2013

Processes Underlying Syntactic Control: Evaluating Linguistically Diverse Children

Vanessa R. Raschke
Loyola University Chicago

LOYOLA UNIVERSITY CHICAGO

PROCESSES UNDERLYING SYNTACTIC CONTROL: EVALUATING LINGUISTICALLY DIVERSE CHILDREN

A DISSERTATION SUBMITTED TO

THE FACULTY OF THE GRADUATE SCHOOL

IN CANDIDACY FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

PROGRAM IN DEVELOPMENTAL PSYCHOLOGY

BY

VANESSA R. RASCHKE

CHICAGO, IL

MAY 2013

ACKNOWLEDGMENTS

I would like to thank all the schools and organizations for their participation and assistance in this project. Without the cooperation of the teachers and principals, this project would not have been possible. I would also like to thank Sandra Vanegas and Ramsha Khan for their efforts in translation and development of the Spanish portions of this study. Also, a special thanks to my committee members, Drs. Denise Davidson, Kathleen Kannass, Christine Li-Grining, and Dina Birman for their extremely thoughtful comments and feedback throughout the dissertation process. I would also like to thank Dr. Grayson Holmbeck for his statistical expertise and assistance. And last, but certainly not least, these efforts would not have been possible without the support (and data management skills) of my wonderful fiancé, Stephen Rainey.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

The current study focused on the mechanisms involved in syntactic awareness development in monolingual and bilingual (English/Spanish-speaking) nine-year-olds. Inclusion of child language brokers (those who translate and interpret for non-English speaking family members) diversified the definition of "bilingual." Previous research has shown bilingual advantages in areas of metalinguistic awareness and executive function (e.g., Bialystok, 2010; Davidson, Raschke, & Pervez, 2010), however, child language brokers have not been distinguished in these studies. These children, due to early language-switching and translation duties, may have differential development of areas of inhibition, cognitive flexibility, and working memory, areas suspected to aid in metalinguistic awareness development. The language brokers, at higher levels of vocabulary knowledge, were more efficient on the syntactic awareness task. No differences were found in inhibitory control or working memory, however, significant advantages were found for the brokers over both the non-brokers and the monolinguals on the test of cognitive flexibility. When examining the linkages between executive function performance and syntactic awareness, linkages were found only in the area of cognitive flexibility for the bilinguals, and this linkage was particularly strong for the language brokers. The consistent use and practice of the cognitive flexibility system may further transform and improve the efficiency of these control processes.

CHAPTER ONE

INTRODUCTION

Based on the premise that attending to two linguistic systems accelerates the development of metalinguistic awareness as well as executive functions (Bialystok, 1986; Bialystok, 1988; Bialystok & Majumder, 1998, Costa et al., 2008; Davidson et al., 2010; Green, 1998), the present research further investigated the cognitive development of English/Spanish-speaking children, particularly those with translation experience. Essentially, children who attend to multiple linguistic systems on a daily basis may be developing a greater level of metalinguistic awareness (i.e., the ability to reflect upon and manipulate various components of one's language system) than monolingual peers. Several studies have provided support for the assertion that preliterate bilingual children outperform monolingual children on tasks measuring levels of metalinguistic awareness (e.g., Bialystok, 1986; 1988; Bialystok & Majumder, 1998; Bruck & Genesee, 1995; Cromdal, 1999; Davidson et al., 2010; Mumtaz & Humphreys, 2001; Rubin & Turner, 1989; Yelland, Pollard, & Mercuri, 1993), although much less work has examined this development through childhood and adolescence (e.g., Bialystok, 1986; Bialystok & Barac, 2012).

According to research examining the processes involved in solving a metalinguistic awareness task, bilingual advantages in metalinguistic awareness have been more consistently found in tasks concentrating demands on attentional control

(e.g., Bialystok, 1992; 2001). These children are not necessarily more intelligent, but are more easily able to control their attention to important components of the task at hand. To aid in allocating the attentional resources necessary for solving a metalinguistic task, executive functions are typically found to develop earlier in bilinguals. Executive functions comprise the higher-level cognitive processes responsible for decision-making, ignoring conflicting information, and controlling prepotent responses (Mazuka, Jincho, & Oishi, 2009; Séguin & Zelazo, 2005; Weyandt, 2005; Zelazo & Müller, 2002). The continual need to switch between multiple language systems and monitor the context to filter out other language distractions enhances executive functions, creating a bidirectional relationship with metalinguistic awareness (e.g., Bialystok, Craik, & Ryan, 2006; Costa, Hernández, & Sebastián-Gallés, 2008; Malakoff & Hakuta, 1991). In particular, bilingual children may be more adequately filtering information to appropriate neural systems, while ignoring irrelevant information that would be detrimental to performance (e.g., Bialystok, 2007; Galambos & Hakuta, 1988).

Numerous past research has found bilingual children to outperform monolingual counterparts on non-linguistic tasks requiring enhanced levels of executive control, suggesting that executive functions tend to develop more rapidly in bilingual children (e.g., Bialystok, 2001; Bialystok & Shapero, 2005; Bialystok & Viswanathan, 2009; Bialystok et al., 2006; Carlson & Meltzoff, 2008; Costa et al., 2008; Mezzacappa, 2004). Although some studies have found performance to be at comparable levels between bilinguals and monolinguals, reaction time measurements are typically more rapid for the bilinguals (e.g., Bialystok, Craik, Klein, & Viswanathan, 2004; Bialystok, Craik, & Luk,

2008a; Costa et al., 2008; Martin-Rhee & Bialystok, 2008). To build upon this work, language brokers were included in this study. These children may be developing an even deeper level of metalinguistic awareness than bilingual non-brokers and monolingual peers due to the metalinguistic demands of translating tasks and continual dual language exposure that these experiences provide (Malakoff & Hakuta, 1991). However, no assessments of executive functioning have been completed with bilingual child language brokers (i.e., those interpreting for their families) in comparison to non-brokering peers. Out of necessity, child language brokers must translate for their non-English speaking families, extended families, and neighbors.

To address the differential cognitive development that this type of linguistic experience may create, children's language brokering duties were assessed in the present study using a questionnaire and a profile of their linguistic environment was created through parental responses to a survey. To assess children's initial language proficiency scores, the children were directly evaluated through vocabulary and reading fluency tests. The children were then tested on a timed measure of syntactic awareness, a new method created for this study that allowed for a measurement of processing speed differences. To examine linkages between executive functions and metalinguistic awareness, the current study also measured children's executive functioning in the foundational areas of executive function: inhibitory control, cognitive flexibility, and working memory (Miyake, Friedman, Emerson, Witzki, & Howerter, 2000; Miyake & Friedman, 2012).

The Development of Metalinguistic Awareness

Metalinguistic awareness is the ability to think about language and consciously manipulate the structural features of a language system (Demont & Gombert, 1996). Beginning with rudimentary skills in preschool years and continually developing throughout adolescence, metalinguistic awareness creates the necessary foundation for fluent reading, writing, and speaking skills (see Castles & Coltheart, 2004; Ehri, Nunes, Stahl, & Willows, 2001; Goswami & Bryant, 1990; Roth, Speece, Cooper, & De La Paz, 1996 for reviews). This type of awareness, which goes beyond simple linguistic knowledge, involves one's aptitude in attending to different aspects of linguistic structure, while creatively reflecting upon and reorganizing these properties (e.g., Bialystok, 1991; Bowey & Patel, 1988; Galambos & Hakuta, 1988; Malakoff & Hakuta, 1991; Tunmer & Herriman, 1984). Metalinguistic awareness begins with rudimentary skills in print and word awareness in the preschool years, eventually leading to the development of phonological awareness and syntactic awareness in the late preschool and early school years (Bialystok, 2001; Bialystok, Shenfield, & Codd, 2000). These developments establish the decoding and comprehension skills necessary to aid in solving linguistic problems (Tunmer & Herriman, 1984).

Although it seems logical that children would acquire language at the same time as the knowledge of language, this is not the case (Saywitz & Cherry-Wilkinson, 1982). A developmental progression occurs through which particular levels of metalinguistic awareness are mastered, and it is not until around seven or eight years of age that applicable metalinguistic knowledge appears and children can consciously manipulate

these structures (Edwards & Kirkpatrick, 1999). These developments also aid in the acquisition of literacy skills, in which a continual reinforcement occurs (Bialystok, 2001). In fact, research has brought to light linkages between metalinguistic abilities (i.e., print and word awareness, phonological awareness, and syntactic awareness) and reading proficiency, writing skills, study skills, and note-taking abilities (e.g., Brady & Shankweiler, 1991; Brown, 1980; Cain, 2007; Downing & Valtin, 1984; Forrest-Pressley & Waller, 1984; Garton & Pratt, 1989; Goswami & Bryant, 1990; Kuo & Anderson, 2006; Lefrançois & Armand, 2003; Muter, Hulme, Snowling, & Taylor, 1997; Plaza & Cohen, 2003; Wagner & Torgesen, 1987).

In accordance with Gombert (1992), four stages occur in children's development of metalinguistic awareness, beginning with the acquisition of early linguistic skills. In this stage, surfacing in the earliest years of life, linguistic skills are constructed upon an adult model in which minimal reflection is required to function. During the second stage, that of epilinguistic control, this acquired knowledge is reorganized in a way that creates linkages with new input. During the third stage of development, typically around age five, the continued acquisition of metalinguistic competency is reinforced and brought into consciousness by external factors such as the development of reading and writing proficiency. The automation of metaprocesses (i.e., the ability to explicitly express metalinguistic abilities) is thought to occur between six to eight years of age, in which more school and reading experience has been attained to reinforce these abilities. During the fourth stage of metalinguistic awareness development, proficiency becomes more automatic and conscious manipulation of linguistic structure follows (Gombert, 1992).

Research concerning bilingual language development has shed light upon rapidly developing metaprocesses, especially those who acquire substantial fluency and literacy in both languages (e.g., Ben-Zeev, 1977; Bialystok, 1991; Campbell & Sais, 1995; Davidson et al., 2010; Feldman & Shen, 1971; Ianco-Worrall, 1972; Kovelman, Baker, & Petitto, 2008; Laurent & Martinot, 2010; Rubin & Turner, 1989; Yelland et al., 1993). When compared to monolingual peers, past research examining print and word awareness showed young preschool bilinguals to more easily accept the conventionality of a word, acknowledging that names can be changed (e.g., Ben-Zeev, 1977; Bialystok, 1991; Feldman & Shen, 1971; Ianco-Worrall, 1972). In other words, bilinguals understand the functionality of words at a younger age than their monolingual peers.

For instance, precocious bilingual advantages were demonstrated on a test measuring rudimentary concepts of written text (i.e., the Moving Word Task; Bialystok, 1991). During this task, two object pictures were simultaneously shown to three- to five-year-old children and named accordingly. Afterwards, the pictures were displayed, identified, and matched with corresponding word cards. When each word card was placed under its analogous object picture, the majority of the children correctly identified the printed word. However, in comparison to bilingual children, when a word card was observed being intentionally moved to an unrelated object picture, monolingual children were less cognizant of the invariability of the printed word on the cards.

Phonological awareness in bilingual children

The bilingual experience is thought to modify metalinguistic developments, however, the bulk of this research has focused on the area of phonological awareness and

preliterate children (e.g., Bruck & Genesee, 1995; Kim, 2009; Kuo & Anderson, 2010; Laurent & Martinot, 2010; Marinova-Todd, Zhao, & Bernhardt, 2010; Mumtaz & Humphreys, 2001; Rubin & Turner, 1989; Rubin, Reichman, Crabtree, & Kantor, 1991; Yelland et al., 1993). Phonological awareness is the knowledge of the connections between sounds and phonemes (i.e., discrete sounds of words) and these developments aid in novel word decoding (e.g., Bryant, Nunes, & Bindman, 1998; Cossu, Shankweiler, Liberman, Katz, & Tola, 1988; Demont & Gombert, 1996; Gottardo, Stanovich, & Siegel, 1996; Plaza, 2001; Plaza & Cohen, 2003; Tunmer & Hoover, 1992). This type of metalinguistic awareness is typically measured by requiring children to isolate or delete particular phonemes (e.g., say cat without the /t/) or to substitute certain phonemes (e.g., delete the first sound from cat and substitute it with the first sound from mop-- mat). Beginning in the preliterate years, explicit phoneme knowledge accrues with experience and continues to develop while literacy skills strengthen, creating a bidirectional relationship with these skills (e.g., Bradley & Bryant, 1983; Demont & Gombert, 1996; Gottardo et al., 1996; Maclean, Bryant, & Bradley, 1987; Plaza, 2001; Plaza & Cohen, 2003). Typically developing between the ages of four to five, the ability to detect rhymes has correlated significantly with later literacy skills, such as reading proficiency and spelling abilities (e.g., Bradley & Bryant, 1983). To the same degree, word segmentation abilities correspond positively with reading and spelling mastery (e.g., Goswami & Bryant, 1990; Muter et al., 1997).

When observing the detection and manipulation of phoneme units, several studies have found bilingual children to have a greater command of phonemes, especially when

the bilinguals possess a balanced proficiency in both languages (e.g., Campbell & Sais, 1995; Kovelman et al., 2008; Laurent & Martinot, 2010; Rubin & Turner, 1989; Yelland et al., 1993). For instance, when compared to monolingual, English-speaking peers, an early onset-rime segmentation advantage for English/French-speaking bilingual children was apparent, however, these differences disappeared by the end of first grade (Bruck & Genesee, 1995). Although past research has recognized advantages like this for bilingual children, they are typically conditional upon certain factors, such as the degree of bilingualism, age point, or language proficiency levels (e.g., Bialystok, 2001; Bruck & Genesee, 1995; Campbell & Sais, 1995; Carlisle, Beeman, Davis, & Spharim, 1999; Kuo & Anderson, 2010; Shwartz, Leiken, & Share, 2005). In another study, when bilingual English/French-speaking, English/Spanish-speaking, and English/Chinese-speaking children were assessed on several measures of phonological awareness, the English/Spanish-speaking group was the only group to show a significant bilingual advantage over peers (Bialystok, Majumder, & Martin, 2003). Additionally, these effects were only found in one of the measures, the phoneme segmentation task.

Additional bilingual effects may be dependent upon literacy skills in both languages. For instance, in a study focusing on biliterate versus monoliterate Russian/Hebrew-speaking first-graders, advantages were found on measures of syllable deletion, initial consonant isolation, and final consonant isolation for the children who could read in both of their languages, suggesting that these advantages extend beyond bilingualism per se (Shwartz et al., 2005). Still other evidence has suggested that the particular languages that a child speaks can lead to advantages in phoneme detection

skills (e.g., Bialystok, 2001; Davidson et al., 2010; Xuereb, 2009). Depending on the language of study, the orthographic and lexical complexity may vary across language systems, which may serve to illuminate irregularities between the language systems (Abu-Rabia & Siegel, 2002; Geva & Wade-Woolley, 1998; Xuereb, 2009). For instance, English has an irregular orthography, in which letter-to-sound correspondence is irregular (Spencer & Hanley, 2003). However, in languages with a regular orthography, such as Spanish or Italian, word decoding is more easily attainable when the correspondences between orthography and sound are established (Xuereb, 2009). For instance, one study examining five-year-old monolinguals' and bilinguals' performance on phonological awareness tasks found bilingual advantages, however, only when the children's second language was phonologically simpler than their first language (Loizou & Stuart, 2003). In addition to this finding, it was discovered that phoneme detection skills in the bilingual children were boosted from learning to read in an alphabetic language first (Loizou & Stuart, 2003).

Although many studies have found early letter recognition abilities and phonological awareness abilities to be the best predictors of reading abilities in monolingual samples, research has begun to investigate connections between syntactic awareness and literacy development (e.g., Cain, 2007; Cain & Oakhill, 2004; Mokhtari & Thompson, 2006; Nation & Snowling, 2000; Nation & Snowling, 2004; National Institute of Child Health and Human Development Early Child Care Research Network, 2000). Additionally, research examining the effects of bilingualism on syntactic awareness

developments has been less studied, which is a promising area of research considering these skills continue to develop beyond first grade.

Syntactic Awareness

Syntactic awareness is the ability to detect and reflect upon the grammar and structure of sentences (Cain, 2007; Tunmer, Nesdale, & Wright, 1987), and competency in syntactic awareness has been positively linked to text comprehension during literacy development (e.g., Cain, 2007; Demont & Gombert, 1996; Lefrançois & Armand, 2003; Leikin, 2002; Low & Siegel, 2005; Lyster, 2002; Mahony, Singson, & Mann, 2000; Marinellie, 2010; Mokhtari & Thompson, 2006; Nation & Snowling, 2004; Nation, Clark, Marshall, & Durand, 2004; Stothard & Hulme, 1992). To predict regularities in future word sequences and to manipulate components of the language more explicitly, awareness of syntactic regularities aids in extraction of meaning from text (Lipka & Siegel, 2007; Marinellie, 2010; Mokhtari & Thompson, 2006; Cain & Oakhill, 2004). In other words, the use of typical syntactic constraints bootstraps decoding of unfamiliar words during literacy development, allowing for children to integrate the meaning of individual words at the sentence level (e.g., Nation & Snowling, 2000; Rego & Bryant, 1993; Tunmer & Hoover, 1992). Studies focusing on syntactic awareness have found correlations between vocabulary development and performance on these tasks (e.g., Cain, 2007; van Gelderen, Schoonen, de Glopper, Hulstijn, Simis, Snellings, & Stevenson, 2004; Shiotsu & Weir, 2007), suggesting that a certain level of vocabulary knowledge is necessary to develop a more abstract understanding of language. Through reading and

writing training, vocabulary development and syntactic awareness create a bidirectional relationship, in which they continually reinforce each other throughout the school years.

Tasks measuring syntactic awareness allow children to reflect upon and control their knowledge of linguistic structure (Gombert, 1992; Lefrançois & Armand, 2003), using tests such as oral cloze tasks, word-order correction tasks, ambiguity tasks, oral imitation tasks, symbol substitution tasks, and grammaticality judgment tasks. During a relatively simplistic oral cloze task, children listen to a sentence with a missing portion, and they are instructed to supply the missing word(s) (e.g., *It was a sunny day with a pretty ______ sky*). Even while accounting for word reading abilities, Low and Siegel (2005) found scores on an oral cloze task, in combination with measures of phonological awareness and working memory, to contribute significantly to reading comprehension. Likewise, Nation and Snowling (2000) found higher scores on a word-order correction task to be correlated with more proficient reading skills, even when poor and good comprehenders were matched on decoding ability. In these types of tasks, children must reorder words in scrambled sentences to render the sentences meaningful and grammatical (e.g., Cain, 2007; Nation & Snowling, 2000; Tunmer et al., 1987).

Other tasks, such as an oral imitation task require children to imitate grammatically incorrect sentences, while keeping the grammaticality incorrect (e.g., *The boys was coming home*), or a symbol substitution task, in which they must substitute a word (e.g., *hamburger*) for another word (e.g., *tiger*) in a sentence (e.g., “The *tiger* is hungry” must be repeated as “The *hamburger* is hungry”) challenge children to inhibit prepotent responses to correct the sentences. Other challenging syntactic awareness tasks

that force children to reflect upon grammar directly and children must distinguish and explain grammatical and ungrammatical sentences (e.g., Bentin, Deutsch, & Liberman, 1990; Bialystok, 1986; Bialystok, 1992; Davidson et al., 2010; Gaux & Gombert, 1999; Plaza & Cohen, 2003).

To further challenge syntactic awareness abilities at an older age, simple grammaticality judgment tasks can incorporate semantic anomalies into the sentences (Bialystok & Barac, 2012). By introducing absurdities into the sentences and requiring children to judge the grammar alone, grammaticality judgment tasks become more complex to children (e.g., *Apples grow on noses*). When required to focus attentional resources on grammaticality, a shift away from sentence meaning to sentence structure is necessary, which is much more challenging when the sentence sounds absurd (Edwards & Kirkpatrick, 1999). Young children tend to focus on the content of sentences, thereby making this momentary shift in attention from content to form more difficult (Edwards & Kirkpatrick, 1999). With age, children can more easily focus on the form of linguistic utterances, allowing children to master different levels of grammatical constructs (Edwards & Kirkpatrick, 1999; McDonald, 2008). Identification and correction of grammatical violations such as word order and omission of articles occur much earlier in development, whereas violations to irregular past tense and third person singular agreement are mastered much later (McDonald, 2008).

Most emerging readers can identify grammatical sentences, however, explaining why the ungrammatical sentence constructions are incorrect poses a challenge for preliterate children (e.g., Bialystok & Ryan, 1985; Davidson et al., 2010; Galambos &

Goldin-Meadow, 1990). Developmental assessments indicate that challenging syntactic awareness tasks, such as a grammaticality judgment task with semantic anomalies, are not feasibly possible until around seven to eight years of age (Edwards & Kirkpatrick, 1999). This is a time in which children's linguistic and cognitive systems become inextricably linked (Edwards & Kirkpatrick, 1999). However, some researchers have used simplified versions of this task with younger children (e.g., Bialystok & Ryan, 1985). With age, children increasingly become more resistant to the semantic anomalies and are able to focus their attentional resources purely on the grammar and structure of the sentences. An awareness of these structural components begins in the early school years as children are exposed to reading and writing materials. However, through continued reading and writing instruction, these skills are strengthened, thereby allowing their syntactic awareness to become more explicit and conscious (Roth et al., 1996). Syntactic awareness and literacy skills continually reinforce each other throughout childhood and continually develop into the adolescent years (McDonald, 2008). The way in which these developments proceed in bilingual children has been explored in recent research, pointing to the benefits of exposure to two languages, even in spite of smaller vocabularies in two languages.

Syntactic awareness in bilingual children. Compared to the monolingual child, conscious attention to syntactic form is more essential to the daily life of a bilingual child in order to separate two different language systems (Davidson et al., 2010). As a result of continuous experience analyzing the linguistic structure of two languages, requiring greater control over cognitive processing and attention to form, syntactic skills may be

hastened in the mind of the bilingual child (Bialystok & Barac, 2012; Bruck & Genesee, 1995; Davidson et al., 2010). Although bilingual advantages have been documented in the research, particularly in children in the early school years (e.g., Davidson et al., 2010; Foursha-Stevenson & Nicoladis, 2011), discrepancies are typically contingent upon factors such as vocabulary knowledge, details of the task items, level and balance of bilingualism, and literacy practices in the home (e.g., Cromdal, 1999; Da Fontoura & Siegel, 1995; Davidson et al., 2010; Galambos & Goldin-Meadow, 1990; Galambos & Hakuta, 1988; McDonald, 2000; Rosenblum & Pinker, 1983; Serratrice, Sorace, Filiaci, & Baldo, 2009).

In a seminal symbol substitution task comparing monolingual and bilingual five- to eight-year-olds, children were asked to substitute a word in sentences that ultimately rendered sentences meaningless (e.g., *substitute "spaghetti" for "we" in a sentence*; Ben-Zeev, 1977). While attending to the word substitution process, bilingual children more easily disregarded the nonsense meaning of the sentences and ignored the prepotent response to answer with a word that would create a meaningful sentence. Since then, researchers have investigated the connections between these precocious developments in bilinguals and balance of their bilingual skills, finding those to be more fully balanced to receive more benefits in metalinguistic awareness (e.g., Cromdal, 1999; Galambos & Hakuta, 1988; Galambos & Goldin-Meadow, 1990). Through a balanced bilingual environment, greater metalinguistic awareness may be more readily available to these children than to their monolingual and unbalanced bilingual peers. For instance, when fully proficient English/Spanish-speaking bilinguals were compared to their monolingual

peers, Galambos and Goldin-Meadow (1990) found four- to seven-year-olds bilinguals to progress more rapidly in identification and correction of errors in simple grammaticality judgment tasks. However, when asked to explain the errors, performance between the monolingual and bilinguals groups was not significantly different. Lower levels of syntactic awareness are developing more rapidly in bilinguals in the early school years, however, deeper levels of syntactic awareness may be developing at later ages. Deeper levels of awareness begin to occur when they are able to explain the errors in syntax and consciously manipulate the language system. Although the children were able to identify syntactic errors at this age, they could not consciously express this knowledge yet. Similarly, Cromdal (1999) found Swedish/English-speaking bilinguals to outperform monolingual Swedish-speaking peers on tests of simple grammaticality judgment and symbol substitution, but only when they were fully proficient in both languages.

Leading from this work, recent research has focused on the role of vocabulary knowledge in syntactic awareness (e.g., Bialystok, Craik, & Luk, 2008b; Davidson et al., 2010; Davidson & Raschke, in preparation; Luo, Luk, & Bialystok, 2010; Guo, Roehrig, & Williams, 2011). Considering the strong reliance on vocabulary knowledge to complete a test of syntactic awareness, it is vital to measure initial vocabulary development when comparing monolingual and bilingual children (Bialystok et al., 2009). Weak vocabulary development that typically occurs in bilingual children often negates a bilingual advantage (August & Hakuta, 1998). For instance, differences were found in a study examining monolingual and bilingual differences in category and letter fluency (Luo et al., 2010). Children were instructed to generate as many words as

possible in a certain category (e.g., animals) or to name words that began with a particular letter in 60 seconds. After testing vocabulary knowledge, the bilingual children were divided into low and high vocabulary groups, allowing for a comparison of monolinguals and bilinguals across different vocabulary levels. Although no differences were found in the category fluency task, it was found that the high vocabulary bilinguals outperformed their monolingual counterparts on the letter fluency task. The letter fluency task placed a greater demand on executive control processes, an area suspected to be more fully developed in bilinguals due to practice managing language conflict (Green, 1998). These findings were replicated by Sandoval, Gollan, Ferreira, and Salmon (2010) using the same tasks.

Other studies have made initial efforts to match the bilingual and monolingual groups on receptive vocabulary knowledge. For instance, in a recent study matching three- to six-year-old children on vocabulary knowledge (using children fully proficient in both languages), a bilingual advantage was found in the identification of grammatically incorrect sentences for the five- to six-year-old English/Urdu-speaking children when administered a simple grammatically judgment task in English and in Urdu (Davidson et al., 2010). The three- and four-year-old bilinguals outperformed their monolingual peers' English performance when tested on the Urdu version, presumably because Urdu was the main language used in the home during this age span. Similarly, a subsequent study compared the performance of five- and six-year-old monolingual and English/Spanish-speaking bilinguals on a grammaticality judgment task (Davidson & Raschke, in preparation). When the children were divided based on their receptive

vocabulary level, bilingual advantages were found mainly in the children with above age level vocabulary knowledge. Together, these studies provide evidence that vocabulary knowledge is an important part of syntactic awareness development. This is also a factor that should be taken into consideration when comparing monolingual and bilingual cognitive development, as differences may only be apparent in children at higher levels of vocabulary knowledge. Without a reference to language proficiency, it is not possible to know if effects are caused by bilingualism or weaknesses in language of testing (Bialystok et al., 2009). Basically, the participants must have the initial linguistic resources to complete the task.

The amount of dual language exposure and support children receive in upholding their bilingual skills are also important considerations when examining bilingual differences in syntactic awareness. For instance, when examining literacy practices in the home, Gathercole and Montes (1997) found Spanish/English-speaking bilinguals' performance on grammaticality judgment tasks looking at *that*-trace usage to be strongly influenced by English input in the home. That is, children receiving more English parental input performed equally as well as the monolinguals on grammaticality judgments. Additionally, Bialystok, Luk, & Kwan (2005) found that even minimal amounts of first language instruction for Spanish-speaking first-grade bilinguals, by means of weekly Spanish school lessons, facilitated advantages over English-speaking monolingual peers on English non-word decoding tasks (i.e., when asked to pronounce "secret codes" consisting of words such as *gog* and *fiss*). These studies evidence that

even limited development of a child's minority language skills reinforces syntactic awareness skills in bilingual children.

Other research has explored the differences between children's language systems and the way in which these differences may contrast and highlight structural components, thereby increasing metalinguistic awareness (e.g., Bialystok & Herman, 1999; Davidson et al., 2010). For instance, Davidson et al. (2010) found, across two experiments, that bilingual Urdu/English-speaking children were more efficient than monolingual English-speaking peers at identifying inconsistencies in gender agreement (e.g., *She is a good boy*), owing to differences in gender representation between the English and Urdu linguistic systems. Additionally, when examining orthographic differences between English and Urdu (i.e., Urdu has a more regular orthography), the inconsistencies between the orthography of their two language systems may have aided in illuminating these differences for the bilingual children.

Furthermore, recent studies have begun examining differences in metalinguistic awareness across diversified language systems, noting the importance of individual structural components of each system (e.g., Barac & Bialystok, 2012; Davidson et al., 2010; Low & Siegel, 2005; Serratrice et al., 2009; Shwartz et al., 2005; Tsang & Stokes, 2001), however, less research has addressed differences in English and Spanish, a dominant language in the United States. Even though English and Spanish are both alphabetic languages using Roman letters with similar cognates, Spanish has a more regular orthography (i.e., greater sound-to-letter correspondence) than English, and this is apparent in the many distinctions between vowel sounds in English (e.g., the sound of the

/a/ in *hat* versus *hate*; Defior, 2004). This difference in orthography may help to illuminate structural differences between these language systems.

Because bilingual advantages are found even in the early preliterate years, it has been suggested that bilinguals' language use is much more intimately linked to the cognitive system than monolingual peers (Bialystok et al., 2009). This general cognitive system helps to manage attention to the different language systems and to inhibit unwanted information from the other language. To more fully understand how linguistic experiences may lead to bilingual advantages, the processes that work in conjunction with metalinguistic awareness must be further investigated (Bialystok, 2001).

Processes Underlying Metalinguistic Awareness

The development of metalinguistic awareness, occurring throughout childhood and adolescence, is comprised of two distinct, yet inseparable processes: analysis of representational structures and attentional control (Bialystok, 1992; Bialystok, 1993; Bialystok, 2001; Karmiloff-Smith, 1992). Analysis of representational structures consists of the "ability to construct mental representations with more detail and structure than was part of initially implicit knowledge" (Bialystok, 2001, p. 177). In other words, representations of linguistic knowledge are reorganized and restructured to accommodate new, incoming information received from the environment (Bialystok, 1992; 2001). This information is continually incorporated into multiple, hierarchical representations of analogous information to make knowledge more readily accessible during problem solving (Bialystok, 1992; Karmiloff-Smith, 1992).

Concurrently, attentional control is necessary to selectively direct attention toward the important components of a linguistic problem (Bialystok, 1992; 2001). Based on studies contrasting measures of metalinguistic awareness that place differing demands on attentional control, it has been proposed that tasks requiring greater attentional control (e.g., counting words in sentences, word-referent problems, symbol substitution tasks, sun-moon problems, novel naming in sentences, grammaticality judgments of anomalous sentences, phoneme segmentation tasks) are considered truly metalinguistic in nature (Bialystok, 1992; 2001).

When examining the development of syntactic awareness through grammaticality judgment tasks with semantic anomalies, previous research has demonstrated that children younger than eight years are heavily influenced by the semantic content of sentences, leading to difficulties in redirection of attentional resources towards grammaticality (e.g., Bialystok, 2001; Catts, 1991; Edwards & Kirkpatrick, 1999). Specifically, grammaticality judgment tasks integrating semantic anomalies (e.g., *Apples grow on noses*) create a distraction when solving the linguistic problem, therefore increasing the cognitive demands of the task because the absurdity of the sentences must be ignored. Younger children tend to fixate on the absurd meaning of the anomalous sentences and base judgments on meaning alone (e.g., *apples cannot grow on noses*; Tsang & Stokes, 2001). A developmental shift generally occurs during the early elementary years, moving children from a content-based approach to analysis to a more structure-based focus (Edwards & Kirkpatrick, 1999).

When comparing monolingual and bilingual populations, it has been argued that a more discernible bilingual pattern shows on tasks emphasizing the need to control attention and ignore absurdities in the task (e.g., Bialystok, 1986; Bialystok, 1988; Bialystok & Majumder, 1998; Cromdal, 1999). When a higher degree of attentional control is necessary to solve a problem, metalinguistic awareness tasks are more easily or rapidly solved by bilinguals in comparison to monolingual peers. Overall, tasks emphasizing analysis of representational structure (e.g., counting words in strings, describing attributes of words, determining ambiguity, explaining grammaticality errors, judging grammaticality of meaningful sentences) do not tend to find a consistent bilingual advantage because only specific knowledge is required to complete these tasks (Bialystok, 1992; 2001). Although recent studies using balanced bilingual children have found advantages on simple grammaticality judgment tasks (e.g., Davidson et al., 2010; Galambos & Goldin-Meadow, 1990; Galambos & Hakuta, 1988), a certain degree of attentional control may still be necessary to focus on the grammaticality of the sentences. Bilinguals are constantly faced with conflict from two language systems, thereby recruiting efforts from the executive functioning system (Bialystok & Barac, 2012; Green, 1998). This management system of the brain helps to resolve conflict across different domains of processing, and the consistent use of this system may be modified in bilinguals (Bialystok et al., 2009).

Executive Functions

Developing early in life, mainly around the end of the first year (Diamond, 2006; Diamond, Carlson, & Beck, 2005; Zelazo & Müller, 2002), executive functions aid in the

development of metalinguistic awareness skills. Broadly defined, executive function is a term used to describe the set of functions that control thought and action in the face of conflicting information, including processes such as strategic planning, problem-solving, decision-making, judgment, mental representation of information, inhibitory control, selective attention, rule use, working memory, cognitive flexibility, and self-perception (Best, Miller, & Jones, 2009; Best & Miller, 2010; Diamond, 2006; Mazuka et al., 2009; Séguin & Zelazo, 2005; Stuss & Benson, 1984; Weyandt, 2005; Zelazo & Müller, 2002). Operating and interacting in a hierarchical manner to accomplish certain goals, the processes and structures involved in executive functions coordinate and organize incoming information (Miyake et al., 2000; Zelazo, Carter, Reznick, & Frye, 1997; Zelazo & Müller, 2002). Although not limited exclusively to this area, executive functions have been linked to the prefrontal cortex (Olson & Luciana, 2008; Zelazo & Müller, 2002).

Besides being essential to everyday functioning, strengths in these areas have been positively linked with social competence and school readiness (e.g., Diamantopoulou, Rydell, Thorell, & Bohlin, 2007; Morgan & Lilienfeld, 2000; St. Clair-Thompson & Gathercole, 2006; Tranel, Anderson, & Benton, 1994). For instance, working memory and inhibitory control have both independently predicted math and reading competence (St. Clair-Thompson & Gathercole, 2006). Although an unproportional amount of research has focused on the preschool years, significant improvements in executive functions have been shown to happen after age five and continuing through middle childhood (Best et al., 2009; Brocki & Bohlin, 2004;

Klenberg, Korkman, & Lahti-Nuuttila, 2001; Luna et al., 2004; Romine & Reynolds, 2005; Simonds, Kieras, Rueda, & Rothbart, 2007).

These processes continue to develop throughout childhood and adolescence, with myelination and synaptic pruning continually occurring in conjunction with children's experiences (Best et al., 2009; Casey, Amso, & Davidson, 2006). Although research has discerned three core executive functions, that of inhibitory control, cognitive flexibility, and working memory, these processes are linked to each other and work in conjunction, referred to as the unity and diversity theory of executive functions (Asato, Sweeney, & Luna, 2006; Bull & Scerif, 2001; Luna, Garver, Urban, Lazar, & Sweeney, 2004; Miyake et al., 2000; Miyake & Friedman, 2012; St. Clair-Thompson & Gathercole, 2006). Even though certain tasks have been designed to tap particular core process, these functions work in conjunction and interact in different ways across the lifespan (Best et al., 2009; Huizinga & van der Molen, 2007; Senn, Espy, & Kaufmann, 2004).

Inhibitory Control

Inhibitory control processes monitor performance when faced with conflicting cues, mainly by controlling urges to perseverate with prepotent responses (Best & Miller, 2010; Diamond, Kirkham, & Amso, 2002). These processes can be further differentiated as interference suppression or response inhibition (Bunge, Dudukovic, Thomason, Vaidya, & Gabrieli, 2002). In order to ignore competing cues from incoming information and attend to the most relevant cue, even if it may not be the most salient cue, interference suppression serves to monitor these responses (Blasi et al., 2006; Nigg, 2000). Simultaneously, response inhibition monitors and suppresses automatically-cued

responses, reducing quick prepotent responses to stimuli (Best & Miller, 2010; Blasi et al., 2006). To measure interference suppression, researchers typically administer tasks similar to that of a Flanker Task (Eriksen & Eriksen, 1974) or, to distinguish between both interference suppression and response inhibition processes, an anti-saccade task has been adapted (Bialystok et al., 2006; Luna et al., 2004; Simonds et al., 2007). The use of these computerized inhibition tasks provides for a measures of reaction time to the stimuli in addition to overall accuracy on the task.

Cognitive Flexibility

Often termed shifting, set-shifting, or task switching, cognitive flexibility refers to the ability to switch one's focus of attention and perspective between mental states or tasks (Mazuka et al., 2009; Miyake et al., 2000; Miyake & Friedman, 2012; Séguin & Zelazo, 2005; Weyandt, 2005; Zelazo & Müller, 2002). This is typically measured by changing task demands periodically, forcing participants to switch between these differing task demands (Bunge et al., 2002; Davidson, Amso, Anderson, & Diamond, 2006). In a popular test of cognitive flexibility, the Wisconsin Card Sorting Task, cards displaying different designs, colors, and quantities are presented and must be sorted in a certain way based on feedback from the experimenter (Grant & Berg, 1948). To measure participant flexibility through perseveration errors, sorting rules change without explicit instruction, and must be continually reconfigured based on experimenter feedback.

According to the unity and diversity theory of executive functions, tasks isolating cognitive flexibility are not feasible, as a certain amount of inhibition and working memory must come online to complete the tasks (Diamond & Taylor, 1996; Miyake et

al., 2000). For instance, to complete a card sorting task, participants must keep certain rules and previous responses in mind while figuring out the intended rule for that set of cards. Similar functional integration applies for working memory tasks (Best & Miller, 2010). For example, to properly complete a backward digit span task, in which digits are to be repeated backwards as the string lengths increase, inhibition skills are necessary to control the prepotent forward response and to also inhibit previous digit sets.

Working memory

Another core executive function, that of working memory, incorporates information into short-term memory stores and continually updates this information in accordance with incoming input (Miyake et al., 2000; Séguin & Zelazo, 2005; Weyandt, 2005; Zelazo & Müller, 2002). Working memory is more than storing a simple phone number in short-term memory, but being able to manipulate and update this information, as in a backwards digit span task (Davidson et al., 2006). Typically, working memory is assessed through simple nonverbal tasks or forward digit-span tasks, more complex spatial self-ordered searches or backward digit-span tasks, or through n-back tasks in which complexity can be manipulated (Best et al., 2009).

Executive Functions and Bilingualism

As suggested by bilingual research focusing on executive functions, bilingualism may be reinforcing executive function development (e.g., Bialystok, 1992; Bialystok, 1993; Bialystok, 2001; Mazuka et al., 2009). Research investigating child, adult and elderly populations have generally found bilingual populations to respond more quickly and efficiently on executive function tasks (e.g., Bialystok, 2001; Bialystok & Shapero,

2005; Bialystok et al., 2006; Carlson & Meltzoff, 2008; Costa et al., 2008; Mezzacappa, 2004). The need to constantly monitor the context and switch between two different language systems may be aiding in the development of these skills in bilinguals (Bialystok, 2007; McQuillan & Tse, 1995; Perner & Lang, 1999). However, these advantages are usually dependent upon task demands or level of bilingualism of the participants. Precocious development of these skills have been found in areas of inhibition and cognitive flexibility (e.g., Adi-Japha et al., 2010; Bialystok, 1999; Bialystok & Martin, 2004; Bialystok & Shapero, 2005; Bialystok et al., 2006; Carlson & Meltzoff, 2008; Martin-Rhee & Bialystok, 2008; Yang, Yang, & Lust, 2011), however research using inhibitory control measures has been the bulk of the literature in this area, based on the premise that language conflict in the mind creates the need for improved inhibition skills in bilinguals (Green, 1998).

For instance, in one study examining fMRI differences in brain activation between monolingual and bilingual young adults, it was found that different brain regions were activated during congruent and incongruent trials on a Flanker task, however these differences were not apparent in the no-go trials (Luk, Anderson, Craik, Grady, & Bialystok, 2010). Bilingual-specific pathways may be necessary to deal with interference suppression, however, response inhibition tasks activate similar brain regions in monolingual and bilingual participants (Luk et al., 2010). Advantages on tasks tapping inhibitory control, such as the Simon Task (i.e., requiring attention to the color of stimuli and inhibition of the tendency to respond to the location), have also been prevalent in the

literature (e.g., Bialystok et al., 2004; Carlson & Meltzoff, 2008; Martin-Rhee & Bialystok, 2008).

However, not all studies have revealed an unconditional bilingual advantage, revealing that these effects may be apparent only when measuring reaction times or conflict effects on tasks, or when trials with more demanding high-switch conditions are included (e.g., Bialystok, 2006; Bialystok et al., 2004; Bialystok et al., 2008b; Costa et al., 2008; Costa, Hernández, Costa-Faidella, & Sebastián-Gallés, 2009; Martin-Rhee & Bialystok, 2008). In one particular study examining young adult bilinguals' reaction times, it was found that advantages over monolingual peers were only apparent in the more demanding conditions of a Flanker task, in which it was necessary to constantly monitor and adapt behavioral responses (Costa et al., 2009). In the low-monitoring conditions, where most trials were congruent (i.e. flanker arrows faced same direction on 80% of the trials), no differences were found between the monolinguals and bilinguals. However, in the high-monitoring conditions, where congruent and incongruent trials were evenly distributed across the task, more intense monitoring processes were necessary to complete the task accurately, thereby revealing an advantage for the bilingual participants.

These types of findings have been conditional in younger children as well (e.g., Carlson & Meltzoff, 2008; Yang et al., 2011). For example, in a study examining English/Spanish-speaking and monolingual kindergarteners, bilingual advantages were only found in response inhibition tasks requiring a heavier load on working memory (Carlson & Meltzoff, 2008). No advantages were found in conditions where the children

were instructed to suppress a motor response or to delay gratification of a reward. Additionally, these effects were only found when socioeconomic status was statistically controlled for in the sample.

Although advantages have been found in inhibitory control, less work has focused on cognitive flexibility and the way it can be modified by linguistic experience (Prior & Gollan, 2011). Comparisons of cognitive flexibility skills between monolinguals and bilinguals have not been well studied across the lifespan, however, certain studies have pointed to advantages in younger and older adults (e.g., Prior & Gollan, 2011; Prior & MacWhinney, 2010) and tend to be sensitive to factors such as the balance of the bilingual's languages (e.g., Barac & Bialystok, 2012; Vega & Fernandez, 2011). Less work has focused on the middle school years and the effects of different types of linguistic experiences on these cognitive mechanisms.

Recent work has begun to examine the ways in which these skills can be modified across the lifespan, suggesting that bilingual advantages extend beyond inhibition skills (e.g., Bialystok, 2010; Prior & Gollan, 2011; Prior & MacWhinney, 2010). Cognitive flexibility skills develop more slowly than inhibition skills, developing into adolescence and early adulthood (e.g., Anderson, 2002; Best & Miller, 2010; Bialystok, Craik, Green, & Gollan, 2009; Cepeda, Kramer, & Gonzalez de Sather, 2001; Conklin, Luciana, Hooper, & Yarger, 2007; Davidson et al., 2006; Luciana, Conklin, Hooper, & Yarger, 2005; Romine & Reynolds, 2005), leaving these skills open to be modified by different linguistic experiences during later developmental periods. Although early developments in rudimentary cognitive flexibility skills have been found in simple rule-switching tests

such as Dimensional Change Card Sort Task (i.e., sort cards based on rules that change) or a trail making test (i.e., lines are drawn and must be alternated between numbers and letters) (e.g., Adi-Japha et al., 2010; Bialystok, 1999; Bialystok & Martin, 2004; Bialystok & Shapero, 2005; Martin-Rhee & Bialystok, 2008), these patterns are less discernable in the elementary school years. In a recent study using a simple trail making test, bilingual and monolingual six-year-olds were instructed to sequentially draw lines between letters and numbers on a page (Bialystok, 2010). They had to consistently alternate between numbers and letters while maintaining the correct number/letter order. When examining the children's completion times on this test, the bilingual children outperformed the monolingual children, suggesting that they had more well-developed mental flexibility skills in the early school years.

When examining several types of executive functioning skills, Bialystok & Viswanathan (2009) found eight-year-old bilinguals (of a variety of languages) to outperform monolinguals on certain components of a complex anti-saccade task (i.e., the Faces Task developed by Bialystok et al., 2006). This task tapped response inhibition (i.e., suppressing an automatic response), interference suppression (i.e., ignoring competing cues) and cognitive flexibility (i.e., set-shifting). Children were shown a schematic face flanked by two boxes on a computer screen. The eyes of the face turned either red or green, while an asterisk flashed in one of the flanking boxes. The children were instructed to press the button on the corresponding side of the asterisk when the eyes were green and the opposite side when the eyes were red. The gaze aversion of the face also changed, either facilitating or interfering with children's responses, depending

on the color of the eyes and the location of the asterisk. When examining the reaction times, the bilingual children were more efficient than the monolingual children in conditions requiring high levels of interference suppression and cognitive flexibility. In an adult study using the same task, advantages were found for adult bilingual participants in comparison to monolingual counterparts on all three components, and this advantage extended into elderly populations (Bialystok et al., 2006).

Another study focusing on English/Spanish- and English/Mandarin-speaking young adults, found the English/Spanish-speaking group to have reduced switch costs on linguistic and non-linguistic switching tasks (Prior & Gollan, 2011). However, these effects were dependent upon controlling for socioeconomic status, a factor linked to deficits in executive functioning (Carlson & Meltzoff, 2008). These language-specific group differences were attributed to the fact that the English/Spanish-speaking group reported switching between their languages more often than the English/Mandarin-speaking group, however, consistently measuring these switching behaviors was not the intent of this past study. Similarly, in another study, degree of bilingualism and vocabulary knowledge of the children were taken into account during measurement of executive functioning skills (Yang & Lust, 2007). Spanish-, French-, Korean-, and Chinese-speaking children with English as a second language all outperformed English-speaking monolinguals on a measure of executive functioning. However, even though the Korean- and Chinese-speaking bilinguals scored lower on a test of English lexical knowledge, it was found that they performed the task even more efficiently than the other bilingual groups. Case in point, if all bilingual children, regardless of language spoken,

had been grouped as one homogenous bilingual sample, then differences between the language groups would not have emerged.

Bilingual research in the area of working memory has been mixed (e.g., Adesope et al., 2010; Bialystok, 2009; Bialystok & Feng, 2009; Bonifacci, Giombini, Bellocchi, Contento, 2011; Danahy, Windsor, & Kohnert, 2007). The ability to hold two language systems in the bilingual mind could put an overwhelming load on the working memory system (Lee, Plass, & Homer, 2006; Sweller & Chandler, 1994; van Merrienboer & Sweller, 2005). On the other hand, the extra effort needed to organize this information in the working memory system could end up increasing the overall efficiency of this system (Bialystok et al., 2004; Bialystok et al., 2008b; Fernandes, Craik, Bialystok, & Kreuger, 2007; Just & Carpenter, 1992; Michael & Gollan, 2005; Rosen & Engle, 1997). Most findings in the bilingual literature have been inconclusive. However, when bilingual advantages are found, they are usually found in complex working memory tasks, in which other areas of executive function are greatly taxed (e.g., Adesope et al., 2010; Bialystok, 2009; Bialystok & Feng, 2009; Bonifacci et al., 2011; Danahy et al., 2007). For instance, in one study examining young and older adults, participants were to repeat back a sequence of touches that the experimenter performed on a set of blocks (i.e., the Corsi blocks test; Bialystok et al., 2008b). On this task, bilingual advantages were found, but only in conditions where the sequence was to be repeated in a backward manner. These types of responses require recruitment from other areas of executive function, mainly to inhibit the prepotent response to repeat the original sequence of the blocks.

Linkages Between Executive Functions and Metalinguistic Awareness

To help solve language-switching tasks, these domain-general mechanisms are utilized to help control attentional focus, leading to improvements in nonverbal areas as well (Fabbro, Skrap, & Aglioti, 2000; Fan, Flombaum, McCandliss, Thomas, & Posner, 2003). Evidence shows greater activation in language-processing areas of the brain during nonverbal goal-directed tasks in bilinguals, when compared to monolinguals (e.g., Novick, Trueswell, & Thompson-Schill, 2005). Due to experience managing language conflict, these areas may be more highly developed and utilized during nonverbal tasks (Novick et al., 2005). As these skills become more practiced and automatic, the bilingual child is more able to function in conditions where conflicting information may be distracting or ambiguous (Bialystok, 1992).

Above all, it is not just any type of conflict in the mind between different systems that enhances executive functions, but advantages are limited to conditions in which conflict lies in the same modality. This was evidenced in a recent study comparing conflict resolution skills in unimodal (speech-speech bilinguals) and bimodal (speech-sign) bilinguals (Emmorey, Luk, Pyers, & Bialystok, 2008). In this study, the unimodal (speech-speech) bilinguals outperformed their monolingual peers on tests of conflict resolution, however, the bimodal (speech-sign) bilinguals did not. Bimodal bilinguals, or those whose second language is a sign language, receive information from two different modules, so this information is mapped onto different areas of the brain (Bialystok, 2010; Emmorey et al., 2008). When receiving conflict in a unimodal pathway (i.e., speech-speech bilinguals), a greater need for recruitment of the executive control system is in

order to keep the language systems straight, thereby improving executive functions through practice. There is something particular about conflicting information in the language center of the brain that aids in development of the executive control system.

Although recent research has shown that executive functioning can be shaped by linguistic experience, it is unclear exactly the extent of this modification depending on certain linguistic experiences, such as exposure and use of their languages (Bialystok & Viswanathan, 2009; Carlson & Meltzoff, 2008; Mazuka et al., 2009). In a recent study examining bilingual adults, professional translators, interpreting school students, untrained bilinguals, and monolinguals were compared on a task in which they were to identify semantic and syntactic errors in text passages (Yudes, Macizo, Morales, & Bajo, 2012). Although all of the bilingual groups were able to comprehend the passage better than the monolinguals, showing that they were not distracted by the identification task, the professionally-trained translators were able to comprehend the task and identify more errors than the other groups. Although interesting, this study does not tell us about children who have acquired natural translation skills from a young age.

Child Language Brokers

A primary goal of the present research was to include a group of English/Spanish-speaking bilingual children whose cognition may have been shaped differently by unique linguistic experiences. Specifically, the sample incorporated Spanish/English-speaking children serving as language brokers for their families, a role that requires translating and interpreting from a very young age, sometimes beginning as early as eight to ten years of age (McQuillan & Tse, 1995; Orellana, Dorner, & Pulido, 2003; Orellana, Reynolds,

Dorner, & Meza, 2003; Tse, 1995; Tse, 1996a; 1996b). In order to maintain the well-being of their family, child language brokers must translate and interpret for their non-English-speaking families, including siblings, extended family members, and neighbors, mainly because they are receiving English instruction in daycares and schools (e.g., Dorner et al., 2007; McQuillan & Tse, 1995; Morales & Hanson, 2005; Orellana, Reynolds, Dorner, & Meza, 2003).

On an almost daily basis, these children translate conversations between family members and teachers, store clerks, receptionists, and doctors in many different settings. They may also translate text for their family in a variety of different formats, including letters, homework, report cards, newspapers, signs, bills, bank statements, and other legal documents (Dorner et al., 2007). Some of these children even translate television shows, movies, and telephone conversations for family members. By means of immersion in an additive bilingual environment, positive effects on cognitive development may come about (Malakoff & Hakuta, 1991). Language brokering is more than bilingualism or even balanced bilingualism, creating a unique bilingual population to study (Morales & Hanson, 2005). These children are literally experiencing the world through two different languages, thereby gaining a much different experience than most other children (Dorner et al., 2007; Malakoff & Hakuta, 1991; Orellana, 2007). Not only must a well-developed understanding of both languages be formed, but also an efficient management system for switching between the language systems. Although past work has found advantages in areas of metalinguistic awareness and executive functioning, less work has focused on

child language brokers and the way in which these translation experiences can affect cognitive functioning.

In order to perform these translations efficiently, a complex series of manipulations occur, at which the linguistic intermediary must bring understanding between individuals speaking different languages. At one level, the broker must understand the vocabulary and the content of the incoming language. Almost concurrently, at another level, the meaning must then be translated and conveyed into the target language, while maintaining proper grammaticality (De Groot, 1997; Malakoff & Hakuta, 1991). To maintain grammaticality between languages, brokers must maintain the contents of the incoming message in working memory, while retrieving and integrating information, such as grapheme-phoneme conversion rules, from long-term memory (Low & Siegel, 2005). To complicate matters, depending on the age and intelligence of the intended audience, the message content may need to be modified or paraphrased in several different ways to properly convey the meaning of the message (Orellana, Dorner, & Pulido, 2003; Dorner et al., 2007; Orellana, 2007). The metalinguistic demands and language switching experiences that these children encounter may be leading to the modification of the executive control network and metalinguistic awareness.

Past Research on Child Language Brokers

Past research investigating language brokers' adjustment has been mixed and focused mainly on academic achievement and socioemotional development. Some believe that language brokering creates positive adult-like situations for the children (e.g.,

Acoach & Webb, 2004; Buriel et al., 1998; Dorner et al., 2007; McQuillan & Tse, 1995; Orellana, 2003; Volk & Angelova, 2007). Others believe brokering to be a stressful and negative experience that limits the child's time and future opportunities, especially in families in dire need of translator (e.g., Parke & Buriel, 2006; Suárez-Orozco & Suárez-Orozco, 2001; Tse, 1996b; Umaña-Taylor, 2003).

Nevertheless, positive connections with academic self-efficacy, self-reported GPAs, and standardized test scores have been reported (e.g., Acoach & Webb, 2004; Buriel et al., 1998; Dorner et al., 2007; Orellana, 2003). Although assessed qualitatively, adult-level task comprehension, problem solving, and decision-making have been found in child language brokers (McQuillan & Tse, 1995). No systematic assessments concerning metalinguistic awareness and executive functioning in child language brokers have been conducted in past research. In combination with knowledge of two language systems, a diverse vocabulary, and the constant division of attention between two language systems, metalinguistic awareness and executive functions may be more well-developed in child language brokers (Buriel et al., 1998; De Groot, 1997; Heath, 1986; Krashen, 1985; Malakoff & Hakuta, 1991).

Purpose and Hypotheses

The current study assessed the role of executive functioning on syntactic awareness in monolingual and bilingual (English/Spanish-speaking) children, with a particular focus on the role that child language brokering has on syntactic awareness and components of executive functioning. Complex translation strategies may be supporting the development of greater metalinguistic awareness in child language brokers, and this

advantage may also be found in executive functions, the mechanisms suspected to aid in metalinguistic abilities (Bialystok, 1992; Bialystok, 1993; Bialystok, 2001; Malakoff & Hakuta, 1991; Mazuka et al., 2009). Bilingual language brokers (English/Spanish-speaking), bilingual non-language brokers (English/Spanish-speaking) and monolingual (English-speaking) children, with a mean age of nine years, were assessed on a measure of syntactic awareness and tasks designed to examine the core executive functioning areas.

This particular age group was chosen because this is a time in which syntactic awareness becomes more explicitly conscious to the child and they are able to move from evaluation of meaning to content (Edwards & Kirkpatrick, 1999). This is a time in which the linguistic and cognitive systems are inextricably linked and children are able to think in more abstract ways (Edwards & Kirkpatrick, 1999). Although past studies have mainly examined bilingual developments in preliterate children in the preschool and early school years, this study extended this work to an older age group using a timed task of syntactic awareness. This is also a time in which bilingual children begin more frequent translation for their family members (Dorner et al., 2007), and the way in which this experience translating and interpreting may affect these connections was explored in the current study by including a group of language brokers. Developments in executive function skills are still developing, particularly in the area of cognitive flexibility, which has been evidenced to develop much later into adolescence than inhibitory control (e.g., Anderson, 2002; Best & Miller, 2010; Bialystok et al., 2009; Cepeda et al., 2001; Conklin et al., 2007; Davidson et al., 2006; Luciana et al., 2005; Romine & Reynolds, 2005).

These skills may be slower to develop due to the dependence on children's ability to inhibit prepotent responses and store information in working memory to complete a task of cognitive flexibility (Best & Miller, 2010; Garon et al., 2008). The way in which executive functions may be modified by translation experience in child language brokers and their connections to syntactic awareness development has not been explored in past research.

A timed version of a grammaticality judgment task was created for this study to gain a measure of processing speed on a syntactic awareness task. This type of task allows for a measure of accuracy, as well as a measure of speed-accuracy tradeoffs by measuring the children's reaction times. This was important to include, as the differences between the language groups in this study, particularly between the brokers and non-brokers, may simply lie in their speed of processing the sentences. This timed task also allowed for a measure of low levels of syntactic awareness, in which children could hear the sentences and respond via button response. Additionally, using a task in which the children could perform auditorily was important because the bilingual children had weaker biliteracy skills. Presumably, these children heard their two languages on a daily basis and received instruction in reading and writing in the majority language.

The executive function tasks used for this study were derived from past research using similar tasks. A flanker task, a popular test used to measure inhibitory control, was designed to measure accuracy and speed in inhibiting prepotent responses. To measure cognitive flexibility, a trail making test was used to obtain a measure of perseverative errors and time to complete the trails. This is a widely-used measure of visual attention

and task-switching and has been used in past literature with bilingual populations. With the exception of the digit span task, these tasks were timed versions to obtain a measure of processing speed. From past studies, timed working memory tasks place greater demands on the other areas of executive functioning, and efforts were made to choose tasks tapping each function separately in the current study.

Additionally, children’s language proficiency levels and reading abilities were measured to determine degree of bilingualism. Based on past research, to establish language broker status of the children (i.e., broker vs. non-broker), parent and child questionnaires were used to assess the children’s language learning environments and daily translation duties (Dorner et al., 2007). This was an important aspect of this project, as past work has not investigated cognitive skills in child language brokers. Broadly, the goals of the present research were to (1) build upon past research examining syntactic awareness in bilinguals by examining children who have acquired significant reading and writing training, (2) include a group of child language brokers, and (3) examine the linkages between the linguistic and non-linguistic domains and how these can be modified with greater linguistic experience.

Syntactic Awareness Hypotheses

Hypothesis 1A: Accuracy on syntactic awareness task. When comparing accuracy on the syntactic awareness task, it was hypothesized that the bilingual groups, both brokers and non-brokers, would outperform the monolingual group. Bilingual advantages may be even more evident in conditions in which greater demands are placed on children’s attentional control (Bialystok, 1992; Bialystok, 1993; Bialystok, 2001;

Karmiloff-Smith, 1992). If bilingual children are more easily able to control their attentional resources, this would then free up resources to focus on the representational structures of the sentences. Even more so, it was predicted that the bilingual language brokers would be even more accurate than both groups. By distinguishing brokers from non-brokers, this uniquely contributed to past research examining syntactic awareness, in which information on brokering status has been absent.

Hypothesis 1B: Reaction times on the syntactic awareness task. When analyzing reaction times to the syntactic awareness task, it was expected that the bilingual groups, both brokers and non-brokers, would have more rapid reaction times than the monolinguals, due to practice switching between two language systems (e.g., Bialystok, 2007; Bialystok, 2010; Bialystok et al., 2008b; Costa et al., 2008; Green, 1998; Martin-Rhee & Bialystok, 2008). Although past research has found bilingual advantages on grammaticality judgment tasks, reaction times have not been systematically measured (e.g., Cromdal, 1999; Davidson et al., 2010; Galambos and Hakuta, 1988; Galambos and Goldin-Meadow; 1990). Furthermore, it was predicted that the language brokers would respond more rapidly than both the bilingual non-brokers and the monolingual group. On an almost daily basis, language brokers must simultaneously speak, listen, and interpret a variety of conversations and documents (Dorner et al., 2007; McQuillan & Tse, 1995; Morales & Hanson, 2005; Orellana, Dorner, & Pulido, 2003).

Executive Functioning Hypotheses

Hypothesis 2A: Accuracy on the executive function tasks. When assessing accuracy scores on the executive function tasks, it was hypothesized that the bilingual

groups, particularly the language brokers, would outperform the monolingual group. The use of general executive functions to manage multiple language systems may be more enhanced due to practice (Green, 1998). Past research has found some bilingual populations to be comparable to or more accurate than monolingual counterparts on tasks designed to measure core executive functions (e.g., Bialystok, 2001; Bialystok & Shapero, 2005; Bialystok et al., 2006; Bialystok, 2010; Carlson & Meltzoff, 2008; Costa et al., 2008; Lundberg, 1978; Mezzacappa, 2004; Owens, 1996). However, the effects of language brokering on this management system of the brain have not been explored, particularly in the foundational areas of executive function (i.e., inhibitory control, cognitive flexibility, working memory). It was predicted that all areas of executive function would be improved due to the demands placed on this network and the interrelations between these areas. According to the Unity and Diversity theory of executive function (Miyake et al., 2000), these areas are separable but still moderately correlated constructs.

Hypothesis 2B: Reaction times on the executive function tasks. When examining reaction time measures on the executive function tasks, it was further predicted that the bilingual children would respond more rapidly and accurately than the monolingual children. This effect may be further emphasized with the language brokers, who must continuously monitor their language use to make it appropriate for the intended speaker (Costa et al., 2009).

Linkages Between Verbal and Non-Verbal Performance

Hypothesis 3: Correlation between performance on the executive function tasks and performance on the syntactic awareness task. Across all language groups, a positive correlation with performance on the executive function tasks and performance on the syntactic awareness task was expected, due to the need for executive functions to complete a challenging linguistic task. It was further predicted that language group (monolingual, bilingual non-broker, bilingual broker) would moderate the relationship between executive functions and syntactic awareness performance. A moderation analysis was used because a moderator is one that influences the strength of a relationship between variables, rather than explaining the relationship between them (Aiken & West, 1991; Holmbeck, 1997; Judd, 2009). Executive functions are used in language development in general to resolve intra-language conflict, so a correlation between these variables is expected regardless of language group status. However, it was expected that language group would moderate, or influence the strength of this relationship. A stronger positive correlation was anticipated for the bilingual groups, particularly the language brokers, when compared to the monolingual group. Due to experience managing language conflict, executive functions may be more highly developed and utilized during both verbal and nonverbal tasks for bilinguals (Mazuka et al., 2009; Novick et al., 2005). By including within-subjects data on the executive function tasks and the syntactic awareness measure, correlations between these two areas could be examined, which has not been linked in past research assessing bilingualism and language brokers.

CHAPTER TWO

METHODS

Participants

In total, 92 children were tested, (*M* = 9 years, 6 months, *SD* = 5.65 months, Range = 8 years, 7 months - 10 years, 5 months). Of these children, 26 were monolingual English-speaking (*M* = 9 years, 4 months, *SD* = 6.33 months, Range = 8 years, 7 months - 10 years, 5 months), 30 were bilingual English/Spanish-speaking non-brokers (*M* = 9 years, 6 months, *SD* = 5.74 months, Range = 8 years, 5 months - 10 years, 4 months), and 36 were bilingual English/Spanish-speaking language brokers (*M* = 9 years, 6 months, *SD* = 4.96 months, Range = 8 years, 10 months - 10 years, 5 months). Approximately 47% of the sample was female, 85% of the children were Latino-American, 11% were African-American, and 4% were European-American. A total of four children were not included in the study, due to problems finishing testing or absences on testing dates.

Children were recruited from schools, community centers, and after-school programs in and around Chicago that contained large percentages of bilingual speakers. In order to control for extraneous factors, efforts were made to obtain both the monolingual and bilingual samples from the same schools, which were all in neighborhoods of similar demographic. To verify socioeconomic status, all schools were part of the Reduced/Free Lunch program for the Fiscal Year 2011, with at least 70% of

the students at each site being eligible for free or reduced lunch. All community centerafter-school programs contained children from schools within the same range, with large percentages of bilingual speakers. Only children between the ages of 103 and 125 months were chosen to participate in this research. Those whose parental consent forms indicated that their child only knew a little bit of Spanish or who were not sure if their child was truly bilingual were excluded from the study. This step was taken because they were not appropriate to be placed in the monolingual group, due to their minimal exposure to a second language.

Measures

Parent Questionnaire of Language Learning Environment

Parents filled out a questionnaire assessing their child's language learning environment (subset adapted from Duursma et al., 2007). To assist bilingual parents, this questionnaire was provided in both English and Spanish. The questionnaire contained questions pertaining to child and parent demographics (e.g., countries of birth, languages spoken, and birth order) and home literacy environment (see Appendix A).

Language Usage Questionnaire (Dorner et al., 2007)

Through this questionnaire, all bilingual children answered questions about their language usage. This questionnaire assessed how often children used the languages they spoke, where they were used, and with whom they used these languages. Most importantly, this survey indicated frequency of translation and interpretation performed by the child. This questionnaire took about 10-15 minutes to complete with each child.

After completion of this questionnaire, a composite language broker score was

obtained for each bilingual child, following the guidelines of past research (Buriel et al., 1998; Dorner et al., 2007; Tse, 1995). From the responses on the survey, the following factors were taken into account: how often they reported translating for parents and grandparents, how often they reported translating for siblings or other family members, number of places they translated, and number of things they translated. The composite language broker score distinguished those who were language brokers and those who were non-brokers. Children categorized as language brokers were those who reported translating at least four things, within three or more different locations for immediate family members at least sometimes or extended family members every day. Non-brokers were children who did not meet these criteria. Reliability of this survey showed a Cronbach's alpha of $p = .77$.

Oral Reading Fluency Subtest from the Dynamic Indicators of Basic Early Literacy Skills-6th Edition (DIBELS; Good & Kaminski, 2002)

The DIBELS, a reading comprehension task, was administered in English to all children. Each child read an age-appropriate passage for one minute, while the number of correctly read words was recorded by the experimenter.

Oral Reading Fluency Subtest from the Indicadores Dinámicos del Éxito en la Lectura-7a edición (IDEL; Cummings, Baker, & Good, 2006)

The IDEL, a Spanish reading comprehension measure, was administered in the same manner as the DIBELS, except in Spanish.

Peabody Picture Vocabulary Test-4th Edition (PPVT-IV; Dunn & Dunn, 2007)

To measure receptive vocabulary skills in English, the PPVT was administered to each child. Beginning at their age level, each child was presented with four colored pictures arranged on a page, and they were instructed to point to the picture that best described the word verbalized by the experimenter. Testing on the PPVT took about 10-15 minutes per child. This test was normed on a sample of 3,540 participants between the ages of 2 years, 6 months and 90+ years, with diverse ethnic and socioeconomic backgrounds. Based upon literature investigating the development of reading comprehension and syntactic awareness, the PPVT has been shown to correlate significantly with reading comprehension skills (e.g., Adi-Japha, Berberich-Artzi, & Libnawi, 2010; Ben-Zeev, 1977; Bialystok & Feng, 2009; Bialystok et al., 2000; Bialystok et al., 2004; Bialystok et al., 2008b; Bialystok, 2010; Davidson et al., 2010; Martin-Rhee & Bialystok, 2008; Shwartz et al., 2005; Spira, Bracken, & Fischel, 2005; Swanson, Rosston, Gerber, & Solari, 2008).

Test de Vocabulario en Imagenes Peabody (TVIP; Dunn, Lugo, Padilla, & Dunn, 1986)

The TVIP, a norm-referenced Spanish version of the PPVT, was used to measure receptive vocabulary skills in Spanish. In a similar format as the PPVT-IV, bilingual children viewed arrangements of four pictures on a page, and they were asked in Spanish to indicate the picture depicting the word. This test was normed on a sample of participants between the ages of 2 years, 6 months and 18 years.

Timed Grammaticality Judgment Task to Measure Syntactic Awareness

A timed version of a grammaticality judgment task (adapted from Bialystok, 1986; Bialystok, 1992; Cromdal, 1999) was developed on Superlab Stimulus Presentation Software. Children heard sentences that were either grammatical and semantic (e.g., *The woman prepares the meal for her three children*), grammatical and containing a semantic anomaly (e.g., *The dog prepares the meal for its three books*), ungrammatical and semantic (e.g., *The woman prepare the meal for her three children*), or ungrammatical and containing a semantic anomaly (e.g., *The dog prepare the meal for its three books*). Although the semantics, or the meaning, of some of the sentences were misleading (e.g., *The dog prepare the meal for its three books*), these inconsistencies were to be ignored and the grammaticality of the sentence was to be evaluated.

Fifty sentence constructions were created in English for use with monolingual and bilingual participants. Fifty additional sentences were created in Spanish for use with the bilingual participants. The sentences were presented via audio recordings of a female voice with a speaking rate of 100 WPM, controlled randomly by SuperLab software. This program controlled prosodic presentation and randomization of the recorded sentence constructions, while accurately measuring reaction times. The ungrammatical sentences incorporated errors involving missing articles (e.g., I have never had cat, but I have had two dogs), word order problems (e.g., What the girls are doing?), past tense errors (e.g., I am knowing the answer), third person agreement (e.g., They was going to the beach), errors in plurality (e.g., Juan has five bird), and problems with use of the present progressive (e.g., Tomas is climb the tree).

The first eight training trials introduced children to the procedure and the testing equipment. The experimenter told each child that they would hear sentences and that they should respond with the correct answer as quickly as possible. They were instructed to press the green button with a smiley face to indicate a grammatically correct sentence and to press the red button with a frown face to indicate a grammatically incorrect sentence. Based on past research, during the training trials, the experimenter provided feedback on how to properly respond to the task (e.g., Bialystok, 1986; McDonald, 2008). After training, noise-cancelling headphones were worn by the children to block out environmental distractions. This task took approximately 10-15 minutes to administer to the monolingual children and approximately 20-30 minutes to administer to the bilingual children.

Delis-Kaplan Executive Function System-Trail Making Test (Delis, Kaplan, & Kramer, 2001)

The Trail Making Test was used as a measure of the children's cognitive flexibility, which has been used more recently in research and validated as a reliable indicator of executive control skills (e.g., Bialystok, 2010; Esposito & Baker-Ward, 2011; Sánchez-Cubillo et al., 2009). This test is comprised of five conditions, in which the researcher can also determine issues in visual scanning (Condition 1), number sequencing (Condition 2), letter sequencing (Condition 3) or motor speed (Condition 5). Condition 4 (the switching condition) was the main measure of cognitive flexibility. In Condition 1 (visual scanning), children were instructed to scan the page and mark off all the number threes that they could see as quickly as possible. In Condition 2 (number sequencing),

the children drew lines between circles containing numbers, while maintaining numerical order (i.e., 1, 2, 3…). In Condition 3 (letter sequencing), the children drew lines between circles containing letters, while maintaining alphabetical order (i.e., A, B, C…). In Condition 4 (switching condition), the children sequentially switched between number and letter circles, while maintaining both numerical and alphabetical order (i.e., 1-A-2-B-3-C…). In Condition 5 (motor speed), the children quickly traced a dotted line that connected open circles.

Flanker Task

This task assessed children's inhibitory control through a visual experiment created on Superlab Stimulus Presentation Software. Presented on a computer screen, the children had to indicate the direction of a red flanker fish surrounded by four other fish (adapted from Mezzacappa, 2004). They were instructed to press the colored button on the right hand side of the keyboard if the fish faced to the right and to press the colored button on the left side if the fish faced to the left. There were approximately 11 training trials, in which feedback on performance was given to the children. After training, 108 trials were then presented to the children with no feedback.

Fifty-percent of the trials were congruent (i.e., red fish matched the direction of the flanking fish) and 50% of the trials were incongruent (i.e., red fish faced a different direction than the flanking fish). Incongruent trials typically yield greater reaction times and less accurate responses than congruent trials, due to conflicting information from surrounding fish that must be inhibited. This would be even more so in 33% of the trials that created a dual conflict for the children (i.e., red fish faced a different direction as

flanking fish *and* appeared on the opposite side of the screen). The children were monitored during the testing to ensure both hands were on the keyboard throughout the duration of the task. Accuracy and reaction times in milliseconds on the trials were measured via Superlab. This task took approximately 10-15 minutes to administer.

Digit Span Task (Wechsler Intelligence Scale for Children-Fourth Edition, 2003; WISC-IV)

To assess working memory, the forward and backward digit span task were administered to all children, which took approximately 10-15 minutes. For the forward digit span task, the experimenter read a list of single-digit numbers in English at the rate of one digit per second, and the child repeated the digits in the same order. Starting with two digits, the task became progressively more difficult on every other trial by adding a digit to the span length. Testing ceased when the child was unable to reproduce both trials of the same span length. For the backward digit span task, the same procedure was in place, except the child was instructed to repeat the digits backward. Once again, testing ended when the child was unable to reproduce both trials within a span length.

Procedure

To calculate language broker status, bilingual children were administered the language usage questionnaire and their scores on this measure were calculated (i.e., language broker, non-broker) according to the guidelines of Dorner et al. (2007). Language proficiency levels of both monolingual and bilingual children were measured using the PPVT and the DIBELS. Additionally, bilingual children's Spanish language proficiency levels were examined using the Spanish equivalents of these tests, the TVIP

and the IDEL. Parents of all children filled out the parent questionnaire, which was returned with the parental consent form.

Both monolingual and bilingual children were then administered the timed grammaticality judgment task, the Trail Making Test, the Flanker Task, and the Digit Span Task, counterbalanced. The monolingual children were assessed in one session and the bilingual children were assessed across two sessions due to the extra testing demands (i.e., Spanish version of the timed grammaticality judgment task, Spanish language proficiency measures). All testing took place in a quiet location (e.g., library, empty classroom) in the child's school or after-school program. At the end of each testing session, children were compensated with colorful school supplies and a popular, age-appropriate book.

CHAPTER THREE

RESULTS

Demographic Measures

Approximately 19% (n = 7) of the children categorized as language brokers were considered active language brokers (i.e., translate eight or more things, with at least one thing being difficult, for an immediate family member every day in four or more locations), and the remaining 81% (n = 29) were considered partial language brokers. Children in the active and partial language broker groups were bilingual, and preliminary analyses confirmed no differences in language skills between the active and partial language brokers, $t(34) \leq 1.79$, $p \geq .05$, or in age, $t(34) = .58$, $p > .05$. Thus, the current analyses collapsed these children as one group. This decision was also supported by the fact that a main goal of this dissertation was to compare brokers to non-brokers, and that the active broker group was relatively small, as was expected at this age.

Next, the family demographics of the monolingual children were examined to confirm that children lived in a monolingual environment. Among the monolingual children, 38% (n = 10) came from families in which another language was known by one or more of the parents. However, the parents of these monolingual children stated in the parental consent form that their child spoke and understood only English. As an additional confirmation of monolingual status, children were asked before the testing

sessions if they spoke any another languages besides English, and these children responded that they did not.

Demographic Comparisons Between Language Groups

To assess potential differences between the language groups (i.e., monolinguals, brokers, non-brokers) with regard to socioeconomic status and language proficiency, preliminary chi-square analyses were conducted with the data. When assessing parental education, the results of a chi-square test indicated that there were no significant differences in the modal response (some college) between the language groups , χ^2 (2, N = 92) = 4.63, $p > .05$. When examining birth order, a significant difference was found between the proportions of children who were monolingual and those who were considered bilingual non-brokers, χ^2 (2, N = 92) = -2.22, $p = .03$ (see Figure 1), and no differences were found between the brokers and the non-brokers or the monolinguals and the brokers, χ^2 (2, N = 92) $\leq$ -1.66, $p > .05$. That is, the bilingual non-brokers contained more first-born children than the monolinguals. When examining the gender distributions, males and females were found to be equally distributed across monolinguals, brokers, and non-brokers, χ^2 (2, N = 92) = 1.07, $p > .05$.

When generational status of the groups was compared, only one of the children, a language broker, was a 1.5 generation immigrant (i.e., child was born in another country and immigrated to the United States under the age of 12). There were significantly more 2nd generation (i.e., child born in United States of immigrant parents) in the broker and non-broker groups than in the monolingual group, χ^2 (1, N = 92) $\geq$ -3.83, $p < .001$, a finding that was expected. No differences in proportion of 2nd generation children were

found between the brokers and the non-brokers, χ^2 (1, N = 92) = -.36, p > .05, ns. The monolingual children were mostly 3rd generation and later, χ^2 (1, N = 92) $\geq$ -3.48, p < .001 (see Figure 1).

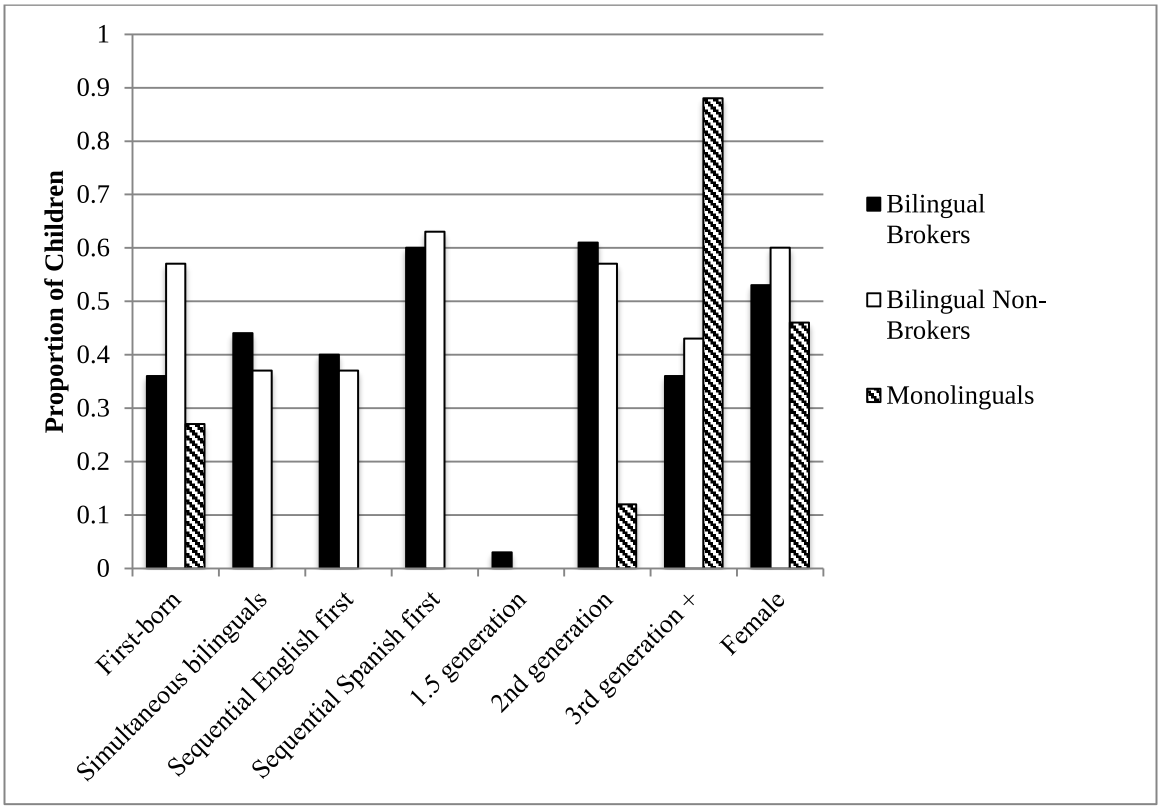

Figure 1. Characteristics of the language groups (bilingual brokers, bilingual non-brokers, monolinguals).

When assessing the bilingual language groups exclusively (i.e., the brokers vs. the non-brokers), no differences were found in the proportion of children who were simultaneous bilinguals (i.e., learned English and Spanish at the same time), χ^2 (1, N = 66) = -.64, p > .05. Furthermore, within the sequential bilinguals (those who learned one

language first), the proportion of children learning English or Spanish first was equally distributed across the brokers and non-brokers, χ^2 (1, N = 39) = -.36, p > .05. Although not statistically significant, Figure 1 shows that among a higher proportion of children, Spanish was the first language spoken by both bilingual groups of sequential bilinguals.

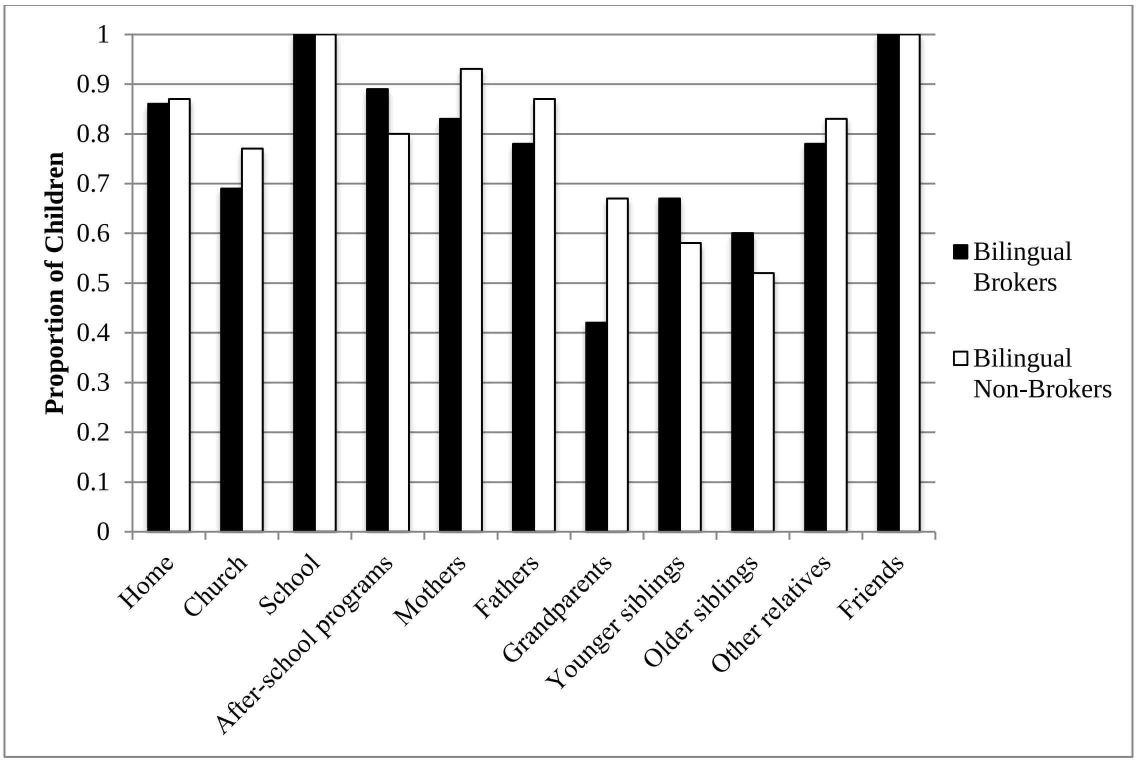

Figure 2. Where, and with whom, the bilingual children used English. Note that all children reported using English at school and with friends.

To assess potential language usage differences between the two bilingual groups (i.e., brokers, non-brokers), the child questionnaire data (assessing use of English and Spanish with different individuals and in different locations) was analyzed using a series of chi-square analyses. The only significant difference between the brokers and the non-

brokers was their use of English with grandparents, χ^2 (1, N = 66) = -2.01, p = .044, showing that the non-brokers used English more often with grandparents (see Figure 2). However, when examining Spanish language use differences, there were significant differences in use of Spanish with older siblings and teachers, χ^2 (1, N = 66) $\geq$ -1.99, $p <$ .049, showing that the brokers used Spanish more often with their older siblings and teachers (see Figure 3). Additionally, marginal differences between the groups were found in use of Spanish at church, at school and with younger siblings, χ^2 (1, N = 66) $\geq$ -1.89, $p <$ .059, trending towards the brokers using Spanish more often in these locations and with younger siblings. Overall, these findings suggest that the brokers tended to use Spanish in a wider range of environments. This finding was not unexpected. The brokers would be more likely to engage in greater use of Spanish across a wider range of contexts due to the role that they play in their families.

Literacy Environments of the Language Groups

Through the parent questionnaire, a description of each child's literacy environment was constructed. To assess potential language group differences in children's literacy environments, chi-square analyses were performed. No significant differences were found in English book availability between the language groups (i.e., monolingual, bilingual brokers, bilingual non-brokers), χ^2 (2, N = 92) = 2.99, $p > .05$, nor were there differences in Spanish book availability between the bilingual groups, χ^2 (1, N = 66) = -.59, $p > .05$, with most children owning between 31-70 books in English and less than ten books in Spanish.

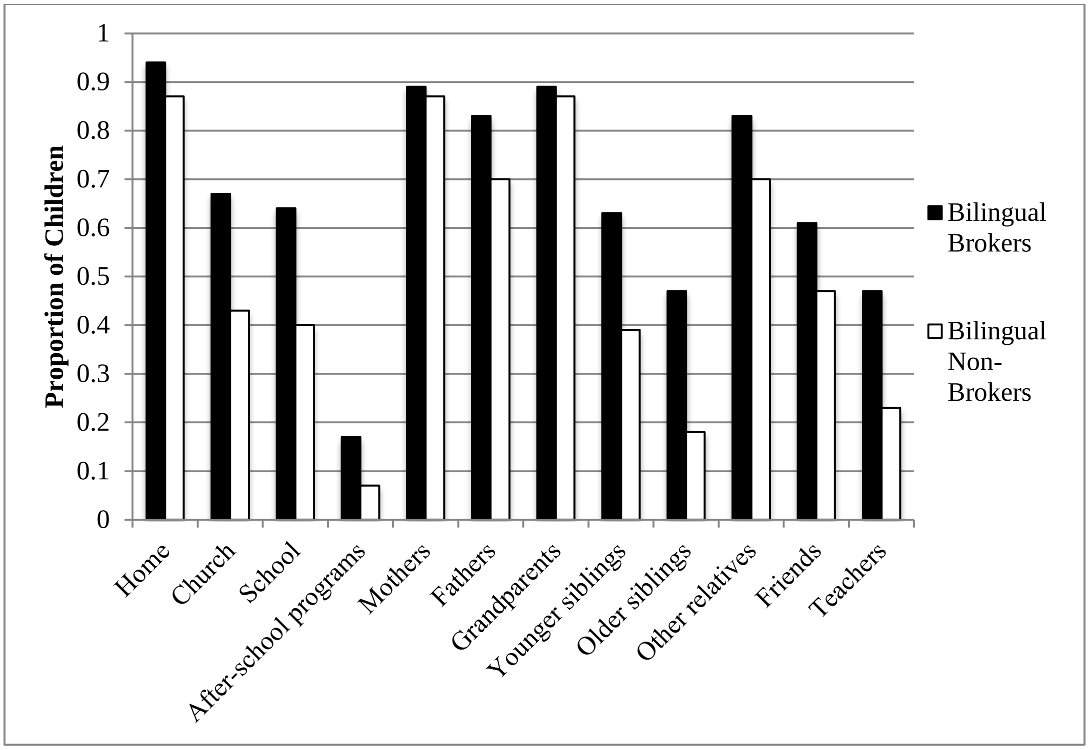

Figure 3. Where, and with whom, the bilingual children used Spanish.

To examine parent scaffolding of literacy activities in the home and any potential differences between the groups, analyses were conducted with the input from the parent questionnaire. No differences were found between the language groups with regard to the amount of time parents read to their child in English, the amount of time stories were told in English, or how often they took their child to the library, χ^2 (2, N = 92) $\leq$ 5.56, p > .05. Typically, parents took their children to the library twice a month, and literacy activities took place in the home about two-three times a week. Parents of all three language groups reported that their child read individually on a daily basis, χ^2 (2, N = 92) = 1.19, p > .05. When assessing Spanish literacy activities between the two bilingual groups, no differences were found, χ^2 (2, N = 66) $\leq$ 1.60, p > .05, with Spanish literacy

assistance occurring about once a week. These findings suggest that the various language groups investigated here did not receive more parental input and literacy support than each other.

Comparison of Language Proficiency Skills Between Language Groups

Children's vocabulary and reading fluency scores were compared across the language groups to test for differences in children's language proficiency. Examination of the distribution of these scores for normality found it to be within normal limits (skewness = -0.18). Using a one-way analysis of variance (ANOVA) with Language Group (monolingual, bilingual brokers, bilingual non-brokers) and Gender as between-subjects variables, no significant differences in standardized English receptive vocabulary scores on the PPVT-IV were found, $F(2, 86) \leq 0.98$, $p > .05$ (see Table 1). When using children's DIBELS English reading fluency scores as the dependent variable in a similar analysis, no differences were found between the language groups, $F(2, 86) \leq 1.16$, $p > .05$. In a similar manner, no differences were found in the bilingual children's standardized TVIP scores or IDEL scores, $F(1, 62) \leq 1.81$, $p > .05$, which assess Spanish vocabulary and reading fluency, respectively (see Table 1).

As was calculated by Bialystok and Barac (2012), balance ratios were calculated for the receptive vocabulary and reading fluency scores by dividing the Spanish score by the English score, with a score of one indicating perfect balance (e.g., Bialystok & Barac, 2012). As can be seen in Table 1, no differences were found in the balance ratios between the two bilingual groups, indicating that the children had a similar balance in bilingualism across the groups, $F(1, 62) \leq 2.59$, $p > .05$. From these preliminary

language skill analyses, it can be safely concluded that the two bilingual groups have similar language skills.

Table 1. Mean Receptive Vocabulary and Reading Fluency Scores in English and Spanish

	English	Spanish	Balance Ratio
	Receptive Vocabulary Scores (Standardized)		
Monolinguals	95.04 (15.54)	-	-
Bilingual Non-Brokers	97.27 (12.13)	70.80 (15.06)	.74 (.18)
Bilingual Brokers	94.61 (16.34)	77.03 (19.93)	.84 (.30)
	Reading Fluency Scores (Median)		
Monolinguals	109.85 (27.58)	-	-
Bilingual Non-Brokers	120.60 (35.19)	41.97 (28.51)	.33 (.18)
Bilingual Brokers	109.86 (36.41)	46.14 (31.01)	.40 (.22)

Note. Standard deviations are in parentheses. Higher scores indicate greater skills. The receptive vocabulary measures are standardized with a mean of 100 and a standard deviation of 15. For the reading fluency scores, a score of 0-79 indicates an "at risk" group, a score of 80-109 indicates "some risk" and 110 and above indicate "low risk." The balance ratios were calculated by dividing the Spanish scores by the English scores, in which a score of one would indicate perfect balance.

Syntactic Awareness Measured on a Timed Grammaticality Judgment Task

It was expected that the bilingual children, especially the language brokers, would have greater accuracy and efficiency on the English timed grammaticality judgment task, a task incorporated because of its complexity and ability to measure syntactic awareness at this age. To examine the way in which level of vocabulary knowledge would interact

with these variables, vocabulary level was also included in the analyses. These hypotheses were tested through moderated regression analyses, allowing for receptive vocabulary scores to interact with the language group in the prediction of performance on the English timed grammaticality judgment task. The dataset were checked for missing data, and one monolingual child's data was not included in the following analyses due to technical errors encountered during testing.

Children's Accuracy on the English Timed Grammaticality Judgment Task

To first test any differences that may be present between the groups with regard to the children's accuracy, a moderated regression model was conducted using children's accuracy on the English timed grammaticality judgment task as the criterion variable. Each child's accuracy score was computed by dividing the number of correct responses by the total number of trials. Children's accuracy data were examined for outliers and normality of distribution, and were found to be normally distributed with no outliers (skewness = -0.42). Preliminary analyses showed no effects of gender, so this variable was excluded from the following analyses. Mean-centered predictor variables of PPVT Score and contrast-coded Language Group (bilingual brokers, bilingual non-brokers, monolinguals) were entered into the model. As vocabulary knowledge may be a confounding factor in completion of this task, this variable was included in the analyses to examine its influence on the criterion variable. The interaction term using mean-centered variables (PPVT Score X Language Group) was then added to the model to examine the association with children's accuracy (see Table 2 for means and correlations). This interaction term was not only driven by the specific hypotheses of the study, but also

due to the widely-documented linkages of receptive vocabulary knowledge to syntactic awareness in children (e.g., Bowey & Patel, 1988; Carlisle et al., 1999; Da Fontoura & Siegel, 1995). To successfully complete the task, a certain level of vocabulary knowledge is necessary to understand the sentences presented to the children. This was particularly relevant in assessing bilingual differences that may only be apparent when comparing children at differing levels of prior vocabulary knowledge.

As shown in Table 1, there were no initial differences between the language groups in their PPVT scores, however, there was a linkage between PPVT scores and children's accuracy. A higher PPVT score (i.e., greater vocabulary knowledge) was associated with greater accuracy on the English grammaticality judgment task ($\Delta R^2 = .30$, $\Delta F(1, 89) = 37.72$, $p < .001$, $\beta = .55$, $p < .001$). However, there was no significant increase in the R^2 with the addition of the PPVT Score X Language Group interaction term, $\Delta R^2 = .009$, $\Delta F(1, 86) = 1.11$, $p > .05$. This regression, using accuracy as the criterion variable, indicated no language group differences, nor any interactions of PPVT Score X Language Group, in accuracy on the English timed grammaticality judgment task.

Children's Reaction Times to the English Timed Grammaticality Judgment Task

Next, processing speed differences, which accounted for speed-accuracy trade-offs were examined. It was predicted that the monolingual children would respond less rapidly than the bilinguals when solving this task, especially the language brokers. Inverse efficiency scores on this task were calculated by dividing the children's mean reaction times of the correct trials by their accuracy, providing a basis for processing

efficiency independent of possible speed-accuracy trade-offs (i.e., Mean Reaction Time/Accuracy). This method of merging both accuracy and reaction time data is a standard method used in past research to account for speed-accuracy tradeoffs in reaction time data (e.g., Anzures, Ge, Wang, Itakura, & Lee, 2010; Goffaux, Hault, Michel, Vuong, & Rossion, 2005; Salthouse & Hedden, 2002; Townsend & Ashby, 1978; Yang et al., 2011).

Table 2. Mean Scores and Correlations Between the Predictor and Criterion Variables Predicting Children's Performance on the English and Spanish Timed Grammaticality Judgment Tasks

		English version		Spanish version	
		Mean (Standard Deviation)	PPVT Score Correlation	Mean (Standard Deviation)	TVIP Score Correlation
Brokers					
	Accuracy	.74 (.13)	.66**	.66 (.13)	.60**
	IE	22.15 (15.18)	-.66**	14.08 (7.55)	-.35*
Non-Brokers					
	Accuracy	.74 (.13)	.45*	.59 (.13)	.67**
	IE	19.61 (9.22)	-.32	18.48 (10.03)	-.07
Monolinguals					
	Accuracy	.73 (.10)	.48*	-	-
	IE	18.32 (8.62)	-.09	-	-

Note. IE = Inverse Efficiency. A lower IE score indicates better performance on the grammaticality judgment task. ** = $p < .01$, * = $p < .05$

The distribution of the children's inverse efficiency was positively skewed (i.e., towards longer reaction times), possibly due to distractions the children may have encountered (e.g., inattention, computer error, or uncontrollable external interruptions). To deal with extreme outliers in individual trials, Tukey's method of winsorization was employed (Tukey, 1977; Lachaud & Renaud, 2011), much like past research (e.g., Prior & Gollan, 2011). This method of winsorization transformed approximately 4.84% of the trials outside of the interquartile range (i.e., the difference between the upper and lower quartiles) to extreme values at the upper and lower quartiles. This method was chosen because it is robust to extreme observations and maintains power in relatively small datasets (Tukey, 1977; Lachaud & Renaud, 2011). Through this method, the skewness was brought to an acceptable level (skewness = 0.85). Preliminary analyses showed no effects of gender, so this variable was excluded from the following analyses.

Inverse efficiency scores based on the English grammaticality judgment task were entered as the criterion variable in a moderated multiple regression model, with mean-centered PPVT Score and contrast-coded Language Group (bilingual brokers, bilingual non-brokers, monolinguals) entered as predictor variables. The interaction term derived using mean-centered data (PPVT Score X Language Group) was then added to the model to examine the change in R^2 (see Table 2 for means and correlations).

Initially, there was a significant increment in R^2 when PPVT Score was entered into the model, $\Delta R^2 = .21$, ΔF (1, 89) = 23.26, $p < .001$, indicating that PPVT Score significantly predicted inverse efficiency scores on the English timed grammaticality judgment task. That is, a better PPVT score predicted a lower (i.e., more rapid) inverse

efficiency score on the English grammaticality judgment task (β = -.46, p < .001). The addition of the two-way interaction of PPVT Score X Language Group (brokers vs. non-brokers and monolinguals) resulted in a significant increase in R^2, $\Delta R^2 = .09$, ΔF (1, 86) = 11.68, p = .001, however, this was not significant for the interaction term contrasting bilingual non-brokers and monolinguals, $\Delta R^2 = .01$, ΔF (1, 85) = 0.91, p > .05. With all significant predictor variables and interaction terms in the model, R^2 was significant, F(9, 78) = 7.67, p < .001. Together these predictors accounted for 32.3% of the variance in the inverse efficiency scores based on the English timed grammaticality judgment task.

The plot of the interaction term revealed that bilingual brokers' ability to efficiently complete the English grammaticality judgment task was significantly higher (i.e., indicating poorer performance) for those who scored lower on the PPVT (see Figure 4), t(85) = -5.96, p < .001. However, for the bilingual non-brokers and the monolingual children, efficiency on the English grammaticality judgment task did not differ significantly with regards to PPVT Score, $t(85) \leq -1.57$, p > .05 (see Figure 4). Although this suggests differences among the three language groups, it is unknown if there are group differences at different levels of vocabulary knowledge.

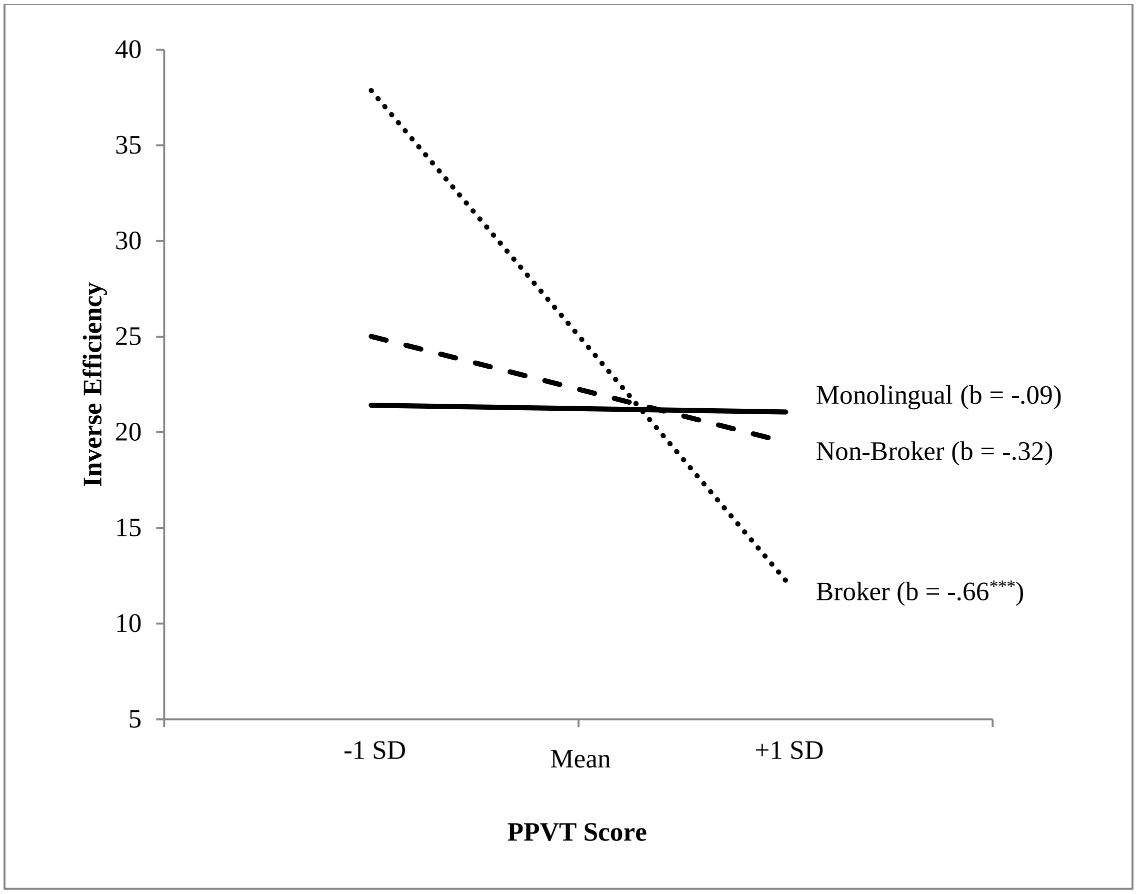

Figure 4. The interaction of PPVT score and language group in the prediction of performance on the English grammaticality judgment task. A greater PPVT score indicates better performance on the vocabulary test and lower inverse efficiency scores indicate more efficient performance, accounting for speed-accuracy trade-offs.
***$p < .001$

A post-hoc ANOVA test was then conducted to examine the differences between the language groups at higher and lower levels of vocabulary knowledge by creating a median split on PPVT score. Roughly equal groups of low versus high scorers were distributed across the three language groups, χ^2 (2, N = 45) $\leq$ 1.00, $p > .05$. To test these differences, a one-way ANOVA was conducted using the inverse efficiency score on the

English timed grammaticality judgment task as the dependent variable and language group (monolingual, bilingual brokers, bilingual non-brokers) and PPVT score (high, low) as between-subjects variables. A significant interaction of Language Group X PPVT Score was revealed, $F(2, 85) = 3.15$, $p = .048$, partial $\eta^2 = .07$ (see Figure 5). Follow-up testing found that within the low PPVT scorers, a marginal difference existed between the brokers and the monolinguals, $t(35) = 2.20$, $p = .063$, suggesting that the brokers took longer to complete the task at lower levels of vocabulary knowledge. Differences were not apparent between the other groups, $t(33) \leq -1.35$, $p > .05$. However, when the language groups were compared within the high PPVT scorers, the opposite trend was found (see Figure 5). That is, the brokers were more efficient processors on this task than the monolinguals, although also at a marginal level, $t(22) = -1.78$, $p = .089$. Differences between the other language groups were not found, $t(22) \leq -1.19$, $p > .05$.

This interaction finding suggests that bilingual advantages are conditional upon vocabulary knowledge and language brokering experience. When vocabulary scores were stronger across the groups, the bilingual brokers outperformed both the monolingual children. However, the bilingual brokers were negatively affected when vocabulary knowledge was not as strong, in which processing speed was compromised.

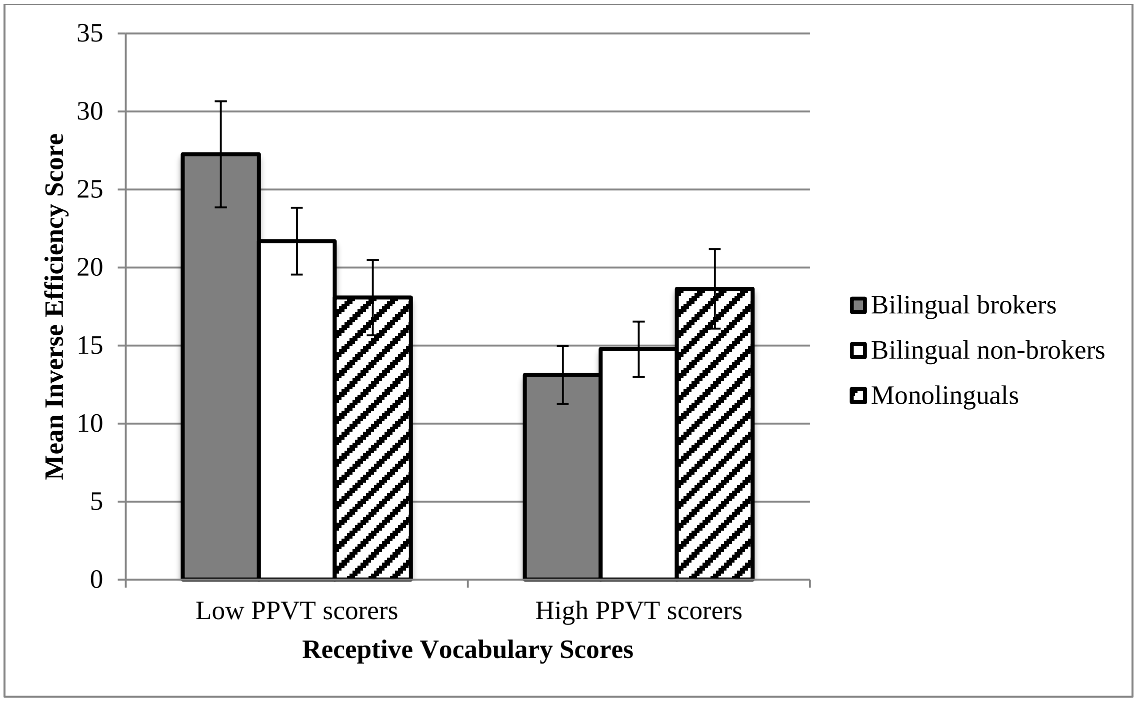

Figure 5. Children's mean inverse efficiency scores on the English syntactic awareness task as a function of language group and English receptive vocabulary skills. Note that lower scores indicate more efficient processing, adjusted for speed-accuracy trade-offs.

Children's Accuracy on the Spanish Timed Grammaticality Judgment Task

To find potential group differences in Spanish syntactic awareness, the bilingual children were given a Spanish version of the timed grammaticality judgment task, using an alternative set of sentences. It was predicted that the bilingual brokers would outperform the non-brokers on this task. To initially test differences in children's accuracy between the groups, a moderated regression model, similar to the one examining English scores, was conducted using children's accuracy on the task as the criterion variable. Accuracy scores were derived by dividing the number of correct responses to the task by the total number of trials. The accuracy data were initially

examined for outliers and normality of distribution. No outliers were detected, and a normal distribution of responses was found (skewness = -0.13). Preliminary analyses showed no effects of gender, so this variable was not included in the following analyses. The TVIP Score and a contrast-coded Language Group variable (bilingual brokers, bilingual non-brokers) were entered as mean-centered variables into the model. The mean-centered interaction term (TVIP Score X Language Group) was then added to the model (see Table 2 for means and correlations).

Initially, TVIP Score significantly predicted accuracy scores, $\Delta R^2 = .40$, $\Delta F(1, 64) = 43.19$, $p < .001$, with a higher TVIP score (i.e., better Spanish vocabulary knowledge) associated with greater accuracy on the Spanish grammaticality judgment task ($\beta = .64$, $p < .001$), which was expected. There was also a marginally significant increment when language group was entered into the model, $\Delta R^2 = .03$, $\Delta F(1, 63) = 3.40$, $p = .070$, indicating that the brokers were more accurate than the non-brokers on the Spanish grammaticality judgment task ($\beta = -18$). The addition of the TVIP Score X Language Group interaction term was not significantly related to children's accuracy scores, $\Delta R^2 = .01$, $\Delta F(1, 62) = 1.55$, $p > .05$, suggesting that Spanish vocabulary knowledge did not interact with the language group in the prediction of accuracy. However, the results of this test must be viewed cautiously, as accuracy scores were relatively low on the Spanish version of this test (refer to Table 2). The timed version of this task in Spanish may have been quite difficult due to its minority language status (refer to Table 1).

Children's Reaction Times to the Spanish Timed Grammaticality Judgment Task

Next, reaction time data was examined in a subsequent moderated regression model. As with the English version, to examine processing efficiency independent of speed-accuracy tradeoffs, inverse efficiency scores were computed to merge accuracy with reaction times on the trials (Townsend & Ashby, 1978; Yang et al., 2011). Data were checked for missing values and normality of distribution. As with most reaction time measurements, the data were positively skewed, and individual trials were winsorized using Tukey's guidelines, transforming approximately 4.7% of the trials to upper or lower quartiles (Tukey, 1977; Lachaud & Renaud, 2011). As a result, the skewness was reduced to an acceptable level (skewness = 0.93).

Children's inverse efficiency score on the Spanish grammaticality judgment task was entered as the criterion variable in a moderated regression model, and a mean-centered TVIP Score and a contrast-coded Language Group variable (bilingual brokers, bilingual non-brokers) were initially entered as predictors. The interaction between TVIP Score and Language Group, derived using mean-centered data, was subsequently entered into the model to examine whether its addition was related to a change in the R^2 (see Table 2 for means and correlations).

When TVIP Scores were entered into the model, there was a significant increment in the R^2, $\Delta R^2 = .06$, $\Delta F(1, 64) = 4.21$, $p = .044$, indicating that TVIP score significantly predicted inverse efficiency scores on the Spanish timed grammaticality judgment task. In other words, a greater TVIP score (i.e., wider Spanish vocabulary) predicted a more efficient score on the Spanish grammaticality judgment task ($\beta = -.25$, p

= .044). Although only at marginal levels, with the addition of language groups to the model, there was an increment in the R^2, $\Delta R^2 = .04$, $\Delta F(1, 63) = 3.00$, $p = .088$, indicating that the brokers had marginally lower inverse efficiency scores than the non-brokers on the task ($\beta = .21$, $p = .088$). Similarly, the TVIP Score X Language Group interaction did not significantly predict children's inverse efficiency scores, $\Delta R^2 = .01$, $\Delta F(1, 62) = 0.45$, $p > .05$.

Overall, across the syntactic awareness tasks, it can be seen that there are significant advantages for the brokers, dependent upon certain conditions. When assessed in English, these advantages were dependent on the level of English vocabulary knowledge and were seen exclusively in the inverse efficiency scores. At higher levels of English vocabulary levels, the brokers were more efficient on the English syntactic awareness task. In the Spanish version, a main effect of language broker status was found in both the accuracy scores and the inverse efficiency scores, however, only at marginal levels.

Executive Function Measures

To examine potential executive function differences between the groups, analyses were conducted on the tests of the three core areas of executive function (i.e., cognitive flexibility, inhibition, working memory). It was predicted that the bilingual children, particularly the bilingual brokers, would outperform the monolingual children in all three areas of executive function due to practiced use of nonverbal functions to manage language conflict.

Cognitive Flexibility Assessed Through the Trail Making Test

Performance on the D-KEFS Trail Making Test was examined to assess language group differences in cognitive flexibility. To first test for initial problems in these areas, preliminary ANOVA analyses were conducted using the inverse efficiency for each condition as the dependent variable and Language Group (monolingual, bilingual brokers, bilingual non-brokers) and Gender as between-subjects variables.

From these preliminary analyses, no differences were found between the language groups on the visual scanning trail, in which children had to scan the pages and mark off a certain number, suggesting no issues with visual scanning (condition 1) between the groups, $F(2, 86) \leq 2.11$, $p > .05$. Furthermore, when the analyses for the number and letter sequencing trails were conducted, no significant differences were found between the language groups as well, $F(2, 86) \leq 1.13$, $p > .05$, suggesting that children in the language groups did not differ in their ability to sequence numbers or letters (conditions 2 and 3). Finally, no differences were found in overall motor speed (condition 5) when connecting empty circles, suggesting no initial motor speed differences between the language groups, $F(2, 86) \leq 1.57$, $p > .05$. From these preliminary tests, it can be seen that differences in the switching trail cannot be attributed to initial differences between the language groups in visual scanning abilities, number or letter sequencing abilities, or motor speed. Of main interest in the Trail Making Test battery was performance on the switching trail (i.e., condition 4), in which the children rapidly connected circles while switching between numbers and letters (e.g., 1-A-2-B-3-C, etc.).

Differences in errors on the switching condition of the Trail Making Test. It was predicted that the bilingual children, particularly the brokers would have fewer errors than the monolingual children on the switching trail of the Trail Making Test. Sequential errors (e.g., 1-A-2-B-3-***D***) and set-loss errors (e.g., 1-A-2-B-3-***4***) were summed and converted to a scaled score, according to the D-KEFS manual. The data were checked for missing values and outliers, and the distribution of the scores was checked for normality. There were no missing data, and there was a normal distribution of scores (skewness = -0.94). To test for differences in scaled score error rates on this condition, an ANOVA was conducted, with Language Group (monolingual, bilingual brokers, bilingual non-brokers) and Gender as between-subjects variables. Planned comparisons were used to test a priori hypotheses that differences would lie between the language groups (as used in Bialystok et al., 2010; Tabachnick & Fidell, 2007). These comparisons revealed no significant Language Group differences, $t(89) \leq 0.96$, $p > .05$ (see Table 3).

Differences in children's completion time on the switching condition of the Trail Making Test. As no bilingual advantages were found in the errors on the switching trail of the Trail Making Test, potential differences in children's completion time were subsequently examined. Completion times on the switching condition were first converted to a scaled score according to the D-KEFS manual, and this score was used as the dependent variable in a priori contrasts between the language groups, embedded within an ANOVA framework. Language Group (monolingual, bilingual brokers, bilingual non-brokers) and Gender were used as between-subjects variables.

Initially, the data were checked for outliers and normality of distribution, yielding a normal distribution and no outliers (skewness = -0.48).

Table 3. Error and Efficiency Scores on the Switching Condition of the Trail Making Test

	Error Rate (Scaled)	Completion Time (Scaled)	Interference Ratio	Inverse Efficiency
Monolinguals	10.42 (1.60)	7.77 (4.16)[a]	1.97 (1.36)[a]	1.80 (0.72)[a]
Bilingual Non-Brokers	10.50 (1.64)	8.13 (3.79)[a]	1.93 (0.94)[a]	1.77 (0.82)[a]
Bilingual Brokers	10.44 (1.65)	10.00 (3.41)[a]	1.26 (0.81)[a]	1.42 (0.58)[a]

Note. Standard deviations are in parentheses. A higher scaled score indicates better performance, and a lower inverse efficiency score or interference ratio indicates better performance. Scaled scores range from 1-19.
[a] = between-subjects effects

Planned comparisons confirmed the hypothesis that the bilingual brokers would have better scaled scores than both the non-brokers and the monolinguals, $t(89) \geq -2.01$, $p \leq .048$ (see Figure 6), $F(2, 86) = 3.40$, $p = .038$, partial $\eta^2 = .07$. No differences were found between the non-brokers and the monolinguals, $t(89) = 0.72$, $p > .05$. No additional main effects or interactions were reflected in the omnibus ANOVA, $F(2, 86) \leq 0.55$, $p > .05$. This finding is partially in line with the prediction that the bilingual

brokers would outperform the other language groups on this task. Specifically, language group differences were only apparent in the children's time to complete the task, with the brokers outperforming the other groups.

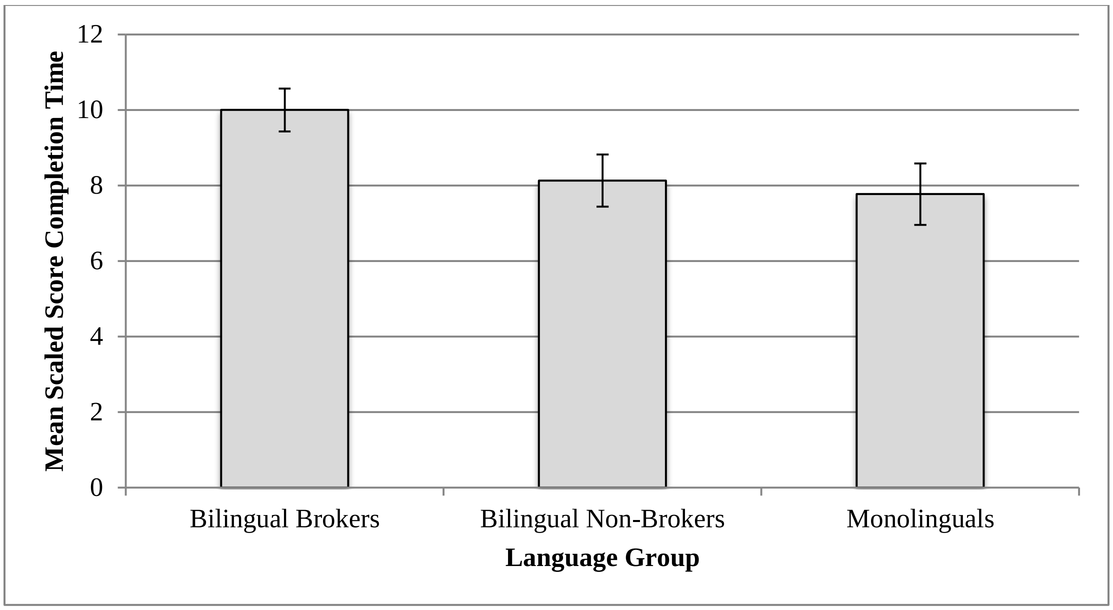

Figure 6. Children's scaled completion time (scale= 1-19) on the switching trail of the Trail Making Test as a function of language group. Note that higher scores signify better performance.

Although predicted language group differences were found, it could be argued that scaled score completion times do not accurately account for speed-accuracy trade-offs, mainly because the children could have completed the task quickly with no regard to accuracy. To resolve this issue, the completion time scores were examined in a subsequent ANOVA by merging the children's accuracy with their completion time. To

calculate the dependent variable, the completion time on the switching trail was divided by the child's accuracy, yielding an inverse efficiency score (Townsend & Ashby, 1978; Yang et al., 2011). A higher inverse efficiency score signified poorer performance, in comparison to other participants. This method of merging accuracy and completion time has been used to successfully isolate speed-accuracy tradeoffs (e.g., Yang et al., 2011). A similar ANOVA with planned contrasts between the language groups was conducted using this inverse efficiency score as the dependent variable and Language Group (monolingual, bilingual brokers, bilingual non-brokers) and Gender as between-subjects variables.

Similar to the scaled score data, contrasts confirmed hypotheses that the brokers would be significantly more efficient than both the non-brokers and the monolinguals, $t(89) \geq 1.98$, $p \leq .051$ (see Table 3 for means), $F(2, 86) = 3.18$, $p = .046$, partial $\eta^2 = .07$. The non-brokers and the monolinguals were not significantly different from each other, $t(89) = -0.17$, $p > .05$. No additional main effects or interactions were found in the omnibus ANOVA test, $F(2, 86) = 1.21$, $p > .05$. Similar to Figure 6, the bilingual brokers were more efficient processors on the switching condition of the Trail Making Test than both the bilingual non-brokers and the monolingual children.

In spite of these findings, it could also be argued that these calculations do not properly isolate shifting costs on this task. To explore this issue, shifting differences between groups were isolated by calculating an interference ratio [(switching trail completion time – letter sequencing trail completion time)/switching trail completion time]. This calculation allowed for an estimation of the interference created by the

shifting demands of the switching trail (Esposito & Baker-Ward, 2011). A similar set of planned contrasts embedded in an ANOVA were then conducted, using this Interference Ratio as the dependent variable, with Language Group (monolingual, bilingual brokers, bilingual non-brokers) and Gender as between-subjects variables.

Similar to the scaled score and inverse efficiency results, the planned contrasts confirmed the a priori contrasts, showing that the brokers had significantly less interference than both the non-brokers and the monolinguals, $t(89) \geq 2.64$, $p \leq .010$ (see Table 3), $F(2, 86) = 5.31$, $p = .007$, partial $\eta^2 = .11$. No differences were found between the non-brokers and the monolingual children, $t(89) = -0.15$, $p > .05$. Similar to Figure 6, the bilingual brokers had significantly less interference from the switching conditions than both the bilingual non-brokers and the monolingual children. Overall, these findings point to bilingual advantages in cognitive flexibility when the child is a language broker.

Inhibitory Control Measured Through the Flanker Task

To examine potential differences between language groups in inhibitory control, children's performance on the Flanker Task was analyzed. The first analysis focused on children's accuracy on this task, followed by an assessment of reaction time. It was predicted that the bilingual children, particularly the language brokers, would execute the Flanker Task more accurately and more efficiently than the monolingual children.

Children's accuracy on the Flanker Task. Accuracy rates were measured on the Flanker Task by dividing the number of correctly identified trials by the total number of trials. The within-subjects variable on a mixed-model ANOVA was Type of Trial (congruent trials, incongruent trials, dual conflict trials) and the between-subjects

variables were Language Group (monolingual, bilingual brokers, bilingual non-brokers) and Gender. A priori contrasts were set up to test the hypothesis that the bilingual groups, especially the brokers, would be more accurate on this task. Type of Trial was used as a within-subjects variable to see if the trial type might interact with language group (e.g., brokers may be better at the inconsistent trials). Note that the congruent trials were those in which the fish all faced the same direction and the incongruent trials were those in which the flanking fish were facing the opposite direction. The dual conflict trials were those in which the target fish was facing the opposite direction as the flanking fish and was on the opposite side of the screen as the correct response button.

Through this analysis, a priori hypotheses were not confirmed, $t(89) \leq -.91$, $p > .05$, with the omnibus ANOVA only showing a main effect of the Type of Trial, $F(2, 172) = 25.41$, $p < .001$, partial $\eta^2 = .23$, and no interaction effects, $F(2, 172) \leq 1.56$, $p > .05$ (see Table 4). Post-hoc Bonferroni tests revealed a significant difference between children's accuracy on the dual conflict trials and the congruent trials, $t(91) = 5.11$, $p = .001$, as well as the dual conflict trials and the incongruent trials, $t(91) = 5.82$, $p < .001$, but no differences between the congruent and incongruent trials, $t(91) = 1.33$, $p > .05$. The lack of language group differences does not support the hypothesis that language group differences would be found in the children's inhibitory control skills. To examine this data further, the children's reaction times to this measure were assessed in a subsequent ANOVA.

Children's reaction time performance on the Flanker Task. Although no differences were found between the groups on accuracy, potential differences in processing speed was examined next. Prior to analysis, reaction time data were checked for missing values and outliers, and no missing data were found. To deal with individual reaction time outliers, Tukey's method was used to trim the data, which is a robust method to deal with positively skewed data. These may have been apparent due to interruptions in testing, such as inattention, computer error, or uncontrollable external interruptions. This method, which eliminates responses outside of the interquartile range, is robust to extreme observations trimmed approximately 7% of the trials (Tukey, 1977; Lachaud & Renaud, 2011). Upon inspection of the data, the skewness was brought to an acceptable level, and the distribution of the children was also normally distributed (skewness = 0.58).

A mixed-model ANOVA was conducted with the children's Inverse Efficiency Score as the dependent variable. Inverse efficiency scores were computed by dividing the mean reaction times of the correct trials by accuracy, allowing for speed-accuracy trade-offs (Townsend & Ashby, 1978; Yang et al., 2011). This was an important component of this task because the children could have quickly completed the task with no regard for their accuracy. The within-subjects variable was the Type of Trial (congruent trials, incongruent trials, dual conflict trials) and the between-subjects variables were Language Group (monolingual, bilingual brokers, bilingual non-brokers) and Gender. As with the accuracy scores, a priori contrasts were conducted to test the

hypothesis that the bilingual groups, particularly the brokers, would be more efficient processors on this task of inhibitory control.

Table 4. Children's Accuracy and Inverse Efficiency Scores on the Flanker Task Used to Assess Inhibitory Control

	Congruent Trials	Incongruent Trials	Dual Conflict Trials
		Accuracy	
Monolinguals	.92 (.08)	.92 (.10)	.86 (.16)
Bilingual Non-Brokers	.89 (.16)	.88 (.14)	.83 (.18)
Bilingual Brokers	.90 (.17)	.89 (.19)	.86 (.21)
Mean Totals	.90 (.15)[b]	.89 (.15)[b]	.85 (.18)[b]
		Inverse Efficiency	
Monolinguals	10.18 (1.82)	10.69 (2.33)	12.51 (4.42)
Bilingual Non-Brokers	12.13 (7.58)	12.02 (4.98)	14.17 (9.21)
Bilingual Brokers	12.06 (6.92)	14.22 (17.32)	14.61 (15.37)
Mean Totals	11.55 (6.19)[b]	12.51 (11.27)[b]	13.86 (11.08)[b]

Note. Standard deviations are in parentheses. A lower inverse efficiency score indicates better performance. [b] = within-subjects effects.

The ANOVA was used to examine interactions with the language group and the type of trial. Once again, the contrasts were not significant, $t(89) \leq 1.38$, $p > .05$, and only a main effect of Type of Trial (congruent trials, incongruent trials, dual conflict trials) was found in the omnibus test, $F(2, 170) = 8.09$, $p < .001$, partial $\eta^2 = .09$ (see

Table 4). Follow-up t-tests revealed that reaction times were significant between the dual conflict trials and both the congruent and incongruent trials, $t(90) > -2.82$, $p \leq .006$, but not between the congruent and incongruent trials, $t(91) = -1.25$, $p > .05$. Overall, the children were most efficient in the congruent trials, followed by the incongruent trials, and the dual conflict trials. No language group differences or interactions were found, $F(2, 170) \leq 0.59$, $p > .05$. As with the accuracy data, these findings do not support the hypotheses that the bilingual children would show bilingual advantages in processing speed on the inhibitory control task, even for the language brokers.

Children's Working Memory Assessed Through the Digit Span Task

To assess working memory, the children's digit span lengths were assessed using a mixed-model ANOVA. It was predicted that the bilinguals, particularly the brokers, would have a larger digit span length on this task. In this analysis, the child's Digit Span Length (forward digit span length, backward digit span length) was entered as the within-subjects variable and Language Group (monolingual, bilingual brokers, bilingual non-brokers) and Gender were between-subjects variables. A priori planned contrasts were conducted to test the hypothesis that the bilinguals, especially the brokers, would have a better digit span length than their monolingual peers. Forward and backward digit span length were calculated by adding the number of correctly recalled digits from the forward and backward digit span tasks. No missing values were found when data were checked for missing values and outliers, and the data had a normal distribution (skewness = 0.53).

From these analyses, the planned contrasts did not support the hypothesis that the bilingual groups would outperform the other groups, $t(89) \leq 0.77$, $p > .05$, and only a

within-subjects effect of Digit Span Length was found, $F(1, 86) = 61.08$, $p < .001$, partial $\eta^2 = .42$ (see Table 5). Specifically, the children overall recalled more digits when they were asked to recall the digits forward than when they were asked to recall them in a backward manner. No language group or interaction effects were found in the omnibus test, $F(2, 86) \leq 0.80$, $p > .05$, lending no support to the hypothesis that the bilingual groups, especially the brokers, would outperform the monolingual group on a test of working memory.

Overall, on the executive function tasks, there were language group differences found only within the processing speed on the cognitive flexibility test. That is, the language brokers were more efficient processors on this There were no differences in accuracy on this test, nor were there any language group differences on the measure of inhibitory control or working memory.

Table 5. Children's Forward and Backward Digit Span Lengths Derived from the Digit Span Task (WISC-IV)

	Forward	Backward
Monolinguals	4.54 (0.71)	3.54 (0.71)
Bilingual Non-Brokers	4.53 (0.68)	3.53 (0.68)
Bilingual Brokers	4.53 (0.84)	3.53 (0.84)
Mean Totals	4.53 (0.75)[b]	3.53 (0.75)[b]

Note. Standard deviations are in parentheses. Forward and backward digit span maximum score = 9, 8, respectively. [b] = within-subjects effect

Linkages Between Executive Function Performance and the English Timed Grammaticality Judgment Task

In addition to specific hypotheses for the syntactic awareness and executive function tasks, it was further predicted that the children's performance on the English timed grammaticality judgment task would be linked to their performance on the executive function tasks (i.e., Trail Making Test that measured cognitive flexibility, Flanker Task that measured inhibitory control, and Digit Span Task that measured working memory). Specifically, this hypothesis predicted that this relationship would be moderated by language group (i.e., bilingual broker, bilingual non-broker, monolingual), thereby showing linkages between verbal and non-verbal tasks within each language group.

To test these hypotheses, a moderated multiple regression analysis was conducted on the data, with processing speed (i.e., inverse efficiency score) on the English timed grammaticality judgment task entered as the criterion variable. This analysis was chosen due to the continuous nature of the data. Four mean-centered predictor variables (Trail Making Test Inverse Efficiency Score, Flanker Task Inverse Efficiency Score, Backward Digit Span Length, and PPVT Score) and contrast-coded Language Group (bilingual brokers, bilingual non-brokers, monolinguals) were added into the model.

Table 6. Means and Correlations for all Predictor and Criterion Variables Predicting Children's Performance on the English Grammaticality Judgment Task

Variable	*M (SD)*	1	2	3	4	5
			Brokers			
1. Trail Making Test IE	1.42 (0.58)	-	.04	-.29	-.59**	.53**
2. Flanker Task IE	11.27 (4.28)		-	-.39*	-.01	.09
3. Backward Digit Span	3.53 (0.84)			-	.13	-.16
4. PPVT Score	94.61 (16.34)				-	-.66**
5. Grammaticality Judgment Task IE	22.15 (15.18)					-
			Non-Brokers			
1. Trail Making Test IE	1.77 (0.82)	-	.08	-.09	-.28	.45*
2. Flanker Task IE	11.19 (3.99)		-	.15	-.18	-.01
3. Backward Digit Span	3.53 (0.68)			-	-.06	-.08
4. PPVT Score	97.27 (12.13)				-	-.32
5. Grammaticality Judgment Task IE	19.61 (9.22)					-
			Monolinguals			
1. Trail Making Test IE	1.75 (0.69)	-	.56**	.07	.12	-.23
2. Flanker Task IE	10.00 (1.70)		-	-.09	-.08	.02
3. Backward Digit Span	3.52 (0.71)			-	.23	.26
4. PPVT Score	95.20 (15.84)				-	-.09
5. Grammaticality Judgment Task IE	18.32 (8.62)					-

Note. Backward digit span maximum possible score = 8. IE = inverse efficiency. A higher inverse efficiency score indicates poorer performance. *p < .05, **p < .01.

The backward digit span was used because the forward digit span requires minimal executive control, relying mainly on the phonological loop (Best & Miller, 2010). Measures such as this necessitate reliance on rules, so executive control is needed more so during these more complex tasks. The interaction terms, derived using mean-centered data (Trail Making Test Inverse Efficiency X Language Group, Flanker Task Inverse Efficiency X Language Group, and Backward Digit Span Length X Language Group), were then added to this model (see Table 6 for means and correlations). The choice of interaction terms was driven by the specific hypotheses of the study, allowing for language group to serve as a three-group categorical moderator. As the bilingual groups, especially the brokers, may rely more on executive function tasks during verbal processing, performance in the areas of executive function in these children should be more closely correlated with performance on the syntactic awareness task. Note that a lower inverse efficiency score represented faster processing speed, accounting for speed-accuracy tradeoffs (Yang et al., 2011). Preliminary analyses showed no effects of gender, so this was excluded from the following analyses. Data was not included from one monolingual child due to technical errors.

Table 7. Moderated Multiple Regression of Each Area of Executive Function and Receptive Vocabulary in the Prediction of Performance on the English Grammaticality Judgment Task

Variable	β	*t*	R^2	ΔR^2	*F*
PPVT Score	-.455	-4.82	.207		23.26***
Trail Making Test IE	.173	1.80	.235	.028	3.25[a]
Language Group (1 vs. 2 & 3)	.158	1.65	.259	.023	2.72
Language Group (2 vs. 3)	.062	0.67	.262	.004	0.45
Backward Digit Span	.013	0.14	.263	.001	0.02
Flanker Task IE	.002	0.02	.263	.000	0.00
Trail Making IE X Language Group (1 vs. 2 & 3)	.219	2.18	.303	.040	4.76*
Trail Making IE X Language Group (2 vs. 3)	.164	1.70	.326	.024	2.87[a]
Backward Digit Span X Language Group (1 vs. 2 & 3)	-.060	-0.59	.329	.003	0.35
Backward Digit Span X Language Group (2 vs. 3)	-.129	-1.40	.345	.016	1.97
Flanker IE X Language Group (1 vs. 2 & 3)	.064	0.61	.348	.003	0.37
Flanker IE X Language Group (2 vs. 3)	-.121	-0.74	.353	.005	0.55

Note. **p* < .05, ****p* < .001, [a] = marginally significant.
Language Group 1 = bilingual brokers; Language Group 2 = bilingual non-brokers; Language Group 3 = monolinguals. Note that the Trail Making Test measures cognitive flexibility, the Flanker Task measures inhibition, and the Digit Span Task measures working memory. IE = Inverse Efficiency.

Table 7 shows the results of the regression predicting children's performance on the English grammaticality judgment task. There was an increment in R^2 when PPVT Score, $\Delta R^2 = .207$, ΔF (1, 89) = 23.64, $p < .001$, and Trail Making Test Inverse Efficiency Score were entered into the model, $\Delta R^2 = .028$, ΔF (1, 88) = 3.25, $p = .075$. This indicated that greater vocabulary scores ($\beta = -.46$, $p < .001$) predicted more efficient performance on the English grammaticality judgment task, and greater cognitive flexibility skills ($\beta = .17$, $p = .075$) marginally predicted more efficient performance on this task. The addition of the two-way interaction of Trail Making Test Inverse Efficiency X Language Group (brokers vs. non-brokers and monolinguals) resulted in a significant increase in R^2, $\Delta R^2 = .040$, ΔF (1, 83) = 4.76, $p = .032$, indicating that this interaction term was a significant predictor of performance on the English grammaticality judgment task. The interaction term using the non-brokers vs. monolinguals contrast code revealed a marginally significant change in R^2, $\Delta R^2 = .024$, ΔF (1, 82) = 2.87, $p = .094$. With all significant predictor variables and interaction terms in the model, R^2 was significant, $F(8, 82) = 4.96$, $p < .001$. Together these predictors accounted for 32.6% of the variance in the inverse efficiency scores based on the English timed grammaticality judgment task.

The plot of the significant interaction between efficiency on the Trail Making Test and language group revealed that bilingual brokers' ability to efficiently complete the English grammaticality judgment task was significantly lower (i.e., indicating more efficient performance) for those who performed more efficiently on the Trail Making Test (see Figure 7), $t(85) = 4.53$, $p < .001$. This was also the case for the non-brokers,

$t(85) = 2.12$, $p = .037$. However, monolingual children's efficiency on the grammaticality judgment task did not change significantly at different levels of the Trail-Making Test, $t(85) = -0.94$, $p > .05$. For the bilingual children, particularly the brokers, performance on the Trail Making Test (measuring cognitive flexibility) was significantly linked to performance on the English grammaticality judgment task measuring syntactic awareness. For the monolingual group of children, performance on the Trail Making Test was not significantly linked to performance on the grammaticality judgment task.

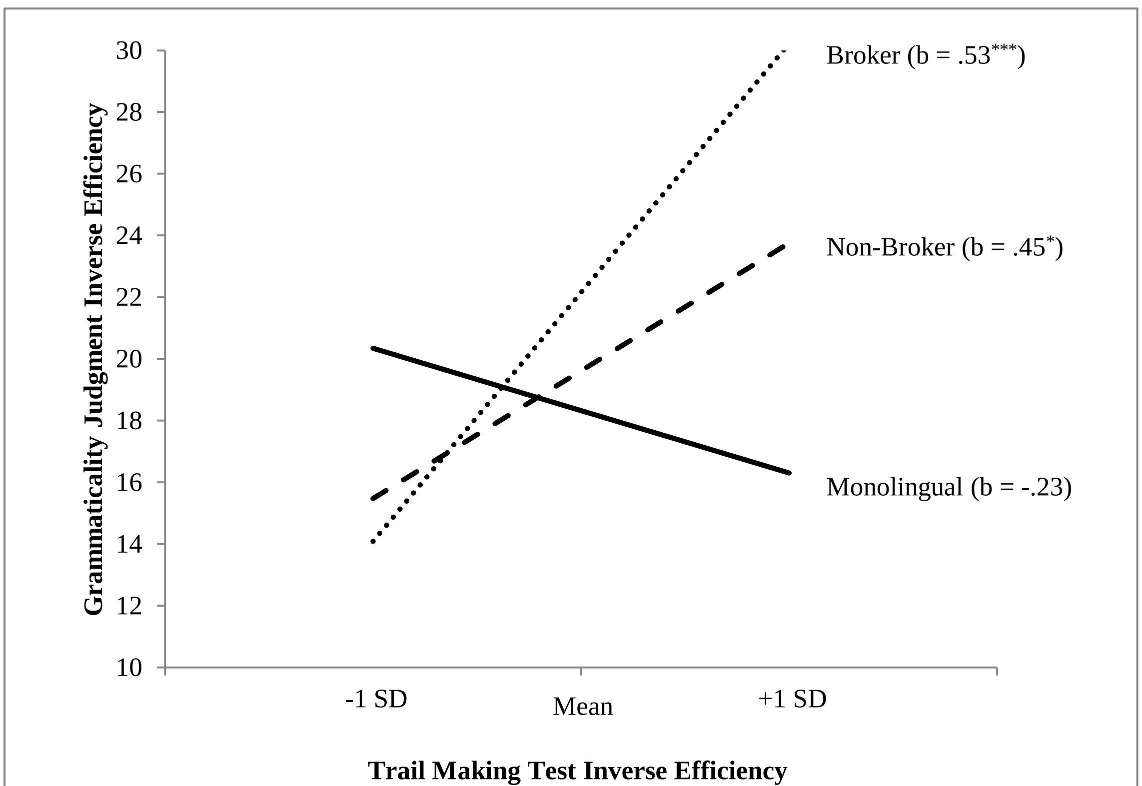

Figure 7. The interaction of the inverse efficiency scores on the Trail Making Test and language group in the prediction of inverse efficiency on the English grammaticality judgment task. $*p < .05$, $***p < .001$.

This moderated multiple regression model lends partial support to the predicted direction of the hypotheses. Overall, the areas of executive function were not significantly linked with performance on the English syntactic awareness task, except in the area of cognitive flexibility. Cognitive flexibility performance on the Trail Making Test was marginally linked with syntactic awareness performance, however, this relationship was moderated by language group (i.e., broker, non-broker, monolingual). These linkages were more significant in the bilingual groups than the monolingual group, particularly the language brokers. This suggests that the bilinguals, particularly the brokers have greater linkages between their verbal and nonverbal performance, but only in the area of cognitive flexibility.

Linkages Between Executive Function Performance and the Spanish Timed Grammaticality Judgment Task

To further explore the linkages between executive function and syntactic awareness, it was predicted that all areas of executive function would be linked to performance on the Spanish version of the timed grammaticality judgment task, with an even stronger correlation in the bilingual brokers. To test these hypotheses, a moderated multiple regression analysis was conducted on the bilingual data. Inverse efficiency score on the Spanish grammaticality judgment task was used as the criterion variable. Four mean-centered predictor variables (Trail Making Test Inverse Efficiency Score, Flanker Task Inverse Efficiency Score, Backward Digit Span Length, and TVIP Score) and contrast-coded Language Group (bilingual brokers, bilingual non-brokers) were added into the model. The interaction terms, derived using mean-centered data (Trail

Making Test Inverse Efficiency X Language Group, Flanker Task Inverse Efficiency X Language Group, and Backward Digit Span Length X Language Group), were then added to this model (see Table 8 for means and correlations). Preliminary analyses showed no effects of gender, so this was not included in the following analyses.

Table 8. Means and Correlations for all Predictor and Criterion Variables Predicting Children's Performance on the Spanish Version of the Grammaticality Judgment Task

Variable	*M (SD)*	1	2	3	4	5
				Brokers		
1. Trail Making Test IE	1.42 (0.58)	-	.04	-.29	.26	.11
2. Flanker Task IE	11.27 (4.28)		-	-.39*	.17	.09
3. Backward Digit Span	3.53 (0.84)			-	-.19	-.05
4. TVIP Score	77.03 (19.93)				-	-.35*
5. Grammaticality Judgment Task IE	14.08 (7.55)					-
				Non-Brokers		
1. Trail Making Test IE	1.77 (0.82)	-	.08	-.09	-.29	.36
2. Flanker Task IE	11.19 (3.99)		-	.15	-.23	.15
3. Backward Digit Span	3.53 (0.68)			-	.02	.10
4. TVIP Score	70.80 (15.06)				-	-.07
5. Grammaticality Judgment Task IE	18.48 (10.04)					-

Note. Backward digit span maximum possible score = 8. IE = inverse efficiency. A higher inverse efficiency score indicates poorer performance. *$p < .05$, **$p < .01$.

Table 9 shows the results of the regression predicting inverse efficiency performance on the Spanish grammaticality judgment task. There was a significant increment in R^2 when inverse efficiency on the Trail Making Test was entered into the equation, $\Delta R^2 = .093$, $\Delta F(1, 64) = 6.53$, $p = .013$, and also when TVIP score was entered, $\Delta R^2 = .056$, $\Delta F(1, 63) = 4.13$, $p = .046$. This indicated that greater cognitive flexibility skills ($\beta = .30$, $p = .013$) and a wider Spanish receptive vocabulary repertoire ($\beta = -.24$, $p = .046$) predicted more efficient performance on the Spanish grammaticality judgment task. The two-way interactions did not result in significant increments in R^2 when entered into the model (see Table 9). With all significant predictor variables in the model, R^2 was significant, $F(2, 63) = 5.49$, $p = .006$, and together these predictors accounted for 14.9% of the variance in performance on the Spanish grammaticality judgment task.

Overall, performance on the Spanish task was affected mainly by the Trail-Making test performance and Spanish vocabulary knowledge, and was not moderated by the language group of the children. However, as mentioned earlier, the Spanish results should be viewed cautiously, as overall accuracy scores on this task were quite low (refer to Table 2).

Table 9. Moderated Multiple Regression of Each Area of Executive Function and Receptive Vocabulary in the Prediction of Performance on the Spanish Grammaticality Judgment Task

Variable	β	*t*	R^2	ΔR^2	*F*
Trail Making Test IE	.304	2.56	.093		6.53*
TVIP Score	-.237	-2.03	.149	.056	4.13*
Language Group	.147	1.21	.168	.020	1.47
Flanker Task IE	.105	0.91	.179	.011	0.82
Backward Digit Span	.062	0.51	.183	.004	0.26
Backward Digit Span X Language Group	.175	0.48	.186	.003	0.23
Trail Making IE X Language Group	.231	0.51	.190	.004	0.26
Flanker IE X Language Group	-.035	-0.09	.190	.000	0.01

Note. The Trail Making Test measures cognitive flexibility, the Flanker Task measures inhibition, and the Digit Span Task measures working memory. IE = Inverse Efficiency. *$p < .05$.

CHAPTER FOUR

DISCUSSION

Overview of Aims of Study

The current study focused on the mechanisms involved in syntactic awareness development in bilingual (English/Spanish-speaking) nine-year-olds, distinguishing those bilingual children who were also language brokers for their families. Syntactic awareness, an aspect of metalinguistic awareness that develops throughout adolescence, involves the ability to reflect upon grammar and structure in one's language system (Bialystok & Herman, 1999; Bowey, 2005; Cain, 2007; Davidson et al., 2010; Goswami & Bryant, 1990; Tunmer, 1984). It has been theorized that bilingual advantages in metalinguistic awareness have been linked with the need for a greater awareness and understanding of how the language systems work and how they are structurally different from each other (Castles & Coltheart, 2004; Davidson et al., 2010; Ehri et al., 2001; Foursha-Stevenson & Nicoladis, 2011; Goswami & Bryant, 1990). This simultaneous processing of multiple language systems forces bilingual individuals to consciously reflect on their language systems and to inhibit interference from the unwanted language (Bialystok, 1986; Bialystok, 1988; Bialystok & Majumder, 1998, Costa et al., 2008; Davidson et al., 2010; Green, 1998; Sandoval et al., 2010).

Syntactic awareness abilities begin with rudimentary skills in the preschool years, such as the ability to understand the variability of words, and continue to develop

throughout adolescence and early adulthood (e.g., Bialystok, Shenfield, & Codd, 2000). Around the early elementary years, rapid developments in expression of this knowledge occur, a time in which linguistic and cognitive systems become inextricably linked (Edwards & Kirkpatrick, 1999). Even prior to these rapid developments, precocious development in early identification of syntactic mistakes has been observed in bilingual children, although it has not been studied extensively or in older children with a timed paradigm (e.g., Bialystok, 1986; 1992; 2001; Bialystok & Majumder, 1998; Cromdal, 1999; Davidson et al., 2010). One recent study, looking at time spent in an immersion program between bilinguals only, did use a timed version of the grammaticality judgment task and found only a significant contribution from receptive vocabulary score at fifth grade on their accuracy and reaction time performance (Bialystok & Barac, 2012). When a simplified version of the regression model was used, the number of months spent in an immersion program contributed to performance, although the overall model was not significant.

In order to complete a syntactic awareness task, a certain amount of analytical knowledge is necessary to comprehend the words and the task demands. However, control over attentional mechanisms is also necessary to focus attention on the important aspects of the task. A task is considered to be a metalinguistic problem when its solution requires a high demand on both of these components (Bialystok, 1992; 2001). As documented in previous research, tasks that place greater demands on this attentional control component show the most distinguishable pattern of bilingual advantages (e.g.,

Bialystok, 1986; Bialystok, 1988; Bialystok & Craik, 2010; Bialystok & Majumder, 1998; Cromdal, 1999).

Linkages between the linguistic and non-verbal areas have been studied most recently, suggesting that non-verbal control mechanisms are responsible for allocating the resources for a verbal task (Carlson & Meltzoff, 2008; Green, 1998; MacWhinney, 2005; Mazuka et al., 2009). Indeed, precocious development of executive functions, as well as lifelong advantages, have been documented in recent research on bilingual individuals, although some findings have been mixed regarding working memory (e.g., Bialystok et al., 2006; Carlson & Meltzoff, 2008; Costa et al., 2008; Mezzacappa, 2004; see Adesope, Lavin, Thompson, & Ungerleider, 2010 for a review). In order to maintain a specific goal in spite of distractions, executive functions are involved in inhibiting prepotent responses, storing and updating information in working memory, and switching between contexts. From this work, it has been theorized that the bilingual needs to constantly monitor the context and switch between different language systems, and this positively influences the development of above-average executive functions in proficient bilinguals (Bialystok et al., 2006; Carlson & Meltzoff, 2008; Costa et al., 2008; MacWhinney, 2005; McQuillan & Tse, 1995; Mezzacappa, 2004; Perner & Lang, 1999). Additionally, some work has suggested that bilingual advantages are restricted to inhibitory control, while most recent work has found advantages beyond inhibition, particularly in cognitive flexibility skills (Bialystok, 2010; Barac & Bialystok, 2012; MacWhinney, 2005; Prior & MacWhinney, 2010; Soveri, Rodriguez-Fornells, & Laine, 2011).

Although past research has shown bilingual advantages in areas of metalinguistic awareness and executive function, children's use of translation and interpretation skills was not measured and used in these studies. Consequently, one of the major goals of the current study was to include a group of child language brokers to examine the way in which translating may affect these areas. These children, in general, have not been studied extensively in the bilingual literature, although several articles have examined retrospective or qualitative accounts of language brokering (Malakoff & Hakuta, 1991; Orellana, Dorner, & Pulido, 2003; Orellana, 2007), or academic performance of language brokers (e.g., Buriel et al., 1998; Dorner et al., 2007). Using standardized test scores or academic grades can obscure cognitive differences, missing out on the underlying mechanisms involved in language broker advantages. By using direct measures of tests of syntactic awareness and executive functioning, a developmental profile of these cognitive skills was assessed in the present study. It was hypothesized that these areas would be more developed in child language brokers due to the significant switching and inhibition duties involved in language brokering situations, thereby strengthening connections between the language-processing and non-verbal areas of the brain (Fabbro et al., 2000; Fan et al., 2003; Novick et al., 2005; Prior & Gollan, 2011). Analyses examined bilingual language brokers, bilingual non-brokers, and monolingual children's performance on tests tapping the core areas of executive function (i.e., inhibitory control, cognitive flexibility, working memory). To examine linkages between functioning in these areas and syntactic awareness, the children were also assessed on a timed grammaticality judgment task with mismatched semantics. Broadly defined, the main

goals of this study were to (1) assess differences in processing speed between the language groups on a timed task of syntactic awareness, (2) examine language brokering differences in areas of syntactic awareness and executive functioning, and (3) assess the connections between these areas of functioning and how different levels of dual language exposure may affect these connections.

Conditional Effects of Bilingualism on Syntactic Awareness

It was predicted that the bilingual children, particularly the language brokers, would outperform the monolingual children on the timed grammaticality judgment task. This challenging syntactic awareness task, using semantic anomalies as a distracting factor, created a conflict between the grammar and semantics of the sentences. The children had to quickly inhibit the distracting anomalies and focus on the grammaticality of the sentences. Linguistic tasks incorporating distracting factors place a greater demand on the executive control system, considered by some to be the key attribute of a metalinguistic measure (e.g., Bialystok, 1986; Bialystok, 1988; Bialystok & Majumder, 1998; Cromdal, 1999).

The results from the English timed grammaticality judgment task partially supported this hypothesis. When examining children's accuracy alone, performance on this measure of syntactic awareness was affected only by children's receptive vocabulary scores, showing no bilingual effects. However, when merging children's accuracy with their reaction times to create an estimation of processing speed (i.e., to be assured that accuracy was not compromised for speed), a pattern of language broker advantages

emerged in the data, but only when level of English receptive vocabulary knowledge was taken into consideration.

The inverse efficiency scores of the children were calculated to deal with the issue of speed-accuracy trade-offs in the children's reaction time data (Townsend & Ashby, 1978; Yang et al., 2011). This is a standard way to merge reaction time and accuracy into one measure. For example, a child may have a particularly fast reaction time overall, however, they may have compromised accuracy for speed. Calculating an inverse efficiency score helps to solve this issue by figuring accuracy into the equation, thereby creating a measure of processing efficiency (Salthouse & Hedden, 2002). To illustrate, if two children both had mean reaction times of 1200 milliseconds, but child A had an accuracy rate of 94% and child B had an accuracy rate of 90%, this speed-accuracy trade-off would be apparent in their inverse efficiency score. By calculating the inverse efficiency (Mean Reaction Time/Accuracy), child A would receive a score of 1277 and child B would receive a score of 1333. A lower score indicates more efficient processing skills, illustrating that child A would have a better score because they maintained a high accuracy score than child B.

The pattern of results was found specifically when the children were compared at higher English receptive vocabulary levels. When compared at higher levels of receptive vocabulary, the bilingual brokers performed more efficiently than the other groups when responding to the timed grammaticality judgment task. This is not to say that the bilingual brokers were more knowledgeable of the language system or were more intelligent, as was evidenced by comparable between-group language skills and accuracy

on the judgment task. The brokers were simply more superior in controlling what aspects of the task to attend to and therefore, were more efficient processors on this timed syntactic awareness task. At lower levels of English receptive vocabulary knowledge, the opposite pattern emerged, in which the language brokers responded more slowly to the sentences than the other groups. When receptive vocabulary levels were not as strong, brokering advantages were not apparent.

When assessing the Spanish syntactic awareness task, both Spanish receptive vocabulary and language group contributed to accuracy and inverse efficiency scores. Children with stronger Spanish vocabulary skills and those who were language brokers were marginally more accurate and more efficient on this task. However, the accuracy of the children overall was relatively low on this task, so these results must be interpreted with caution. Overall, language brokering advantages were found across the syntactic awareness tasks when the children possessed the vocabulary knowledge to supplement their performance on the task, and these brokering advantages were found even when assessing the Spanish version of this task.

Connections to Past Research on Syntactic Awareness

These findings are partially in line with past research examining syntactic awareness in bilingual children, although much of this work examined developments without regard to brokering status (e.g., Bialystok, 1986; 1988; Bialystok & Majumder, 1998; Cromdal, 1999; Davidson et al., 2010; Foursha-Stevenson & Nicoladis, 2011). Many of the reported bilingual advantages in past research were found in phonological awareness, and these advantages frequently disappeared by the end of first grade, leading

to the assumption that bilingualism offers the most benefits to young, preliterate children's metalinguistic awareness (e.g., Bialystok & Herman, 1999; Bruck & Genesee, 1995; Campbell & Sais, 1995; Carlisle et al., 1999; Chen, Anderson, Li, Hao, Wu, & Shu, 2004; Foursha-Stevenson & Nicoladis, 2011; Göncz & Kodzopeljic, 1991). However, syntactic awareness, an aspect of metalinguistic awareness that develops in conjunction with reading and writing training, continues to develop throughout the grade school years and has been shown to be a promising method of examining metalinguistic awareness in both preliterate children beginning reading instruction (e.g., Davidson et al., 2010; Göncz & Kodzopeljic, 1991) and children beyond first grade (McGuinness, 2005; Roth et al., 1996).

Through past work examining metalinguistic awareness differences between bilinguals and monolinguals, bilinguals typically outperform monolinguals on the tasks, although these patterns of findings are usually conditional upon factors such as balance of bilingualism, receptive vocabulary level, or task demands (e.g., Bialystok & Barac, 2012; Barac & Bialystok, 2012; Bialystok & Feng, 2009; Bialystok et al., 2008b; Cromdal, 1999; Da Fontoura & Siegel, 1995; Davidson et al, 2010; Davidson & Raschke, in preparation; Fernandes et al., 2007; Galambos & Goldin-Meadow, 1990; Gathercole & Montes, 1997; Serratrice et al., 2009). Past studies have examined the way in which a child's balance of bilingualism, or relative strength of their two languages, contributes to syntactic awareness abilities (e.g., Bialystok & Barac, 2012; Hakuta & Diaz, 1985). It has been suggested that weak vocabulary development negates advantages to bilinguals in academic performance, suggesting that a stronger grasp on a child's native language

leads to greater ease and development of English vocabulary skills (August & Hakuta, 1998).

To examine the effects of balance of bilingualism, one study examined this issue by measuring children's time in an immersion education program. Through this work, it was found that the greater number of years in an immersion program was correlated with greater syntactic awareness (Bialystok & Barac, 2012). This support of both languages was important to the children's syntactic awareness development. This evidence sheds light on why the language brokers were advantaged over the bilingual non-brokers in the current study. Although the brokers and non-brokers showed an equal distribution in their balance ratios of bilingualism, the brokers may be unintentionally receiving support through varied translation experiences with adults, thereby creating an additive bilingual environment. The particular language environment and the linguistic experiences encountered by the language broker have contributed to a greater awareness of the structural components of each language system, allowing them to step back and reflect upon these differences. Furthermore, the language brokering advantages cannot be attributed to biliteracy (i.e., able to read fluently in both languages), which distinguished first grade bilingual biliterates from bilingual monoliterates on tests of phonological awareness in a past study (Shwartz et al., 2005). The children in the current study had comparable scores on English and Spanish reading fluency measures.

Besides balance of bilingualism, connections to receptive vocabulary have been found in past research as well (e.g., Sandoval et al., 2010; Luo et al., 2010; Bialystok & Feng, 2009; Bialystok et al., 2008b). Receptive vocabulary plays a large part in syntactic

awareness tasks because children must have the initial linguistic resources to perform the challenging linguistic task (Bialystok et al., 2009). Without accounting for these initial knowledge levels, results may be confounded by this factor. Children with below age level vocabulary skills might have issues in lexical access of the words presented to them, thereby creating difficulties in comprehension of meaning and grammar at that point. Once children can easily access these lexical stores, resources can be allotted to the manipulation of syntactic structure and the separation of semantics and grammar (Bialystok et al., 2008b). This factor was a particularly important component in the current study, in which advantages were dependent upon the level of vocabulary knowledge.

These connections between vocabulary levels and bilingual advantages have been illuminated in other studies as well. For instance, a recent study focused on different vocabulary levels of English/Spanish-speaking five- and six-year-olds in comparison to monolingual peers (Davidson & Raschke, in preparation). In this study, the bilinguals with above age level English vocabulary knowledge outperformed their monolingual counterparts with similar vocabulary knowledge. However, this was not the case at lower vocabulary levels, in which the children had comparable levels of performance. Similar effects were found in other studies that controlled for vocabulary level of the monolinguals and bilinguals (e.g., Bialystok & Feng, 2009; Bialystok et al., 2008b; Fernandes et al., 2007; Luo et al., 2010).

In another study examining differences between bilingual and monolingual young adults, bilinguals categorized as high-vocabulary scorers performed comparably to

monolingual counterparts on the category fluency task and outperformed them on the letter fluency task, which required a greater degree of executive control (Luo et al., 2010). Without a control for initial levels of vocabulary knowledge, which are necessary to complete the task, it would have been difficult to localize the effects of bilingualism as opposed to the effects of language proficiency skills. If these factors had not been controlled for, then potential bilingual advantages in resource control could be confounded by this factor. Most importantly, these past studies provide information about what happens at different levels of vocabulary knowledge, rather than partialing out vocabulary knowledge as a covariate.

Even when comparing only bilinguals, Bialystok and Barac (2012) found performance on an untimed syntactic awareness task in which Hebrew/English-speaking second- and third-graders in immersion programs were to manipulate nonsense words to conform to English rules of morphology (i.e., the Wug task; Berko, 1958) to be dependent upon vocabulary knowledge. That is, the bilinguals with higher PPVT scores in English, but not on the Hebrew version of the PPVT, were more successful in transforming the nonsense words to comply with English morphology rules, evidencing a greater ability to manipulate the language structure. This effect was also found when a timed version of a grammaticality judgment task, very similar to the current study, was used with second- and fifth-grade children speaking a variety of languages, with the most significant contribution coming from initial vocabulary knowledge (Bialystok & Barac, 2012).

From past research, it has also been shown that task demands can influence bilingual differences, particularly in tasks requiring a greater degree of attentional control (e.g., ignoring nonsense meaning) and moderate levels of representational analysis (e.g., judging grammaticality) typically reveal a more consistent bilingual advantages in identification skills (e.g., Bialystok, 1986; Bialystok, 1988; Bialystok & Majumder, 1998), although bilingual advantages have been discovered in tasks stressing only the representational analysis component in preliterate children (see Davidson et al., 2010; Galambos & Hakuta, 1988; Galambos & Goldin-Meadow, 1990).

In an early study using a grammaticality judgment task with mismatched semantics, five-, seven-, and nine-year-old monolingual and bilingual children's identification of grammatical errors was compared across language groups (Bialystok, 1986). Similar to the task used in the present study, grammar and meaning were to be isolated, in which the children had to focus on judgments of grammaticality. Although an untimed paradigm with no time constraints was used in this pioneer study, it was found that the bilinguals more easily resisted the urge to correct the anomalous meaning of the sentences and focused on repairing the grammar. Interestingly, the monolinguals identified more grammatical errors when conflicting semantics did not block this analytical process, demonstrating that even though the monolinguals had more knowledge of grammar, the presence of misleading sentences distracted them from this task more easily than the bilinguals.

The current study builds upon these past studies on syntactic awareness by examining vocabulary level differences in a group of nine-year-old children with a

monolingual comparison group and using a timed version of the grammaticality judgment task, which presents an additional constraint on attentional control. This study also included a group of language brokers. This was an important consideration, as the differences found in the current study were dependent upon these two factors. The bilingual language brokers with high receptive vocabulary skills were more efficient processors of the syntactic awareness task in both English and Spanish than both their non-brokering and monolingual counterparts. These differences would have been lost if the language groups were examined as homogenous groups, without consideration of vocabulary levels. However, considering more recent research suggesting that only bilinguals at higher vocabulary levels outperform their monolingual counterparts, this was considered in the present study. Additionally, the inclusion of the child language brokers brings an important insight into this area of literature, showing that significant translation experience can influence further development of syntactic awareness skills.

Above all, this work lends support to the theory that greater metalinguistic awareness is created through the bilingual experience, particularly on tasks requiring a high degree of control of linguistic processes (e.g., Bialystok, 1997; 2001; Bialystok & Barac, 2012; Bialystok & Ryan, 1985; Cromdal, 1999). However, this theory must be modified to account for the effects of the language brokering experience, an experience bringing children's metalinguistic awareness skills above and beyond their peers without brokering responsibilities. Stemming from work manipulating levels of dependence on analysis and attentional control in metalinguistic awareness tasks (e.g., Bialystok, 1992; 2001; Bialystok & Craik, 2010) and neuroimaging studies demonstrating activation in

non-verbal areas of the brain on language tasks (e.g., Garbin et al., 2010; Novick et al., 2005), the mechanisms thought to support these metalinguistic awareness developments have been suspected to lie in the area of executive function, or the management system of the brain (e.g., Bialystok, 1992; 1994; Green, 1998; MacWhinney, 2005). General language conflict in the bilingual brain is resolved by this executive control system, thereby leading to the transformation and improvement in the efficiency of this network, especially through extensive practice dealing with this language conflict (Bialystok, 2009; Costa et al., 2008; Green, 1998; Prior & Gollan, 2011). To investigate the influence of bilingualism and types of bilingualism on executive functions, the current study also compared executive function differences between the brokers, the non-brokers, and the monolinguals.

Conditional Bilingual Effects on Areas of Executive Function

To understand the extent to which mastery of two languages affects non-verbal skills, the current study assessed potential language group differences in performance in the core areas of executive function, using tasks that assessed inhibitory control, cognitive flexibility, and working memory. Recent research has found executive control to be composed of these distinct, yet correlated functions (Miyake et al., 2000). However, much of the research examining bilingualism’s effects on executive functions has focused mainly on inhibition skills, with less emphasis on cognitive flexibility differences (Prior & MacWhinney, 2010). Although it has been found that a great deal of effort is put into inhibiting the unwanted language (Green, 1998), bilingualism also places demands on cognitive flexibility, particularly when the bilingual individual must

decide when and how to switch between languages (Prior & MacWhinney, 2010). By examining the interactions between linguistic and cognitive systems in bilingual children, including those with significant switching experiences, the current study was able to further explore the relationship between syntactic awareness and executive functions. It was hypothesized that the bilingual children, and most distinguishably the bilingual language brokers, would outperform the monolingual children on tests of each area of executive function, and this hypothesis was partially supported by the results of this study. The bilinguals, especially the language brokers, were particularly advantaged in their cognitive flexibility skills; however, no differences were found between the language groups with regards to inhibitory control or working memory.

With regard to the measure of cognitive flexibility, when assessing the number of perseverative errors on the Trail Making Test, which signals a failure of mental flexibility, no differences were found between the brokers, the non-brokers, and the monolinguals. However, when assessing the children's time to complete this test and the amount of interference from the switching demands of the task, the language brokers outperformed both the bilingual non-brokers and the monolingual children, distinguishing themselves as a group with more efficient mental flexibility skills. The Trail Making Test was a particularly powerful measurement tool, as the non-switching trails screened for problems with visual scanning, number or letter sequencing, and motor speed, ruling out differences due to these potentially confounding factors.

Connections to Past Research on Executive Functions

Although no research to date on executive functions has considered language brokers as a distinct group, these results are supported by past research examining executive functions in bilingual populations. Although the lack of language group differences in inhibitory control was somewhat surprising, the lack of differences in working memory was less surprising considering the mixed findings in this area (e.g., Adesope et al., 2010; Bialystok, 2009; Bialystok & Feng, 2009; Bonifacci, Giombini, Bellocchi, Contento, 2011; Danahy, Windsor, & Kohnert, 2007).

When considering the working memory system, on the one hand, holding two language systems in one's mind could put an overwhelming cognitive load on the working memory system (Lee et al., 2006; Sweller & Chandler, 1994; van Merrienboer & Sweller, 2005). On the other hand, the inhibition abilities developed to manage this cognitive overload could increase the overall efficiency of the working memory system (Bialystok et al., 2004; Bialystok et al., 2008a; Fernandes et al., 2007; Just & Carpenter, 1992; Michael & Gollan, 2005; Rosen & Engle, 1997). However, addressing bilingual differences in the working memory system has been difficult. Past research has mainly shown inconclusive results, with most bilingual advantages dependent upon the attentional demands of the task (e.g., Bialystok, 2009; Bialystok et al., 2008b; Fernandes et al., 2007). When administering simple working memory tasks, in which executive control demands are reduced, language group differences typically have not been apparent (e.g., Adesope et al., 2010; Bialystok, 2009; Bialystok & Feng, 2009; Bonifacci et al., 2011; Danahy et al., 2007). However, when executive control demands have been

increased, some bilingual advantages have been found (e.g., Bialystok, 2009; Bialystok et al., 2008b; Feng, Diamond, & Bialystok, 2007).

For instance, in a study examining simple working memory tasks involving the memorization of sequences of both verbal and non-verbal material, no bilingual advantages were found for the six- to eight-year-olds tested (Bonifacci et al., 2011). On tasks such as this, in which the children must recall simple sequences of numbers or symbols, no updating is needed to continually manipulate the information stored in short-term memory, possibly obscuring potential bilingual advantages. The continual updating and management of the contents of short-term memory stores is the key attribute of the working memory system (Bialystok, 2009; Miyake et al., 2000; Miyake & Friedman, 2012). However, in another study with young adults and older adults using the Corsi blocks test, bilingual advantages were found over monolingual participants (Bialystok et al., 2008b). In this task, the experimenter touched a sequence of blocks that the participant was to repeat back. Bilingual advantages were found in this study, but only in the more challenging backward response condition of this task, in which participants repeated the sequence backwards. The need to continually manipulate the contents of the short-term memory (i.e., the spatial sequence of the blocks) in order to respond in a backward manner illustrates use of the working memory system, a separate system from that of short-term memory.

Similarly, other studies using a non-verbal task to assess spatial memory have found bilingual advantages in both seven-year-olds (Feng et al., 2007) and adults, but only on the more complex level of the task (Bialystok, 2009). Specifically, this task

required the children to remember where the "frog" jumped (or for the adults, where the squares turned red) in either a 3 x 3 or a 5 x 5 matrix. In the simple conditions, where participants simply recalled the sequential order, no bilingual advantages were found. However, when executive control demands were increased by including ordering rules for recall (e.g., systematically recall the squares from left to right across the rows), both the younger and older bilinguals maintained a similar level of recall as in the simple condition, while recall in monolinguals decreased significantly in this challenging condition. Although advantages were found for the bilinguals, the issue with using a more complex working memory task, such as tasks like these, is the overreliance on other areas of executive control (e.g., inhibitory control), thereby decreasing the construct validity of the task as a "pure" measure of working memory (Kane, Conway, Miura, & Colflesh, 2007). The current null findings in working memory between the brokers, non-brokers, and monolinguals is not surprising, as past research has been quite mixed and plagued by the effects of greater demands on other areas of executive function.

The current study did not find differences between the language groups in inhibitory control. When reviewing past research on inhibitory control differences between bilinguals and monolinguals, some work has documented bilingual advantages or comparable performance between the groups (e.g., Carlson & Meltzoff, 2008; Bonifacci et al., 2011; Martin-Rhee & Bialystok, 2008). However, many of these differences were documented in the early preschool years, so the children in the current study might have already reached adult levels on this task. Inhibitory control has been shown to develop most rapidly in the preschool and early elementary years (Best &

Miller, 2010; Garon, Bryson, & Smith, 2008; Hughes, 1998). Studies looking at early developmental differences in inhibitory control have found precocious bilingual development on tasks such as the Simon Task, the ambiguous figures task, and the Dimensional Change Card Sort (DCCS) task in preschoolers (e.g., Bialystok, 1999; Bialystok, Martin, & Viswanathan, 2005; Bialystok & Martin, 2004; Bialystok & Shapero, 2005; Bialystok et al., 2006; Carlson & Meltzoff, 2008; Yang et al., 2011). In one particular study looking at English/Spanish-speaking kindergarteners, it was found that bilingual advantages in response inhibition were confined to tasks in which high levels of working memory were required (Carlson & Meltzoff, 2008). However, no differences were found when the children had to suppress a motor response, delay gratification, or when demands on the working memory system were lessened during the tasks.

The developmental course and stability of inhibitory control is questionable, however, due to less evidence in middle school children and mixed findings with young adult bilinguals (Bialystok, Martin, & Viswanathan, 2005; Bialystok et al., 2008a; Carlson, 2005; Colzato, Bajo, van den Wildenberg, Paolieri, Nieuwenhuis, La Heij, & Hommel, 2008; Costa et al., 2008; Costa et al., 2009; Gerstadt, Hong, & Diamond, 1994; Martin-Rhee & Bialystok, 2008; Romine & Reynolds, 2005), lending support to the idea that inhibitory control may have reached its peak levels in the early school years (Best & Miller, 2010; Carlson, 2005; Garon et al., 2008; Klenberg et al., 2001; Lehto et al., 2003). At this age group, inhibitory control skills may be at their peak performance, leading researchers to form complex tasks to measure inhibition that ultimately recruit other areas

of executive function (Best & Miller, 2010; Bialystok et al., 2009). On the other hand, some have found improvements across childhood and adolescence (e.g., Gerstadt et al., 1994; Romine & Reynolds, 2005), particularly when the tests are sensitive to measurement issues such as the response modality and working memory demands. However, considering these developments are seen in tasks using computerized paradigms to measure reaction times, these age-related changes could also be attributed to improvements in use of computers/keyboards and motor speed improvements that come with age when responding to the stimuli, rather than in improvements of inhibition (Best & Miller, 2010). Consequently, finding an appropriate measure that can be used across the lifespan is challenging when assessing developmental changes in executive function (Best & Miller, 2010; Bialystok et al., 2009).

One study, however, did find specific bilingual differences in a group of middle school children on a Simon bivalent arrows task (Martin-Rhee & Bialystok, 2008). On this task, performance of monolingual and bilingual English/Hebrew (or Russian) speaking eight-year-old children was assessed, in which certain conditions measured interference suppression (bivalent display) and response inhibition (univalent display). Bilingual advantages were found, however, only in conditions in which interference suppression was needed, suggesting that bilinguals had a greater ability to ignore the initial irrelevant spatial information. However, there were no differences in the Simon effect between the language groups, which is the difference between the incongruent (i.e., arrows face different directions) and the congruent trials (i.e., arrows face same direction). The Simon effect is the typical indicator of inhibitory control and interference

from the spatial location of the stimulus. These findings were attributed to the idea that bilingual differences are not necessarily apparent in a certain aspect of inhibition, but the differences are an overall efficiency in monitoring competing cues in conflict tasks (Martin-Rhee & Bialystok, 2008). Other studies have found the strongest bilingual differences in inhibitory control to be found in young children and older adults (see Bialystok, Martin, & Viswanathan, 2005).

Some studies testing young adults have found that bilingual inhibitory control advantages persisted past childhood, but these effects were mainly confined to high-monitoring conditions, which require a greater integration of executive functions (e.g., Carlson, 2005; Colzato et al., 2008; Costa et al., 2009; Gerstadt et al., 1994; Martin-Rhee & Bialystok, 2008; Romine & Reynolds, 2005). For instance, in Costa et al. (2009), when a Flanker-type task was used, bilingual differences emerged only when congruent and incongruent trials were split across a 50/50 paradigm (i.e., high monitoring), rather than an 80/20 design (i.e., low monitoring). With the chance of both congruent and incongruent stimuli appearing equally across the trials, the participants' monitoring processes are on alert throughout the duration of the task. For the bilinguals, these processes may be more efficient due to the monitoring demands of managing two language systems (Costa et al., 2009). Other researchers, however, have found no differences between language groups in young adult populations (e.g., Bialystok, Martin, & Viswanathan, 2005; Bialystok et al., 2008a; Costa et al., 2008; Colzato et al., 2008). These participants may have been at their peak performance on inhibition skills due to

their age, or group differences were not detectable due to ceiling performance on the tasks (Bialystok, 2006; Costa et al., 2008).

Because past research has been mixed on the developmental trajectory of inhibitory control, the present findings of no bilingual or language broker differences in inhibitory control skills can be partially supported by this past research. It may be that bilingual advantages are no longer present at this age, as inhibitory control skills may have leveled out, with the most significant improvements in inhibition skills occurring in the preschool and early school years. Bilingualism may also be more relevant in the maintenance of cognitive reserves in aging adults, as shown in recent work comparing inhibition skills in monolingual and bilingual older adults (Bialystok et al., 2004; Bialystok, Martin, & Viswanathan, 2005; Salvatierra & Rosselli, 2010). By the middle school years, the monolinguals may have caught up to the bilinguals and the most benefits to inhibitory control are in the early preschool and preliterate school years and later in life. By including a group of language brokers, this provides evidence that even the presence of more intensive dual language exposure does not improve inhibition skills at this age. Nevertheless, recent work has suggested that bilingualism extends beyond improvements in inhibition skills, leading to advancements in cognitive flexibility across the lifespan for the bilingual (Bialystok, 2010; Prior & MacWhinney, 2010).

Bilingualism's effects on cognitive flexibility has been documented to a lesser extent, nevertheless, this is a promising area of research considering the coordination of functions necessary to complete a test of cognitive flexibility (Best & Miller, 2010). These skills continue to develop throughout adolescence and early adulthood, with

evidence suggesting that they develop rather slowly (e.g., Anderson, 2002; Best & Miller, 2010; Bialystok et al., 2009; Cepeda et al., 2001; Conklin et al., 2007; Davidson et al., 2006; Luciana et al., 2005; Romine & Reynolds, 2005). These skills may be slower to develop due to the dependence on children's ability to inhibit prepotent responses and store information in working memory to complete a task of cognitive flexibility (Best & Miller, 2010; Garon et al., 2008).

The current study found differences between the language groups in the area of cognitive flexibility, particularly in the language brokers. The language brokers had greater cognitive flexibility skills than both the non-brokers and the monolinguals when examining their completion time on the Trail Making Tests. Precocious development of rudimentary cognitive flexibility skills has been documented in a few studies examining preschool-aged bilinguals' performance on simple rule-switching tasks (e.g., Adi-Japha et al., 2010; Bialystok, 1999; Bialystok & Martin, 2004; Bialystok & Shapero, 2005; Martin-Rhee & Bialystok, 2008), with some continued findings at later ages as well (e.g., Bialystok & Barac, 2012; Bialystok & Viswanathan, 2009; Vega & Fernandez, 2011). The current study is in line with past studies examining cognitive flexibility differences for bilinguals, adding the language broker piece to this research. The rather slow development of cognitive flexibility skills may contribute to the prominent effect for the bilinguals in the current study, particularly the language brokers.

In a recent study examining the cognitive flexibility skills of five- and six-year-old bilinguals (speaking a variety of languages), children were given a version of the trail making test in which they (1) had to sequence numbers, and then (2) switch between the

numbers and letters (Bialystok, 2010). This neuropsychological test, similar to the one used in the present study, measured the children's time to complete the trails as an indicator of the ability to switch contexts. Across three studies, it was found that even though the bilinguals had lower or comparable receptive vocabulary and digit span scores as the monolinguals, the bilinguals still outperformed the monolingual group on the trail-making tests. The bilinguals were not simply faster to respond in general, as this possibility was ruled out by using similar stimuli with simpler processing demands, but because the bilinguals more easily processed the switching demands of the task. This provides evidence that bilingual children recruit a broader network of executive functions, not just inhibition, when dealing with language conflict, as was the focus in former accounts of bilingual advantages (e.g., Bialystok, 2001, Costa et al., 2008; Green, 1998). The current study is in line with this evidence finding bilingual advantages on a similar trail making test. Most importantly, the language brokers distinguished themselves from both the bilingual non-brokers and the monolinguals, showing more efficient processing times on the switching trail. This is an important consideration, showing that this type of bilingual may be developing greater executive control networks, particularly in the area of cognitive flexibility. Additionally, using the D-KEFS version of the Trail Making Test allowed for further assessments of motor speed, scanning speed, and sequencing speed, finding no initial differences between the language groups. Speed-accuracy tradeoffs and measurements of interference from the non-switching (i.e., simple letter sequencing trail) to the switching trail were also examined, leading to a consistent language broker advantage on shifting abilities.

Although not using a monolingual comparison group, Vega and Fernandez (2011) found that English/Spanish-speaking third- and fourth-grade children with a more balanced bilingual score had a greater ability to resist perseverative errors on the Wisconsin Card Sorting Test. That is, when asked to sort cards based on changing rule sets, the bilinguals with a more balanced knowledge of English and Spanish more easily switched between these rule sets and did not perseverate on the previous rule. Although the language brokers in the current study were not necessarily more balanced than the non-brokers, as in Vega and Fernandez's study, it is assumed that they have more diversified linguistic experiences with their two languages. Thereby, they have more experience inhibiting and switching between their language systems on a daily basis.

Additionally, in a recent study examining cognitive flexibility in six-year-olds, monolingual and bilingual (Chinese/English-, French/English-, and Spanish/English-speaking) children were compared on a task in which they had to switch between colors and shapes when viewing images of red and blue horses and cows (Barac and Bialystok, 2012). On each trial, the children were cued to attend to either the color or the shape of the stimulus, and then subsequently, they had to touch the target picture matching on this dimension. Through this innovative computer-based paradigm, it was found that no differences were found in accuracy between the groups, but when looking at mean reaction times, all three bilingual groups were faster to respond than the monolingual group. Although at a much younger age then the current study, there was a particular advantage in the reaction times, rather than on accuracy, suggesting a general processing advantage for the bilinguals. Likewise, a recent review of research on bilingual

advantages found bilinguals to possess a general processing advantage, an advantage that can be found early on and persists throughout the lifespan (Hilchey & Klein, 2011). This study supports the current study, in which advantages were found only in their reaction times, suggesting a processing advantage, rather than an advantage in accuracy, for the bilinguals.

In a study focusing on young adults speaking a variety of languages, bilingual advantages also went beyond inhibition of competing responses and were most prominent in their cognitive flexibility skills (Prior & MacWhinney, 2010). In a task-switching paradigm, participants attended to a particular dimension of electronically presented stimuli, based on a cue given prior to presentation. A reduced switch cost was found on this task for the bilinguals, suggesting that they were more easily able to inhibit proactive interference from the previous task rule and attend to the new rule set. In a similar study examining monolinguals, English/Spanish-speaking, and English/Mandarin-speaking young adults, language-switching abilities were compared to non-linguistic task-switching abilities (Prior & Gollan, 2011). After controlling for SES, the English/Spanish-speaking bilinguals had reduced switch costs compared to the other groups on the non-linguistic task. In the language-switching task, in which the participants switched between naming digits out loud in their different languages, based on the cue of an American flag (i.e., name in English) or a Mexican/Chinese flag (i.e, name in Spanish/Mandarin). The English/Spanish-speaking bilinguals outperformed the English/Mandarin-speaking group, and it was suggested that these advantages were present because the English/Mandarin group had reported switching languages less often

in daily life and had rated themselves as less proficient in Mandarin compared to the English/Spanish group. Through further analyses, they suggested "language switching performance (and perhaps daily rates of switching), and not degree of other-language fluency, is the key difference leading to a switch advantage" (Prior & Gollan, 2011, p. 688). This evidence supports the findings from the present study that language-switching in daily life influences the development of certain components of executive functioning, mainly in the realm of cognitive flexibility.

The current study extends this past work by looking at the early cognitive effects of significant experience switching between two languages. Although some bilingual advantages in cognitive flexibility have been found in prior research (e.g., Bialystok, 1999; Bialystok & Martin, 2004; Prior & MacWhinney, 2010), this research has not been extensive, especially in the middle school years, and language-brokering advantages in this area have not been documented as well. If the bilingual children had all been categorized as a homogenous group, then any advantage of the "bilingual" group would have been attributed to bilingualism alone. However, the data from the current research suggests that it may not be bilingualism itself, but the translation and interpretation experiences between linguistically different people that positively affect the development of cognitive flexibility in the middle school years.

Superior Cognitive Flexibility Underlying Syntactic Awareness Efficiency

Models of bilingual development suggest that the language conflict endured by bilinguals increases the efficiency of executive functions, thereby, increasing metalinguistic awareness abilities in a bidirectional manner (e.g., Bialystok, 2001; Green,

1998). Thus, it was hypothesized that increases in executive function abilities would be linked with increases in children's syntactic awareness performance in the current study. In addition, it was predicted that language group (monolingual, bilingual broker, bilingual non-broker) would moderate the relationship between executive function performance and efficiency on this syntactic awareness task. That is, a stronger relationship was anticipated for the bilingual children, especially those who were language brokers. Stemming from experience managing language conflict, areas of executive function may be more developed and used in both linguistic and non-linguistic tasks for bilingual populations (Abutalebi & Green, 2007; Garbin et al., 2010; Mazuka et al., 2009; Novick et al., 2005). By linking these areas together in one study, the relationships can be examined within each language group.

These hypotheses were partially supported by the data from this study. Although inhibition skills and working memory were not connected to syntactic awareness abilities, the results did demonstrate a correlation between cognitive flexibility skills and syntactic awareness. That is, when predicting processing speeds on the English grammaticality judgment task, it was found that greater cognitive flexibility skills, along with higher vocabulary scores, predicted positive change in the grammaticality judgment task. As predicted, the relationship between cognitive flexibility skills and syntactic awareness skills was much stronger in the bilingual groups, with processing speed on the Trail Making test predicting processing speed on the timed grammaticality judgment task. Interestingly, this correlation was even more pronounced for the bilingual language

brokers. When examining these correlations exclusively in the monolingual children, no relationships were apparent.

This provides evidence that the brokers, who may have developed a more efficient cognitive flexibility system, are utilizing these well-developed shifting abilities in the linguistic domain when encountering a challenging language task. This is supported by past research linking task-switching abilities in the brain and examining the overlap of the neural circuits involved in these abilities (Botvinick, Cohen, & Carter, 2004; Hedden & Gabrieli, 2010; Hernandez, 2009; Hyafil, Summerfield, & Koechlin, 2009; Xue, Aron, & Poldrack, 2008; see Abutalebi & Green, 2007 for a review). Other research has found that the carryover from the linguistic domain into the non-linguistic domain is more easily achieved by balanced bilinguals, or those who have developed proficiency in both languages (e.g., Bialystok & Barac, 2012; Bialystok & Majumder, 1998). For instance, third graders in one study were given a grammaticality judgment task, as well as nonverbal tests emphasizing either the control of attention or analysis of grammaticality (Bialystok & Majumder, 1998). It was found that the more fully balanced bilingual children had more of an advantage than the partial bilinguals on the tests that emphasized attentional control (i.e., Block Design Task and Water Level Task), but not on the tests emphasizing analysis (i.e., Noelting Juice Task). They also more easily solved the portion of the grammaticality judgment task that required attentional control to ignore the misleading semantics. The balanced bilinguals were not necessarily more intelligent, but more easily focused their attention on the important aspects of the task at

hand. The greater experience and exposure to both languages improved both linguistic and non-linguistic areas of functioning for the more fully balanced children.

The current study is in compliance with this past evidence, however, showing advantages for the brokers over both the non-brokers and the monolinguals, in spite of similar levels of bilingual balance. At this age, the balance of the bilinguals may not matter as much as the amount of exposure to both languages when examining bilingual advantages. The current study further supports the idea that language recruits processes from the general cognitive system, and these processes can be modified with greater linguistic experience, thereby creating a more efficient executive control network (Bialystok et al., 2009; Green, 1998). This study builds upon this evidence, suggesting that the accumulation of even greater and varied linguistic experiences in the same context, such as that in a language brokering situation, can modify components of this control network further.

Why Language Brokering Advantages?

Language brokers, who are constantly faced with the need to avoid interference from a non-target language and to monitor two simultaneously active languages, may have developed a more efficient executive control system, particularly in the area of cognitive flexibility (Malakoff & Hakuta, 1991; Prior & Gollan, 2011). Because both languages are jointly activated and available to the bilingual child, even when only one of them is in use, a unique problem of attentional control presents itself (Bialystok et al., 2009; Chee, 2006; Crinion et al., 2006; Dijkstra, Grainger, & van Heuven, 1999; Hernandez, Bates, & Avila, 1996; Kaushanskaya & Marian, 2007; Kroll, Bobb, &

Wodniecka, 2006; Marian, Spivey & Hirsch, 2003; Rodriguez-Fornells, van der Lugt, Rotte, Britti, Heinze, & Muente, 2005; Sumiya & Healy, 2004), and not only is there competition for executive resources from within-language alternatives (e.g., cup vs. mug), but also between-language competition for similar concepts (e.g., cup vs. taza; Bialystok et al., 2009). Executive functions are then recruited to manage the simultaneous activation present in the bilingual mind, creating a differing set of attentional and control procedures for bilingual speech production (De Groot, 1997; Green, 1998). Practice regulating these areas are much more relevant for those faced with daily language brokering situations, particularly when inhibiting the unwanted language and switching between their two language systems.

In general, literature on child language brokers is scarce, however, a few studies have focused on children's self-reported grades, GPA, or standardized test scores, finding a positive outcome of language brokering (Acoach & Webb, 2004; Buriel et al., 1998; Dorner et al., 2007; Orellana, 2003). One recent study examining adult translators explored error detection differences between professional translators, students in interpreting training school, untrained bilinguals, and monolinguals (Yudes et al., 2012). When given short passages in English and asked to underline errors, while also comprehending the text, it was found that all bilingual groups had better comprehension scores when tested for comprehension of the passages. However, the professionally-trained translators identified more semantic and syntactic errors in the text than their non-professionally trained counterparts and monolingual peers (Yudes et al., 2012). Although all bilinguals groups evidenced better executive control networks than the monolinguals,

the professional translators had greater lexical access through intensive practice interpreting and translating, allowing for a deeper understanding of semantic analyses. The error processing and monitoring required during dual language processing requires a greater reliance on the areas that direct attentional control, which can be improved during varied linguistic experience and practice (Bialystok, 2007; Bialystok et al., 2008b; Costa et al., 2008).

The data from the current study is in line with this past work, while also contributing a new facet to this research, particularly in the examination of the cognitive consequences of naïve child translators who have no formal training. Through this study, slight advantages were found for the bilingual language brokers when examining processing speeds on the syntactic awareness task (at high levels of vocabulary knowledge) and the cognitive flexibility test. These findings suggest that bilingualism alone does not contribute to cognitive advantages in the middle school years, but also that the accumulation of linguistic experience can contribute to advantages in certain areas of functioning.

Metalinguistic Demands of a Translating Task

Every bilingual translates to a certain extent, but not necessarily as often or to the extent as that of a language broker. These children are more intensely involved and exposed to both of their languages than their peers, particularly when engaging in frequent translation experiences. This metalinguistic process of translation takes these children above and beyond the inhibition of an unwanted language, forcing them to step back and understand how their languages are structured (Malakoff & Hakuta, 1991).

Translation is not a direct one-to-one transformation, requiring the utmost level of metalinguistic ability to successfully communicate between linguistically different speakers (Buriel et al., 1998; De Groot, 1997; Malakoff & Hakuta, 1991). The translator must successfully step back and use language as a rule-governed system, continually evaluating whether or not they have successfully conveyed the intended message and have abided by the rules of the target-language system. This necessity to reflect upon language structure across two languages makes translating a particularly challenging metalinguistic task (Malakoff & Hakuta, 1991). This evidence, in conjunction with other studies on balance of bilingualism and fluency (e.g., Bialystok & Barac, 2012; Bialystok & Majumder, 1998; Galambos & Goldin-Meadow, 1990; Galambos & Hakuta, 1988), suggest that in the middle school years, bilingual advantages are maintained when both languages are reinforced to a certain degree.

Diglossic Sociolinguistic Environments

Bilingual advantages are not unconditional advantages found across any bilingual group, being sensitive to certain conditions, which has also been explored in recent research examining sociolinguistic environmental effects on the development of executive function skills, suggesting that bilinguals with a greater degree of separation and boundaries between their language systems have less of a need for a strong reliance on the executive function system (e.g., Costa et al., 2009; Tao, Marzecová, Taft, Asanowicz, & Wodniecka, 2011). For instance, when bilinguals use Spanish exclusively at home and English at school, there is a clear separation between the language systems, creating a diglossic sociolinguistic environment for bilingual non-brokers that have no

need to translate (Costa et al., 2009). This environment does not contribute to bilingual advantages because monitoring processes are not needed to choose the appropriate language and to switch back and forth between languages (Costa et al., 2009; Soveri et al., 2011).

While many bilingual non-brokers find that their languages are conveniently separated in this diglossic manner, language brokers are forced to break these bounds and use both language systems simultaneously, creating a greater need for the executive function system to help allocate the resources for this task (Costa et al., 2009; Soveri et al., 2011). For language brokers, switches between languages happen more often in the same context, especially when translating conversations. Although general inhibitory skills are still necessary for all bilinguals to block one language over the other, language brokers further "train" their cognitive flexibility skills with increased demands on the executive control system (Bialystok, 2007).

Broader Implications of Research

Evidence from this study has broader implications, ranging from theoretical beliefs to educational and parental implications. For one, this further supports the idea that cognition is organized around an integration of centralized processing skills, rather than modularized units of thought (Bialystok, Martin, & Viswanathan, 2005). Clearly, experience in the domain of language in the current study affected processing in another domain (i.e., the executive control system). Additionally, this system and the organization of this system is plastic and can be changed by experience, which was particularly seen in the language brokers, who have a very different linguistic experience

than most of their peers (Bialystok, Martin, & Viswanathan, 2005). Similarly, this work also contributes to the idea that bilingualism adds to one's cognitive reserve, or the maintenance of cognitive functioning, across the lifespan (e.g., Bialystok, Craik, & Freedman, 2007; Bialystok, Martin, & Viswanathan, 2005; Schweizer, Ware, Fischer, Craik, & Bialystok, 2012). In one particular study, bilingual older adults had a later onset of dementia than their monolingual counterparts (Bialystok et al., 2007), stemming from the complex mental stimulation across the lifespan that built up these reserves, strengthening areas such as neural plasticity, compensatory use of alternative brain regions, or enriched brain vasculature (Fratiglioni et al., 2004). The current study builds upon these ideas, demonstrating that the act of switching between languages, especially in complex translation tasks and linguistically differing situations can contribute even more so to these lifelong cognitive reserves.

From a parent's perspective, the results from this study are positive when making the decision to raise their child in a bilingual environment. By allowing children the freedom to use both languages and aiding in scaffolding of their language skills, parents can help to improve their child's cognitive skills. These results are also consolatory to parents in need of their child as a family translator and interpreter. The young child language brokers in the current study may not have been translating for long periods of time, however, positive cognitive benefits can already be seen for these children when comparing them to their non-brokering and monolingual peers.

Educational Implications

Through continued work, research in recent decades continues to show the cognitive benefits, rather than the detriments, of bilingualism. These findings have educational implications for school systems, particularly those in which bilingual education falls to the way-side, with the focus on a quick transition of English language learners into mainstream, English-only classrooms (August & Hakuta, 1998; Thomas & Collier, 2002). However, evidence points to the benefits of creating an additive bilingual environment, in which children are allowed to continue development of proficiency in both of their languages. In these types of environments, learning is freely enforced in both languages, and cross-linguistic transfer of skills in both languages can be used to reinforce new knowledge (Dickinson, McCabe, Clark-Chiarelli, & Wolf, 2004; Kenner, Ruby, Jessel, Gregory, & Arju, 2007; Thomas & Collier, 2002; Yoshida, 2008).

The halting of development in one's foundational language could lead to detrimental effects on cognitive and academic development (Yoshida, 2008). Some research has found that learning concepts in two languages, with one being their native language, reinforces and deepens children's understanding of fundamental mathematical concepts (e.g., Kenner, Gregory, Ruby, & Al-Azami, 2008) or helps to build phonological awareness in both languages (e.g., Dickinson et al., 2004). The current study provides further evidence that a continued reinforcement of both languages, presumably through language brokering interactions, may be improving cognitive skills, particularly in cognitive flexibility and syntactic awareness. Consequently, improvements in these areas have been linked to greater academic performance and

greater reading skills (Cain, 2007; Diamantopoulou et al., 2007; Morgan & Lilienfeld, 2000; St. Clair-Thompson & Gathercole, 2006; Tranel et al., 1994).

In one particular study examining immersion programs, young adults educated with these types of programs were more easily able to understand a novel language (Ter Kuile, Veldhuis, van Veen, & Wicherts, 2011). Through this type of education and an immersion in both languages, a greater awareness of metalinguistic knowledge was apparent, even in young adult populations.

Resilience Factor in Areas of Lower Socioeconomic Status

Other research has also begun to examine the way in which bilingualism can offset adverse effects of lower socioeconomic status, which can be useful for parents confined to these areas (e.g., Engel de Abreu et al., in press; Noble et al., 2005; Prior & Gollan, 2010). Although in a positive direction, much of the research has been plagued by confounding issues such as socioeconomic status, immigration status, and other sociolinguistic factors (Engel de Abreu et al., in press; Yoshida, 2008). Children faced with poverty have been typically found to be disadvantaged in areas of executive function, which can leader to poorer academic performance (Engel de Abreu et al., in press; Noble et al., 2005). A recent study examined the cognitive skills of first- and second-generation low-income Portuguese immigrants residing in Luxembourg (i.e., Luxembourgish/Portuguese-speaking second graders) to further understand the interaction of bilingualism and poverty (Engel de Abreu et al., in press). Although vocabulary skills were weaker for the bilinguals than their monolingual peers, the bilinguals were superior in other cognitive domains, such as focusing their attention on

the task at hand, providing evidence that bilingualism served as a protective factor in adverse conditions. The children in this study were all from areas in which the majority of the schools were eligible for Reduced/Free Lunch program, showing that even in areas of lower socioeconomic status, bilingualism and increased exposure to two languages can help serve as a protective factor in cognitive development.

Limitations of Study

In spite of the contributions to the literature, the limitations need to be addressed. These limitations concern the categorical designation of the bilingual language groups (i.e., bilingual non-brokers, bilingual brokers) and the lack of balanced biliteracy skills in the bilingual children. Although many of these issues continue to be dealt with in the bilingual literature, the implications of these limitations must be addressed.

Categorical Designation of Language Groups

Most bilingual studies designate children into two categorical groups, either as "bilingual" or "monolingual," however, this presents an issue, as the linguistic experiences of the children in the bilingual group tend to be quite varied. For instance, some children learn one language first, while others learn both languages simultaneously from birth. For the sequential bilinguals, the age of acquisition of a second language may also differ across individuals. To further complicate issues, the balance of children's bilingualism also differs across individuals, with some bilinguals presumably stronger in the majority language. In a similar manner, the current study created categorical distinctions between the bilingual children as "bilingual brokers" or "bilingual non-brokers." Although these designations were calculated using the criteria of past research

(see Dorner et al., 2007; Orellana, Dorner, & Pulido, 2003), variability may have still existed within the groups due to differing linguistic experiences. For instance, even though the language brokering criteria was met, the amount of translating or number of people each individual child typically translated for varied within the group.

Despite this limitation, this method of categorizing the children allowed for a monolingual reference group. The use of a monolingual group was needed to compare these children, which does not allow for the addition of individual linguistic experiences in the analyses. These initial findings, showing language group differences for the language brokers, can be built upon in future research. A closer assessment of the effects of certain brokering experiences (e.g., translation versus interpretation) and frequency of brokering experiences on cognitive development, both from a young age and across childhood and adolescence, would further build upon this foundation. Considering the relative lack of research examining language brokering effects in this area, this research is a positive contribution to the cognitive literature.

Unbalanced Biliteracy

Another limitation of the current study was the unbalanced biliteracy of a majority of the bilingual children. As was found in Shwartz et al. (2005), Russian/Hebrew-speaking children who were both bilingual and biliterate had a greater sense of metalinguistic awareness than their bilingual, monoliterate counterparts. From this work, it was evidenced that proficiency in both the verbal and literate domains created an even greater awareness of linguistic structures, beyond bilingualism in only the verbal domain. Although English and Spanish skills were directly measured, measures that are

advantageous over parent report or child self-report, most of the bilingual children showed relatively weaker reading fluency scores in Spanish. Even though the children showed an imbalance in literacy skills, the Spanish reading fluency test may not have captured children's true literacy skills due to the timed nature of the task (i.e., one minute of reading). The children may have been literate in Spanish, but required more time to process the words in this language, which is lost in the one minute timing. Although the research questions of this study did not address biliteracy versus monoliteracy, this is still an important limitation to address.

Despite this limitation, this was not considered a serious confound in this study due to the lack of differences in reading fluency between the two bilingual groups (i.e., the brokers versus the non-brokers). This finding may also reflect the true demographic of bilingual children in the area of data collection (i.e., in and around Chicago, IL). Language attrition may have been occurring in the children, due to the main language of instruction being in English. As initial differences have been found between the brokers and the non-brokers with relatively unbalanced literacy skills, future research on syntactic awareness and executive functions could benefit from a more comprehensive measure of language skills in both languages, including tests of reading comprehension that are untimed. Additionally, a sample of language brokering children from a different geographical location might display stronger biliteracy skills, further building upon this foundation.

Recommendations for Further Study

To examine changes in development across the lifespan, future research paths could benefit from the use of longitudinal methods to address syntactic awareness and executive function differences between language groups. Further questions examining the frequency of language brokering duties throughout childhood and adolescence could show a different developmental picture for those with different linguistic experiences. For instance, those brokering from a very young age who continue these duties may show differential cognitive development than those who started brokering in high school. Family circumstances, such as an older sibling moving out of the household for college, may force younger siblings to take over these duties at different ages. The younger brokers may benefit from precocious development in areas of metalinguistic awareness and executive functions, especially due to the fact that their executive functions are still developing at this age. The early effects of practiced use of these functions may create advantages that endure across the lifespan.

However, starting these duties in high school may lead to undue stress on the adolescent, creating adverse effects. This sudden burden, one they are not accustomed to, may create distractions from school studies, socialization with peers, thereby creating an obligation to stay with the family unit beyond high school (Love & Buriel, 2007; Umaña-Taylor, 2003; Wu & Kim, 2009). Conversely, brokers starting these duties from a young age may not feel the effects of this stress because they are accustomed to these obligations from a young age, seeing this as normal family functioning (Orellana, Dorner, & Pulido, 2003).

To address changes across generations, future work could address the "immigrant paradox." This paradox states that first (i.e, those born in another country and who immigrated at an older age) and 1.5 generation immigrants (those born in another country and who immigrated here before the age of 12) tend to have higher achievement and positive attitudes toward schooling than their peers, however, this motivation tends to decrease across generations (Suárez-Orozco, Rhodes, & Milburn, 2009). Although these ideas were beyond the scope of the current research questions, the current study was mainly composed of 2nd generation children and did not allow for these types of interactions. Differing cultural interactions, higher levels of exposure to both languages, and the necessity of these brokering abilities may be more prevalent in communities with a higher percentage of 1.5 generation children. However, these types of children may be more accessible in other geographical locations outside of Chicago and could bring new insight into the extent of the immigrant paradox.

Conclusions

Complex language conflicts encountered on a daily basis by bilinguals, especially child language brokers, have been suspected to be resolved by the executive control system (Bialystok, 2009; Green, 1998; Hilchey & Klein, 2011; Prior & Gollan, 2011). This control system serves to allocate the resources to the information (Luk et al., 2010), and constant use of this system in bilinguals consequently enhances these processes through practice, making them more efficient and available for other applications (Bialystok, 2009). Above all, the major contributions of the current study to the bilingual literature were (1) the use of a timed paradigm to measure processing differences on the

syntactic awareness task, revealing a particular advantage for language brokers at higher levels of vocabulary knowledge, (2) the contribution of receptive vocabulary to these advantages in syntactic awareness, and (3) the contribution of linguistic experiences in the reformulation of the executive control network in cognitive flexibility. Bilinguals do not simply endure an advantage in control mechanisms, but rather that certain and prolonged linguistic experiences reconfigure the cognitive processes in the executive control system, has begun to be explored in other work as well (e.g., Bialystok & Viswanathan, 2009; Hilchey & Klein, 2011; Prior & Gollan, 2011).

The language brokers in this study distinguished themselves from the bilingual non-brokering children in their efficiency in processing both the syntactic awareness tasks (at higher levels of vocabulary knowledge) and the cognitive flexibility task. Additionally, performance in these two areas of functioning were more closely correlated in the language brokers, providing further evidence that the continual recruitment of the executive control system to switch between language systems and to solve complex language tasks restructures the organization of this system, making it more efficient and available for use on other tasks. The linguistic and cognitive systems, inextricably linked and sensitive to changes in one area, can be modified by experience and ability (Bialystok, Martin, & Viswanathan, 2005; Craik & Bialystok, 2006).

Although these advantages were found on certain tasks for the bilingual language brokers, it must be noted that child language brokers may be disadvantages in other areas of functioning. An emerging body of research suggests that language brokering skills acquired during childhood may impact the development of cognitive and emotional

function in both beneficial and detrimental ways (Tse, 1995; Umaña-Taylor, 2003; Wu & Kim, 2008). Child language brokers translate in contexts ranging from bank documents to conversations between parents and health professionals. Involvement in these activities, many requiring adult comprehension levels, may negatively affect mental health by placing undue stress on children, while also taking them away from school studies and creating pressure to stay involved with their family as young adults (Umaña-Taylor, 2003).

APPENDIX A

PARENT QUESTIONNAIRE OF LANGUAGE LEARNING ENVIRONMENT

1. Does your child speak only English?

If no, what other language(s) does your child speak?

2. Did your child learn English or Spanish first or did they learn them at the same time?

English

Spanish

Same Time

3. What is the birthdate of your child?

4. Is your child the first born?

5. What is the country of birth of your child?

6. What is your country of birth?

How long have you lived in the United States?

7. Were you educated in the United States?

8. What is your highest level of education?:

Grade School

Some High School

High School

Some College

College Degree

Graduate/Professional (e.g., M.A., Ph.D.)

9. Are you your child's:

Mother

Father

10. What languages do you speak?

English

Spanish

Other

What languages does your spouse speak?

English

Spanish

Other

11. How many books for children are there in your home in English?

0-10

11-30

31-50

51-70

71-90

91-110

111+

How many books for children are there in your home in Spanish?

0-10

11-30

31-50

51-70

71-90

91-110

111+

12. How often does an adult/older sibling read or look at English language books (not related to homework) with your child?

    Daily

    Three times a week

    Twice a week

    Once a week

    Twice a month

    Never

    How often does an adult/older sibling read or look at Spanish language books (not related to homework) with your child?

    Daily

    Three times a week

    Twice a week

    Once a week

    Twice a month

    Never

13. How often does an adult/older sibling tell your child a story (not related to homework) in English?

    Daily

    Three times a week

    Twice a week

    Once a week

    Twice a month

    Never

    How often does an adult/older sibling tell your child a story (not related to homework) in Spanish?

    Daily

    Three times a week

    Twice a week

    Once a week

    Twice a month

    Never

14. How often does someone from your family or household go to the library with your child?

    Daily

    Three times a week

    Twice a week

    Once a week

Twice a month

Never

15. How often does your child read or look at books at home on his/her own?

Daily

Three times a week

Twice a week

Once a week

Twice a month

Never

REFERENCE LIST

Abu-Rabia, S., & Siegel, L. S. (2002). Reading, syntactic, orthographic, and working memory skills of bilingual Arabic-English speaking Canadian children. *Journal of Psycholinguistic Research, 31,* 661-678.

Abutalebi, J., & Green, D. (1997). Bilingual language production: The neurocognition of language representation and control. *Journal of Neurolinguistics, 20,* 242-275. doi: 10.1016/j.jneuroling.2006.10.003

Acoach, C. L., & Webb, L. M. (2004). The influence of language brokering on Hispanic teenagers' acculturation, academic performance, and nonverbal decoding skills: A preliminary study. *Howard Journal of Communications, 15,* 1-19. doi: 10.1080/10646170490275459

Adesope, O. O., Lavin, T., Thompson, T., & Ungerleider, C. (2010). A systematic review and meta-analysis of the cognitive correlates of bilingualism. *Review of Educational Research, 80,* 207-245. doi: 10.3102/0034654310368803

Adi-Japha, E., Berberich-Artzi, J., & Libnawi, A. (2010). Cognitive flexibility in drawings of bilingual children. *Child Development, 81,* 1356-1366. doi: 10.1111/j.1467-8624.2010.01477.x

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions.* Newbury Park, CA: Sage.

Anderson, P. (2002). Assessment and development of executive function (EF) during childhood. *Child Neuropsychology, 8,* 71–82. doi: 10.1076/chin.8.2.71.8724

Anzures, G., Ge, L., Wang, Z., Itakura, S., & Lee, K. (2011). An own-age bias in young adults' facial age judgments. *Psychologia, 54,* 166-174. doi: 10.2117/psysoc.2011.166

Ardila, A., Rosselli, M., Matute, E., & Guajardo, S. (2005). The influence of the parents' educational level on the development of executive functions. *Developmental Neuropsychology, 28,* 539-560. doi: 10.1207/s15326942dn2801_5

Asato, M. R., Sweeney, J. A., & Luna, B. (2006). Cognitive processes in the development of TOL performance. *Neuropsychologia, 44,* 2259-2269. doi: 10.1016/j.neuropsychologia.2006.05.01

August, D., & Hakuta, K. (1998). *Improving schooling for language-minority children: A research agenda.* Washington, DC: National Academy Press.

Barac, R., & Bialystok, E. (2012). Bilingual effects on cognitive and linguistic development: Role of language, cultural background, and education. *Child Development, 83,* 413-422. doi: 10.1111/j.1467-8624.2011.01707.

Ben-Zeev, S. (1977). The influence of bilingualism on cognitive strategy and cognitive development. *Child Development, 48,* 1009-1018. doi: 10.2307/1128353

Bentin, S., Deutsch, A., & Liberman, L. Y. (1990). Syntactic competence and reading ability in children. *Journal of Experimental Child Psychology, 48*, 147-172. doi: 10.1016/0022-0965(90)90053-B

Berko, J. (1958). The child's learning of English morphology. *Word, 14,* 150–177.

Best, J. R., & Miller, P. H. (2010). A developmental perspective on executive function. *Child Development, 81,* 1641-1660. doi: 10.1111/j.1467-8624.2010.01499.x

Best, J. R., Miller, P. H., & Jones, L. L. (2009). Executive functions after age 5: Changes and correlates. *Developmental Review, 29,* 180-200. doi: 10.1016/j.dr.2009.05.002

Bialystok, E. (1986). Factors in the growth of linguistic awareness. *Child Development, 57,* 498-510. doi: 10.2307/1130604

Bialystok, E. (1988). Levels of bilingualism and levels of linguistic awareness. *Developmental Psychology, 24,* 560-567. doi: 10.1037/0012-1649.24.4.560

Bialystok, E. (1991). Letters, sounds, and symbols: Changes in children's understanding of written language. *Applied Psycholinguistics, 12,* 75-89. doi: 10.1017/S0142716400009383

Bialystok, E. (1992). Attentional control in children's metalinguistic performance and measures of field independence. *Developmental Psychology, 28* (4), 654-664. doi: 10.1037/0012-1649.28.4.654

Bialystok, E. (1993). Metalinguistic awareness: The development of children's representations of language. In C. Pratt & A. Garton (Eds.), *Systems of representation in children: Development and use* (pp. 211-233). London: Wiley & Sons.

Bialystok, E. (1994). Analysis and control in the development of second language proficiency. *Studies in Second Language Acquisition, 16,* 157-168.

Bialystok, E. (1997). Effects of bilingualism and biliteracy on children's emerging concepts of print, *Developmental Psychology, 3,* 429-440. doi: 10.1037/0012-1649.33.3.429

Bialystok, E. (1999). Cognitive complexity and attentional control in the bilingual mind. *Child Development, 70,* 636-644. doi: 10.1111/1467-8624.00046

Bialystok, E. (2001). Bilingualism in development: Language, literacy, and cognition. New York: Cambridge University Press.

Bialystok, E. (2006). Effect of bilingualism and computer video game experience on the Simon Task. *Canadian Journal of Experimental Psychology, 60,* 68-79. doi: 10.1037/cjep2006008

Bialystok, E. (2007). Acquisition of literacy in bilingual children: A framework for research. *Language Learning, 57,* 45-77. doi: 10.1111/j.1467-9922.2007.00412.x

Bialystok, E. (2009). The good, the bad, and the indifferent. *Bilingualism: Language and Cognition, 12,* 3-11. doi: 10.1017/S1366728908003477

Bialystok, E. (2010). Global–local and trail-making tasks by monolingual and bilingual children: Beyond inhibition. *Developmental Psychology, 46,* 93-105. doi: 10.1037/a0015466

Bialystok, E., & Barac, R. (2012). Emerging bilingualism: Dissociating advantages for metalinguistic awareness and executive control. *Cognition, 122,* 67-73. doi: 10.1016/j.cognition.2011.08.003

Bialystok, E., & Craik, F. I. M. (2010). Cognitive and linguistic processing in the bilingual mind. *Current Directions in Psychological Science, 19,* 19-23. doi: 10.1177/0963721409358571

Bialystok, E., & Feng, X. (2009). Language proficiency and executive control in proactive interference: Evidence from monolingual and bilingual children and adults. *Brain and Language, 109,* 93-100. doi: 10.1016/j.bandl.2008.09.001

Bialystok, E., & Herman, J. (1999). Does bilingualism matter for early literacy? *Bilingualism: Language and Cognition, 2,* 35-44. doi: 10.1017/S1366728999000139

Bialystok, E., & Martin, M. M. (2004). Attention and inhibition in bilingual children: Evidence from the dimensional change card sort task. *Developmental Science, 7,* 325-339. doi: 10.1111/j.1467-7687.2004.00351.x

Bialystok, E., & Majumder, S. (1998). The relationship between bilingualism and the development of cognitive processes in problem-solving. *Applied Psycholinguistics, 19,* 69-85. doi: 10.1017/S0142716400010584

Bialystok, E., & Ryan, E. B. (1985). A metacognitive framework for the development of first and second language skills. In D. L. Forrest-Pressley, G. E. Mackinnon, & T. G. Waller (Eds.), *Meta-cognition, cognition, and human performance* (pp. 207-252). New York: Academic Press.

Bialystok, E., & Shapero, D. (2005). Ambiguous benefits: The effect of bilingualism on reversing ambiguous figures. *Developmental Science, 8,* 595–604. doi: 10.1111/j.1467-7687.2005.00451.x

Bialystok, E., & Viswanathan, M. (2009). Components of executive control with advantages for bilingual children in two cultures. *Cognition, 112,* 494-500. doi: 10.1016/j.cognition.2009.06.014

Bialystok, E., Barac, R., Blaye, A., & Poulin-Dubois, D. (2010). Word mapping and executive functioning in young monolingual and bilingual children. *Journal of Cognitive Development, 11,* 485-508. doi: 10.1080/15248372.2010.516420

Bialystok, E., Craik, F. I. M., & Freedman, M. (2007). Bilingualism as a protection against the onset of symptoms of dementia. *Neuropsychologia, 45,* 459-464. doi: 10.1016/j.neuropsychologia.2006.10.009

Bialystok, E., Craik, F. I. M., & Ryan, J. (2006). Executive control in a modified anti-saccade task: Effects of aging and bilingualism. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 32,* 1341-1354. doi: 10.1037/0278-7393.32.6.1341

Bialystok, E., Craik, F. I. M., & Luk, G. (2008a). Cognitive control and lexical access in younger and older bilinguals. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 34,* 859-873. doi: 10.1037/0278-7393.34.4.859

Bialystok, E., Craik, F. I. M., & Luk, G. (2008b). Lexical access in bilinguals: Effects of vocabulary size and executive control. *Journal of Neurolinguistics, 21,* 522-538. doi: 10.1016/j.jneuroling.2007.07.001

Bialystok, E., Luk, G., & Kwan, E. (2005). Bilingualism, biliteracy, and learning to read: Interactions among languages and writing systems. *Scientific Studies of Reading, 9,* 43-61. doi: 10.1207/s1532799xssr0901_4

Bialystok, E., Martin, M. M., & Viswanathan, M. (2005). Bilingualism across the lifespan: The rise and fall of inhibitory control. *International Journal of Bilingualism, 9,* 103-119. doi: 10.1177/13670069050090010701

Bialystok, E., Majumder, S., & Martin, M. M. (2003). Developing phonological awareness: Is there a bilingual advantage? *Applied Psycholinguistics, 24,* 27-44. doi: 10.1017/S014271640300002X

Bialystok, E., Craik, F. I. M., Green, D. W., Gollan, T. H. (2009). Bilingual minds. *Psychological Science in the Public Interest, 10,* 89-129. doi: 10.1177/1529100610387084

Bialystok, E., Craik, F. I. M., Klein, R., & Viswanathan, M. (2004). Bilingualism, aging, and cognitive control: Evidence from the Simon task. *Psychology and Aging, 19,* 290–303. doi: 10.1037/0882-7974.19.2.290

Bialystok, E., Shenfield, & Codd (2000). Languages, scripts, and the environment: Factors in developing concepts of print. *Developmental Psychology, 36,* 66-76. doi: 10.1037/0012-1649.36.1.66

Blasi, G., Goldberg, T., Weickert, T., Das, S., Kohn, P. Zoltick, B., … Mattay, V. S. (2006). Brain regions underlying response inhibition and interference monitoring and suppression. *European Journal of Neuroscience, 23,* 1658-1664. doi: 10.1111/j.1460-9568.2006.04680.x

Bonifacci, P., Giombini, L., Bellocchi, S., & Contento, S. (2011). Speed of processing, anticipation, inhibition and working memory in bilinguals. *Developmental Science, 14,* 256-269. doi: 10.1111/j.1467-7687.2010.00974.x

Botvinick, M. M., Cohen, J. D., & Carter, C. S. (2004). Conflict monitoring and anterior cingulate cortex: An update. *Trends in Cognitive Science, 8,* 539–546. doi: 10.1016/j.tics.2004.10.003

Bowey, J. A. (2005). Predicting individual differences in learning to read. In M. J. Snowling, & C. Hulme (Eds.), *The science of reading: A handbook* (pp. 155–172). Malden, MA: Blackwell Publishing.

Bowey, J. A., & Patel, R. K. (1988). Metalinguistic ability and early reading achievement. *Applied Psycholinguistics, 9,* 367-383. doi: 10.1017/S0142716400008067

Bradley, L., & Bryant, P. E. (1983). Rhyme and reason in reading and spelling. In *JARLD Monograph No. 1.* Ann Arbor, MI: University of Michigan Press.

Brady & Shankweiler (Eds.) (1991). *Phonological processes in literacy: A tribute to Isabelle Liberman.* Hillsdale, NJ: LEA Publishers.

Brice, A. E., Shaunessy, E., Hughes, C., McHatton, P. A., & Ratliff, M. A. (2008). What language discourse tells us about bilingual adolescents: A study of students in gifted programs and students in general education programs. *Journal for the Education of the Gifted, 32,* 7-33.

Brocki, K. C., & Bohlin, G. (2004). Executive functions in children aged 6 to 13: A dimensional and developmental study. *Developmental Neuropsychology, 26,* 571-593. doi: 10.1207/s15326942dn2602_3

Brown, A. L. (1980). Metacognitive development and reading. In R. J. Spiro, B. C. Brice, & W. F. Brewer (Eds.), *Theoretical issues in reading in reading comprehension* (pp. 453-481). Hillsdale, NJ: Erlbaum.

Bruck, M. & Genesee, F. (1995). Phonological awareness in young second language learners. *Journal of Child Language, 22,* 307-324. doi: 10.1017/S0305000900009806

Bryant, P. E., Nunes, T., & Bindman, M. (1998). Awareness of language in children who have reading difficulties: Historical comparisons in a longitudinal study. *Journal of Child Psychology and Psychiatry, 39,* 501-510. doi: 10.1111/1469-7610.00346

Bull, R., & Scerif, G. (2001). Executive functioning as a predictor of children's mathematical ability: Inhibition, switching, and working memory. *Developmental Neuropsychology, 19,* 273-293. doi: 10.1207/S15326942DN1903_3

Bunge, S. A., Dudukovic, N. M., Thomason, M. E., Vaidya, C. J., & Gabrieli, J. D. E. (2002). Immature frontal lobe contributions to cognitive control in children: Evidence from fMRI. *Neuron, 33,* 301-311.

Buriel, R., Perez, W., de Ment, T. L., Chavez, D. V., & Moran, V. R. (1998). The relationship of language brokering to academic performance, biculturalism, and self-efficacy among Latino adolescents. *Hispanic Journal of Behavioral Sciences, 20,* 283-297. doi: 10.1177/07399863980203001

Cain, K. (2007). Syntactic awareness and reading ability: Is there any evidence for a special relationship? *Applied Psycholinguistics, 28,* 679-694. doi: 10.1017/S0142716407070361

Cain, K., & Oakhill, J. (2004). Reading comprehension difficulties. In T. Nunes & P. Bryant (Eds.), *Handbook of children's literacy.* Netherlands: Kluwer Academic Publishers.

Campbell, R. & Sais, E. (1995). Accelerated metalinguistic (phonological) awareness in bilingual children. *British Journal of Developmental Psychology, 13,* 61-68.

Carlisle, J. F., Beeman, M., Davis, L. H., & Spharim, G. (1999). Relationship of metalinguistic capabilities and reading achievement for children who are becoming bilingual. *Applied Psycholinguistics, 20,* 459-478. doi: 10.1017/S0142716499004014

Carlson, S. M. (2005). Developmentally sensitive measures of executive function in preschool children. Developmental Neuropsychology, 28, 595–616. doi: 10.1207/s15326942dn2802_3

Carlson, S. M., & Meltzoff, A. N. (2008). Bilingual experience and executive functioning in young children. *Developmental Science, 11,* 282-298. doi: 10.1111/j.1467-7687.2008.00675.x

Casey, B. J., Amso, D., & Davidson, M. C. (2006). Learning about learning and development with modern imaging technology. In Y. Munakata & M. H. Johnson (Eds.), *Processes of change in brain and cognitive development, attention and performance.* Oxford University Press.

Casey, B. J., Trainor, R. J., Orendi, J. L., Schubert, A. B., Nystrom, L. E., Giedd, J. N., … Rapoport, J. L. (1997). A developmental functional MRI study of prefrontal activation during performance of a Go-No-Go Task. *Journal of Cognitive Neuroscience, 9,* 835-847. doi: 10.1162/jocn.1997.9.6.835

Castles, A., & Coltheart, M. (2004). Is there a causal link from phonological awareness to success in learning to read? *Cognition, 91,* 77-111. doi: 10.1016/S0010-0277(03)00164-1

Catts, H. W. (1991). Facilitating phonological awareness: Role of speech-language pathologists. *Language, Speech, and Hearing in Schools, 22,* 196-203.

Cepeda, N. J., Kramer, A. F., & Gonzales de Sather, J. C. M. (2001). Changes in executive control across the life span: Examination of task-switching performance. *Developmental Psychology, 37,* 715–730. doi: 10.1037/0012-1649.37.5.715

Charmian, K. (2007). Childhood bilingualism: Research on infancy through school age. *Literacy, 41*, 110–111. doi:

Chee, M. W. L. (2006). Dissociating language and word meaning in the bilingual brain. *Trends in Cognitive Sciences, 10,* 527-529. doi: 10.1016/j.tics.2006.09.009

Chen, X., Anderson, R. C., Li, W., Hao, M.,Wu, X., & Shu, H. (2004). Phonological awareness of bilingual and monolingual Chinese children. *Journal of Educational Psychology, 96*, 142–151. doi: 10.1037/0022-0663.96.1.142

Colzato, L. S., Bajo, M. T., van den Wildenberg, W., Paolieri, D., Nieuwenhuis, S., La Heij, W., & Hommel, B. (2008). How does bilingualism improve executive control? A comparison of active and reactive inhibition mechanisms. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 34*, 302-312. doi: 10.1037/0278-7393.34.2.302

Conklin, H. M., Luciana, M., Hooper, C. J., & Yarger, R. S. (2007). Working memory performance in typically developing children and adolescents: Behavioral evidence of protracted frontal lobe development. *Developmental Neuropsychology*, *31*, 103–128. doi: 10.1207/s15326942dn3101_6

Cossu, G., Shankweiler, D., Liberman, I. Y., Katz, L., & Tola, G. (1988). Awareness of phonological segments and reading ability in Italian children. *Applied Psycholinguistics*, *9,* 1-16. doi: 10.1017/S0142716400000424

Costa, A., Hernández, M., Costa-Faidella, J., & Sebastián-Gallés, N. (2009). On the bilingual advantage in conflict processing: Now you see it, now you don't. *Cognition*, *113,* 135-149. doi: 10.1016/j.cognition.2009.08.001

Costa, A., Hernández, M., & Sebastián-Gallés, N. (2008). Bilingualism aids conflict resolution: Evidence from the ANT task. *Cognition, 106*, 59–86. doi: 10.1016/j.cognition.2006.12.013

Craik, F. I. M., & Bialystok, E. (2006). Cognition through the lifespan: Mechanisms of change. *Trends in Cognitive Sciences*, *10*, 131-138. doi: 10.1016/j.tics.2006.01.007

Crinion, J., Turner, R., Grogan, A., Hanakawa, T., Noppeney, U., Devlin, J.T., … Price, C. J. (2006). Language control in the bilingual brain. *Science, 312*, 1537–1540. doi: 10.1126/science.1127761

Cromdal, J. (1999). Childhood bilingualism and metalinguistic skills: Analysis and control in young Swedish-English bilinguals. *Applied Psycholinguistics, 20,* 1-20. doi: 10.1017/S0142716499001010

Cummings, K. D., Baker, D. L., & Good, R. H. (2006). Guía para la administración y calificación de IDEL. En D. L. Baker, R. H. Good, N. Knutson, & J. M. Watson (Eds.), *Indicadores Dinámicos del Éxito en la Lectura* (7a ed.). Eugene, OR: Dynamic Measurement Group.

Da Fontoura, H. A., & Siegel, L. S. (1995). Reading, syntactic, and working memory skills of bilingual Portuguese-English Canadian children. *Reading and Writing: An Interdisciplinary Journal, 7,* 139-153. doi: 10.1007/BF01026951

De Groot, A. M. B. (1997). The cognitive study of translation and interpretation: Three approaches. In J. H. Danks, G. M. Shreve, S. B. Fountain, & M. K. McBeath (Eds.), *Cognitive processes in translation and interpreting.* Thousand Oaks, CA: Sage Publications.

Danahy, K., Windsor, J., & Kohnert, K. (2007). Counting span and the identification of primary language impairment. *International Journal of Language and Communication Disorders, 42,* 349-367. doi: 10.1080/13682820600940083

Davidson, M. C., Amso, D., Anderson, L. C., & Diamond, A. (2006). Development of cognitive control and executive functions from 4 to 13 years: Evidence from manipulations of memory, inhibition, and task switching. *Neuropsychologia, 44,* 2037-2078. doi: 10.1016/j.neuropsychologia.2006.02.006

Davidson, D., & Raschke, V. R. (in preparation). Monolingual and bilingual children's syntactic awareness: The role of receptive vocabulary and grammatical constructions.

Davidson, D., Raschke, V. R., & Pervez, J. (2010). Syntactic awareness in young monolingual and bilingual (Urdu-English) children. *Cognitive Development, 25,* 166-182. doi: 10.1016/j.cogdev.2009.07.003

Defior, S. (2004). Phonological awareness and learning to read: A cross-linguistic perspective. In T. Nunes & P. Bryant (Eds.), *Handbook of children's literacy.* Netherlands: Kluwer Academic Publishers.

Delis, D. C., Kaplan, E., & Kramer, J. H. (2001). The Delis-Kaplan Executive Function System. San Antonio: The Psychological Corporation.

Demont, E., & Gombert, J. E. (1996). Phonological awareness as a predictor of recoding skills and syntactic awareness as a predictor of comprehension skills. *British Journal of Educational Psychology, 66,* 315-332.

Diamantopoulou, S., Rydell, A., Thorell, L. B., & Bohlin, G. (2007). Impact of executive functioning and symptoms of attention deficit hyperactivity disorder on children's peer relations and school performance. *Developmental Neuropsychology, 32,* 521-542.

Diamond, A. (2002). Normal development of prefrontal cortex from birth to young adulthood: Cognitive functions, anatomy, and biochemistry. In D. T. Stuss & R. T. Knight (Eds.), *Principles of frontal lobe function* (pp. 466–503). New York: Oxford University Press.

Diamond, A. (2006). The early development of executive functions. In E. Bialystok & F. I. M. Craik (Eds.), *Lifespan cognition: Mechanisms of change* (pp. 70-95). New York: Oxford University Press.

Diamond, A., & Taylor, C. (1996). Development of an aspect of executive control: Development of the abilities to remember what I said and to "Do as I say, not as I do." *Developmental Psychobiology, 29,* 315-334. doi: 10.1002/(SICI)1098-2302(199605)29:4<315::AID-DEV2>3.0.CO;2-T

Diamond, A., Carlson, S. M., & Beck, D. M. (2005). Preschool children's performance in task switching on the Dimensional Change Card Sort Task: Separating the dimensions aids the ability to switch. *Developmental Neuropsychology, 28,* 689-729. doi: 10.1207/s15326942dn2802_7

Diamond, A., Kirkham, N., & Amso, D. (2002). Conditions under which young children can hold two rules in mind and inhibit a prepotent response. *Developmental Psychology, 38,* 352-362. doi: 10.1037//0012-1649.38.3.352

Dickinson, D. K., McCabe, A., Clark-Chiarelli, N., & Wolf, A. (2004). Cross-language transfer of phonological awareness in low-income Spanish and English bilingual preschool children. *Applied Psycholinguistics, 25,* 323-347. doi: 10.1017/S0142716404001158

Dijkstra, T., Grainger, J., & van Heuven, W. J. B. (1999). Recognition of cognates and interlingual homographs: The neglected role of phonology. *Journal of Memory and Language, 41,* 496-518. doi: 10.1006/jmla.1999.2654

Dorner, L. M., Orellana, M. F., & Li-Grining, C. P. (2007). “I helped my mom,” and it helped me: Translating the skills of language brokers into improved standardized test scores. *American Journal of Education, 113*(3), 451-478. doi: 10.1086/512740

Downing, J., & Valtin, R. (Eds.) (1984). *Language awareness and learning to read.* New York: Springer-Verlag.

Dunn, L. M., & Dunn, L. M. (2007). *Peabody picture vocabulary test (4th edition).* Circle Pines, MN: American Guidance Service.

Dunn, L. M., Lugo, D. E., Padilla, E. R., & Dunn, L. M. (1986). *Test de Vocabulario en Imagenes Peabody.* Circle Pines, MN: American Guidance Service.

Duursma, Romero-Contreras, Szuber, Proctor, & Snow (2007). The role of home literacy environment on bilinguals’ English and Spanish vocabulary development. *Applied Psycholinguistics, 28,* 171-190. doi: 10.1017.S0142716406070093

Edwards, H. T., & Kirkpatrick, A. G. (1999). Metalinguistic awareness in children: A developmental progression. *Journal of Psycholinguistic Research, 28,* 313-329.

Ehri, L. C., Nunes, S. R., Stahl, S. A., & Willows, D. M. (2001). Systematic phonic instruction helps students learn to read: Evidence from the National Reading Panel’s meta-analysis. *Review of Education Research, 71,* 393-447. doi: 10.3102/00346543071003393

Emmorey, K., Luk, G., Pyers, J. E., & Bialystok, E. (2008). The source of enhanced cognitive control in bilinguals. *Psychological Science, 19,* 1201-1206. doi: 10.1111/j.1467-9280.2008.02224.x

Engel de Abreu, P., Cruz-Santos, A., Tourinho, C., Romain, M., & Bialystok, E. (in press). Bilingualism enriches the poor: Enhanced cognitive control in low-income minority children. *Psychological Science.*

Eriksen, B. A., & Eriksen, C. W. (1974). Effects of noise letters upon the idenitification of a target letter in a nonsearch task. *Perception and Psychophysics, 16,* 143-149.

Esposito, E., & Baker-Ward, L. (October, 2011). *Does increased bilingual exposure enhance executive function in low income children?* Poster presented at the Cognitive Development Society Conference, Philadelphia, PA.

Fabbro, F., Skrap, M., & Aglioti, S. (2000). Pathological switching between languages after frontal lesions in a bilingual patient. *Journal of Neurology, Neurosurgery, and Psychiatry, 68*, 650–652. doi: 10.1136/jnnp.68.5.650

Fan, J., Flombaum, J. I., McCandliss, B. D., Thomas, K. M., & Posner, M. I. (2003). Cognitive and brain consequences of conflict. *NeuroImage, 18*, 42–57. doi: 10.1006/nimg.2002.1319

Feldman, C., & Shen, M. (1971). Some language-related cognitive advantages of bilingual 5-year-olds. *Journal of Genetic Psychology, 118,* 235-244.

Fernandes, M. A., Craik, F. I. M., Bialystok, E., & Kreuger, S. (2007). Effects of bilingualism, aging, and semantic relatedness on memory under divided attention. *Canadian Journal of Experimental Psychology, 61*, 128–141. doi: 10.1037/cjep2007014

Forrest-Pressley, D. L., & Waller, T. G. (1984). *Metacognition, cognition, and reading.* New York: Springer-Verlag.

Foursha-Stevenson, C., & Nicoladis, E. (2011). Early emergence of syntactic awareness and cross-linguistic influence in bilingual children’s judgment. *International Journal of Bilingualism, 15,* 521-534. doi: 10.1177/1367006911425818

Fratiglioni, L., Paillard-Borg, S., & Winblad, B. (2004). An active and socially integrated lifestyle in late life might protect against dementia. *Lancet Neurology, 3*, 343–353. doi: 10.1016/S1474-4422(04)00767-7

Galambos, S. J., & Goldin-Meadow, S. (1990). The effects of learning two languages on levels of metalinguistic awareness. *Cognition, 34,* 1-56. doi: 10.1016/0010-0277(90)90030-N

Galambos, S. J., & Hakuta, K. (1988). Subject-specific and task-specific characteristics of metalinguistic awareness in bilingual children. *Applied Psycholinguistics, 9,* 141-162. doi: 10.1017/S0142716400006780

Garbin, G., Sanjuan, A., Forn, C., Bustamante, J. C., Rodriguez-Pujadas, Belloch, V., . . . Avila, C. (2010). Bridging language and attention: Brain basis of the impact of bilingualism on cognitive control. *NeuroImage, 53,* 1272-1278. doi: 10.1016/j.neuroimage.2010.05.078

Garon, N., Bryson, S. E., & Smith, I. M. (2008). Executive function in preschoolers: A review using an integrative framework. *Psychological Bulletin, 134,* 31-60. doi: 10.1037/0033-2909.134.1.31

Garton, A., & Pratt, C. (1989). *Learning to be literate: The development of spoken and written language.* New York: Basil Blackwell.

Gathercole, V. C. M., & Montes, C. (1997). *That*-trace effects in Spanish- and English-speaking monolinguals and bilinguals. In A. T. Pérez-Leroux & W. R. Glass (Eds.), *Contemporary perspectives on the acquisition of Spanish: Vol. 1: Developing grammar* (pp. 75-95). Somerville, MA: Cascadilla Press.

Gaux, C., & Gombert, J. E. (1999). Implicit and explicit syntactic knowledge and reading in pre-adolescents. *British Journal of Educational Psychology, 17,* 169-188. doi: 10.1348/026151099165212

Gernsbacher, M., & Shlesinger, M. (1997). The proposed role of suppression in simultaneous interpretation. *Interpreting, 2,* 119–140. doi: 10.1075/intp.2.1-2.05ger

Gerstadt, C. L., Hong, Y. J., & Diamond, A. (1994). The relationship between cognition and action: Performance of children 3.5–7 years old on a Stroop-like day-night test. *Cognition*, *53,* 129–153. doi: 10.1016/0010-0277(94)90068-X

Geva, E., & Wade-Woolley, L. (1998). Component processes in becoming English-Hebrew biliterate. In A.Y. Durgunoglu and L. Verhoeven (Eds.). *Literacy development in a multilingual context: Cross cultural perspectives* (pp. 85-110). Mahwah, New Jersey: Lawrence Erlbaum.

Gile, D. (1997). Conference interpreting as a cognitive management problem. In J. H. Danks, G. M. Shreve, S. B. Fountain, & M. K. McBeath (Eds.), *Cognitive processes in translation and interpretation* (pp. 196–214). Thousand Oaks. CA: Sage.

Gile, D. (2009). *Basic concepts and models for interpreter and translator training*. Amsterdam: John Benjamins.

Goffaux, V., Hault, B., Michel, C., Vuong, Q. C., & Rossion, B. (2005). The respective role of low and high spatial frequencies in supporting configural and featural processing of faces. *Perception, 34,* 77-86. doi: 10.1068/p5370

Gombert, J. E. (1992). *Metalinguistic development.* Chicago: University of Chicago Press.

Göncz, L., & Kodzopeljic, J. (1991). Exposure to two languages in the preschool period: Metalinguistic development and the acquisition of reading. *Journal of Multilingual and Multicultural Development, 12* (3), 137-163.

Good, R. H., & Kaminski, R. A. (2002). *Dynamic Indicators of Basic Early Literacy Skills (6th Edition).* Eugene, OR: Institute for the Development of Education Achievement.

Goswami, U., & Bryant, P. E. (1990). *Phonological skills and learning to read.* London: Erlbaum.

Gottardo, A., Stanovich, K., & Siegel, L. (1996). The relationships between phonological sensitivity, syntactic processing and verbal working memory in the reading performances of third-grade children. *Journal of Experimental Child Psychology, 63,* 563-582. doi: 10.1006/jecp.1996.0062

Grant, D. A., & Berg, E. A. (1948). A behavioural analysis of degree of reinforcement and ease of shifting to new responses in a Weigl-type card sorting problem. *Journal of Experimental Psychology, 38,* 404-411. doi: 10.1037/h0059831

Green, D. (1998). Mental control of the bilingual lexico-semantic system. *Bilingualism: Language and Cognition, 1,* 67-81. doi: 10.1017/S1366728998000133

Guo, Y., Roehrig, A. D., & Williams, R. S. (2011). The relation of morphological awareness and syntactic awareness to adults' reading comprehension: Is vocabulary knowledge a mediating variable? *Journal of Literacy Research, 43,* 159-183. doi: 10.1177/1086296X11403086

Hakuta, K., & Diaz, R. M. (1985). The relationship between degree of bilingualism and cognitive ability: A critical discussion and some new longitudinal data. In K. E. Nelson (Ed.), *Children's Language, Vol. 5*. Hillsdale, NJ: L. Erlbaum.

Heath, S. B. (1986). Sociocultural contexts of language development. In *Beyond language: Social and cultural factors in schooling language minority students.* Los Angeles: Evaluation, Dissemination, and Assessment Center, California State University, Los Angeles.

Hedden, T., Gabrieli, J. D., 2010. Shared and selective neural correlates of inhibition, facilitation, and shifting processes during executive control. *Neuroimage, 51,* 421–431. doi: 10.1016/j.neuroimage.2010.01.089

Hernandez, A. E. (2009). Language switching in the bilingual brain: What's next? *Brain and Language, 109,* 133-140. doi: 10.1016/j.bandl.2008.12.005

Hernandez, A.E., Bates, E., & Avila, L.X. (1996). Processing across the language boundary: A cross-modal priming study of Spanish- English bilinguals. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 22,* 846–864. doi: 10.1037/0278-7393.22.4.846

Hilchey, M. D., & Klein, R. M. (2011). Are there bilingual advantages on nonlinguistic interference tasks? Implications for the plasticity of executive control processes. *Psychonomic Bulletin and Review, 18,* 625-658. doi: 10.3758/s13423-011-0116-7

Holmbeck, G. N. (1997). Toward terminological, conceptual, and statistical clarity in the study of mediators and moderators: Examples from the child-clinical and pediatric psychology literatures. *Journal of Consulting and Clinical Psychology, 65,* 599-610. doi: 10.1037/0022-006X.65.4.599

Hughes, C. (1998). Executive function in preschoolers: Links with theory of mind and verbal ability. *British Journal of Developmental Psychology*, *16*, 233–253. doi: 10.1111/j.2044-835X.1998.tb00921.x

Hughes, C., & Ensor, R. (2005). Executive function and theory of mind in 2 year olds: A family affair? *Developmental Neuropsychology, 28,* 645-668. doi: 10.1207/s15326942dn2802_5

Huizinga, M., & van der Molen, M. W. (2007). Age-group differences in set-switching and set-maintenance on the Wisconsin Card Sorting Task. *Developmental Neuropsychology, 31,* 193-215. doi: 10.1080/87565640701190817

Hyafil, A., Summerfield, C., & Koechlin, E. (2009). Two mechanisms for task switching in the prefrontal cortex. *Journal of Neuroscience, 29,* 5135–5142. doi: 10.1523/JNEUROSCI.2828-08.2009

Ianco-Worrall, A. (1972). Bilingualism and cognitive development. *Child Development, 43,* 1390-1400. doi: 10.2307/1127524

Judd, C. M. (2009). Multiple regression: Models with multiple continuous predictors. In C. M. Judd, G. H. McClelland, & C. S. Ryan (Eds.), *Data analysis: A model comparison approach, 2nd edition* (pp. 99-128). New York, NY: Routledge.

Just, M. A., & Carpenter, P. A. (1980). A theory of reading: From eye fixations to comprehension. *Psychological Review, 87,* 329–354. doi: 10.1037/0033-295X.87.4.329

Just, M. A., & Carpenter, P. A. (1992). A capacity theory of comprehension: Individual differences in working memory. *Psychological Review, 98*, 122–149. doi: 10.1037/0033-295X.99.1.122

Kane, M. J., Conway, A. R. A., Miura, T. K., & Colflesh, G. J. H. (2007). Working memory, attention control, and the *N*-Back Task: A question of construct validity. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 33,* 615-622. doi: 10.1037/0278-7393.33.3.615

Karmiloff-Smith, A. (1992). *Beyond modularity: A developmental perspective on cognitive science.* Cambridge, MA: MIT Press.

Kaushanskaya, M., & Marian, V. (2007). Bilingual language processing and interference in bilinguals: Evidence from eye tracking and picture naming. *Language Learning, 57,* 119-163. doi: 10.1111/j.1467-9922.2007.00401.x

Kenner, C., Gregory, E, Ruby, M., & Al-Azami, S. (2008). Bilingual learning for second and third generation children. *Language, Culture and Curriculum, 21,* 120-137. doi: 10.1080/07908310802287483

Kenner, C., Ruby, M., Jessel, J., Gregory, E., & Arju, T. (2007). Intergenerational learning between children and grandparents in east London. *Journal of Early Childhood Research, 5,* 219-243. doi: 10.1177/1476718X07080471

Kim, Y. (2009). Crosslinguistic influence on phonological awareness for Korean-English bilingual children. *Reading and Writing, 22,* 843-861. doi: 10.1007/s11145-008-9132-z

Kintsch, W., & van Dijk, T. A. (1978). Toward a model of text comprehension and production. *Psychological Review, 85,* 363–394. doi: 10.1037/0033-295X.85.5.363

Klenberg, L., Korkman, M., & Lahti-Nuuttila, P. (2001). Differential development of attention and executive functions in 3- to 12-year-old Finnish children. *Developmental Neuropsychology, 20,* 407-428. doi: 10.1207/S15326942DN2001_6

Köppe, R., & Meisel, J. M. (1995). Code-switching in bilingual first language acquisition. In L. Milroy & P. Muysken (Eds.), *One speaker, two languages: Cross-disciplinary perspectives on code-switching* (pp. 276-301). Cambridge: Cambridge University Press.

Kovelman, I., Baker, S. A., & Petitto, L. (2008). Age of first bilingual language exposure as a new window into bilingual reading development. *Bilingualism: Language and Cognition, 11,* 203-223. doi: 10.1017/S1366728908003386

Krashen, S. (1985). *The input hypothesis: Issues and implications.* Torrance, CA: Laredo.

Kroll, J.F., Bobb, S.C., & Wodniecka, Z. (2006). Language selectivity is the exception, not the rule: Arguments against a fixed locus of language selection in bilingual speech. *Bilingualism: Language and Cognition*, *9*, 119–135. doi: 10.1017/S1366728906002483

Kuo, L., & Anderson, R. C. (2006). Morphological awareness and learning to read: A cross-language perspective. *Educational Psychologist, 41,* 161-180. doi: 10.1207/s15326985ep4103_3

Lachaud, C. M., & Renaud, O. (2011). A tutorial for analyzing human reaction times: How to filter data, manage missing values, and choose a statistical model. *Applied Psycholinguistics, 32,* 389-416. doi: 10.1017/S0142716410000457

Lambert, W. E. (1975). Culture and language as factors in learning and education. In A. Wolfgang (Ed.), *Education of immigrant students* (pp. 55-83). Toronto: O.I.S.E.

Laurent, A., & Martinot, C. (2010). Bilingualism and phonological awareness: The case of bilingual (French-occitan) children. *Reading and Writing, 23,* 435-452. doi: 10.1007/s11145-009-9209-3

Lee, H., Plass, J.L., & Homer, B.D. (2006). Optimizing cognitive load for learning from computer-based science simulations. *Journal of Educational Psychology, 89,* 902-913. doi: 10.1037/0022-0663.98.4.902

Lefrançois, P., & Armand, F. (2003). The role of phonological and syntactic awareness in second-language reading: The case of Spanish-speaking learners of French. *Reading and Writing: An Interdisciplinary Journal, 16,* 219-246.

Lehto, J. E., Juujärvi, P., Kooistra, L., & Pulkkinen, L. (2003). Dimensions of executive functioning: Evidence from children. *British Journal of Developmental Psychology, 21,* 59-80. doi: 10.1348/026151003321164627

Leikin, M. (2002). Processing syntactic functions of words in normal and dyslexic readers. *Journal of Psycholinguistic Research, 31,* 145-163.

Lipka, O., & Siegel, L. S. (2007). The development of reading skills in children with English as a second language. *Scientific Studies of Reading, 11,* 105-131.

Loizou, M., & Stuart, M. (2003). Phonological awareness in monolingual and bilingual English and Greek five-year-olds. *Journal of Research in Reading, 26,* 3-18. doi: 10.1111/1467-9817.261002

Long, D. L., & Chong, J. L. (2001). Comprehension skill and global coherence: A paradoxical picture of poor comprehenders' abilities. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 27,* 1424–1429. doi: 10.1037/0278-7393.27.6.1424

Love, J. A., & Buriel, R. (2007). Language brokering, autonomy, parent-child bonding, biculturalism, and depression: A study of Mexican American adolescents from immigrant families. *Hispanic Journal of Behavioral Sciences, 29,* 472-491. doi: 10.1177/0739986307307229

Low, P. B., & Siegel, L. S. (2005). A comparison of the cognitive processes underlying reading comprehension in native English and ESL speakers. *Written Language and Literacy, 8,* 207-231. doi: 10.1075/wll.8.2.09low

Luciana, M., Conklin, H. M., Hooper, C. J., & Yarger, R. S. (2005). The development of nonverbal working memory and executive control processes in adolescents. *Child Development, 76,* 697–712. doi: 10.1111/j.1467-8624.2005.00872.x

Luk, G., Anderson, J. A. E., Craik, F. I. M., Grady, C., & Bialystok, E. (2010). Distinct neural correlates for two types of inhibition in bilinguals: Response inhibition versus interference suppression. *Brain and Cognition, 74,* 347-357. doi: 10.1016/j.bandc.2010.09.004

Luna, B., Garver, K. E., Urban, T. A., Lazar, N. A., & Sweeney, J. A. (2004). Maturation of cognitive processes from late childhood to adulthood. *Child Development, 75,* 1357-1372. doi: 10.1111/j.1467-8624.2004.00745.x

Lundberg, I. (1978). Aspects of linguistic awareness related to reading. In A. Sinclair, R. Jarvella, & W. Levelt (Eds.), *The child's conception of language* (pp. 83-96). New York: Springer-Verlag.

Luo, L., Luk, G., & Bialystok, E. (2010). Effect of language proficiency and executive control on verbal fluency performance in bilinguals. *Cognition, 114,* 29-41. doi: 10.1016/j.cognition.2009.08.014

Lyster, S. H. (2002). The effects of morphological versus phonological awareness training in kindergarten on reading development. *Reading and Writing: An Interdisciplinary Journal, 15,* 262-294.

Maclean, M., Bryant, P. E., & Bradley, L. (1987). Rhymes, nursery rhymes, and reading in early childhood. *Merrill-Palmer Quarterly, 33,* 255-281.

MacWhinney, B. (2005). A unified model of language acquisition. In J. F. Kroll & A. M. B. De Groot (eds.), *Handbook of bilingualism: Psycholinguistic approaches,* pp. 49–67. New York, NY: Oxford University Press.

Mahony, D., Singson, M., & Mann, V. (2000). Reading ability and sensitivity to morphological relations. *Reading and Writing: An Interdisciplinary Journal, 12,* 191-218.

Malakoff, M., & Hakuta, K. (1991). Translation skill and metalinguistic awareness in bilinguals. In E. Bialystok (Ed.), *Language processing in bilingual children,* (pp. 141-166). New York: Cambridge University Press.

Marian, V., Spivey, M., & Hirsch, J. (2003). Shared and separate systems in bilingual language processing: Converging evidence from eyetracking and brain imaging. *Brain and Language, 86,* 70–82. doi: 10.1016/S0093-934X(02)00535-7

Marinellie, S. A. (2010). The understanding of word definitions in school-age children. *Journal of Psycholinguistic Research, 39,* 179-197. doi: 10.1007/s10936-009-9132-4

Marinova-Todd, S. H., Zhao, J., Bernhardt, M. (2010). Phonological awareness skills in the two languages of Mandarin-English bilingual children. *Clinical Linguistics and Phonetics 24,* 387-400. doi: 10.3109/02699200903532508

Martin-Rhee, M. M., & Bialystok, E. (2008). The development of two types of inhibitory control in monolingual and bilingual children. *Bilingualism: Language and Cognition, 11,* 81-93. doi: 10.1017/S1366728907003227

Mazuka, R., Jincho, N., & Oishi, H. (2009). Development of executive control and language processing. *Language and Linguistics Compass, 3,* 59-89. doi: 10.1111/j.1749-818X.2008.00102.x

McDonald, J. L. (2000). Grammaticality judgments in a second language: Influences of age of acquisition and native language. *Applied Psycholinguistics, 21,* 395-423. doi: 10.1017/S0142716400003064

McDonald, J. L. (2008). Grammaticality judgments in children: The role of age, working memory and phonological ability. *Journal of Child Language, 35,* 247-268. doi: 10.1017/S0305000907008367

McGuinness, D. (2005). *Language development and learning to read*. Cambridge, MA: MIT Press.

McQuillan, J., & Tse, L. (1995). Child language brokering in linguistic minority communities: Effects on cultural interaction, cognition, and literacy. *Language and Education, 9,* 195-215. doi: 10.1080/09500789509541413

Mezzacappa, E. (2004). Alerting, orienting, and executive attention: Developmental properties and sociodemographic correlates in an epidemiological sample of young, urban children. *Child Development, 75,* 1373-1386. doi: 10.1111/j.1467-8624.2004.00746.x

Michael, E., & Gollan, T. H. (2005). Being and becoming bilingual: Individual differences and consequences for language production. In J. F. Kroll & A. M. B. de Groot (Eds.), *The handbook of bilingualism: Psycholinguistic approaches* (pp. 389–407). New York, NY: Oxford University Press.

Miyake, A., & Friedman, N. (2012). The nature and organization of individual differences in executive functions: Four general conclusions. *Current Directions in Psychological Science, 21,* 8-14. doi: 10.1177/0963721411429458

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex “frontal lobe” tasks: A latent variable analysis. *Cognitive Psychology, 41,* 49-100. doi: 10.1006/cogp.1999.0734

Mokhtari, K., & Thompson, H. B. (2006). How problems of reading fluency and comprehension are related to difficulties in syntactic awareness skills among fifth graders. *Literacy Research and Instruction, 46,* 73-93. doi: 10.1080/19388070609558461

Morales, A., & Hanson, W. E. (2005). Language brokering : An integrative review of the literature. *Hispanic Journal of Behavioral Sciences*, *27,* 471-502. doi: 10.1177/0739986305281333

Morgan, A. B., & Lilienfeld, S. O. (2000). A meta-analytic review of the relation between antisocial behavior and neuropsychological measures of executive function. *Clinical Psychology Review, 20,* 113-136. doi: 10.1016/S0272-7358(98)00096-8

Mumtaz, S., & Humphreys, G. W. (2001). The effect of Urdu vocabulary size on the acquisition of single word reading in English. *Educational Psychology, 22,* 165-190. doi: 10.1080/01443410120115247

Muter, V., Hulme, C., Snowling, M., & Taylor, S. (1997). Segmentation, not rhyming, predicts early progress in learning to read. *Journal of Experimental Child Psychology, 65,* 370-396. doi: 10.1006/jecp.1996.2365

Nation, K., & Snowling, M. J. (2000). Factors influencing syntactic awareness skills in normal readers and poor comprehenders. *Applied Psycholinguistics, 21,* 229-241. doi: 10.1017/S0142716400002046

Nation, K., & Snowling, M. J. (2004). Beyond phonological skills: Broader language skills contribute to the development of reading. *Journal of Research in Reading, 27,* 342-356. doi: 10.1111/j.1467-9817.2004.00238.x

Nation, K., Clark, P., Marshall, C. M., & Durand, M. (2004). Hidden language impairments in students: Parallels between poor reading comprehension and specific language impairment? *Journal of Speech, Language, and Hearing Impairment, 47,* 199-211.

National Institute of Child and Human Development Early Child Care Research Network (2000). The relation of child care to cognitive and language development. *Child Development, 71,* 960-980. doi: 10.1111/1467-8624.00202

Noble, K. G., Norman, M. F., & Farah, M. J. (2005). Neurocognitive correlates of socioeconomic status in kindergarten children. *Developmental Science, 8,* 74-87. doi: 10.1111/j.1467-7687.2005.00394.x

Novick, J. M., Trueswell, J. C., & Thompson-Schill, S. L. (2005). Cognitive control and parsing: Reexamining the role of Broca's area in sentence comprehension. *Cognitive, Affective, and Behavioral Neuroscience, 5,* 263-281. doi: 10.3758/CABN.5.3.263

Orellana, M. F. (2003). Responsibilities of children in Latino immigrant homes. *New Directions for Youth Development, 100,* 25-39. doi: 10.1002/yd.61

Orellana, M. F. (2007). Moving words and moving worlds: The challenges of being "in the middle." In C. Lewis, P. Enciso, & E. Moje (Eds.), *Reframing Sociocultural Research on Literacy: Identity, Agency, and Power*. Mahwah, NJ: Erlbaum.

Orellana, M. F., Dorner, L., & Pulido, L. (2003). Accessing assets: Immigrant youth's work as family translators or "para-phrasers." *Social Problems*, *50*(4), 505-524. doi: 10.1525/sp.2003.50.4.505

Orellana, M. F., Reynolds, J., Dorner, L., & Meza, M. (2003). In other words: Translating or "para-phrasing" as a family literacy practice in immigrant households. *Reading Research Quarterly, 38,* 12-34. doi: 10.1598/RRQ.38.1.2

Owens, R. E., Jr. (1996). *Language development*, *4th ed.* Boston, MA: Allyn and Bacon.

Parke, R. D., & Buriel, R. (2006). Socialization in the family: Ethnic and ecological perspectives. In N. Eisberg, W. Damon, & R. M. Lerner (Eds.), *Handbook of child psychology: Social, emotional, and personality development 6th edition* (pp. 429-504). New York: Wiley.

Perner, J., & Lang, B. (1999). Development of theory of mind and executive control. *Trends in Cognitive Science, 3,* 337-344. doi: 10.1016/S1364-6613(99)01362-5

Plaza, M. (2001). The interaction between phonological processing, syntactic awareness and reading: Longitudinal study from Kindergarten to grade 1. *First Language, 21,* 3-24. doi: 10.1177/014272370102106101

Plaza, M., & Cohen, H. (2003). The interaction between phonological processing, syntactic awareness, and naming speed in the reading and spelling performance of first-grade children. *Brain and Cognition, 53,* 287-292. doi: 10.1016/S0278-2626(03)00128-3

Prior, A., & Gollan, T. H. (2011). Good language-switchers are good task-switchers: Evidence from Spanish-English and Mandarin-English bilinguals. *Journal of the International Neuropsychological Society*, *17,* 682-691. doi: 10.1017/S1355617711000580

Prior, A., & MacWhinney, B. (2010). A bilingual advantage in task switching. *Bilingualism: Language and Cognition, 13,* 253-262. doi: 10.1017/S1366728909990526

Rego, L. L. B., & Bryant, P. E. (1993). The connection between phonological, syntactic and semantic skills and children's reading and spelling. *European Journal of Psychology and Education, 8,* 235-246. doi: 10.1007/BF03174079

Reynolds, J., & Orellana, M. F. (2009). New immigrant youth interpreting in white public space. *American Anthropologist, 111,* 211-223. doi: 10.1111/j.1548-1433.2009.01114.x

Rodriguez-Fornells, A., van der Lugt, A., Rotte, M., Britti, B. Heinze, H.J., & Muente,T.F. (2005). Second language interferes with word production in fluent bilinguals: Brain potential and Functional imaging evidence. *Journal of Cognitive Neuroscience, 17,* 422–433. doi: 10.1162/0898929053279559

Rogers, R. D., & Monsell, S. (1995). Costs of a predictable switch between simple cognitive tasks. *Journal of Experimental Psychology: General, 124*, 207–231. doi: 10.1037/0096-3445.124.2.207

Romaine, S. (1995). *Bilingualism (2nd edition).* Oxford, England: Blackwell.

Romine, C. B., & Reynolds, C. R. (2005). A model of the development of frontal lobe functioning: Findings from a meta-analysis. *Applied Neuropsychology, 12,* 190-201.

Rosen, V. M., & Engle, R. W. (1997). The role of working memory capacity in retrieval. *Journal of Experimental Psychology: General, 126,* 211–227. doi: 10.1037/0096-3445.126.3.211

Rosenblum, T., & Pinker, S. A. (1983). Word magic revisited: Monolingual and bilingual children's understanding of the word-object relationship. *Child Development*, *54,* 773-780. doi: 10.2307/1130064

Roth, F. P., Speece, D. L., Cooper, D. H., & De La Paz (1996). Unresolved mysteries: How do metalinguistic and narrative skills connect with early reading? *The Journal of Special Education, 30* (3), 257-277. doi: 10.1177/002246699603000303

Rubin, H., & Turner, A. (1989). Linguistic awareness skills in grade one children in a French immersion setting. *Reading and Writing: An Interdisciplinary Journal, 1,* 73-86. doi: 10.1007/BF00178839

Rubin, H., Reichman, S., Crabtree, S. H., & Kantor, M. (1991). Linguistic analysis and reading skills of first graders in partial French and Hebrew immersion programs. *Reading and Writing: An Interdisciplinary Journal, 3,* 101-114. doi: 10.1007/BF00420029

Salthouse, T. A., & Hedden, T. (2002). Interpreting reaction time measures in between-group comparisons. *Journal of Clinical and Experimental Neuropsychology, 24,* 858-872. doi: 10.1076/jcen.24.7.858.8392

Sánchez-Cubillo, I., Periáñez, J. A., Adrover-Roig, D., Rodríguez-Sánchez, J. M., Ríos, -Lago, M., Tirapu, J., & Barceló, F. (2009). Construct validity of the Trail Making Test: Role of task-switching, working memory, inhibition/interference control, and visuomotor abilities. *Journal of the International Neuropsychological Society, 15,* 438-450. doi: 10.1017/S1355617709090626

Sandoval, T. C., Gollan, T. H., Ferreira, V. S., & Salmon, D. P. (2010). What causes the bilingual disadvantage in verbal fluency? The dual-task analogy. *Bilingualism: Language and Cognition, 2,* 231-252. doi: 10.1017/S1366728909990514

Saywitz , K., & Cherry-Wilkinson, L. (1982). Age-related differences in metalinguistic awareness. In S. Kuczaj (Ed.), *Language development: Vol. 2. Language, thought, and culture.* Hillsdale, NJ: Erlbaum.

Schweizer, T. A., Ware, J., Fischer, C. E., Craik, F. I. M., & Bialystok, E. (2012). Bilingualism as a contributor to cognitive reserve: Evidence from brain atrophy in Alzheimer's disease. *Cortex, 48,* 991-996. doi: 10.1016/j.cortex.2011.04.009

Séguin, J. R., & Zelazo, P. D. (2005). Executive function in early physical aggression. In J. Archer, R. E. Tremblay, W. W. Hartup, & W. Willard (Eds.), *Developmental origins of aggression* (pp. 307-329). New York: Guilford.

Senn, T. E., Espy, K. A., & Kaufmann, P. M. (2004). Using path analysis to understand executive function organization in preschool children. *Developmental Neuropsychology, 26,* 445-464. doi: 10.1207/s15326942dn2601_5

Serratrice, L., Sorace, A., Filiaci, F., & Baldo, M. (2009). Bilingual children's sensitivity to specificity and genericity: Evidence from metalinguistic awareness. *Bilingualism: Language and Cognition, 12,* 239-257. doi: 10.1017/S1366728909004027

Shiotsu, T., & Weir, C. J. (2007). The relative significance of syntactic knowledge and vocabulary breadth in the prediction of reading comprehension test performance. *Language Testing, 24,* 99-128. doi: 10.1177/0265532207071513

Shwartz, M., Leikin, M., & Share, D. L. (2005). Bi-literate bilingualism versus mono-literate bilingualism: A longitudinal study of reading acquisition in Hebrew (L2) among Russian-speaking (L1) children. *Written Language and Literacy, 8* (2), 179-206. doi: 10.1075/wll.8.2.08shw

Simonds, J., Kieras, J. E., Rueda, M. R., & Rothbart, M. K. (2007). Effortful control, executive attention, and emotional regulation in 7-10-year-old children. *Cognitive Development, 22,* 474-488. doi: 10.1016/j.cogdev.2007.08.009

Soveri, A., Rodriguez-Fornells, A., & Laine, M. (2011). Is there a relationship between language switching and executive functions in bilingualism? Introducing a within-group analysis approach. *Frontiers in Psychology: Cognition, 2,* 1-8. doi: 10.3389/fpsyg.2011.00183

Spencer, L. H., & Hanley, J. R. (2003). Effects of orthographic transparency on reading and phoneme awareness in children learning to read in Wales. *British Journal of Psychology, 94*, 1-28. doi: 10.1348/000712603762842075

Spira, E. G., Bracken, S. S., & Fischel, J. E. (2005). Predicting improvement after first-grade reading difficulties: The effects of oral language, emergent literacy, and behavior skills. *Developmental Psychology, 41*, 225-234. doi: 10.1037/0012-1649.41.1.225

St. Clair-Thompson, H. L., & Gathercole, S. E. (2006). Executive functions and achievements in school: Shifting, updating, inhibition, and working memory. *The Quarterly Journal of Experimental Psychology, 59,* 745-759. doi: 10.1080/17470210500162854

Stothard, S. E., & Hulme, C. (1992). Reading comprehension difficulties in children: The role of language comprehension and working memory skills. *Reading and Writing: An Interdisciplinary Journal, 4*, 245-256.

Stuss, D. T., & Benson, D. F. (1984). Neuropsychological studies of the frontal lobes. *Psychological Bulletin, 95,* 3-28. doi: 10.1037/0033-2909.95.1.3

Suárez-Orozco, C., Rhodes, J., & Milburn, M. (2009). Unraveling the immigrant paradox: Academic engagement and disengagement among recently arrived immigrant youth. *Youth Society, 41*, 151-185. doi: 10.1177/0044118X09333647

Suárez-Orozco, C., & Suárez-Orozco, M. M. (2001). *Children of immigration.* Cambridge, MA: Harvard University Press.

Sumiya, H., & Healy, A. F. (2004). Phonology in the bilingual Stroop effect. *Memory and Cognition, 32,* 752-758. doi: 10.3758/BF03195865

Swanson, H. L., Rosston, K., Gerber, M., & Solari, E. (2008). Influence of oral language and phonological awareness on children's bilingual reading. *Journal of School Psychology, 46,* 413-429.

Sweller, J., & Chandler, P. (1994). Why some material is difficult to learn. *Cognition and Instruction, 12,* 185-233. doi: 10.1207/s1532690xci1203_1

Tao, L., Marzecová, A., Taft, M., Asanowicz, D., & Wodniecka, Z. (2011). The efficiency of attentional networks in early and late bilinguals: The role of age of acquisition. *Frontiers in Psychology: Cognition, 2,* 1-19. doi: 10.3389/fpsyg.2011.00123

Tare, M., & Gelman, S. A. (2011). Bilingual parents'modeling of pragmatic language use in multiparty interactions. *Applied Psycholinguistics, 32,* 761-780. doi: 10.1017/S0142716411000051

Ter Kuile, H., Veldhuis, M., van Veen, S. C., & Wicherts, J. M. (2011). Bilingual education, metalinguistic awareness, and the understanding of an unknown language. *Bilingualism: Language and Cognition, 14,* 233-242. doi: 10.1017/S1366728910000258

Tharp, R. and Gallimore, R. (1988). *Rousing Minds to Life.* Cambridge: Cambridge University Press.

Thomas, W. P., & Collier, V. P. (2002). A national study of school effectiveness for language minority students' long-term academic achievement. Santa Cruz, CA: Center for Research on Education, Diversity & Excellence.

Townsend, J. T., & Ashby, F. G. (1978). Methods of modeling capacity in simple processing systems. In N. J. Castellan, Jr. & F. Restle (Eds.), *Cognitive theory, Volume III* (pp. 199-239). Hillsdale, NJ: Erlbaum.

Tranel, D., Anderson, S. W., & Benton, A. (1994). Development of the concept of "executive function" and its relationship to the frontal lobes. In F. Boller, H. Spinnler, & J. A. Hendler (Eds.), *Handbook of neuropsychology* (pp. 125-148). Amsterdam: Elsevier.

Tsang, K. K., & Stokes, S. F. (2001). Syntactic awareness of Cantonese-speaking children. *Journal of Child Language, 28,* 703-739. doi: 10.1017/S0305000901004822

Tse, L. (1995). Language brokering among Latino adolescents: Prevalence, attitudes, and school performance. *Hispanic Journal of Behavioral Sciences, 17,* 180-193. doi: 10.1177/07399863950172003

Tse, L. (1996a). Language brokering in linguistic minority communities: The case of Chinese- and Vietnamese-American students. *Bilingual Research Journal, 20,* 485-498.

Tse, L. (1996b). Who decides? The effects of language brokering on home-school communication. *Journal of Educational Issues of Language Minority Students, 16,* 225-234.

Tukey, J. W. (1977): *Exploratory data analysis*. Reading, MA: Addison-Wesley.

Tunmer, W. E., & Herriman, M. (1984). The development of metalinguistic awareness: A conceptual overview. In W. Tunmer, C. Pratt, & M. Herriman (Eds.), *Metalinguistic awareness in children: Theory, research and implications* (pp. 12-35). Berlin: Springer-Verlag.

Tunmer, W. E. (1984). *Metalinguistic awareness in children: Theory, research and implications*. New York: Springer-Verlag.

Tunmer, W. E., & Hoover, W. (1992). Cognitive and linguistic factors in learning to read. In P. B. Gough, L. C. Ehri, & R. Treiman (Eds.), *Reading acquisition* (pp. 175-224). Hillsdale, NJ: Erlbaum.

Tunmer, W. E., Nesdale, A. R., & Wright, A. D. (1987). Syntactic awareness and reading acquisition. *British Journal of Developmental Psychology, 5,* 25-34.

Umaña-Taylor, A. J. (2003). Language brokering as a stressor for immigrant children and their families. In M. Coleman & L. Ganong (Eds.), *Points and counterpoints: Controversial relationship and family issues in the 21st century: An anthology.* (pp. 157-159). Los Angeles: Roxbury.

Van Gelderen, A., Schoonen, R., de Glopper, K., Hulstijn, J., Simis, A., Snellings, P., & Stevenson, M. (2004). Linguistic knowledge, processing speed, and metacognitive knowledge in first- and second-language reading comprehension: A componential analysis. *Journal of Educational Psychology, 96,* 19-30. doi: 10.1037/0022-0663.96.1.19

Van Merriënboer, J. J. G., & Sweller, J. (2005). Cognitive load theory and complex learning: Recent developments and future directions. *Educational Psychology Review, 17,* 147-177. doi: 10.1007/s10648-005-3951-0

Vega, C., & Fernandez, M. (2011). Errors on the WCST correlate with language proficiency scores in Spanish-English bilingual children. *Archives of Clinical Neuropsychology, 26,* 158-164. doi: 10.1093/arclin/acq097

Volk, D., & Angelova, M. (2007). Language ideology and the mediation of language choice in peer interactions in a dual-language first grade. *Journal of Language, Identity, and Education, 6,* 177-199.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Wagner, R. & Torgesen, J. (1987). The nature of phonological processing and its causal role in the acquisition of reading skills. *Psychological Bulletin, 101,* 192-212. doi: 10.1037/0033-2909.101.2.192

Wechsler, D. (2003). The Wechsler intelligence scale for children-fourth edition. London: Pearson Assessment.

Weyandt, L. L. (2005). Executive function in children, adolescents, and adults with Attention Deficit Hyperactivity Disorder: Introduction to the special issue. *Developmental Neuropsychology, 27,* 1-10. doi: 10.1207/s15326942dn2701_1

Wu, N. H., & Kim, S. Y. (2009). Chinese American adolescents' perceptions of the language brokering experience as a sense of burden and sense of efficacy. *Journal of Youth and Adolescence, 38,* 703-718. doi: 10.1007/s10964-008-9379-3

Xue, G., Aron, A.R., Poldrack, R.A., 2008. Common neural substrates for inhibition of spoken and manual responses. *Cerebral Cortex, 18,* 1923–1932. doi: 10.1093/cercor/bhm220

Xuereb, R. (2009). Literacy skills in Maltese-English bilingual children. *Journal of Research in Reading, 32,* 327-348. doi: 10.1111/j.1467-9817.2009.01397.x

Yang, S., & Lust, B. (2007). Cross-linguistic differences in cognitive effects due to bilingualism: Experimental study of lexicon and executive attention. In H. Caunt-Nulton, S. Lulatilake, & I. Woo (Eds.), *BUCLD 31: Proceedings of the 31st annual Boston University Conference on Language Development,* (pp. 692-703). Somervill, MA: Cascadilla Press.

Yang, S., Yang, H., & Lust, B. (2011). Early childhood bilingualism leads to advances in executive attention: Dissociating culture and language. *Bilingualism: Language and Cognition, 14,* 412-422. doi: 10.1017/S1366728910000611

Yelland, G. W., Pollard, J., & Mercuri, A. (1993). The metalinguistic benefits of limited contact with a second language. *Applied Psycholinguistics, 14,* 423-444. doi: 10.1017/S0142716400010687

Yoshida, H. (2008). The cognitive consequences of early bilingualism. *Zero to Three*, 26-30.

Yudes, C., Macizo, P., Morales, L., & Bajo, M. T. (2012). Comprehension and error monitoring in simultaneous interpreters. *Applied Psycholinguistics*, *32,* 1-19. doi: 10.1017/S0142716412000112

Zelazo, P. D., & Müller, U. (2002). Executive function in typical and atypical development. In U. Goswami (Ed.), *Blackwell handbook of childhood cognitive development* (pp. 445-469). Malden: Blackwell Publishing.

Zelazo, P. D., Carter, A., Reznick, J. S., & Frye, D. (1997). Early development of executive function: A problem-solving framework. *Review of General Psychology, 1,*198-226. doi: 10.1037/1089-2680.1.2.198

Zelazo, P. D., Muller, U., Frye, D., & Marcovitch, S. (2003). The development of executive function in early childhood. *Monographs of the Society for Research in Child Development, 68*. Serial No. 274.

VITA

Vanessa Raschke received her Bachelor of Science degree in Psychology, minoring in Fine Arts, from Loyola University Chicago. During her undergraduate studies, she worked in the Language and Cognition Lab, directed by Dr. Denise Davidson, where she pursued her Honor's Thesis looking at monolingual and bilingual children's word-learning heuristics. Vanessa then pursued her graduate degree in Developmental Psychology at Loyola University Chicago, under Dr. Davidson's supervision. She has worked as a graduate research and teaching assistant during her time in the program. Upon completion of her doctorate, she plans to continue teaching and will be seeking a post-doctoral position to gain further research experience.