THEORY OF MIND, EXECUTIVE FUNCTIONING AND LANGUAGE IN MONOLINGUAL AND BILINGUAL PRESCHOOL CHILDREN

By

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A THESIS PRESENTED TO THE GRADUATE SCHOOL
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To all bilinguals out there (including those in my family, of course), trying to make sense of our fragmented experiences

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Several cognitive factors have been documented to impact theory of mind (ToM) development, particularly false beliefs in preschool children, such as general language ability, syntactic comprehension, and executive functioning (EF). Most of these studies have examined these relations in monolingual children. However, bilingual children have been documented to perform better on EF tasks, but poorer on language tasks, which raises important issues regarding their ToM development. Two questions were of interest in the current study: Are there differences in bilingual-monolingual preschoolers on ToM, language, and EF? ; and (2) What is the role of language and EF in predicting ToM performance in these monolingual and bilingual groups? These questions were examined by comparing 32 Spanish-English bilinguals and 33 English monolinguals between the ages of 3 and 5 years of age. Even though monolinguals outperformed bilinguals on language measures, after controlling for language, bilinguals outperformed monolinguals on ToM. There were no differences between the groups on EF measures. Finally, after controlling for age, language ability was correlated to ToM performance in the monolingual group; no such relationship was present in the bilingual group.

CHAPTER 1
INTRODUCTION

How do children learn to think about the social world, one filled with agents, desires and necessary and sometimes uncomfortable compromise? These abilities are referred to as social cognition. In social cognition children need to take into account contextual circumstances, self-awareness, and the infinite universe of mental worlds. Acknowledging mental worlds, or the realization that minds exist, that the child herself has a mind and that others have minds, has been called theory of mind (ToM) development. ToM is usually measured in preschool children by looking at their ability to conceptualize the contents of the minds of others as different from their own, specifically by acknowledging others' false beliefs while the children themselves know the truth. If others hold a belief that is true, and the children know that it is true, children's understanding of the knowledge of others could be interpreted as a reflection of reality and not necessarily as an understanding of mental states (Wellman, Cross, & Watson, 2001). For this reason, ToM understanding is measured by using situations in which the child knows the truth, while somebody else holds a mistaken belief; this is referred to as the false belief task (Wimmer & Perner, 1983). An example of a false-belief task is the now widely known Sally-Anne task, which deals with a false belief about the location of an object. In it, Sally has a basket and Anne has a box. Sally places a marble in her basket and goes away. Anne then moves the marble to her box. When Sally returns, the children are asked where will Sally look for the marble? In order to pass this task, children need to ignore their own correct knowledge, and appropriately assess what Sally knows by effectively conceptualizing Sally's mind and knowledge as different from the children's mind. Since Premack and Woodruff coined the term 'Theory of Mind' in

1978, research on ToM has proliferated, providing us with a developmental description of the acquisition of ToM abilities. According to this description, children begin to pass the standard ToM false-belief task around 4 years of age as reported for example in a meta-analysis by Wellman et al. (2001).

ToM research has also focused on determining which cognitive factors predict ToM acquisition. From this research, different studies have found associations between ToM and executive functioning (EF) (Carlson & Moses, 2001), ToM and general language ability (Milligan, Astington & Ain (Dack), 2007), and ToM and a particular type of syntactic structure called complementation syntax consisting of sentences with embedded clauses (de Villiers & Pyers, 2002). Most of these studies have examined children learning English. However, recently, the development of ToM has begun to be explored in children who are bilingual. Of primary interest in the current study is the relative contribution of language and EF to ToM understanding in monolingual and bilingual preschoolers. Also of interest are differences in these cognitive abilities in monolingual and bilingual children.

Executive Functioning

EF is probably best described in terms of what it does, rather than what it is, as there is still considerable disagreement among researchers in terms of its true nature. (Zelazo, Müller, Frye, & Marcovitch, 2003). In spite of this conceptual disagreement, several functions have been readily associated with EF such as inhibitory control, cognitive flexibility, planning, categorization, working memory, and following directions among others (Zelazo et al., 2003). Zelazo and colleagues have conceptualized EF performance more explicitly in terms of the cognitive flexibility required to hold dual representations and to switch between different rules and demands. Of the processes associated with EF, inhibitory control is thought to be primarily involved in ToM tasks. Inhibitory control usually refers to one's ability to inhibit undesired responses, execute desired ones, and decide among relevant information (Carlson & Moses, 2001). An example of a task demanding inhibitory control is the classic Stroop task (Stroop, 1935); in it, one is asked to name the color a word is written in, as opposed to reading the word which is a different color name. For example, the word blue is written in red and one is asked to say “red” as opposed to “blue”.

In ToM tasks, inhibitory control is thought to be reflected in the child's ability to inhibit their own correct knowledge (for example that the marble is now in the box in the case of the Sally-Ann task), correctly assessing the false beliefs of others, and saying what others would think as opposed to what they themselves think (saying that Sally would think that the marble is in the basket). Distancing from one's own mental content in favor of that of other's, as well as suppressing the preponderance of the correct response in favor of the incorrect response, both seem to rely on the child's inhibitory control. Carlson and Moses (2001) for example, found that inhibitory control and ToM were strongly correlated even after controlling for factors such as age and language ability. In their study, inhibitory control tasks were either conflict tasks (requiring the children to inhibit a preponderant response in favor of a conflicting novel one) or delay tasks (requiring the children to delay a preponderant response). The conflict tasks were more strongly correlated with ToM than the delay tasks, thus adding support to the idea that inhibitory control helps children sort out between conflicting beliefs, and inhibit the impulse to respond the ToM questions from their own knowledge. In addition, Wellman et al. (2001) reported in their meta-analysis that false-beliefs were easier for children when the hidden object would disappear (e.g., a chocolate would get eaten) rather than be displaced. With no current preponderant location of the object to inhibit, the task became easier by reducing the inhibitory control demands. This low-inhibitory control task, however, still requires dual representation of the ultimate fate of the object. Such dual representation and switching demands continue to be necessary for ToM tasks even when inhibitory control demands are low as perhaps another form of EF required for ToM performance.

To summarize, there is considerable theoretical as well as empirical information supporting the role of EF as a major contributor to ToM performance in children. In addition, another aspect of EF that will be considered in this project is short term memory. Although there is not much work done on children's short term memory and false belief reasoning, research shows that even though working memory is correlated with false belief performance, it does not mediate more important relationships such as that of language and ToM (Slade & Ruffman, 2005).

Language

As discussed earlier, a large portion of ToM research has focused on the role of language. Many aspects of language are linked to ToM performance, and there are different proposals as to which language component is most important. At the most basic level there is the language comprehension and production demands implicated in interpreting and answering the ToM tasks, which are predominantly verbal. More importantly, is the theoretical argument that language provides the cognitive structures and tools needed to represent and reason about a false belief. Jenkins and Astington (1996), for example, investigated the cognitive abilities that were related to ToM performance after controlling for age. They found that language ability and verbal memory for sentences significantly predicted false belief understanding in 3-5 year olds. In addition, they identified a potential language competency threshold that children needed to attain before understanding false beliefs. This was identified to be the language level of a child 4 years and 1 month old or older, using the Test of Early Language Development (Hresko, Reid, & Hammill, 1981). Schick, deVilliers, deVilliers, and Hoffemeister (2007) also conceptualized language as providing important evidence of “minds in action” by discussing ToM delays in language deprived children, such as deaf children of hearing parents, but with no developmental disabilities. This ToM deficiency was not seen in deaf children of deaf parents who had signed to and with their children since birth.

In terms of which particular aspect of language are most related to ToM, there are important proposals that have linked ToM performance with semantic knowledge; especially mental state talk or children’s usage of words related to emotions, desires, thoughts and other mental actions such as remembering (de Rosnay & Hughes, 2006). Understanding and correctly using these terms seems to denote an awareness of mental activity. General grammar and semantic knowledge have also been associated with ToM performance in preschool children. Slade and Ruffman (2005) studied the role of general grammar and semantic abilities, and found that while a composite of general grammar and semantics predicted ToM performance 6 months later, no particular aspect of these composites significantly predicted ToM. Some researchers however, argue that language provides the structures necessary to hold a ToM by way of specific complex grammatical structures that might require false belief related logic and often involve mental state talk (de Villiers, 2005). This kind of sentence structure is called *complementation syntax*, in which a sentence contains an embedded structure or a complement that might alter the meaning of the sentence, for example, ‘Carlos thinks that Adam is at home, but he really is at the park’. Another example of a complementation sentence would be, “Sally thinks that the marble is in the basket, but it really is in the box.” This sentence provides evidence of a false belief and dual representation in that though the reality is one, and only agrees with one part of the sentence; both parts of the sentence can be true. The ability to understand this kind of sentence by correctly identifying what is really happening in this scenario has been put forth as a predictor of ToM performance.

In a longitudinal study by de Villiers and Pyers (2002), participants of different age cohorts, reliably passed complementation comprehension tasks before ToM tasks, thus prompting the authors to theorize that perhaps being able to understand this kind of grammar allows children to differentiate between reality and the content of another person’s mind. This kind of syntax has been shown in previous research to be more highly correlated with ToM capacities than other forms of language. In a recent metananalysis by Milligan et al. (2007), they reported the largest effect size for complement understanding in predicting ToM. In their analysis, however, only a small number or studies investigated the relationship between ToM and complementation comprehension. Moreover, the effect has not been reliably replicated (Cheung, Hsuan-Chih, Creed, Ng, Wang and Mo, 2004). Cheung and colleagues found that the correlation between ToM and complementation language became insignificant after controlling for general language ability. In sum, the particular aspects of language necessary for false-belief are still being debated, in particular the exact contribution that complementation comprehension makes independently of general language ability.

This relation of both language and EF to false belief understanding has primarily been demonstrated in monolingual children. Surprisingly, however, the relative role of both factors has rarely been investigated. Studies of EF and false belief, typically control for verbal ability (as measured by vocabulary) and show that EF still contributes (e.g., Carlson & Moses, 2001). Only a few studies have specifically examined the relative role of language and EF. Most of these direct comparisons have been done using samples of deaf children in which they find that language is more important for ToM related reasoning than EF (e.g. de Villiers, 2005). In addition, while most researchers assume that language makes a larger contribution to ToM, Hughes and Ensor (2007), found that EF was a stronger predictor of ToM than verbal ability. A shortcoming of this study however, is the fact that the authors did not examine grammatical abilities, which are often a stronger predictor of ToM than vocabulary measures (Milligan et al., 2007).

Bilingualism

In recent years, ToM and EF researchers have begun to investigate the development of these abilities in bilingual children, or those who are fluent in two languages. This population presents an interesting case in that the unique language experience of bilinguals offers natural variations in EF, ToM and language demands that might inform each of these research fields. For example, since very early in development bilinguals are faced with an arguably larger need than monolinguals to assess the knowledge base, and therefore mind content, of every interlocutor they encounter. This requirement will potentially make them more experienced with ToM related reasoning than monolingual children. In addition, after identifying the language of the person, bilingual children need to plan, inhibit the other language, and switch to the appropriate one to produce the proper language output from potentially equally preponderant linguistic responses. This process will arguably lead bilinguals to also be more experienced with EF, particularly inhibitory control related demands. It is not hard to see then, that bilingual children due to their increased experience with two languages might potentially outperform monolingual children of a similar age in ToM and EF tasks While there is a known bilingual disadvantage on language tests compared to monolinguals (e.g., Bialystok & Viswanathan, 2009), there is evidence that there is an advantage for bilinguals in both ToM and EF as reviewed below. Given that both EF and language are known predictors of ToM in monolingual children, we are interested in the role that each of these play in bilingual children's ToM development compared to monolingual children.

Bilingualism and Executive Function

There is an accumulating body of literature supporting an observed advantage of bilingual children over monolingual children on EF related tasks. Bialystok and Viswanathan (2009) investigated which components of EF are responsible for the bilingualism advantage in bilingual children in two cultures. They compared 8 year-old Canadian monolingual children to Canadian bilingual children who spoke English and one of a variety of other languages, and Indian bilingual children who also spoke English and another of two different languages. Results indicated that monolinguals outperformed the bilinguals on English language tests and there were no differences between the two bilingual groups and the monolingual group on short-term memory and working memory tasks. In spite of this, when given EF tasks testing response suppression, inhibitory control and switching, bilingual children outperformed monolinguals on tasks requiring inhibitory control and switching. However, there were no bilingual-monolingual differences on response suppression tasks. In this study, the researchers found bilingual-monolingual differences on EF tasks involving inhibitory control and switching, in spite of vast cultural differences between the bilingual groups.

Similar findings were reported in another study discussed by Bialystok (2010) where Martin-Rhee and Bialystok (2008) found significant bilingual-monolingual differences in 4 to 5 year old preschoolers' EF performance. Bilingual children outperformed monolinguals only when the task required the children to ignore a misleading cue such as in the Simon Says task, and not when they only had to refrain from executing a salient response. Similarly, Carlson and Meltzoff (2008) tested Spanish-English bilinguals, English monolinguals and English speakers enrolled in a second-language immersion kindergarten on a variety of EF tasks. After controlling for marked differences in socio-economic status, Spanish-English bilinguals performed better on EF tasks than English monolinguals and the language immersion group. Importantly, the advantage for bilinguals was only present for EF tasks that required cognitive flexibility such as sorting cards according to different rules (conflict tasks), as opposed to impulse-control tasks such as delayed gratification (delay tasks). In contrast to these findings, Bialystok (2010) reported a series of studies where six year-old bilinguals and monolinguals performed two EF tasks: the global-local and the trail-making task. In the global-local task, participants were asked to identify a letter constituted of smaller letters (either the same letter or a different one) or to identify the smaller letters. In the trail-making task, participants were asked to first draw a trail connecting the numbers 1 to 25 on a page. In the next task, they were asked to connect both numbers and letters (1, A, 2, B, etc). In this study, Bialistok found that bilinguals outperformed monolinguals in both the congruent and incongruent trials of the global-local task, as well as in both the trial tasks connecting both letter and numbers and numbers only. This study provided evidence of a bilingualism advantage even in EF tasks that do not require inhibition.

This EF advantage for bilinguals has also been reported in infants. Kovács and Mehler (2008) found that 7-month-old bilingual infants displayed greater EF in the form of ‘cognitive control’ (or what may also be called cognitive flexibility) than monolingual infants using eye-tracking devices. In these studies, both bilinguals and monolinguals learned to predict the location of a coming stimulus using either speech or visual cues. The bilingual infants, however, displayed greater cognitive flexibility by rapidly learning to switch when the stimulus started coming from another location. Since 7-month old bilingual infants are not yet required to suppress one language while producing another, the authors theorized that just the processing and representation of two different languages requires more cognitive flexibility from the infants in order to effectively acquire both these languages.

Bilingualism and Language

Regarding the other cognitive factor shown to impact ToM performance, language ability has been a contentious topic in which to compare bilinguals and monolinguals. Early in development bilingual children are faced with two competing language groups creating phonetic semantic and grammatical conflicts that need to be resolved. The child is faced with the need to acknowledge that the same object can have two phonetically distinct labels, in order to acquire semantic knowledge. These conflict demands are not experienced nearly as often by monolinguals. It is not surprising then, that often bilingual children score lower on language ability tests compared to monolinguals (e.g. Bialystok & Viswanathan, 2009, Carlson & Meltzoff, 2008,); one might argue that this is a result of the fact that their separate performance in each of the individual languages does not really describe all their language knowledge. A possible solution to this dilemma, creating a composite of their knowledge in both languages, would not be comparable to single language tests for monolinguals.

The topic of comprehension for complementation syntax is one that has not been investigated in bilingual populations. It will be interesting to investigate this question with a bilingual-monolingual comparisons because rather than consisting of a strictly language dimension such as semantics, comprehension for complements seems to include broader language knowledge and perhaps reasoning related to ToM (Milligan et al. 2007). Exploring this question empirically with these populations will allow us to examine the relationship between ToM and general language, with comprehension for complements for bilinguals and monolinguals. It is important to note that complementation syntax works the same in Spanish as in English, where the conjugation *que* acts as the transition *that.*

Bilingualism and Theory of Mind

In summary, bilingual children have been shown to have an advantage over monolingual in EF tasks and a disadvantage on language ability. Further, both EF and language have been shown to be related to ToM performance in monolingual children. There is very limited research comparing bilinguals and monolinguals on ToM development. There has been some evidence that bilinguals attain ToM related reasoning before monolinguals. Goetz (2003) compared the performance of Chinese-English bilinguals on ToM measures to both English and Chinese monolinguals. Goetz found that bilinguals outperformed both groups of monolinguals on false belief tasks, and that the two monolingual groups' performance did not differ from one another in spite of coming from two vastly different language and cultural backgrounds. Goetz attributed the increased performance of bilinguals on ToM to greater EF, such as increased linguistic inhibitory control over conflicting representations; greater metalinguistic understanding, such as increased awareness of the arbitrariness of language (which, she argues, increase representational capabilities); and a greater sensitivity to sociolinguistic interactions with interlocutors. However, EF was not measured in these groups.

In a similar fashion, Kovács (2009) found that 3 year-old Hungarian-Romanian bilinguals passed ToM tasks more often than Romanian monolinguals. In this study, Kovács also compared the bilingual children's performance on the standard ToM task to performance on a modified ToM task that included a language-switching situation. In this task, children were presented with a bilingual and a monolingual puppet, with one language in common, as the puppets go buy ice-cream. There, the puppets encounter an ice-cream seller who only speaks the language that the monolingual does not, and a sandwich seller who speaks the common language. The ice-cream seller then announces in the non-common language that he ran out of ice-cream, but that the sandwich man still has some left. The child is then asked, "Where would the monolingual puppet go buy ice-cream?" Kovács argued that if bilingual's special language knowledge alone could account for their increased performance on ToM, then they should perform better on the bilingual modified task than in the standard task. Since bilinguals performed equally on the standard and the modified task, Kovács theorized that the improved performance of bilinguals compared to monolinguals was a result of increased cognitive abilities related to EF. Though both Goetz and Kovács explained the bilingual advantage on ToM tasks to increased EF abilities, none actually measured EF performance of bilinguals in their articles.

In summary, a large body of research attests to the fact that different aspects of EF and language are predictors of ToM. In addition, bilingualism's status has been posited as an influential factor enhancing both ToM and EF performance. However, in these studies of ToM in bilingual children, neither the relative role of EF or language has been directly examined in their ToM task performance. The present study will investigate whether there are performance differences between Spanish-English bilinguals and English monolinguals on ToM tasks as has been found in other language groups. Of particular interest is whether language and EF play different roles in ToM development for bilinguals and monolinguals. This latter question will help illuminate the relationship between ToM, EF, and language.

Hypotheses

1) Of interest in the present study is whether Spanish-English bilinguals would differ from English monolinguals on ToM, EF and language measures. To my knowledge, this is the first research study comparing both ToM and EF for this language pair. Based on previous literature, we predicted an advantage for Spanish-English bilinguals on ToM and EF performance compared to English monolinguals, who would in turn outperform bilinguals on language tests. 2) The second question involves whether EF and language ability are related differently to ToM for Spanish-English bilinguals compared to English monolinguals. First, regarding the relationship of EF to ToM, given the prediction that bilinguals and monolinguals would perform differently on

EF, it was expected that EF would be more related to ToM performance for bilingual than for monolingual children. Second, regarding the role of language ability, as a preliminary hypothesis, it was predicted that overall language ability comprised of both vocabulary and grammar, would be more related to ToM performance for English monolinguals, as their language ability was expected to be higher than that of bilinguals. To our knowledge, there is no previous study looking at bilingual’s language performance on ToM reasoning.

CHAPTER 2
METHOD

Participants

Thirty-two Spanish-English bilingual and thirty-three English monolingual children 36.5 to 74.4 months of age (bilingual $M = 50.51$, $SD = 6.93$, monolingual $M = 50.82$, $SD = 8.14$), were recruited from Florida preschools. Bilingual children were identified by their parents as being fluent in both Spanish and English, and regularly interacting with speakers of both these languages. The majority of the bilingual children (62%) had been exposed to both languages since birth, and all had been exposed to their non-dominant language for at least one year. In addition, parents reported that in 61% of bilingual children's home both languages were spoken, 19% reported that in the preschool the child attends both were spoken, and 46% of parents read to their children in both languages. Additionally, 58% of mothers to bilingual children speak to them in both languages, as do 48% of fathers, 23% of siblings, and 29% of "others in the home". Finally, 19% of both mothers and fathers actually indicated that their native language was "both" Spanish and English. These values are presented in Table 2-1. In relation to socioeconomic status, there was a significant difference between these groups on maternal level of education with monolingual mothers having significantly higher educational achievement at $t(62) = 3.85$, $p < .001$. There were no significant differences between the groups on age and gender distribution, or significant gender differences on any of the measures below.

Measures

All children were administered the following tests.

Theory of Mind

Unexpected content task (Perner, Leekman, & Wimmer,1987). A closed crayon box was presented to the child while the experimenter (E) asked: "What do you think is inside the box?" Upon receiving an answer, E revealed that the box actually contained candles. E then asked the child: "What is inside the box?" After receiving and answer and putting the candles back in the box, E asked: "When you first saw the box, all closed up like this, what did you think was inside the box?" E then brought out a puppet named Ernie and asked the child, "Ernie has never looked inside the box. What does Ernie think is inside the box?" Finally, E asked the control question: "What is really inside the box?" The child received a pass or fail for each of the two belief questions for a total of two possible points if he or she also passed the memory control questions.

Unexpected location task (Wimmer & Perner, 1983). E introduced Ernie, a box, and a bag, and enacted the following story: "Ernie is putting his toy car inside the box. Now he is going outside to play. Here comes Ernie's friend Elmo. Elmo is taking the toy car out of the box and putting it inside this box. Now Elmo is going home." E then asked, "When Ernie comes back inside, where will he look for the car?". E then showed Elmo where the toy car was, and asked the child "Before I showed him, where did he think the toy car was?" The child received a pass or fail for the last two questions for a total of two points if she also passed the memory control question as to where the object is right now and where it was placed originally.

Object disappearance, low inhibitory control demands (as described in Wellman et al.). E narrated the following story using custom made illustrations. "This is Maxi. Maxi is putting his chocolate inside the box. Now he is going outside to play. Here comes Maxi's mom. Maxi's mom takes the chocolate out of the box and eats it. Now she leaves. When Maxi comes back inside, will he look for the chocolate?" The child received a pass or fail for the last question, and another point for the question "Now his mom tells Maxi that she ate the chocolate, before she told him that, would he have looked for the chocolate?" for a total of two points if she also passed the memory control questions as to where the object is right now and where was it placed originally.

Appearance-Reality, object-identity task. E introduced a sponge that looks like a rock and said: "Look at what I have here, you can touch it." E then asked the child a series of reality questions and belief questions: "What does this look to your eyes right now? What is it really? Is it really a sponge or is it really a rock? When you first saw this, before you squeezed it, what did you think it was a rock or a sponge? Elmo has never touched this before. What does Elmo think this is a sponge or a rock?" The child received a pass or fail for the last three questions, if she also passed the question "What does it look like?" If the child failed that question a point was deducted for the reality question "What is it really? Is it really a sponge or is it really a rock?"

Appearance-Reality: Fish Task-Object property. E introduced a white fish cutout and asked: "When you look at this fish what color is it?" E then placed a red filter over the fish and asked: "When you look at this fish with your eyes right now, what color does it look?" While the filter remained over the fish, E asked: "What color is this fish really and truly?" and "Before I put this plastic over it, what color did you say it was?" The child received a pass or fail for the last two questions for a total of two point.

A theory of mind (ToM) composite was created with the child's pass or fail scores on all these measures for a total of eleven points.

Executive Functioning

Day/night Stroop-like task (Gerstadt, Hong & Diamond, 1994). The child was first asked to identify a card depicting a sun and one depicting a moon and stars. If identified correctly as 'night' and 'day', the child was then given the following instructions: "When you see this card (pointing to the night card), I want you to say 'day', and when you see this one (pointing to the day card), I want you to say 'night'". Understanding was confirmed by giving the child one practice trial with each card. The instructions and practice trials were repeated until the child passed the practice trial. The child was then given 16 trials in a fixed random order for a total of 16 trials in which she was asked to name each card according to the rule. The final score was the sum of times the child named the card correctly on all 16 trials.

Dimensional change card sort task (Frye, Zelazo, & Palfai, 1995). E introduced two containers, one labeled with a red rabbit another with a blue boat. E gave the child the following instructions: "We are going to play the shape game, in the shape game the rabbits go with the rabbits and the boats go with the boats." E then demonstrated the instructions with a blue rabbit and a red boat and asked the child to sort a blue rabbit, a red boat, a blue boat, a red rabbit, and a blue rabbit. E then instructed the child to switch to the color game by saying: "Now we are going to change to the color game, in the color game the blues go with the blues and the reds go with the reds," and began a new trial by asking the child to sort a red boat, a red rabbit, a blue rabbit, a blue boat, a red boat, and a blue rabbit. The child's score was computed out of 4 possible points based on the correct sorting of the red boat (twice) and blue rabbit (twice) in the second set.

Bear/dragon Simon says-like task (Reed, Pien & Rothbart, 1984). E first asked the child to imitate 10 actions such as 'stick out your tongue' or 'touch your ears'. E then introduce two characters and the rules of the task: "This is the nice bear, so, when he talks to us, we will do what he tells us to do, and this is naughty Dragon, so when he talks to us we won't listen to him. If he tells us to do something, we won't do it." E then ran practice trials with each puppet until the child effectively followed at least one bear command, and resisted at least one dragon command. When the task began, five bear trials and five dragon trials of different actions were given in alternating order. The child received one point for ignoring each of the dragon commands, and one point for following each of the bear commands for a total of 10 points.

An executive function (EF) composite score was created by transforming each task score into a z-score due to the differing number of questions per task. A composite was created by adding the z-scores.

Short-term memory-Digit span (as reported in Bialystok, 2010). E read single digit lists at a rate of one per second starting with two digits. The child was asked to repeat the numbers in the same order. One digit was added after each second trial until the child was unable to reproduce both trials at a particular level. The final score consisted of the last number of digits in which the child was able to reproduce at least one sequence.

Language

Language tests were provided in English to English monolinguals, and to Spanish-English bilinguals in their dominant language.

Clinical Evaluation of Language Fundamentals (CELF). Children's core language was measured using three of the CELF's subtests: Expressive Vocabulary, Sentence Structure, and Word Structure, in English or Spanish as appropriate. For Expressive vocabulary, children were shown a series of pictures and were asked to name each one. The trial was discontinued after 7 consecutive zero scores. In the sentence structure trial, the child was read a series of sentences and was asked to point to the picture that represents the sentence out of 4 related drawings. The trial was discontinued after 5 consecutive zero scores. For the word structure trial, the child was asked to use the progressive –ing, prepositions, pronouns, plurals, etc. The trial was discontinued after 8 consecutive zero scores. Total CELF scores and subtests scores were obtained.

Receptive One Word Picture Vocabulary Test (ROWPVT). Children's receptive vocabulary was measured using the English or Spanish English bilingual versions of the ROWPVT as appropriate. For this test, children were presented with a series of 4 drawings. The experimenter instructed the child to point to the picture that matched the word that the experimenter said. The trial was discontinued after 6 incorrect responses out of 8 consecutive items.

Expressive One Word Picture Vocabulary Test (EOWPVT). Children's expressive vocabulary was measured using the English or Spanish-English bilingual versions of the EOWPVT. This test was administered in English for the English monolinguals, and in the language identified as non-dominant by the bilingual children's parents. Children were presented with a series of drawings, and were asked to name what was on the picture. The trial was discontinued after 6 incorrect responses out of 8 consecutive items.

Complementation (de Villiers & Pyers, 2002). Comprehension for complementation was measured in the following manner: E read to the child 12 sentences with embedded complements, accompanied with illustrative pictures. E then asked a comprehension question, e.g.: “She thought the girl was reading a book, but she was really playing cards”; the comprehension question would be, “What did she think?” The child’s score was a total of 12 possible points.

Procedure

Parents were asked for informed consent in English for the English monolingual parents, and in either Spanish or English, according to their preference, for the parents of the bilingual children. With the informed consent parents were asked to fill out a demographic questionnaire as well as a language questionnaire that asked about the child’s language preference and exposure to different languages. All parents were compensated for their child’s participation with a $20 gift card. The testing was conducted in quiet corners at the children’s preschools over two sessions in play-like interaction. These sessions were less than two weeks apart.

All measures were given in English to English monolinguals, and to bilinguals in the language selected by the parents as the child’s dominant language in the parent questionnaire, with the exception of one expressive vocabulary test, the EOWPVT. This test was given to bilingual children in their non-dominant language at the end of the second session. The tasks were given to bilinguals in their dominant language in order to assure the bilinguals’ performance was not hindered by their non-dominance of their second language. The author, who is a native Spanish speaker doctoral student fluent in English, did the translation of all testing and consent materials, as well as conducted all the testing sessions. The testing sessions began with a language test involving pointing to make the child familiar with the experimenter before he/she was asked to speak. Testing then proceeded with ToM and EF tasks in alternating order. The tasks were given to all children in a fixed sequence.

Table 2-1. Bilingual children's "Parent/Guardian Language Questionnaire" responses

	% English only	% Spanish only	% Both
Languages Child Speaks	_	_	100
Child's Preferred Language	81.3	12.5	6.3
Home	19.4	19.4	61.3
Spoken at Preschool	77.4	3.2	19.4
Language of Peers	77.4	_	22.6
Mother's Native Language	16.1	64.5	19.4
Father's Native Language	12.9	67.7	19.4
Other's Native Language	7.1	92.9	_
Language Mother Talks to Child	19.4	22.6	58.1
Language Father Talks to Child	25.8	25.8	48.4
Language Siblings Talk to a Child	69.2	7.7	23.1
Language Other Talks to Child	_	71.4	28.6
Reading Language at Home	45.5	9.1	45.5

CHAPTER 3
RESULTS

Means and standard deviations of all the measures are presented in Table 3-1 and Table 3-2. The first question of interest is whether monolingual and bilingual children differed on theory of mind (ToM), executive function (EF), and language abilities. Comparisons of monolingual and bilingual children were conducted on all the measures using t-tests. As hypothesized, analyses indicated that there were significant differences between bilinguals and monolinguals on language ability as indicated by the CELF at ($t(62) = 5.11$, $p < .001$), the ROWPVT at ($t(62) = 4.93$, $p < .001$), and complementation comprehension at ($t(63) = 2.08$, $p < .05$). Monolinguals outperformed bilinguals on each of these language measures. In contrast to the hypothesis, there were no differences between monolingual and bilingual children on the EF measures. Specifically, there were no differences on the standardized composite, or the individual components (Day/Night, Bear/Dragon, and dimensional change card sort), all t's(63), p's > .05. Similarly, there were no differences on the short-term memory measure at $t(63) = 1.21$, $p > .05$. Finally, comparison of bilingual and monolingual children on the ToM composite indicated no differences between the groups. When looking at the individual components however, there were differences between the groups on the Appearance/Reality component at $t(63) = 2.096$, $p = .040$, with monolinguals outperforming bilinguals.

To further explore whether there are differences between the monolingual and bilingual children on EF and ToM, a series of ANCOVAs were conducted controlling for overall language ability as assessed by the CELF and ROWPVT. Regarding EF, the standardized task composite revealed that there was a marginal main effect of bilingualism status on EF that approached significance at $F(1, 64) = 3.70$, $p = .059$. Although this result was non-significant, the estimated means controlling for language ability were in the direction of bilinguals outperforming monolinguals (see Table 3-1 and Table 3-2). There were no significant main effects of bilingualism status on the EF subcomponents after controlling for language ability.

For the ToM composite, the ANCOVA indicated that there was a significant main effect for bilingualism status on ToM task performance at $F(1, 64) = 4.02$, $p < .05$, with bilinguals significantly outperforming monolinguals. Estimated means are displayed on Table 3-1 and Table 3-2. These results indicate that after controlling for the marked differences on language ability between these groups, bilinguals display a significant advantage over monolinguals on ToM related reasoning.

Finally, to further examine whether bilingualism was related to performance on the EF, language, and ToM measures we examined subgroups of the bilingual children based on competency in their non-dominant language by doing a median split on the EOWPT expressive vocabulary score. We did not find within-bilinguals differences on any of our measured variables. Additionally, we conducted similar analyses comparing cradle (n=20) versus non-cradle bilinguals (n=10) (those who had been exposed to their L2 after 1 year) but did not find any differences within these groups on EF, language and ToM measures.

The second question of interest was how language and EF were related to ToM in the monolingual and bilingual groups. To examine these relations, correlations and partial correlations controlling for age were initially conducted for the total sample, and separately for each of the language groups. The results of these analyses can be found in Table 3-3, Table 3-4, and Table 3-5. For the total sample, correlations indicate that as expected ToM correlated significantly with all of our language measures, (the CELF, ROWPVT and complementation comprehension), as well as the EF composite and short term memory. Examining at the individual language groups, for monolinguals ToM correlated with the EF composite as well as with the Bear/Dragon task in particular. ToM also correlated with the three language measures (CELF, ROWPVT, and complementation), and with the short term memory task. In contrast, however, for bilinguals the correlation between ToM and EF was marginal (*p*=.059), while for this group ToM correlated with another one of the EF tasks, namely, the dimensional change card sort task. In addition, ToM also correlated with the three language measures, similar to the monolingual children, but as mentioned above, not with the EF composite as a whole.

Since age correlated significantly with ToM in both language groups, partial correlations were conducted controlling for age. For the total sample, ToM correlated with the CELF, complementation comprehension, and marginally with short term memory (*p*=.059), but no longer with EF or the ROWPVT. Similarly, for the monolingual sample only, after controlling for age ToM correlated with short term memory, complementation, and the CELF. A different pattern was found, however, for the bilingual preschoolers. Specifically, ToM, after controlling for age, did not correlate with either EF or language for the bilingual group as predicted.

These relations were also examined by conducting a multiple hierarchical regression analysis with the ToM composite as the dependent variable. To the first block of predictors we added language status (bilingual versus monolingual) and age in months. To the second block we added complementation, EF, general language (CELF), and receptive vocabulary. The beta weights associated with age and the CELF were the only significant ones at $b = .44$, $t(58) = 3.73$, $p < .001$, and $b = .55$, $t(58) = 3.48$, $p = .001$ respectively. The beta weights for language status, EF, and the other language predictors were non-significant (see Table 3-6). These latest findings lead support to the hypothesis that general language is more important for ToM performance than particular syntactic abilities such as comprehensions for complements.

Table 3-1. Means, Standard Deviations, Estimated Means and Standard Errors for Bilinguals

	ToM	EF	CELF	ROWPVT	Complements
			(n=32)		
M	6.22	-.25	46.00	44.71	7.69
SD	(2.42)	(2.15)	(14.43)	(13.55)	(3.74)
Estimated *M* [a]	7.29	.49			
SE	(.41)	(.34)			

Note. Standard deviations and standard errors in parentheses.
[a] Estimated means and standard errors obtained from ANCOVA controlling for language ability.

Table 3-2. Means, Standard Deviations, Estimated Means and Standard Errors for Monolinguals

	ToM	EF	CELF	ROWPVT	Complements
			(n = 33)		
M	7.09	.24	62.45	59.18	9.55
SD	(2.70)	(1.72)	(10.96)	(9.75)	(3.47)
Estimated *M* [a]	6.04	-.47			
SE	(.40)	(.32)			

Note. Standard deviations and standard errors in parentheses.
[a] Estimated means and standard errors obtained from ANCOVA controlling for language ability.

Table 3-3. Pearson's Correlations and Partial Correlations between ToM, EF, and Language Measures for the Total Sample.

	ToM	EF	CELF	ROWPVT
		(n=65)		
ToM	_			
EF	.37**(.18)	_		
CELF	.61**(.43**)	.52**(.45**)	_	
ROWPVT	.49**(.24)	.43**(.27^)	.76**(.69**)	_
Complementation	.45**(.35*)	.50** (.44**)	.56**(.51**)	.58**(.56**)

Note. Partial correlations between parentheses.
^*p*<.10; **p*<.05; ***p*<.01

Table 3-4. Pearson’s Correlations and Partial Correlations between ToM, EF, and Language Measures for Bilinguals.

	ToM	EF	CELF	ROWPVT
		(n=32)		
ToM	_			
EF	.34^(.08)	_		
CELF	.58**(.28)	.52**(.47*)	_	
ROWPVT	.38*(-.08)	.44*(.14)	.73**(.35)	_
Complementation	.41*(.21)	.46**(.22)	.56**(.27)	.60**(.48*)

Note. Partial correlations between parentheses.
^*p*<.10; **p*<.05; ***p*<.01

Table 3-5. Pearson’s Correlations and Partial Correlations between ToM, EF, and Language Measures for Monolinguals

	ToM	EF	CELF	ROWPVT
		(n=33)		
ToM	_			
EF	.39*(.30)	_		
CELF	.70**(.43*)	.60**(.47**)	_	
ROWPVT	.61**(.34^)	.42*(.32)	.62**(.63**)	_
Complementation	.44*(.42*)	.53**(.45*)	.47**(.59**)	.47**(.49*)

Note. Partial correlations between parentheses.
^*p*<.10; **p*<.05; ***p*<.01

Table 3-6. Summary of Hierarchical Regression Analysis for Variables Predicting ToM

Variable	*B*	*SE B*	β
	(n=65)		
Step 1			
Language status	-.81	.52	-.16
Age	.20	.03	.59**
Step 2			
Language status	.41	.62	.08
Age	.15	.04	.44**
CELF	.09	.03	.55**
Complementation	.13	.08	.19
EF	-.14	.15	-.10
ROWPVT	-.03	.03	-.17

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

CHAPTER 4
DISCUSSION

There were two main objectives to this study. First we wanted to examine performance differences between bilinguals and monolinguals on theory of mind (ToM), executive function (EF), and language measures. Although bilinguals tend to underperform on language measures when compared to monolinguals (e.g., Bialystok & Viswanathan, 2009), they often outperform on EF measures (Bialystok & Viswanathan, 2009; Bialystok, 2010; Carlson & Meltzoff, 2008; Kovács & Mehler, 2008; Martin-Rhee & Bialystok, 2008), as well as on ToM measures (Goetz, 2003; Kovács; 2009). Since this latest finding has only been reported in a handful of studies, we set out to expand prior findings, and examine other language pairs such as Spanish and English on ToM task performance. The second objective of this study was to examine the ways in which EF and language; known predictors of ToM, might be related differently for ToM in bilinguals and monolinguals. Given the reported bilingual advantage on EF, it was hypothesized that EF would drive bilinguals' performance on ToM more so than for monolinguals.

Bilingual-Monolingual Differences

Using a Spanish-English bilingual sample and an English monolingual sample, we found that as expected monolinguals significantly outperformed bilinguals on language ability using general language (CELF), receptive vocabulary, and complementation comprehension tasks. Importantly, after controlling for this significant language imbalance between the groups, bilinguals outperformed monolinguals on ToM related reasoning tasks. This indicates that growing up in a bilingual environment has the potential to enhance ToM related reasoning in ways that are not adequately explained by better language abilities since bilinguals actually underperform in language tests, or by enhanced executive function as will be discussed below.

Interestingly, we found no significant performance differences between bilinguals and monolinguals on the EF composite. We had predicted based on previous findings that bilinguals would outperform monolinguals in EF, but this was not the case. This failure to find bilingual-monolingual differences in EF is very intriguing in light of the previous research that attests to this difference (see Bialystok & Viswanathan, 2009; Bialystok, 2010; Carlson & Meltzoff, 2008; Kovács & Mehler, 2008; Martin-Rhee & Bialystok, 2008). Even though we failed to replicate the findings that bilinguals significantly outperform monolinguals on EF, our results were in that direction. One reason for this failure to replicate previous findings could be sample size. Since our results were in the direction of bilinguals outperforming monolinguals after controlling for language ability, we hypothesize that with a larger sample size we would have more statistical power to detect this significance. Another possibility for this lack of replication has to do with Miami's cultural environment where most of the bilingual sample was collected. Ostensibly, bilingual children raised in Miami, Florida, might not inhabit a Spanish-English bilingual environment where the use of these languages would be compartmentalized (say one at home, one at preschool), but rather one in which a large proportion of the population these bilingual children interact with is also bilingual. For example, data collected through our "Parent language questionnaire" and reported in our "Participants" section, indicated that in 61% of bilingual children's home both languages are spoken, as well as in 19% of their preschools. Additionally, 58% of mothers to bilingual children speak to them in both languages, as do 48% of fathers.

Finally, 19% of both mothers and fathers actually indicated that their native language was “both” Spanish and English. What these percentages might be pointing to is that perhaps the bilinguals in our sample are not actually being “required” to switch and inhibit one language for the other as often as other bilingual groups might be. This language environment is known colloquially in Miami as “Spanglish”. This impression was corroborated during data collection when we observed that the bilingual children were being spoken to almost simultaneously in both Spanish and English or in a combination of the two. Arguably, this kind of bilingual environment might diminish the EF demands these children experience by not being really required to switch and inhibit one language for the other, but rather, as far as production is concerned, in a lot of situations any individual or combined linguistic output from the child would be acceptable. The end result of this could be that with a less demanding bilingual environment regarding EF demands, these bilingual children might resemble monolingual children more than other bilingual children with more compartmentalized linguistic experiences.

Importantly, our inability to find a bilingual-monolingual difference in EF in addition to a bilingual advantage on ToM, points to the need to question the claim made by ToM bilingualism researchers (i.e. Goetz, 2003; Kovács, 2009) that enhanced EF is perhaps the reason behind bilinguals’ advantage in ToM. In our sample, even though bilinguals outperformed monolinguals in ToM, they did not do so on EF. As an example, Goetz (2003) compared Chinese-English bilinguals in the United States to both English and Chinese monolinguals on ToM tasks and found that the bilinguals outperformed both monolingual groups. Relatedly, Kovács (2009) found that Romanian-Hungarian bilinguals outperformed Romanian monolinguals in ToM. In their discussions, both these researchers argued that perhaps bilinguals outperformed monolinguals on ToM due to their enhanced EF even though EF was not measured in these studies. As stated above, this claim was not supported by our data. Instead, our findings point to necessary future research where other factors that might better explain bilingual's ToM advantages need to be explored. One possibility is to look at bilingual's meta-linguistic awareness. Metalinguistic awareness refers to an understanding of the arbitrariness of language. Prior research on this topic found that meta-linguistic awareness is related to ToM reasoning (Doherty, 2000), and that bilinguals tend to outperform monolinguals on these metalinguistic awareness tasks (Ben-Zeev, 1977), thus making metalinguistic awareness a good candidate ability to study. It seems plausible that bilinguals' precocious understanding of language as a representational system rather than as a direct portrayal of reality might be related to their understanding that mental states are also representational in nature.

Theory of Mind Relationships

For our second objective we looked at how EF and language might be related differently to ToM for each of the language groups. Our analysis of correlations before controlling age revealed that while EF was correlated with ToM in both the monolingual and the general samples, in the bilingual group this relationship did not reach significance. These relationships between EF and ToM were not significant after controlling for age, which suggest that for both bilinguals and monolinguals language ability might be more important for ToM performance than EF for it was still correlated with ToM in the partial correlations. Similar findings were obtained through regression analyses, where general language and age had the only significant beta weights when

EF, complementation, receptive vocabulary and language status were also added as independent predictors. A possible exception for this obviation of EF after controlling for age was that for both the total and monolingual samples short-term memory was still correlated with ToM after controlling for age. This was not the case for the bilinguals either before or after controlling for age, indicating that in fact bilinguals are relying on other cognitive abilities when engaged in ToM reasoning. These results in the very intriguing finding that in fact after controlling for age, none of the relations with ToM in the bilingual group remained significant, which again suggests that other unmeasured factors should be implicated in bilingual's ToM performance. One possible candidate is metalinguistic awareness

In our correlational and regression analyses we also looked at which particular aspects of language were more related to ToM, and found that overall general language ability comprised of both expressive vocabulary and grammar, was more related to ToM than receptive vocabulary or complementation comprehension. This pattern was maintained for the total sample and the individual language groups before controlling for age in the partial correlations. After controlling for age, however, the correlations between ToM and language were only significant for the monolingual group. These findings contradict previous reported findings arguing for the primacy of complementation comprehension over general language (de Villiers and Pyers, 2002; de Villiers, 2005; Milligan et al. 2007). Instead, at least for monolinguals, our findings agree with those reported by Slade and Ruffman (2005) where a combination of general grammar and semantic abilities was the best predictor of ToM reasoning.

Limitations and Future Directions

There were some limitations to this study. For example, our sample size was perhaps too small for regressions analyses. Similarly as discussed above, bilingual–monolingual differences in EF controlling for language ability were marginally significant in the direction of bilinguals outperforming monolinguals as has been shown previously in the literature. A bigger sample could have given us more power to detect this difference. Finally, another limitation is the lack of a Spanish monolingual group for comparison. Although we have no particular reason to suspects that ToM development might be different in Spanish from English, the possibility of differential predictability of certain linguistic factors over others is an intriguing one.

For future directions, this study provides strong evidence for the need to measure other factors that might be associated with ToM in bilinguals since we failed to find any significant correlations after controlling for age. One possibility for this is metalinguistic awareness which is strongly associated with ToM (Doherty, 2000) as well as has been shown to be acquired earlier by bilinguals (Ben-Zeev, 1977). Additionally, it is important to measure the factors represented in the current study as well as those unmeasured ones suspected to have an effect, in a longitudinal matter that will allow us to look at direction of effects, as well as potential differences in developmental trajectories regarding bilingualism.

Conclusion

In conclusion, in this study we looked at bilingual-monolingual differences in ToM, EF and Language, and how both EF and language might be related differently to ToM in bilinguals and monolinguals. Regarding the first objective, we found that as expected, monolinguals outperformed bilinguals in all of our L1 measurements. Once we controlled for this difference in language ability, bilinguals outperformed monolinguals in ToM. Contrary to expectations, however, bilinguals did not outperform monolinguals EF, nor was EF related to ToM performance in bilinguals. These findings cast doubt on the hypothesis found in the literature that bilinguals' enhanced EF drives their performance in ToM. Regarding the relationship between ToM and language ability, we found that general language ability was more highly correlated with ToM than comprehension for complements in the monolingual sample only, for after controlling for age, none of the language measures were correlated with ToM in the bilingual sample. Based on this absence of relatedness with ToM in the bilingual sample, other abilities such as metalinguistic awareness are considered for future research that might effectively predict ToM performance in this group.

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BIOGRAPHICAL SKETCH

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