Title
Performance of Japanese Americans on selected cognitive instruments

Author
Kemmotsu, Nobuko

Publication Date
2010

UNIVERSITY OF CALIFORNIA, SAN DIEGO

SAN DIEGO STATE UNIVERSITY

Performance of Japanese Americans on Selected Cognitive Instruments

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

in

Clinical Psychology

by

Nobuko Kemmotsu

Committee in charge:

University of California, San Diego

Frank Haist
Robert K. Heaton
David P. Salmon
Michael J. Taylor

San Diego State University

Claire Murphy, Chair
Sarah Mattson

2010

The Dissertation of Nobuko Kemmotsu is approved, and it is acceptable in quality and form for publication on microfilm and electronically:

Chair

University of California, San Diego

San Diego State University

2010

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGEMENTS

I would like to express my gratitude to all the study participants who made this project possible. I thank Miyo Reff, Joyce Teague, Steve Sato, Trace and Mildred Kawasaki, Jeanne Elyea, Gwen Momita, Mitsuo Tomita, Timothy and Junko Kajita, Glenn and Kathleen Negoro, Kimie Kaneyuki, Masanobu Kinjo, and So Yamada for their help with providing me the connections to the Japanese American community.

My sincere gratitude also goes to Yurika Enobi, Adeleine Conanan, Miki Ishikawa, Bonnie Aguiar, Catherine Sumida, Susy Bonilla, and Sally Pierce for their hard work with recruitment, testing, and scoring.

I thank Professor Scott Roesch for his expertise in statistics.

I thank Professor Claire Murphy and my committee, for their guidance and warm support.

I thank my parents and my sister, for their confidence in me. Finally, I thank my husband James, for love, encouragement, and sacrifice.

VITA

EDUCATION

2009-2010	Internship, University of Florida, Department of Clinical & Health Psychology
2010	Doctor of Philosophy, University of California, San Diego/San Diego State University Joint Doctoral Program in Clinical Psychology
2003	Master of Arts, San Diego State University
2000	Bachelor of Arts, International Christian University

PROFESSIONAL EXPERIENCE

2001-2003	Research Assistant, Brain Imaging Development Laboratory, San Diego State University
2001-2010	Research Assistant, SDSU Lifespan Human Senses Laboratory, San Diego State University

PUBLICATIONS

Journal Articles

Kemmotsu, N., Price, C.C., Oyama, G., Okun, M.S., & Bowers, D. Pre- and post-DBS neuropsychological profiles of a Filipino gentleman with X-linked dystonia-Parkinsonism (in preparation).

Kemmotsu, N., & Murphy, C. Restrained eaters showed altered brain response to saccharin (in preparation).

Kemmotsu, N. & Murphy, C (2006). Olfactory Event Related Potentials to food and non-food odors in restrained and unrestrained eaters. Physiology and Behavior, 87(2), 323-329.

Kemmotsu. N., Villalobos, M.E., S., Gaffrey, M. S., Coourchesne, E., & Müller, R.A. (2005). Activity and functional connectivity of inferior frontal cortex associated with response conflict. Cognitive Brain Research, 24(2), 335-342.

Villalobos, M.E., Mizuno, A., Dahl, B.C., **Kemmotsu, N.**, & Müller, R.A. (2005). Reduced functional connectivity between V1 and inferior frontal cortex associated with visuomotor performance in autism. Neuroimage, 25(3), 916-25.

Müller, R.A, Kleinhans, N., **Kemmotsu, N**, Pierce, K., & Courchesne, E. (2003). Abnormal variability and distribution of functional maps in autism: an FMRI study of visuomotor learning. American Journal of Psychiatry, 160(10), 1847-62.

Müller, R.A, Kleinhans, N., Pierce, K., **Kemmotsu, N**., & Courchesne, E. (2002). Functional MRI of motor sequence acquisition: effects of learning stage and performance. Cognitive Brain Research, 14(2), 277-93.

ABSTRACT OF THE DISSERTATION

Performance of Japanese Americans on Selected Cognitive Instruments

by

Nobuko Kemmotsu

Doctor of Philosophy in Clinical Psychology

University of California, San Diego, 2010

San Diego State University, 2010

Professor Claire Murphy, Chair

There is ample evidence that African Americans and Hispanic Americans demonstrate lower scores on widely used neurocognitive tests, compared to non-Hispanic Caucasians. However, there is a scarcity of empirical data for Asian Americans. This study aimed to examine cognitive test performance of one of the Asian American subgroups: Japanese Americans.

Seventy-one Japanese Americans (JAs) and 71 Caucasian Americans (CAs), ages between 45-91, participated in the study. The Boston Naming Test-2 (BNT), San Diego Odor Identification Test (SDOIT), Controlled Oral Word Association test (COWA-FAS), category fluency test (Animal Fluency), California Verbal Learning Test (CVLT), California Odor Learning Test (COLT), and Brief Visuospatial Memory Test-Revised (BVMT-R) were administered. We collected data on levels of acculturation, quality of educational attainment (Wide Range Achievement Test-4 Reading and Math Computation subtests), bilingual status, and generation status in the U.S.

There were no significant differences between the two ethnic groups on the battery of neuropsychological tests. However, the two groups showed somewhat different patterns in the associations between the test performance, and age and gender. JAs tended to show a stronger age-score relationship on the BNT, SDOIT, BVMT-R total recall, and COLT total recall. With regard to gender, JA men tended to score lower than JA women and than CA men on CVLT Trial 5. Additionally JA men tended to score lower than JA women on the CVLT Long Delay Cued Recall.

When the raw scores of the JAs were converted into demographically corrected scores using the Caucasian norm, JAs had more measures that yielded larger "impairment" rate compared to theoretically driven rate (15.6%) compared to Caucasian Americans. The second-generation JAs showed a much larger proportion of "impaired" compared to the third-generations, on the BVMT-R Total Recall and BVMT-R Delayed Recall.

The results indicated that some neuropsychological test results need to be interpreted with caution in the older JAs, at least until culturally appropriate norms become available. Future studies are needed to investigate if this pattern would persist in the succeeding generations, and in the descendants of the post-war immigrants from Japan.

I. INTRODUCTION

As the United States becomes more ethnically diverse, the need for culturally sensitive and accurate psychological assessment is increasing. One of the challenges that psychologists face upon conducting an assessment in this diverse society is a potential test bias against ethnic minority groups. The test bias stems from the fact that most psychological instruments in use are standardized and validated with mostly non-Hispanic Caucasian normative samples, therefore, they likely reflect the values of Caucasian-American middle class society. There tend to be systematic errors in assessment due to the questionable validity of an instrument when it is used in ethnic minority groups. Neurocognitive tests, which are used to examine brain-behavior relationships and to detect acquired brain disorders, are frequently subject to such bias. A number of productive research endeavors have been taken in an attempt to explain the reported differences in test performance between Caucasian Americans and some of the ethnic minority groups. These studies continue to inform the practitioners and researchers of how to make the most valid and culturally sensitive assessment of individuals with ethnic minority backgrounds. For African Americans and Hispanic Americans, ethnicity/race specific norms, one of the solutions for the biases against ethnic minorities, are now available for some tests. However, there is a scarcity of empirical data for Asian Americans, despite the fact that they are the fastest growing ethnic minority group in the United States. There are some inherent difficulties to studying Asian Americans. First, Asian Americans are a group that is quite heterogeneous, with inter-group differences among Asian American sub-groups. Furthermore, similar to Hispanic Americans, immigration policies and patterns have influenced the makeup of each subgroup of Asian Americans (Wong, 2000), which is producing intra-group differences. The current study aims to examine cognitive test performance of one of the Asian American subgroups: Japanese Americans. This dissertation will first discuss the importance of "ethnicity" in assessment, review the past literature on cognitive test performance of ethnic minorities, and describe the characteristics of Japanese Americans. This will then be followed by results of a study that aimed at examining Japanese Americans' performance on selected cognitive tests.

Assessment and Ethnicity

Proper evaluation of an assessment instrument is an essential step to responsible and competent test use, when conducting a cognitive assessment of individuals of any ethnic background (Cicchetti, 1994). Especially important aspects of an instrument to be evaluated are adequacy of norms, validity, and reliability.

Evaluation of an Assessment Instrument

Norms on assessment instruments are used as a standard against which an individual's performance will be evaluated and interpreted, by providing psychologists with the information regarding what constitutes a "normal" or expected range of performance. Thus, when the purpose of an assessment is to assess and diagnose the cognitive component of mental status, it is crucial to use a test that is properly standardized and validated with a normative reference group that shares relevant demographic characteristics with the individual being assessed (Heaton, Ryan, Grant, & Matthews, 1996; Mitrushina, Boone, & D'Elia, 1999). As effects of age and education on cognitive test performance have been established, more norms are becoming stratified by age and education, providing clinicians with guidance and tools for an improved diagnostic accuracy.

Validity is considered the most crucial issue in test development. Validity is not a single entity and is established across different types and levels, and usually summarized into content-related, construct-related, and criterion-related validity (Mitrushina, et al., 1999; Strauss, Sherman, & Spreen, 2006). Validity essentially refers to the degree to which a test is measuring what it is intended to measure.

Reliability of a measurement refers to its degree of stability, consistency, predictability, and accuracy. Indices of reliability indicate the degree to which a test is free from measurement error. Internal reliability reflects the extent to which items within a test measure the same cognitive domain or construct. Test-retest reliability provides an estimate of the correlation between two test scores from the same test administered at two different points in time. A test with good temporal stability should show little change over time, providing that the trait being measured is stable.

Even if a particular neurocognitive test is shown to have excellent norms, reliability, and validity with a non-Hispanic Caucasian sample, most psychologists would consider the use of norms consisting of mostly non-Hispanic Caucasians inappropriate when assessing an ethnic minority individual. But, why does ethnicity matter?

Why Does Ethnicity Matter?

Ethnicity is a concept used to categorize human beings based on common ancestry, physical characteristics, language, and heritage, and thus, by definition, it often is confounded with culture, language, and other social variables such as socioeconomic status and education (Wong, 2000), all of which may impact individual's neurocognitive performance. Nevertheless, ethnicity can serve as a convenient concept when initiating an investigation of how people with different social, cultural, and linguistic backgrounds perform on established neurocognitive tests. If individuals of an ethnic minority group perform systematically differently from non-Hispanic Caucasian samples, due to any combinations of cultural, linguistic, and social variables, the definition of normalcy established within non-Hispanic Caucasian population may not be applicable for that minority group. The following section discusses important factors that may vary as a function of ethnicity.

Culture. Triandis (1996) points out that almost all the theories of contemporary psychology were derived from the data in Western culture, such as Europe, North America, and Australia. Thus, psychological theories and constructs often reflect Western assumptions, values, and common backgrounds, which may or may not be salient or valued in other cultures (Helms, 1992; Triandis, 1996). As more work by psychologists from non-Western cultures becomes available, it has been suggested that different cultures may have their own psychology that includes different theories and constructs. For instance, some emotional concepts may be more salient in one culture (e.g., emotion of *amae* in Japan; Niiya, Ellsworth, & Yamaguchi, 2006; Markus & Kitayama, 1991) but difficult to define and conceptualize in another culture. An impact of culture has also been reported in cognition. A recent study suggested that although the mapping of numbers onto space is an intuition universal to all humans, the concept of a linear number line appears to be formed through contact with formal education and certain cultures (Dehaene, Izard, Spelke, & Pica, 2008). Due to these differences in emotion, cognition, and experience, it is possible that a test that was validated with Caucasian samples may show low validity and reliability when used on a culturally different group. Content validity of a test would be questionable if the minority individual has not had an equal opportunity to be exposed to and learn the test items of a measure developed and validated with mostly non-Hispanic Caucasians in the United States. Bias can also exist in construct validity of a test, if the test measures different hypothetical traits for different ethnic groups. Thus, it is possible that poor test scores of ethnic minority individuals may not represent lack of the ability that the test is designed to measure, but instead may represent unfamiliarity with the Caucasian culture, or irrelevance of a construct that is being measured.

Language. Assessing an individual who speaks a language other than English has become more common in the U.S., due to an increase in immigration of people whose primary language is not English. Not only can a language barrier be a confounding variable when diagnosing individual's cognitive status, it can also hinder effective rapport building and information gathering based on behavioral observations (Wong, Strickland, Fletcher-Janzen, Ardila, & Reynolds, 2000). Translations of tests have been attempted mostly into Spanish, however, experts working with Spanish-speaking populations have pointed out that the quality of the language in many of the Spanish versions of neurocognitive tests has been inadequate (Artiola, et al., 2005). Improving the quality and quantity of translations of widely used tests into different languages, establishing validity and reliability in the target ethnic minority populations, and increasing the number of psychologists who are competent in assessing individuals who speak languages other than English, may be needed to address the increasing linguistic diversity of the United States. However, until these issues are resolved, limited English fluency will likely continue to add error in non-native English speakers' neurocognitive performances.

Education. Education is a variable whose impact on individuals' test performances has been established in many tests of cognition, most prominently in the measures of IQ (Heaton, et al., 1996). However, to add more complexity, quality of education has been reported to differ among ethnic minority groups (Baker, Johnson, Velli, & Wiley, 1996; O'Bryant, et al., 2007). This raises the possibility that the effects on cognitive performance of educational attainment, measured simply by the number of years of schooling, can vary across different ethnic groups.

Ethnic Minorities and Test Performance

The observation that some ethnic minority individuals perform differently from Caucasian individuals has been reported as early as the 1920's (Manly & Echemendia, 2007), and potential test bias against members of ethnic minorities has been a controversy throughout the history of cognitive assessment (Reynolds, 2000). Generally, African Americans and Hispanic Americans have been reported to score lower than non-Hispanic Caucasian Americans on instruments that are standardized and validated with mostly non-Hispanic Caucasian American normative samples. Failure to consider these population differences could result in higher rates of misclassification for cognitive impairment among members of the ethnic minority groups due to the attenuated specificity (i.e., the extent to which normal individuals are correctly identified as normal) of assessment instruments (e.g., Fillenbaum, Heyman, Williams, Prosnitz, & Burchett, 1990; Manly, et al., 1998a). Such mistakes in diagnosis of cognitive impairment can lead to unnecessary medical visits, financial burden, inappropriate treatment, adverse side effects of medications, and emotional suffering, and can impact family functioning and the individual's access to educational, financial, and health care resources as well as other resources and opportunities (Heaton, et al., 1996; Patton, et al., 2003; Strauss, et al., 2006). On the other hand, if members of ethnic minority groups score systematically higher than Caucasians, it could potentially lead to an increase in false negatives (i.e., failure to detect cognitive impairment when individuals are cognitively impaired), and patients may be deprived of treatment and services that they require.

Reported ethnic differences in African and Hispanic Americans. Past studies have reported that African Americans consistently scored approximately one standard deviation lower than Caucasian Americans on a number of verbally mediated measures of intellect (Kaufman, McLean, & Reynolds, 1988). African Americans also have been found to score lower on the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS; Patton, et al., 2003), the California Verbal Learning Test (Norman, Evans, Miller, & Heaton, 2000), the Boston Naming Test (Carlson, Brandt, Carson, & Kawas, 1998; Schwartz, et al., 2004; Whitfield, et al., 2000), other visual confrontation naming tests (R. J. Roberts & Hamsher, 1984; Welsh, et al., 1995), verbal category fluency (Schwartz, et al., 2004), verbal phonemic fluency (Gladsjo, et al., 1999; Johnson-Selfridge, Zalewski, & Aboudarham, 1998), the Trail Making Test (Schwartz, et al., 2004), the Finger Tapping Test (Schwartz, et al., 2004), the Rey Complex Figure Test (Schwartz, et al., 2004), the Paced Auditory Serial Addition Test (Diehr, Heaton, Miller, & Grant, 1998), and an expanded Halstead and Reitan Neuropsychological Test battery (Heaton, Miller, Taylor, & Grant, 2004). Recent studies have demonstrated that using putative indicators of educational quality instead of years of education attenuated the observed differences (Manly, Byrd, Touradji, & Stern, 2004; Manly, Jacobs, Touradji, Small, & Stern, 2002). However, a full "deconstruction" of ethnicity has not been successful at this time (see below for more discussion).

Evidence suggests that Hispanic Americans also score lower on a number of neurocognitive tests, including the Mattis Dementia Rating Scale (Lyness, Hernandez, Chui, & Teng, 2006), the Tactual Performance test and the Halstead Category test (Arnold, Montgomery, Castaneda, & Longoria, 1994), the Wechsler Memory Scale-Revised (Demsky, Mittenberg, Quintar, Katell, & Golden, 1998), Benton Visual Retention, Category Fluency, Boston Diagnostic Aphasia Exam (Jacobs, et al., 1997), verbal phonemic fluency, Boston Naming Test (Taussig, Mack, & Henderson, 1996), Wisconsin Card Sorting Test (Coffey, Marmol, Schock, & Adams, 2005), Wechsler Adult Intelligence Scale-Revised (WAIS-R) Block Design, and WAIS-R Digit Span (Lopez & Taussig, 1991), and the third editions of the WAIS and Wechsler Memory Scale (Heaton, Taylor, & Manly, 2003). As Gasquoine points out, these differences have been generally interpreted as results of factors such as educational quality difference, English fluency and bilingualism, and lack of test equivalency in the Spanish translated versions of the measures used (Gasquoine, 1999, 2001).

Demographically Corrected Normative Data

To assist with culturally sensitive assessment, demographically corrected normative data for some ethnic minority groups on some neurocognitive measures have been published (Artiola i Fortuny, Hermosillo, Heaton, & Pardee III, 1999; Heaton, et al., 2004; Heaton, et al., 2003; Lucas, et al., 2005; Ponton, et al., 1996). The benefit of these ethnicity/race specific norms is the improved sensitivity and specificity of assessment measures in detecting cognitive impairment (Lucas, et al., 2005; Manly, 2005).

The use of race/ethnicity specific norms is controversial (Manly & Echemendia, 2007). The criticisms stem from the question of whether “race” or “ethnicity” is a useful and appropriate independent variable. First, it is possible that race/ethnicity specific norms could lead to irresponsible conclusions, stereotypes, and comparisons of different ethnic groups, and leave the ethnic differences unexplained. Second, as the society becomes more ethnically diverse, more individuals will have multi-ethnicity backgrounds. Thus, it is possible to have someone who is not easily and clearly classified into a particular ethnic group, and the utility of race/ethnicity specific norms can be questionable. Third, the empirical data suggest that quantifiable variables such as level of acculturation, quality of education, length of residence in the U.S., and English proficiency can explain some of the observed ethnic differences between Caucasian Americans and African Americans. However, at the moment, observed ethnic differences have not been successfully and completely accounted for by other quantifiable variables. For instance, including the educational quality of Caucasians and African Americans in the analyses attenuated the ethnic differences on measures of selective attention (Byrd, Touradji, Tang, & Manly, 2004), memory, phonemic verbal fluency, and abstract reasoning (Manly, et al., 2002). However, in Manly et al.’s study, between-group variance remained unexplained in verbal fluency and drawing task, suggesting that other cultural variables that were not measured in the study could account for the remaining ethnic differences. In addition, it is not clear if the quality of education as measured by English reading ability would be as useful in other ethnic minorities. Therefore, the use of race/ethnicity specific norms with clinical judgment continues to be the solution for an optimally culturally sensitive assessment.

“Deconstruction” of Ethnicity

Recent studies have attempted to proceed further than merely reporting ethnic differences, and to explore and explain the reported discrepancies. Although it is possible that ethnic differences in cognitive test performance represent biological differences among ethnic groups, many researchers now agree that “ethnicity” is a social, political, and socio-cultural variable, that reflects values, customs, rules, and experiences of an ethnic group (Helms, Jernigan, & Mascher, 2005; Manly, 2006; Manly, et al., 2004). Studies have demonstrated that “ethnicity” serves as a proxy for other social variables that may systematically differ among ethnic groups, such as quality of education, socioeconomic status, and level of acculturation (Manly, 2006). Although a full “deconstruction” of ethnicity has not been accomplished, and thus race/ethnicity specific norms remain useful and informative, the following are some of the variables that past studies have found to partially account for the observed ethnic differences.

Acculturation. Level of acculturation refers to the extent to which an individual shares the values, language, identification, social skills, attitudes, and behavioral norms of the dominant culture. The past literature suggests that acculturation affects aspects of cognitive performance measured by neurocognitive tests. For instance, among elderly African Americans, it was found that level of acculturation was related to performance on tests of memory, naming, and figure matching (Manly, et al., 2004; Manly, Jacobs, et al., 1998). Among young Hispanic Americans, those who identified themselves as primarily Mexican scored lower on the Tactual Performance Test, the Seashore Rhythm Test, and the Halstead Category Test relative to Caucasians (Arnold, et al., 1994). Acculturation has also been reported to correlate with performance on tests of attention and information processing of ethnically diverse minority individuals who are fluent in English, with more acculturated individuals demonstrating better scores on measures such as Digit Symbol, Digit Span, Trail-Making Test A, and the color-naming condition of the Stroop test (Razani, Burciaga, Madore, & Wong, 2007). More years of residence in the United States have been reported to benefit performance on the Wisconsin Card Sorting Test among adult Hispanic Americans (Artiola i Fortuny, Heaton, & Hermosillo, 1998). The authors speculated that increased exposure to and familiarity with the cognitive processes required to solve the test might have played a role.

Quality of education. Recent research has demonstrated that quality of education (measured by reading level in English) may be a more important variable to measure in African Americans than the actual years of education, due to the existing discrepancy in quality of education received by African Americans versus Caucasian Americans. Quality of education, as measured by a test of English oral reading, but not educational attainment, attenuated differences between older African-Americans and Caucasians on a large number of neuropsychological tests (Manly, et al., 2004; Manly, et al., 2002)**.**

In addition to attainment and quality of education in the U.S., it has been suggested that the amount of education obtained outside of the U.S. may relate to individuals' cognitive performance, with more years of education outside of the U.S. associated with poorer performance on measures of attention, information processing speed, knowledge of word definitions, verbal abstraction, and block construction of a group of English fluent ethnically diverse individuals (Razani, Burciaga, et al., 2007;

Razani, Murcia, Tabares, & Wong, 2007). However, it is also possible that education outside of the U.S. may be associated with better performance on some cognitive tests, or that the nature of this relationship may depend on the country in which the education was obtained. For instance, scores of the Scholastic Aptitude Test (SAT) were higher among Asians, Asian Americans, and Pacific Islanders who attended high school outside the United States (National Commission on Asian American and Pacific Islander Research in Education, 2008).

English proficiency and bilingualism. Past studies suggest that not being fluent in a language of test administration lowers scores on some verbally mediated tests. It has been demonstrated that “unbalanced” bilinguals (i.e., bilinguals who were either English dominant or Spanish dominant) performed better on verbally mediated tests such as the Stroop Test, verbal phonemic fluency, and story memory, when the test was administered in their dominant language (Gasquoine, Croyle, Cavazos-Gonzalez, & Sandoval, 2007; Rosselli, Ardila, Santisi, et al., 2002). In a study examining a large archival data set of patients referred to a neuropsychology clinic, those who learned English as a second language scored lower on the Boston Naming Test, phonemic verbal fluency, and Digit Span, while they scored better than native English speakers on a Rey-Osterrieth figure copy (Boone, Victor, Wen, Razani, & Ponton, 2007). Furthermore, being a proficient bilingual by learning the two languages at an early age also appears to have an impact on an individual’s neurocognitive performance. For instance, proficient bilinguals have been reported to score lower on the Boston Naming Test in their dominant language relative to unbalanced bilinguals (Gollan, Fennema-Notestine, Montoya, & Jernigan, 2007), produce fewer items in phonemic verbal fluency in English (Gollan, Montoya, & Werner,

2002) and semantic verbal fluency task in English (Gollan, et al., 2002; Rosselli, et al., 2000; Rosselli, Ardila, Salvatierra, et al., 2002), and perform slower on the Stroop Test (Rosselli, Ardila, Santisi, et al., 2002). Overall, the past literature suggests that not only being non-proficient in English but also being proficient in two languages can lower performance on some linguistic tasks.

Issues with Research on Assessment of Asian Americans

The term "Asian American" is a federally defined ethnic minority category that is used in the United States. Asian Americans are a diverse group of people that consist of over 20 heterogeneous ethnic subgroups, who have ancestry in the Far East, Southeast Asia, or the Indian subcontinent (National Commission on Asian American and Pacific Islander Research in Education, 2008). The paucity of empirical data on how Asian Americans perform on existing neurocognitive tests is concerning in the face of increasing presence of this diverse ethnic group in the U.S. Regardless of whether we will need race/ethnicity specific norms for Asian Americans and/or some of their subgroups, it is important to establish a knowledge base to guide efforts to provide culturally sensitive assessment and treatment for ethnic minorities including Asian Americans.

Current Status

There has been recent effort to include more Asian American participants in neuropsychological studies as part of an "ethnically diverse" group (e.g., Boone, et al., 2007; Razani, Burciaga, et al., 2007; Razani, Murcia, et al., 2007). Razani and colleagues demonstrated that mono-lingual English speaking Anglo Americans scored higher on verbal subtests of the Wechsler Abbreviated Scale of Intelligence (WASI) compared to a group of fluent English speaking ethnically diverse individuals including Asian Americans, but performances on the non-verbal subtests were comparable between the two groups. They also found that the "ethnically diverse" group scored lower on measures of attention and information processing speed. However, these studies do not elucidate factors that are specific to Asian Americans, and overall, the amount of research on assessment of Asian Americans is extremely limited (Okazaki & Sue, 2000). As a result, we do not know if ethnicity is an important variable to consider when interpreting and evaluating cognitive performance of Asian Americans. Some researchers point out that the popular "model minority" view (see below) towards Asian Americans, the tendency of some Asian Americans to be reluctant to seek mental health services, a large diversity within Asian Americans, and the smaller population size compared to other ethnic minority groups, can partly account for why they have remained underrepresented in psychological research (Okazaki & Sue, 2000; Sue & Okazaki, 1990; Yeh, et al., 2003; Yeh & Inose, 2002).

Diversity of Asian Americans

Since the term "model minority" was coined in 1966, Asian Americans and Pacific Islanders were often lumped together and labeled as a high-achieving ethnic minority, in spite of a large variability in economic and educational attainment. In addition, despite the popular image of Asian Americans as successful minorities, they continue to face problems such as a discrepancy between education and income (Sue & Okazaki, 1990), insufficient mastery of English, racism, and psychosocial problems (Ting, 2000).

One of the difficulties with conducting a study on the Asian American population is their diversity. As Sue and his colleagues put it, “we have to prepare ourselves for methodological and conceptual headaches” if we were to try to draw correct conclusions from aggregate research (Sue, Sue, Sue, & Takeuchi, 1995). Although there are merits to conducting research examining Asian Americans as a whole, collectively grouping the subgroups into one composite could mask important differences among them. In addition to some of the more obvious variations such as language and religion, Asian American subgroups can present a large variability in social and educational variables. For instance, overall, when grouped together, Asian Americans are found to have the highest proportion of college graduates (Stroops, 2004). However, there was a large variability among Asian American subgroups, showing a proportion as high as 63.9% in Asian Indians, and as low as 7.5% in Hmong Americans. In addition, location of high school attended (domestically in the U.S. vs. outside of the U.S., with specific nations unknown) seems to have affected SAT performance of Asian Americans and Pacific Islanders. This suggests that multiple factors and their interactions impact academic achievement of Asian Americans. With regard to financial attainment, when grouped together as Asian Americans, the percentage of people below poverty (12.6%) was comparable to the U.S. average (12.4%). However, an economic diversity emerged when ethnic subgroups were separately examined, with as low as 6.3% of Filipino Americans and as high as 37.8% of Hmong Americans below the poverty level. For this reason, the current study elects to focus on a relatively homogeneous subgroup of Asian Americans: Japanese Americans.

Japanese Americans

Japanese Americans are a subgroup of Asian Americans, who have heritage in Japan, which is a multi-archipelagic nation located east of China and Korea. According to the U.S. census, there are about eight hundred thousand Japanese Americans, making them the sixth largest Asian American group (U.S. Census Bureau, 2000).

History

The first wave of Japanese immigrants arrived in the U.S. in the late 19th century, mostly from the southern rural areas of Japan, when Japan's isolationist policy was abandoned and the nation was transitioning from a feudal society to a more modern Westernized nation (Azuma, 1999; Ichioka, 1988). These immigrants from Japan were the second Asian group to arrive in the U.S. after Chinese immigrants (Hirschman & Wong, 1986). Most of them came to the U.S. for work and economic opportunity: Many worked in the sugar plantations in Hawaii and in railroad construction in California. A second wave of immigrants came after the Second World War, when approximately 45,000 Japanese "war brides" moved to the U.S.

The generations in the U.S. are often referred by numbering them, such as, *issei* (the first generation), the generation born in Japan who came to the U.S. in the 19th century, *nisei* (the second generation), the first generation born in the U.S., *sansei* (the third generation), *yonsei* (the fourth generation), and so forth. These terms are in common use in the Japanese American community as well as in the islands of Japan. The very first immigrants (*issei*) were young adults between the ages of approximately 20 to 30 years at their arrival. The Immigration Act of 1924 prohibited further immigration of Asians including Japanese, as well as limited immigration from Southern and Eastern Europe. Because of the clustered age distribution of the original first generation Japanese

Americans, their children (*nisei*) and grandchildren (*sansei*) constituted fairly discrete succeeding generations of Japanese Americans (Fujimoto, et al., 1994). In addition, Fujimoto et al. reported that intra-marriage was common at least through the third generation, and inter-marriage was infrequent (less than 1% among *issei*, and approximately 10% among *nisei*). As a result, the Japanese-American population has maintained relatively high ethnic homogeneity despite their long presence in the United States. Although any Japanese individuals born in Japan who then immigrate to the US are "first generation" by definition, the term "*issei*" is reserved for those who arrived in the US during the first wave of immigration from Japan. Other first generation individuals who arrived in the U.S. after the Second World War are thus differentiated from the original first generations, and are called "*shin-issei*" (the new first generation).

Cognitive Test Performance of Individuals with Japanese Ancestry

Currently, only a few sets of ethnicity specific normative data for widely used cognitive measures in the U.S. exist for individuals with Japanese ancestry (Boone, et al., 2007). The norms developed by Abe, et al. (2004) are of adapted/translated versions of verbal-fluency and the Wisconsin Card Sorting Test for mono-lingual Japanese individuals living in Japan. Thus, with the exception of their applicability to very recent immigrants from Japan tested in the Japanese language, they are not appropriate for most Japanese Americans living in the U.S. McCurry, et al. (2001) and Fillenbaum, et al. (2005) presented data on cognitive performance of elderly Japanese Americans with and without dementia on tests of the Consortium to Establish a Registry for Alzheimer's Disease (CERAD) Neuropsychology Battery (i.e., verbal fluency, confrontation naming, word list learning, constructional praxis) as well as Trail Making Test Part A, Digit Span, Digit Symbol, Purdue Pegboard, and Finger tapping test. McCurry, et al. have shown that participants above the age of 80 performed poorer on all the tests compared to those between the ages of 70 and 79, confirming that age is an important variable that affects cognitive performance in this population. Education also was an important variable in all the tests except for the Digit Span subtest, Purdue Pegboard, and Finger Tapping. Gender also affected the test scores in this sample, with women scoring higher on word list learning, construction recall and percent savings, the Trail Making Test, Digit Symbol, Digit Span, and the Purdue Pegboard. In addition, McCurry, et al. reported that when compared to performance of Caucasian Americans on the CERAD tests (Welsh, et al., 1994), Japanese Americans with education of less than 12 years scored consistently lower, at least one standard deviation lower for confrontation naming, word list recall, and word list percent savings. The authors speculated that factors other than age and education, such as effects of language and cultural variables, might have affected the performance of the Japanese Americans. McCurry et al. (2001) reported a comparable performance of Japanese Americans compared to Caucasian Americans on a semantic (animal) fluency task. However, participants who preferred to be tested in Japanese were tested in Japanese. Thus Japanese Americans as a group, when tested in English, may generate a smaller number of words.

Characteristics of Japanese Americans

Acculturation of Japanese Americans. Previous research studies of acculturation of Japanese Americans have demonstrated reduced identity as “Japanese” with the progression of generation (Iwamasa, Pai, Hilliard, & Lin, 1998; Marsella, Johnson, Johnson, & Brennan, 1998). Levels of acculturation to the American culture had an impact on preference of "end of life" cares and increased health service utilization (McCormick, et al., 2002; Yamashiro & Matsuoka, 1997). Impact of the levels of acculturation on performance on cognitive instruments among Japanese Americans has not been studied to date.

Language. Japanese Americans demonstrate the highest rate of people who only speak English at home among Asian American ethnic groups. In the 2000 Census, 53.7% of Japanese Americans reported that they only speak English at home, compared to 21% of Asian Americans all combined (National Commission on Asian American and Pacific Islander Research in Education, 2008). This high rate of English usage may be due to a relatively smaller number of recent immigrants from Japan compared to other Asian American subgroups, as well as an effort of the *nisei* (second generation) and *sansei* (third generation) Japanese Americans to assimilate into the American society and establish themselves as American citizens during the difficult time of the World War II internment era.

The native language of Japan is the Japanese language, which is characterized by a combined use of three different writing scripts: A logogram, *kanji* (literally means Chinese characters, due to the fact that they were borrowed from the Chinese language), and two syllabograms, *hiragana* and *katakana* (syllabic scripts modified from Chinese characters). Another interesting characteristic of the Japanese language is that it allows two directions of reading and writing; horizontal, from left to right, just as in English, and vertical, from top to down while progressing from right to left. Past literature in cognitive and experimental psychology suggests the possibility that native Japanese speakers' cerebral localization of cognitive functioning may be different than what is established from the data of English speakers, potentially due to difference in language characteristics (Hatta & Kawakami, 1997). However, effects of English-Japanese bilingualism or English fluency of Japanese Americans' neurocognitive performance in English have not been studied to date.

Other social variables. As shown by McCurry et al. (2002), education seems to be an important variable impacting cognitive performance of Japanese Americans (although perhaps not differently from other American ethnic groups). According to the 2000 U.S. Census, 41.9% of Japanese achieved the bachelor's degree or higher, which is substantially higher than the U.S. Average (24.4%). There also has been a report on SAT scores suggesting that scores of mathematics or quantitative skills are a better predictor of university grades than scores of verbal skills for Japanese as well as other Asian subgroups, regardless of academic majors (Sue & Abe, 1988; Ting, 2000). In addition, when using a regression equation derived from Caucasian Americans, Japanese Americans' GPAs during the first year of college were over-predicted using SAT scores and high school GPA as predictor variables (Sue & Abe, 1988). Thus, it is possible that the educational attainment may differently predict some cognitive scores of Japanese Americans and Caucasian Americans.

In terms of socioeconomic status of the Japanese Americans, the 2000 Census shows that 9.7% of Japanese Americans were below the poverty line, compared to 12.6% of total Asian Americans, and 12.4% of the U.S. population (National Commission on Asian American and Pacific Islander Research in Education, 2008). These data may suggest that Japanese Americans as a group may be one of the Asian American subgroups who are more consistent with the popular view of Asian Americans as a high-achieving and successful minority.

Aims of the Current Study

Despite the increasing diversity of the U.S. and the increasing number of Asian Americans, empirical data on how Asian American individuals perform on neurocognitive tests have been scarce. This translates into a lack of guidance in appropriate norm selection and interpretation of the test results, which may affect the diagnostic accuracy in this population and quality of care that Asian Americans are receiving. Furthermore, despite their diversity, different sub-groups of Asian Americans tend to be collectively grouped together as one group or as "other minorities" in various research studies, ignoring the important differences among the sub-ethnic groups. Thus, the current study aimed to examine performance of Japanese Americans on selected cognitive tests. Examining a relatively homogeneous group of Asian Americans, with a realization that the findings may not be generalizable to other Asian American ethnic groups, nevertheless is an important starting point for a better understanding of ethnicity effects and diversity among Asian Americans.

Significance of the Present Study

The purpose of the current study was to examine performance of Japanese Americans on selected cognitive measures. In light of the increasing need for research in elderly and minority populations in our society, the current study aimed to examine cognitive performance of the aging population. The age range of participants of the current study was above 45, and the assessment instruments were chosen so that our results would be relevant in the aging population (such as for differential diagnosis of dementia). We have chosen measures of memory (both visual and verbal), olfaction, and verbal abilities (verbal fluency and confrontation naming). The study aimed to investigate whether ethnic membership had an effect on the test performance of Japanese Americans, whether other demographic variables (such as age and education) had a similar impact across the Caucasian and Japanese American groups, and, if levels of acculturation predicted cognitive performance of Japanese Americans. The results from the current study provide valuable information to researchers and practitioners regarding how ethnic minority status influences cognitive test performance among Japanese Americans, and will be an important piece of evidence that will guide decisions upon selecting the appropriate normative data set to use and interpreting the test performance of Japanese Americans.

Hypotheses

The following are the specific hypotheses of the current study:

Hypothesis 1. Although it was shown that demographic variables such as age and education are associated with Japanese Americans' performance on some cognitive instruments (Fillenbaum, et al., 2005; McCurry, et al., 2001), it is not clear whether the relationships between basic demographic variables (age, education, and gender) and test scores are similar to that observed in Caucasian Americans, and also how they compare to other ethnic minority groups reported in the past literature. Based on the past literature in other ethnic minority populations (i.e., African Americans and Hispanic Americans), it was hypothesized that age and education do correlate with Japanese Americans' test scores and that the magnitude of relationship would be smaller than those observed in Caucasian Americans.

Specifically, age was expected to negatively correlate with test scores of verbal memory, visual memory, confrontation naming, odor identification, odor memory, and verbal fluency. Education (years completed) was expected to positively correlate with phonemic fluency, animal fluency, confrontation naming, and verbal list learning. The past literature also suggests that the quality of education, as measured by academic achievement tests, may explain a sizable amount of the variance of cognitive test performance among ethnic minorities. It was thus hypothesized that the scores on the measure of academic achievement in English would be significant predictors of the Japanese American's cognitive test performance. With regard to gender, it was hypothesized that correlation between olfactory and verbal learning/memory measures would be significant.

Hypothesis 2. The existing literature indicates that "ethnicity" is an important demographic variable in the cognitive performance of ethnic minorities, including African Americans and Hispanic Americans. It was hypothesized that Japanese Americans' performance on the tests of confrontation naming, odor identification, verbal and odor memory, and verbal fluency, when controlled for age and education, would be lower than that of Caucasian Americans. Performance on the visual memory task was hypothesized to be comparable.

Hypothesis 3. The past literature indicates that association between age and test scores may be different among ethnic minority individuals compared to Caucasian American individuals. Thus, it was hypothesized that age-score relationship would differ as a function of ethnic group membership. Association between education and test performance, and gender and test performance, would be comparable across the two ethnic groups.

Hypothesis 4. It was hypothesized that within the Japanese American sample, more acculturated individuals would perform better on measures that are considered to be culturally laden, including visual confrontation naming, odor identification test, odor and verbal learning and memory, and verbal fluency.

II. METHODS

Participants

English-speaking individuals with self-identified Japanese ancestry, and monolingual (English) self-identified Caucasian individuals who reside in Southern California, were recruited via newspaper and internet advertisements, referrals from participants themselves, and flyers posted at places such as local temples and churches, senior residences, and Japanese grocery stores. Participants were excluded if they had a known history of neurological or psychiatric illness, substance use disorders, learning disability (diagnosed, or special education classes or grade retention), or head trauma with loss of consciousness greater than 5 minutes. The participants included in the two groups were matched to the extent possible in terms of age and education. Educational attainment was recorded as years completed, based on the criteria specified in the widely used demographically corrected normative data manual (Heaton, et al., 2004). The total study sample consisted of 142 participants that included 71 Japanese Americans and 71 Caucasian Americans, ages between 45 and 91. Recruitment of Japanese American individuals was considerably more difficult than that of Caucasian Americans. As a result, we were unable to attain equal number of male and female participants in this group, and the age distribution in each gender differed significantly.

Assessment

Participants were administered the following cognitive tests as part of a larger test battery.

1. Naming Ability:

- San Diego Odor Identification Test (SDOIT; Murphy, Anderson, & Markison, 1994; Murphy, et al., 2002)
- 60-item Boston Naming Test (BNT; Kaplan, Goodglass, & Weintraub, 1983)

2. Language Fluency:
    - Controlled Oral Word Association Test (COWA-FAS: Benton & Hamsher, 1989)
    - Semantic (animal) Verbal Fluency Test (Gladsjo, et al., 1999)
3. Learning and Memory:
    - California Verbal Learning Test (CVLT; Delis, Kramer, Kaplan, & Ober, 1987)
    - Brief Visuospatial Memory test-Revised (BVMT-R; Benedict, 1997)
    - California Odor Learning Test (COLT; Murphy, Nordin, & Acosta, 1997)
4. Measures for Quality of Education in English
    - Wide Range Achievement Test-4 (WRAT4) Reading (Wilkinson & Robertson, 2006)
    - Wide Range Achievement Test (WRAT4) Math Computation (Wilkinson & Robertson, 2006)

Verbal fluency tests and the WRAT4 Reading were administered during the interval of the BVMT-R. The WRAT4 Math Computation was administered during the interval of the COLT. In order to minimize practice effects and order effects, the tests were divided into five blocks (SDOIT, BNT, CVLT, COLT, and BVMT) and the order of these blocks was pseudo-randomized across participants. The following section discusses each of the instruments that were used in the current study. On some occasions, past studies on Japanese individuals residing in Japan are cited. It should be noted however that the culture of islands of Japan and that of Japanese Americans are not the same.

Naming Abilities

San Diego Odor Identification Test. Due to the involvement of entorhinal cortex in the human olfactory system, olfactory impairments have been reported at early stages of dementia, especially in Alzheimer's disease (Doty, Reyes, & Gregor, 1987; Koss, Weiffenbach, Haxby, & Friedland, 1988; Murphy, Gilmore, Seery, Salmon, & Lasker, 1990; Nordin & Murphy, 1998). The literature suggests that a test of olfactory identification may be a useful tool not only in the early detection of pathological changes in "normal" geriatric populations, but also in the differential diagnosis of dementia (Morgan, Nordin, & Murphy, 1995). Specifically, it has been reported that patients with Alzheimer's disease were more impaired than normal individuals in identifying the odors in a Caucasian sample (Morgan, et al., 1995).

The San Diego Odor Identification test (SDOIT; Murphy, et al., 1994; Murphy, et al., 2002) is an olfactory identification test that consists of eight common household odors, which has an adequate test-retest reliability (concordance correlation coefficient = .85; Krantz, et al., 2009). The examinee is requested to choose the correct response among 20 pictures (8 target odors and 12 distracters). Initially, the examinee is presented a picture-board consisting of twenty pictures. Each picture is reviewed with the participant until all pictures are correctly identified. The examinee is then told that all odors presented are found on the picture board. Eight common odors (e.g. coffee, chocolate, and peanut butter) in white opaque jars are presented one by one, to the examinee with his or her eyes closed. The examinee is asked to identify the odorant in between each odor presentation. Odors are presented birhinically in random order, with a 45-second inter-stimulus interval to avoid adaptation (Ekman, Berglund & Berglund, 1967). The participant's score is the number of correctly identified odors, which can range from 0 to 8.

Because the olfactory identification task involves not only the ability to smell, but also the ability to identify and name the odors, individuals from different cultural backgrounds may score lower on this test due to unfamiliarity with the "common household odors" used. With respect to individuals with the Japanese ancestry, all the 8 target odors are readily available in the Japanese markets. However, some items, such as baby powder and peanut butter, may not be commonly used in a traditional Japanese household. Thus, the levels of acculturation and generation status may correlate with performance.

Boston Naming Test. The Boston Naming Test (BNT) is a picture-naming test originally developed by Kaplan, Goodglass, and Weintraub (1983), and is a very popular confrontation-naming test in the U.S. (Strauss, et al., 2006). It consists of 60 items that are arranged in an order such that easily named pictures are presented at the beginning. The items progressively become more difficult because later items are lower frequency words. The BNT taps several cognitive skills, such as visual analysis, object recognition, semantic, lexical, and phonological processing, and is used as a measure of naming impairments in aphasic patients, and is also widely used in dementia assessment as an indicator of the presence, characteristics, and the degree of cognitive impairment. For instance, patients with Alzheimer's disease demonstrated a larger number of lexical retrieval and semantic deficits than patients with early vascular dementia who were comparable in terms of the overall cognitive functioning measured by Mini Mental Status Exam (Lukatela, Malloy, Jenkins, & Cohen, 1998).

A number of studies have reported that ethnic minorities scored lower on the BNT than Caucasian Americans (Azrin, et al., 1996; Fillenbaum, et al., 2005; Heaton, et al., 2004; Lucas, et al., 2005; Manly, Miller, et al., 1998; P. M. Roberts, Garcia, Desrochers, & Hernandez, 2002; Ross, Lichtenberg, & Christenesn, 1995; Welsh, et al., 1995). Within an African American group, those who were more acculturated scored higher than those less acculturated (Manly, Miller, et al., 1998; Touradj, Manly, Jacobs, & Stern, 2001), suggesting that some of the ethnicity effects can be explained by levels of acculturation.

With regard to individuals of the Japanese ancestry, Fujita, Tanaka, Koyama, Nonaka, and Oka (2004) translated and adopted the original BNT to better suit Japanese individuals residing in Japan. Fujita and his colleagues used 40 items that were correctly named by 80% of Japanese participants, suggesting that some of the items were unfamiliar to Japanese individuals residing in Japan. Items that were excluded are pretzel, dart, wreath, beaver, igloo, stilts, dominoes, knocker, muzzle, unicorn, funnel, noose, latch, tripod, scroll, tongs, sphinx, yoke, trellis, and abacus (Y. Tanaka, personal communication, March 6, 2008). Levels of acculturation and generation status may impact how Japanese Americans perform on this measure. As previously mentioned, McCurry et al. (2001) used a 15-item version of the BNT with Japanese Americans residing in Seattle, Washington, and Honolulu, Hawaii. Japanese Americans with education of less than 12 years scored consistently lower on verbally mediated tests, including the 15-item BNT. In addition, some of the Japanese American participants were tested in Japanese using the translated version of the instrument. Had they been given the test in English, they might have scored even lower as a group. Thus, English proficiency/bilingual status and quality of education (as measured by an academic achievement test) may impact their performance as well.

Verbal Fluency

The Verbal Fluency Test involves the generation of words under a phonemic or category restriction within a certain time limit (usually one minute). In the current study, widely used phonemic (COWA-FAS) and semantic (Animal Fluency) tasks were administered. For the phonemic task, the participant produces as many words as possible beginning with a specified letter ("f," "a," and "s") in one minute. For the semantic task, the participant produced as many animal names as possible during one minute. Both versions of this test measure the speed and ease of verbal production, language functions, response speed, executive functioning, lexicon and semantic storage, retrieval mechanisms and working memory. Impairment on this measure is often observed in patients with aphasia, frontal lobe damage, and diffuse brain damage (Lezak, Howieson, Loring, Hannay, & Fischer, 2004). Performance on both semantic and phonemic fluency is known to decrease with increased age. Individuals with higher education typically generate a larger number of items in both semantic and phonemic fluency tasks.

Measures of Learning and Memory

California Verbal Learning Test. The California Verbal Learning Test (CVLT: Delis, et al., 1987) is a clinical instrument of verbal list learning and memory, which quantifies verbal learning, retrieval, and recognition. In this test, sixteen words on List A are presented for learning over five consecutive trials. After trial 5, List B, consisting of a different set of 16 items, is presented as an interference trial. Then, the participant is asked to recall items from List A (short delay free recall), followed by a cued trial (short delay cued recall). After a 20-minute delay, long delay free and long delay cued recall trials are administered. A recognition trial follows, in which the participant is read 40 items and asked to indicate whether or not each item was on List A.

The CVLT scores are known to be affected by age, with older individuals showing declining memory, and by gender, with women scoring better than men across the five learning trials, and by education and IQ. In terms of ethnicity, Norman et al. (2000) reported that African Americans scored lower than Caucasian Americans.

California Odor Learning Test. The California Odor Learning Test (COLT) is a measure developed for odor recall and learning, in a format analogous to the CVLT. A set of 16 odors is presented as List A to the participant, who then verbally recalls the odors across five learning trials, and in short and long delay recall trials following a presentation of an interference list of 16 items. The COLT requires semantic coding of the odors and verbal responses from the participant, thus performance is dependent on the ability to identify the odors. In order to correct for identification errors, the participants are asked to identify the odors after all the memory trials are finished. Past studies have shown that discrepancies in the scores between young and old adults were larger than the verbally mediated CVLT, suggesting the utility of the COLT for age-related memory decline (Murphy, et al., 1997). In addition, because the procedure enables correction for verbal identification errors, the task was considered to be less verbally mediated compared to the CVLT, which might be useful for memory assessment of ethnic minorities. To date, ethnic differences on the COLT have not been studied.

Brief Visuospatial Memory Test-Revised. The Brief Visuospatial Memory Test-Revised (BVMT-R) was included in the current study in order to examine possible differences in the impact of ethnicity compared to verbal and olfactory memory tasks, and to investigate the utility of less verbally mediated measures on the assessment of Japanese Americans. The BVMT-R is a three-trial measure of visual learning, followed by delayed recall and recognition trials. Age is known to affect performance on the BVMT-R. However, gender and education did not yield significant associations with the BVMT-R measures of recall and recognition (Strauss, et al., 2006).

Quality of Education in English

The Blue form of the Word Reading and Math Computation subtests of the Wide Range Achievement Test 4 (WRAT-4: Wilkinson & Robertson, 2006) were used to assess the quality of education obtained in English. The WRAT4 measures the basic academic skills of reading, spelling, and math computation, standardized on over 3000 U.S. individuals with the ages between 5 and 94. The Word Reading subtest is a standardized test of single word oral reading, consisting of 15 letters that are to be identified and 45 words that range in pronunciation difficulty. Previously, Manly and her colleagues reported that African Americans matched for education with Caucasians scored about 5 points lower on the third edition of the Wide Range Achievement Test (Manly, et al., 2002). They used the third edition of the WRAT Word Reading score as a covariate when comparing the test performance of African Americans and Caucasians, and demonstrated that it accounted for 34% of the variance of test scores and that it significantly reduced the effect of ethnicity. Thus, the scores of WRAT4 Word Reading was used in the current study as a measure of quality of educational attainment in English. In addition, given that mathematics score was a better predictor for college GPA among Japanese Americans, WRAT4 Math Computation was administered to explore the utility of this subtest.

Additional Instruments for the Japanese American Participants

Bilingualism. For Japanese American participants who were bilinguals, fluency in Japanese was also measured, in order to estimate their English fluency relative to Japanese fluency. For phonemic fluency in Japanese, the Japanese syllabaries of "hu" "a" and "ni" were used (Abe, et al., 2004). Furthermore, fluency in English and Japanese was also measured by participants' self-report, following Kohnert et al. (1998) and Gollan et al. (2007). Participant reported their English and Japanese fluency using a scale of 1 to 7, with 1 being "little to no knowledge," 4 being "functional," and 7 being "like a native speaker." Only those who indicated higher English fluency compared to Japanese fluency were included in the current study.

Those who reported speaking Japanese more fluently compared to English based on the above self-rating were not included in the current study. These excluded individuals were often more recent immigrants, or "new first generations," i.e., those who were born and raised in Japan, received the majority of their education in the post-war Japan, and came to the United States. These new first generation individuals are often pointed out to be a qualitatively different population compared to Japanese American individuals who are the descendants of the *Issei*s (first generation that came to the US in 1885-1924). For instance, the new first generations do not share the experience of being an ethnic minority during the time when racial discrimination was more apparent. They also have not gone through the social/political events that the *Isseis* experienced. In contrast, *Nisei* and *Sansei* study participants were fluent in English. In fact, often times they were English monolingual and they spoke little Japanese.

Acculturation. The levels of acculturation of the Japanese American participants were assessed using the Suinn-Lew Asian Self-Identity Acculturation Scale (SL-ASIA; Suinn, Rickard-Figueroa, Lew, & Vigil), the most widely used instrument for assessing acculturation among Asian American individuals (Abe-Kim, Okazaki, & Goto, 2001) that has demonstrated adequate reliability (.91; Suinn, Ahuna, & Khoo, 1992) and concurrent validity (Abe-Kim, et al., 2001; Suinn, et al., 1992; Suinn, et al., 1987). It includes 21 multiple-choice items that measure cognitive, behavioral, and attitudinal aspects of acculturation of an individual of Asian heritage. Response options, ranging from 1 to 5 are averaged to yield an overall acculturation score. Item scores range from 1 (low acculturation) to 5 (high acculturation).

Procedures

Participants were individually invited to the assessment session at the Lifespan Human Senses Laboratory at San Diego State University. They signed the consent forms before participation, and received monetary compensation for their time at the completion of the assessment. Assessment was conducted in English. Demographic information was collected first to ensure that the participant met criteria for the study. In addition, all participants were administered an odor threshold test in order to assess their olfactory functioning. Odor threshold was assessed monorhinically for each nostril using a two-alternative (blank and odorant), forced choice, ascending method of limits test (Cain, Gent, Catalanotto, & Goodspeed, 1983, modified as in Murphy, Gilmore, Seery, Salmon, & Lasker, 1990). A series of 10 aqueous (deionized water) dilution levels were used. The dilution levels ranged from 349 ppb (dilution level 9) to 3055 ppm (dilution level 0) with each successive dilution step being one-third the concentration of the preceding solution. The stimuli, vapor phase from 60-ml solutions, were presented via 250-ml squeezable polyethylene bottles with pop-up spouts. To avoid adaptation, trials were presented approximately 45s apart. The order of the blank and odorant presentations was randomized for each trial. Beginning with dilution level 9, participants were asked to identify the stimulus of the presented pair with the stronger smell. An incorrect choice led to a one-step increase in concentration on the next trial. A correct choice led to the presentation of the same concentration until the criterion of five consecutive correct choices was met. Participants were required to meet a criterion threshold of 3 or better to continue with the SDOIT and COLT in order to exclude anosmics and severe hyposmics.

All the cognitive instruments were administered according to the published manuals, with the exception of the BNT, for which all the 60 items were administered regardless of participant's performance, in order to examine effects of ethnicity on Japanese Americans' responses to all the items. The instruments were administered by a doctoral student in a clinical psychology doctoral program (the first author) and four additional female research assistants in the SDSU Lifespan Human Senses Laboratory. Among the five testers, three were English-Japanese bilingual Japanese students. Two other testers were mono-lingual English speakers. All the testers were also trained in scoring the tests. Tests were scored twice, independently by two different scorers. After the data were entered onto a spreadsheet, the accuracy of the data entry was checked by another research assistant.

Statistical Methods

For tests that yield several raw scores, the following raw test scores were used in the analyses of the current study.

- CVLT: List A Total Trials 1-5 (CVLT Total; score range 0 to 80), List A Long-Delay Free Recall (CVLT LDFR; score range 0 to 16), List A Long-Delay Cued Recall (CVLT LDCR; score range 0 to 16), List A Trial 1 (CVLT-1; score range 0 to 16), List A Trial 5 (CVLT-5; score range 0 to 16).
- COLT: List A Total Trials 1-5 (COLT Total; score range 0-80), List A Long-Delay Free Recall (COLT LDFR; score range 0 to 16), List A Long-Delay Cued Recall (COLT LDCR; score range 0 to 16), List A Trial 1 (COLT-1; score range 0 to 16), List A Trial 5 (COLT-5; score range 0 to 16).
- BVMT-R: Total Recall (BVMT-R TR; score range 0 to 36), Delayed Recall (BVMT-R DR; score range 0 to 12)
- BNT: The number of spontaneously produced correct responses (score range 0 to 60)

Data Screening

All variables were screened for univariate and multivariate outliers, normality of distribution, and potential multicollinearity prior to analysis. Visual inspection of the data distribution, univariate and multivariate outlier analyses led to one data point each from WRAT4 Reading (in the Caucasian group) and Math Computation (in the Japanese American group) being excluded due to being extremely low in the univariate analysis (*z* score > |3.29|) and being disproportionately low scores when age, education, and gender were considered (Mahalanobis distance greater than 16.266). Negatively skewed distributions were noted on the Boston Naming Test, which showed that the majority of the participants scored towards the upper end on this test. Although a logarithmic transformation slightly improved the distribution, the results of the subsequent analyses were essentially unchanged most likely due to the robustness of regression analyses. Thus, for the ease of interpretation, the BNT raw scores are reported in the current study. After the screening, bivariate correlation analyses were conducted to determine the strength of the relationships among the predictors (i.e., age, years of education, gender, and WRAT4 Reading and Math Computation scores). Additionally, hierarchical regression analyses were performed to formally test the interaction between ethnicity and demographic variables. Specifically, to test the interaction of age and ethnicity, mean-centered age and ethnicity were entered at step 1, with the interaction of the two at step 2. For the criterion variable, education-corrected z-scores were used to test the effects of age. Age-corrected z-scores were used to test the effects of education.

In order to test the hypotheses outlined earlier, the following statistical analyses were then conducted, with alpha for all the analyses at $p = .01$ level to achieve a balance between committing the Type I and Type II errors.

Hypothesis 1

Bivariate correlation coefficients were calculated to examine relationships between the demographic variables and cognitive/olfactory test scores, separately for the Japanese American and Caucasian American groups. Correlation coefficients were evaluated at an alpha level of .05. Then, Fisher's z-transformations were computed in order to test the hypothesis that correlation coefficients are not significantly different between the two groups. Then, the next set of analyses used bivariate regression models to determine the relationships between each of the predictor variables (age, education, gender, acculturation level as measured by the SL-ASIA, and, WRAT4 Reading and Math Computation scores), to evaluate unique effects that each demographic variable has on the test scores.

Hypothesis 2

Hierarchical regression analyses were conducted predicting each test score with a combination of significant (at an alpha of .05) basic demographic variables (age, education, and gender; dummy coded as 0 being women and 1 being men) and ethnicity (dummy coded as 0 being Caucasian and 1 being Japanese American) as predictors. To determine the contributions of age, years of education, gender, and an added contribution of "ethnicity" above and beyond the basic demographic variables, significant basic demographic variables were entered at step 1 and ethnicity at step 2.

Hypothesis 3

In order to examine the difference in age- score, education-score, and gender-score relationships between the JA and CA groups, interactions of age by ethnicity, and education by ethnicity were investigated with hierarchical regression analyses, and gender by ethnicity was investigated by Analyses of Variance (ANOVAs). Continuous predictors (age and education) were first mean-centered. Then, to investigate interaction of age and ethnicity, age and ethnicity were entered at step 1, followed by age by ethnicity interaction term at step 2. To investigate interaction of education and ethnicity, education and ethnicity were entered at step 1, followed by education by ethnicity interaction term at step 2. ANOVAs were conducted with Ethnicity and Gender as between-subject factors. Since there was significant associations between age and education, education corrected z-scores were used when the effect of age was examined, and age-corrected z-scores were used when the effect of education was examined, as a criterion variable for each regression analysis. In addition, due to significant association between age and gender in the Japanese American group, age-corrected z-scores were used when the effect of gender was examined.

Hypothesis 4

In order to test the hypothesis that more acculturated Japanese American individuals would score higher on the BNT, SDOIT, CVLT, COLT, and VFT compared to less acculturated individuals, bivariate regression analyses were conducted to examine if acculturation significantly contributes to the prediction of performance of Japanese Americans on the cognitive tests. Then, hierarchical regression analyses were conducted with significant basic demographic variables (combination of age, education, and gender) at step 1, and the SL-ASIA score at step 2, in order to investigate if the levels of acculturation predict the scores above and beyond significant basic demographic variables.

Supplemental Analyses

To better understand the within-ethnicity score variability in Japanese Americans, regression analyses were performed to investigate the effect of (1) bilingual status (coded 0 for monolinguals, and 1 for bilinguals) and (2) generation status, independently and after covarying for basic demographic variables. Correlation coefficients between the SL-ASIA and cognitive/olfactory test scores were calculated separately for the second and third generation Japanese Americans. In addition, item analyses on the BNT were performed, by calculating the proportion of participants answering each of the test items correctly for (1) each ethnic group, and (2) for monolingual and bilingual Japanese Americans. Item analysis was also performed for the SDOIT.

III. RESULTS

A total of 142 individuals between ages of 45 and 91 participated in the study. Seventy-one of those were self-identified Japanese Americans, and the remaining 71 were self-identified Caucasian Americans.

Demographic Information

For all participants (N = 142), the mean age was 64.8 (SD = 10.38) and the mean years of education was 15.5 (SD = 2.20). Demographic characteristics of the Japanese Americans (JA) and Caucasian Americans (CA) are presented in Table 1. The JA and CA groups were matched, to the extent possible, on age and years of education. Although gender was not matched due to difficulty with matching participants on all the three dimensions (age, education, and gender), it was included in the analyses in light of its well-documented effects on olfactory tests and verbal list learning.

In terms of the quality of education measures (WRAT4 Reading and Math Computation subtests), correlation analyses separately conducted for the two ethnic groups indicated that the years of education significantly correlated with both reading and math scores in the JA and CA groups (Table 2). There was no significant difference between the group correlation coefficients between the two groups in the Reading subtest, which is a finding that is not consistent with the previous literature that showed attenuated association in ethnic minority groups (Ryan, et al., 2005). Participants' age correlated significantly with the Reading score in both groups. However, the Math Computation score significantly correlated with age in the JA group, but not in the CA group. Gender was not associated with either of the WRAT4 scores. The comparison of the correlation coefficients using Fisher's *z* indicated that the JA group showed significantly stronger relationship between age and Math Computation scores compared to the CA group. The hierarchical regression of the WRAT4 scores between the two groups indicated that ethnicity did not predict the test scores above and beyond age and education, for Mathematic Computation. However, for the Reading subtest, the effect of ethnicity was approaching significance, with JAs scoring lower. Additionally, hierarchical regression analyses were conducted to investigate the interaction of ethnicity and the other two demographic variables (age, education). For the effects of age, education corrected z-scores were used, and for the effects of education, age-corrected z-cores were used. The analyses did not provide evidence for significant interactions for either age or education (Table 4).

Table 1
Demographic Characteristics of Participants

Variable	Japanese Americans (n=71)	Caucasian Americans (n=71)
Age (years)	65.0 (10.7)	64.6 (10.1)
Age range	45-89	45-91
Education (years)	15.5 (2.4)	15.4 (2.0)
Education range	12-20	10-20
WRAT4 Reading	63.8 (4.6)	65.1 (4.4)
WRAT4 Math Computation	45.8 (6.2)	45.1 (5.8)
Gender (% male)	43.50%	47.10%

Note. WRAT4 = Wide Range Achievement Test 4.

Table 2
Comparison of Correlation Coefficients of Age and Education with WRAT4 Test Scores.

	Correlation		Fisher's z		
Subtest	JA	CA	JA	CA	z score
		Age			
Reading	-.52 **	-.31 **	-.58	-.32	-1.47
Math Computation	-.57 **	-.22	-.66	-.14	-2.47 *
		Education			
Reading	.40 **	.45 **	.47	.46	-0.07
Math Computation	.41 **	.60 **	.44	.66	-1.48
		Gender			
Reading	-.22	.11	-.22	.11	-1.93
Math Computation	.00	-.22	.00	-.22	1.29

Note. JA = Japanese Americans; CA = Caucasian Americans.
** $p<.01$. * $p<.05$.

Table 3

Proportion of Variance of the WRAT4 Scores Explained by Ethnicity (R^2) and After Covarying for Age and Educations ($R^2 \Delta$)

	Bivariate regression		Hierarchical regression			
	Ethnicity		Step 1		Ethnicity	
WRAT4 Subtests	R^2	*p*	R^2	*p*	$R^2 \Delta$	*p*
Reading	.021	NS	.265	**<.001**	.024	.033
Math Computation	.003	NS	.301	**<.001**	.002	NS

Note. Bold font indicates R^2 statistically significant at p<.01

Table 4

Partial Regression Coefficients (b) for Age, Ethnicity, and Interaction, and for Education, Ethnicity, and Interaction, in the WRAT4 Subtests

	Step 1						Interaction		
WRAT4 Subtest	*b*	*t*	*p*	*b*	*t*	*p*	*b*	*t*	*p*
		Age			*Ethnicity*				
Reading	-.03	-3.6	< **.001**	-.35	-2.2	.028	-.02	-0.94	NS
Math Compuation	-.03	-3.18	**.002**	.10	0.6	NS	-.03	-1.92	NS
		Education			*Ethnicity*				
Reading	.14	4.00	< **.001**	-.33	-2.1	.037	-.05	-0.65	NS
Math Compuation	.17	4.81	< **.001**	.11	0.73	NS	-.14	-1.90	NS

Note. Bold font indicates R^2 statistically significant at p<.01. *b* = unstandardized regression coefficient; *t* = the test statistic for the regression coefficient; *p* = p-value associated with the *t*.

Characteristics of the Japanese Americans

Table 5 summarizes the makeup of the Japanese American participants in the current study. There were no *issei* (first generation) individuals. The majority were *sansei* (third generation) individuals, followed by *nisei* (second generation), *yonsei* (fourth generation), and *shin-issei* (the new first generation) individuals. As expected from the immigration history, with regard to *nisei, sansei,* and *yonsei* generations, each succeeding generation was younger. Majority of the Japanese American participants were U.S.-born, with the exception of 6 who were born in Japan, and 1 who was born in Spain. Thus, years of residence in the U.S., which typically is found to highly correlate with levels of acculturation of immigrants, was not a very informative variable in this particular sample, because years of residence in the U.S. was equivalent to age for most of the participants, making the association between the two very strong (r = .968). Similarly, the majority (65) of the participants received all of their education in the U.S., resulting in high correlation between the actual years of education and years of education in the U.S. (r = .880).

Table 6 presents the summary of interrelationships of the demographic, social, and achievement variables. There was a significant correlation between age and the number of years of education attained in our sample (r = -.401, p = .001), indicating that with progression of generation, people tended to have attained more years of formal education.

Acculturation. The mean score of the SL-ASIA, an acculturation measure for Asian Americans, was 3.5 (SD = .32), suggesting that overall our participants showed a medium level of acculturation, based on the developer's conceptualization (Suinn, et al., 1992; Suinn, et al., 1987). This level of acculturation is comparable with a past study of Japanese American participants in southern California (Iwamasa, et al., 1998). Correlation analyses indicated statistically significant relationships between the SL-ASIA score with age ($r = -.35$, $p = .002$), and with generation status ($r = .25$, $p = .036$), indicating older participants and earlier generations self-reported lower levels of acculturation (Figure 1 and 2). The SL-ASIA score was not significantly correlated with years of education in this sample. When correlation coefficients were calculated separately for *nisei* and *sansei*, the relationship between age and SL-ASIA score was only marginally significant among *sansei* ($r = -.30$, $p = .051$), and not significant in *nisei* ($r = -.02$, $p = .942$). The low correlation in the *Nisei* group may be due to the restricted age range.

Language. Thirty-seven of the 71 Japanese American participants indicated that they had some knowledge of the Japanese language. Their subjective ratings of Japanese fluency ranged from 1 (little to no knowledge) to 4 (Functional), while their subjective ratings of English fluency were all 7 (like a native speaker). Among the 37 participants who reported having varying degrees of knowledge of the Japanese language, 18 participants performed the phonemic fluency test in Japanese. Their raw scores ranged from 0 to 31, with a mean of 17.4, a standard deviation of 7.6, and a median of 16. The remaining 19 indicated that the task appeared too difficult to perform and thus declined to perform this task. In order to examine their relative fluency in Japanese compared to English, the ratio of the number of responses on the verbal fluency test in Japanese to English was calculated for each of the 18 participants, which ranged from .00 to .86, indicating that they generated more words in English than in Japanese in a one-minute interval. In addition, when compared to the age-corrected normative data on the phonemic fluency test of Japanese speaking individuals residing in Japan (Abe, et al., 2004), 9 of our participants performed within ±1 standard deviation from the mean, and the rest .8 performed over 1 standard deviation below the mean.

Table 5

Characteristics of Each Generation of the Japanese American Participants

Variable	Shin-Issei (New-first)	Nisei (Second)	Sansei (Third)	Yonsei (Fourth)
Number of participants	3	22	43	3
Age range	50-59	50-89	45-79	47-61
Average age	55.0 (4.58)	75.7 (8.68)	61.7 (7.60)	52.7 (7.37)
Years of Education	16.7 (1.16)	14.3 (2.78)	16.0 (2.06)	17.3 (1.16)
Mean SL-ASIA Score	3.57	3.39 (.29)	3.61 (.32)	3.66
Number of "bilinguals"	2 (66.7%)	15 (71.4%)	19 (44.2%)	0 (0%)
Subjective English Fluency	7	6.285 (1.54)	6.7 (.869)	NA
SubjectiveJapanese Fluency	3	3.57 (1.398)	3.05 (1.35)	NA
English fluency (FAS)	48.33 (13.31)	36.33 (10.43)	46.11 (13.13)	53.33 (10.50)
Japanese fluency (hu, a, ni)	5	15.57 (2.64)	18.3 (9.52)	NA

Note. SL-ASIA = Suinn-Lew Asian Self Identity Acculturation

Table 6

Correlation Coefficients Among Demographic Variables and Achievement Test Scores of Japanese Americans

	1	2	3	4	5	6
1. Age	1					
2. Education	-.401**	1				
3. Gender	.334**	.065	1			
4. WRAT4 Reading	-.517**	.440**	-.223	1		
5. WRAT4 Math Computation	-.524**	.357**	.045	.576**	1	
6. Generation	-.445**	.239*	-.184	.325**	.319**	1
7. SL-ASIA	-.354**	-.049	.041	.189	.240*	.250*

Note. SL-ASIA = Suinn-Lew Asian Self Identity Acculturation

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

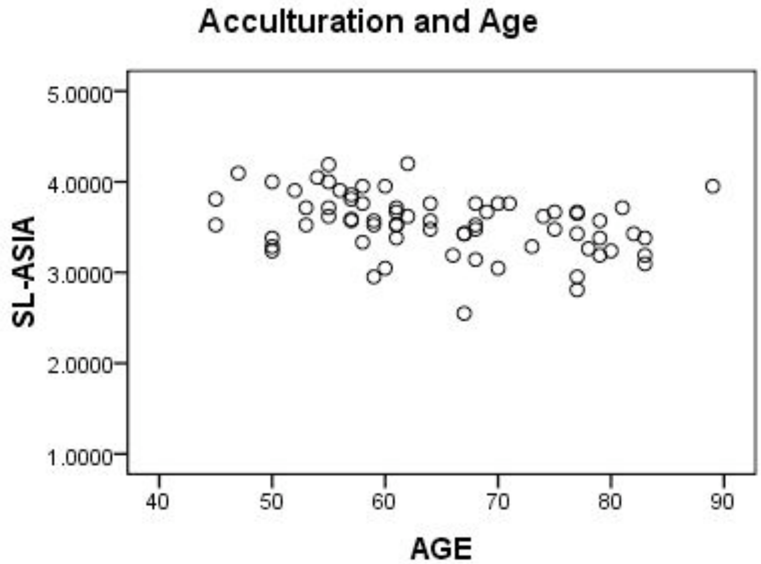

Figure 1: Scatter Plot of SL-ASIA Score and Age in Japanese Americans. $r = -.354$.

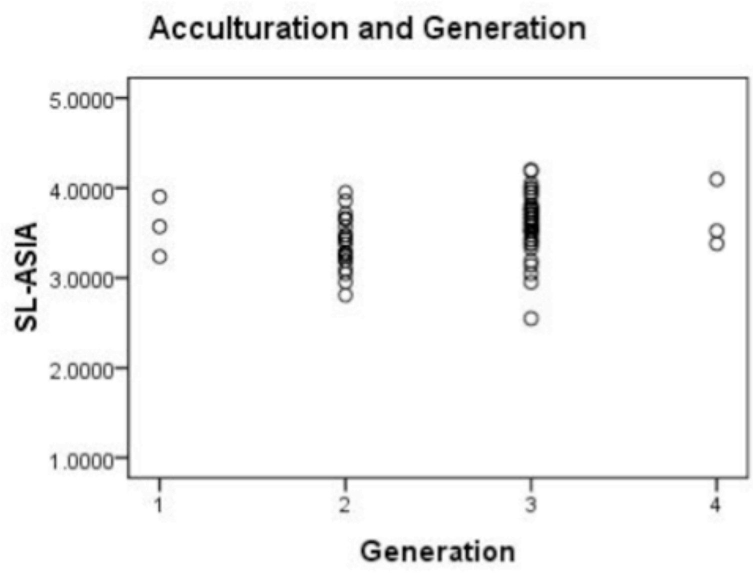

Figure 2: Scatter Plot of SL-ASIA Score and Generation Status in Japanese Americans. $r = .250$

Cognitive and Olfactory Test Scores

Table 7 summarizes the mean and standard deviation of each of the test scores, and Tables 8 a-c present the correlation coefficients between the two demographic variables (age, education, and gender) and test scores within each ethnic group.

Hypothesis 1: Relationship of Demographics to Test Performance

The correlation coefficients between age and test scores were significant for most of the test scores in the JA and CA groups, partially supporting the hypothesis. Age negatively correlated with all the test scores that were selected for analyses in JA, and all but two test scores (BNT and SDOIT) in the CA groups. Contrary to the hypothesis that the association of age and test scores would be smaller in Japanese Americans, stronger negative correlations in JA compared to CA were observed with the SDOIT, BNT, BVMT-R Total, and BVMT-R Delay. Years of education was not as strongly associated with test scores as age was, but it was significantly positively correlated with the BNT, COWA-FAS, BVMT-R Total, and BVMT-R Delay in both groups. Additionally, education was positively correlated with the CVLT LDFR and LDCR in the CA group, but not in the JA group, although the difference in the strength of association did not reach significance when assessed at an alpha of .01. Gender was significantly correlated in tests of olfaction in both ethnic groups, with women performing better than men, supporting our hypothesis. In the JA group, gender also significantly correlated with performance on the verbal list-learning test (CVLT), thus supporting our hypothesis, and with performance on the verbal fluency measures (both phonemic and category). The JA group demonstrated a stronger association between gender and the verbally oriented memory measure (CVLT Total, CVLT-1, CVLT-5, and CVLT LDCR), with women scoring higher than men. The strength of association between gender and test scores was similar on the measures of visual memory (BVMT-R), olfactory memory (COLT), odor identification (SDOIT), and confrontation naming (BNT). Since COLT-1 and COLT-5 did not demonstrate significant associations with any of the basic demographic variables, they were not included in the subsequent analyses.

Table 9 presents the proportion of variance of the test scores accounted for by each of the predictor variables based on bivariate regression analyses. Age accounted for 12 to 44% of the variance of cognitive/olfactory test scores in the JA group. This is overall much larger proportion compared to what has been reported in the previous study in an African American sample, where age explained 1% to 11% of variance in measures of leaning/memory, reasoning, language, and visuospatial abilities (Manly, et al., 2004). As expected, gender was a significant predictor for olfactory-based test scores in both ethnic groups. Gender also predicted verbally mediated test scores in the JA group, which is different from what past literature demonstrated for African Americans, for whom gender was overall a very weak predictor (accounting for 1 to 5% of the variance) of cognitive test scores. The WRAT4 math computation score also was a strong predictor of the test scores in the JA group, explaining 7% to 45% of the variance. WRAT4 reading score overall was a weaker predictor that predicted fewer measures than age and WRAT4 Math Computation score.

Table 7

Means and Standard Deviations of Olfactory and Cognitive Tests for the Japanese Americans and Caucasian Americans

	JA		CA	
Tests	Mean	*SD*	Mean	*SD*
Naming				
SDOIT	5.7	1.7	5.9	1.4
BNT (raw score)	55.9	4.0	56.3	3.4
Leaning/Memory				
CVLT Total	46.1	13.0	48.1	10.5
CVLT-1	6.1	2.1	6.1	1.8
CVLT-5	11.0	3.2	11.5	2.5
CVLT LDFR	9.9	3.8	9.7	3.7
CVLT LDCR	10.6	3.7	10.7	3.2
COLT Total	31.8	10.4	32.2	11.1
COLT-1	5.0	2.4	4.8	1.9
COLT-5	7.3	2.9	7.1	2.7
COLT LDFR	7.4	3.2	7.2	2.7
COLT LDCR	6.5	2.7	6.2	2.8
BVMT-R TR	20.8	7.9	20.5	7.4
BVMT-R DR	8.5	3.1	8.6	3.0
Language Fluency				
Phonemic fluency	43.8	13.1	44.0	13.0
Smantic fluency	20.3	6.1	20.7	5.0

Note. JA = Japanese Americans; CA = Caucasian Americans; SDOIT = San Diego Odor Identification Test; BNT = Boston Naming Test; CVLT = California Verbal Learning Test; LDFR = Long Delay Free Recall; LDCR = Long Delay Cued Recall; COLT = California Odor Learning Test; BVMT-R = Brief Visuospatial Memory Test Revised; TR = Total Recall; DR = Delayed Recall.

Table 8-a

Comparison of Group Correlations (Age and Scores)

Test	Correlation coefficients JA		Correlation coefficients CA		Fisher's *z* JA	Fisher's *z* CA	*z* score	
Naming								
SDOIT	-.584	**	-.223		-0.67	-0.23	-2.43	*
BNT	-.583	**	-.204		-0.67	-0.21	-2.68	**
Learning/Memory								
CVLT Total	-.352	**	-.378	**	-0.37	-0.40	0.17	
CVLT-1	-.316	**	-.254	*	-0.33	-0.26	-0.39	
CVLT-5	-.265	*	-.339	**	-0.27	-0.35	0.48	
CVLT LDFR	-.426	**	-.334	**	-0.45	-0.35	-0.63	
CVLT LDCR	-.441	**	-.367	**	-0.47	-0.38	-0.52	
BVMT-R TR	-.659	**	-.317	**	-0.79	-0.33	-2.70	**
BVMT-R DR	-.534	**	-.216		-0.60	-0.22	-2.19	*
COLT Total	-.624	**	-.329	**	-0.73	-0.34	-2.14	*
COLT-1	-.097		.001		-0.10	0.00	-0.54	
COLT-5	-.080		-.013		-0.08	-0.01	-0.37	
COLT LDFR	-.534	**	-.313	*	-0.60	-0.32	-1.49	
COLT LDCR	-.434	**	-.341	**	-0.46	-0.36	-0.60	
Verbal Fluency								
COWA-FAS	-.481	**	-.325	**	-0.52	-0.34	-1.09	
Animal Fluency	-.370	**	-.491	**	-0.39	-0.54	0.87	

Note. See Table 7 for abbreviations.

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

Table 8-b
Comparison of Group Correlations (Education and Scores)

Test	Correlation coefficients JA		Correlation coefficients CA		Fisher's z JA	Fisher's z CA	z score
Naming							
SDOIT	.127		.004		0.13	0.00	0.68
BNT	.342	**	.344	**	0.36	0.36	-0.01
Learning/Memory							
CVLT Total	.045		.264	*	0.05	0.27	-1.31
CVLT-1	.055		.152		0.06	0.15	-0.57
CVLT-5	.051		.222		0.05	0.23	-1.02
CVLT LDFR	.116		.307	**	0.12	0.32	-1.17
CVLT LDCR	.112		.344	**	0.11	0.36	-1.44
BVMT-R TR	.291	*	.440	**	0.30	0.47	-1.01
BVMT-R DR	.273	*	.323	**	0.28	0.33	-0.32
COLT Total	.272	*	.200		0.28	0.20	0.42
COLT-1	.138		.025		0.14	0.03	0.63
COLT-5	.045		-.030		0.05	-0.03	0.41
COLT LDFR	.139		.137		0.14	0.14	0.01
COLT LDCR	.087		.101		0.09	0.10	-0.08
Verbal Fluency							
COWA-FAS	.393	**	.321	**	0.42	0.33	0.48
Animal Fluency	.159		.248	*	0.16	0.25	-0.54

Note. See Table 7 for abbreviations.
** p<.01. * p<.05.

Table 8-c

Comparison of Group Correlations (Gender and Scores)

Test	Correlation coefficients JA		Correlation coefficients CA		Fisher's *z* JA	Fisher's *z* CA	*z* score	
Naming								
SDOIT	-.386	**	-.361	**	-0.41	-0.38	-0.16	
BNT	-.089		.192		-0.09	0.19	-1.65	
Learning/Memory								
CVLT Total	-.472	**	-.124		-0.51	-0.12	-2.26	*
CVLT-1	-.368	**	-.036		-0.39	-0.04	-2.04	*
CVLT-5	-.491	**	-.113		-0.54	-0.11	-2.47	*
CVLT LDFR	-.438	**	-.150		-0.47	-0.15	-1.86	
CVLT LDCR	-.513	**	-.115		-0.57	-0.12	-2.63	**
BVMT-R TR	-.198		-.163		-0.20	-0.16	-0.21	
BVMT-R DR	-.116		-.057		-0.12	-0.06	-0.35	
COLT Total	-.331	**	-.277	*	-0.34	-0.28	-0.33	
COLT-1	.045		-.078		0.05	-0.08	0.68	
COLT-5	.075		-.199		0.08	-0.20	1.52	
COLT LDFR	-.318	*	-.325	**	-0.33	-0.34	0.04	
COLT LDCR	-.433	**	-.346	**	-0.46	-0.36	-0.56	
Verbal Fluency								
COWA-FAS	-.288	*	-.014		-0.30	-0.01	-1.65	
Animal Fluency	-.284	*	-.118		-0.29	-0.12	-1.01	

Note. See Table 7 for abbreviations. Gender was coded as 0 for women, and 1 for men.
** $p<.01$. * $p<.05$.

Table 9

Proportion of Variance (R^2) in Cognitive/Olfactory Test Scores Uniquely Accounted for by Demographic, Acculturation, and Quality-of-Education Measures

Tests	SL-ASIA		Age		Education		Gender		WRAT4 Reading		WRAT4 Math	
	R^2	*p*	R^2	*p*	R^2	*p*	R^2	*p*	R^2	*p*	R^2	*p*
JAPANESE AMERICANS												
Naming												
SDOIT	.084	.015	**.337**	**<.001**	.016	NS	**.145**	**.002**	**.157**	**.001**	**.168**	**<.001**
BNT	.095	.014	**.359**	**<.001**	**.117**	**.003**	.008	NS	**.337**	**<.001**	**.365**	**<.001**
Learning and Memory												
CVLT Total	.048	NS	**.124**	**.003**	.002	NS	**.223**	**<.001**	.078	.018	**.109**	**.005**
CVLT-1	.054	NS	**.100**	**.007**	.003	NS	**.136**	**.002**	**.112**	**.004**	.059	.043
CVLT-5	.011	NS	.070	.025	.003	NS	**.241**	**<.001**	.059	.042	.074	.023
CVLT LDFR	.039	NS	**.181**	**<.001**	.013	NS	**.192**	**<.001**	.078	.018	**.137**	**.002**
CVLT LDCR	.024	NS	**.195**	**<.001**	.013	NS	**.263**	**<.001**	**.104**	**.006**	**.137**	**.002**
BVMT-R TR	.045	NS	**.435**	**<.001**	.085	.014	.026	NS	**.161**	**.001**	**.434**	**<.001**
BVMT-R DR	.010	NS	**.286**	**<.001**	.075	.021	.014	NS	**.133**	**.002**	**.447**	**<.001**
COLT Total	.073	.037	**.393**	**<.001**	.073	.035	**.115**	**.008**	**.146**	**.002**	**.145**	**.002**
COLT LDFR	.045	NS	**.280**	**<.001**	.019	NS	.097	.015	.061	.047	**.131**	**.003**
COLT LDCR	.056	NS	**.185**	**.001**	.008	NS	**.180**	**.001**	.044	.094	.073	.031
Verbal Fluency												
COWA-FAS	**.096**	**.009**	**.232**	**<.001**	**.105**	**.006**	.083	.015	**.257**	**<.001**	**.254**	**<.001**
Animal fluency	.083	.016	**.137**	**.001**	.025	NS	.014	NS	.078	.018	**.179**	**<.001**
CAUCASIAN AMERICANS												
Naming												
SDOIT			.050	NS	.000	NS	**.131**	**.003**	.009	NS	.000	NS
BNT			.042	NS	**.118**	**.003**	.037	NS	.039	NS	**.196**	**<.001**
Learning and Memory												
CVLT Total			**.143**	**.001**	.070	.026	.015	NS	**.155**	**.001**	.072	.024
CVLT-1			.065	.032	.023	NS	.001	NS	.086	.014	.066	.031
CVLT-5			**.115**	**.004**	.049	NS	.013	NS	**.113**	**.004**	.039	NS
CVLT LDFR			**.112**	**.004**	**.094**	**.009**	.023	NS	**.126**	**.003**	**.098**	**.008**
CVLT LDCR			**.116**	**.005**	**.119**	**.003**	.013	NS	**.001**	**.006**	**.148**	**.001**
BVMT-R TR			**.100**	**.007**	**.194**	**<.001**	.093	NS	**.114**	**.004**	**.149**	**.001**
BVMT-R DR			.047	NS	**.104**	**.006**	.003	NS	.081	.017	**.140**	**.001**
COLT Total			**.108**	**.007**	.039	NS	.077	.025	.006	NS	**.021**	**.006**
COLT LDFR			.098	.011	.019	NS	**.106**	**.008**	.000	NS	.004	NS
COLT LDCR			**.116**	**.005**	.011	NS	**.120**	**.005**	.044	NS	.000	NS
Language												
COWA-FAS			**.105**	**.006**	**.232**	**<.001**	.000	NS	**.267**	**<.001**	**.142**	**.001**
Animal fluency			**.241**	**<.001**	.062	.037	.081	.016	.092	.010	.026	NS

Note. NS = not significant. Bold font indicates R^2 statistically significant at $p<.01$. See Table 7 for abbreviations for the tests.

Hypothesis 2. Added Effects of Ethnicity

Bivariate regression analyses with ethnicity as a predictor, and hierarchical regression analyses with significant (at an alpha of .05) basic demographic variables (combination of age, education, and gender depending on their significance for each test score) at step 1 and with ethnicity at step 2, indicated that ethnicity was not a significant predictor either by itself or after controlling for other demographic variables in any of the tests scores in the current study (Table 10).

Table 10

Proportion of Variance Explained by Ethnicity (R^2) and After Covarying for Significant Basic Demographic Variables ($R^2 \Delta$)

	Bivariate regression Ethnicity		Hierarchical regression Step 1		Ethnicity	
	R^2	*p*	R^2	*p*	$R^2 \Delta$	*p*
Naming						
SDOIT[a,g]	.000	NS	.268	<.001	.000	NS
BNT[a,e]	.003	NS	.214	<.001	.003	NS
Learning/Memory						
CVLT Total[a,g]	.007	NS	.192	<.001	.007	NS
CVLT-1[a,g]	.000	NS	.110	<.001	.000	NS
CVLT-5[a,g]	.010	NS	.158	<.001	.011	NS
CVLT LDFR[a,g]	.001	NS	.197	<.001	.001	NS
CVLT LDCR[a,g]	.001	NS	.231	<.001	.001	NS
COLT Total[a,g]	.000	NS	.245	<.001	.001	NS
COLT LDFR[a,g]	.001	NS	.246	<.001	.000	NS
COLT LDCR[a,g]	.002	NS	.251	<.001	.001	NS
BVMT-R TR[a,e]	.000	NS	.285	<.001	.000	NS
BVMT-R DR[a,e]	.001	NS	.175	<.001	.001	NS
Verbal Fluency						
COWA-FAS[a,e]	.000	NS	.217	<.001	.000	NS
Animal Fluency[a]	.001	NS	.179	<.001	.000	NS

Note. See Table 7 for abbreviations. Superscripts indicate basic significant (at alpha = .05) demographic variables that were entered at Step 1; a = age, e = education, and g = gender.

Hypothesis 3: Interaction of Basic Demographics with Ethnicity

The analyses for hypothesis 2 indicated that there were no overall group differences in the test scores between the two ethnic groups when controlled for basic demographic variables (combination of age, education, and gender, depending on the significance). However, the correlation analyses conducted earlier indicated that there was a statistically significant difference between the two groups in the magnitude of association between age and some of the test scores. Thus, interaction of basic demographic variables with ethnicity was formally tested with regression analyses (Tables 11 a-c). Since there was significant associations between age and education (r = -.401 and r = -.306 for JA and CA, respectively), education corrected z-scores were used when the effect of age was examined, and age-corrected z-scores were used when the effect of education was examined, as a criterion variable for each regression analysis. In addition, due to significant association between age and gender in the JA group (r =.334), age-corrected z-scores were used when the effect of gender was examined.

When the two ethnic groups were analyzed together, age was a significant predictor of all the test scores examined. The partial regression coefficients reflecting the relationship between age and the comparison between the JA and CA groups was approaching statistical significance in the BNT (b = -.037, p = .015), the BVMT-R Total (b = -.031, p = .041), the COLT total (b = -.032, p = .05), and the SDOIT (b = -.039, p = .017), indicating that the relationship between age and test scores tended to differ as a function of ethnicity. Further analyses of these interactions, by conducting simple bivariate regressions, indicated the following; For the BNT and the SDOIT, age was significantly and negatively associated to the scores in JA (β = -.474; p < .001; R^2 = .225, and $\beta = -.559$; $p < .001$; $R^2 = .313$, respectively) in that the older participants scored lower, but not in CA. For the BVMT-R TR, age was negatively associated to the scores in both groups but the slope was steeper in JA ($\beta = -.531$, $p < .001$, $R^2 = .282$) than CA ($\beta = -.236$, $p = .047$, $R^2 = .056$). Similarly, for the COLT, age was negatively associated to the scores in both groups but the slope was steeper in JA ($\beta = -.567$, $p < .001$, $R^2 = 321$) than in CA ($\beta = -.264$, $p = .033$, $R^2 = 070$). Additional analyses comparing ethnicity-score relationship at younger (50), medium (65), and older (80) age values indicated that on the BNT, JA tended to score lower than CA at the older age ($b = -.702$, $p = .013$). Similarly, on the COLT, JA tended to score lower than CA at the older age ($b = -.584$, $p = .049$). On the SDOIT, JA tended to score higher than CA at the younger age ($b = .594$, $p = .038$), and lower at the older age ($b = -.562$, $p = .017$). Education was a significant predictor of the test scores in the COWA-FAS, and marginally significant predictor of the BNT, CVLT LDFR, CVLT LDCR, and BVMT-R TR, but no significant education-ethnicity interaction was observed. The ANOVA revealed that the main effect of gender was significant for odor naming, verbal learning, and odor learning measures. For CVLT LDCR and CVLT-5, interaction of gender by ethnicity was approaching statistical significance. Simple main effects analyses indicated that JA women performed significantly better than JA men on the CVLT LDCR ($F = 15.20$, $p < .001$). On the CVLT-5, JA men performed significantly lower than JA women ($F = 14.99$, $p < .001$), and than CA men ($F = 6.06$, p = .017).

In order to examine the applicability of the existing normative data based on Caucasian normative sample or the test standardization sample, scores of our participants who were within the age range for the normative datasets were converted to demographically corrected T-scores based on the existing Caucasian normative dataset (Heaton, et al., 2004) for the BNT, CVLT Total, CVLT-1, CVLT-5, CVLT LDFR, COWA-FAS, and Animal fluency (up to age 85), and based on the standardization sample for the BVMT-R (up to 79 years of age, not education- and gender-adjusted), to examine whether the group mean T-scores and the percentage of people classified as "impaired" (defined here as T-score less than 40, a commonly used cut-point that has been demonstrated to provide an optimal balance between sensitivity and specificity) would differ between the two ethnic groups (Table 12). For the SDOIT, impaired performance was defined as a score lower than 6 based on the previous study (Murphy, et al., 2002). The pattern of distribution of "impairment" was not statistically different when comparing the two groups using chi-square independence tests. However, when the impairment rates of each group was compared against what would be expected within the normal distribution (i.e., 15.6% impairment rate), Japanese Americans demonstrated more test instruments with significantly greater rates of impairment compared to Caucasian Americans. Specifically, a statistically larger proportion of Japanese American individuals were classified as "impaired," when compared to the 15.6% impairment rate, on the CVLT-1 (χ^2 (1, N = 70) = 11.024, p = .001), CVLT-5 (χ^2 (1, N = 70) = 24.674, p < .001), CVLT Total (χ^2 (1, N = 70) = 15.833, p < .001), and CVLT LDFR (χ^2 (1, N = 70) = 5.439, p = .020). Our Caucasian group also showed statistically larger proportion of impairment on CVLT-1 (χ^2 (1, N = 69) = 7.460, p = .006) and CVLT-5 (χ^2 (1, N = 69) = 9.390, p = .002), when compared to the expected impairment rate. Given the marginally significant gender-ethnicity interaction on the CVLT, rates of impairment were calculated separately for the two genders (Table 13), which indicated disproportionately high percentage of Japanese American men were classified as “impaired” on CVLT Total compared to JA women (χ^2 (1, N = 70) = 4.538, p = .042), and on CVLT LDFR compared to CA men, (χ^2 (1, N = 70), p = .038) when the T-scores were derived from the Caucasian norm.

Table 11-a

Interactions of Age and Ethnicity

	Step 1			Interaction		
Test	*b*	*t*	*p*	*b*	*t*	*p*
		Age			Age by Ethnicity	
Naming						
SDOIT	-.040	-4.933	**<.001**	-.039	-2.43	.017
BNT	-.030	-3.85	**<.001**	-.131	-2.47	.015
Learning/Memory						
CVLT Total	-.030	-3.96	**<.001**	-.001	-.05	NS
CVLT-1	-.025	-3.12	**.002**	-.008	.06	NS
CVLT-5	-.024	-3.12	**.002**	.003	.21	NS
CVLT LDFR	-.030	-3.93	**<.001**	-.005	-.30	NS
CVLT LDCR	-.033	-4.27	**<.001**	-.008	-.53	NS
BVMT-R TR	-.038	-5.11	**<.001**	-.031	-2.07	.041
BVMT-R DR	-.028	-3.58	**<.001**	-.027	-1.72	NS
COLT Total	-.042	-5.23	**<.001**	-.032	-1.98	.05
COLT LDFR	-.039	-4.70	**<.001**	-.025	-1.52	NS
COLT LDCR	-.035	-4.20	**<.001**	-.004	-.211	NS
Verbal Fluency						
COWA-FAS	-.028	-3.67	**<.001**	-.009	-.56	NS
Animal Fluency	-.034	-4.54	**<.001**	.009	.59	NS

Note. *b* = unstandardized regression coefficient; *t* = the test statistic for the regression coefficient; *p* = p-value associated with the *t*. See Table 7 for abbreviations for tests. Bold font indicates R^2 statistically significant at p<.01

Table 11-b

Interaction of Education and Ethnicity

	Step 1			Interaction		
Test	*b*	*t*	*p*	*b*	*t*	*p*
	Education			Education by Ethnicity		
Naming						
SDOIT	-.032	-.80	NS	.059	.72	NS
BNT	.096	2.57	.011	-.016	-.20	NS
Learning/Memory						
CVLT Total	.002	.04	NS	-.113	-1.47	NS
CVLT-1	.085	1.13	NS	-.086	-.56	NS
CVLT-5	.006	.15	NS	-.084	-1.08	NS
CVLT LDFR	.345	2.43	.016	-.384	-1.33	NS
CVLT LDCR	.031	.82	.013	-.129	-1.67	NS
BVMT-R TR	.093	2.47	.015	-.113	-1.49	NS
BVMT-R DR	.077	2.04	.043	-.057	-.74	NS
COLT Total	.042	1.02	NS	.031	.38	NS
COLT LDFR	-.006	-.00	NS	-.003	-.03	NS
COLT LDCR	-.015	-.36	NS	-.020	-.25	NS
Verbal Fluency						
COWA-FAS	.106	2.831	**.005**	-.005	-.07	NS
Animal Fluency	.022	.574	NS	-.054	-.70	NS

Note. *b* = unstandardized regression coefficient; *t* = the test statistic for the regression coefficient; *p* = p-value associated with the *t*. See Table 7 for abbreviations. Bold font indicates R^2 statistically significant at $p<.01$

Table 11-c
Interaction of Gender and Ethnicity

	Main Effect		Interaction	
Test	*F*	*p*	*F*	*p*
	Gender		Gender by Ethnicity	
Naming				
SDOIT	14.25	**<.001**	.11	NS
BNT	2.42	NS	.87	NS
Learning/Memory				
CVLT Total	10.56	**.001**	3.83	NS
CVLT-1	4.13	.044	3.07	NS
CVLT-5	12.13	**.001**	4.85	.021
CVLT LDFR	8.64	**.004**	1.36	NS
CVLT LDCR	11.67	**.001**	4.76	.031
BVMT-R TR	1.384	NS	.52	NS
BVMT-R DR	.032	NS	.13	NS
COLT Total	12.98	**<.001**	.39	NS
COLT LDFR	13.61	**<.001**	.07	NS
COLT LDCR	21.12	**<.001**	.15	NS
Verbal Fluency				
COWA-FAS	.04	NS	.93	NS
Animal Fluency	2.82	.NS	.23	NS

Note. *F* = the test statistic for the main effect and interaction based on analyses of variance; *p* = p-value associated with the *F*. .See Table 7 for abbreviations for tests. Bold font indicates R^2 statistically significant at p<.01

Table 12

Demographically Corrected Test Scores and Rates of Impairment

	JA			CA		
	Mean	*SD*	% impaired	Mean	*SD*	% impaired
Naming						
SDOIT	-	-	31.3	-	-	35.4
BNT	53.4	10.1	5.7	53.7	11.2	10.1
Learning/Memory						
CVLT Total	44.4	11.3	32.9[1]	46.3	9.9	23.2
CVLT-1	45.2	10.4	30.0[1]	45.7	8.9	27.5[1]
CVLT-5	44.7	13.1	37.1[1]	46.8	10.7	29.0[1]
CVLT LDFR	47.0	12.2	25.7[1]	46.6	11.9	18.8
BVMT-R TR^	50.1	12.2	21.9	48.4	13.0	23.9
BVMT-R DR^	52.3	12.4	21.9	52.2	12.9	14.9
Verbal Fluency						
COWA-FAS	50.5	10.0	14.3	51.5	10.6	20.3
Animal fluency	49.4	12.7	18.6	51.1	9.3	10.1

Note. See Table 7 for abbreviations. For BNT, CVLT, COWA-FAS, and Animal Fluency, n = 70 for JA and n = 69 for CA. For BVMT-R, n = 64 for JA and n = 67 for CA.

[1] The rate is significantly different from what would be expected (15.6%) within the normal distribution.

^ The normative data for the BVMT-R do not correct for education and gender.

Table 13

Demographically Corrected T-scores and Rates of Impairment for the Two Genders

	Men			Women		
	Mean	*SD*	% impaired	Mean	*SD*	% impaired
			CVLT TOTAL			
JA	43.1	10.3	46.7[1,g]	45.9	11.7	22.5[g]
CA	47.7	10.9	22.6	45.2	11.7	23.7
			CVLT-1			
JA	44.4	10.6	36.7[1]	45.8	10.4	25.0
CA	47.6	10.0	16.1	44.1	7.7	36.8[1]
			CVLT-5			
JA	41.6	11.9	50.0[1]	47.1	13.6	27.5[1]
CA	48.4	12.5	29.0[1]	45.4	8.9	28.9[1]
			CVLT LDFR			
JA	45.2	13.0	36.7[1,e]	48.6	11.3	17.5
CA	46.5	12.4	15.2[e]	46.3	11.3	23.7

Note. See Table 7 for abbreviations. JA men; n = 40, JA women; n = 30, CA men; n = 40, and CA women; n = 32.

[1] The rate is significantly different from what would be expected (15.6%) within the normal distribution.

[g] Significantly different distribution of % impaired/not-impaired between the two genders within Japanese Americans.

[e] Significantly different distribution of % impaired/not-impaired between the two ethnic groups within the male gender.

Hypothesis 4: Relationship of Acculturation to Test Performance

Bivariate regression analyses revealed that the SL-ASIA score was a significant predictor of the COWA-FAS score (Table 14) and was a marginally significant predictor of the SDOIT, BNT, and Animal fluency scores, thus supporting the hypotheses that more acculturated individuals would score higher on the measures that were considered to be more culture-laden. However, hierarchical regression analyses with significant basic demographic variables (combination of age, education, and gender depending on their significance) at Step 1, and with the SL-ASIA score at step 2, indicated that the association of the SL-ASIA and cognitive test scores was attenuated when controlling for other basic demographic variables. For CVLT Total and CVLT-1, SL-ASIA score was a marginally significant predictor after covarying for gender, with more acculturated individuals tending to perform better than less acculturated individuals.

Other Supplemental Analyses

Bilingual status. Regression analyses indicated that bilingual status was a significant predictor for the odor memory test (COLT) scores among Japanese Americans (Table 15). Specifically, those who were bilinguals performed poorer on the COLT. However, after controlling for age and gender, bilingual status was no longer a significant predictor. Bilingual status did not predict performance on the other measures, including verbally mediated tests.

Item analyses. Item analysis on the SDOIT indicated that fewer Japanese Americans compared to Caucasian Americans correctly identified cinnamon and mustard. Item analyses on the BNT indicated that the JA and CA groups responded similarly to the test items (Figure 4). The only exceptions were item 44 (muzzle), which fewer Japanese

Americans correctly identified, and item 60 (abacus) which more Japanese Americans correctly identified, relative to Caucasian Americans. When the performance was compared between monolingual English speakers and Japanese-English bilingual speakers (Figure 5), there was some discrepancy in the item 59 (compass), but response patterns was overall similar. It should be noted, however, that the participants in the current study were chosen only if they were more fluent in English than in Japanese.

SL-ASIA and generation. When correlation between the SL-ASIA score and cognitive/olfactory test scores were evaluated separately for the second and third generation Japanese Americans, second generations showed significant correlation only with SDOIT ($r = .45$, $p = .04$), and third generation showed significant correlation with BNT ($r = .36$, $p = .02$) and COLT LDCR ($r = .36$, $p = .02$). However, significant association between the SL-ASIA score and verbal fluency measures (as examined earlier) were no longer significant once the Japanese Americans were subdivided into different generations.

Generation status. Finally, regression analyses (Table 16) indicated that the generation status was a significant predictor of the scores on all the tests except for COWA-FAS, and that individuals who were later generations performed better. After controlling for significant demographic variables, the association between generation status and the test scores was attenuated on many of the tests, but remained significant for the verbal memory test scores (CVLT Total, CVLT-1, CVLT-5, and CVLT Long Delay Free Recall), and marginally significant for Animal Fluency, even after controlling for age (Animal Fluency), gender (CVLT Total) and age and gender (CVLT LDFR). The effects of generation status were not attenuated after entering WRAT4 scores prior to entering generation status. Table 17 presents the rates of impairment for the second- and third-generation Japanese Americans. A significantly larger proportion of the second-generation individuals were classified as "impaired" on BVMT-R TR (χ^2 (1, N = 58) = 6.843, p = .026) and BVMT-R DR (χ^2 (1, N = 58) = 8.320, p = .008).

Table 14

Proportion of Variance Accounted for by the SL-ASIA Alone and After Covarying for Age and Education

	Bivariate regression SL-ASIA			Hierarchical regression Step 1		SL-ASIA		
	R^2	β	*p*	R^2	*p*	R^2 Δ	β	*p*
Naming								
SDOIT[a]	.095	.309	.013	.337	<.001	.012	.118	NS
BNT[a]	.085	.291	.014	.340	<.001	.008	.097	NS
Learning/Memory								
CVLT Total[g]	.048	.220	NS	.223	<.001	.057	.240	.023
CVLT-1[g]	.054	.232	NS	.136	.002	.061	.247	.026
CVLT-5[g]	.011	.106	NS	.241	<.001	.016	.127	NS
CVLT LDFR[a,g]	.045	.196	NS	.280	<.001	.011	.116	NS
CVLT LDCR[a,g]	.024	154	NS	.345	<.001	.005	.075	NS
COLT Total[a]	.073	.267	.038	.393	<.001	.002	.048	NS
COLT LDFR[a]	.045	.212	NS	.280	<.001	.001	.025	NS
COLT LDCR[a,g]	.057	.238	NS	.276	<.001	.024	.171	NS
BVMT-R TR[a]	.045	.213	NS	.435	<.001	.001	-.668	NS
BVMT-R DR[a]	.010	.101	NS	.286	<.001	.009	-.101	NS
Verbalu Fluency								
COWA-FAS[a,e]	.097	.311	**.008**	.279	<.001	.042	.224	.047
Animal Fluency[a]	.083	.289	.015	.137	.001	.028	.180	NS

Note. See Table 7 for abbreviations. Bivariate regression R^2 = Proportion of variance accounted for by the SL-ASIA score; Step 1 R^2 = Proportion of variance accounted for by significant basic demographic variables (indicated by superscripts a = age, e = education, g = gender) when entered as a set; R^2 Δ = increase in the amount of variance accounted for by adding the SL-ASIA at step 2. Bold font indicates R^2 statistically significant at p<.01 for the SL-ASIA.

Table 15

Proportion of Variance Explained by Bilingual Status Independently and after Covarying for Significant Basic Demographic Variables

	Bivariate regression Bilingual Status			Hierarchical regression Bilingual Status		
	R^2	β	*p*	R^2 Δ	β	*p*
Naming						
SDOIT[a]	.014	-.118	NS	.004	.388	NS
BNT[a]	.016	-.126	NS	.002	.070	NS
Learning/Memory						
CVLT Total[g]	.057	-.239	NS	.047	-.217	NS
CVLT-1[g]	.065	-.255	.032	.056	-.238	.033
CVLT-5[g]	.029	-.170	NS	.022	-.147	NS
CVLT LDFR[a,g]	.040	-.199	NS	.009	-.100	NS
CVLT LDCR[a,g]	.014	-.118	NS	.000	-.102	NS
COLT Total[a]	.139	-.373	**.003**	.004	-.566	NS
COLT LDFR[a]	.110	-.331	**.009**	.021	-.157	NS
COLT LDCR[a,g]	.177	-.343	**.007**	.043	-.224	NS
BVMT-R TR[a]	.047	-.218	NS	.001	-.028	NS
BVMT-R DR[a]	.043	-.207	NS	.003	-.055	NS
Verbal Fluency						
COWA-FAS[a,e]	.007	-.083	NS	.000	.011	NS
Animal Fluency[a]	.024	-.156	NS	.003	-.053	NS

Note. See Table 7 for abbreviations. Bivariate regression R^2 = Proportion of variance accounted for by bilingual status; Step 1 R^2 = Proportion of variance accounted for by significant basic demographic variables (indicated by superscripts a = age, e = education, g = gender) when entered as a set; R^2 Δ = increase in the amount of variance accounted for by adding bilingual status at step 2. Bold font indicates R^2 statistically significant at $p<.01$ for bilingual status.

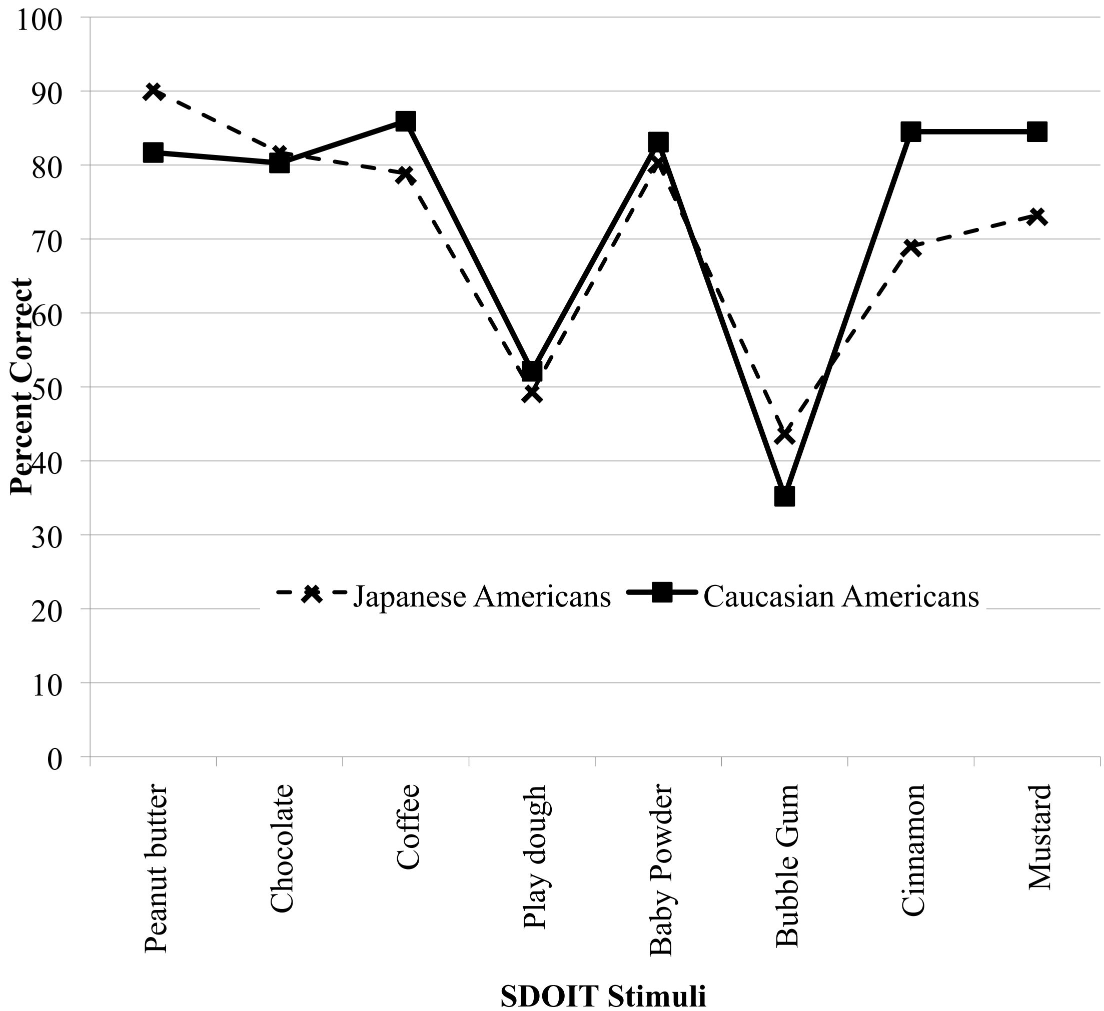

Figure 3. Proportion of correct responses for each item of the San Diego Odor Identification Test for the two ethnic groups.

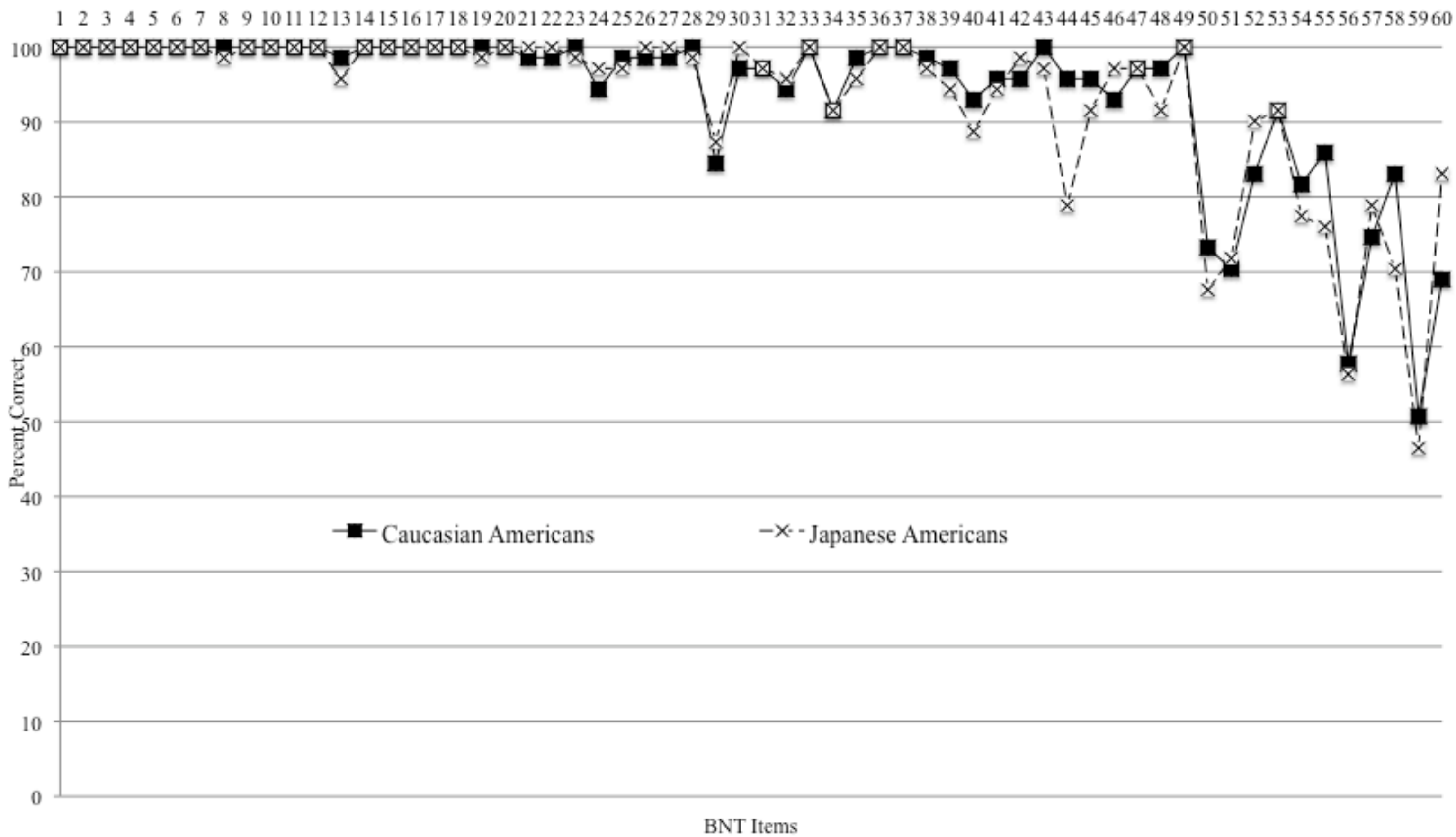

Figure 4. Proportion of correct responses for each item of the Boston Naming Test for the two ethnic groups.

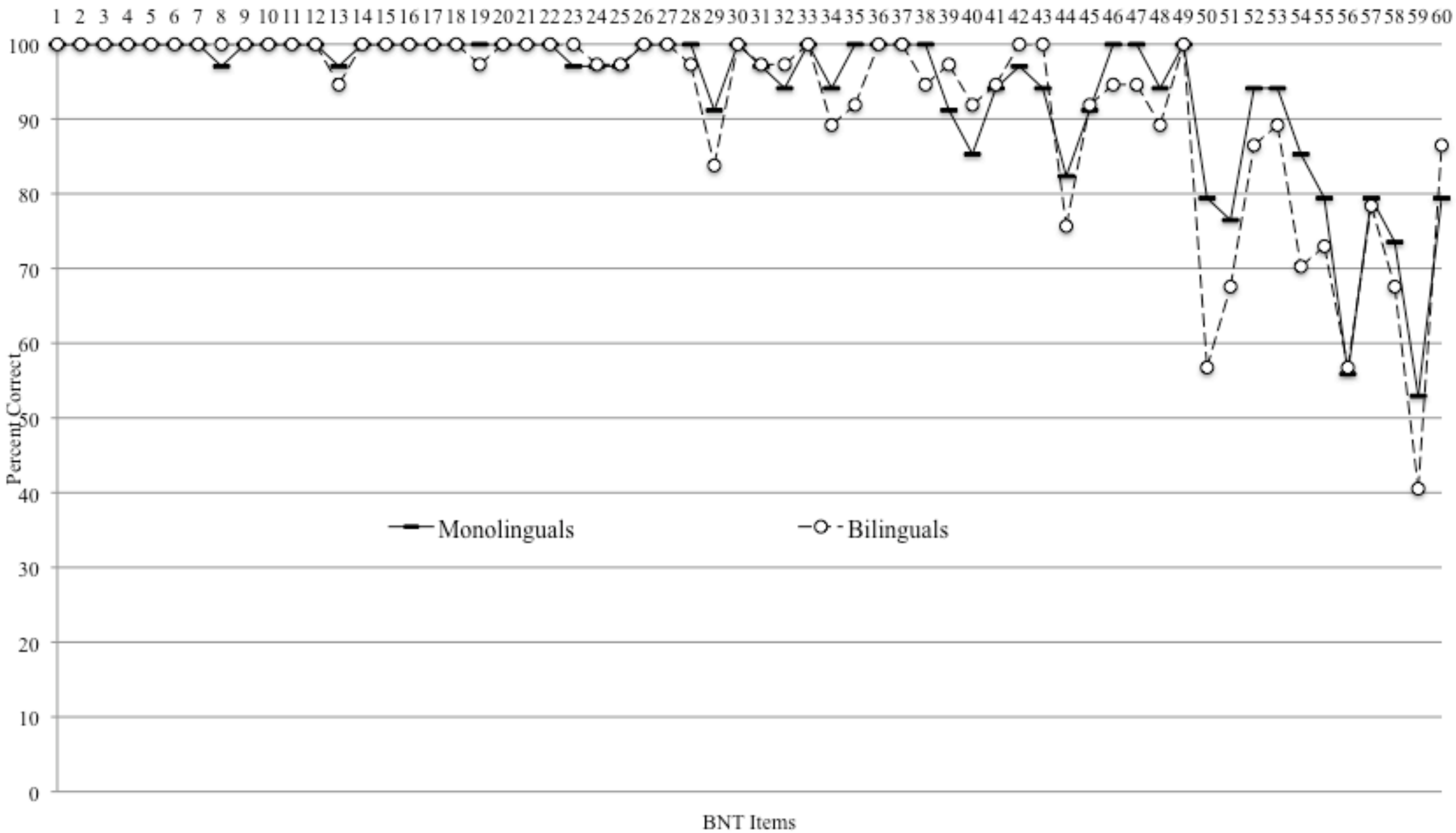

Figure 5. Percent of correct responses for each item of the Boston Naming Test for English-monolingual and English-Japanese bilinguals in the Japanese American group.

Table 16

Proportion of Variance Explained by Generation Status Independently and After Covarying for Significant Basic Demographic Variables

	Bivariate regression Generation Satus			Hierarchical regression Genearation Status		
	R^2	β	*p*	R^2 Δ	β	*p*
Naming						
SDOIT[a]	.147	.383	.002	.005	.084	NS
BNT[a]	.159	.398	.001	.024	.173	NS
Learning/Memory						
CVLT Total[g]	.209	.457	<.001	.142	.383	**<.001**
CVLT-1[g]	.159	.399	.001	.113	.342	**.002**
CVLT-5[g]	.140	.374	.001	.083	.294	**.005**
CVLT LDFR[a,g]	.234	.484	<.001	.112	.100	**.002**
CVLT LDCR[a,g]	.156	.396	<.001	.043	.231	.034
COLT Total[a]	.179	.423	.001	.008	.105	NS
COLT LDFR[a]	.131	.362	.004	.006	.095	NS
COLT LDCR[a,g]	.109	.330	.009	.003	.063	NS
BVMT-R TR[a]	.161	.401	.001	.015	.135	NS
BVMT-R DR[a]	.156	.396	.001	.031	.197	NS
Verbal Fluency						
COWA-FAS[a,e]	.061	.248	NS	.000	.024	NS
Animal Fluency[a]	.167	.409	<.001	.074	.304	.014

Note. See Table 7 for abbreviations. Bivariate regression R^2 = Proportion of variance accounted for by generation status; Step 1 R^2 = Proportion of variance accounted for by significant basic demographic variables (indicated by superscripts a = age, e = education, g = gender) when entered as a set; R^2 Δ = increase in the amount of variance accounted for by adding generation status at step 2. Bold font indicates R^2 statistically significant at p<.01 for bilingual status.

Table 17
Demographically Corrected Test Scores and Rates of Impairment Based on the Caucasian Normative Dataset

	Nisei (second generation) n = 22			Sansei (third generation) n = 43		
	Mean	*SD*	% impaired	Mean	*SD*	% impaired
Naming						
BNT	51.7	9.9	4.8	55.1	10.7	7.0
Learning/Memory						
CVLT Total	45.9	13.8	33.3[1]	44.2	9.6	30.2[1]
CVLT-1	47.1	10.6	28.6	45.3	9.0	25.6
CVLT-5	45.6	16.7	28.6	44.1	11.4	39.5[1]
CVLT LDFR	46.1	14.9	31.8[1]	47.9	10.5	18.6
BVMT-R TR	39.7	11.5	46.7[1,2]	53.2	11.7	14.0
BVMT-R DR	42.6	11.2	46.7[1,2]	55.9	11.5	11.6
Verbal Fluency						
COWA-FAS	48.1	9.6	23.8	51.8	10.3	9.3
Animal Fluency	47.4	13.6	28.6	51.2	10.3	14.0

Note. See Table 7 for abbreviations.
[1] The rate is significantly different from what would be expected (15.6%) within the normal distribution.
[2] Significantly different distribution of % impaired/not-impaired between the two generations within Japanese Americans.

IV. DISCUSSION

The purposes of the current study were to (1) examine the relationships between basic demographic variables (age, education, and gender) and cognitive and olfactory test performance in Japanese Americans, (2) investigate whether "ethnicity" was an important variable in evaluating cognitive and olfactory performance of Japanese American individuals, and (3) investigate the impact of levels of acculturation on test performance of Japanese Americans.

Demographic Influences Within Groups

The results indicated that age, education, and gender were important predictors of cognitive and olfactory performance in the JA group, a finding that is similar to other ethnic groups. Age had the most prominent effect, showing strong associations with all the test scores that were selected for the analyses in the Japanese American group. One difference compared to other ethnic minority groups was that Japanese Americans in this study showed stronger correlation between age and test scores than Caucasian Americans and than African Americans in the past studies. It is possible that the makeup of the Japanese American population caused the age-score correlation to be stronger, that is, due to age being inherently associated with the years of education, and with the generation status/acculturation.

Education correlated with the test scores less frequently compared to age. As expected from previous literature (Murphy, et al., 2002), gender was a significant predictor of olfactory test scores. In addition, gender was significantly associated with Japanese American's performance on the verbal memory task (CVLT), with female outperforming males, which is a finding that is consistent with the previous literature with Japanese American individuals (McCurry, et al., 2001), or with the CVLT standardization sample.

Acculturation, when assessed for its independent effect on test scores of Japanese Americans, was a significant predictor for scores of the tests that were conceptualized to be more culturally-biased than others, including phonemic verbal fluency, semantic verbal fluency, visual confrontation naming, odor identification, and olfactory memory. In fact, the proportion of variance explained by the acculturation score was greater than that reported in African Americans, although one should note that the acculturation measure used was not the same. For instance, in African American elderly, acculturation accounted for 4.8% of the variance in the BNT (8.4% in the current study), 3% of the variance in phonemic fluency (9.6% in the current study), and 2.8% in semantic fluency (8.3% in the current study). However, similar to Manly et al. (2004), acculturation no longer predicted test scores after covarying for other basic demographic variables. Furthermore, when the association between the SL-ASIA and test scores was evaluated separately for the second and third generation Japanese Americans, only odor identification was significantly associated in the second, and confrontation naming and odor memory scores were significant in the third generation. This indicates that in the bivariate regression analyses conducted earlier, the acculturation scores explained between-generation variability in the phonemic and semantic verbal fluency, but not as much as within-generation score variability.

Ethnicity Effects

Ethnicity was not a significant predictor of cognitive/olfactory test scores in terms of its overall impact, that is, there was no gross group difference between Japanese

Americans and Caucasian Americans in their performances on the instruments that were selected for the current study. The past literature on ethnic minority cognitive performance, specifically with African American and Hispanic Americans, have consistently demonstrated that individuals who belong to the minority groups tended to perform significantly lower compared to Caucasian American individuals. The current study did not detect a statistically significant gross group difference between the JA and CA groups. However, there were differences between the two ethnic groups in terms of the strength of age-score and gender-score relationships in some of the tests administered. Specifically, Japanese Americans tended to show stronger relationships between age and test scores in confrontation naming (BNT), odor identification (SDOIT), learning and immediate memory for visually presented figures (BVMT-R TR), and odor list learning (COLT Total) compared co Caucasian Americans.

In terms of naming tests (BNT and SDOIT), analyses indicated that age-score relationship was stronger in the Japanese American group compared to Caucasian group. Older (age 80) Japanese American participants tended to score lower on both the BNT and the SDOIT. Additionally, younger Japanese Americans tended to score higher than Caucasian American participants on the SDOIT. There was not a concerning discrepancy in the rate of impairment between the two ethnic groups, or between the second and third generation Japanese Americans, when using the Caucasian-based norm to convert the BNT raw score. The BNT item analyses indicated that the two ethnic groups performed comparable, with only a few items demonstrating discrepancy between the two ethnic groups. With regard to the SDOIT, fewer Japanese Americans correctly identified cinnamon and mustard.

With regard to memory measures, there was a stronger age-score relationship on the BVMT-R TR in the Japanese American group than Caucasian American counterparts. When rates of impairment (T-score below 40) were examined separately for the second and third Japanese Americans, half of the second-generation participants were classified as "impaired" on visuospatial memory measures (BVMT-R TR and DR), which is a rate much higher than expected based on the cutpoint that was used. It is interesting that the age-by-ethnicity interaction was observed in this visual memory test, which is typically conceptualized to be more robust for cultural or ethnic influences. Japanese Americans showed stronger age-score correlations compared not only to the Caucasian American counterparts in the current study, but also to the mono-lingual Spanish speakers in the past literature where they showed correlation coefficients of -.20 for Total recall, and -.23 for Delayed recall (Cherner, et al., 2007). With regard to verbal memory, more Japanese Americans were classified than Caucasians as "impaired" on the CVLT Total, and CVLT Long Delay Free Recall. Further analyses within the JA group indicated that generation status explained a measureable amount of variance above and beyond what age and gender accounted for in the CVLT. In addition, Japanese American men tended to score lower than Japanese American women on the fifth learning trial (CVLT-5) and on the cued recall after a long delay (CVLT LDCR) on this test. The extent of the gender discrepancy was larger in the Japanese American individuals and our results indicate that caution is required when interpreting performance of Japanese American males and early generation individuals on the CVLT. The COLT, the olfactory memory test, also showed a tendency for Japanese Americans to show stronger age-score relationship. However, no significant effects of acculturation or generation status were observed after covarying for basic demographic variables. It may be a useful measure to consider when assessing ethnic minorities, although further study with other minority populations, as well as development of normative performance expectations, would be necessary.

With regard to verbal fluency, Animal Fluency was a measure on which more Japanese Americans were classified as "impaired." Generation status explained a sizable, though not significant, amount of variance after covarying for age. For the phonemic fluency test (COWA-FAS), acculturation level explained a measurable, though not significant at an alpha of .01, proportion of variance after covarying for age and education. A considerably larger proportion of the second generation scored below T of 40 on phonemic (COWA-FAS) and category fluency (Animal Fluency) than did the third generation.

Across these analyses, "generation status" turned out to be an important factor to consider regarding Japanese American test performance, which may be due to the fact that generation status within the current Japanese American population carries a combined impact of age, acculturation level, bilingualism, social/historical experience, and education. In our sample, older generations had fewer years of education and they were less acculturated. What explains this lower performance in older (earlier generation) Japanese American participants? Does this performance pattern continue to exist? It is possible that this pattern is due to the specific history and sociocultural factors that early immigrants from Japan experienced, and that the impact is locked in time. It is also possible that this pattern is not specific to the time frame and it will continue to emerge for the succeeding generations. The potential mechanisms for the latter would be factors that are specific to this ethnic group that affect the process of aging.

Finally, the lack of overall group difference between the Japanese Americans and Caucasian Americans may be partly explained by the quality of education. The past literature indicated that lower scores of African American individuals were partially explained by the difference in quality of education between the African Americans and Caucasian Americans, as measured by a test of academic achievement (WRAT-3 Reading subtest). Manly et al. (2002) reported that there was approximately one standard deviation difference in the academic achievement test scores between the two groups. When those scores were entered into the analysis, the ethnicity effect disappeared, indicating that the ethnicity effect was explained by the difference in the achievement test scores. In contrast, the Japanese American participants in the current study did not show such differences in the academic achievement scores when compared to Caucasian Americans. It is often pointed out that the Asian American culture in general places high values on the importance of education. It is possible that this cultural value had led Japanese Americans, despite their minority status in the United States, to obtain a quality of education that is comparable to the mainstream Caucasian American individuals.

Conclusion and Future Directions

In summary, despite the lack of overall effect of “ethnicity,” our analyses indicated that older old Japanese Americans scored lower on verbal learning, visuospatial learning and memory, odor identification, visual confrontation naming, and verbal fluency measures. This is a finding that is in line with the past literature that showed older Japanese Americans scored lower on confrontation naming and verbal list learning and memory. It is not clear at this time if this pattern will persist in the future generations to come, or if the difference would be attenuated as the Japanese American population as a whole becomes even more acculturated and assimilated into the main stream culture. That question can be answered through continued research with this population at a future time. In addition, longitudinal studies to examine the age-related cognitive changes over time in this population may help clarify a presence of ethnicity specific cognitive aging processes, if they exist. Our results indicate that it is important to investigate interactions of ethnic group membership and other demographic variables, even when there is no group difference.

One limitation of the current study is that the majority of the participants were descendants of the first wave of immigrants in the late 1800s. As described earlier, there are recent immigrants, who may not be as acculturated and as fluent in English as the current study participants. In addition, the new second-generation individuals (i.e., descendants of the post-war immigrants from Japan) may demonstrate a different pattern of acculturation, due to lessened degree of racism and inter-ethnicity marriage becoming more common in the Japanese American population. Another limitation of the current study is that it did not include individuals with low education. All the Japanese American participants had at least 12 years of education, and we were unable to find individuals who did not complete high school. We should also note that the current results may not be readily applied to other Asian American subgroups, who have different immigration histories and patterns, cultures, and languages. Despite these limitations, the current study indicates that highly acculturated, English-fluent Japanese Americans who were in the age range of young-old and medium-old, with greater than 12 years of formal education, performed comparable to Caucasian Americans on measures of memory, confrontation naming, odor identification, verbal, visual, and olfactory learning and memory, and verbal fluency. This finding may generalize to other Asian Americans who have similar background.

REFERENCES

Abe, M., Suzuki, K., Okada, K., Miura, R., Fujii, T., Etsurou, M., et al. (2004). [Normative data on tests for frontal lobe functions: Trail Making Test, Verbal fluency, Wisconsin Card Sorting Test (Keio version)]. *No To Shinkei, 56*(7), 567-574.

Abe-Kim, J., Okazaki, S., & Goto, S. G. (2001). Unidimensional versus multidimensional approaches to the assessment of acculturation for Asian American populations. *Cultur Divers Ethnic Minor Psychol, 7*(3), 232-246. doi: 10.1037//1099-9809.7.3.232

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

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

Artiola i Fortuny, L., Hermosillo, D., Heaton, R. K., & Pardee III, R. E. (1999). *Manual de normas y procedimientos para la bateria neuropsicologica en Espanol*. Tucson, AZ: m Press.

Artiola, I. F. L., Garolera, M., Hermosillo Romo, D., Feldman, E., Fernandez Barillas, H., Keefe, R., et al. (2005). Research with spanish-speaking populations in the United States: lost in the translation. A commentary and a plea. *J Clin Exp Neuropsychol, 27*(5), 555-564. doi: 10.1080/13803390490918282

Azrin, R. L., Mercury, M. G., Millsaps, C., Goldstein, D., Trejo, T., & Pliskin, N. H. (1996). Cautionary note on the Boston Naming Test: Cultural considerations [abstract]. *Arch Clin Neuropsychol, 11*(5), 365-366.

Azuma, E. (1999). Brief historical overview of Japanese emigration, 1868-1998. *International Nikkei Reseach Project: First Year Report*, 6-8.

Baker, F. M., Johnson, J. T., Velli, S. A., & Wiley, C. (1996). Congruence between education and reading levels of older persons. *Psychiatr Serv, 47*(2), 194-196.

Benedict, R. H. B. (1997). *Brief Visuospatial Memory Test-revised*. Odessa, FL: Psychological Assessment Resources, Inc.

Benton, A., & Hamsher, K. D. (1989). *Multilingual aphasia examination*. Iowa City: AJA Associates.

Boone, K. B., Victor, T. L., Wen, J., Razani, J., & Ponton, M. (2007). The association between neuropsychological scores and ethnicity, language, and acculturation variables in a large patient population. *Arch Clin Neuropsychol, 22*(3), 355-365. doi: 10.1016/j.acn.2007.01.010

Byrd, D. A., Touradji, P., Tang, M. X., & Manly, J. J. (2004). Cancellation test performance in African American, Hispanic, and White elderly. *J Int Neuropsychol Soc, 10*(3), 401-411. doi: 10.10170S1355617704103081

Carlson, M. C., Brandt, J., Carson, K. A., & Kawas, C. H. (1998). Lack of relation between race and cognitive test performance in Alzheimer's disease. *Neurology, 50*(5), 1499-1501.

Cherner, M., Suarez, P., Lazzaretto, D., Artiola i Fortuny, L., Mindt, M. R., Dawes, S., et al. (2007). Demographically corrected norms for the Brief Visuospatial Memory Test-revised and Hopkins Verbal Learning Test-revised in monolingual Spanish speakers from the U.S.-Mexico border region. *Archives of Clinical Neuropsychology, 22*, 343-353. doi: 10.1016/j.acn.2007.01.009

Cicchetti, D. V. (1994). Guidelines, criteria, and rules of thumb for evaluating normed and standarized assessment instruments in psychology. *Psychological Assessment, 6*(4), 284-290.

Coffey, D. M., Marmol, L., Schock, L., & Adams, W. (2005). The influence of acculturation on the Wisconsin Card Sorting Test by Mexican Americans. *Arch Clin Neuropsychol, 20*(6), 795-803. doi: 10.1016/j.acn.2005.04.009

Dehaene, S., Izard, V., Spelke, E., & Pica, P. (2008). Log or linear? Distinct intuitions of the number scale in Western and Amazonian indigene cultures. *Science, 320*(6880), 1217-1220.

Delis, D., Kramer, J. H., Kaplan, E., & Ober, B. A. (1987). *The California Verbal Learning Test: Research edition*. New York: Psychological Corporation.

Demsky, Y. I., Mittenberg, W., Quintar, B., Katell, A. D., & Golden, C. J. (1998). Bias in the use of standard American norms with Spanish translations of the Wechsler Memory Scale-Revised. *Assessment, 5*(2), 115-121. doi: 10.1177/107319119800500202

Diehr, M. C., Heaton, R. K., Miller, W. S., & Grant, I. (1998). The Paced Auditory Serial Addition Task (PASAT): Norms for age, education and ethnicity. *Assessment, 5*, 375-387. doi: 10.1177/107319119800500407

Doty, R. L., Reyes, P. F., & Gregor, T. (1987). Presence of both odor identification and detection deficits in Alzheimer's disease. *Brain Res Bull, 18*(5), 597-600.

Fillenbaum, G. G., Heyman, A., Williams, K., Prosnitz, B., & Burchett, B. (1990). Sensitivity and specificity of standardized screens of cognitive impairment and dementia among elderly black and white community residents. *J Clin Epidemiol, 43*(7), 651-660.

Fillenbaum, G. G., McCurry, S. M., Kuchibhatla, M., Masaki, K. H., Borenstein, A. R., Foley, D. J., et al. (2005). Performance on the CERAD neuropsychology battery of two samples of Japanese-American elders: norms for persons with and without dementia. *J Int Neuropsychol Soc, 11*(2), 192-201. doi: 10.10170S1355617705050198

Fujimoto, W. Y., Bergstrom, R. W., Boyko, E. J., Kinyoun, J. L., Leonetti, D. L., Newell-Morris, L. L., et al. (1994). Diabetes and diabetes risk factors in second- and third-generation Japanese Americans in Seattle, Washington. *Diabetes Res Clin Pract, 24 Suppl*, S43-52.

Fujita, K., Tanaka, Y., Koyama, Y., Nonaka, C., & Oka, T. (2004). [Naming ability in normal aging: analysis on the Boston Naming Test and the Action Naming Test.]. *Neurological Medicine, 61*(6), 575-578.

Gasquoine, P. G. (1999). Variables moderating cultural and ethnic differences in neuropsychological assessment: the case of Hispanic Americans. *Clin Neuropsychol, 13*(3), 376-383. doi: 10.1076/clin.13.3.376.1735

Gasquoine, P. G. (2001). Research in clinical neuropsychology with Hispanic American participants: a review. *Clin Neuropsychol, 15*(1), 2-12. doi: 10.1076/clin.15.1.2.1915

Gasquoine, P. G., Croyle, K. L., Cavazos-Gonzalez, C., & Sandoval, O. (2007). Language of administration and neuropsychological test performance in neurologically intact Hispanic American bilingual adults. *Arch Clin Neuropsychol, 22*(8), 991-1001. doi: 10.1016/j.acn.2007.08.003

Gladsjo, J. A., Schuman, C. C., Evans, J. D., Peavy, G. M., Miller, S. W., & Heaton, R. K. (1999). Norms for letter and category fluency: demographic corrections for age, education, and ethnicity. *Assessment, 6*(2), 147-178. doi: 10.1177/107319119900600204

Gollan, T. H., Fennema-Notestine, C., Montoya, R. I., & Jernigan, T. L. (2007). The bilingual effect on Boston Naming Test performance. *J Int Neuropsychol Soc, 13*(2), 197-208. doi: 10.10170S1355617707070038

Gollan, T. H., Montoya, R. I., & Werner, G. A. (2002). Semantic and letter fluency in Spanish-English bilinguals. *Neuropsychology, 16*(4), 562-576. doi: 10.1037//0894-4105.16.4.562

Hatta, T., & Kawakami, A. (1997). Image generation and handedness: is the hemi-imagery method valid for studying the hemisphere imagery generation process? *Neuropsychologia, 35*(11), 1499-1502.

Heaton, R. K., Miller, S. W., Taylor, M. J., & Grant, I. (2004). *Revised comprehensive norms for an expanded Halstead-Reitan Battery: Demographically adjusted neuropsychological norms for African American and Caucasian adults Scoring Program*. Odessa, FL: Psychological Assessment Resources, Inc.

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

Heaton, R. K., Taylor, M. J., & Manly, J. J. (2003). Demographic effects and use of demographically corrected norms with the WAIS-III and WMS-III. In D. S. Tulsky, D. H. Saklofske, G. J. Chelune, R. J. Ivnik, A. Prifitera, R. K. Heaton, B.

R. & M. F. Ledbetter (Eds.), *Clinical Interpretation of the WAIS-III and WMS-III* (pp. 181-210). San Diego, CA: Academic Press, Inc.

Helms, J. E. (1992). Why is there no study of cultural equivalence in standardized cognitive ability testing? *Am Psychol, 47*(9), 1083-1101.

Helms, J. E., Jernigan, M., & Mascher, J. (2005). The meaning of race in psychology and how to change it: a methodological perspective. *Am Psychol, 60*(1), 27-36. doi: 10.1037/0003-066X.60.1.27

Hirschman, C., & Wong, M. G. (1986). The extraordinary educational attainment of Asian-Americans: A search for historical evidence and explanations. *Social Forces, 65*(1), 1-27.

Ichioka, Y. (1988). *The Issei The World of the First Generation Japanese Immigrants, 1885-1924*. New York: The Free press.

Iwamasa, G. Y., Pai, S. M., Hilliard, K. M., & Lin, S. H. (1998). Acculturation of Japanese Americans: Use of the SL-ASIA with a Community Sample. *Asian Am Pac Isl J Health, 6*(1), 25-34. doi: 10.1037//1099-9809.7.3.203

Jacobs, D. M., Sano, M., Albert, S., Schofield, P., Dooneief, G., & Stern, Y. (1997). Cross-cultural neuropsychological assessment: a comparison of randomly selected, demographically matched cohorts of English- and Spanish-speaking older adults. *J Clin Exp Neuropsychol, 19*(3), 331-339. doi: 10.1080/01688639708403862

Johnson-Selfridge, M. T., Zalewski, C., & Aboudarham, J. F. (1998). The relationship between ethnicity and word fluency. *Arch Clin Neuropsychol, 13*(3), 319-325.

Kaplan, E., Goodglass, H., & Weintraub, S. (1983). *Boston Naming Test*. Philadelphia: Lea & Febiger.

Kaufman, A. S., McLean, J. E., & Reynolds, C. R. (1988). Sex, race, residence, region, and education differences on the 11 WAIS-R subtests. *J Clin Psychol, 44*(2), 231-248.

Kohnert, K. J., Hernandez, A. E., & Bates, E. (1998). Bilingual performance on the boston naming test: preliminary norms in Spanish and English. *Brain Lang, 65*(3), 422-440.

Koss, E., Weiffenbach, J. M., Haxby, J. V., & Friedland, R. P. (1988). Olfactory detection and identification performance are dissociated in early Alzheimer's disease. *Neurology, 38*(8), 1228-1232.

Krantz, E. M., Schubert, C. R., Dalton, D. S., Zhong, W., Huang, G. H., Klein, B. E. K., et al. (2009). Test-retest reliability of the San Diego Odor Identification Test and comparison with the Brief Smell Identification Test. *Chemical Senses, 34*, 435-440. doi: 10.1093/chemse/bjp018

Lezak, M. D., Howieson, D. B., Loring, D. W., Hannay, H. J., & Fischer, J. S. (2004). *Neudopsychological Assessment* (Fourth ed.). New York, NY: Oxford University Press.

Lopez, S. R., & Taussig, I. M. (1991). Cognitive-intellectual functioning of Spanish-speaking impaired and nonimpaired elderly: Implication for culturally sensitive assessment. *Psychological Assessment, 3*(3), 448-454.

Lucas, J. A., Ivnik, R. J., Smith, G. E., Ferman, T. J., Willis, F. B., Petersen, R. C., et al. (2005). Mayo's Older African Americans Normative Studies: norms for Boston Naming Test, Controlled Oral Word Association, Category Fluency, Animal Naming, Token Test, Wrat-3 Reading, Trail Making Test, Stroop Test, and Judgment of Line Orientation. *Clin Neuropsychol, 19*(2), 243-269.

Lukatela, K., Malloy, P., Jenkins, M., & Cohen, R. (1998). The naming deficit in early Alzheimer's and vascular dementia. *Neuropsychology, 12*(4), 565-572.

Lyness, S. A., Hernandez, I., Chui, H. C., & Teng, E. L. (2006). Performance of Spanish speakers on the Mattis dementia rating scale (MDRS). *Arch Clin Neuropsychol, 21*(8), 827-836. doi: 10.1016/j.acn.2006.09.003

Manly, J. J. (2005). Advantages and disadvantages of separate norms for African Americans. *Clin Neuropsychol, 19*(2), 270-275. doi: 10.1080/13854040590945346

Manly, J. J. (2006). Deconstructing race and ethnicity: implications for measurement of health outcomes. *Med Care, 44*(11 Suppl 3), S10-16.

Manly, J. J., Byrd, D. A., Touradji, P., & Stern, Y. (2004). Acculturation, reading level, and neuropsychological test performance among African American elders. *Appl Neuropsychol, 11*(1), 37-46. doi: 10.1207/s15324826an1101_5

Manly, J. J., & Echemendia, R. J. (2007). Race-specific norms: using the model of hypertension to understand issues of race, culture, and education in neuropsychology. *Arch Clin Neuropsychol, 22*(3), 319-325. doi: 10.1016/j.acn.2007.01.006

Manly, J. J., Jacobs, D. M., Sano, M., Bell, K., Merchant, C. A., & Small, S. A. (1998a). African American acculturation and neuropsychological test performance among nondemented community elders. *Journal of the International Neuropsychological Society, 4*(7).

Manly, J. J., Jacobs, D. M., Sano, M., Bell, K., Merchant, C. A., Small, S. A., et al. (1998). Cognitive test performance among nondemented elderly African Americans and whites. *Neurology, 50*(5), 1238-1245.

Manly, J. J., Jacobs, D. M., Touradji, P., Small, S. A., & Stern, Y. (2002). Reading level attenuates differences in neuropsychological test performance between African American and White elders. *J Int Neuropsychol Soc, 8*(3), 341-348. doi: 10.1017.S135561770102015X

Manly, J. J., Miller, S. W., Heaton, R. K., Byrd, D., Reilly, J., Velasquez, R. J., et al. (1998). The effect of African-American acculturation on neuropsychological test performance in normal and HIV-positive individuals. *J Int Neuropsychol Soc, 4*(3), 291-302.

Markus, H. R., & Kitayama, S. (1991). Culture and the self: Implication for cognition, emotion, and motivation. *Psychological Review, 98*(2), 244-253.

Marsella, A. J., Johnson, F. A., Johnson, C. L., & Brennan, J. (1998). Ethnic Identity in Second (Nisei), Third (Sansei), and Fourth (Yonsei) Generation Japanese Americans in Hawaii. *Asian Am Pac Isl J Health, 6*(1), 46-52.

McCormick, W. C., Ohata, C. Y., Uomoto, J., Young, H. M., Graves, A. B., Kukull, W., et al. (2002). Similarities and differences in attitudes toward long-term care between Japanese Americans and Caucasian Americans. *J Am Geriatr Soc, 50*(6), 1149-1155.

McCurry, S. M., Gibbons, L. E., Uomoto, J. M., Thompson, M. L., Graves, A. B., Edland, S. D., et al. (2001). Neuropsychological test performance in a cognitively intact sample of older Japanese American adults. *Arch Clin Neuropsychol, 16*(5), 447-459.

Mitrushina, M. N., Boone, K. B., & D'Elia, L. F. (1999). *Handbook of Normative Data for Neuropsychological Assessment*. New York: Oxford University Press.

Morgan, C. D., Nordin, S., & Murphy, C. (1995). Odor identification as an early marker for Alzheimer's disease: impact of lexical functioning and detection sensitivity. *J Clin Exp Neuropsychol, 17*(5), 793-803.

Murphy, C., Anderson, J. A., & Markison, S. (1994). *Psychophysical assessment of chemosensory disorders in clinical populations*. Berlin: Springer Verlag.

Murphy, C., Gilmore, M. M., Seery, C. S., Salmon, D. P., & Lasker, B. R. (1990). Olfactory thresholds are associated with degree of dementia in Alzheimer's disease. *Neurobiol Aging, 11*(4), 465-469.

Murphy, C., Nordin, S., & Acosta, L. (1997). Odor learning, recall, and recognition memory in young and elderly adults. *Neuropsychology, 11*(1), 126-137.

Murphy, C., Schubert, C. R., Cruickshanks, K. J., Klein, B. E., Klein, R., & Nondahl, D. M. (2002). Prevalence of olfactory impairment in older adults. *JAMA, 288*(18), 2307-2312.

National Commission on Asian American and Pacific Islander Research in Education. (2008). Asian American and Pacific Islanders. Facts, not fiction: Setting the record straight. Retrieved March 8, 2008, from http://www.nyu.edu/projects/care/reports_pubs.html

Niiya, Y., Ellsworth, P. C., & Yamaguchi, S. (2006). Amae in Japan and the United States: an exploration of a "culturally unique" emotion. *Emotion, 6*(2), 279-295. doi: 10.1037/1528-3542.6.2.279

Nordin, S., & Murphy, C. (1998). Odor memory in normal aging and Alzheimer's disease. *Ann N Y Acad Sci, 855*, 686-693.

Norman, M. A., Evans, J. D., Miller, W. S., & Heaton, R. K. (2000). Demographically corrected norms for the California Verbal Learning Test. *J Clin Exp Neuropsychol, 22*(1), 80-94. doi: 10.1076/1380-3395(200002)22:1;1-8;FT080

O'Bryant, S. E., Lucas, J. A., Willis, F. B., Smith, G. E., Graff-Radford, N. R., & Ivnik, R. J. (2007). Discrepancies between self-reported years of education and estimated reading level among elderly community-dwelling African-Americans: Analysis of the MOAANS data. *Arch Clin Neuropsychol, 22*(3), 327-332. doi: 10.1016/j.acn.2007.01.007

Okazaki, S., & Sue, S. (2000). Implications of test revisions for assessment with Asian Americans. *Psychol Assess, 12*(3), 272-280. doi: 10.1037//1040-3590.I2.3-272

Patton, D. E., Duff, K., Schoenberg, M. R., Mold, J., Scott, J. G., & Adams, R. L. (2003). Performance of cognitively normal African Americans on the RBANS in community dwelling older adults. *Clin Neuropsychol, 17*(4), 515-530. doi: 10.1076/clin.17.4.515.27948

Ponton, M. O., Satz, P., Herrera, L., Ortiz, F., Urrutia, C. P., Young, R., et al. (1996). Normative data stratified by age and education for the Neuropsychological Screening Battery for Hispanics (NeSBHIS): Initial report. *J Int Neuropsychol Soc, 2*(2), 96-104.

Razani, J., Burciaga, J., Madore, M., & Wong, J. (2007). Effects of acculturation on tests of attention and information processing in an ethnically diverse group. *Arch Clin Neuropsychol, 22*(3), 333-341. doi: 10.1016/j.acn.2007.01.008

Razani, J., Murcia, G., Tabares, J., & Wong, J. (2007). The effects of culture on WASI test performance in ethnically diverse individuals. *Clin Neuropsychol, 21*(5), 776-788. doi: 10.1080/13854040701437481

Reynolds, C. R. (2000). Methods for detecting and evaluating cultural bias in neuropsychological tests. In E. Fletcher-Janzen, T. L. Strickland & C. R. Reynolds (Eds.), *Handbook of Cross-Cultural Neuropsychology* (pp. 249-285). New York, NY: Kluwer Academic/Plenum Publishers.

Roberts, P. M., Garcia, L. J., Desrochers, A., & Hernandez, D. (2002). English performance of proficient bilingual adults on the Boston Naming Test. *Aphasiology, 16*, 635-645.

Roberts, R. J., & Hamsher, K. D. (1984). Effects of minority status on facial recognition and naming performance. *J Clin Psychol, 40*(2), 539-545.

Ross, T. P., Lichtenberg, P. A., & Christenesn, B. K. (1995). Normative data on the Boston Naming Test for elderly adults in a demograpically diverse medical sample. *The Clinical Neuropsychologist, 9*, 321-325.

Rosselli, M., Ardila, A., Araujo, K., Weekes, V. A., Caracciolo, V., Padilla, M., et al. (2000). Verbal fluency and repetition skills in healthy older Spanish-English bilinguals. *Appl Neuropsychol, 7*(1), 17-24. doi: 10.1207/S15324826AN0701_3

Rosselli, M., Ardila, A., Salvatierra, J., Marquez, M., Matos, L., & Weekes, V. A. (2002). A cross-linguistic comparison of verbal fluency tests. *Int J Neurosci, 112*(6), 759-776. doi: 10.1080/00207450290025752

Rosselli, M., Ardila, A., Santisi, M. N., Arecco Mdel, R., Salvatierra, J., Conde, A., et al. (2002). Stroop effect in Spanish-English bilinguals. *J Int Neuropsychol Soc, 8*(6), 819-827. doi: 10.1017.S1355617702860106

Ryan, E. L., Baird, R., Mindt, M. R., Byrd, D., Monzones, J., & Morgello, S. (2005). Neuropsychological impairment in racial/ethnic minorities with HIV infection and low literacy levels: Effects of education and reading level in participant characterization. *Journal of International Neuropsychological Society, 11*(7), 889-898. doi: 10.1017/S1355617705051040

Schwartz, B. S., Glass, T. A., Bolla, K. I., Stewart, W. F., Glass, G., Rasmussen, M., et al. (2004). Disparities in cognitive functioning by race/ethnicity in the Baltimore Memory Study. *Environ Health Perspect, 112*(3), 314-320.

Strauss, E., Sherman, E. M. S., & Spreen, O. (2006). *A compendium of neuropsychological tests* (Third ed.). New York, NY: Oxford University Press.

Stroops, N. (2004). Educational Attainment in the United States: 2003 *Current Population Reports* (pp. 1-10): U.S. Census Bureau.

Sue, S., & Abe, J. (1988). Predictors of academic achievement among Asian American adn White students *College BOard Report No. 88-11*. New York, NY: College Entrance Examination Board.

Sue, S., & Okazaki, S. (1990). Asian-American educational achievements. A phenomenon in search of an explanation. *Am Psychol, 45*(8), 913-920.

Sue, S., Sue, D. W., Sue, L., & Takeuchi, D. T. (1995). Psychopathology among Asian Americans: a model minority? *Cult Divers Ment Health, 1*(1), 39-51.

Suinn, R. M., Ahuna, C., & Khoo, G. (1992). The Suinn-Lew Asian self-identity acculturation scale: Concurrent and factorial validation. *Educational and Psychological Measurement, 52*, 1041-1046. doi: 10.1177/0013164492052004028

Suinn, R. M., Rickard-Figueroa, K., Lew, S., & Vigil, P. (1987). The Suinn-Lew Asian self-identity acculturation scale: An initial report. [Journal Article]. *Educational and Psychological Measurement, 47*, 401-407. doi: 10.1177/0013164487472012

Taussig, I. M., Mack, W. J., & Henderson, V. W. (1996). Concurrent validity of Spanish-language versions of the Mini-Mental State Examination, Mental Status Questionnaire, Information-Memory-Concentration Test, and Orientation-Memory Concentration Test: Alzheimer's disease patients adn nondemented elderly comparison subjects. *Journal of the International Neuropsychological Society, 2*, 286-298.

Ting, S.-M. R. (2000). Predicting Asian Americans' academic performance in the first year of college: An approach combining SAT scores adn noncognitive variables. *Journal of College Student Development, 41*(4), 44-49.

Touradj, P., Manly, J. J., Jacobs, D. M., & Stern, Y. (2001). Neuropsychological test performance: a study of non-Hispanic White elderly. *J Clin Exp Neuropsychol, 23*(5), 643-649.

Triandis, H. C. (1996). The Psychological Measurement of Cultural Syndromes. *American Psychologist, 51*(4), 407-415.

Welsh, K. A., Butters, N., Mohs, R. C., Beekly, D., Edland, S. D., Fillenbaum, G., et al. (1994). The Consortium to Establish a Registry for Alzheimer's Disease (CERAD). Part V. A normative study of the neuropsychological battery. *Neurology, 44*, 609-614.

Welsh, K. A., Fillenbaum, G., Wilkinson, W., Heyman, A., Mohs, R. C., Stern, Y., et al. (1995). Neuropsychological test performance in African-American and white patients with Alzheimer's disease. *Neurology, 45*(12), 2207-2211.

Whitfield, K. E., Fillenbaum, G. G., Pieper, C., Albert, M. S., Berkman, L. F., Blazer, D. G., et al. (2000). The effect of race and health-related factors on naming and memory. The MacArthur Studies of Successful Aging. *J Aging Health, 12*(1), 69-89. doi: 10.1177/089826430001200104

Wilkinson, G. S., & Robertson, G. J. (2006). *Wide Range Achievement Test*: Psychological Assessment Resources, Inc.

Wong, T. M. (2000). Neuropsychological assessment and intervention with Asian Americans. In E. Fletcher-Janzen, T. L. Strickland & C. R. Reynolds (Eds.), *Handbook of Cross-Cultural Neuropsychology*. New York, NY: Kluwer Academic/Plenum Publishers.

Wong, T. M., Strickland, T. L., Fletcher-Janzen, E., Ardila, A., & Reynolds, C. R. (2000). Theoretical and practical issues in the neropsychological assessment and trreatment of culturally dissimilar patients *Handbook of Cross-Cultural Neuropsychology*. New York: Kluwer Academic/Plenum Publishers.

Yamashiro, G., & Matsuoka, J. K. (1997). Help-seeking among Asian and Pacific Americans: a multiperspective analysis. *Soc Work, 42*(2), 176-186.

Yeh, C. J., Arora, A. K., Inose, M., Okubo, Y., Li, R. H., & Greene, P. (2003). The cultural adjustment and mental health of Japanese immigrant youth. *Adolescence, 38*(151), 481-500.

Yeh, C. J., & Inose, M. (2002). Difficulties and coping strategies of Chinese, Japanese, and Korean immigrant students. *Adolescence, 37*(145), 69-82.