CULTURAL DIFFERENCES ON THE CHILDREN'S MEMORY SCALE

A Dissertation

by

DEBORAH DYER CASH

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

August 2007

Major Subject: School Psychology

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Chair of Committee,	Cynthia Riccio
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ABSTRACT

Cultural Differences on the Children's Memory Scale.

(August 2007)

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Memory is an essential component for learning. Deficits in verbal short-term memory (STM) and working memory (WM) are thought to hinder language learning, reading acquisition, and academic achievement. The Children's Memory Scale (CMS) is an assessment instrument used to identify memory and learning deficits and strengths in children ages five through 16. This study investigated the impact of culture and parent educational level (PEL) on student performance on the Children's Memory Scale using the CMS standardization data. The major question addressed was: Will CMS subtest performance differ significantly between ethnic groups or as a function of PEL?

The results of this study support a relationship between STM and WM performance and culture. Culture as defined by ethnicity minimally impacted student subtest performance on the CMS when PEL was taken into account. In contrast, PEL was significantly associated with student subtest performance within each ethnic group. Student subtest performance improved with each increase in PEL regardless of ethnicity. CMS subtest performance of Hispanic and African American students was most affected by PEL; however, no difference occurred in subtest performance by ethnicity or as a function of PEL for African American and Hispanic students on the Family Pictures subtest which examines visual and auditory memory processes through recall of everyday life tasks in meaningful context. Although statistical significance was found between CMS subtest performance and cultural factors, the effect sizes were mainly in the small range and variance was not specific to any one subtest. Larger effect sizes were found on verbal subtests which in previous studies have been found to be most impacted by quality of schooling and lower PELs. Mean score differences did not exceed one standard deviation with the exception of one subtest. The results of this study provide a better understanding of the effect of culture and PEL on memory and learning.

DEDICATION

To my parents, Jack and Shirley Dyer, my children, Lori, Christopher, Ian, and husband, Billy, for their encouragement, love and perseverance.

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Thanks also to Carol Wagner for always providing the technical support needed. I also want to extend my gratitude to Dr. Cohen and Psych Corporation for providing the Children's Memory Scale standardization data.

NOMENCLATURE

BICS	Basic interpersonal communication skills
CALP	Cognitive academic language proficiency
CMS	Children's Memory Scale
ELL	English language learner
PEL	Parent educational level
STM	Short-term memory
WM	Working memory

TABLE OF CONTENTS

LIST OF TABLES

TABLE Page

CHAPTER I

INTRODUCTION

Memory is thought to be an essential component for language development and academic achievement. Specifically, verbal short-term memory (STM) and working memory (WM) appear to play an important role in language acquisition and development. Children with verbal memory deficits have impaired expressive language ability (Cohen et al., 2000), difficulty learning the phonological form of new words (Baddeley, Pagagno, & Vallar, 1988; Trojano & Grossi, 1995), and deficits in retaining sequentially ordered information (Montgomery, 1996). These deficits hinder language learning and the acquisition of reading (Daneman & Carpenter, 1980). An investigation of the level of association between verbal STM skills and language learning in young children found that children with verbal STM skill deficits typically lagged behind their counterparts on standardized measures of language by 18 to 24 months (Gathercole & Baddeley, 1990). Furthermore, a study by Oakhill and Kyle (2000) found that WM ability predicted performance on phonemic awareness tasks (a necessary skill for emergent readers) in 7- and 8-years-old students.

WM and STM deficits left undiagnosed can lead to inadequate development of reading skills. Gathercole and Pickering (2001) found that children who demonstrated statistically significant impaired performances on verbal and WM assessments also performed poorly on standardized achievement subtests of reading comprehension and

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This dissertation follows the style of *Archives of Clinical Neuropsychology*.

vocabulary at age seven; thus, STM and WM deficits are associated with deficits in language acquisition, vocabulary development, and reading comprehension, which are necessary for adequate academic achievement.

Inadequate academic achievement can lead to the diagnosis of a learning disability. In fact, learning disabilities affect 5% to 20% of all children attending public school in the United States (American Psychiatric Association [APA], 2000; National Information Center for Children & Youth with Disabilities [NICHCY], 2004). Unfortunately, children diagnosed with a learning disability drop out of school at a rate of one and a half times higher than children who are not experiencing academic difficulties (APA, 2000). Since one's level of education is positively correlated with one's earnings, inadequate academic achievement can negatively impact a child's quality of life in adulthood due to their inability to provide for themselves or their family (U.S. Department of Labor, 2005). In order to provide appropriate instruction for students who experience academic difficulty due to STM or WM deficits, comprehensive memory assessment is needed to accurately identify learning and memory deficits, as well as, strengths to construct "needs-specific" remediation plans (Barkley, 1996). This requires adequate measures for the assessment process.

Confounding the issue of memory and language deficits is the cultural and linguistic diversity of the student population in U.S. public schools today. In the past 20 years, the U.S. public school system has experienced a large influx of immigrant children. From 1990-1999, the general population in public schools has increased 24.2%, while the English language learner (ELL) population has increased 104.97% (U.S.

Census, 2000). Although there has been an increase in the number of students who are culturally and linguistically diverse, research on the impact of culture and second language learning on memory and learning in children has not kept pace. In fact, there is a paucity of research on the effects of culture on children's memory in the United States; however, research exists that investigates the effects of culture on memory in children and adults living outside the United States. Cultural and educational variables, such as use of mnemonic strategies, language, questioning strategies, and task presentation, are thought to influence student performance on memory tasks (Abu-Rabia & Siegel, 2002; Boivin, 1991; Buium & Turnure, 1977; Meacham, 1975). For example, Scottish and Zairian children performed equally well on visual-spatial memory tasks using geometric shapes of natural pieces of wood, colors, and textures. In contrast, the Scottish children performed significantly better than the Zairian children on the visual-spatial task involving household items that were familiar to Scottish culture (Boivin, 1991).

Cultural effects of bilingualism on verbal learning and memory in Hispanic adults have also been found (Figueroa, 1983; Gutierrez-Clellen & Calderon, 2004; Harris, Cullum, & Puente, 1995). Ardila, Rosselli, and Rosas (1989) assessed verbal learning and memory in English and Spanish of balanced bilinguals, "nonbalanced" bilinguals, and monolingual English speaking clients. Each group was matched for age, education, and gender. Comparisons of group performance produced no significant differences on any of the memory tasks examined when the individuals were assessed in their dominant language. Conversely, the nonbalanced bilinguals assessed in English on verbal recall memory skills scored significantly lower than the monolingual English speakers and the balanced bilinguals; thus, there is some evidence that cultural and language differences impact verbal STM performance.

STM and WM skills are associated with language acquisition, vocabulary development, and reading ability. Culture and language further impact memory performance. This paper will investigate the impact of culture on the Children's Memory Scale (CMS; M. J. Cohen, 1997a), a measure of learning and memory in children and adolescents. Findings should provide a better understand of the impact of culture on the CMS and on memory performance in general in children living in the United States.

Statement of the Problem

STM and WM have been identified as necessary components for language acquisition, vocabulary development, and reading comprehension. Psychometrically valid measures are needed to assess memory and learning of all children. Identification of score variance due to ethnic differences or parent educational level (PEL) yields the possible influence of culture and socioeconomic status on assessment. This knowledge allows for a more culturally valid and reliable assessment. The primary goal of a clinician is to accurately assess a child's ability so that appropriate interventions can be designed to facilitate learning. Clearer knowledge of the impact of culture through the lens of ethnicity and PEL on test scores facilitates a more accurate diagnosis and precise treatment intervention for the child that acknowledges cultural or linguistic differences. Given the extent to which memory and learning are expected to impact school success as well as the increasing number of ELLs in U.S. schools, it is important to examine cultural differences on measures used to assess these domains. The purpose of this study is to examine student performance on the CMS (Cohen, 1997a) by ethnicity and PEL.

Specific research questions to be addressed are:

1) *Will performance differ significantly between ethnic groups or as a function of PEL on the CMS subtests?* It is hypothesized that cultural differences between ethnic groups and PEL will affect memory performance on the CMS. English proficiency, acculturation, and familial factors (e.g., length of time in United States, importance placed on education) could affect student performance.
2) *Will PEL be significantly associated with student performance on the CMS across all ethnic groups?* Since PEL has been found to be highly correlated with student performance on cognitive and memory assessments, it is hypothesized that PEL will be a significant factor in predicting student performance on the CMS across ethnic groups.
3) *Will performance on the CMS subtest Family Pictures differ significantly across ethnic groups or as a function of PEL? Family Pictures* is a subtest that explores incidental learning and recall of visual information in context. It is hypothesized that performance on this subtest will not differ significantly across ethnic groups or as a function of PEL if the children in the CMS standardization sample are fully acculturated into U.S. family life and are proficient in English at the basic interpersonal skills (BICS) level.

Potential Implications for Practice

STM and WM are associated with the adequate development of vocabulary and reading skills, which impact a child's educational performance in the classroom. Cultural and linguistical diversity in U.S. classrooms are added factors that influence the educational performance and assessment results of students who acknowledge cultural and linguistical differences. Little is known about the influence of language, culture, and PEL on assessment measures used to make critical decisions with regard to a child's educational plan. Providing the practitioner with the ability to decipher valid learning and memory deficits from cultural variations in memory performance can lead to more accurate interpretation of assessment results. This in turn will enhance the educational process by providing educational decision makers with a clearer picture of the child's cognitive strengths and weaknesses, support appropriate remedial instruction, and provide the opportunity for academic success.

Finally, this research highlights the need to recognize the impact of culture in U.S. schools. Hopefully, this critical look at the effect of culture on the standardization sample of the CMS will encourage test developers and researchers to investigate the cultural impact of PEL, ethnicity, and language on other frequently used measures of memory and cognitive ability on children.

Definitions

A number of terms frequently used in the literature and this dissertation have specific meanings. Definitions of these terms are as follows:

Acculturation - the process of an individual adopting the beliefs, values, and practices of a new culture.

Basic Interpersonal Communication Skills (BICS; Cummins, 1979) - Conversational language skills necessary for daily interpersonal communication.

Cognitive Academic Language Proficiency (CALP; Cummins, 1979) - Higher level language skills necessary for interpreting cognitively demanding academic material.

Culture – the shared ideas, belief systems, and concepts of a group of people.

Short-term memory (STM) – the ability to retain small amounts of information over a brief period of time.

Working memory (WM) – the ability to hold and manipulate information in memory.

English language learner (ELL) - an individual who is learning to read, write, and speak the English language. Previously, these individuals have been referred to as English as a Second Language or Limited English Proficient.

Monolingual - an individual who speaks only one language.

Balanced bilingual - an individual who from birth has been exposed to and learned to speak two languages simultaneously.

Nonbalanced bilingual - an individual who is learning to speak (and possibly read and write) a second language after mastering their native language, but has not attained the fluency and comprehension level of their first language in the second language.

Consecutive bilingual - an individual who has learned to speak (and possibly read and write) a second language after mastering their native language.

CHAPTER II

REVIEW OF THE LITERATURE

Memory and Language: History, Theory and Impact on Reading Acquisition

For decades, STM and WM and their relationship to language and learning have been of interest to psychologists; however, these two memory processes have not always been viewed as separate functions. The study of STM became a major area of concern for cognitive psychologists in the 1960s due to the impact of computer technology development, air traffic communication concerns (Broadbent, 1958), and the need for longer telephone and postal codes (Conrad, 1964). During this time of industry expansion, parameters for postal and telephone codes needed to be established that allowed for system growth but were within the mnemonic ability range of the average individual. As research flourished, controversy in the field arose over STM models and the inclusion of what is now known as WM. By 1974, a broader framework emerged that included the concept of WM (Baddeley & Hitch, 1974). Models and theories of STM and WM were challenged, refined, and expanded over the next 15 years as research broadened its understanding of these mnemonic processes (Baddeley, 1986; Cowan & Kail, 1996; Pascual-Leone & Baillargeon, 1994). Under the STM framework that included WM, interest in auditory and visual memory processing increased and was greatly enhanced in the 1990's by the development of functional imaging techniques, such as positron emission topography (PET) and functional magnetic resonance imaging (fMRI). Also, the willingness of neuropsychologists and cognitive psychologists to work together to develop a cognitive framework that was supported by neuroanatomy greatly enhanced the progress toward understanding STM and WM processes (Baddeley, 2000b).

Over the years, different theories have emerged as to how the STM system functions (Atkinson & Shiffrin, 1968; Baddeley, 1986; Cowan, 1988, 1993). Expanding the Baddeley and Hitch (1974) theory, Baddeley's (1986) theory proposed that the STM system consists of three sub-systems: an auditory information storage center described as the "phonological loop"; a visio-spatial storage center for the storage of visual information; and the central executive center that monitors, synchronizes, and coordinates incoming information to the auditory and visuo-spatial STM stores. The phonological loop is thought to consist of two compartments: a phonological STM store and an articulatory rehearsal compartment that allows for the rehearsal of phonological information (Baddeley, 1986).

Within the context of the Baddeley theory (1986), STM can be defined as the retention of small amounts of information over brief periods of time (Baddeley, 2000a). Usually, an individual can store about six seconds of information without outside interference. Auditory STM tasks include the recall of details in a short story, word span, sentence repetition, and digit span; whereas, visual STM tasks include recall of the placement of objects or picture recall. WM provides a system for holding (via subvocal articulatory rehearsal) and manipulating incoming information during the performance of a complex cognitive task (Baddeley, 2000b; Torgensen, 1999); thus, WM requires one to attend to, concentrate on, and manipulate auditory information. Digit Span Backward and the Sentence Span task are thought to be examples of WM tasks (Cohen, 1997b; Daneman & Carpenter, 1980).

Distinct patterns are found in the memorization of serial and free recall tasks. A "U-shaped", serial position curve has been found to occur when average individuals are asked to recall lists of numbers or words (Murdock, 1962). Also, trends in memorization (according to serial position) known as "effects" have emerged for the average individual. The "primacy effect" is an individual's ability to recall the first couple of items in a verbal series of words (Hockey, 1973). Excellent recall of the last few items in the series is known as the "recency" effect (Glanzer, 1972). Words in the middle of a list are recalled inconsistently with no emergence of a typical recall pattern (Baddeley, 2000a; Wagner, 1996).

Other patterns have emerged that support the existence of the phonological loop and the articulatory rehearsal. The "word length effect" states that an individual can only remember as many items as can be verbalized in two seconds with interference and six seconds with no interference (Baddeley, Thompson, & Buchanan, 1975). The impairment of one's immediate serial recall if the items are similar in phonological structure is the "phonological similarity' effect (Conrad & Hull, 1964). There are also memory strategies that can be employed to increase STM ability (Cole, Frankel, & Sharp, 1971). Typically, individuals can only remember as many items as they can say in six seconds (without interference); however, the strategy of "chunking" allows an individual to cluster groups of words together to form a single bit of information and increases the amount of information that can be held in STM (Miller, 1956). Other mnemonic strategies used to increase STM and WM include the categorization of words, numbers or objects, and verbal rehearsal (Baddeley, Vallar, & Wilson, 1987).

Daneman and Carpenter (1980) operationally defined WM as a system responsible for the simultaneous storage and manipulation of information. They developed a WM span task that required an individual to remember and recall the final word at the end of several different sentences. The average WM span was found to be four to six words. An individual's WM span has been found to be highly correlated with their reading comprehension ability (Daneman & Carpenter, 1980; Daneman & Merikle, 1996). Conversely, deficits in STM and WM are thought to impact language acquisition and vocabulary development. Children with STM and WM deficits typically exhibit an inability to make age appropriate speech sounds, limited ability to learn new vocabulary, and have difficulty with sequential order. These language deficits hinder a child's ability to acquire new vocabulary contributing to deficits in global language learning and academic difficulties (Tallal, 1975, 2003).

Deficits in STM and WM are thought to negatively impact reading ability. STM deficits have been correlated with reading deficits related to phonology and syntax (Torgesen, 1978). Children who performed below average on STM tasks have difficulty with sound-symbol relationships, word recognition, rhyming ability, and work attack skills (Riccio & Hynd, 1993). These deficits are supported by neuroimaging studies that suggest that fluency in word identification skills is related to the functional integrity of two left hemisphere posterior systems: a temporo-parietal circuit and an occipito-temporal circuit (Pugh et al., 2001).

WM tasks have been found to be good predictors of reading comprehension skills (Daneman & Carpenter, 1980; Daneman & Merikle, 1996). Although there is discussion and disagreement as to the complexity of WM tasks employed by different test batteries, individuals with WM spans of only two or three final words on the Daneman and Carpenter Sentence Span Test did more poorly on tests of language comprehension than individuals who can recall the average five to seven words (Daneman & Carpenter, 1980; Daneman & Merikle, 1996).

In summary, an intact memory system is thought to be an essential component for language acquisition, vocabulary development, and reading acquisition and comprehension. Within the context of the Baddeley (1986) model of STM, three components - a phonological loop, visio-spatial sketch pad, and the central executive are needed for successful visio-spatial and audio-verbal STM performance. Deficits in STM and WM are thought to hinder the acquisition of new vocabulary development, sequential order memorization, sound-symbol relationships, and reading comprehension all of which are skills needed for academic achievement.

Memory and Culture

Culture is thought to affect how and what we remember. Culture can be described as the shared ideas, belief systems, and perceptions of a group of people (Armour-Thomas, 1992). Institutions, technologies, survival systems, and codes of conduct developed within a cultural group mirror the group's ideas and belief systems (Payne & Taylor, 2002). Public schooling reflects the society's emphasis on formal education and is included under institutions.

In the early 1970s, social psychologists investigated the impact of culture on cognitive and psychological development (Cole & Bruner, 1971; Cole & Scribner, 1974; Dasen, 1972; Glick, 1975; Hakstian & Vandenberg, 1979; LeVine & White, 1986; Vygotsky, 1978). Different theories were developed as to how cultural influences affect psychological and cognitive development (Cacioppo & Berntson, 1992; Leong, 1996; Ratner, 1991; Resnick, 1991; Shore, 1996; Vygotsky, 1978). Vygotsky's cultural perspective theory (1978) posits that cultural influences shape the cognitive and psychological development of children through their caregivers and surrounding environment. Vygotsky theorized that adults within a culture transmit cultural knowledge to children by demonstrating cultural norms through their everyday actions. Children observe and mimic their caregivers. As they grow older, children are provided opportunities to practice the skills and knowledge of their culture on a daily basis and in different settings. Direct and indirect instruction in formal and informal settings is provided so that children master skills and tasks in accordance with cultural standards. Language is an integral part of the cultural socialization process because language is the medium used to receive and express ideas and concepts in a culturally appropriate manner (Schrauf, 2000).

Over the past 50 years, researchers have investigated the impact of culture on memory processes (e.g., visio-spatial memory, auditory-verbal memory, STM, WM, autobiographical memory) and strategies (e.g., chunking, verbal rehearsal, visual cues, categorization) through the lenses of age, amount and type of schooling, setting (e.g., urban/rural/suburban), socio-economic status, PEL, and second language. These intraand inter-country, cross-cultural studies have compared memory function of different groups of children and adults yielding attributes of memory that are thought to be both universal and cultural-specific. The following review summarizes research findings on how culture is thought to impact memory.

Autobiographical Memory. Culture and language are thought to influence the age of earliest memories and the detail of autobiographical memories (Fivush & Nelson, 2004). For example, Eastern and Western cultures differ in their definition of self. Western cultures define self as one who is independent and autonomous from a group and with control of the future; whereas, Eastern cultures define self as an interdependent part of a social group where the group affects the individual's actions, emotions, and future (Markus & Oyserman, 1989). Mothers within these cultures are thought to transfer these concepts of self to their children through their actions and language. Mothers from Western societies are more verbally interactive with their children and encourage more self-expression from their children than mothers from Eastern cultures. Children from Western cultures have been found to tell more verbally elaborate, emotionally charged narratives of events in their lives than children from Eastern cultures (Fivush & Nelson, 2004). Furthermore, adults from Eastern cultures have been found to have a later age of remembering first memories and less vivid childhood memories in general than adults from Western societies (Fivush & Nelson, 2004).

Language plays an integral part in the retrieval of autobiographical memories. A study examining autobiographical memory in consecutive bilinguals found that memories are more easily retrieved if the language used to retrieve the memories is the same language used at the time of memory encoding (Schrauf, 2000). Consecutive bilinguals can be defined as individuals who learn a second language after learning their first language. Study results also indicated differential retrieval of memories according to whether the individual was cued in the language that the memory was encoded in or not. Language specific autobiographical memory recall appears to exist because consecutive bilinguals appear to acquire "dual cultural-linguistic self-representations" that act as filters for memory retrieval (Schrauf, 2000, p. 387). Possibly, we retrieve memories in the language encoded more easily and vividly because we identify with the memory through that specific cultural-linguistic lens (Schrauf, 2000).

In summary, autobiographical memories are thought to be shaped by social and cultural expectations. Language plays an integral part in the self-representation process because language functions as the mechanism that facilitates the acculturation process (Schieffelin & Ochs, 1986). Hence, autobiographical memories may serve as an essential mechanism for constructing our understanding of self within our environment (Fivush & Nelson, 2004).

Mnemonic Process and Strategy Use. Culture is thought to influence mnemonic process and strategy. Early studies that examined the development of short-term and incidental memory among urban and rural students in Yucatan, Mexico found that the developmental changes in the STM task of serial position of pictures among the urban, educated students in Meridian, Mexico were similar to those of American middle-class students; however, the memory performance of the rural students in Mayapan, Mexico did not demonstrate consistent developmental changes in STM performance due to lack of use of verbal rehearsal strategies (Wagner, 1974). Incidental learning, such as recognition tasks, remained constant between urban and rural students suggesting that incidental learning is a universal memory skill that is not affected by culture. To further examine the theory of a universal and a culture specific aspect to memory, Wagner (1977, 1978) conducted a cross-cultural study in Morocco to examined the effects of schooling, culture, and environment on STM and recognition memory (incidental learning) in Koranic students, Moroccan rug sellers, and American university students. This study found that certain aspects of memory, such as the rate of forgetting and sentence recall, were relatively constant across age and cultural background, while mnemonic strategies, such as verbal rehearsal and the rate of acquisition of new information, depended on cultural background and schooling (Wagner, 1977). These results were supported by the Rogoff and Waddell (1982) and Engle, Klein, Kagan, and Yarbrough (1977) studies where the strategy of verbal rehearsal enhanced the verbal STM tasks of memorizing unorganized lists of words, digit span forward, digit span backward, and auditory integration tasks with Guatemalan children. In the above studies, the impact of culture through formal schooling is thought to have influenced auditory and visio-spatial STM strategies. Incidental learning (e.g., recognition tasks) was found to be less affected by culture.

The development of mnemonic processes and strategies has been found to be highly correlated with age. Research that investigated the mnemonic processing strategies of 5- and 11-year-olds in the United States found that the sequential WM of 5-year-olds is influenced by the visual similarity of stimuli and visual interference;

whereas, the sequential WM of 11-year-olds is influenced by audio-verbal interference, phonemic similarity, and word length (Hitch, Halliday, Schaafstal, & Heffernam, 1991; Hitch, Halliday, Schaafstal, & Schraagen, 1988). Thus, short-term memorization strategies used by preschoolers were found to be nonverbal, visual-visual motor, visual inspection, and pointing to remember; whereas, children ages nine and older used verbal semantic strategies such as verbal rehearsal and categorization to memorize verbal material (Hitch et al., 1991).

The shift in mnemonic strategies from visual to auditory with age is supported by event-related potential (ERP) research. A strong relationship between reading performance and activation of the right parietal cortex of the brain in kindergarten and first grade students learning to read has been found (Licht, Bakker, Kok, & Bouma, 1988). The right parietal cortex of the brain is associated with visual and spatial process and visual association (Zillmer & Spiers, 2001). With increased age and schooling, there is a strong relationship between reading performance and left temporal cortex activation (Licht et al., 1988). The left temporal cortex is associated with receiving and interpreting auditory information (Zillmer & Spiers, 2001).

Cross Cultural Impact on Mnemonic Processes. Cross cultural studies have investigated the shift in mnemonic process and strategies between auditory-verbal memory and visual memory span to query the findings of Hitch et al. (1988, 1991). The development of mnemonic processes and strategies was found to be highly correlated with formal reading and writing instruction. In these studies, age and schooling emerged as the significant factors impacting the correlation between auditory-verbal and visual memory span in Laotian, American, and Zairian children (Conant et al., 2003; Conant et al., 1999). A significant increased relationship between auditory-verbal and visual memory span with an increase in age was observed in Laotian and American children (ages 8 to 12 years) who received intense, direct reading and written language instruction through their public educational systems (Conant et al., 2003). Conversely, no increased relationship between auditory and visual memory span was observed in the younger (ages 4 to 8 years) Laotian and American children. In contrast, school-aged Zairian children did not demonstrate an increased relationship between auditory-verbal memory and visual memory skills with age. After controlling for nutritional deficits and health issues, the only remaining significant factor accounting for the lack of increased relationship in verbal and visual memory span with age in the Zairian children was that they did not receive the structured reading and writing instruction that their counterparts received in the public school setting (Conant et al., 1999). The change in mnemonic strategy appears to occur when the child becomes proficient in reading and writing skills (Conant et al., 2003). Therefore, it could be hypothesized that memory strategy selection is significantly influenced by socio-cultural factors (e.g., education) and reflects a developmental change in cerebral organization that is brought about by literacy training (Conant et al., 2003).

Other factors have been explored to ascertain the impact of culture on memory. Research was equivocal for an urban-rural effect. In studies investigating verbal fluency and visual-motor memory abilities, urban, Italian children, 4- to 10-year-olds, were found to generate more examples on semantic verbal fluency tests than their rural counterparts, while urban, Brazilian children, 7-to 10-year-olds, performed significantly better on complex figure reproduction than their rural counterparts (Orsini, Schiappa, & Grossi, 1981; Santos, Mello, Bueno, & Dellatolas, 2005). In Buganda, Africa the opposite effect was reported. Children in rural schools out performed children in urban schools on recall of word lists, with the religious-based, rural school children significantly outperforming their urban and rural counterparts (Pollnac, 1976). Upon further investigation, Pollnac found that the children who attended the religious-based, private school were required to memorize and recite long prayers as part of their religious training. These students performed significantly better than their counterparts at the urban and rural schools on serial recall and free recall tests. These findings support Wagner's (1978) study where the amount of schooling was associated with adolescent and adult performance on visio-spatial tasks. The unschooled participants scored significantly lower on visuo-spatial tasks than schooled participants due to a primacy effect providing support for the association between literary training and verbal and visio-spatial STM function.

Along with schooling, PEL has been found to be highly correlated with serial memory performance and story recall. Stevenson, Parker, Wilkinson, Bonnevaux, and Gonzalez (1978) conducted a large study with 824 Peruvian students, ages five and six years (kindergarten and first graders), to specifically examine the effect of urban-rural settings, socio-economic status, schooling, and age on seven memory tasks. The memory tasks included serial memory recall of words, numbers, pictures and patterns, auditory story recall, pictorial story recall, matching (incidental learning), and enactive memory (recalling the location of objects). Although schooling accounted for 5% to 12% of the variance on seven different memory tasks across setting (urban-rural), PEL was highly correlated with student performance on three of the STM tasks. PEL accounted for 18% of the variance for serial memory of words, 26% of the variance for serial memory of numbers, and 16% of the variance for verbal memory of stories. Interestingly, PEL was not significantly associated with pictorial or visual memory tasks performance (Stevenson et al., 1978).

More recently, PEL and schooling was found to be significantly correlated with verbal and graphic fluency test scores. Ardila, Rosselli, Matute, and Guajardo (2005) investigated the impact of private-public education, age, and PEL on 622, 5- to 16-year-old students residing in Mexico and Columbia. Eight tests developed in the Spanish language explored student performance on semantic verbal fluency (e.g., naming animals), phonemic verbal fluency (e.g., naming words starting with *M*), semantic graphic fluency (e.g., drawing meaningful figures), and non-semantic graphic fluency tests (e.g., drawing geometric shapes). PEL level was highly correlated with student performance on all tasks of semantic and phonemic verbal fluency and semantic and non-semantic graphic fluency (Ardila et al., 2005). Although the privately schooled children performed significantly better than the children in public school on all tests except Card Sorting, the difference in performance decreased with age and years of schooling. For example, the semantic verbal fluency test scores of the kindergarteners in private school were 50% higher than the kindergarteners in public school. This score variance decreased to a 10% difference between 15-year-old students in public and private schools (Ardila et al., 2005); thus, age, PEL, and schooling are significantly associated with STM performance in children.

Certain aspects of memory have been found to be relatively unaffected by culture. Memory of contextually organized spatial scenes that used physical objects that were common to the culture was an area of memory ability that was relatively unaffected by culture (Boivin, 1991; Kagan, Klein, Finley, Rogoff, & Nolan, 1979). A study examining performance differences in Mayan children living in Guatemala and U.S. children living in Salt Lake City, Utah found that the children from the United States performed significantly better on memory span tests for pictures, nouns, and orientation of dolls. On a memory task that called for the replacement of 20 items in their correct locations on a three dimensional scene, the Mayan children and the U.S. children performed equally well. Different mnemonic strategies were used by each group, with the U.S. children applying verbal rehearsal strategies in order to remember the correct placement for an item and the Mayan children using substitution to replace items (Rogoff & Waddell, 1982). These findings suggest that providing culturally relevant items to be manipulated in a meaningful contextual setting could facilitate memory recall efficiency.

Further impacting immigrant children in the United States is their immersion into a culture and language that is different from their own. Acculturation can be described as the process of an individual adopting the beliefs, values, and practices of the new culture (Horton, Carrington, & Lewis-Jack, 2001). The acculturation process can be emotionally and socially difficult for all family members. This process is influenced by an individual's age, education, language, occupation, familial relationships, personality, interaction with the mainstream society, and ethnic support systems (Horton et al., 2001). Intra-country studies in Peru found a significant interaction effect between location and cultural group. Children of families that were indigenous to rural Peru performed poorly on STM tasks when families moved to urban areas; likewise, children of families who were indigenous to urban life performed more poorly on STM tasks when moved to rural areas in Peru (Stevenson et al., 1978). Although it is unclear how acculturation affects test performance, some evidence suggests that the degree of familiarity with the testing situation and stimuli deemed important in the culture affects test scores (Pontón, 2001; Stevenson et al., 1978).

In summary, memory is thought to be an essential component for learning and academic achievement. Memory development appears to be influenced by the accumulation of life and learning experiences in the context of one's culture. Language plays an integral part since it is the medium used to communicate thoughts and ideas. Evidence suggests that we remember events and information best in the context of our dominant language and culture. Schooling has been associated with reduced differences in children's performances on STM tasks (Stevenson et al., 1978). Formal schooling with an emphasis on reading and writing skills is thought to strengthen mnemonic strategies such as categorization and verbal rehearsal. Other factors that are strongly correlated with visual and auditory STM are PEL and age. The children of parents with some college education have been found to perform significantly better on verbal STM tasks (Ardila et al., 2005). Urban-rural settings have been implicated in impacting memory ability; however, the availability and quality of schooling (emphasis on reading and writing skills) overshadow the influence of location. Furthermore, familiarity of environment provided by one's own culture is correlated with better memory performance. Each cultural group's environment is organized so that children experience and interpret life experiences consistent with cultural norms. Acculturating into a new culture has been found to negatively impact school performance and the assessment setting confounding the diagnosis of memory and learning difficulties. Further research is needed to identify the influence of culture on the memory assessment measures used in U.S. schools to provide accurate diagnosis and treatment plans for children with STM deficits.

Measures of Children's Memory

Psychometrically valid instruments are needed to assess memory and learning of all children. Identification of score variance due to cultural differences and PEL yields the possible influence of culture and socioeconomic status on assessment; thus, knowledge allows for a more culturally valid and reliable assessment.

The assessment of memory performance in children has been hampered due to the lack of properly normed, comprehensive memory measures to assess children. Until recently, memory performance in children has been assessed using measures that were standardized on an adult sample or memory measures that assessed only one domain of memory. Minimum standards for a comprehensive memory battery for children include age-appropriate norms from a standardization sample that represents the children being assessed, developmentally appropriate domains, and age appropriate stimuli (Franzen, 2000). Memory constructs to be included in the evaluation are short-term and delayed memory, auditory-verbal and visual-non-verbal memory, the encoding, storage and retrieval of verbal and visual information, literal recall and thematic recall of information, and WM ability (Cohen, 1997b). The relationship of memory to cognitive ability and the correlation of memory with academic achievement and language ability provide the examiner with the information needed to identify strengths and weaknesses in the child's memory ability (Cohen, 1997b; Franzen, 2000).

Given the multicultural character of our society, memory and cognitive evaluations must be sensitive to potential sources of variability in test scores (Figueroa, 1983; Franzen, 2000). Test bias must be addressed when using a standardized memory measure. Internal and external sources of bias include inappropriate item content, measurement of an unidentified or unintended construct, and cultural, language, or examiner bias (Figueroa, 1983; Gutierrez-Clellen & Calderon, 2004; Harris, Cullum, & Puente, 1995; Reynolds, Lowe, & Saenz, 1999). There are several ways to reduce test bias. External bias can be minimized by a competent, adequately trained examiner, appropriate test selection, proper test administration, consideration of language and dialectical differences, and well established rapport with the client (Reynolds et al., 1999). Bias due to limited English proficiency and acculturation can be minimized by evaluating and establishing the child's language proficiency and acculturation levels before testing begins (Pontón, 2001). Internal test bias can be minimized by the careful screening of the standardization sample participants. The standardization sample should proportionately represent the population to be tested by geographic regions, ethnicity, sex, PEL, public or private schooling, and age. Other criteria to be considered for participation in the standardization sample is reading level, academic achievement, learning disabilities, neuropsychological disorders, brain injury, and English language proficiency. Examining item bias during test construction can minimize internal test bias. Item bias can be evaluated by three methods: delta plot, chi-square approach, or item response theory (Franzen, 2000). Item difficulty indices could be constructed by group to measure item difficulty by different subgroups of the standardization sample.

Currently, there are three individually administered, standardized memory batteries for children and adolescents on the market in the United States. They are the CMS (Cohen, 1997a), Test of Memory and Learning – Second Edition (TOMAL-2; Reynolds & Voress, 2007), and Wide Range Assessment of Memory and Learning – Second Edition (WRAML- 2; Sheslow & Adams, 2003). These memory batteries examine verbal and visual memory function. Since there are distinct differences in these instruments, the following will be a brief review that compares and contrasts the CMS, TOMAL-2, and WRAML-2.

The CMS (Cohen, 1997b) is a standardized measure of memory and learning designed for children and adolescents ages 5 to 16 years. Normed on 1,000 participants, the CMS was designed to represent the U.S. population by gender, age, ethnicity, geographic location, and PEL. English language skills were established for each participant by parent, teacher, and examiner verification. The CMS is a measure of memory that consists of nine subtests, six core subtests and three supplemental subtests that examine verbal and nonverbal memory, immediate and delayed memory, WM, and attention and concentration. Since the CMS is the subject of this research, further details will be presented later in this paper.

The TOMAL-2 (Reynolds & Voress, 2007) is normed for children and adults ages 5 to 59 years, 11 months. The standardization sample of 1,900 children, adolescents, and adults was designed to representative the U.S. population by gender, age, ethnicity, urban-rural settings, and geographic distributions. Socio-economic level and PEL were not considered in the design process. The test battery consists of eight core subtests, six supplemental subtests and two delayed recall tasks. Like the CMS, the TOMAL-2 is thought to examine verbal and nonverbal memory, immediate and delayed memory, WM, and attention and concentration.

Like the CMS and TOMAL-2, the WRAML-2 (Sheslow & Adams, 2003) investigates verbal, nonverbal, immediate, and delayed memory function in children and adults ages 5 to 90. Unlike the CMS, the WRAML-2 and the TOMAL-2 do not control for PEL in the standardization samples. Furthermore, there is no research to date investigating the impact of PEL, ethnicity, and language on these two memory instruments.

In summary, the purpose of this study is to address a gap in the literature on the impact of culture on STM and WM by examining student performance on the CMS by ethnicity and PEL (Cohen, 1997a). The CMS is a standardized measure of memory and learning for children and adolescents. STM and WM have been identified as necessary components for language acquisition, vocabulary development, and reading comprehension. Given the extent to which memory and learning are expected to impact school success, as well as the increasing number of ELLs in U.S. schools, it is important to examine cultural differences on measures used to assess these domains. The method used to examine CMS performance as a function of ethnicity and PEL is provided in Chapter III.

CHAPTER III

METHODS

Research Participants

The participants in this study include a subset of the standardization sample of the CMS, which consisted of 1000 children ranging from 5 to 16 years of age (Cohen, 1997b). The sample was stratified by age, gender, race-ethnicity, geographic region, and PEL in accordance with the 1995 U.S. Census Bureau. In terms of age, the standardization sample consisted of 500 boys and 500 girls separated into 10 age groups with 50 boys and 50 girls in each age bracket. The categories of race-ethnicity included in the standardization sample were African American, Caucasian, Hispanic, Native American, Eskimo, Aleut, Asian American, Pacific Islander and Other. For this study, the categories of African American, Caucasian, and Hispanic were used for a total of 961 children. Table 1 shows the sample breakdown by gender and ethnicity. Children who were reading one year below age expectancy or were not proficient in English were excluded from the standardization sample. English language proficiency was based on parent and teacher report and confirmed by examiner judgment (M. J. Cohen, personal communication, January 28, 2004).

Table 1

Characteristics of Sample by Gender and Ethnicity

Ethnicity	Females	Males	Total
African American	86	75	161
Hispanic	58	58	116
White	333	351	684
Totals	477	484	961

In terms of geographic region, the United States was divided into four regions: the Northeast, North Central, South, and West. PEL was divided into five categories to include 8th grade or less, 9th through 12th grade, high school graduate, one to three years of college or technical school, and four or more years of college. For this study, PEL was further collapsed into three categories: Less than a 12th grade education, high school graduate, and one or more years of college or technical school. PEL was collapsed into three groups to increase group sample size and insure sufficient power for analysis (Lenth, 2001). PEL was averaged for two parent households. If only one parent lived with the child, the educational level of that parent was used (Cohen, 1997b). Table 2 represents the research sample by ethnicity and PEL.

Measure

The CMS was developed to assess memory, learning, and concentration in children and adolescents ages 5 to 16 years (Cohen, 1997b). The CMS examines memory function in three domains: (a) auditory-verbal learning and memory, (b) visual-nonverbal learning and memory, and (c) WM, attention and concentration.

Table 2

Characteristics of Sample by PEL and Ethnicity

Ethnicity	Years of schooling			Total
	<12	12	>12	
African American	33 (20%)	69 (43%)	59 (37%)	161 (17%)
Hispanic	50 (43%)	36 (31%)	30 (26%)	116 (12%)
White	56 (8%)	211 (31%)	417 (61%)	684 (71%)
Totals	139 (14%)	316 (33%)	506 (53%)	961 (100%)

Note. PEL = parent education level.. $<12^{th}$ = parent did not obtain high school diploma; 12^{th} = parent obtained high school diploma; $>12^{th}$ = parents obtained some college or technical school training including completion of college degrees. % = percentage of students in that category.

Each domain is comprised of several indices. Under the Auditory-Verbal Learning and Memory Domain, the indices include verbal immediate memory, verbal delayed memory, and delayed recognition. The Visual-Nonverbal Learning and Memory Domain include the Visual Immediate Memory Index and the Visual Delayed Memory Index. The Learning Index is included under both the Auditory-Verbal Domain and the

Visual-Nonverbal Domain. Finally, there is an Index for attention and concentration. The General Memory Composite Score is derived from the Verbal and Visual Immediate and Delayed Memory Indices and represents global memory functioning (Cohen, 1997b).

Nine subtests were created to assess memory and learning function. Six of the subtests are considered core battery subtests and must be administered to obtain domain scores and a general memory score. Three subtests are supplemental. The subtests of Stories (core), Word Pairs (core), and Word Lists (supplemental) assess auditory-verbal memory and learning. Dot Locations (core), Faces (core), and Family Pictures (supplemental) are subtests that assess visual-nonverbal memory and learning. Each subtest for the domains of auditory-verbal memory and visual-nonverbal memory contains a delayed section to assess delayed verbal and visual memory within each of these domains. Attention and concentration is assessed with the Numbers (core), Sequences (core), and Picture Locations (supplemental) subtests and is thought to measure WM abilities (Cohen, 1997b). Table 3 describes the CMS domains, indices, and subtests.

Test reliability examines the extent to which a test score is consistent across time and groups (Tuckman, 1988). The split-half reliability method with the Spearman-Brown formula for correction was used to determine if both halves of each subtest assess a particular aspect of memory (Cohen, 1997b). This method was selected to analyze internal consistency on most of the CMS subtests because split-half reliability estimates were used for measurement uniformity with the subtests of the Wechsler Intelligence

Scale for Children-Third edition (WISC-III; Wechsler, 1991). Generalizability theory was used to examine internal consistency on the subtests of Dot Location (long delay), Stories (long delay), and Word Pairs (long delay) due to formatting of test items and interitem dependency. Reliability coefficients for the CMS were reported for all age groups across all subtests. Split-half reliability coefficients on the indices were 0.76 for visual immediate and visual delayed memory, 0.86 for verbal immediate memory, 0.84 for verbal delayed memory, and 0.91 for general memory.

To examine test-score reliability over time, a subsample of 125 students across three age groups was used to examine test-retest reliability. The age groups from the subsample were 5 to 8 years, 9 to 12 years, and 13 to 16 years. The average time interval between the first testing and retesting was 59.6 days with a standard deviation of 29.2 days (Cohen, 1997b). Test-retest reliability coefficients across indices ranged from 0.29 (Visual Immediate, ages 13 to 16 years) to 0.89 (Attention-Concentration, ages 9 to 12 years). Test-retest reliability coefficients were generally in the acceptable range; however, the visual immediate and delayed coefficients for ages 13 to 16 years were unacceptable due to a practice effect of up to one standard deviation. A retest delay of longer than nine weeks would likely show less of a practice effect in the subtest scores.

Table 3

CMS Domains, Subtests and Descriptions

Domain	Indices	Subtest	Description
Auditory/Verbal	Verbal Immediate	Stories (Core)	Ability to recall meaningful and semantically related verbal information
	Verbal Delayed	Word Pairs (Core)	Ability to learn a list of word pairs over a series of trials
	Delayed Recognition	Word Lists (supplemental)	Ability to learn a list of unrelated words over a series of trials
Visual/Nonverbal	Learning	Dot Locations (Core)	Ability to learn the spatial location of an array of dots over a series of trials
	Visual Immediate	Faces (Core)	Ability to remember and recognize a series of faces
	Visual Delayed	Family Pictures (Supplemental)	Ability to remember scenes of family members doing different activities
Attention/ Concentration	Attention/ Concentration	Numbers (Core)	Ability to repeat random digit sequences of graduated length
		Sequences (Core)	Ability to manipulate and sequence auditory/verbal information rapidly
		Picture Location (Supplemental)	Immediate visual/nonverbal memory for spatial location of pictured objects

Interrater reliability scores assess the degree of rater bias or judgment on a test score. Most subtests on the CMS are unambiguous; however, the subtests of Stories and Family Pictures require examiner recall and judgment. Intraclass correlations were used to measure score consistency between two examiners. Intraclass correlations were very high ranging from 0.98 to 1.00.

Validity is the overall evaluative judgment of the degree to which the meaning and interpretation of test scores holds across persons or population groups and across settings or contexts (Messick, 1995). In other words, does the empirical evidence (test scores) and theoretical rational support the interpretation and actions taken on behalf of the student who was evaluated? Validity has evolved from the traditional approach (content, criterion, and construct validity) to determine the validity of an assessment instrument to a process that encompasses all the components of the research process (Fiske, 2002; Messick, 1995). It is a long-term process that begins at the inception of the test and continues throughout the life of the instrument (Cohen, 1997b).

Construct validity examines to what extent score meaning and action implications hold across individuals, population groups, and across setting or context; it is the base for which other forms of validity are tested (Fiske, 2002; Messick, 1995). The six aspects of construct validity include content, structure, generalizability, external, consequential, and substantive validity (Messick, 1995). These aspects of construct validity function as a general foundation for all educational and psychological measurement and will be used to examine the validity of the CMS (Messick, 1995).

The goal of the CMS is to provide a comprehensive assessment of the learning and memory abilities in children. To this end, the content and substantive aspect of validation of the CMS was to ensure that the test items and subtests adequately sampled the domain of behaviors delineated by the construct of memory. The first subtests were developed in 1986 based on an extensive review of the literature on memory and learning. This research encompassed a review of brain-behavior relationships related to learning and memory, the impact of neurological disease on memory, and the development of learning and memory from childhood to adult (Cohen, 1997b). The subtests were developed to assess aspects of visual-nonverbal and auditory-verbal STM, WM and attention, delayed recall, and learning.

Research studies with healthy and clinical samples led to content revisions to better assess delayed recall (Cohen, 1997b). In 1992, an expert panel of U.S. pediatric neurologists and school psychologists reviewed the content of the CMS. Based on these experts' recommendations, some subtests were eliminated or modified. In 1993, the CMS was administered to 300 healthy children and a clinical sample to determine subtest and item composition, basal and ceiling rules, and clinical sensitivity of the subtests for standardization. Examiners were asked to comment on the ease of administration of the CMS, the length of subtests, and aspects of "child-friendliness". Expert recommendations and the comments of examiners determined the CMS items used for national standardization. After the standardization process was completed, the generalizability aspect of validity was examined through reevaluation of the content, item bias, and psychometric properties on CMS subtests (Cohen, 1997b).

To acquire the standardization sample, invitations were mailed to numerous school districts across the United States. Criteria for school district selection were based on their SES status, ethnicity composition, and availability of test examiners (Cohen, 1997b). One hundred fifty school districts and several non-school based sites participated in the standardization of the CMS. All participating schools were mailed parental consent forms and instructions for distribution in the classrooms (Cohen, 1997b).

A database was compiled of children available to participate in the study using the consent form information. The consent forms were sent only to families of children who met the standardization criteria; each consent form requested the student's age, sex, ethnicity, and the occupation and educational level of the parents (Cohen, 1997b; M. J. Cohen, personal communication, January 28, 2004). This information was stratified by student age, sex, race/ethnicity, and PEL based on the 1995 U.S. Census data.

Students met defined criteria to qualify for participation in the study. Only one child per family could participate in the study (Cohen, 1997b). All study participants were based on teacher nomination. Each child that participated was reading at or near grade level, had never repeated a grade, had never received special education or Title I remedial services, had never been diagnosed with a neurological disorder, and had never sustained a head injury that might put them at risk for memory impairment (Cohen, 1997b). English language ability was based on teacher and parent report and confirmed with examiner judgment (M. J. Cohen, personal communication, January 28, 2004). In most cases, the standardization sample matched the 1995 U.S. Census. In the areas of

PEL and race/ethnicity, weighting was used to align these groups with the 1995 U.S. Census. For this study, the raw data will be used; therefore, the results of this study will not be affected by the weighting used to adjust the standardization sample.

Construct validity on the CMS was measured by a confirmatory factor analysis that produced a three-factor model consisting of auditory-verbal memory, visual-nonverbal memory, and attention-concentration (Cohen, 1997b). The structural aspect of construct validity addresses the patterns of correlations between the construct domains/indices and the assessment subtests. Within each CMS domain, subtests of auditory-verbal memory (Word Pairs and Stories) and attention-concentration (Numbers and Sequences) correlated moderately, whereas the subtests for visual-nonverbal memory (Faces and Dot Location) demonstrated a low correlation. The General Memory Index exhibited moderate to high moderate correlations with the Visual and Auditory Memory Indices. The Index of attention and concentration exhibited low to low moderate correlations with visual memory, auditory memory and general memory. The Learning Index exhibited low to high moderate correlations with all memory indices. Refer to Table 4 for CMS indices correlations.

The external aspect of validity was evaluated through correlations between scores on the CMS and measures of cognitive ability such as the WISC-III (Wechsler, 1991), Wechsler Preschool and Primary Scale of Intelligence-Revised (WPPSI-R; Wechsler, 1989), Otis-Lennon School Ability Test (OLSAT; Otis & Lennon, 1989), and Differential Abilities Scale (DAS; Elliot, 1990). The CMS General Memory Index produced moderate to high moderate, positive correlations across all areas of these cognitive abilities measures. Refer to Tables 5 and 6 for correlations of the CMS general memory and cognitive ability measures.

Table 4

Intercorrelations of the CMS Indices for All Ages

	Visual		Verbal		Gen. Mem.	Attention
Indices	Imm.	Delay	Imm.	Delay		
Visual Imm.						
Visual Delayed	.65					
Verbal Imm.	.27	.21				
Verbal Delayed	.23	.21	.79			
General Memory	.70	.68	.79	.77		
Attention	.27	.20	.41	.41	.44	
Learning	.57	.33	.68	.46	.69	.40

Note. CMS = Children Memory Scale. Imm. = immediate memory; Delay = delayed memory; Gen. mem. = general memory; Attention = attention and concentration.

Table 5

Correlations between Memory and Cognitive Ability: CMS, WISC-III, and WPPSI-R

	WISC-III			WPPSI-R		
CMS	VIQ	PIQ	FSIQ	VIQ	PIQ	FSIQ
General Memory scale	0.53	0.52	0.58	0.55	0.49	0.56

Note. VIQ = verbal IQ; PIQ = performance IQ; FIQ = full scale IQ. CMS = Children's Memory Scale; WISC-III = Wechsler Intelligence Scale for Children, n = 413; WPPSI-R = Wechsler Preschool and Primary Scale of Intelligence-Revised, n = 38.

Table 6

Correlations between Memory and Cognitive Ability: CMS, OLSAT, and DAS

	OLSAT			DAS		
CMS	VIQ	PIQ	FSIQ	VIQ	PIQ	FSIQ
General Memory scale	0.59	0.40	0.65	0.64	0.72	0.73

Note. VIQ = verbal IQ; PIQ = performance IQ; FIQ = full scale IQ. CMS = Children's Memory Scale; OLSAT = Otis-Lennon School Ability Test, n = 15; DAS = Differential Abilities Scale, n = 33.

Procedure

A proposal to investigate the impact of culture and PEL using the standardization sample of the CMS was submitted to Psychological Corporation. Following the approval of the Institutional Review Board for the use of extant data, the Psychological

Corporation approved the project. The data was provided and cases to be excluded (due to race/ethnic group membership and insufficient numbers) were identified. Prior to conducting the analyses to address the research questions, preliminary assumption testing was conducted to verify sample size, normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices, and multicollinearity. SPSS General Linear Model (multivariate) was used for the analyses (SPSS, 2000). Sample size was sufficient for all analyses with thirty or more subjects in each cell (Tabachnick & Fidell, 2001).

Pearson correlations were conducted between all CMS subtests to assess multicollinearity. Correlations greater than .80 were found between several of the subtests violating the assumption of multicollinearity (Tabachnick & Fidell, 2001). Intercorrelation Tables A-1, A-2 and A-3 can be found in the appendix. The high correlations involving these various subtests were due to interitem dependency between immediate memory, delayed memory, and the total subtest scale scores; therefore, the CMS Dot Location scaled scores, CMS Word Pairs scaled score, CMS Numbers scaled score, CMS Story Delayed scaled score, and CMS Family Pictures Delayed scaled score were excluded from the analyses. Accordingly, nineteen subtests were used as the dependent variables to explore the impact of culture and PEL on student performance on CMS. Refer to Table 7 for subtests used for SPSS analyses.

Table 7

Nineteen CMS Subtests Used in SPSS Analyses

CMS Dot Location Learning
CMS Dot Location Short Delay
CMS Dot Location Long Delay
CMS Stories Immediate
CMS Stories Delayed Recognition
CMS Faces Immediate
CMS Faces Delayed
CMS Word Pairs Learning
CMS Word Pairs Immediate
CMS Word Pairs Long Delay
CMS Word Pairs Delayed Recognition
CMS Family Pictures Immediate
CMS Word Lists Learning
CMS Word Lists Delayed
CMS Word Lists Delayed Recognition
CMS Numbers Forward
CMS Numbers Backward
CMS Sequences
CMS Picture Location

Note. CMS = Children's Memory Scale.

A test of homogeneity of regression was used to determine if there was a significant interaction effect between PEL and ethnicity. The interaction of these two factors violated the regression assumption, F (19,925) = 2.517, p <.001; therefore, it was determined that analyses would be conducted using ethnicity as the independent variable with data stratified by PEL to explore the impact of culture on student performance (Pallant, 2004). Analyses specific to the research questions were conducted. Results of these analyses are presented in Chapter IV.

CHAPTER IV

RESULTS

Three major questions were addressed with the data obtained. Six between-subjects multivariate analysis of variance (MANCOVA) were performed using the 19 CMS subtests as the dependent variables to determine if test performance was significantly different between ethnic groups or as a function of PEL. Age was used as a covariate for all analyses. Due to an interaction effect between ethnicity and PEL, the data was stratified by three PEL categories (Pallant, 2004).

Research Question #1

The first question addressed was: Will performance differ significantly between ethnic groups or as a function of PEL on the CMS subtests? It was hypothesized that cultural differences due to schooling, language, and acculturation factors would affect memory performance on the CMS. Research suggests that schooling through systematic, direct instruction of reading and writing skills positively impacts mnemonic strategy to recall auditory and visual material; thus, the quality of instruction could impact mnemonic performance. English proficiency would affect CMS subtest performance for children in the standardization sample who were ELLs. Knowledge of test-taking strategies in the U.S. culture could impact test performance. Furthermore, PEL has been found to be highly correlated with student performance on memory and cognitive assessments. As a result, PEL level is expected to be highly correlated with student performance on the CMS.

Three MANCOVA were conducted using ethnicity as the independent variable, Age as a covariant, and the nineteen CMS subtests as dependent variables. The first 2 x 19 MANCOVA was conducted to determine if students whose parents did not complete high school performed significantly different on the CMS subtests when compared by their ethnicity. Refer to Table 8 for the number of students by ethnic group whose parents did not complete high school. Box's M was significant at the $p < .001$ indicating that the CMS subtests differed in their covariance matrices. Failure to meet the assumption of homogeneity of variances-covariance is not fatal to MANCOVA, which is relatively robust, when groups are of equal sample size (Tabachnick & Fidell, 2001). A significant multivariate effect for ethnicity, Wilks'Λ = 0.507, $F(38, 232) = 2.466$, $p < .01$, was found. According to the eta-square effect size, $\eta^2 = 0.288$, ethnicity accounted for 29% of the variance in performance on the CMS subtests. Refer to Table 9 for a summary of all MANCOVA analyses by ethnicity and PEL for this research project.

Table 8

Number of Students by Ethnicity in PEL < 12

Ethnicity	*N*
African American	33
Caucasian	56
Hispanic	50
Total	139

Note. PEL = parent educational level. < 12 = parent did not complete high school.

Univariate analyses were conducted to examine the effect of culture on each CMS subtest. The Levene statistic was significant for CMS subtests Story Delayed Recall, Faces Immediate Recall and Word List Learning indicating that the error variance of these three subtests is not equal across the ethnic groups. When the Levene statistic assumption is violated, a more conservative alpha level is recommended to determine significance (Tabachnick & Fidell, 2001, p. 80). Univariate test analyses revealed significant differences at the .01 levels on the Word Pairs Learning subtest, F (2,134) = 6.806, $p = .002$, $\eta^2 = 0.092$, and Word Pairs Immediate Recall subtest, F (2,134) = 11.951, $p < .001$, $\eta^2 = 0.151$. Refer to Table 10 to review all statistically significant ANOVA tables comparing CMS subtest performance by ethnicity within each PEL. The ANOVA tables comparing all CMS subtest performance by ethnicity within each PEL are located in Tables A-4, A-5, and A- 6 of the appendix.

Pairwise comparisons of the ethnic groups based on marginal means of these two subtests were conducted to determine which ethnic groups differed in their CMS subtest performance and by how much. An alpha level of .016 (.05/3) was set to correct for Type I error rate due to multiple comparisons. These analyses revealed that Caucasian children performed better than African American children on the Word Pairs Learning (*M* difference = 2.268, $p = .001$) and Word Pairs Immediate Recall (*M* difference = 3.069, $p < .001$). There was also a significant difference between Hispanic student performance and African American student performance on Faces Immediate Recall (*M* difference = 1.903, $p = .015$). See Table 11 for a summary of all statistically significant pairwise comparisons of CMS subtests by ethnicity within each PEL.

Table 9

Summary Table of MANCOVAs Comparing CMS Subtest Performance by Ethnicity and PEL

Source	*Wilks'* Λ	*df*	*F*	*p*	η^2
Student test performance by ethnicity; PEL = <12th grade education (n = 138)	0.510	38, 232	2.445**	.001	.288
Student test performance by ethnicity; PEL = 12th grade education (n = 307)	0.815	38, 570	1.619*	.012	.097
Student test performance by ethnicity; PEL >12th grade education (n = 506)	0.854	38, 966	2.087**	.001	.076

Table 9 (continued)

Source	*Wilks'Λ*	*df*	*F*	*p*	η²
African American student CMS performance compared across PEL (n = 155)	0.612	38, 268	1.959**	.001	.217
Hispanic student CMS performance compared across PEL (n = 113)	0.544	38, 223	1.707**	.006	.263
Caucasian student CMS performance compared across PEL (n = 680)	0.861	38, 1318	2.701**	.001	.072

Note. MANCOVA = multivariate analysis of variance-covariance. CMS = Children's Memory Scale. PEL = parent educational level. Wilks'Λ = Wilks lambda; *df* = degrees of freedom; *F* = Fisher's F ratio; *p* = significance; η^2 = eta² = effect size. <12th = parent did not obtain high school diploma; =12th = parent obtained high school diploma; >12th = parent obtaining some college or technical school training to completion of college degrees. *$p < .05$. **$p < .01$.

Table 10

Summary Table of Univariate ANOVAs Comparing CMS Subtest Performance by Ethnicity in Each PEL Group

Source	CMS Subtest	*F*	*df*	*p*	η^2
Univariate ANOVA					
for ethnicity; PEL <12	Word Pairs Learning	6.806**	2	.002	.092
(n = 139)	WP Imm. Mem.	11.951**		.001	.151
Univariate ANOVA					
for ethnicity; PEL = 12	Word Lists Learning	4.804**	2	.009	.031
(n = 316)	WL Delayed Recog.	8.783**		.001	.055

Table 10 (continued)

Source	CMS Subtest	*F*	*df*	*p*	η^2
Univariate ANOVA					
for ethnicity; PEL > 12th	Dot Location LT Delay	10.427**	2	.001	.040
(n = 506)	Stories Imm. Mem.	11.115**		.001	.042
	WP Learning	4.723**		.009	.019
	WL Delayed Mem.	4.819**		.008	.019
	Sequences	7.146**		.001	.02

8

Note. CMS = Children Memory Scale. PEL = parent educational level. ANOVA = analysis of variance. WP = Word Pairs; WL = Word Lists; Mem. = memory; Imm. = immediate; Recog. = recognition; LT = long term; ST = short term. df = degrees of freedom; *F* = Fisher's *F* ratio; *p* = probability; η^2 = eta² = effect size. *$p < .05$. ** $p < .01$.

Table 11

Summary Table of Pairwise Comparisons of CMS Subtests by Ethnicity in Each PEL Group

Variable	<12th	12th	>12th
Dot Location Learning			AA<C, H**
Dot Location Short Delay			
Dot Location Long Delay			
Stories Immediate Recall			AA, H<C**
Stories Delayed Recognition			
Faces Immediate			
Faces Delayed			
Word Pairs Learning	AA<C**		AA<C**
Word Pairs Immediate	AA<C**		
Word Pairs Long Delay			
Word Pairs Delayed Recognition			
Family Pictures Immediate			
Word Lists Learning		AA<C**	
Word Lists Delayed		AA<C**	
Word Lists Delayed Recognition			
Numbers Forward			
Numbers Backward			
Sequences			AA<C**

Note. CMS = Children's Memory Scale. PEL = parent educational level. AA = African American; C = Caucasian; H = Hispanic. < 12th = parent did not obtain high school diploma; =12th = parent obtained high school diploma; >12th = parents obtaining some college or technical school training to completion of college degrees. *$p < .05$. **$p < .01$.

Pairwise comparisons of all CMS subtests by ethnicity are located in Tables A-7, A-8, and A-9 in the appendix. Performance of students whose parents did not complete high school was statistically impacted by ethnicity on two subtests. The effect size was in the moderate to large range.

The second 2 x 19 MANCOVA was conducted to determine if students whose parents graduated from high school performed significantly different on the CMS across ethnic groups. Table 12 shows the number of students by ethnicity whose parents obtained a high school diploma. Box's M was not significant at the $p = .001$. A significant multivariate effect for ethnicity, Wilks' $\Lambda = 0.815$, F (38, 570) = 1.619, $p = .012$, was found. According to the eta square effect size, $\eta^2 = 0.097$, ethnicity accounted for 10% of the variance in the CMS subtests in this group of students. Refer to Table 9 on page 47. The Levine statistic was not significant at the $p < .05$ indicating that the error variance across groups was equal for each subtest. Univariate test analyses revealed significant differences at the .01 level on the Word Lists Learning subtest, F (2, 303) = 4.804, $p = .009$, $\eta^2 = 0.031$ and Word Lists Delayed Recognition subtest, F (2, 303) = 8.783, $p < .001$, $\eta^2 = 0.055$]. Refer to Table 10 on page 49.

Pairwise comparisons were conducted to identify which ethnic groups demonstrated the statistically significant performances on the CMS subtests. This analysis revealed that Caucasian students performed statistically better than African American students on the Word List Learning (*M* difference 1.297, $p = .007$) and Word List Delayed Recognition subtests (*M* difference = 1.620, $p < .001$). Refer to Table 11 on page 51. The mean score differences were less than one standard deviation.

Table 12

Number of Students by Ethnicity in PEL =12

Ethnicity	*N*
African American	69
Caucasian	211
Hispanic	36
Total	307

Note. PEL = parent educational level. = 12 = Parent obtained high school diploma.

A third 2 X 19 MANCOVA was conducted to explore differences in CMS subtest performance between students whose parents obtained college or technical school education. Refer to Table 13. Box's M was not significant at the $p < .001$ indicating that the CMS subtests did not differ in their covariance matrices. A significant multivariate effect for ethnicity, Wilks' $\Lambda = 0.854$, $F(38, 966) = 2.087$, $p < .05$, was found. According to the eta square effect size, $\eta^2 = .076$, ethnicity accounted for 8% of the variance in the CMS subtests. Refer to Table 9 on page 47. The Levene statistic was significant at the $p < .05$ for CMS subtest Dot Location Short Delay subtest indicating that the error variance for this subtest was not equal across ethnic groups.

Univariate test analyses revealed significant differences at the .016 level on the Dot Location Long Delay Memory subtest, $F(2, 501) = 10.427$, $p < .001$, $\eta^2 = 0.040$, Stories Immediate Recall subtest, $F(2, 501) = 11.115$, $p < .001$. $\eta^2 = .042$, Word Pairs Learning subtest, $F(2, 501) = 4.723$, $p = .009$, $\eta^2 = 0.019$, Word Lists Delayed subtest, F (2, 501) = 4.819, *p* = .008, η^2 = 0.019, and Sequences subtest, F (2, 501) = 7.146, *p* = .001, η^2 = 0.028. Refer to Table 10 on page 49.

Table 13

Number of Students by Ethnicity in PEL > 12

Ethnicity	*N*
African American	59
Caucasian	417
Hispanic	30
Total	506

Note. PEL = parent educational level. > 12 = Parents completed some college or technical school.

A pairwise comparison revealed a significant difference between two or more ethnic groups on five subtests. There was a significant difference between Caucasian and African American students on the Dot Location Learning subtest (*M* difference = 1.821, *p* < .001), Stories Immediate Recall subtest (*M* difference = 1.519, *p* = .001), Word Pairs Learning subtest (*M* difference = 1.290, *p* = .007), Word Lists Learning subtest (*M* difference = 1.129, *p* = .014), and Sequences subtest (*M* difference = 1.492, *p* = .001). There was also significant difference between White and Hispanic students on the Stories Immediate Recall subtest (*M* difference = 1.699, *p* = .005) and a significant difference between Hispanic and African American students on Dot Location Learning subtest (*M* difference = 1.991, *p* = .012). Although ethnicity significantly impacted student performance statistically, all scores differences were less than one standard deviation with the exception of African American students performing one standard deviation below Caucasian students on Word Pairs Immediate subtest in the PEL group with less than a 12th grade education. Furthermore, significant difference in CMS subtest performance was random and did not consistently affect one particular subtest. Refer to Table 11 on page 51. Overall, student test performance on the CMS subtests was minimally associated with ethnicity.

Research Question #2

Due to the decrease in test performance variance between ethnic groups as PEL increased, a new question was raised - Is PEL a significant factor in predicting student performance on the CMS within individual ethnic groups? It was hypothesized that PEL, regardless of ethnicity, will be a significant factor in predicting student performance on CMS performance. PEL has been found to be highly correlated with test performance on memory and cognitive assessments (Ardila et al., 2005).

Three MANCOVA were conducted to investigate differences in test performance between students of the same ethnicity across PEL. For example, Hispanic student performance was examined across the three PEL to assess the impact of PEL on that particular ethnic group.

The first 2 x 19 MANCOVA was conducted to examine performance differences associated with PEL in Caucasian students. Refer to Table 14. Box's M was not significant at the p <. 01 indicating that the CMS subtests did not differ in their covariance matrices. A significant multivariate effect for PEL, Wilks'Λ = 0.861, F = (38,

1318) 2.701, $p < .001$, was found. According to the eta-square effect size, $\eta^2 = 0.072$, PEL accounted for 7% of the variance in Caucasian student performance on the CMS subtests. Refer to Table 9 on page 47. The Levene statistic was significant at the $p = .05$ for the CMS subtests of Word Pairs Long Delay Memory, Word List Delayed Recognition Memory, and Numbers Backward indicating that the error variance for these three subtests was not equal across PEL groups. Univariate test analyses revealed significant differences at the .01 level on nine subtests: Dot Location Learning, F (2, 677) = 10.819, $p < .001$, Stories Immediate Recall, F (2, 677) = 13.154, $p < .001$, Stories Delayed Recognition, F (2, 677) = 8.485, $p < .001$, Family Pictures Immediate Recall, F (2, 677) = 9.557, $p < .001$, Word Lists Learning, F (2, 677) = 13.795, $p < .001$, Sequences, F (2, 677) = 14.623, $p < .001$, Picture Locations, F (2, 677) = 12.042, $p < .001$, Numbers Forward, F (2, 677) = 11.611, $p < .001$, and Numbers Backward, F (2, 677) = 8.999, $p < .001$.

Table 14

Caucasian Students in PEL Groups

PEL	*N*
< 12th grade	56
High School graduate	211
> 12th grade	417
Total	684

Note. PEL = parent educational level. < 12th grade = parents without a high school diploma; > 12th grade = parents with some college or technical education.

Refer to Table 15 for a summary of statistically significant ANOVAs comparing CMS subtest performance of ethnic groups by PEL. Analysis of variance tables comparing all CMS subtest performance of individual ethnic groups by PEL are in Tables A-10, A-12, and A-14 in the appendix. Although PEL was significantly associated with Caucasian student performance, effect sizes remained in the small range. PEL accounted for 2% to 4% of the variance in subtest scores of Caucasian students.

Pairwise comparisons based on marginal means were conducted to identify which groups of Caucasian students were statistically significant by PEL and by how much. An alpha level of .016 was set to correct for Type I error rate due to multiple comparisons. This analysis revealed that there was a statistically significant difference in student performance associated with PEL on the CMS subtests of Dot Location Learning, Stories Immediate Recall, Stories Delayed Recognition, Family Pictures Immediate Recall, Word Lists Learning, Word List Delayed Recall, Sequencing, Picture Location, Numbers Forward, and Numbers Backward. Refer to Table 16 for a pairwise summary table of all statistically significant CMS subtests by PEL. Pairwise tables examining the association of PEL with CMS subtest performance for each ethnic group can be found in Tables A-11, A-13, and A-15 in the appendix. Caucasian students whose parents obtained a high school diploma performed significantly better than students whose parents did not complete high school on three CMS subtests. Students whose parent had some college or technical school training performed significantly better than students whose parents completed high school on six CMS subtests.

Similarly, African American students whose parents had a high school diploma or college education performed significantly better than African American students whose parents did not complete high school. Refer to Tables 15 and 17. Box's M was not significant at the $p = .001$ indicating that the CMS subtests did not differ in their covariance matrices. A significant multivariate effect was found for PEL, Wilks' Λ = 0.612, $F(38, 268) = 1.959$, p =. 001. According to the eta-square effect size, $\eta^2 = 0.217$, PEL accounted for 22% of the variance in African American student performance on the CMS subtests. Refer to Table 9 on page 47. The Levene statistic was significant at the $p < .05$ for CMS subtests Dot Location Learning, Word Pairs Long Delay, and Sequences indicating that these three subtests have unequal error variance across groups.

Univariate test analyses revealed significant differences at the .05 level on seven subtests: Stories Immediate Memory, F (2, 152) = 5.768, *p* = .004, η^2 = .071, Stories Delayed Recognition, F (2, 152) = 7.186, *p* = .001, η^2 = .086, Word Pairs Learning, F (2, 152) = 4.594, *p* = .012, η^2 = .057, Word Pairs Immediate Recall, F (2, 152) = 11.095, *p* < .001, η^2 = .127, Word Lists Learning, F (2, 152) = 3.619, *p* < .029, η^2 = .045, Sequences F (2, 152) = 3.640, *p* < .029, η^2 = .046, and Numbers Backward, F (2, 152) = 5.304, *p* = .006, η^2 = .065. Refer to Table 15.

Pairwise comparisons based on marginal means were conducted to identify which subtest scores were statistically associated with PEL and by how much. This analysis revealed a significant difference in African American student performance by PEL on the CMS subtests of Stories Immediate Recall, Stories Delayed Recognition, Word Pair Learning, Word Pair Immediate Memory, Word List Learning, Sequences, and Numbers Backward. Refer to Table 16. African American students whose parents completed high school or college performed significantly better than students whose parents did not complete high school.

Table 15

Summary Table of Statistically Significant Univariate ANOVAs Comparing CMS Subtest Performance of Ethnic Groups by PEL

Source	CMS Subtest	*F*	*df*	*p*	η^2
Univariate ANOVA table by					
PEL of African American students	Stories Imm. Mem.	5.768**	2	.004	.071
(n = 161)	Stories Delayed Recog.	7.186**		.001	.086
	Word Pairs Learning	4.594*		.012	.057
	Word Pairs Imm. Mem.	11.095**		.001	.127
	Word Lists Learning	3.619*		.029	.045
	Numbers Backward	5.304**		.006	.064
	Sequences	3.640*		.029	.046
Univariate ANOVA table by					
PEL of Caucasian students	Dot Location Learning	10.819**	2	.001	.031
(n = 684)	Stories Imm. Mem.	13.154**		.001	.037
	Stories Delayed Recog.	8.485**		.001	.024
	FP Imm. Memory	9.557**		.001	.027

Table 15 (continued)

Source	CMS Subtest	*F*	*df*	*p*	η²
	Word Lists Learning	13.795**		.001	.039
	Sequences	14.623**		.001	.041
	Picture Location	12.042**		.001	.034
	Numbers Forward	11.611**		.001	.033
	Numbers Backward	8.999**		.001	.026
Univariate ANOVA table by PEL of					
Hispanic students	Dot Location ST Recall	5.957**	2	.004	.099
(n = 116)	Word Pairs Imm. Mem.	5.499*		.005	.092
	WP Delayed Recog.	3.985*		.021	.068
	Word Lists Learning	3.498*		.034	.060
	WL Delayed Recall	4.415*		.014	.075
	Sequences	7.004**		.001	.114
	Numbers Forward	11.639**		.001	.176

Note. CMS = Children Memory Scale. ANOVA = analysis of variance. PEL = parent educational level. WP = Word Pairs; WL = Word Lists. Mem. = memory; Imm. = immediate; Recog. = recognition; LT = long term; ST = short term. df = degrees of freedom; *F* = Fisher's *F* ratio; *p* = probability; η^2 = eta² = effect size. **p* < .05. **p < .01.

Table 16

Summary Table of Pairwise Comparisons of CMS Subtest Performance by PEL

Variable	African American	Caucasian	Hispanic
Dot Location Learning		0<1, 2**	
Dot Location Short Delay			0<2**
Dot Location Long Delay			
Stories Immediate Recall	0<2**	0, 1<2**	
Stories Delayed Recognition	0<1, 2**	0, 1<2**	
Faces Immediate			
Faces Delayed			
Word Pairs Learning	0<1, 2**		
Word Pairs Immediate	0<1, 2**		0<1*
Word Pairs Long Delay			
Word Pairs Delayed Recognition			0<1*
Family Pictures Immediate		0, 1<2**	
Word Lists Learning	0<2*	0< 1<2**	0<2*
Word Lists Delayed		0<2**	0<2*
Word Lists Delayed Recognition			
Numbers Forward		0, 1<2**	0<1, 2**
Numbers Backward	0<1, 2**	0<2**	
Sequences	0<2*	0, 1<2**	0<2**
Picture Location		0<1, 2**	

Note. CMS = Children's Memory Scale. PEL = parent educational level. 0 = less than a 12th grade education; 1 = a high school graduate; 2 = college or technical school. < 12th = parent did not obtain high school diploma; = 12th = parent obtained high school diploma; > 12th = parents obtaining some college or technical school training to completion of college degrees. *p < .05. **p < .01.

Students of Hispanic origin whose parents had a high school diploma or some college scored significantly higher on the CMS subtests than Hispanic students whose parents had not completed high school. Refer to Table 18. Box's M was significant at the $p < .001$ indicating that the CMS subtests differed in their covariance matrices. A significant multivariate effect was found for PEL, Wilks' $\Lambda = 0.544$, $F (38, 182) = 1.707$, $p = .011$. According to the eta-square effect size, $\eta^2 = 0.263$, PEL accounts for 26% of the variance in Hispanic student performance on the CMS subtests. Refer to Table 9 on page 47. The Levene statistic was significant at the $p < .05$ for CMS subtests Dot Location, Word Pair Long Delay, and Numbers Forward indicating that these three subtests did not have equal error variance between PEL groups. Univariate test analyses revealed significant differences at the .05 level on seven CMS subtests: Dot Location Delayed Memory, $F (2, 109) = 5.957$, $p < .001$, $\eta^2 = 0.099$, Word Pairs Immediate, $F (2, 109) = 5.499$, $p = .005$, $\eta^2 = 0.092$, Word Pairs Delayed Recognition, $F (2, 109) = 3.985$, $p < .021$, $\eta^2 = .068$, Word Lists Learning, $F (2, 109) = 3.498$, $p < .034$, $\eta^2 = .060$, Word Lists Delayed Memory, $F (2, 109) = 4.415$, $p = .014$, $\eta^2 = 0.075$, Sequences, $F (2, 109) = 7.004$, $p = .001$, $\eta^2 = 0.114$, and Numbers Forward, $F (2, 109) = 11.639$, $p < .001$, $\eta^2 = 0.176$. Refer to Table 15 on page 58.

Table 17

African American Students in PEL Groups

PEL	*N*
< 12^{th} grade	33
High School Diploma	69
> 12^{th} grade education	59
Total	161

Note. PEL = parent educational level. < 12^{th} grade = parents did not obtain a high school diploma; > 12^{th} grade = parents with some college or technical education.

Pairwise comparisons based on marginal means were conducted to identify which groups of Hispanic students performed statistically significant when grouped by PEL and by how much. This analysis revealed that there was a significant difference in performance on seven CMS subtests. These included Dot Location Short Delayed, Word Pairs Immediate Recall, Word Pairs Delayed Recognition, Word Lists Learning, Word Lists Delayed, Sequences, and Numbers Forward subtests. Refer to Table 16 on page 61. Hispanic students whose parents completed high school or had some college education performed better than Hispanic students whose parents did not complete high school or were high school graduates.

Table 18

Hispanic Students in PEL Groups

PEL	*N*
< 12th grade Education	50
A High School Diploma	36
> 12th grade Education	30
Total	116

Note. PEL = parent educational level. < 12th grade = parents without a high school diploma; > 12th grade = parents with some college or technical education.

As hypothesized, PEL was significantly associated with student test performance for all ethnic groups. Generally, variance associated with PEL was much higher for African American and Hispanic students than for Caucasian students. Refer to Table 19. Although PEL significantly impacted student performance statistically, all mean score differences were less than one standard deviation for all subtests.

Table 19

Variance in Subtest Performance Associated with PEL

	Caucasian	African American	Hispanic
Variance	7%	22%	26%

Note. PEL = parent educational level. Variance = variance associated with PEL.

Research Question #3

The final research question addressed whether performance on the CMS subtest Family Pictures differed significantly across ethnic groups or as a function of PEL. It was hypothesized that performance on the subtest Family Pictures would not differ significantly across ethnic groups or as a function of PEL if the children in the CMS standardization sample were fully acculturated into U.S. family life and were proficient in English at a basic interpersonal communication skills (BICS) level, since this subtest measures incidental learning and recall on contextualized scenes. Refer to Tables 20 and 21. As hypothesized, performance on the Family Pictures subtest did not vary significantly across ethnic groups or as a function of PEL for the African American or Hispanic students; however, performance varied significantly across PEL for the Caucasian students with a small effect size ($\eta^2 = .027$). Although subtest performance was statistically significant, the mean score difference for Caucasian students was less than one-half SD (*M* score difference = 1.3). These results will be discussed further in Chapter V.

Table 20

Univariate ANOVA Table Comparing CMS Subtest – Family Pictures - by Ethnicity

Dependent Variable – Family Pictures	*F (2,134)*	*p*	η^2
PEL < 12 years (n = 139)	1.622	.201	.024
PEL = 12 years (n = 307)	.689	.503	.005
PEL > 12 years (n = 506)	.212	.809	.001

Note. ANOVA = analysis of variance. CMS = Children's Memory Scale. PEL = parent educational level. *$p < .05$.

Table 21

Univariate ANOVA Table Comparing CMS Subtest – Family Pictures - by PEL

Dependent Variable – Family Pictures	*F (2,134)*	*p*	η^2
African American (n = 161)	2.960	.055	.037
Caucasian (n = 684)	9.557	.01*	.027
Hispanic (n = 116)	.614	.543	.011

Note. ANOVA = analysis of variance. CMS = Children's Memory Scale. PEL = parent educational level. *$p < .05$.

CHAPTER V

SUMMARY AND CONCLUSIONS

The primary goal of a clinician is to accurately assess a child's ability so that appropriate interventions can be designed to facilitate learning. Clearer knowledge of the impact of ethnicity, familial factors, and PEL on test scores facilitates a more accurate diagnosis and precise treatment intervention for the child that acknowledges cultural or linguistic differences. Psychometrically valid instruments are needed to assess memory and learning of all children. Identification of score variance due to ethnic differences and PEL allows for a more culturally valid and reliable assessment. Given the extent to which memory and learning are expected to impact school success, as well as the increasing number of ELLs in U.S. schools, it is important to examine cultural differences on measures used to assess these domains. The purpose of this study was to examine student performance on the CMS by ethnicity and PEL.

As found in numerous previous studies, the results from the present study support a relationship between STM performance and culture. A statistically significant relationship between CMS subtests performance and cultural factors was found. Culture as defined by ethnicity minimally impacted student subtest performance on the CMS when PEL was taken into account. In contrast, PEL was significantly associated with student subtest performance within each ethnic group. Student subtest performance improved with each increase in PEL regardless of ethnicity. CMS subtest performance of Hispanic and African American students was most affected by PEL suggesting that PEL impacts the acculturation process into the educational system of the majority society.

This notion is further supported by the fact that there was no difference in student subtest performance by ethnicity or as a function of PEL for African American and Hispanic students on the Family Pictures subtest, which examines visual and auditory memory processes through recall of everyday life tasks in a meaningful context. A small effect size was found as a function of PEL for Caucasian students. Verbal subtests performance of Hispanic students was not statistically different than African American and Caucasian student CMS verbal subtests suggesting that all students participating in the standardization sample were proficient in English. Although statistical significance was found between subtest performance and cultural factors on various CMS subtests, effect sizes were mainly in the small range. Larger effect sizes were found on verbal subtests (e.g., memorization of word lists) which in previous studies have been found to be most impacted by quality of schooling and lower PELs. Although, statistically significant variance in student test performance was found on various CMS subtests, the variance was not specific to any one subtest and the mean score differences did not exceed one standard deviation with the exception one subtest in the lowest PEL group.

This study adds support to the validity of the CMS as an appropriate comprehensive assessment of memory for children and adolescents living in the United States that are proficient in English at a cognitive academic proficiency skill (CALP) level. Students, regardless of ethnicity, whose parents have not completed high school, could perform slightly lower than their counterparts on subtests requiring verbal serial memory (e.g., Word Pairs and Word Lists). Finally, this study supports the notion that memory performance is influenced by cultural background (e.g., schooling) and PEL. Areas for further study could include an in-depth look at the factors that influence PEL and the influence of reading and instructional methods on STM memory development.

Limitations of the Study

There are some limitations to this study. Due to the continued increase in the number of monolingual Spanish speakers, other ELLs and bilingual students in U.S. schools, studies are needed that investigate the impact of language and acculturation on assessment and learning. In this study, the language spoken in the home was not identified making it impossible to account for possible variance in subtest scores due to bilingualism. There exists the potential impact of factors, such as method and intensity of reading and writing instruction that were not measured or controlled for in this study. In past studies, the method and intensity of reading and writing instruction has been found to be associated with memory development and could have impacted student performance on the CMS. Although a strong association between PEL and memory performance was found in this study, the reasons for this association are unclear. Further research is needed in this area.

Implications for Research and Practice

Memory is essential for language development and academic achievement. Children who exhibit verbal STM and WM deficits are at risk for underdeveloped language, reading difficulties and inadequate school achievement. PEL and cultural background are associated with memory performance. In this study, student test performance improved significantly with each increase in PEL across all three ethnic groups supporting the notion that PEL is a significant factor in assessment performance and possibly academic achievement. The examination of PEL and the factors that influence an individual's pursuit of a college education could shed light on the relationship between standardized memory test scores and PEL. Possible reasons for not pursuing a college education could include but are not limited to personal academic experience and interest, the importance of education, limited financial resources, family traditions, cognitive ability, and the ability to delay reward (Ardila et al., 2005). Also, the investigation of "academic" acculturation through the exploration of parental perceptions of academic learning and their understanding of the skills needed to achieve in school could improve parental support for their child's education and increase student achievement in school. Further investigation of the impact of systematic reading and writing skills on memory development could aid in the development of new interventions for remediation of memory deficits, lags in language development, and learning disabilities.

Verbal serial memory performance is associated with type of instruction, PEL and culture. African American and Hispanic students whose parents had not attended college or technical school scored approximately one half standard deviation below Caucasian students on verbal serial memory and learning tasks (e.g., Word Pairs and Word Lists) on the CMS. One possible explanation for this variance is the lack of importance placed on the memorization of lists of random words within the minority culture. In an effort to diminish this variance, the novel task of non-word repetition and the semantically meaningful task of sentence memory could replace the tasks of associating word pairs and memorizing word lists. The task of non-word repetition requires students to repeat nonwords that are presented to them auditorally (Torgesen, 1999). Generally, the nonwords are constructed of phonemes that are standard within the English language and are presented to the student in order of increasing difficulty. After a given number of errors, the task is halted. Difficulty with the task of nonword repetition is associated with STM deficits and the ability to learn the phonological form of new words (Baddeley, Papagno, & Vallar, 1988). Sentence memory (Woodcock & Johnson, 1989) is a task that requires students to listen to sentences and repeat them verbatim. The sentences increase in length until the student is unable to repeat them verbatim. Difficulty with this task is associated with STM deficits (Hashimoto & Sakai, 2002). These two tasks, along with digit span, have been found, through confirmatory factor analysis, to assess individual differences in verbal STM (Torgesen, 1999). The tasks could be included during the re-norming process of the CMS.

Finally, there is a need for systematic study on the effects of ethnicity, language, and PEL across measures used to assess children in our schools today. Frequently, ELLs or bilingual students are referred for educational and psychological assessment in our schools. Formal English language proficiency testing should be conducted on all referred children who have immigrated to the United States within the last five years or speak a language other than English in the home to determine their level of English proficiency. The language proficiency results should drive the practitioner's choice of measures used to assess the psychological and academic needs of the ELL. Currently, the CMS as well as other frequently used measures of memory, cognitive ability, and academic achievement are not normed on ELLs or bilingual children; therefore, these measures should not be used to assess children who have not attained a cognitive-academic level in English proficiency. Extreme caution should be used when interpreting the results of any ELL or bilingual student's assessment results due to the dynamic implications of acculturation and language on learning and assessment.

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APPENDIX

Table A-1

Intercorrelations between CMS Subtests When PEL < 12 Years (N=139)

Subtests	STYIMSS	DOTTOTSS	WPTOTSS	NUMTOTSS	FPDLSS
STYDLSS	.894				
DOTLRNSS		.923			
WPLRNSS			.967		
NUMFWDSS				.841	
FPIMSS					.796

Note. PEL = parent educational level. CMS = Children's Memory Scale. STYIMSS = Story Immediate Memory scaled score; DOTTOTSS = Dot Location total scaled score; WPTOTSS = Word Pairs Total scaled score; NUMTOTSS = Numbers total scaled score; FPDLSS = Family Pictures Learning scaled score; STYDLSS = Story Delayed Memory scaled score; DOTLRNSS = Dot Location Learning scaled score; WPLRNSS = Word Pairs Learning scaled score; NUMFWDSS = Numbers Forward scaled score; FPIMSS = Family Pictures Immediate Memory scaled score.

Table A-2

Intercorrelations between CMS Subtests When PEL = 12 Years (N=307)

Subtests	STYIMSS	DOTTOTSS	WPTOTSS	NUMTOTSS	FPSLSS
STYDLSS	.899				
DOTLRNSS		.925			
WPLRNSS			.957		
NUMFWDSS				.832	
FPIMSS					.835

Note. PEL = parent educational level. CMS = Children's Memory Scale. STYIMSS = Story Immediate Memory scaled score; DOTTOTSS = Dot Location total scaled score; WPTOTSS = Word Pairs total scaled score; NUMTOTSS = Numbers total scaled score; FPDLSS = Family Pictures Learning scaled score; STYDLSS = Story Delayed Memory scaled score; DOTLRNSS = Dot Location Learning scored score; WPLRNSS = Word Pairs Learning scaled score; NUMFWDSS = Numbers Forward scaled score; FPIMSS = Family Pictures Immediate Memory scaled score.

Table A-3

Intercorrelations between CMS Subtests When PEL > 12 Years (N=506)

Subtests	STYIMSS	DOTTOTSS	WPTOTSS	NUMTOTS	FPSLSS
STYDLSS	.850				
DOTLRNSS		.900			
WPLRNSS			.949		
NUMFWDSS				.825	
FPIMSS					.814

Note. PEL = parent educational level. CMS = Children's Memory Scale. STYIMSS = Story Immediate Memory scaled score; DOTTOTSS = Dot Location total scaled score; WPTOTSS = Word Pairs total scaled score; NUMTOTSS = Numbers total scaled score; FPDLSS = Family Pictures Learning scaled score; STYDLSS = Story Delayed Memory scaled score; DOTLRNSS = Dot Location Learning scored score; WPLRNSS = Word Pairs Learning scaled score; NUMFWDSS = Numbers Forward scaled score; FPIMSS = Family Pictures Immediate Memory scaled score.

Table A-4

Univariate ANOVA Table Comparing CMS Subtests by Ethnicity When PEL < 12 Years (n = 139)

Dependent Variable	*F (2,134)*	*p*	η^2	β
Dot Location Learning	.776	.462	.011	.061
Dot Location Short Term Memory	.422	.657	.006	.034
Dot Location Long Term Delayed Memory	3.115	.048	.044	.347
Stories Immediate Memory	3.788	.025	.054	.440
Stories Delayed Recognition	3.723	.027	.053	.431
Faces Immediate Memory	4.069	.019	.057	.478
Faces Delayed Memory	2.755	.067	.039	.297
Word Pairs Learning	6.806	.002	.092	.772
Word Pairs Immediate Memory	11.951	.001*	.151	.971
Word Pairs Long Delayed Memory	1.228	.296	.018	.104
Word Pairs Delayed Recognition	.546	.581	.008	.042
Family Pictures Immediate Memory	1.622	.201	.024	.148
Word Lists Learning	.619	.540	.009	.048
Word Lists Delayed Memory	.033	.968	.000	.011
Word Lists Delayed Recognition	.335	.716	.005	.028
Sequences	1.693	.188	.025	.157
Picture Location	1.051	.353	.015	.086
Numbers Forward	2.491	.087	.036	.260
Numbers Backward	2.664	.073	.038	.284

Note. ANOVA = analysis of variance. CMS = Children's Memory Scale. PEL = parent educational level. *$p < .01$.

Table A-5

Univariate ANOVA Table Comparing CMS Subtests by Ethnicity When PEL = 12

(n = 307)

Dependent Variable	*F (2, 303)*	*p*	η²	β
Dot Location Learning	1.883	.154	.012	.185
Dot Location Short Term Memory	1.899	.151	.012	.187
Dot Location Long Term Delayed Memory	1.031	.358	.007	.086
Stories Immediate Recall	4.228	.015	.027	.509
Stories Delayed Recognition	2.431	.090	.016	.258
Faces Immediate Memory	1.223	.296	.008	.106
Faces Delayed Memory	.641	.528	.004	.051
Word Pairs Learning	2.468	.086	.016	.264
Word Pairs Immediate Memory	3.899	.021	.025	.465
Word Pairs Long Delayed Memory	.272	.762	.002	.024
Word Pairs Delayed Recognition	2.588	.077	.017	.280
Family Pictures Immediate Memory	.689	.503	.005	.055
Word Lists Learning	4.804	.009*	.031	.582
Word Lists Delayed Memory	3.566	.029	.023	.419
Word Lists Delayed Recognition	8.783	.001*	.055	.897
Sequences	1.452	.236	.009	.132
Picture Location	1.197	.303	.008	.103
Numbers Forward	.870	.420	.006	.071
Numbers Backward	.974	.379	.006	.080

Note. ANOVA = analysis of variance. CMS = Children's Memory Scale. PEL = parent educational level. *$p < .01$.

Table A-6

Univariate ANOVA Table Comparing CMS Subtests by Ethnicity When PEL > 12

(n = 506)

Dependent Variable	F (2, 501)	*p*	η^2	β
Dot Location Learning	1.883	.153	.007	.186
Dot Location Short Term Memory	2.908	.055	.011	.328
Dot Location Long Term Delayed Memory	10.427	.001*	.040	.950
Stories Immediate Memory	11.115	.000*	.042	.963
Stories Delayed Recognition	1.893	.152	.008	.187
Faces Immediate Memory	1.525	.219	.006	.141
Faces Delayed Memory	.100	.905	.000	.015
Word Pairs Learning	4.723	.001*	.019	.576
Word Pairs Immediate Memory	1.445	.237	.006	.132
Word Pairs Long Delayed Memory	1.742	.176	.007	.168
Word Pairs Delayed Recognition	3.739	.024	.015	.446
Family Pictures Immediate Memory	.212	.809	.001	.021
Word Lists Learning	4.263	.015	.017	.517
Word Lists Delayed Memory	4.819	.008*	.019	.588
Word Lists Delayed Recognition	3.141	.044	.012	.362
Sequences	7.146	.001*	.028	.810
Picture Location	2.975	.052	.012	.338
Numbers Forward	.420	.657	.002	.034
Numbers Backward	2.458	.087	.010	.264

Note. ANOVA = analysis of variance. CMS = Children's Memory Scale. PEL = parent educational level. *$p < .01$.

Table A-7

Pairwise Comparisons of CMS Subtests by Ethnicity When PEL < 12 (n = 139)

Dependent Variable	Ethnicity	*M* Diff.	*p*
Dot Location Learning	C>AA	.591	1.000
	C<H	.684	.828
	AA<H	.743	.907
Dot Location Short Term Memory	C>AA	.452	1.000
	C>H	.541	1.000
	AA>H	.086	1.000
Dot Location Long Term Delayed	C>AA	1.254	.154
	C<H	.328	1.000
	AA<H	.654	.051
Stories Immediate Memory	C>AA	1.712	.024
	C>H	.928	.313
	AA<H	.785	.693
Stories Delayed Recognition	C>AA	1.745	.022
	C>H	.573	.955
	AA<H	1.172	.230
Faces Immediate Memory	C>AA	1.208	.197
	C<H	.695	.702
	AA<H	1.903	.020
Faces Delayed Memory	C>AA	.694	.897
	C<H	.878	.426
	AA<H	1.572	.069

Table A-7 (continued)

Dependent Variable	Ethnicity	*M* Diff.	*p*
Word Pairs Learning	C>AA	2.268	.001*
	C>H	1.221	.093
	AA<H	1.047	.319
Word Pairs Immediate Memory	C>AA	3.069	.001*
	C>H	1.271	.076
	AA<H	1.798	.018
Word Pairs Long Delayed Memory	C>AA	1.138	.403
	C>H	.160	1.000
	AA<H	.978	.627
Word Pairs Delayed Recognition	C>AA	.695	.928
	C>H	.382	1.000
	AA<H	.313	1.000
Family Pictures Immediate Memory	C>AA	.148	1.000
	C<H	.914	.383
	AA<H	.685	.371
Word Lists Learning	C>AA	.650	1.000
	C<H	.110	1.000
	AA<H	.760	.880
Word Lists Delayed Memory	C<AA	.131	1.000
	C>H	.045	1.000
	AA>H	.176	1.000

Table A-7 (continued)

Dependent Variable	Ethnicity	*M* Diff.	*p*
Word Lists Delayed Recognition	C>AA	.308	1.000
	AA>H	.194	1.000
Sequences	C>AA	.909	.487
	C>H	.963	.294
	AA>H	.053	1.000
Numbers Forward	C<AA	.369	1.000
	C>H	1.119	.244
	AA>H	1.488	.132
Numbers Backward	C>AA	1.194	.115
	C<H	.053	1.000
	AA<H	1.200	.217

Note. CMS=Children's Memory Scale. AA=African American; C=Caucasian; H=Hispanic. *M* Diff. = mean difference in test scores. PEL = parent educational level. $*p < .01$.

Table A-8

Pairwise Comparisons of CMS Subtests by Ethnicity When PEL = 12 (n = 307)

Dependent Variable	Ethnicity	*M* Diff.	*p*
Dot Location Learning	C>AA	.836	.204
	C<H	.175	1.000
	AA<H	1.011	.414
Dot Location Short Term Memory	C>AA	.786	.178
	C<H	.060	1.000
	AA<H	.847	.516
Dot Location Long Term Delayed	C>AA	.596	.482
	C<H	.013	1.000
	AA<H	.609	1.000
Stories Immediate Memory	C>AA	.916	.102
	C>H	1.306	.061
	AA>H	.390	1.000
Stories Delayed Recognition	C>AA	.406	1.000
	C>H	1.195	.101
	AA>H	.789	.659
Faces Immediate Memory	C>AA	.389	1.000
	C<H	.586	.857
	AA<H	.975	.362
Faces Delayed Memory	C>AA	.131	1.000
	C<H	.555	.936
	AA<H	.686	.824

Table A-8 (continued)

Dependent Variable	Ethnicity	*M* Diff.	*p*
Word Pairs Learning	C>AA	.931	.101
	C<H	.123	1.000
	AA<H	1.054	.317
Word Pairs Immediate Memory	C>AA	.699	.341
	C<H	1.128	.150
	AA<H	1.827	.017
Word Pairs Long Delayed Memory	C<AA	.057	1.000
	C>H	.381	1.000
	AA>H	.438	1.000
Word Pairs Delayed Recognition	C>AA	.514	.748
	C<H	.994	.262
	AA<H	1.508	.071
Family Pictures Immediate Memory	C>AA	.091	1.000
	C<H	.591	.824
	AA<H	.682	.812
Word Lists Learning	C>AA	1.297	.007*
	C>H	.490	1.000
	AA<H	.806	.598
Word Lists Delayed Memory	C>AA	1.147	.024
	C>H	.379	1.000
	AA<H	.768	.695

Table A-8 (continued)

Dependent Variable	Ethnicity	*M* Diff.	*p*
Word Lists Delayed Recognition	C>AA	1.620	.001*
	C>H	1.261	.065
	AA<H	.359	1.000
Sequences	C>AA	.589	.475
	C>H	.648	.700
	AA>H	.058	1.000
Numbers Forward	C<AA	.522	.576
	C<H	.037	1.000
	AA>H	.485	1.000
Numbers Backward	C>AA	.545	.527
	C<H	.037	1.000
	AA<H	.582	.994

Note. CMS = Children's Memory Scale. AA = African American; C = Caucasian; H = Hispanic. *M* Diff.= mean difference in test scores. PEL = parent educational level. *$p < .01$.

Table A-9

Pairwise Comparisons of CMS Subtests by Ethnicity When PEL > 12 (n=506)

Dependent Variable	Ethnicity	*M* Diff.	*p*
Dot Location Learning	C>AA	.752	.162
	C<H	.039	1.000
	AA<H	.791	.615
Dot Location Short Term Memory	C>AA	.636	.401
	C<H	.993	.246
	AA<H	1.628	.050
Dot Location Long Term Delayed	C>AA	1.821	.001*
	C<H	.392	1.000
	AA<H	2.213	.002*
Stories Immediate Memory	C>AA	1.519	.001*
	C>H	1.699	.005*
	AA>H	.181	1.000
Stories Delayed Recognition	C>AA	.614	.371
	C>H	.683	.611
	AA>H	.068	1.000
Faces Immediate Memory	C>AA	.430	.941
	C<H	.760	.560
	AA<H	1.190	.246
Faces Delayed Memory	C<AA	.186	1.000
	C>H	.061	1.000
	AA>H	.247	1.000

Table A-9 (continued)

Dependent Variable	Ethnicity	*M* Diff.	*p*
Word Pairs Learning	C>AA	1.290	.007*
	C>H	.403	1.000
	AA<H	.888	.568
Word Pairs Immediate Memory	C>AA	.681	.258
	C>H	.023	1.000
	AA<H	.658	.897
Word Pairs Long Delayed Memory	C>AA	.698	.199
	C<H	.091	1.000
	AA<H	.790	.582
Word Pairs Delayed Recognition	C>AA	1.152	.018
	C>H	.027	1.000
	AA<H	1.125	.279
Family Pictures Immediate Memory	C>AA	.154	1.000
	C<H	.270	1.000
	AA<H	.424	1.000
Word Lists Learning	C>AA	1.129	.014
	C<H	.283	1.000
	AA<H	1.412	.081
Word Lists Delayed Memory	C>AA	1.089	.034
	C<H	.902	.357
	AA<H	1.991	.012

Table A-9 (continued)

Dependent Variable	Ethnicity	*M* Diff.	*p*
Word Lists Delayed Recognition	C>AA	.995	.041
	C<H	.152	1.000
	AA<H	1.147	.227
Sequences	C>AA	1.492	.001*
	C>H	.520	.995
	AA<H	.972	.381
Numbers Forward	C>AA	.377	1.000
	C>H	.051	1.000
	AA<H	.326	1.000
Numbers Backward	C>AA	.770	.243
	C>H	.949	.331
	AA>H	.179	1.000

Note. CMS = Children's Memory Scale. AA = African American; C = Caucasian; H = Hispanic. *M* Diff. = mean difference in test scores. PEL = parent educational level. $*p < .01$.

Table A-10

Univariate ANOVA Table of CMS Subtests Comparing African American Students Across PEL (n = 161)

Dependent Variable	F (2, 152)	*p*	η^2	β
Dot Location Learning	1.314	.272	.017	.114
Dot Location Short Term Memory	.496	.610	.006	.039
Dot Location Long Term Delayed Memory	2.185	.116	.028	.220
Stories Immediate Memory	5.768	.004*	.071	.681
Stories Delayed Recognition	7.186	.001*	.086	.802
Faces Immediate Memory	1.149	.320	.015	.096
Faces Delayed Memory	1.955	.145	.025	.190
Word Pairs Learning	4.594	.012*	.057	.548
Word Pairs Immediate Memory	11.095	.001*	.127	.959
Word Pairs Long Delayed Memory	2.862	.060	.036	.313
Word Pairs Delayed Recognition	.769	.465	.010	.060
Family Pictures Immediate Memory	2.960	.055	.037	.327
Word Lists Learning	3.619	.029*	.045	.419
Word Lists Delayed Memory	.019	.981	.000	.011
Word Lists Delayed Recognition	.542	.583	.007	.042
Sequences	3.640	.029*	.046	.422
Picture Location	1.976	.142	.025	.193
Numbers Forward	1.775	.173	.023	.168
Numbers Backward	5.304	.006*	.064	.632

Note. ANOVA = analysis of variance. CMS = Children's Memory Scale. PEL = parent educational level. *$p < .05$.

Table A-11

Pairwise Comparisons of CMS Subtests Comparing African American Students Across PEL (n = 161)

Dependent Variable	PEL	*M* Diff.	*p*
Dot Location Learning	0 < 1	.530	1.000
	0 < 2	1.122	.346
	1 < 2	.592	.943
Dot Location Short Term Memory	0 < 1	.567	1.000
	0 < 2	.621	1.000
	1 < 2	.547	1.000
Dot Location Long Term Delayed Memory	0 < 1	1.162	.250
	0 < 2	.173	1.000
	1 < 2	.989	.248
Stories Immediate Memory	0 < 1	1.756	.018*
	0 < 2	2.117	.004*
	1 < 2	.361	1.000
Stories Delayed Recognition	0 < 1	2.047	.011*
	0 < 2	2.639	.001*
	1 < 2	.592	.943
Faces Immediate Memory	0 < 1	.986	.525
	0 < 2	1.031	.500
	1 < 2	.455	1.000

Table A-11 (continued)

Dependent Variable	PEL	*M* Diff.	*p*
Faces Delayed Memory	0 < 1	.877	.497
	0 < 2	1.274	.151
	1 < 2	.397	1.000
Word Pairs Learning	0 < 1	1.503	.046*
	0 < 2	1.852	.011*
	1 < 2	.349	1.000
Word Pairs Immediate Memory	0 < 1	2.221	.001*
	0 < 2	2.844	.001*
	1 < 2	.622	.672
Word Pairs Long Delayed Memory	0 < 1	1.480	.062
	0 < 2	1.233	.178
	1 < 2	.247	1.000
Word Pairs Delayed Recognition	0 < 1	.698	.718
	0 < 2	.639	.881
	1 < 2	.590	1.000
Family Pictures Immediate Memory	0 < 1	.646	.928
	0 < 2	1.522	.061
	1 < 2	.876	.317
Word Lists Learning	0 < 1	.633	.833
	0 < 2	1.537	.033*
	1 < 2	.904	.207

Table A-11 (continued)

Dependent Variable	PEL	*M* Diff.	*p*
Word Lists Delayed Memory	0 < 1	.349	1.000
	0 < 2	.716	1.000
	1 < 2	.107	1.000
Word Lists Delayed Recognition	0 < 1	.321	1.000
	0 < 2	.056	1.000
	1 < 2	.578	.904
Sequences	0 < 1	1.359	.060
	0 < 2	1.502	.037*
	1 < 2	.143	1.000
Picture Location	0 < 1	1.079	.347
	0 < 2	1.358	.162
	1 < 2	.280	1.000
Numbers Forward	0 < 1	1.118	.207
	0 < 2	.956	.387
	1 < 2	.162	1.000
Numbers Backward	0 < 1	1.664	.034*
	0 < 2	2.119	.005*
	1 < 2	.455	1.000

Note. PEL = parent educational level. CMS = Children's Memory Scale. *M* Diff. = mean difference in scores. *$p < .05$.

Table A-12

Univariate ANOVA Table of CMS Subtests Comparing Caucasian Students Across PEL (n = 684)

Dependent Variable	F (2, 677)	*p*	η^2	β
Dot Location Learning	10.819	.001*	.031	.959
Dot Location Short Term Memory	2.314	.100	.007	.245
Dot Location Long Term Delayed Memory	1.495	.225	.004	.138
Stories Immediate Memory	13.154	.001*	.037	.986
Stories Delayed Recognition	8.485	.001*	.024	.888
Faces Immediate Memory	.268	.765	.001	.024
Faces Delayed Memory	.500	.607	.001	.040
Word Pairs Learning	4.214	.015	.012	.512
Word Pairs Immediate Memory	2.316	.099	.007	.245
Word Pairs Long Delayed Memory	3.901	.021	.011	.470
Word Pairs Delayed Recognition	3.177	.042	.009	.368
Family Pictures Immediate Memory	9.557	.001*	.027	.928
Word Lists Learning	13.795	.001*	.039	.990
Word Lists Delayed Memory	4.066	.018	.012	.492
Word Lists Delayed Recognition	3.305	.037	.010	.386
Sequences	14.623	.001*	.041	.993
Picture Location	12.042	.001*	.034	.976
Numbers Forward	11.611	.001*	.033	.971
Numbers Backward	8.999	.001*	.026	.909

Note. ANOVA = analysis of variance. CMS = Children's Memory Scale. PEL = parent educational level. *$p < .01$.

Table A-13

Pairwise Comparisons of CMS Subtests by PEL of Caucasian Students (n = 684)

Dependent Variable	PEL			*M* Diff.	*p*
Dot Location Learning	0	<	1	1.331	.007*
	0	<	2	1.849	.001*
	1	<	2	.518	.107
Dot Location Short Term Memory	0	<	1	.952	.109
	0	<	2	.865	.133
	1	>	2	.869	1.000
Dot Location Long Term Delayed	0	<	1	.498	.765
	0	<	2	.690	.287
	1	<	2	.192	1.000
Stories Immediate Recall	0	<	1	.918	.109
	0	<	2	1.795	.001*
	1	<	2	.877	.001*
Stories Delayed Recognition	0	<	1	.693	.299
	0	<	2	1.374	.002*
	1	<	2	.682	.012
Faces Immediate Memory	0	<	1	.143	1.000
	0	<	2	.266	1.000
	1	<	2	.124	1.000
Faces Delayed Memory	0	<	1	.299	1.000
	0	<	2	.426	1.000
	1	<	2	.128	1.000

Table A-13 (continued)

Dependent Variable	PEL	*M* Diff.	*p*
Word Pairs Learning	0 < 1	.122	1.000
	0 < 2	.778	.206
	1 < 2	.656	.031
Word Pairs Immediate Memory	0 < 1	.183	1.000
	0 < 2	.340	1.000
	1 < 2	.523	.105
Word Pairs Long Delayed Memory	0 < 1	.317	1.000
	0 < 2	.859	.108
	1 < 2	.543	.080
Word Pairs Delayed Recognition	0 < 1	.489	.888
	0 < 2	.945	.098
	1 < 2	.457	.251
Family Pictures Immediate Recall	0 < 1	.531	.658
	0 < 2	1.365	.003*
	1 < 2	.834	.002*
Word Lists Learning	0 < 1	1.309	.008*
	0 < 2	2.015	.001*
	1 < 2	.705	.013
Word Lists Delayed Memory	0 < 1	1.209	.026
	0 < 2	1.216	.016
	1 < 2	.656	.911

Table A-13 (continued)

Dependent Variable	PEL	M Diff.	p
Sequences	0 < 1	1.018	.063
	0 < 2	1.927	.001*
	1 < 2	.909	.001*
Picture Location	0 < 1	1.357	.006*
	0 < 2	1.938	.001*
	1 < 2	.580	.057
Word Lists Delayed Recognition	0 < 1	1.007	.057
	0 < 2	1.028	.034
	1 < 2	.206	1.000
Numbers Forward	0 < 1	1.017	.063
	0 < 2	1.772	.001*
	1 < 2	.755	.007*
Numbers Backward	0 < 1	.983	.083
	0 < 2	1.618	.001*
	1 < 2	.635	.035

Note. CMS = Children's Memory Scale. M Diff. = mean difference in scores. PEL = parent educational level. *$p < .01$.

Table A-14

Univariate ANOVA Table of CMS Subtests Comparing Hispanic Students Across PEL (n = 116)

Dependent Variable	F (2, 109)	*p*	η²	β
Dot Location Learning	1.099	.337	.020	.090
Dot Location Short Term Recall	5.957	.004*	.099	.692
Dot Location Long Term Delayed	.509	.602	.009	.040
Stories Immediate Recall	1.172	.313	.021	.097
Stories Delayed Recognition	1.536	.220	.027	.137
Faces Immediate Recall	.160	.853	.003	.018
Faces Delayed Memory	.461	.632	.008	.036
Word Pairs Learning	2.900	.059	.051	.314
Word Pairs Immediate Recall	5.499	.005*	.092	.646
Word Pairs Long Delayed Memory	1.270	.285	.023	.107
Word Pairs Delayed Recognition	3.985	.021*	.068	.462
Family Pictures Immediate Recall	.614	.543	.011	.047
Word Lists Learning	3.498	.034*	.060	.396
Word Lists Delayed Recall	4.415	.014*	.075	.518
Word Lists Delayed Recognition	2.481	.088	.044	.256
Sequences	7.004	.001*	.114	.783
Picture Location	2.260	.109	.040	.227
Numbers Forward	11.639	.001*	.176	.966
Numbers Backward	1.363	.260	.024	.117

Note. ANOVA = analysis of variance. CMS = Children's Memory Scale. PEL = parent educational level. $*p < .05$.

Table A-15

Pairwise Comparisons of CMS Subtests by PEL of Hispanic Students (n = 116)

Dependent Variable	PEL	*M* Diff.	*p*
Dot Location Learning	0 < 1	.725	.886
	0 < 2	.994	.514
	1 < 2	.268	1.000
Dot Location Short Term Memory	0 < 1	1.472	.088
	0 < 2	2.313	.004*
	1 < 2	.841	.794
Dot Location Long Term Delayed Memory	0 < 1	.147	1.000
	0 < 2	.665	.968
	1 < 2	.518	1.000
Stories Immediate Memory	0 < 1	.556	1.000
	0 < 2	1.016	.406
	1 < 2	.460	1.000
Stories Delayed Recognition	0 < 1	.167	1.000
	0 < 2	1.162	.326
	1 < 2	1.146	.422
Faces Immediate Memory	0 < 1	.829	1.000
	0 < 2	.348	1.000
	1 < 2	.265	1.000
Faces Delayed Memory	0 < 1	.342	1.000
	0 < 2	.560	1.000
	1 < 2	.557	1.000

Table A-15 (continued)

Dependent Variable	PEL	*M* Diff.	*p*
Word Pairs Learning	0 < 1	1.462	.134
	0 < 2	1.502	.146
	1 < 2	.399	1.000
Word Pairs Immediate Memory	0 < 1	2.158	.005*
	0 < 2	1.399	.145
	1 < 2	.760	.946
Word Pairs Long Delayed Memory	0 < 1	.608	1.000
	0 < 2	1.078	.413
	1 < 2	1.017	.575
Word Pairs Delayed Recognition	0 < 1	1.792	.020*
	0 < 2	1.123	.305
	1 < 2	.670	1.000
Family Pictures Immediate Memory	0 < 1	.273	1.000
	0 < 2	.813	.812
	1 < 2	.540	1.000
Word Lists Learning	0 < 1	.614	1.000
	0 < 2	2.041	.029*
	1 < 2	1.427	.268
Word Lists Delayed Memory	0 < 1	.898	.599
	0 < 2	2.162	.011*
	1 < 2	1.264	.327

Table A-15 (continued)

Dependent Variable	PEL	*M* Diff.	*p*
Word Lists Delayed Recognition	0 < 1	.240	1.000
	0 < 2	1.644	.101
	1 < 2	1.404	.270
Sequences	0 < 1	1.305	.103
	0 < 2	2.340	.001*
	1 < 2	1.035	.402
Picture Location	0 < 1	.513	1.000
	0 < 2	1.355	.107
	1 < 2	.841	.665
Numbers Forward	0 < 1	2.113	.002*
	0 < 2	2.819	.001*
	1 < 2	.706	.907
Numbers Backward	0 < 1	1.022	.327
	0 < 2	.632	1.000
	1 < 2	.390	1.000

Note. CMS = Children's Memory Scale. *M* Diff. = mean difference in scores. PEL = parent educational level. *$p < .05$.

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PUBLICATIONS AND PRESENTATIONS

Cash, D. L., Gsanger, K., & Hasbrouck, J. E. (April 2003). *Effective reading programs for limited English proficient students.* Poster presented at the meeting of the National Association of School Psychologists, Toronto, Canada.