipo</i>	38	15
Motorcycle	32	25	Sofá/ <i>sofa</i>	19	44
Cabinet	14	46	Ojo/ <i>eye</i>	23	22
Zebra	43	18	Madre/ <i>mother</i>	12	33
Subway	18	32	Sillón/ <i>armchair</i>	8	56
Lamp	25	43	Cebra/ <i>zebra</i>	15	44
Celery	18	18	Tío/ <i>uncle</i>	42	7
Cow	7	39	Mano/ <i>hand</i>	8	52
Desk	39	7	Armario/ <i>wardrobe</i>	12	30
Boat	46	11	Pantera/ <i>panther</i>	35	19
Squirrel	61	0	Primo/ <i>cousin</i>	31	15
Cabbage	89	0	Nariz/ <i>nose</i>	58	4
CVLT-II List B ⁺			SVLT List B ⁺		
% recalled	4 or 5 times	0 or 1 time	% recalled	4 or 5 times	0 or 1 time
Violin	76	8	Piano/ <i>piano</i>	77	0
Cucumber	56	4	Elefante/ <i>elephant</i>	59	9
Elephant	52	8	Camisa/ <i>shirt</i>	32	36
Closet	32	16	Cabeza/ <i>head</i>	27	23
Turnip	8	60	Leopardo/ <i>leopard</i>	18	45
Guitar	24	28	Violín/ <i>violin</i>	9	45
Basement	52	12	Pie/ <i>foot</i>	23	36
Sheep	4	40	Falda/ <i>skirt</i>	14	36
Clarinet	28	20	Dedo/ <i>finger</i>	32	14
Garage	8	52	Oso/ <i>bear</i>	5	55
Corn	8	40	Vestido/ <i>dress</i>	23	45
Rabbit	8	52	Trompeta/ <i>trumpet</i>	27	36
Patio	24	24	Rinoceronte/ <i>rhino</i>	64	18
Saxophone	56	8	Abrigo/ <i>coat</i>	18	36
Tiger	40	8	Oreja/ <i>ear</i>	45	9
Radishes	76	4	Tambor/ <i>drum</i>	73	5

Percent of participants that recalled the word 4-5 times and 0-1 times across all 5 learning trials

*Words are presented in the order of administration

provides evidence that the two lists are generally functionally equivalent in terms of recall, the pattern of frequency of recall and apparent familiarity. In order to gauge whether the word categories themselves were comparable with regard to these factors, the percent of high frequency words within each category was averaged to provide an overall percentage of high frequency recall for each category of words (Table 5).

Table 5 Percentage of Recall by Category on the CVLT-II and SVLT

CVLT –II Categories		SVLT Categories	
List A		List A	
<i>Animals</i>	35%	<i>Animals</i>	35%
<i>Furniture</i>	27%	<i>Furniture</i>	22%
Ways of Traveling	38%	Family Members	41%
Vegetables	49%	Body Parts	31%
List B		List B	
<i>Animals</i>	26%	<i>Animals</i>	36%
<i>Instruments</i>	46%	<i>Instruments</i>	47%
Locations in Home	29%	Body Parts	32%
Vegetables	37%	Clothing	22%

Average of time words from the category were recalled 4 or 5 times across 5 learning trials

Because the four lists shared a total of three categories (Animals, Furniture, and Instruments), it was possible to evaluate the comparability of these scores using two chi square tests. The first test compared the proportions in the two shared categories of list A (Animals and Furniture). The analysis was not significant, $\chi^2 (1, N = 103) = 0.30, p = .60$. The second test compared the proportions from the categories of list B (Animals and Instruments), and again found no significant differences across these proportions, $\chi^2 (1, N = 103) = 0.85, p = .36$. These results indicate that there are no differences across shared word categories with regard to how frequently words within these categories were recalled.

Analyses were completed to assess the psychometric similarity of the Spanish and English-language list-learning measures. Correlations were completed across all of the outcome measures provided by both the CVLT-II and the SVLT list-learning measures under the standard task administration condition. The outcome measures included the following: recall across individual trials 1-5, total learning (sum of trials 1-5), learning slope, semantic clustering, serial clustering, serial order effect (primacy, middle, recency), total repetitions, total intrusions, and type of intrusion (synonym intrusions, categorical intrusions, cross-list intrusions, other intrusions). The correlations between these selected scores, within the CVLT-II and the SVLT independently, were significant for all key variables ($P < .001$), indicating that the two tests'

outcomes measured similar aspects of verbal episodic memory functioning, and were intercorrelated in similar ways.

Therefore, we suggest that all the preceding analyses provide evidence that these two measures each adequately capture total learning and process score differences for Hispanic and Caucasian participants, and that the differences between these group's performances are not due to some fundamental differences between the two measures.

3.2 Comparison of Hispanic and Caucasian Groups under Standard Task

Administration

The first aim of this study was two-fold: (1.1) to identify similarities and differences in performance and learning strategy (e.g., semantic clustering) during list learning memory performance between Spanish- and English-speaking older adults when standard administration is employed, and (1.2) to observe whether group differences are reduced given explicit strategy instruction.

Preliminary checks of normality, linearity and homogeneity of variance were conducted for all analyses to ensure no violations of assumptions. With regard to semantic clustering, outcome variances were not equal between the Hispanic and Caucasian groups. According to Grayson (2004), transformations of these data to address this violation would not be appropriate, as the focus of our hypotheses regarding semantic clustering are based on arithmetic mean differences in strategy use between the two groups. Transformation of these data would therefore impact interpretation of the outcomes. Because within-group variances for the instruction subgroups are observed to be equal (LE vs. HE), the semantic clustering scores are believed to reflect a true difference in strategy use between the Hispanic and Caucasian sample. Therefore, data transformations were not utilized.

3.2.1 Aim 1.1. Standard Administration

In order to compare performance of the Hispanic and Caucasian group under standard administration, three Analyses of Covariance (ANCOVAs) were conducted assessing performance differences across the three CVLT outcome variables of interest: total learning, semantic clustering and serial clustering. Because significant differences were noted across the ethnic group with regards to education, number of years of education was used as a covariate to statistically adjust for possible effects of this variable.

Table 6 Group Means, Standard Deviations and One-Way ANCOVAs for Standard List-Learning Variables

Variables	Hispanic	Caucasian	F	P	Effect Size (R^2)
Total Learning	42. (± 9.41)	45.55 (± 8.42)	0.59	.45	.01
Education	--	--	4.35	.04*	.04
Semantic Clustering	-0.36 (± 0.51)	1.29 (± 1.4)	41.15	<.001*	.29
Education	--	--	1.28	.26	.02
Serial Clustering	0.59 (± 0.73)	0.59 (± 0.80)	0.23	.64	<.01
Education	--	--	1.19	.28	.01

Years of Education was used as a covariate across all analyses

*Significant omnibus effect of race/ethnicity on semantic clustering, where Caucasian>Hispanic

Contrary to expectation, no significant group differences were observed in terms of total performance, $F(1, 99) = 0.59$, $p = 0.45$, $\eta^2 = 0.01$. With regard to the learning strategies, a significant main effect for the use of semantic clustering was observed, such that the Hispanic group had significantly lower semantic clustering ratios than the Caucasian group, $F(1, 99) = 40.07$, $p < .001$, $\eta^2 = 0.29$. Interestingly, a significant main effect of serial clustering was not

observed, $F(1, 99) = 0.17$, $p = 0.68$, $\eta^2 = <.01$, suggesting that additional strategies may have been employed by the Hispanic group that were not captured in these analyses (see Table 6).

Impact of Education on Learning Outcomes under Standard Administration

Based on the above findings, follow-up post-hoc analyses were conducted to assess the impact of education on the performance of the groups. In order to carry out these analyses, the groups were divided into a low education group (i.e., less than 12 years of education) and a high education group (i.e., 12 or more years of education). With regards to the Hispanic group, 38% of the sample were determined to comprise a low education group ($n=18$), while 62% fell in the high education group ($n=30$). Within the Caucasian group, 98% of the sample fell in the high education group, with the remaining participant ($n=1$) having 11 years of education. Because of this significant discrepancy, only three education groups were created for follow-up analyses: (1) High Education Caucasian group, (2) Low Education Hispanic group, and (3) High Education Hispanic group.

Table 7 One-Way ANOVAs for Standard List-Learning Outcome Variables by Education Group

Variables	Low Edu Hispanic	High Edu Hispanic	High Edu Caucasian	F	p	Effect Size (R^2)
Total Learning	38.11 (± 8.66)	44.57 (± 9.12)	45.55 (± 8.42)	5.09	.01*	.09
Semantic Clustering	-0.51 (± 0.52)	-0.26 (± 0.48)	1.29 (± 1.47)	29.51	<.01*	.37
Serial Clustering	0.47 (± 0.68)	0.66 (± 0.68)	0.59 (± 0.80)	0.33	.72	.01

Significant omnibus effects display significant main effects of education group:

Total Learning: HEC=HEH>LEH; Semantic Clustering: HEC>HEH=LEH

Three ANOVAs were conducted to assess total performance and learning strategy differences across the three education groups. With respect to total performance, a significant main effect of educational group on total performance was observed, $F(2, 99) = 4.44$, $P = 0.01$. Post hoc comparisons revealed a significant performance difference between the Caucasian

group and the Low Education Hispanic group ($p=.004$), but not the High Education Hispanic group ($p=.621$). A significant difference was also observed within the Hispanic groups, with the Low Education Hispanic group performing significantly more poorly than the High Education Hispanic group ($p=.022$).

With regard to the learning strategies assessed, a significant main effect of semantic clustering was observed across the groups, $F(1, 94) = 20.82, p < .001$. Post hoc comparisons indicated significant differences between the Caucasian group and the two Hispanic education groups ($p=.001$), such that Caucasian participants had significantly higher semantic clustering ratios than both Hispanic groups, but no differences were observed between the two Hispanic education groups ($p=.48$), suggesting this difference is not due to a level of education effect. Consistent with previous analysis, no significant effects were observed for serial clustering across groups.

3.2.2 Further Exploratory Analyses for Aim 1.1

Although not part of the original hypotheses, the following list-learning outcome scores were generated for each participant: individual trial recall (1-5), learning slope, serial position effect (i.e., %primacy, middle, recency), and errors (i.e., repetitions, intrusions). A series of one-way ANOVAs were conducted to compare these additional learning process metrics for each of the three educational groups (see Table 8). These analyses revealed that while no differences were observed in terms of learning slope, the low education Hispanic group had significantly lower recall in three out of 5 learning trials, leading to lower total learning across trials (see Table 7). In addition, Hispanic participants appear to make significantly more repetition and intrusion errors than Caucasian participants, even when their total learning is similar. These findings suggest that Hispanic participants demonstrate a reduced ability to inhibit already

processed and less relevant information during the learning trials, a possible indicator of differences in executive functioning and monitoring strategies. This difference may also be related to the reduced rates of semantic clustering observed within the Hispanic sample.

Table 8 One-Way ANOVAs for Additional List-Learning Outcome Variables by Education Group

Variables	Low Edu Hispanic	High Edu Hispanic	High Edu Caucasian	F	p
Individual Trial					
Trial 1	4.50 (±1.58)	5.50 (±1.46)	5.35 (±1.58)	2.62	.78
Trial 2	6.67 (±1.78)	8.00 (±1.74)	8.44 (± 2.04)	5.81	<.001**
Trial 3	8.61 (±2.36)	9.57 (±2.65)	9.60 (±2.29)	1.22	.31
Trial 4	8.83 (±2.50)	10.53 (±2.47)	10.73 (±2.34)	4.34	.02*
Trial 5	9.50 (±2.68)	10.97 (±2.65)	11.55 (±2.24)	4.76	.01*
Learning Slope	1.22 (±0.61)	1.35 (±0.55)	1.46 (±0.57)	1.37	.26
Serial Position					
%Primacy	29.94 (±11.12)	31.57 (±6.23)	30.00(±7.54)	.42	.66
%Middle	36.28 (±7.90)	40.53 (±10.34)	38.67(±7.78)	1.38	.26
%Recency	32.06 (±12.27)	27.80 (±10.64)	29.76(±7.44)	1.17	.31
Repetition Errors	5.06 (±3.65)	6.97 (±5.74)	2.40(±2.94)	12.77	<.001**
Intrusion Errors	2.61(±2.83)	3.23(±3.29)	1.36(±2.16)	5.19	.01*

Significant omnibus effects display significant main effects of education group:

Trials 2, 4 & 5: HEC=HEH>LEH; Repetition Errors: HEC>HEH=LEH; Intrusion Errors: HEC>HEH=LEH

In order to explore differences in strategy selection between the Hispanic and Caucasian study groups beyond the available learning process scores, all participants were asked to identify the primary strategy they used under standard task instruction immediately following administration. These data are presented on Figure 3 (see below). As can be observed, the majority of participants endorsed using either semantic clustering or serial clustering. In addition, consistent with semantic clustering results presented above, Caucasian participants were more likely to endorse use of the semantic clustering strategy (51%) compared to Hispanic participants

(28%) as a whole. In fact, only 11% of the low education Hispanic group endorsed semantic clustering, compared to 40% of the high education Hispanic group. Additionally, about one fourth of all Hispanic participants were unable to identify a strategy at all (28%) compared to only 7% of the Caucasian sample.

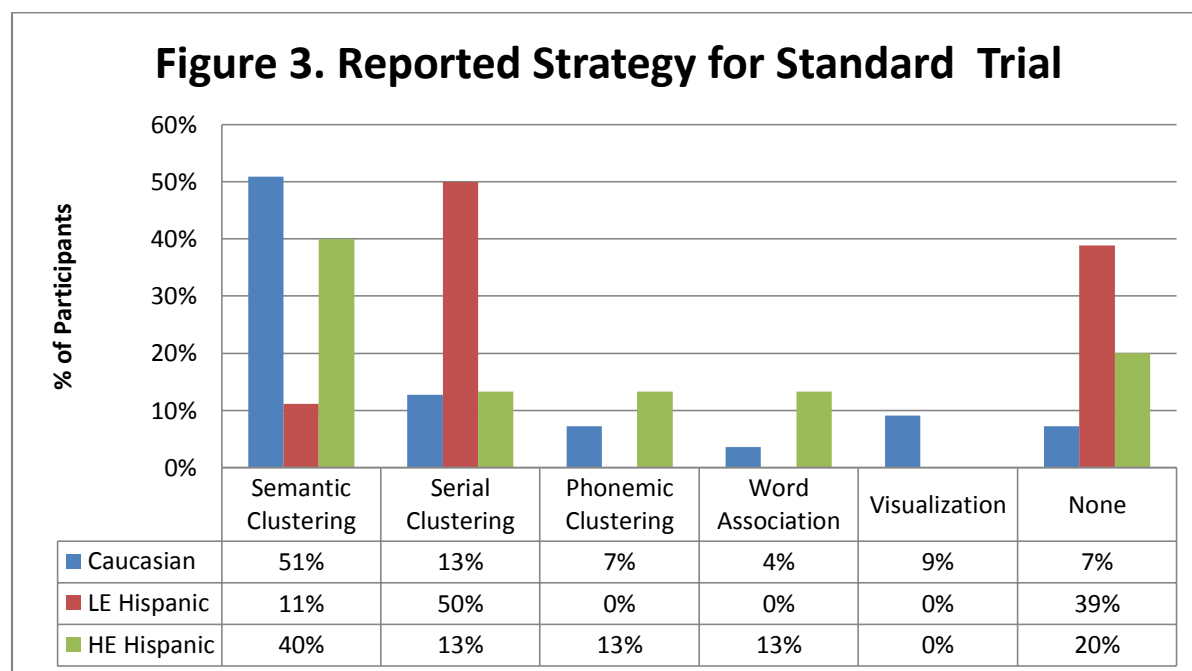


Figure 3 Reported Strategy for Standard Trial

In order to gauge whether the self-reported strategy used was related to years of education for the Hispanic sample, a one-way ANOVA was used to compare years of education by the selected strategy. No statistically significant education differences were noted across strategy selected, although this finding may be limited given the small sample sizes. In order to investigate whether participants who reported use of the semantic clustering strategy had better performance on the list-learning task, a one-way ANOVA comparing the six endorsed strategies (semantic clustering, serial clustering, phonemic clustering, word association, visualization, none) and the three outcome variables of interest was performed. No omnibus effects were found across learning outcome variables.

3.3 Comparison of Hispanic and Caucasian Groups after Explicit Strategy Instruction

As observed above, differences were not identified across the Caucasian and all Hispanic participants with regard to total list-learning performance or serial clustering. However, as predicted, there were significant differences across the groups with regards to semantic clustering, such that Hispanic participants had significantly lower semantic clustering ratios than Caucasians. Based on this information, various analyses were performed in order to assess the *impact of explicit strategy instruction* on these observed learning outcomes.

3.3.1 Analyses for Aim 1.2.

A group scatter plot, exploring the relationship between semantic clustering at baseline and semantic clustering given explicit strategy instruction across the two racial/ethnic groups, indicated that while Caucasians demonstrated a trend towards improved performance given more explicit strategy instruction, Hispanic participants had low semantic clustering scores both at baseline and after explicit strategy instruction (see Figure 5). This figure suggests that Hispanic and Caucasian participants responded differently given the explicit strategy instruction. Means and standard deviations are provided for the learning outcome variables of interest for each racial/ethnic group by instruction condition (see Table 9). In order to explore the rate of change in total learning from baseline performance (standard administration) given strategy instruction, a repeated measures ANCOVA was conducted to assess racial/ethnic group (Hispanic v. Caucasian) performance by type of instruction (Standard v. Explicit). The two levels of explicit instruction (LE & HE) were collapsed for this analysis. As the sample size did not permit an evaluation based on the three previously described education groups, education was used as a covariate in these analyses.

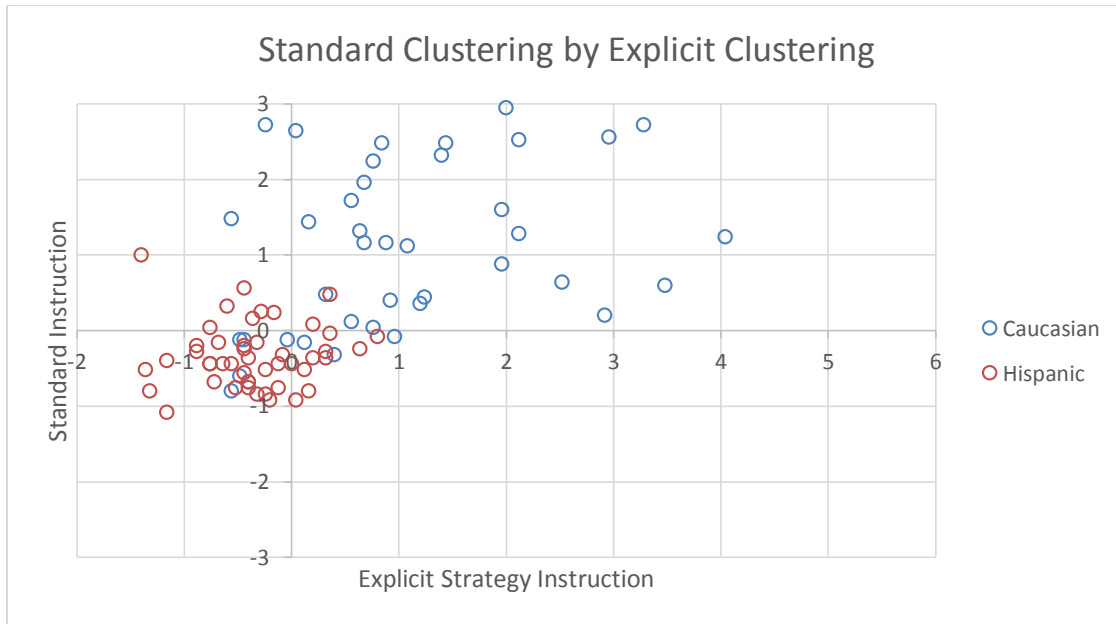


Figure 4 Clustering Scatterplot.

Relationship between semantic clustering under standard task instructions and semantic clustering after explicit strategy instruction based on study group.

The results of the analysis, with a Wilk's Lambda correction, determined that total learning significantly differed across type of strategy instruction provided, $F(1, 99) = 7.84$, $p = .01$, $\eta^2 = .07$. Unexpectedly, these results suggest that when any explicit strategy instruction is provided, total learning of the word lists significantly declines. In addition, there is no evidence of a significant interaction between the change in recall observed and racial/ethnic group membership, $F(1, 99) = .84$, $p = .36$, $\eta^2 = .01$. While education played a key role in the outcomes of the Hispanic group under standard administration, the analyses suggest that response to strategy instruction is not significantly impacted by years of education, $F(1, 99) = 3.04$, $p = .08$, $\eta^2 = .03$.

In terms of semantic clustering, the results of the analysis with a Wilk's Lambda correction suggest a significant interaction between race and type of strategy instruction on semantic clustering, such that Caucasians appear to demonstrate significantly greater benefit

Table 9. Mean Learning Outcome Scores by Group and Type of Instruction

Variable	N	Standard Instruction		Explicit Strategy Instruction	
		Mean	SD	Mean	SD
Total Learning					
Hispanic	48	42.15	9.41	38.87	9.48
Caucasian	54	45.43	8.46	41.87	10.77
Semantic Clustering					
Hispanic	48	-0.36	0.51	-0.34	0.43
Caucasian	54	1.31	1.41	2.00	1.81
Serial Clustering					
Hispanic	48	0.59	0.72	0.17	0.62
Caucasian	54	0.58	0.80	-0.003	0.72

Table 10. ANCOVA for Main and Interaction Effects of Instruction and Race

Variable	F	p	Effect Size
Total Learning			
Instruction	7.84	.01*	.07
Instruction x Education	3.04	.08	.03
Instruction x Race	0.84	.36	.01
Semantic Clustering			
Instruction	0.30	.60	<.01
Instruction x Education	0.03	.85	<.01
Instruction x Race	4.28	.04*	.04
Serial Clustering			
Instruction	0.01	.93	<.01
Instruction x Education	3.04	.08	.03
Instruction x Race	<.01	.97	<.01

from explicit strategy instruction on their semantic clustering ratios than Hispanic participants, $F(1, 99) = 4.28, p = .04, \eta^2 = .04$. For this analysis, a significant interaction between years of education and semantic clustering was also not observed, $F(1, 99) = .03, p = .85, \eta^2 < .01$. These

analyses were repeated using serial clustering as the dependent variable, and no significant main effects or interaction effects were noted.

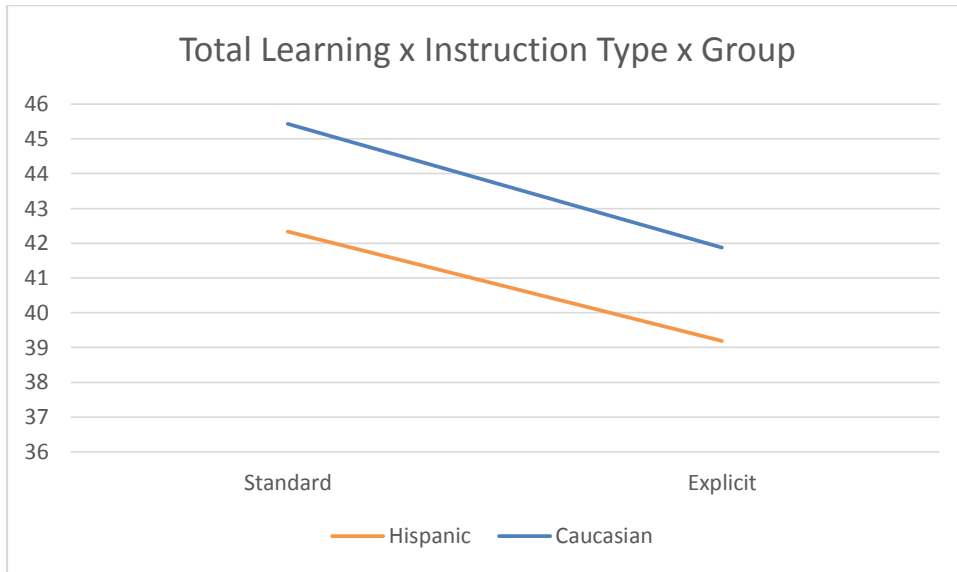


Figure 5 Total Learning by Instruction Type.

Mean of total words learned by participants in each racial/ethnic group given standard and Explicit Instructions. Main effect of instruction is significant ($p=.01$).

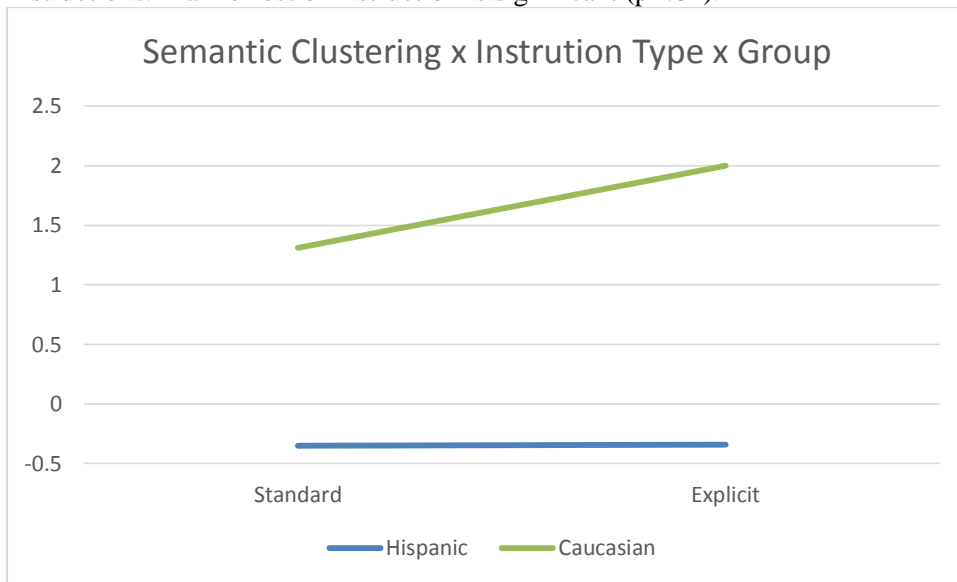


Figure 6 Semantic Clustering by Instruction Type.

Mean semantic clustering ratios in each racial/ethnic group given Standard and Explicit Instructions. An interaction effect of race by instruction type is significant ($p=.04$).

3.3.2 Impact of Level of Explicitness of Strategy Instruction

In order to assess the impact of the two different levels of strategy instruction on the list-learning outcomes (Total Learning, Semantic Clustering, Serial Clustering), three two-way ANCOVAs were performed comparing group performance across the LE and HE intervention conditions. Learning outcome scores under standard instruction and education were utilized as covariates for these analyses.

The first ANCOVA analysis evaluated response to strategy instruction based on total learning across trials. With regard to total learning, (see Figure 8) there is little evidence to suggest a significant interaction effect of level of explicitness in strategy instruction and race/ethnicity, $F(1, 96) = 1.65$, $p = 0.13$, $\eta^2 = 0.02$). In addition, neither of the main effects were statistically significant. These results suggest that, with regard to total learning, Hispanic and Caucasian participants respond relatively similarly to the two different levels of explicit instruction.

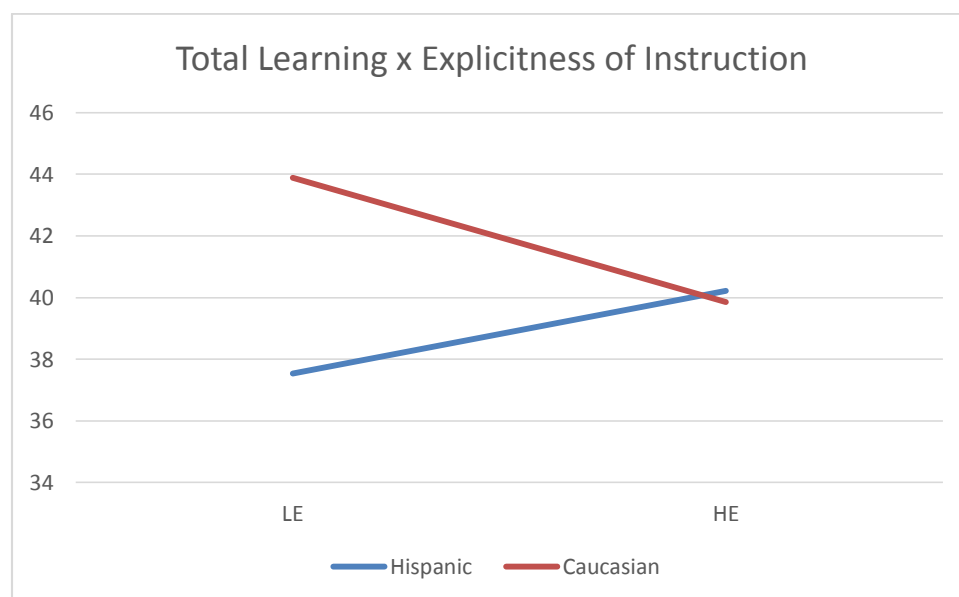


Figure 7 Total Learning by Explicitness of Strategy Instruction

Mean total learning in each racial/ethnic group given Low Explicit or High Explicit strategy instruction. While an interaction effect of race by explicitness of instruction is suggested by this figure, the interaction is not significant ($p = .10$). No other significant main or interaction effects noted.

Table 11. Mean Learning Outcome Scores by Group and Explicitness of Instruction

Variable	N	Low Explicit		High Explicit	
		Mean	SD	Mean	SD
Total Learning					
Hispanic	48	37.54	10.25	40.21	8.64
Caucasian	54	43.89	9.48	39.85	11.74
Semantic Clustering					
Hispanic	48	-0.37	0.51	-0.31	0.35
Caucasian	54	2.04	1.85	1.97	1.82
Serial Clustering					
Hispanic	48	0.31	0.67	0.04	0.55
Caucasian	54	0.09	0.75	-0.09	0.70

Table 12. ANCOVA for Main and Interaction Effects of Strategy Instruction on Learning

Variable	F	P	Effect Size
Total Learning			
Explicitness	0.14	.77	.12
Race	0.10	.935	.01
Explicitness x Race	2.80	.10	.03
Semantic Clustering			
Explicitness	0.23	.63	<.01
Race	19.46	<.001*	.17
Explicitness x Race	0.43	.52	<.01
Serial Clustering			
Explicitness	2.47	.12	.03
Race	0.41	.52	<.01
Explicitness x Race	0.11	.71	<.01

The second ANCOVA analysis evaluated response to level of explicit strategy instruction on semantic clustering. With regard to semantic clustering, there is no evidence of a significant interaction effect across conditions and groups, $F(1, 96) = 0.47$, $p = 0.49$, $\eta^2 = .211$. However, a

significant main effect of race was observed, such that Hispanic participants scored lower on semantic clustering across conditions than Caucasian participants, $F(1, 91) = 24.268, p < .001, \eta^2 = .211$. A significant main effect of level of explicitness of instruction was not observed. These results suggest that the different levels of explicit strategy instruction did not impact semantic clustering gains (or decreases). Rather, the two racial/ethnic groups responded differently to the intervention based on other factors. For the Hispanic group, these factors will be explored in Aim 2.

The third ANCOVA analysis evaluated response to strategy instruction on serial clustering. As suggested by previous analyses, no significant main effects or interaction effects were noted.

3.4 Cultural and Demographic List-Learning Predictors for Spanish-Speakers

3.4.1 Preliminary Analyses

This aim explores factors within the Hispanic group that might be related to their observed performance on the list learning tasks. The role of standard demographic (e.g., age, education, SES) and culture (e.g., acculturation, years residing in the US) factors on performance outcomes and strategy use during list learning were explored. The relationship between these variables was explored using bivariate correlations (see Appendix A).

The results of these analyses revealed some noteworthy relationships between the learning and memory variables. In terms of demographic variables, age demonstrated a negative correlation to aerobic exercise, such that older participants reported a lower level of aerobic exercise ($p = .04$). Sex of participant did not significantly correlate with other outcome variables. Years of education was positively correlated with several subjective SES variables, including childhood and current SES (ladder), and the childhood social class rating scale ($p < .01$).

Interestingly, years of education was unrelated to the current yearly income scale, in which participants endorsed a range of yearly incomes. The current yearly income rating scale was positively correlated with number of years having lived in the United States, but unrelated to any other variable assessed. Years of education was also strongly correlated with region of origin, English and Spanish picture vocabulary scores, aerobic exercise, and quality of education.

With regard to cultural variables, acculturation was positively correlated with current SES (ladder), years lived in the US, and English picture vocabulary. Years lived in the United States also demonstrated a positive correlation with English picture vocabulary, current income and aerobic exercise. Interestingly, performance on the English Picture Vocabulary test showed a strong positive correlation with performance on the Spanish Picture Vocabulary test and with overall native language proficiency. Region of origin significantly correlated with years of education, English picture vocabulary and native language proficiency, such that participants originating from South America on average had higher years of education and better language scores. Aerobic exercise practices appeared to be strongly linked to SES factors, such that participants with higher years of education, more years living in the United States, and higher SES ratings (ladder) appeared to engage in more aerobic exercise.

With regard to variables aimed at assessing quality of participant's education, four subtests (Understanding Directions, Dictation, Passage Comprehension, and Story Recall) from the WMLS-R made up the composite score of native language proficiency. The only significant correlations observed within this group of variables were with years of education ($p < .01$) and among each other. These variables appear to be unrelated to other study variables, including SES, and may thus be able to provide a unique contribution to the performance variance

observed during list-learning tasks. Interestingly, the Story Recall subtest of the WMLS-R does not appear to be related to any outcome measures, including Spanish language proficiency. Based on these initial analyses, a select number of variables were chosen for inclusion in the primary analysis: (1) Demographic variables including age, sex, years of education. Additional SES measures were excluded due to their high correlation with years of education. (2) Cultural variables include acculturation, aerobic exercise, English picture vocabulary, and quality of education (i.e., native language proficiency score).

3.4.2 Correlations with Learning Variables

Using a bivariate correlation, the selected demographic and cultural variables were correlated with the list-learning outcomes from the SVLT (total learning, semantic clustering, serial clustering). In terms of total learning, a significant correlation was observed for sex, such that women had higher recall than men ($p=.05$). Total learning was also highly positively correlated with Spanish language proficiency, such that participants with higher language proficiency also had higher total learning ($p=.009$). No other significant relationships were observed.

With regard to semantic clustering, an expected negative correlation was observed between age and use of semantic clustering such that older participants tended to utilize the semantic clustering strategy with less frequency ($p<.001$). Bilingualism, as measured by English picture vocabulary, was also positively related to use of semantic clustering, such that participants with higher English vocabulary scores utilized the semantic clustering strategy at greater rates ($p=.05$). Aerobic exercise was also positively related to semantic clustering, such that persons who engaged in more regular aerobic exercise demonstrated higher semantic clustering index scores ($p=.004$). In terms of serial clustering, a significant correlation was

Table 13 Bivariate Correlations of Demographic and Cultural Variables and Learning Outcomes

	1	2	3	4	5	6	7	8	9	10	11
1. Age	--	--	--	--	--	--	--	--	--	--	--
2. Sex	-0.19	--	--	--	--	--	--	--	--	--	--
3. Years of Education	0.03	-0.07	--	--	--	--	--	--	--	--	--
4. Acculturation (categorical)	-0.09	0.05	0.26	--	--	--	--	--	--	--	--
5. Years lived in the US	0.17	0.06	0.04	0.35*	--	--	--	--	--	--	--
6. Aerobic Exercise	-0.31*	-0.11	0.32*	0.11	0.31*	--	--	--	--	--	--
7. English Picture Vocabulary	-0.1	0.02	0.41**	0.56**	0.52**	0.2	--	--	--	--	--
8. Quality of Education	0.27	-0.09	0.68**	0.14	0.17	0.15	0.30*	--	--	--	--
9. Total Learning	0.02	-0.29*	0.24	0.1	0.09	0.01	0.23	0.39**	--	--	--
10. Semantic Clustering	-0.39**	0.06	0.06	0.12	0.23	0.29*	0.29*	0.15	0.05	--	--
11. Serial Clustering	0.1	0.33*	0.27	-0.23	-0.13	-0.06	-0.05	0.25	-0.27	-0.26	--

* $p < .05$; ** $p < .01$

observed with sex, such that men tended to utilize a rote memory strategy more than women ($p=.019$) No other significant relationships were observed.

3.4.3 Primary Analyses for Aim 2

Multiple linear regression was used to help determine which of the demographic and cultural variables best predicted the list-learning outcome variables for Hispanic participants.

3.4.4 Exploratory Stepwise Regressions

Three stepwise multiple regressions, using the backward entry method, were employed to assess *total learning* (trials 1-5), *semantic clustering* and *serial clustering* outcome scores. With regard to *total learning*, the final model indicated that two of the eight predictors (quality of education and sex) accounted for a significant portion of the variance, $R^2=.23$, $F(2, 43) = 6.44$, $p=.004$. Specifically, this model revealed that quality of education most strongly predicted total words recalled across five trials, such that stronger proficiency in their native language predicts a higher number of words recalled, $\beta=.37$, $p=.01$. Sex also predicted total learning, such that women recalled more words across the five trials, $\beta = -.26$, $p=.01$. Although years of education approached significance during correlation analysis, it was not included in this stepwise model. This indicated that quality of education may be a stronger predictor of verbal learning outcomes than years of education.

After performing these analyses using *semantic clustering* as an outcome variable, the final model indicated that four predictors (age, years of education, English Picture Vocabulary (bilingualism), quality of education) accounted for the most significant portion of the variance, $R^2=.28$, $F(4, 41) = 3.93$, $p<.01$. Two of these predictor variables were found to be significant predictors of semantic clustering. Quality of education was the strongest predictor of semantic clustering use among the Hispanic sample, $\beta= 0.44$, $p=.03$. Age was also found to be a significant predictor of semantic clustering, with the oldest adults utilizing semantic clustering at a lower rate, $\beta= -0.43$, $p=.01$. With regard to serial clustering, the final model identified three predictors (sex, years of education, acculturation) that accounted for a significant portion of the variance, $R^2=.34$, $F(3, 42) = 7.16$, $p=.001$. Specifically, the model indicated that sex and years of education were the strongest predictors of serial clustering use. As indicated by correlation

Table 94 Variables Identified by Stepwise Regression Analysis as Predicting the Learning Outcome Variables

Model	Variables	R	R ²	Unstandardized coefficient (β)	Unstandardized Coefficient (Standard Error)	Standardized Coefficient (β)	t	P
Total Learning	Constant	--	--	28.01	9.06	--	3.07	<.01*
	Sex and Quality of Education	0.48	0.23	-5.19 0.23	2.61 0.08	-0.26 0.37	-1.99 2.75	.05* .01*
Semantic Clustering	Constant	--	--	0.53	0.68	--	0.77	.44
	Age			-0.03	0.01	-0.43	-2.96	.01*
	Years of Education			-0.03	0.02	-0.35	-1.85	.07
	Bilingualism and Quality of Education	0.53	0.28	0.01 0.02	0.01 0.01	0.26 0.44	1.76 2.30	.09 .03*
Serial Clustering	Constant	--	--	-0.16	0.40	--	-0.41	.68
	Sex,			0.57	0.18	0.40	3.15	<.01*
	Years of Education and Acculturation	0.58	0.34	0.05 -0.50	0.02 0.19	0.40 -0.34	3.05 -2.59	<.01* .01*

analyses, men tended to use serial clustering more often than women, $\beta=0.41$, $p=.004$. In addition, participants with fewer years of education relied on rote memorization more frequently $\beta=0.40$, $p=.003$. Acculturation was also identified as a strong predictor of serial clustering use, such that those with lower levels of acculturation tended to rely on rote memorization more than those with higher levels of acculturation, $\beta=-0.34$, $p=.01$.

3.4.5 Hierarchical Regressions

The aim of these analyses was to observe the added predictive ability of cultural factors above and beyond standard demographic factors. Our initial hypothesis was that cultural variables would be able to provide additional information in predicting the learning outcomes of Spanish-speakers on standard list-learning tasks. Based on the findings from the previous backward regression analyses, hierarchical regression modeling was performed to assess the predictive ability of the identified cultural variables of interest, after controlling for significant demographic predictors.

The first hierarchical regression model was used to predict *total learning* across the five learning trials. Based on the previous analysis, sex was used as a significant demographic predictor. Years of education was also included as a demographic predictor because we predicted that quality of education, as measured by native language proficiency, would be a stronger predictor of total learning than years of education alone. Quality of education, therefore, was identified as the cultural predictor of interest.

Two standard demographic variables were entered into the first step of the model (sex, years of education). This model was statistically significant, $F(2, 43) = 3.58, p = .04$ and explained 14 % of variance in Total Learning (see Table 15). After entry of quality of education at Step 2 the total variance explained by the model as a whole was 23%, $F(3, 42) = 4.18, p = .01$. The introduction of quality of education explained an additional 9% of the variance in total learning across trials, after controlling for the effects of sex and years of education (R^2 Change = .09; $F(1,42) = 4.76, p = .04$). In the final model, only quality of education was statistically significant, with quality of education recording a higher Beta value ($\beta = .40, p = .04$) than sex ($\beta = -.27, p = .06$) and years of education ($\beta = -.05, p = .80$). The results indicate that a measure of

Table 10 Results of Hierarchical Regression Analysis of Cultural Variables on Learning Outcomes

Model	Variables	R	R ²	R ² Change	B	Standard Error	β	t	p
Total Learning	Step 1	0.38	0.14	0.14					
	Sex				-5.54	2.69	-0.29	-2.06	.05*
	Years of Education				0.39	0.25	0.22	1.57	.12
	Step 2	0.48	0.23	0.09					
	Sex				-5.05	2.59	-0.27	-1.95	.06
	Years of Education				-0.08	0.33	-.05	-0.26	.80
	Quality of Education				0.24	0.11	0.40	2.18	.04*
Semantic Clustering	Step 1	0.37	0.14	0.14					
	Age				-0.03	0.01	-0.37	-2.58	.01*
	Years of Education				0.01	0.01	0.07	0.51	.62
	Step 2	0.53	0.28	0.15					
	Age				-0.03	0.01	-0.45	-3.17	<.01*
	Years of Education				-0.03	0.02	-0.31	-1.64	.11
	Bilingualism				0.01	0.01	0.24	1.63	.11
	Quality of Education				0.01	0.01	0.43	2.23	.03*
Serial Clustering	Step 1	0.44	0.20	0.20					
	Sex				0.52	0.20	0.36	2.66	.01*
	Years of Education				0.04	0.02	0.29	2.14	.04*
	Step 2	0.56	0.31	0.11					
	Sex				0.54	0.18	0.37	2.95	<.01*
	Years of Education				0.05	0.02	0.38	2.92	<.01
	Acculturation				-0.53	0.20	-0.35	-2.70	.01*

native Spanish academic language proficiency, as a proxy for quality of education, is a better predictor of total learning outcomes than sex and years of education alone.

With regard to *semantic clustering*, previous analysis revealed that age at testing and years of education were important demographic predictors, and both bilingualism and quality of education may play important roles as cultural predictors for this analysis. Age and years of education were entered into the first step of the model as key demographic predictors. This model was statistically significant, $F(2, 43) = 3.43, p = .04$ and explained 14 % of variance in semantic clustering strategy use. After entry of the cultural variables at Step 2 the total variance explained by the model as a whole was 53%, $F(4, 41) = 4.07, p < .01$. The introduction of the cultural variables explained an additional 15% of the variance in semantic clustering, after controlling for the effects of age and years of education (R^2 Change = .15; $F(2, 41) = 4.21, p = .02$). In the final model, two predictor variables were statistically significant, with age at testing recording the highest Beta value ($\beta = -0.45, p < .01$). Quality of education was the second best predictor ($\beta = 0.43, p = .03$). The results indicate that age and quality of education combined provide the strongest predictors for semantic clustering use in the Hispanic sample, above and beyond years of education and level of bilingualism.

The final analysis evaluated demographic and cultural predictors for *serial clustering* strategy use during standard list-learning in the Hispanic sample. Previous analyses revealed that both age at testing and years of education may be important demographic predictor. They also suggested that acculturation may play an important role as a cultural predictor for serial clustering use. Thus, the two demographic predictors (age and years of education) were entered into the first step of the model as the key demographic predictors. This model was statistically significant, $F(2, 45) = 5.46, p = .01$, indicating that these standalone demographic variables

explain a significant amount of the variance of serial clustering use. The model explained 20% of the total variance of serial clustering use. After entry of acculturation at Step 2 the total variance explained by the model as a whole was 31%, $F(3, 44) = 6.59$, $p = .001$. The introduction of acculturation explained a significant amount of the variance in serial clustering use, after controlling for the effects of age and years of education (R^2 Change = 0.11; $F(1, 44) = 7.30$, $p = .01$). Consistent with predictions, this analysis suggests that acculturation is a significant predictor of serial clustering use, such that participants with lower levels of acculturation tended to rely more heavily on serial clustering strategy than participants with higher levels of acculturation.

4 DISCUSSION

The current study focused on improving the memory and learning abilities in diverse older adults, with a focus on Spanish-speaking Hispanic older adults. Its goal was to expand our general understanding of the impact of culture and language on verbal memory and semantic organization. This goal was addressed by: (1) examining performance differences between Hispanic Spanish-speaking and Caucasian English-speaking older adults using a standard verbal list-learning task administration, (2) then by modifying the standard task instructions to provide more explicit instruction on effective strategy use, and examining learning outcomes and changes from the standard results on the same participants. Finally, attention turned to explaining the differences found (3) by examining the impact of demographic and cultural variables on Hispanic within-group differences on standard list-learning outcomes.

4.1 Standard List-Learning Task

We examined differences between Spanish- and English-speaking older adults in the performance of a verbal list-learning memory test under standard task administration. This allowed us to discern any normative learning differences between the two racial/ethnic groups that might be observed within a typical evaluation. Based on findings in the literature suggesting variable performance of Spanish-speakers on memory tasks (Fernández & Marcopulos, 2008; Harris et al., 1995; La Rue et al., 1999), we hypothesized that learning differences would be present, with Spanish-speaking older adults recalling fewer words and utilizing less effective learning strategies than English-speaking older adults. Specifically, we predicted that Spanish-speaking older adults would rely more heavily on rote memory (serial order recall) than on a semantic organizational strategy (semantic clustering recall).

Our hypotheses were only partially supported. No overall differences in total learning were observed across the two racial/ethnic groups. Examination of the educational attainment of our groups revealed that while nearly all of the Caucasian sample had at least 12 years of education, 38% of the Hispanic sample had 11 or fewer years of education. We conducted further analyses by dividing Hispanic participants into a high education group (12 or more years of education) and a low education group (11 or fewer years of education). This allowed us to describe a group of participants with a higher mean education level than the national average for Hispanic older adults as a whole, as 100% of our high education Hispanic group had at least a secondary school degree, compared to only 55% in the Hispanic older adult population as a whole in the U.S. (Administration on Aging, 2010). As such, we were able to identify significant performance differences across the low education and high education Hispanic groups. Hispanic participants with low education recalled significantly fewer words than both the Caucasian and the Hispanic high education group. These findings suggest that level of formal education may be a significant contributor to the lower normative performance observed in Spanish-speakers across memory tests within both our study, and in the literature (Manly, Touradji, Tang, & Stern, 2003; Mungas, Reed, Haan, & González, 2005).

In terms of strategy use, a different story emerged. As predicted, Hispanic participants had lower semantic clustering index scores than Caucasian participants, regardless of level of education. In addition, no differences were observed across racial/ethnic groups in terms of reliance on rote memory (serial clustering). The fact that rates of serial clustering are not different across the groups, coupled with the observation that higher education Hispanic participants did not differ from higher education Caucasian participants in terms of total learning, is intriguing. This suggests that other strategies, or factors that are not captured by traditional

learning outcome scores, may be playing a role in the approach of Hispanic participants to this task.

Strategy selection has been described as an implicit process that results from learning experiences; research suggests that a history of success with a particular strategy would lead to its selection for use on future tasks with similar features (Reder & Schunn, 1996). Based on this notion, strategy use in our participants prior to explicit instruction provides a look at implicitly selected strategies for each racial/ethnic group, with strong links to previous learning experiences. Within our study, rates of semantic clustering use were depressed for Hispanic participants. This lower rate of clustering may be related to a shared early language learning experiences in the Spanish-speaking sample. These early experiences may have led to the development of different approaches to memory tasks that result in reduced semantic clustering use across all Hispanic participants.

However, for Hispanic participants with higher education in particular, reduced semantic clustering does not lead to reductions in total learning on list-learning tasks, and, they are not found to be using serial clustering at higher levels in a compensatory manner. As such, it is possible that different, and unidentified strategies have been employed by this group that allowed them to perform similarly to Caucasian participants with regard to total recall performance. Therefore, we hypothesize that Hispanic participants with higher levels of formal education have had greater opportunities to develop alternative strategies, which we don't understand at this point, for episodic word learning, than Hispanic participants with low formal education given their additional years of classroom instruction.

Within this study, we attempted to characterize differences in strategy selection by exploring participants' insight into their own strategy selection and self-monitoring of their

learning. In order to do so, participants were asked to report their primary learning strategy after standard list learning administration. A large proportion of Hispanic participants with high levels of education endorsed using the semantic clustering strategy (40%). In addition, a substantial percentage of Hispanic participants with low formal education (39%) were not able to identify a specific learning strategy use compared to 20% for those with high education, and 7% of Caucasian participants. Fifty percent of the low education Hispanic participants also indicated that serial clustering was their primary strategy, (e.g., “I try to remember them in the order you gave them to me”). These data largely fit the notion that participants with low education rely more heavily on rote learning approaches (Norman et al., 2000) and have reduced self-monitoring of learning (Dunlosky, Kubat-Silman, & Hertzog, 2003)

While low education Hispanic participants were unable to articulate additional strategies beyond semantic and serial clustering, 39% of high education Hispanic participants reported utilizing additional strategies. Some of the reported strategies included grouping together words that sounded similar (e.g., “camisa,” “cabeza”), or what we call *phonemic clustering* (13%), as well as linking related words together in different ways, or *word association* (13%). Examples provided of the word association strategy suggested that words were also often being related to the participants own lives (e.g., “my **father** has **leg** pain”). Nonetheless a significant proportion of Hispanic participants (28%) were unable to identify a strategy after standard list-learning. These findings are noteworthy, in that they support the idea that Hispanic participants may have learned different ways to encode verbal material, or may have related differences in self-monitoring of their learning processes.

We also explored the possibility that the differences in the observed rates of clustering may be related to differences in the “clusterability” of the words selected for the English and

Spanish lists themselves. A review of the methodology for the development of the list learning tasks suggests that both list-learning tasks used the same methodology for developing their lists of related words, with the exception that the SVLT only discarded two (rather than four) of the most prototypical words from their final semantically-related lists. This purposeful difference in developing the set of words in each semantic cluster was done so that the SVLT lists would be very familiar and easy to recall, and therefore possibly more easily clustered. Based on our own analyses of the data, rates of recall for words averaged by semantic category were comparable across the Spanish and English word lists, which supports the notion that the Spanish word lists are just as “clusterable” as the English versions. However, our results indicate that despite the comparable frequency scores, the Hispanic sample did not utilize a clustering strategy in the same way as our Caucasian sample. Further research would be needed to understand the interactive relationship between Spanish language, cognitive organization and formal education on verbal learning processes.

4.2 Performance given Explicit Strategy Instruction

Given the observed performance of the groups under standard task administration, we were able to evaluate how changes to task instruction impacted the learning outcomes across our two study groups. Specifically, we were interested in whether explicit instruction on the use of an effective learning strategy (i.e., semantic clustering) would impact the learning outcomes observed in both racial/ethnic groups. We developed two explicit instruction sets aimed at facilitating semantic clustering use. As we originally hypothesized, the Caucasian sample appeared to already implicitly select semantic clustering as their primary learning strategy compared to the Hispanic sample under standard task instruction. We therefore hypothesized that the more explicit strategy instruction would be most helpful to the Hispanic participants and that,

given increases in use of semantic clustering, observed total learning differences between the groups would be reduced.

Contrary to predictions, total learning for both the Hispanic and the Caucasian groups uniformly declined given any level of explicit strategy instruction. This finding is striking in that it suggests that strategy instruction actually created an interference effect for participants in terms of total list learning, possibly more for participants who had less exposure to related activities and tasks through formal education. Further analysis to determine the impact of different explicit levels of instruction yielded only some suggestion of an interaction between level of instruction and race/ethnicity observed.

With regard to semantic clustering, there was no indication that the more explicit strategy instruction mitigated the differences observed between Caucasian and Hispanic participants during standard task instruction. In fact, a significant interaction was observed between type of instruction and race, such that Hispanic participants demonstrated no response to the instructional change, while Caucasian participants increased their semantic clustering. Caucasians participants benefited similarly from both LE and HE strategy level of instruction on their semantic clustering use, while Hispanic participants showed no semantic clustering changes regardless of level of explicit strategy instruction.

While it is difficult to discern why the groups responded differently to explicit strategy instruction related to their clustering results, it is likely that baseline differences between the two groups may be a factor in their differential response to explicit strategy instruction. In the case of the Caucasian group, it is possible that the added strategy instruction served as a reminder, or prime, for a familiar strategy. In early work aimed at understanding strategy selection, Blessing & Ross (1996) demonstrated that strategy “reminding” influenced the method selected to solve

various tasks with similar features. It appears that for Caucasian participants, the strategy instruction, rather than teaching a novel approach to the task, served as such a reminder of the strategy.

The fact that the majority of Caucasian participants endorsed semantic clustering as a primary strategy under standard instruction supports the idea that adding more explicit strategy instruction served, at minimum, as a reminder of a previously used strategy and, at best, as a reinforcer for strategy preference during List B. In addition, while under standard instruction, the expected positive relationship between semantic clustering and total performance for Caucasians is observed (Delis et al., 2000). A reduction in total performance in this group is observed under more explicit strategy instruction, despite semantic clustering gains. The observation that Caucasian participants saw a decline in total learning as a result of the added instruction suggests that the more explicit strategy instruction may have shifted their attentional resources to the execution of the semantic clustering strategy, and reducing it toward their learning and memory resources, leading to a reduction in total recall performance. Thus, these semantic clustering gains appear to be in competition with the practice effects typically expected. These findings also indicate that high levels of semantic clustering do not always lead to better performance outcomes.

For Hispanic participants, the explicit strategy instruction appears to have introduced a relatively novel approach to the list-learning task for most participants given their performance under standard instruction. Attempts at semantic clustering may have even provided interference for a previously employed learning strategy. On the other hand, there is some evidence to suggest that Hispanic participants may employ less self-monitoring during learning tasks, which may have led to a less robust response to the strategy instruction. One indication of possible

reduced self-monitoring is that Hispanic participants make significantly more perseverative and intrusion errors than Caucasian participants in the study. While these monitoring errors are known indicators of brain pathology (Davis, Price, Kaplan, & Libon, 2002), our study suggests that it would be inappropriate to interpret them as such for Spanish-speaking older adults. Within our carefully screened sample of healthy Spanish-speaking older adults, these memory errors may tell a different story. The increase in memory errors may be, in fact, a compensatory strategy to increase learning gains, as well as an indicator of reduced cognitive self-monitoring during the learning task. The higher number of errors may also be a reflection of shifted attentional resources, as an increased focus on learning the list of words may lead to a reduction of self-monitoring processes.

Furthermore, this reduced cognitive self-monitoring may also explain why Hispanic participants showed less response to explicit strategy instruction on semantic clustering than Caucasian participants. In a recent study aimed at teaching compensatory learning strategies to older adults, Hertzog and Dunlosky (2011) found that participants who were taught cognitive self-monitoring techniques *in addition* to compensatory strategies were able to make much greater gains in overall learning when compared to participants who received compensatory strategy instruction alone. These self-monitoring techniques involved asking participants how likely they would be to recall the words in a subsequent trial, thereby redirecting their attention to learn material for which they feel less confident. Perhaps a similar approach to strategy instruction may have assisted Hispanic participants in gaining greater benefit from the explicit strategy instruction provided as part of this study. Within our study, we instead directed participants to focus on a particular strategy at the expense of focusing on total learning. Nonetheless, there appears to be a link between self-monitoring of learning and decreased

strategy use that should be further explored. As these patterns may be a result of differences in educational or cultural experiences between Caucasian and Hispanic older adults, exploring the link between self-monitoring and quality of education for Hispanic participants educated outside of the United States may provide further insight as to why Hispanic older adults are not implicitly selecting the semantic clustering strategy, nor respond similarly to strategy intervention as Caucasian older adults.

4.3 Demographic and Cultural Variables related to Hispanic Learning Outcomes

For Spanish-speaking older adults, the generalizability of the above findings is further complicated by the vast heterogeneity of this group on several demographic and cultural factors. For example, education differences were observed when comparing different regions of origin across our Hispanic sample, such that South American participants tended to have higher levels of education than groups from North and Central America. Within our Hispanic sample, other factors also demonstrated a wide range of variability including acculturation, socioeconomic status, exercise practices as well as our selected indices of the quality of education. Thus, our sample reflects the complexity of the Hispanic/Latino community within the United States, and many of the factors that make this population very complex to evaluate.

With regard to education, while it is hard to discern differences in formal education for our older adult participants across these regions, basic comparisons of current data are available. For example, a recent study assessing various educational factors characterizing Latin American schools found that training for teachers in the region as a whole varied greatly, with only 60% of teachers having completed university degrees, and 11% of teachers having high school or lesser educational attainment (Duarte, Bos, & Moreno, 2010). Nicaragua, Guatemala, Paraguay, and Peru were found to have the least percentage of teachers with university training, while Uruguay,

Costa Rica, Chile, and Argentina had the highest amount of teachers with formal university training. In addition, countries like Peru, El Salvador, Guatemala, and Nicaragua have the lowest percentage of students actually completing full school days, with most completing only part-time schooling (Duarte et al., 2010). Socioeconomic status is also strongly linked to the type of educational experiences available to individuals regardless of country of origin, as free primary education is not universally available to all children in Latin America. Clearly, a predictor such as years of education alone would have significant variability and wouldn't provide an accurate measure of achievement for Latin American immigrants.

Given the impact that these factors might have on verbal learning outcomes, analyses were carried out to determine the predictive ability of various demographic and cultural factors on list-learning outcomes. The result of this study have supported the notion that important cultural variables predict learning outcomes above and beyond standard demographic variables (Boone et al., 2007; Coffey et al., 2005; O'Bryant, O'Jile, & McCaffrey, 2004; Razani, Murcia, et al., 2007; Saez et al., 2014). Our initial predictions were that more years of education, better quality of education, higher SES, higher acculturation, and higher English-language competency would lead to better learning outcomes, but the relationships are complex.

4.4 Quality of Education

Several researchers have made efforts to quantify the 'quality of education' factor as it relates to cognitive testing in English-speaking older adults. In these studies, quality of education has been assessed in several ways, including single word reading (Manly, Jacobs, Touradji, Small, & Stern, 2002; Mathews et al., 2013), irregularly spelled word reading (Chin, Negash, Xie, Arnold, & Hamilton, 2012), and even a collection of quality of education indicators gathered through reports from the Department of Education from 1935, including school funding

and student-teacher ratio (Crowe et al., 2013). These studies overwhelmingly point to quality of education as a significant predictor of cognitive performance for these groups, above and beyond years of education alone. With regard to Spanish-speaking older adults, many of these approaches are not feasible, given that they were formally educated outside of the US and in a different language. Less work has evaluated the use of these methods with Spanish-speakers, though a word-reading measure as an index of pre-morbid IQ demonstrates some promise as a proxy for quality of education (Del Ser, González-Montalvo, Martínez-Espinosa, Delgado-Villapalos, & Bermejo, 1997; Krueger, Lam, & Wilson, 2006; J.Manly, Byrd, Touradji, Sanchez, & Stern, 2004).

In our study, we explored the impact of quality of education on the verbal learning performance of Hispanic older adults. We attempted to move beyond word-reading proxies of premorbid IQ with the hope that a more detailed measure of native language, academic verbal abilities would provide a more powerful tool for understanding performance variance in verbal learning outcomes. Our findings with regard to total learning and semantic clustering use are both consistent with previous studies of the impact of quality of education, but also suggest the need to pay closer attention to native language proficiency itself when evaluating Spanish-speakers, even for those who have more years of education. As Spanish-language neurocognitive measures continue to be developed, test developers may need to explore to what extent language proficiency demands of their measures impacts performance in older adults.

With regard to *total learning*, quality of education, as estimated through measurement of native academic language proficiency, appeared to be the most important predictor of how many words participants are able to learn across five trials. Quality of education was also a significant predictor of semantic clustering, explaining a significant proportion of the variance above and

beyond participant's age. This finding is noteworthy, in that it allows us to determine that quality of education is probably a contributor to strategy selection, independent of both a measure of years of education alone, as well as the "natural decline" of semantic clustering with age (Haarmann et al., 2005; Manly, Jacobs, Touradji, Small, & Stern, 2002a). This suggests that quality of education, as assessed through native academic language proficiency, may be an especially important factor to consider when conceptualizing cognitive test outcomes of Hispanic older adults.

4.5 Acculturation

While our analyses comparing serial clustering across racial/ethnic groups showed no between-group differences, our within-group analyses provided insight into the factors that predict serial clustering use in the Hispanic sample. Consistent with previous literature, sex and years of education were related to use of semantic clustering, such that women demonstrated less serial clustering use, and persons with higher education utilized the serial clustering strategy at lower rates (Norman et al., 2000; Stricker et al., 2002). We also identified level of acculturation as an important predictor for the use of serial recall during list-learning. Participants who were less acculturated appeared to rely more heavily on the serial recall strategy, even after controlling for years of education. In fact, with regard to acculturation, the two evaluated groups (traditional and low bicultural) did not differ in years of education or region of origin, thus these are not confounding factors of the relationship between serial recall and acculturation.

In order to better understand the implications of this analysis, a closer look at the way we defined the construct of acculturation is warranted. Generally, measurement of acculturation is conducted to provide a rough guide as to where a person is situated across a continuum of culture, with traditional culture on one end of the continuum and mainstream culture on the

other. The measure we selected for use, the ARSMA-II, provided such an orthogonal approach to assessing acculturation, while also providing two levels of biculturalism (low and high) to further characterize acculturation across immigrants living in the US. Within this measure, the basic components of acculturation that were examined were language use, ethnic identity, and ethnic social relations. Traditional acculturation, therefore, describes individuals with a strong endorsement of cultural identity to their home country, who select Spanish as their primary language for both conversation as well as media use, and whose social connections are primarily with others from their home culture. For primarily Spanish-speaking older adult immigrants, we expected that most would fall into the lower end of this continuum.

As predicted, our sample represents a group of older immigrants who are clustered around the lower ends of the cultural continuum of acculturation, with most falling either in the traditional level or the low bicultural level of acculturation. Several factors may account for these lower levels of acculturation. First and foremost, the number of years that our participants have lived in the United States is lower, as many older adult immigrants who continue to speak Spanish as their primary language have immigrated into the United States during older adulthood. This simply means that these individuals have typically had less opportunity to integrate into US culture than more bilingual persons. In fact, the two acculturation groups assessed in this study (traditional & low bicultural) significantly differed in the number of years they had lived in the US, where participants with traditional acculturation lived fewer years in the US compared to those with low bicultural levels of acculturation. Second, older immigrants have had longer exposure to their own cultural norms and values, which may create resistance to changes in their beliefs and behavioral systems (Yamada, 2006). In addition, older adults have been shown to have reduced cognitive flexibility and slowed processing speed that may make it

difficult to adjust to a new cultural environment (Deary et al., 2009; Friedman, Nessler, Cycowicz, & Horton, 2009). Considering these factors, the lower levels of acculturation of monolingual Spanish-speaking older adult immigrants may provide a clearer indication of how learning experiences outside of the United States may impact learning and memory assessment results for Spanish-speakers. Taken together, these findings imply that those less acculturated (perhaps due to the fewer years they have resided in the US) are likely to rely more heavily on serial recall strategies for initially learning the list of words relative to those who are more acculturated. Whether learning strategies are acquired explicitly (e.g., in the education system) or implicitly (e.g., as one is exposed to testing in the US) as one learns US culture warrants further investigation in future studies.

Based on the above findings, we suggest that the basic approach towards verbal learning tasks of our Hispanic sample may be influenced by a number of factors, including some basic demographic factors such as age and sex, as well as other important cultural factors, including the quality of education they received and more traditional levels of acculturation. While we are not able to directly link aspects of their learning to specific curricula or differences in learning experience, these findings further highlight the importance of considering cultural values in both the interpretation of verbal learning test outcomes.

4.6 Clinical Implications

The assessment of verbal learning and memory through list-learning tests has become a critical component in the evaluation of older adults, since a large range of psychiatric and neurological conditions present with impairments in encoding, storage and retrieval of verbal information. Given the importance of verbal list-learning tests, these measures should ideally be able to be used across different cultural and linguistic groups, with equivalent validity. A clearer

picture of how demographic and cultural variables impact such assessment measures will assist us in developing more accurate neuropsychological diagnosis with diverse older adults.

Overall, our results suggest that there are differences in the way that Spanish-speakers and English-speakers perform on verbal learning tasks. These differences are thought to reflect variations in the way Spanish-speaking older adults have “learned to learn” verbal information. In particular, while level of education may lead to comparable total learning outcomes, the strategies that Hispanic older adults use to learn the material may not be well characterized by our gold-standard list-learning measures. In fact, their initial approach to verbal learning tasks appears to be both culturally and educationally bound, and likely relate to the way they “learned to learn” prior to immigration into the United States.

Understanding how older Spanish-speaking immigrants “learned to learn” becomes especially important within the context of their response to cognitive intervention. As we discussed above, Spanish speaking older adults demonstrated minimal response to the types of strategy intervention used in this study, both for total learning and semantic clustering. In addition, markers of reduced self-monitoring of learning, such as the increased level of memory errors observed under standard administration, and the increased reliance on rote memory for participants with traditional acculturation, suggest that Hispanic participants may have a different predispositions for using cognitive control strategies during verbal learning as assessed by our traditional list-learning measures.

Further investigation into how cultural and demographic factors may impact verbal learning for Spanish-speakers may help us both reduce misattribution of learning outcomes (e.g., memory errors) as signs of pathology, as well as assist us in better identifying true abnormal cognitive declines in Spanish-speaking older adults. In fact, a recently published longitudinal

study aimed at identifying older adults who are at increased risk of future cognitive decline found that the ability of a verbal memory measure to predict longitudinal cognitive decline in Hispanic older adults was eliminated once demographic variables were included into analysis models (Farias, Mungas, Hinton, & Haan, 2011). Therefore, traditional assessment of verbal memory that does not take into account these demographic factors may not be the most suitable tools for predicting cognitive decline in Spanish-speaking older adults. Our study highlights how two important factors, quality of education and acculturation directly impact learning outcomes, and provide a call for further investigation of these relationships for the characterization of verbal learning in Spanish-speakers.

4.7 Limitations

We recognize that this study is not without its limitations. One of the major limitations of this study is that there are still many unknowns with regard to the best assessment measures for Spanish-speakers. While the selected instruments used in this study were considered the best available to provide appropriate and comparable measurement of the constructs of interest across language/ethnic groups, there remains ongoing measurement questions regarding their validity for work with ethnic minorities and linguistically diverse individuals. One example of this issue lies in the methodology for the development of our list-learning measures. Both measures were developed using similar methodology: a normative sample was given a series of categories and asked to generate as many words as they could think of that fit into that category. Essentially, the lists were developed through a verbal fluency-like procedure. An examination of the literature comparing verbal fluency outcomes between Spanish- and English-speakers indicates performance differences (Portocarrero, Burright, & Donovanick, 2007; Rosselli et al., 2000; Salvatierra, Rosselli, Acevedo, & Duara, 2007). Nonetheless, these measures are routinely used

for the assessment of a memory construct (i.e., episodic verbal learning), and it is likely that Spanish-speakers would be assessed with this or a similar measure during a standard cognitive evaluation. Therefore, it was still important to assess the clinical implications of using these measures with Spanish-speakers, and our findings provide some insight into these issues.

Another example of the measurement limitation is the challenge of differentiating quality of education measurements from measures of language abilities. As a field, we struggle with being able to separate the influence of education with a true measure of academic language abilities. In the case of our quality of education proxy score, native academic language proficiency, we expect that the added educational demands for the subtests (e.g., knowledge of sentence structure and grammar) allows us to differentiate this score from measures of more general language abilities (e.g., confrontation naming, verbal fluency). In addition, formal education has been more closely linked with these formal aspects of language use. While increases in formal education do not necessarily mitigate difficulties in general language abilities, formal academic language skills, such as reading and writing, are significantly advanced via quality of education. Therefore, we believe that native academic language proficiency is an appropriate proxy for quality of education in this context.

In addition to these measurement limitations, we are limited in the generalizability of our findings across the education spectrum, particularly for Caucasian participants. As we were unable to recruit a comparable low education sample for Caucasians, we cannot truly estimate how performance in the list-learning task may have been impacted by many of the same factors for our Caucasian group. In addition, it is difficult to know if the participants in our sample are representative of older adults outside of the Southeast United States. Particularly within our Hispanic sample, there are several sociopolitical factors that influence immigration patterns into

the United States, and related factors that we were not able to capture may influence the outcomes of this study. Future research would be needed to further explore these outcomes with a more educationally- and geographically-diverse sample.

Sample sizes were also a limitation in two aspects of this study. First, due to a small sample size for each explicit instruction level (e.g., only 24 participants in the Hispanic high explicit group), we may have limited our ability to identify significant findings due to loss of power. For example, an interaction between level of explicit strategy instruction and total learning is suggested by the data (see Figure 7). A larger sample size may have allowed us to more easily discern the impact of our instructional manipulation. In addition, while we assessed several demographic and cultural variables within our Hispanic sample, a larger sample would have permitted us to develop more complex hierarchical models for analysis.

Finally, while the aim of this study was to assess how demographic and cultural factors predict verbal learning outcomes for *primarily Spanish-speaking* older adults, the inclusion of balanced bilingual older adults would have allowed us to differentiate the impact of linguistic organization by language, and by learning history, on these learning and memory scores. Data such as this would undoubtedly enrich future studies in this area. Nonetheless, for the state of Georgia in particular, the number of balanced English/Spanish bilingual older adults is far lower than of monolingual Spanish-speaking immigrants, as Hispanic/Latino immigration into this region is relatively new. As such, we believe that assessing monolingual Spanish-speakers living in the United States poses unique challenges that are important to examine in their own right, particularly if we aim to provide valid evaluations for these individuals.

4.8 Future Direction

Two important areas of research emerge from this work: (1) a “look forward,” or an understanding of how these factors may influence both diagnosis of brain pathology and rehabilitation measures with ethnically and linguistically diverse older adults, and (2) a “look back” at how past experiences impacts organization for learned information both at the cognitive level and at the level of the brain.

In terms of “looking forward,” outside of improving our ability to differentiate cultural and experiential influences from pathological processes in our assessments, further characterization of these relationships may help us to improve our rehabilitation efforts with older adults. In a study investigating a memory-enhancement program geared toward teaching older adults to self-monitor their learning gains, Dunlosky, Kubat-Silman, and Hertzog (2003) studied two groups of older adults. In the first group, similar to our participants, older adults were taught only compensatory strategies geared at improving memory for paired associates. In the second group, participants were taught the standard compensatory strategies along with self-testing techniques geared at guiding adaptive learning. Their results indicated that the self-regulating group was able to take better advantage of the strategy instruction and make greater gains in overall learning. Given this intriguing literature, as well as our own findings, adapting interventions to include training in self-monitoring may assist in teaching compensatory strategies to older adults. Given our findings, this training in self-monitoring may be especially important for rehabilitation efforts with Hispanic older adults and groups with low education.

In addition to improving our diagnostic and rehabilitation efforts with diverse older adults, this research lays the foundation for “looking back” and investigating how past learning experiences can lead to structural changes in the brain. Within the current literature, frontal lobe

regions have been implicated in self-monitoring, and strategy selection and use, and the basal ganglia in particular, may also have a particularly important role in some of the implicit components of learning and memory. These regions are often associated with purposeful motor movement, but appear to also be fundamental in learning tasks involving goal-directed action such as strategy selection (Grahn, Parkinson & Owen, 2009). In fact, research has demonstrated that the dorsolateral pathway enhances the capacity of individuals to remember the association between words, which facilitates learning of these words (Blumenfeld & Ranganath, 2006; Murray & Ranganath, 2007). Through PET studies, it has been demonstrated that blood flow through the orbitofrontal cortex is also strongly correlated with total learning and semantic clustering use (Savage et al., 2001). In fact, a recent study has indicated that semantic clustering strategy training can lead to increases in activation of related memory and executive functioning networks (Miotto et al., 2013).

Our finding that primarily Spanish-speaking Hispanic older adults demonstrate reduced semantic clustering during standard list-learning trials may provide a valuable tool for exploring the relationship between white matter integrity in cortico-cortical pathways, blood flow to prefrontal regions and learning strategy selection in the context of diverse cultural and educational experiences. This work could greatly enhance our understanding of human development for the underlying mechanisms of learning, and further our understanding of the general plasticity of the human brain.

Conclusion

This study represents an important step forward towards better understanding the impact of culture and language on verbal memory and semantic cognitive organization and its assessment. Little research has examined the impact of culture and language on learning strategy

use and overall learning outcomes. This study examined these factors by comparing two groups of individuals (Hispanic and Caucasian older adults) from different cultural and linguistic backgrounds, but also by taking a closer look at those factors that impact verbal learning in an immigrant population.

As part of the first aim of this study, we examined performance differences between our two racial/ethnic groups under standard task instructions. Our findings suggest that education plays an important role in regard to total learning outcomes between Spanish-speaking and English-speaking older adults. When our Spanish-speaking participants had comparable levels of education to our English-speaking sample, we were able to observe that total learning was equal across groups, whereas Spanish-speakers with low levels of formal education performed significantly worse. Despite the benefit from education, we also identified a difference with regard to semantic clustering, where Caucasian participants successfully used this strategy while our Hispanic participants had significantly lower rates of use.

A significant strength of our study was the ability to not only compare the performance of English- and Spanish-speaking elders on a list-learning task, but to also examine their response to explicit strategy instruction. We expected that with the added instruction, differences observed between our two groups would be mitigated, and that both groups would ultimately benefit from this explicit instruction. While this hypothesis was not supported, the observations made with regard to group response to the instruction manipulation were informative and helped us better understand learning within our groups. We identified a decline in performance across groups given more explicit strategy instruction, which appears to have created an interference effect, or shifted attentional resources, particularly for Caucasian participants.

With regard to strategy instruction, we observed an interaction between strategy instruction and semantic clustering use. Caucasian participants who already implicitly employed semantic clustering as a primary strategy benefitted from instruction, while Hispanic participants did not show a response to added instruction. This differential response to intervention suggests that it is especially challenging for our Hispanic participants to employ this strategy, as it was not an implicitly employed strategy for most of these participants during the standard task. In order to expand on these findings, we explored factors related the performance of Hispanic participants under standard strategy instruction. Our findings support the notion that past cultural and learning experience impact strategy use, as participants with better quality of education utilized semantic clustering at higher rates, while participants with low levels of acculturation were more likely to rely on rote memory as a primary learning strategy.

We believe that these findings are useful when performing memory and learning assessments with these types of patients, and will assist us in understanding the verbal learning outcomes of diverse older adults. We also suggest that our findings highlight a need to move beyond the characterization of performance for diverse older adults. While characterizing the impact of linguist and cultural variables on the outcomes of cognitive assessment is important in helping us to better serve diverse older adults, we believe that a move towards more experimental examination of learning will greatly propel cross-cultural neuropsychological research forward. In this way, we can also improve the link between cultural competency in our diagnostic work and efforts to provide rehabilitation therapies for individuals from diverse backgrounds.

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APPENDICES

Appendix A. Bivariate Correlations of Demographic and Cultural Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Age	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2. Sex	-.19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3. Years of Edu	.03	-.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4. Current Income (range)	-.08	-.14	.22	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
5. Ladder: Current SES	-.02	-.15	.64**	.21	--	--	--	--	--	--	--	--	--	--	--	--	--	--
6. Ladder: Childhood SES	-.17	.09	.56**	.14	.40**	--	--	--	--	--	--	--	--	--	--	--	--	--
7. SES: Childhood Rating	-.07	.05	.57**	.07	.38*	.77**	--	--	--	--	--	--	--	--	--	--	--	--
8. Acculturation	-.1	.05	.26	.27	.37*	.24	.21	--	--	--	--	--	--	--	--	--	--	--
9. Years lived in the US	.17	.06	.04	.33*	.16	.07	.08	.35*	--	--	--	--	--	--	--	--	--	--
10. Region of Origin	.14	-.14	.46**	.23	.21	.27	.13	.03	.20	--	--	--	--	--	--	--	--	--
11. English Picture Vocabulary	-.1	.02	.41**	.27	.17	.40**	.37*	.56**	.52**	.31*	--	--	--	--	--	--	--	--
12. Aerobic Exercise	-.31*	-.11	.32*	.13	.48**	.03	0.04	.11	.31*	.11	.20	--	--	--	--	--	--	--
13. Language Proficiency	.27	-.09	.68**	.23	.41**	.47**	.64**	.14	.17	.38*	.30*	.15	--	--	--	--	--	--
14. Dictation	.04	-.13	.17	-.11	.05	-.18	-.14	-.10	-.08	.06	.26	.12	.91**	--	--	--	--	--
15. Passage Comprehension	.04	-.12	.14	-.12	.03	-.20	-.16	-.11	-.08	.4	.23	.11	.83**	.99**	--	--	--	--
16. Understanding Directions	.06	-.10	.19	-.11	.07	-.16	-.11	-.10	-.08	.05	.26	.12	.81**	.99**	.99**	--	--	--
17. Spanish Picture Vocabulary	-.40	.19	.52**	.08	.29	.40**	.54**	.27	-.06	-.02	.27	.13	.77**	.55**	.65**	.73**	--	--
18. Story Recall	.09	-.25	.18	.24	.19	.05	.07	.25	.15	.16	.18	.09	.20	-.04	-.04	-.02	.05	--

* $p < .05$; ** $p < .01$

Appendix B: Screening Materials

Telephone Screening: English

Participant Screening Form

Participant # _____ Screener: _____ Date: _____

Hello, my name is xxx and I am a student at Georgia State University. I'm (**contacting you/returning your call**) on behalf of the GSU memory study. First, to let you know a little more about the study, we are conducting memory and language tests with healthy older persons in Georgia to better understand the memory changes during the aging process. This study involves a 1-time testing appointment of about 1 ½ to 2 hours, and we will give you up to \$20 for your time.

If you are interested, I can ask you some screening questions today. These questions will help me determine if you are eligible to participate in the study and should take only 5 minutes. If you are not eligible to participate at this time, all information that I have collected from you today will be destroyed.

Would you like to answer some questions to see if you are eligible for the study?

Circle:

YES NO

Name: _____ Phone: _____

Age: _____ (**Must be 60+**)

Sex (M/ F/ Other _____)

Race/Ethnicity: _____ (**Must endorse Caucasian/White**)

"I will begin with a brief memory test. I am going to read you 3 words that you will have to remember now and later on. Listen carefully. When I am through, tell me all the words that you can remember. It doesn't matter in what order you say them"

Words (check): Glasses Bus Nose

I am going to read the same list for a second time. Try to remember and tell me as many words as you can, including words you said the first time."

Words (check): Glasses Bus Nose

"I will ask you to recall those words again at the end of the screening."

PLACE OF BIRTH: _____ (**MUST BE US**)

Were your parents born in the United States? YES/ NO (**Must be YES**)

Language:

First language: _____ (**Must be English**)

Dominant Language English? YES/ NO (**Must be YES**)

Fluency in English language: poor / fair / good/ excellent (**Must be good or excellent**)

Other languages spoken: _____

Are you currently experiencing **significant** memory problems (not related to normal aging)? YES/
NO **(Must be NO)**

Do you have any neurological conditions (e.g. seizures, strokes, etc.)? YES/ NO **(Must be NO)**

Have you ever had a head injury in which you lost consciousness for more than 5 minutes? YES/
NO **(Must be NO)**

How many standard drinks of alcohol do you have in a typical day? ____ **(Must be 0-2)**

Are you currently using any street drugs or other illicit substances? **(Must be NO)**

“I read some words to you earlier, which I asked you to remember. Tell me as many of those words as you can remember.”

Words (check): Glasses Bus Nose

If eligible:

Thank you very much for taking the time to answer my questions. At this time, you are a great candidate for this study. As a reminder, the study will require you to schedule an appointment for approximately 1 ½ to 2 hours. This time can also be split into two appointments, for your convenience. On the day of testing, you will receive another brief screening measure during the first 30 minutes of testing. If you are found ineligible, you will receive a small thank you gift of \$10. If you complete all testing, you will receive a gift of \$20. You will receive a small gift of \$20 for your time. Are you interested in participating at this time?

Circle:

YES NO

If **yes**, schedule appointment using google calendar. **Remind them to bring list of meds.**

Circle: GSU WW Home visit (complete home visit form)

Appointment Date, time and tester:

If **no**: “Thanks you for your help. I will be shredding your information at this time. Have a nice day/evening. Bye.”

If ineligible:

Thank you very much for taking the time to answer my questions. Your responses are very helpful to us. At this time, based on the answers you gave us, you are not eligible to participate in the study because

1. You endorsed learning English as a second language/having parents who didn't speak English/immigrating to the US.
2. You have endorsed a medical difficulty/neurological condition that can sometimes cause memory difficulties.
3. You are experiencing memory difficulties.
4. You have endorsed a level of alcohol/substance use, which can sometimes lead to memory difficulties.

Do you have any questions? If you have any further questions about our study, you can call me at 404-413-6343. You can also reach Dr. Robin Morris at 404-413-2502

Thanks again for your help and have a nice day/evening.

Telephone Screening: Spanish

Participant Screening Form (SPANISH)

Participant # _____ Screener: _____ Date: _____

Hola, mi nombre es XXX y soy un estudiante de la Universidad Georgia State. Le estoy (**llamando / devolviendo la llamada**) para darle información sobre nuestro proyecto con personas mayores en Georgia. Estamos realizando pruebas de memoria y de lenguaje con personas edad avanzada (60 años o más) en Georgia para comprender mejor los cambios en la memoria humana durante el proceso de envejecimiento. Si le interesa participar, se le haría una entrevista y algunas pruebas durante una sola cita que tomará alrededor de 1 1/2 a 2 horas, y le daremos un regalo de agradecimiento de hasta \$ 20.

Si usted está interesado/a, le puedo hacer unas preguntas de selección hoy. Estas preguntas me ayudarán a determinar si usted es elegible para participar toman sólo 5 minutos. Si usted no es elegible para participar, toda la información que me dé será destruida.

¿Le gustaría responder a algunas preguntas para ver si es elegible para esta investigación? SI NO

Nombre: _____ Numero Telefónico : _____
 Edad: _____ (**Must be 60+**)
 Sexo (M/ F/ Other _____)
 Raza/Etnia: _____ (**Must endorse Hispanic/Latino**)

“Ésta es una pequeña prueba de memoria. Le voy a leer 3 palabras que debe recordar. Escuche con atención y, cuando yo termine, me gustaría que me diga todas las palabras.”

Words (check): Mesa Gato Amigo

“AHORA LE VOY A REPETIR LAS 3 PALABRAS UNA VEZ MÁS. INTENTE ACORDARSE DEL MAYOR NÚMERO POSIBLE.”

Words (check): Mesa Gato Amigo

DONDE NACIÓ?: _____ **PRIMAR LENGUAJE:** _____

¿Su lenguaje primario de uso es el español? SI/ NO (**Must be SI**)

Fluidez en Español: limitada / más o menos /buena/ excelente (**Must be buena or excelente**)

Fluidez en Ingles: limitada / más o menos /buena/ excelente (**Must be buena or excelente**)

¿Está teniendo problemas **significativos** de memoria (no relacionados con el envejecimiento normal)? SI/ NO (**Must be NO**)

¿Tiene alguna enfermedad neurológica (por ejemplo, convulsiones, derrames cerebrales, etc)? SI/ NO (**Must be NO**)

¿Alguna vez ha sostenido un golpe a la cabeza en el cual perdió la conciencia por más de 5 minutos? SI/ NO (**Must be NO**)

¿Cuántas bebidas de alcohol toma en un día normal? ____ (**Must be 0-2**)

¿Utiliza actualmente drogas ilegales u otras sustancias ilícitas? (**Must be NO**)

“Antes le leí una serie de palabras y le pedí que las recordara. Dígame ahora todas las palabras de las que se acuerde”.

Words (check): Mesa Gato Amigo

If eligible:

Muchas gracias por tomarse el tiempo para responder a mis preguntas. En este momento, usted es un/a buen/a candidato/a para este estudio. para recordarle, el estudio requiere que haga una cita de aproximadamente 1 1/2 a 2 hours. Las citas se realizan en GSU, el Hospital de Emory, o también podemos ir a su casa. En el día de la prueba, recibirá otra breve prueba de selección durante los primeros 30 minutos. Si no es elegible después de esta prueba, usted recibirá un pequeño regalo de agradecimiento de \$ 10. Si completas todas las pruebas, usted recibirá un regalo de \$20. ¿Estás interesado en participar en este momento?

Circle: SI NO

If **yes**, schedule appointment using google calendar. **Remind them to bring list of meds.**

Circle: GSU WW Home visit (complete home visit form)

Appointment Date, time and tester:

If **no**: “Gracias por su ayuda. Vamos a destruir la información que lo identifica. Que tenga un/a buen/a día/noche. Adiós.”

If ineligible:

Muchas gracias por tomar el tiempo para responder a mis preguntas. Sus respuestas nos van a ayudar mucho en nuestro estudio. Es este momento, basada en sus respuestas de hoy, usted no es elegible para participar en esta investigación porque:

[dar la razón adecuada por la cual no es elegible]

- 1) Usted tiene una condicion medica/neurológica/psiquiátrica que a veces puede causar problemas de memoria.
- 2) Usted indico que está teniendo problemas con su memoria.
- 3) Usted indico que le han dado una diagnosis de demencia.
- 4) Usted a indicado un nivel de consumo de sustancias/alcohol que a veces pueden causar problemas de memoria.

¿Tiene alguna pregunta? Si usted tiene más preguntas acerca de nuestro estudio, puede llamarme al 404-413-6343. También puede comunicarse con el Dr. Robin Morris en el departamento de psicología en 404-413-2502 y el le puede dar más información.

Muchas gracias de nuevo por su ayuda y que tenga un/a buen/a dia/noche.

Day of Testing Questionnaire: English

Participant Information Questionnaire

*To be completed by examiner via **oral interview***

Subject Code#: _____

DOB: _____ Age: _____ Sex (M/ F/ Other _____)

Handedness: Left/ Right/ Ambidextrous

Race (check one): Hispanic or Latino _____; Caucasian/White _____; Black or African American _____ Other (please write in): _____

Ethnicity (write in): _____

Currently employed: Full-time/ Part-time/ Retired (how long? _____ years)Profession (present or past for those who are retired): _____Socioeconomic Status:

Household income: < 25K/ 25K-49,999K/ More than 50K

Marital Status: Married/Partnered /Single /Divorced/Widowed1. Where were you born? _____ (**must be U.S.**)

Have you ever lived in another country? Yes _____ No _____

If yes, where and how many years? _____

2. Were your parents born in this country? Yes _____ No _____ (**must be YES**)

If not, where were they born? _____

3. *Language*:Is English your first language? _____ (**must be YES**)

Do you speak other languages? _____

What % of time do you speak English currently in your home? _____

Fluency in English language: poor fair good excellent (**must be Good or Excellent**)4. *Education*:

How many years of education/school have you completed? _____

What degree(s) have you earned? _____

Did you complete all of your education in the US? _____

If not in the US, where? _____

What's the length of time you were educated outside of US? _____

What were your average grades? Poor Average Good Excellent

Did you have trouble learning in school? _____

Ever suspected or diagnosed with an LD? _____

5. Do you have any chronic medical problems (e.g, heart condition, high blood pressure, lung disease, diabetes)?

Yes / No

If yes, what is (are) the condition(s)? _____

When were you diagnosed? _____

When did you start treatment? _____

What treatment are you receiving? _____

Details of chronic medical condition:

6. Are you experiencing **significant** memory problems? Yes/No (**must be NO**)

7. Do you have any neurological conditions (e.g., seizures, stroke, etc.)? Yes / No

(**must be NO**)

If yes, what is the condition? _____

5. Have you ever had a head injury? Yes / No

If yes, how many (include age)? _____

Did you lose consciousness? _____

If yes, how long did you lose consciousness for? _____

(**must have lost consciousness for no more than ___ minutes**)

Details of head injury:

6. Have you had any mental health treatment? Yes / No

If yes, for what reason?

What was your diagnosis? _____

When were you diagnosed? _____

What was the treatment? _____

Details of mental health condition:

7. **AUDIT-C:** Alcohol Screen

I. How often do you have a drink containing alcohol?

- a. Never
- b. Monthly or less
- c. 2-4 times a month
- d. 2-3 times a week
- e. 4 or more times a week

II. How many standard drinks containing alcohol do you have on a typical day?

- a. 1 or 2
- b. 3 or 4
- c. 5 or 6
- d. 7 to 9
- e. 10 or more

III. How often do you have six or more drinks on one occasion?

- a. Never
- b. Less than monthly
- c. Monthly
- d. Weekly
- e. Daily or almost daily

Scoring: a=0 points, b= 1 pt, c= 2 pts, d= 3 pts, e= 4 pts

SCORE: _____

Discontinue testing if:

In men, scores above 4

In women, scores above 3

8. Are you currently using any drugs or other illegal substances? Yes /No
(must **NOT** endorse current use)

Past use? Yes /No

If yes, when and how long did you use? _____

During the heaviest, how much did you use? _____

When did you stop? _____

Did you receive treatment? _____

Details of drug use:

_____f. 9. Are you currently on medications? Yes/ NO

Medication	Dosage	Reason why taking Med	How long?
------------	--------	-----------------------	-----------

Day of Testing Questionnaire: Spanish

Cuestionario de Información del Participante
Sera completado por el investigador en una entrevista oral

Subject Code#: _____

Fecha de Nacimiento: _____ Edad: _____ Sexo (M / F/ Otro _____)

USO DE LA MANO: IZQUIERDA/ DERECHA/ LAS DOS

Raza (marque una): Hispano o Latino _____; Anglosajón/Blanco _____; Negro o Afro-Americano _____ Otra (por favor describa): _____

NACIONALIDAD (PAÍS DE ORIGEN DE UD. O SU FAMILIA): _____

Profesión (actual, o pasada para los que se han jubilado): _____

Actualmente empleado: Tiempo completo/ Medio Tiempo/ Jubilado/Desempleado
 Tiempo Jubilado: _____

Estado civil: Casado/ En pareja estable /Soltero / Divorciado/Viudo

1. ¿Cuándo llegó usted a este país? _____
 ¿De dónde inmigro? _____

2. ¿Sus padres inmigraron a este país? Sí _____ No _____
 ¿Cuántos años llevan en los EEUU? _____

3. *Lenguaje:*

¿Cuál fue su primer lenguaje? _____

Aptitud en Español: Mínima Suficiente buena excelente

¿Habla Inglés? _____

Aptitud del idioma Ingles: Mínima Suficiente buena excelente

¿Qué lenguaje usaban en la casa durante su niñez? _____

¿Qué % del tiempo se hablaba Inglés? _____

¿Cuántos años tenía cuando empezó a hablar Inglés? _____

¿Qué lenguaje se usa actualmente en su hogar? _____

¿Qué % del tiempo se habla Inglés en su hogar? _____

4. *Educación:*

¿Cuántos años atendió a la escuela? _____

¿Qué título obtuvo? (en cualquier país)? _____

¿En qué país atendió a la escuela? _____

¿Cuántos años de estudios a completado en los EEUU? _____

¿Cómo estaban sus calificaciones en la escuela?

Bajas Pasables Buenas Excelente

¿Tuvo problemas de aprendizaje? _____

5. ¿Tiene usted alguna enfermedad crónica? (ej., enfermedades del corazón, presión alta, enfermedades de los pulmones, diabetes)?

Sí / No

Si la respuesta es sí, ¿Cuál es (son) esta(s) enfermedad(es)?

¿Cuándo fue usted diagnosticado? _____

¿Cuándo comenzó su tratamiento? _____

¿Qué tratamiento está recibiendo? _____

Detalles sobre las enfermedades crónicas:

6. ¿Está usted teniendo problemas con su memoria?

Sí / No

¿Ha sido diagnosticado con alguna forma de demencia?

Sí / No

Si la respuesta es sí, ¿Cuál es el diagnóstico? (e.j., Párkinson, Alzheimer, demencia frontotemporal, demencia vascular, etc.) _____

7. ¿Tiene/a tenido usted alguna enfermedad neurológica (como derrames cerebrales, epilepsia, embolio, convulsiones, migrañas, etc.)? Sí / No

Si su respuesta es sí, ¿cuál es la enfermedad? _____

¿Cuándo fue diagnosticada? _____

8. ¿Ha sostenido en el pasado una lesión o golpe a la cabeza?

Sí / No

Si su respuesta es sí, ¿Cuántos golpes (incluya la edad)? _____

¿Perdió usted el conocimiento/se desmallo? _____

¿Por cuánto tiempo? _____

Detalles del golpe a la cabeza:

9. ¿Obtuvo alguna vez tratamiento psicológico/psiquiátrico?

Sí / No

¿Por cuál razón? _____

¿Cuál fue su diagnóstico? _____

¿Cuándo fue diagnosticado? _____

¿Cuál fue su tratamiento? _____

Detalles de la enfermedad psiquiátrica:

11. AUDIT-C Alcohol Screen

I. ¿Con que frecuencia toma alcohol?

a. Nunca

b. Mensual o menos

c. 2-4 veces al mes

- d. 2-3 veces a la semana
- e. 4 o más veces a las semana

II. ¿Cuántas bebidas alcohólicas tiene usted en un día normal?

- a. 1 o 2
- b. 3 o 4
- c. 5 o 6
- d. 7 o 9
- e. 10 o mas

III. ¿Con qué frecuencia tiene seis o más bebidas alcohólicas en una ocasión?

- a. Nunca
- b. Mensual o menos
- c. Mensual
- d. Semanal
- e. Diario o casi diario

Calificar: a=0 points, b= 1 pt, c= 2 pts, d= 3 pts, e= 4 pts

CALIFICACION: _____

Termine la evaluación, si:

En los hombres, **4 o más**

En las mujeres, **3 o más**

12. ¿Utiliza actualmente algún medicamento o sustancias ilegales? Sí / No (**must be no**)

13. Utilizo en el pasado? Si/No

Cuáles drogas usaba? _____

¿Por cuánto tiempo las uso? _____

Las veces que consumió la mayor cantidad de sustancias, ¿cuánto consumía?

¿Cuándo paro de usar las drogas/alcohol? _____

¿Recibió tratamiento? _____

Detalles del abuso de alcohol/sustancias:

13. Actualmente, ¿está tomando algún medicamento?

Sí / No

Medicación Dosis Razon por cual la toma Por cuánto tiempo?