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"Do you know what I think?" A cross-linguistic investigation of children's understanding of mental state words

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“Do you know what I think?”
A cross-linguistic investigation of children’s understanding of mental state words

by

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Dedication

To my parents, Décio and Elizabeth Souza.

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“Do you know what I think?”
A cross-linguistic investigation of children’s understanding of mental state words

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Two studies were conducted to: (1) investigate children’s developing understanding of mental state words , specifically “think” and “know,” and (2) explore possible differences between U.S. English-speaking and Brazilian Portuguese-speaking children in their understanding of these words. Brazilian Portuguese is of interest because it has two words for “think” (one indicating a lesser degree of certainty, ‘achar,’ and another indicating the process of thinking, ‘pensar’) and two words for “know” (one indicating knowing a fact, ‘saber,’ and another indicating knowing a person, ‘conhecer’). Predictions were that there would be developmental changes in the understanding of these words and that having such distinctions marked in their language would help Brazilian children in the process of acquiring a conceptual understanding of “think” and “know.”

In Study 1, 48 English-speaking children, divided into three age groups (2½, 3½, and 4½) participated in a series of tasks during which the degree of certainty about the identity of an object was varied. Children were asked "Do you know that this is a …. or do you think that this is a ….?"

In Study 2, 32 Brazilian Portuguese-speaking and 32 English-speaking children in each of 3 age groups (4, 5, and 6) saw a series of videotaped scenarios during which the two senses of "know" and the two senses of "think" were indicated by novel words. Participants were asked to interpret the novel words. Children also were asked metalinguistic questions regarding whether each pair of words differed in meaning.

Results suggest that a complete understanding of these mental state words starts emerging at age 4 and that an understanding of "know" may precede an understanding of "think." The effects of language were less than anticipated. The two senses of "think" and "know" that were tested may be represented conceptually by U.S. children even if they are not marked in the language. Nonetheless, having the distinctions marked in the language appear to increase older children's awareness of the distinctions at a metalinguistic level.

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I. Introduction

An important milestone in cognitive development is the acquisition of a theory of mind, or an ability to explain and predict human behavior in terms of mental phenomena (i.e., intentions, beliefs and emotions). A substantial body of research has been devoted in the last two decades to improving our understanding of how and when children develop such a theory (e.g., Astington, Harris & Olson, 1988; Flavell et al., 1983; Frye & Moore, 1991; Wellman, 1990; Wimmer & Perner, 1983). The findings originating from this research enterprise have provided us with a window into children's thinking about the mind at different points of the developmental process.

Recently, there has been increasing interest in the investigation of possible relationships between language and theory of mind (Astington, 2001; Astington & Jenkins, 1999; DeVilliers & DeVilliers, 2000, 2003; Jenkins & Astington, 1996; Shatz, 1994). A study of children's language about the mental world may prove to be informative of the developmental process through which young children achieve an understanding of others' minds and thinking (Schwanenflugel, 1998). In fact, an investigation of children's language about the mental world can be fruitful for several other reasons. For example, little work has been conducted regarding the acquisition of a wide range of abstract words (Souza, 2002). Mental state words, like any other category of abstract words, have referents that cannot be seen, or more specifically, that do not exist in concrete form in the external

world. Consequently, the process underlying the acquisition of these terms may differ from those that have been identified for learning of concrete words like "mommy," "car," or "bottle." An investigation of how children acquire mental state words may be revealing of specific strategies or processes involved in the acquisition of abstract words, and more generally, in word learning.

A second reason that mental state words are interesting is that they point to an important asynchrony between language and cognition. There is consistent evidence that children acquire their first mental state words early in life, around their second birthday (Barstch & Wellman, 1995; Shatz, Wellman & Silber, 1983). However, some studies indicate that a more sophisticated understanding of mental states appears much later, at around the age of 4 (Johnson & Maratsos, 1977; Miscione, O'Brien, & Greenberg, 1978; Moore, Bryant & Furrow, 1989). It remains unclear what the underlying causes of this asynchrony are. When very young children are using mental state terms, are they making reference to a true mental state? Can they really understand the concept of a mental state? Are they using those terms as conversational devices (e.g., using "you know" as a pause-filler) or are they using them to refer to mental states like "think" and "know" but without a complete understanding of the concepts?

Finally, another good reason for the interest in mental state words is that languages vary in the specific mental state terms that they use. For example, in Chinese, there is a verb that explicitly denotes "thinking falsely." In Portuguese,

two different words correspond to the English verb “know.” One could raise the question of whether language differences influence children’s understanding of mental state terms or, as in the case of Chinese, children’s performance in false-belief tasks (Lee & Olson, 1999; Liu, Wellman & Tardif, 2003). Consequently, research in this area allows us to examine possible interactions between language and thought, specifically, we might ask whether the pattern of development of mental states and mental state terms is universal or whether linguistic differences affect the acquisition of mental state concepts and mental state terms. However, there is little cross-linguistic work looking at the development of an understanding of mental states.

I will present in the following chapter a review of the different studies on the acquisition of mental state words. Firstly, I will focus on what naturalistic studies have revealed about when these words emerge in children’s vocabularies and how young children acquire them. The goal here is to discuss research that is relevant to our understanding of how and when children acquire these mental state words and whether there is something special about the process through which they acquire mental state words when compared to concrete words or other kinds of abstract words.

Secondly, I will discuss the different arguments concerning the relationship between language and theory of mind. There is disagreement among researchers in the field concerning the role of language in the development of a

theory of mind (ToM). Some researchers argue that language may play an important and specific role in children's understanding that others have minds and can have beliefs different from their own (Astington, 2001; Astington & Jenkins, 1999; De Villiers & DeVilliers, 2000); of this group, some hold a particularly strong version of this position (De Villiers & De Villiers, 2003), claiming that more advanced aspects of an understanding of mind actually depend on language. Other researchers are more cautious and suggest that more studies looking at the exact nature of the relationship between language and theory of mind are needed (Shatz, 1994; Shatz et al., 2003). The goal of the discussion presented here is to provide justification for why an investigation of mental state words may contribute to our current understanding of a relationship between language and theory of mind, and not to provide a review of the literature on the development of a theory of mind.

In the third section of this literature review, I will present recent evidence on possible differences among speakers of different languages regarding the acquisition of mental states and the development of a theory of mind. In order to investigate possible effects of language on cognition, and more specifically, on theory of mind, one needs to rely on as many cross-linguistic comparisons as possible and, particularly comparisons between languages that differ in theoretically interesting ways. The more comparisons there are, the better the chance that possible cultural confounds will be eliminated (Bloom & Keil, 2001).

Finally, I will describe two studies investigating the development of children's understanding of mental state words. The purpose of Study 1 was to investigate children's understanding of the distinction between "think" and "know" as indicating different degrees of certainty and, more specifically, to test the assumption that children may display an understanding of this distinction at an earlier time than suggested by previous research (Johnson & Maratsos, 1977; Miscione et al., 1978; Moore et al., 1989) . The goal of Study 2 was to explore similarities and differences in children's understanding of mental states across languages. Portuguese is of interest because there are important differences between English and Portuguese concerning mental state words like "think" and "know." More specifically, the main goal of Study 2 was to investigate whether English-speaking children differ from Brazilian children in the way they understand the finer-grained senses of "think" and "know" that are present in Portuguese but not in English (i.e., "the act of thinking" versus a "thought" or "opinion," and, "knowing a person" versus "knowing a fact").

II. Literature Review

Mental State Words: when are they acquired?

Among a child's first fifty words, the majority of terms refer to concrete entities in the child's world, for example, food, people, body parts and household items (Gentner & Boroditsky, 2001; Nelson, 1973). The predominance of concrete words in children's early vocabularies may be one of the reasons that most of the word learning research has focused on the acquisition of concrete words. Although concrete words predominate in the beginning, a significant part of children's early vocabularies consists of words that map onto abstract concepts and these words start emerging even before the second birthday (Barstch & Wellman, 1995; Gopnik, 1984; Shatz et al., 1983). As discussed above, our main interest lies in one special category of abstract words: mental states.

Recent research has helped enhance our understanding of the acquisition of mental state words. As far as emotions are concerned, most children acquire their first feeling-state words (e.g., happy, sad) at around the age of 18 to 20 months (Bretherton & Beeghly 1982; Dunn, Bretherton & Munn, 1987; Wellman, Harris, Banerjee & Sinclair, 1995). Wellman et al.'s (1995) findings also indicate that by age 2, children can use emotion terms to refer to themselves or others as well as to past, present and future states. During the period between 2 and 5 years of age, children become capable of making several important distinctions: between emotions or pains and the circumstances that elicit them; between

emotions and actions (e.g., anger vs. hitting) or the expressions they cause (e.g., happiness vs. smiling); and they can attribute distinct emotional experiences to different individuals (Wellman et al., 1995).

Children start producing words that refer to desires, such as *want*[1], and *wish*, very early: by 1 ½ to 2 years of age (Bartsch & Wellman, 1995). Bartsch and Wellman (1995) argue that the acquisition and understanding of desire words represent a "foundation for the child's continuing efforts to understand the mind" (p. 93). It is after their second birthday, however, that they develop a more sophisticated understanding of desire words. For example, they are able to make use of contrastives indicating they understand that "what I want" may be different from "what somebody else wants." In addition, they seem to understand that "what I want" may be different from "what I get," in other words, that the wish and the outcome may not necessarily coincide.

Desire words seem to emerge before belief words like *think* and *know* (Bartsch & Wellman, 1995). Bartsch and Wellman (1995) argue that a child's initial conception of desire is not necessarily representational. In other words, when a 2-year-old is saying "Mary wants an apple," he/she is not construing in his/her head a representation of an apple (or of Mary wanting an apple) and understanding that his/her representation may or may not be in accordance with the given circumstances of real life (the presence of an apple in the immediate

surroundings). A 2-year-old is simply relying, according to this view, on his/her knowledge of the world (his/her knowledge, for example, of apples and where they may be found) and attributing to Mary a desire for a real object in the world, without having a representation in the mind of a hypothetical object or event (e.g., having or eating the apple).

Words that refer to thoughts and beliefs start emerging in children's vocabularies in the months shortly after their second birthday (Barstch & Wellman, 1995; Shatz et al., 1983). Shatz (1994), for example, reports that, in the period between 25 and 30 months, her grandson, Ricky, understood that *think* could be used to indicate a probability (or a lesser degree of certainty). When Ricky's mother was asked "Are there toys in the bag?" and she replied, "Yes, some little people, I think," Ricky added "And a pig, maybe." The first instances of *know* pointing to a state of "nonignorance" appeared to be used around the 30th month (Shatz, 1994). Before then, *know* was being used only in stereotypical sentences like "I don't know" but without any indication of a more sophisticated understanding of what this term refers to.

Studies looking at naturalistic data have revealed, in fact, that children first use mental verbs as conversational devices, and it is only during the third year of life that there seems to be reference to a true mental state (Barstch &

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[1] Italics are used when I am referring to mental state words and capitals are used when I am referring to mental state concepts.

Wellman, 1995; Shatz et al., 1983). There is evidence that the ability to produce the syntactic constructions needed to express mental states (such as predicate complementation) is present before the first reference to a true mental state. For example, Shatz et al. (1983) examined transcripts of a child from the CHILDES database (Abe) and found instances of sentences including predicate complementation (e.g., "show me how to work this") prior to the first occurrence of a mental state utterance. Therefore, the limitations appear to be conceptual rather than linguistic in nature.

Once children are able to recognize that words like *know* and *think* refer to mental states, they are faced with the task of understanding what exactly makes each mental state distinct. There are data suggesting that it is only at a later period that children come to make such distinctions.

Johnson and Maratsos (1977), for instance, investigated children's understanding of THINK and KNOW at 3 and 4 years of age. Participants in this study were told a story about two characters. The first character (hider) moved an object from one location to another without the second character (seeker) knowing. They were then asked several questions: a) where the second character would look for the object, b) whether he "thought" it was in a certain location, c) whether he "knew" it was in that location and finally, d) a forced choice question: "Does the 'seeker' think it's under box B or does he know it's under box B?" The same questions were asked about the 'hider.' Results indicated that the 3-year-

olds showed no discrimination between the *think* and the *know* questions and responded at chance to the forced-choice question.

Another study (Miscione et al., 1978) tested children from 3 ½ to 7 years of age on their ability to make a distinction between KNOW and GUESS. Children were asked to participate in a game during which they had to determine which of three "magic boxes" contained a small object that had been hidden previously. In some conditions, participants saw the experimenter hide the object and in other conditions, they did not see the object being hidden. After choosing a box, they were asked whether they "knew" or "were guessing" the location of the object. Results indicated that no child younger than 4 was able to make a systematic distinction between KNOW and GUESS, that is, they either responded with *know* in all conditions or *guess* in all conditions or their responses were random. Between the ages of 4 and 5, children tended to associate *know* with successful performance (that is, the object is in the location predicted by them) and *guess* with an incorrect or unsuccessful performance.

Johnson and Wellman (1980) were interested in children's ability to differentiate three mental state verbs: *know*, *guess*, and *remember*. Additionally, they wanted to provide an alternative to the forced-choice question used in the Miscione et al. (1978) study. Johnson & Wellman (1980) argued that children's responses to the forced-choice question could not reveal whether children were interpreting *know* and *guess* as opposites or whether they were associating

guessing with incorrect performance. 4- and 5-year-olds were presented with 8 hidden-object tasks that varied according to 3 different criteria: a) whether the child knew about the location of the object beforehand; b) whether the child had immediate knowledge of the object's location and c) whether the subject correctly found the object. Importantly, children were also presented with a "trick" condition during which the object was secretly moved to a different location. After each task, children were asked about the location of the hidden object and when an answer was provided, children were asked questions including each mental state verb: a) "Do you know it's there?" b) "Do you think it's there?" c) "Do you guess it's there?"

Contrary to Miscione et al's (1978) findings, their results suggested that GUESS was being judged like KNOW which is evidenced by children at age 4 claiming to GUESS when their performance was "right" significantly more often than when their performance was "wrong." However, both Miscione et al.'s (1978) and Johnson & Wellman's (1980) findings seem to converge in two respects: preschoolers have trouble distinguishing between mental state words like *remember*, *know* and *guess* and it is only during the school years that children actually achieve a complete understanding of the differences between these terms.

Another study looking at children's understanding of the use of mental terms to indicate relative certainty or reliability (Moore et al., 1989) provided additional evidence for the claim that a sophisticated understanding of mental

state verbs emerges only during the school years. Children (3- to 8-year-olds) were presented with a task in which they had to determine the location of a hidden object. But before they provided an answer, two different puppets uttered two conflicting statements involving one of the following mental terms: *know*,*think* or *guess*. For example, one puppet would say "I think it's in the red box" and the other one would say "I know it's in the blue box." Children were then asked to find the object. Results of this experiment suggested that it is only at around 4 years of age that children start differentiating KNOW from THINK and from GUESS, and this understanding seems to be complete by age 5.

Based on the results from the different studies discussed here, (Bartsch & Wellman, 1995; Johnson & Maratsos, 1977; Miscione et al., 1978; Moore et al., 1989; Shatz et al, 1983;), we could try to trace the developmental sequence that leads to children's understanding of mental states. At around the second birthday, children start using mental state words but without any reference to true mental states or without a complete understanding of what mental states are (Bartsch & Wellman, 1995; Shatz et al., 1983; Wellman et al., 1995).

During the year after they turn 3, children start producing their first references to mental states, as can be seen in their use of contrastives (Barstch & Wellman, 1995; Shatz et al., 1983). Two kinds of contrastives are used: those in which children contrast thought and reality and those in which they contrast their own thoughts or beliefs with somebody else's. Barstch and Wellman (1995)

provides us with good examples of each kind. An example of the first on comes from Abe (3;8): “I thought I could rip the papers off, ‘cept it doesn’t have any paper.” An example of the second kind of contrastive comes from Ross (3;3). An adult says “I thought you were downstairs” to which Ross replies “I thought me was upstairs.”

At around the age of 4, children are then finally capable of displaying a more sophisticated understanding of mental states, one that includes, for example, an ability to distinguish among different mental states like KNOW versus THINK (Johnson & Maratsos, 1977; Miscione et al., 1978; Moore et al., 1989). Interestingly, this is also the period during which children start succeeding at false-belief tasks (Wimmer & Perner, 1983; Baron-Cohen et al, 1985). However, there is no conclusive evidence yet about how these changes take place. More work examining the asynchrony present here is needed: children use words that refer to mental states early on but only two years later can they display an understanding of the semantic differences among these mental state words.

Mental State Words: how are they acquired?

The questions of when children start producing mental state words and when they truly can refer to mental states are indeed fundamental; however, the question of how children learn mental state words, or rather, any kind of abstract word is equally important. Research in the past twenty years has provided

extensive evidence on the mechanisms by which children acquire new words (for reviews, see Bloom, 2000; Woodward & Markman, 1998). Although most of this research has focused on the learning of concrete words, some of the knowledge gained may apply to the learning of abstract words and, more specifically, to mental state terms.

Lila Gleitman and colleagues have suggested that the answer to the question of how children learn words that refer to abstract concepts is not especially complicated.

> Children's first words are determined by the tools available for word learning. The true beginner can only try to observe elements in the world that systematically occur with the use of particular words. This leads to success in those cases in which the word meaning is concrete enough to be readily observable in the flow of events: mostly nouns, but also a heterogeneous set of other words. To learn less concrete (less observable terms), the learner needs other kinds of evidence: linguistic evidence, boostrapped from the previously acquired vocabulary of concrete words. (Fisher & Gleitman, 2002, p. 475)

The syntactic bootstrapping theory proposes then that children learn the meaning of abstract words via the linguistic information they can extract from the sentences that include those words, and from the cues they can obtain from the

meaning of other parts of the sentences. In fact, results from several studies indicate that children do use syntactic cues for determining word meanings (Fisher et al., 1994; Gleitman, 1990; Gillette et al, 1999; Hirsh-Pasek & Golinkoff, 1996; Waxman & Markow, 1995).

One of the recent studies supporting this view is a "human simulation" study conducted by Gillette, Gleitman, Gleitman and Lederer (1999). In one of their conditions, adults were shown silenced videotaped scenarios of mothers talking to their children and then were asked to guess what word the mother said at specific moments of the tape (whenever a beep was introduced). One interesting finding was that the participants were able to identify concrete verbs (e.g., *throw* or *come*) quite frequently but they were never able to guess mental verbs like *think* and *know*. However, in another condition, participants were provided with some syntactic information about the sentence being uttered but had no access to the videotapes. Surprisingly, participants performed better when trying to guess the abstract verbs than when trying to guess the concrete words. Gillette et al. (1999) argue that whereas the meanings of concrete words can be extracted from experience, the meanings of abstract words require syntactic cues.

Several studies have revealed, however, that children can use social-pragmatic cues to learn a word whose referent is absent (Akhtar & Tomasello, 1996; Tomasello, Strosberg & Akhtar, 1996). For example, in one study, the experimenter said "Let's find the toma." The experimenter then looked for the

“toma” in a barn that was locked. Infants as young as 18 months learned the novel label without ever seeing the referent in association with the word (Tomasello et al., 1996). In another study, 24-month-olds learned novel labels for actions and objects they could not see at the time of labeling (Akhtar & Tomasello, 1996).

These researchers claim that in non-ostensive contexts, that is, when the referent is not present and thus, cannot be pointed at or named, children can rely on their ability to understand the speaker’s referential intent. These findings are not necessarily in conflict with those of Gillette et al. (1999). Although the “toma” could not be seen in the barn task, it still referred to something concrete. Moreover, children could use linguistic information in the “toma” task because the new label was embedded in a sentence (e.g., “Let’s find the toma”), and that linguistic context might have helped them to identify the entity to which “toma” referred. Nonetheless, one could argue, based on these same data, that we need social-pragmatic cues in conjunction with linguistic information to achieve the goal of identifying the speaker’s referential intent, that is, identifying what exactly the speaker wants to refer to. These same cues also may be valuable for learning the meaning of abstract words.

In an exploratory set of studies, Souza (2002) looked at the strategies parents utilize when introducing different kinds of abstract words (including mental states) versus when introducing concrete words. Two studies were conducted. In the first study, transcripts from CHILDES (Child Language Data

Exchange System) were examined to assess the frequency of particular abstract terms in children's and adults' speech and the strategies that parents used when discussing them. In the second study, 2-, 3- and 4-year-olds were videotaped with a parent at home. Parents were given a set of 6 different words during each of the two sessions and they were asked to use those words while interacting with the child (four of these words were abstract and two referred to concrete entities).

Across both studies, the strategy most frequently used by parents was associating the word with something that is concrete and visible. For example, when introducing an abstract word like "nothing," a parent might find a box in the room and say "What's in the box? Look. Nothing is in the box now." The second most frequently used strategy was referring to a past, present or future event. For example, when using the word "scared," one parent said, "Sometimes the cat likes to sit in the chair with us. Daddy doesn't like that, does he? And then what does Daddy do? He scares her off, right? He goes... (mom claps hands). He scares her off. Do you think that makes her *scared*?" This finding was consistent with previous suggestions that parents try to facilitate the word learning process for their children (Nelson, 1973; Snow, 1977).

More research is needed, however, examining the process through which children become successful at learning mental state words and, more generally, abstract words. Some questions that remain unanswered are the following: do children rely on different strategies and cues for learning abstract words at

different points in development? What are the prerequisites for children to be able to succeed at this task? Do they include syntactic knowledge, as Gleitman and colleagues suggest, vocabulary size, or a cognitive ability such as the ability to make inferences about the speaker's referential intent? Or is it a combination of linguistic knowledge, cognitive ability and social cues that enable the child to go from concrete to abstract? Finally, is there something special about the acquisition of one category of abstract words- mental states? These questions all point to interesting future directions for word learning research. Moreover, the entire discussion of when and how children acquire words that refer to mental states may contribute to a renewed interest in another very important discussion: that of the relationship between language and mind (Gentner & Golden-Meadow, 2003).

Language and Mind

Researchers interested in cognitive and language development have been pursuing for decades the question of the exact nature of the relationship between language and mind. One of the several accounts entertained by these researchers is derived from the Sapir-Whorf hypothesis, that is, the idea that each language, specific to a given culture, shapes the way the members of its culture and linguistic community carve up the world. Whorf (1956) argued that speakers of the Hopi language had concepts of "time," "space," and "matter" that differed from those of English speakers. Moreover, he suggested that this difference had

an effect on their behavior. For example, Whorf claims that “a characteristic of Hopi behavior is the emphasis on preparation” (1956, p. 148). According to him, this form of behavior is intrinsically related to the pattern of counting time and the expression of time in the Hopi language.

Whorf’s claims about the Hopi language have been challenged (Lakoff, 1987) and, in fact, the Sapir-Whorf hypothesis has collected a considerable amount of opposition in past years. However, the question of the relationship between language and thought has reemerged and has been yielding interesting and important research findings (Gentner & Goldin-Meadow, 2003).

There are many different paths to be followed if one wants to pursue the language-cognition question or test the Sapir-Whorf hypothesis. Slobin (2003), for example, works within the framework of his “thinking for speaking” hypothesis which states that language has special effects on cognition only when there is a need for linguistic expression, in other words, when one is “thinking” with the purpose of “speaking.”

Slobin’s most recent work is derived from the finding that different languages encode motion in different ways which, according to him, seems to have specific (and limited) effects on how speakers of different languages conceptualize motion events. For example, there are some languages (so called Satellite-languages) like English that tend to encode the path of motion through means of a particle or preposition -- a “satellite” (e.g., *out*) -- whereas other

languages (verb-framed languages) like Portuguese encode path of motion in a verb (e.g., *exit*). Moreover, according to Slobin (2003), what deserves attention is the fact that these languages differ in how they encode *manner* of motion. In English, manner is encoded in the verb itself as in his example "The dog ran into the house." In verb-framed languages like Portuguese, manner is not encoded in the verb; it is encoded in another part of the sentence as in "O marido saiu de casa correndo" ('The husband left the house by running'). Slobin proposes then that "online attention to manner has made it especially salient in S-language [satellite-language] speakers' conceptualizations of motion events" (p.164).

Melissa Bowerman and Soonja Choi are more interested in the effects of language on spatial reasoning. In Choi and Bowerman's (1991) study contrasting English and Korean, they observed that in Korean, there are terms that represent "tight fit" versus "loose fit" spatial relationships and English does not make such a distinction. Another example that illustrates interesting cross-linguistic differences concerning spatial terms is that Portuguese does not make a distinction between "in" and "on" (the equivalent to both is "em") whereas English has these two different semantic categories explicitly marked.

Based on this type of evidence and other cross-linguistic research and studies with spontaneous speech, Bowerman and Choi (2001) reach the following conclusion: what a language marks as support or containment is not determined by reality, but by the conventions present in each language. Consequently,

children's conceptualizations of space may be influenced both by non-linguistic conceptual development and the semantic categories present in the input language. Their view is interactionist in the sense that cognition and language work side by side, that is, they both play a role in early word meaning.

Dendre Genter, on the other hand, chooses to look at more general effects of language on cognition. She is interested in investigating how language can affect reasoning or representational abilities. Some of the evidence she presents comes from mapping tasks. In one of her studies, for example, she shows children two sets of objects (the experimenter's and their own), then they see the experimenter hide a sticker under one of the objects in the experimenter's set. Finally, they are asked to find the sticker which is said to be in the "same place" in their own set. In order to give a correct response, children had to take into consideration relational similarity, that is, to find the object of the same relative size and position in the experimenter's set. Gentner and colleagues' findings seem to indicate that relational language (e.g., hearing words like *top* or *bottom*) helps to improve children's performance (Rattermann & Gentner, 1998) in this mapping task. Based on this kind of evidence, Gentner argues that "language is neither a lens through which one forever sees the world, nor a control tower for guiding cognition, but a set of tools with which to construct and manipulate representations" (Gentner, 2003, p.223).

As can be seen, the language-thought question is and will be, at least for the foreseeable future, generating a lot of work, especially because researchers in the field have not yet reached a consensus about the nature and direction of the relationship between language and thought. However, in spite of differences in theoretical perspectives, there is little disagreement about the value of research investigating this relationship in a wide range of domains: spatial reasoning, motion events, number, gender and in the domain that is of most interest to this paper, understanding of mental states and, more broadly, the mind.

In particular, studies examining the relationship between language and theory of mind may provide valuable information and insights about children's understanding of mental state terms. For this reason, a significant part of the literature reviewed in this paper will be focused on theory of mind development. By reviewing this literature, I hope to clarify and emphasize the importance of studies looking at early language about the mind. It is important to note, however, that the majority of the studies reviewed here concentrate on false belief understanding, which is an important requirement for the complete acquisition of a theory of mind, but is not the only component. Before I discuss the different positions and findings concerning the relationship between language and theory of mind, I will describe how false belief understanding has been assessed by researchers in the field.

Speaking and Theorizing about the mind

False belief understanding generally is tested in what has become known as false-belief tasks. There are, actually, several variants of the false belief task. For example, in one variant of the false belief task, the "unexpected content" task, the child is presented with a box with pictures of candy on it (Gopnik & Astington, 1988). The child is then asked about the contents of the box and later is shown that the box actually contains something else, for example, pencils. When asked to report their original idea about the contents of the box, children under the age of 4 claim that they knew there were pencils in the box and predict that other people will know there are pencils there.

In another variant of the false-belief task (Wimmer & Perner, 1983; De Villiers & De Villiers, 2000), a confederate shows the child an object (e.g., a sticker) and puts it in location A. The confederate then leaves the room and the experimenter suggests moving the object to location B. The child is then asked "When …. (the confederate) comes back, where will he/she look for the object?" Again, 3-year-olds consistently respond that the confederate will look in location B, even though he/she had not witnessed the change of location. These findings suggest that before age 4, children have difficulty in attributing a false belief to themselves and others.

There is robust evidence of correlations between false belief reasoning and language measures. For example, Happé (1995) found that success at false-belief tasks was significantly correlated with verbal ability as measured by the British Picture Vocabulary Scale (BPVS). Moreover, individuals with autism require a higher level of verbal ability than typically developing children in order to pass false-belief tasks (Happé, 1995). Jenkins & Astington (1996) used the Test of Early Language Development (TELD) to provide a measure of syntactic and semantic abilities in children between 2 and 5 years of age and a sentence memory measure of the Stanford-Binet to assess verbal memory. Success at false belief tasks was significantly correlated with children's general language ability and verbal memory.

Cutting and Dunn (1999) were more interested in the effect of family background on the development of a theory of mind; however, they also found evidence that receptive vocabulary as measured by the BPVS and narrative expressive language ability were associated with false-belief understanding. Farrar and Maag (2002) found that vocabulary and grammatical complexity as measured by the MacArthur Communicative Development Inventory (MCDI) at 2 years of age were strong predictors of performance on different theory of mind tasks at age 4 (appearance-reality; false belief and representational change). Because all of these studies are correlational, it not only is unclear whether there is a causal relationship and what the direction of any such relationship would be,

but it is also entirely possible that a third variable is responsible for this relationship (e.g., some might argue general intelligence). Studies with special populations might provide additional insights.

Peterson and Siegal (1998) provide evidence for similarities between autistic and deaf children from hearing families in the development of a theory of mind. Both groups performed significantly worse at false-belief tasks than typically developing 4-year-olds. Peterson and Siegal (1998) argue that this similarity stems from a reality shared by autistic and deaf children of hearing parents: they are both deprived of talk about mental states early in development. Deaf children of hearing parents get little language input overall, particularly if they are being "orally" trained. Moreover, the few words they may acquire most likely refer to concrete things. With regard to the autistic children, the argument is that their difficulties in the social realm as well as their limited pragmatic skills may contribute to diminished talk about the mind early in life. This concern with the role of early talk about the mind in theory of mind development seems to resonate with previous work by Judy Dunn and colleagues (Dunn, Brown & Beardsall, 1991), which suggests that early family talk about emotions is correlated with children's later ability to recognize emotions (at age 6).

More recently, Cicchetti et al. (2003) argued that we may find support for this hypothesis in yet another population: maltreated children. Their results indicate a correlation between child maltreatment and delays in theory of mind

development. One possible explanation for such a relationship is that parents of maltreated children are less likely to address their child's internal experience due to their restricted sensitivity and reduced levels of empathy towards their children. Consequently, these children may also be deprived of early communication promoting the development of theory of mind. Although this is an interesting claim, more research on the exact nature and content of the verbal interactions of these families needs to be conducted.

Other researchers, however, have focused their attention on other aspects of language development. For example, the de Villiers are more interested in the role of syntax. They claim that the syntax of complementation is an important pre-requisite for the acquisition of a theory of mind (de Villiers & de Villiers, 2000; 2003). Some sentences in English, like those including mental states, require an embedded proposition or complement. For example, the sentence "I think he's coming for dinner" includes the mental state verb *think* which demands an embedded complement: "he's coming for dinner" in this case. Through the use of embedded complements, one can express a belief that may actually be very different from someone else's belief or even reality.

The de Villiers (2000) gathered evidence from a longitudinal study with children from ages 3 to 4 which indicated that the strongest predictor of success at false-belief tasks was production of sentential complements. Additionally, they

presented empirical data from deaf children suggesting that they are significantly delayed in two different kinds of false-belief tasks.

In one task (the sticker-finding game), 23 deaf children (aged 4 to 9) had to find a sticker that was hidden by an experimenter in one of several boxes. They received clues from a confederate (who had been blindfolded when the sticker was hidden) and from the experimenter who actually knew where the sticker was. Only 47.8% of these orally-taught deaf children chose the box to which the experimenter (the "knower") had pointed more often than would be expected by chance. Moreover, the average age of the deaf children who succeeded at this task was 7.31 years.

In another task (the "what face?" game), another group of profoundly deaf children (aged 5:2 to 10:1) were presented with a set of pictures showing a character looking into a familiar container that had unexpected content (e.g., a crayon box that has a key inside). Participants were then asked to predict whether the character was surprised or not by choosing the picture of a face with the right facial expression and placing it on the character's blank face.

Surprisingly, only 32% of participants mastered this task, which seemed to indicate that this less verbal task was even harder for deaf children than the verbal one. It is important to note that the scores of normally hearing children in the standard verbal tasks were significantly correlated with their score on this less verbal "what face?" task (r (26) = +.61, $p < .001$). More importantly, the best

predictor of success for deaf children in both tasks was again mastery of complementation syntax. In summary, De Villiers & De Villiers (2000) argue that deaf children tend to have difficulties with the false belief task before they acquire complementation syntax and the direction of causality is that language is determining false belief success.

Yet another group of researchers, however, has focused on semantics and the process through which children come to understand the meaning of mental state words. For example, Barstch and Wellman (1995) tracked the process through which young children gradually incorporate mental state words into their productive vocabulary by analyzing CHILDES data. One of their interesting findings is that children acquire desire words before belief words like *think* and know, and that these belief words start emerging in children's vocabularies right after their second birthdays. Another example is the work of Moore, Pure & Furrow (1990) who found that children's competence with verbs expressing different levels of certainty like *think* and know correlate with their performance on theory of mind tasks (false-belief, appearance-reality and representational change).

Marilyn Shatz has been working for a number of years on the acquisition of mental state words and more importantly, she has been interested in the question of when young children start displaying a clear understanding of mental states, or rather, when they start making reference to a "true mental state" (Shatz

et al., 1983; Shatz, 1994). More recently, Shatz and her colleagues (2003) have investigated the possibility that differences in the explicitness with which languages express a concept of false belief has an effect on children's understanding of false belief. Some languages, like Turkish and Puerto Rican Spanish, have explicit terms for false belief (e.g., "san" in Turkish and "creer-se" in Puerto Rican Spanish) whereas other languages like English and Brazilian Portuguese do not have words that explicitly convey a "false belief." Their results suggest that there is an effect of lexical explicitness on children's false belief performance but it is a "local" effect. Having the explicit term for false belief was correlated with improved performance only when the task questions included the explicit term. Therefore, Shatz et al. (2003) remind us that caution is needed when making claims about the nature of the relationship between language and theory of mind.

It is possible that all of these different aspects of language may play a role in theory of mind development. However, what remains problematic about research investigating the possible link between language and theory of mind is that most, if not all of the relevant studies provide only correlational data and use false belief tasks as a proxy for ToM. Based on the current evidence, claims about a causal relationship between language and theory of mind are inappropriate, as are claims about the direction of this relationship.

Perhaps before one can establish the true nature of the relationship between language and ToM, it will be necessary to take one step back and dedicate more attention to each of the language components proposed to have an impact on theory of mind. For example, one should look at children's understanding of mental state words alone. Once it becomes clear how and when this understanding develops, we will be able to make more inferences about how it may affect children's understanding of the mind. Moreover, the question of whether the developmental pattern towards such an understanding is universal also deserves attention. For example, evidence that the process is not universal might point to linguistic and cultural influences on the development of an understanding of the mind. Cross-linguistic studies may prove to be particularly instrumental in the process of finding answers to this question.

Different Languages, Different Theories?

An important source of evidence for researchers interested in the role of language in children's understanding of mind is cross-linguistic work. The question that needs to be asked is whether children follow the same developmental pattern across different languages and cultures. Importantly, differences in the expression of mental states across languages could have effects on children's understanding of the mental world and, possibly, on the time frame during which they acquire a theory of mind. Although recent studies have

revealed some important findings, there is still an enormous need for more cross-linguistic work.

Tardif and Wellman (2000), for example, were interested in possible differences between Chinese- and English-speaking children in the developmental pattern through which they acquire a theory of mind. They argue that the comparison between Chinese and English is interesting for the following reasons: a significant part of language about the mind consists of verbs (e.g., *know* and *think*) and, unlike English-speaking children, Mandarin-speaking children are exposed to approximately equal numbers of nouns and verbs early in development. Secondly, syntax of complementation in Mandarin and Cantonese is simpler than in English. If mastery of predicate complementation is indeed a pre-requisite for theory-of-mind development (de Villiers & de Villiers, 2000, 2003), then one should expect that speakers of Chinese would have an advantage.

Additionally, some of the verbs used to convey mental states have more than one meaning. For example, *xiang3*[2] could be translated into *think* but also into "want to do something." The question Tardif and Wellman (2000) ask is whether having the same word to indicate both a belief and a desire could have any effect on children's progression towards a psychology that includes not only desires but also beliefs. Researchers have argued that American children progress from a theory focused on desires to a theory focused on beliefs (Bartsch &

Wellman, 1995; Wellman, 1990). Should we expect the same pattern among Chinese children?

Tardif and Wellman (2000) recorded everyday conversations of 10 Mandarin-speaking children over a period of 6 months and 8 Cantonese-speaking children over a period of 1 year. The transcripts were analyzed for utterances that contained words that referred to mental states. The researchers found that even though Chinese-speaking children showed a similar developmental pattern to English-speaking children in the acquisition of vocabulary referring to mental states, that is, they produced words that referred to desires before they produced words that referred to beliefs, the Chinese children used desire terms much earlier and used "thinking" terms less frequently. These findings seem to indicate that there are no differences in the "overall sequence;" however, there are differences in the time frame during which children acquire specific mental state words.

Tardiff and Wellman (2000) entertain possible explanations for some of these differences. For example, what could explain the fact that English-speaking children use words referring to "thinking" more frequently than Mandarin- and Cantonese-speaking children? One possibility is that parents of Chinese-speaking children simply do not make many references to "thinking" early on. Another possibility is that a more complex syntactic structure is required when *xiang3* is used to express "thinking" than when this same verb is used to express "wanting."

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[2] Tone contours are indicated in Mandarin by the numbers 1-4 at the end of each syllable.

Examination of naturalistic data has contributed greatly to our understanding of the acquisition of mental state words (Bartsch & Wellman, 1995) and the Tardif and Wellman paper is no exception. However, Tardif and Wellman (2000) only tested ToM abilities by looking at mental state word use, and therefore, they cannot make any claims concerning actual conceptual differences. In addition, the question of what specific aspect(s) of the Chinese language affects this time frame of theory-of-mind development remains unanswered.

Lee, Olson and Torrance (1999) were interested in possible differences between Chinese- and English-speaking children in performance on false belief tasks. Another important distinction between Chinese and English, these authors point out, is that Chinese possesses verbs that explicitly denote "thinking truthfully" and verbs that denote "thinking falsely." Lee et al.'s (1999) goal was to test the effect of this particular linguistic difference on children's performance in false-belief tasks.

In order to test this effect, participants were assigned to one of three conditions. Each condition consisted of the same three false-belief tasks: an unexpected content task; a variation of the Maxi task (Wimmer & Perner, 1983) which involved telling participants a story about a boy named Maxi who puts his candy in a basket and whose mother moves it to a box without his knowledge; and a third task in which children listened to a story about a mother cat and her family

and then reported the cat's belief about the identity of another character. The only difference among the three conditions concerned the type of verb used in the questioning part of the three tasks. The verb *xiang* is considered more "neutral" and can be translated into either *think* or *believe*. *Yiwei*, on the other hand, indicates that the belief *may* be false. *Dang* is even less neutral because it literally applies to instances in which there is a false belief. There were two important findings. The first was that Chinese-speaking children seem to follow the same developmental pattern in false-belief understanding as Western children do, that is, they display increasing success at false-belief tasks between 3 and 5 years of age. However, the second important finding was that performance at these false-belief tasks is affected by the use of these different belief verbs. Participants performed significantly better when the verbs *yiwei* and *dang* were used, which suggests that children's performance in false belief tasks may be influenced by the language used during questioning.

Shatz et al. (2003) also provide a test of how differences in the way false belief is conveyed in particular languages may affect performance in false-belief tasks. As described in the previous chapter, they did so comparing four different languages: two of them, Turkish and Puerto Rican Spanish, have verbs that explicitly denote a false belief whereas the other two, Brazilian Portuguese and English, do not. Once again, the effect was local: children from the first group performed better in the false-belief tasks but only when the explicit term was

being used. These crosslinguistic studies suggest that influences of language on cognition, at least with regard to false belief, are relatively restricted.

An interesting feature of Shatz et al.'s (2003) study is that linguistic differences cut across culture differences. They were able to group these four languages using the criterion of having or not having a verb to express "false-belief," with the result that Puerto Rican Spanish and Turkish were grouped together and contrasted with the second group, Brazilian Portuguese and English. One could argue that speakers of Brazilian Portuguese have far more in common, in terms of cultural background, with Puerto Rican Spanish speakers than with English speakers. This study thus represented an opportunity to isolate possible linguistic effects from cultural confounds (Bloom & Keil, 2001).

Shatz et al. (2003) remind us, however, that there are linguistic similarities between Puerto Rican Spanish and Brazilian Portuguese, and this is a fact worthy of attention. For example, they both have a specific verb to indicate performing the action of thinking as in "What are you thinking about right now?" and that verb is *pensar* for both languages. In fact, another potential and interesting cross-linguistic comparison would be one between Portuguese- and English-speaking children, given some peculiarities of the Portuguese language regarding certain mental state verbs, in particular, verbs like *think* and *know*.

In Portuguese, the English verb *know* can be translated into two different words. According to Ganho & McGovern (2004), *conhecer* indicates familiarity

with an object, concept or person whereas *saber* is used to indicate memorized knowledge. For example, if one wants to say "I know Math" in Portuguese, one will say "Eu sei Matemática." However, if one wants to express "being acquainted with someone," as in "I know Melissa," one will use the verb *conhecer*: "Eu conheço a Melissa" (see also Prista, 1966 and Fernández, 1965)

The word *think* also can be translated into two different words, depending on whether one wants to refer to the actual process of thinking (*pensar*) or whether one wants to express an opinion (*achar*). Fernández (1965, p. 45) provides three examples of *think* as referring to the process of thinking (in which *pensar* is used and *achar* is not appropriate): a) "Pense antes de falar" [Think before you speak]; b) "Sem pensar" [Without thinking]; and c) "Ela está pensando nas férias" [She's thinking about her vacation]. *Achar* can be used in different contexts (Ferreira, 1986): a) find by accident or by searching (e.g., Eu achei o livro [I found the book]); b) to suppose, to judge (e.g., Ele achou sua presenca desagradavel [He found/judged his presence unpleasant]) and finally, c) to think, to believe (e.g., Acho que ele não vem) [I think he is not coming].

There is little work examining whether these cross-linguistic differences in mental state words are associated with differences in the acquisition of mental state terms. One particular study (Bassano, 1985) investigated French children's understanding of *savoir*(*know*) and *croire* (*think*). Although Bassano's study did not include any cross-linguistic comparisons, it provided valuable information

about the understanding of these mental state terms among children whose native language is not English[3]. Participants were introduced to four different dolls and each had a box in front containing an object (either a fish or a bird). Doll #1 had her eyes open and had a fish inside the box; doll #2 was blindfolded and had a bird inside the box; doll # 3 had open eyes and had a bird; and doll # 4 was blindfolded and had a fish. The task was to indicate which of the dolls was likely to say the following statements:

a. "I know that I have a fish"

b. "I know that I do not have a fish"

c. "I do not know if I have a fish"

d. "I think that I have a fish"

Results suggest that 4- and 5-year-old French-speaking children have a clear understanding of *savoir* (*know*) when it is used in the affirmative but they showed some difficulties with the two negative sentences. In particular, 60% of the subjects were not able to interpret the "I know that I do not have a fish" correctly.

[3] French has several features in common with Portuguese because they are both Romance languages. For example, French makes the same distinctions that Portuguese makes between "knowing a person" ("connaitre") and "knowing a fact ("savoir"); and between "thinking about something" ("penser") and "expressing an opinion" ("croire"). However, these distinctions were not investigated in this particular study.

The confusion seemed to derive from a tendency of these children to interpret the negation as being assigned to the verb *know*, that is, they interpreted the sentence as “I do not know that I have a fish.” Another interesting finding was that children’s performance in the “think” trial was far below their performance in the “know” affirmative trial. Bassano (1985) argued that most 4- and 5-year-olds treat the mental state term *think* as having the properties of certainty and it is only later that children are able to understand that *think* involves a certain level of indeterminacy.

Far more cross-linguistic work is needed. There are very few studies of mental state and theory of mind development with children in countries other than the United States (c.f., Vinden, 1996; Avis & Harris, 1991); therefore, our knowledge of non-English-speaking children’s developing understanding of mental states and theory-of-mind is limited. For instance, research on false belief understanding and theory-of-mind in Brazil is scarce.

In one study, Roazzi and Santana (1999) tested 4- and 5-year-old Brazilian children in an adapted version of a false-belief task. The task consisted of presenting the child with three dolls that were introduced to the child as students in a school and a fourth doll who represented the teacher. One of the three student dolls had a tomato head and was called “Tomatinha,” another had a carrot head and was called “Cenourinha;” the third one had a banana head was called “Bananinha.” “Tomatinha” always brought tomatoes for lunch; “Cenourinha”

always brought carrots and “Bananinha” always had bananas. A confederate left the room with the three dolls while the experimenter suggested that they replace “Bananinha’s” lunch with bubble gum. Then the child was asked three questions:

1. What does (the confederate) think (“pensa”) “Bananinha” has in her lunch box?

2. What does “Bananinha” think (“pensa”) is in her lunch box?

3. What does “Bananinha” have in her lunch box?

Roazzi and Santana (1999) found that only 32% of the 4-year-olds in their study passed this false-belief task whereas 98% of the 5-year-olds were successful. These results could be taken to suggest that Brazilian children are delayed in the development of false-belief understanding if compared to British children who participated in the original studies (Baron-Cohen et al., 1985; Wimmer & Perner, 1983). However, confounding variables could be affecting the results in the Roazzi and Santana study (1999). For example, they used dolls because one of the goals of the study was to test whether using inanimate actors rather than animate actors had any effect on children’s performance in a false-belief task. However, the dolls had an unusual appearance and seemed to be highly attractive to the children and they may have been too much of a distraction for the younger children. In addition, children were presented with *four* dolls, which could have added to the complexity of the task. These facts could also explain why the researchers were unable to run the study with 3-year-olds, who

seemed to pay little or no attention to the task itself. Studies with other variants of the false-belief task are necessary in order for us to reach any conclusion about the pattern in theory-of-mind development in Brazilian children.

In fact, results from a previous study seem to contradict Roazzi and Santana's (1999) findings. Dias (1993) tested false belief understanding in orphanage children as well as children from low and middle SES families in Brazil using adaptations of three false belief tasks: the "Sally-Ann task," the "unexpected content" task and the "sticker-finding game." Participants were shown a doll called Silvia who had a marble in her basket. They were then told that Silvia was going to leave the room and go for a walk but would leave her basket in the room. Another doll called Ana was introduced to children. Ana removed the marble from the basket and put it inside a cardboard box on the table. The experimenter asked the child where Silvia would look for the marble when she came back.

In the second false belief task, children were shown a box of "ping-pong" bubble gum box(a popular bubble gum in Brazil). They were asked what was inside the box and then shown that the box actually contained pencils. Children were also asked what a third person (a classmate who was not in the room) would say about what was inside the box. In the third task, a confederate put a "ping-pong" bubble gum underneath one of three cardboard boxes, then left the room. The experimenter told children that they should move the bubble gum to another

box. After doing that, children were asked where the confederate would look for the bubble gum when he/she came back. Although orphanage children had scores below chance at ages 4 and 5, children from low and middle SES performed above chance at the three tasks at all three ages (4, 5 and 6). These results suggest that Brazilian children do not differ from U.S. and European children in their performance on false belief tasks (Baron-Cohen et al., 1985; Gopnik & Astington, 1988; Wimmer & Perner, 1983).

Nevertheless, there is other evidence that could point to differences in Brazilian children's developing understanding of mental states. Results from another study (Roazzi & Arcoverde, 1997) seem to suggest that it is not until age 5 that Brazilian children are able to make a distinction between factive verbs (verbs whose complements must be true) like *know*, versus counterfactive verbs (verbs whose complements must be untrue) like *make-believe*. Children were presented with a series of statements, each including a factive verb (*know* or *find out*) or a counterfactive verb (*make believe* or *make someone believe*). The child was then asked two questions, one designed to test the truth value children attributed to the complement and one designed to test the level of certainty children attributed to the target verb. For example, a child would hear the sentence "Paulo knows that Bruna is playing with her dog." The first question would be "So, is Bruna playing with her dog?" and the child could answer "yes," "you can't tell," or "no." The second question would be "If Paulo knows, is Paulo

sure that Bruna is playing with her dog? Or is Paulo not sure that Bruna is playing with her dog?”

Three- and four-year-olds still had trouble with the counterfactive verbs, treating them as if they were factives. However, there is a possible confound in this study as well. The counterfactive verb that presented the most difficulties to children at all ages was *make someone believe*. As the authors themselves point out, this is not a very common expression in young Brazilian children’s lexicon. Therefore, it is very likely that these results were caused by children’s unfamiliarity with this expression. Additionally, it remains unclear whether a potential delay in their understanding of counterfactive verbs could have an effect on children’s performance in theory-of-mind tasks.

One could argue that there are many difficulties associated with cross-linguistic research and that is why there are only a limited number of cross-linguistic studies. There is a significant increase in expenses when one is conducting cross-linguistic research. In addition, there is the difficulty of establishing relationships with researchers in other countries as well as concerns about possible confounds. However, if researchers in the field truly want to establish whether children’s understanding of mental state words and theory of mind both involve a developmental process that is universal, and if they want to investigate the relationship between language and cognition about the mind, there

needs to be more attention devoted to research conducted in other countries as well as research comparing different linguistic communities.

III. Study 1

The general purpose of the research presented here was to investigate children's developing understanding of two mental state terms: *think* and know. It is important to note, however, that *think* and *know* can be used in different contexts and, therefore, can imply different senses. For instance, *know* can be used to express sympathy, to express "knowing how to do something," or being acquainted with somebody. Additionally, *know* can be used in contrast to *think* to indicate different degrees of certainty.

Study 1 focuses specifically on children's developing understanding of the distinction between *think* and *know* as indicating two different degrees of certainty. More specifically, the purpose of this study was to test the assumption that children achieve an understanding of this distinction between *think* and *know* at an earlier time than suggested by previous research Johnson & Maratsos, 1977; Miscione et al., 1978; Moore et al., 1989). There is consistent evidence suggesting that this understanding is not achieved until the age of 4 (e.g., Moore et al., 1989) but the study reported here was innovative in two important respects: (a) it required children to reflect on their own mental states and not on those of a third person, and (b) it required children to reflect on different types or modalities of evidence (seeing an object/how it works, feeling, hearing, inference) as potential sources of knowledge. It was expected that, by introducing these changes to the

task, an incipient understanding of the distinction between *think* and *know* could be revealed before age 4.

Method

Participants

Forty-eight English-speaking children participated in this study. They were divided equally into three different age groups: 2½-, 3 ½- and 4 ½ - year-old children (8 boys and 8 girls in each age group)[4]. English-speaking participants were recruited using a database maintained at the Children's Research Lab at the University of Texas. Parents with children of the appropriate age for the study were contacted with a letter that explains the goals of the study and describes what would be required of them and their child if they chose to participate. Several days after receiving the letter, the parents were called and asked whether they had additional questions and whether or not they were interested in having their child participate in the study.

The consent form for the study included a set of five questions aimed at assessing the participants' socio-economic status (SES; see Appendix A). These questions were extracted from a questionnaire used by the Universidade de São Paulo to assess SES. One question was excluded from the original questionnaire because it concerned family income. It was expected that some parents would feel uncomfortable in answering such a question. Answers to the first question concerning family size were not considered in the final calculation because they

were relevant only in conjunction with the information about family income. Therefore, the SES scores were based on parents' answers to the four remaining questions of the questionnaire. The SES scores revealed that participants were, on average, upper-middle class.

Materials and Procedure

At the Children's Research Lab, both parent and child were asked to come to a room and sit at a table with an experimenter.

In order to have children familiarized with the format of the test question, the session began with a warm-up task. Initially, children heard the following instructions: "We're going to be playing some games today. I'll show you some things and then I'll ask you some questions. Sometimes you know what these things are and sometimes you don't. So you just may need to guess. But there are no wrong answers. Is that okay?" Then they were presented with three different objects, one at a time: a red pen, a ball and a cup. After a child was given the red pen, the experimenter said:

- "Look at this. What is it? Yes, it's a pen (if child says that it is a pen). Is this pen *blue* or is this pen *red*?"

After the child provided an answer, the experimenter gave him/her the ball and said:

[4] The three age groups ranged from 2;6 to 2;11, from 3;6 to 3;11 and from 4;6 to 4;11.

- “Now, let’s think about what we can do with some objects, what we can do with some things. What is this? Yes, it’s a ball (if child says “ball”). Let’s talk about what we can do with a ball. Do you *throw* a ball or do you *eat* a ball?”

The third training trial consisted of showing the child a cup and then saying:

- “Now, let’s talk about how we figure out things. Sometimes we see stuff and sometimes we smell stuff. Now, what is this? (after showing the cup). Yes, it’s a cup (if child says “cup”). Do you *see* that it’s a cup or do you *smell* that it’s a cup?”

The training trials were designed to familiarize children with a forced choice task that involved making a judgment about qualities associated with an object. During all three training trials, the child had to make a choice between two different properties or two different attributes of the same object. The first trial was asking them to reflect on the visible property of a pen, that is, its color; the second and third trials required some abstract reasoning from the child: what potentially can be done with a ball and how to figure out that an object is a cup.

Children’s performance in this training task was also used as a test of whether they had difficulties with the forced-choice type of questioning. If children’s performance in the test trials was found to be poor, one could argue that their “failure” could be attributed to difficulties with the task itself and not to their understanding of the distinction between *know* and *think*. Therefore, only

children who succeeded, that is, provided a correct answer in at least two of the three training trials, were included in our analyses. Only one child failed more than one training trial and, as a result, was excluded from our analyses.

The experimental portion of the session consisted of presenting the child with a series of different toys and objects, in a set of tasks in which the certainty about the identity of the objects varied. The child was then asked questions about what the objects were and how certain she/he was about what they were. For example, a child was shown a bag with an object inside that could be felt but not seen and then asked "What is it?" or "What could it be?"; after the child provided an answer, the experimenter asked "Do you *know* that this is a….. or do you *think* that this is a…..?" Both target words were equally stressed and the intonation was kept constant during all trials. Then the child was given a bag containing an object that could be both seen and felt and again asked what the object was, followed by the "know versus think" question. During the other four games, the same kind of questioning was used but the kind of evidence presented to the child varied (see Appendix B). In summary, each of the five games included one trial during which children either saw the object or they saw how it worked and one trial during which children did not have sufficient evidence to claim certainty about the identity of the object, that is, they did not see the object or how it worked. For the purpose of clarity, the former will be called the "more evidence" trial and the latter will be called the "less evidence" trial.

The order of the words *know* and *think* in the test question was counterbalanced across games and across children but kept constant within a game. For example, in the bag game described above, half of the children heard *know* first and half heard *think* first but a given child would hear *think* first for both the "more evidence" trials and the "less evidence" trials of that particular game. The games were also presented in two alternate orders: a) cards, boxes, bags, novel object, gift or b) gift, novel object, bags, boxes, cards. The order of trials within each game, that is, whether the game began with the "more evidence" trial or the "less evidence" trial was also counterbalanced, with two exceptions. In the light bulb game, it was necessary to start with the "less evidence" scenario because the object no longer was ambiguous once its function was demonstrated. In the card game, it was necessary to start with the "more evidence" scenario and show the "dog" card first to set the context for the child to infer the identity of the other card.

When asked what the target object was, participants occasionally said "I don't know" or simply shrugged their shoulders and refused to answer. One 2-year-old boy, when asked about the novel object, seemed to struggle to find an answer but, when nothing came to mind, simply said "It's a mystery!" If children failed to provide an answer even after prompting with "What could it be"?, the experimenter offered some possibilities. For example, during the novel object game, the experimenter would say: "Well, could this be a ball? Or could it be ice-

cream? Or a pineapple?" (answers that had been given by children who participated during the piloting phase). The experimenter continued to offer suggestions until the child agreed that it could be one of those things. After the child said "yes" to one of these options, for example, a ball, the experimenter introduced the test question "Do you know that this is a ball or do you think that this is a ball?" Sometimes, children provided an answer that was not specific enough. For example, in the bag game, children would place their hand inside the bag and say "it's a toy" or "it's a stuffed animal." In such cases, the experimenter asked "What kind of toy?" or "What kind of animal?"

Results

The goal of the test trials was to determine whether 2 ½-, 3 ½- and 4 ½-year-old children can make a conceptual distinction between the words *know* and *think* and, specifically, whether they can understand the differing degrees of certainty associated with each. I predicted there would be a significant difference among the three age groups. 4 ½ year olds would perform significantly better than the 3 ½- and the 2 ½-year olds. However, I expected this task to be easier than the ones used in prior research (Johnson & Maratsos, 1977; Moore et al., 1989) and thus, I predicted that children would perform successfully at this task before age 4.

Coding was based on the following criteria: every child got a score of 0-2 for each game, that is, they received a score of 2 if they gave the correct answer in both “more evidence” and “less evidence” trials, a score of 1 if they provided a correct answer to only of the two trials and a score of 0 if they gave incorrect answers in both trials. When their scores in the “more evidence” and the “less evidence” trials were combined, the maximum possible score was 10 (maximum of 2 for each of the 5 games). Children’s scores in the “more evidence” trials were compared to their scores in the “less evidence” trials and in that case, their scores ranged from 0 to 5 for each type of trial (there was one “more evidence” trial and one “less evidence” trial in each of the five games). In the “less evidence” trials, children got a score of 1 if the answer was “I think this is a…” and a score of 0 if the answer was “I know this a….”or any other answer. In the “more evidence” trials, when they could see what the object was or what it was used for, children were assigned a score of 0 if the answer was “I think” or anything other than “know” and a score of 1 if the answer was “I know.” Data were coded to determine the relative performance on “less evidence” and “more evidence” trials, that is, whether children were giving correct answers in both types of trials (more evidence and less evidence) or whether their performance differed according to the kind of information with which they were presented.

The results will be described as follows. First, preliminary analyses which were conducted to test for influences of gender and counterbalancing will be

presented. The analyses of primary interest will be discussed next. The goal of these analyses was to identify whether relative performance on the “more evidence” and on the “less evidence” trials varied with age. Additionally, analyses were conducted to test whether overall performance in any particular game was especially poor, which could indicate that the game presented greater difficulties to the children. These analyses will be presented last.

In order to test for the influences of gender, a 3 x 2 ANOVA was conducted with age (2 ½, 3 ½, 4 ½) and gender as between-subjects factors. There was no main effect of gender, $F(1, 42) = 1.26$, $p = 0.27$, nor did it interact significantly with age, $F(2, 42) = 0.54$, $p = 0.58$. In order to test for possible influences of counterbalancing, three 3 x 2 ANOVAs were each conducted with age and one of the following three variables entered as between-subject factors: order of games, order of *think* and *know*, and order of type of trial (more evidence x less evidence). They revealed no main effect of order of games, $F(1, 42) = 0.13$, $p = 0.72$, no main effect of word order (*think* x *know*), $F(1, 42) = 0.05$, $p = 0.83$ and no main effect of order of type of trial, $F(1, 42) = 0.12$, $p = 0.91$. None of these variables had a significant interaction with age. Therefore, the resulting analyses were collapsed across gender, order of games, order of *think* and *know*, and finally, order of type of evidence.

The goals of the primary analysis were to examine the scores in the “more evidence” trials and the “less evidence” trials in each game and to test whether

children's performance on each trial varied with age. The mean scores (out of 5 possible for each type of trial) are presented in Table 1 below. As can be seen, the means were higher for 4-year-olds, particularly, in the "more evidence" trials.

Table 1
Mean scores per trial at each age

Age	Trial	Mean	SE
2 yrs	more evid	1.94	0.32
	less evid	2.37	0.41
3 yrs	more evid	3.37	0.32
	less evid	2.37	0.41
4 yrs	more evid	4.75	0.32
	less evid	2.75	0.41

In order to test whether these differences were significant, a two way repeated measures ANOVA was conducted with age (2 ½, 3 ½, 4 ½) as the between-subject factor and type of trial (more evidence, less evidence) as the within-subject factor. A significant main effect of type of trial was found, $F(1, 45) = 7.51$, $p = .009$ as well as a significant main effect of age, $F(2, 45) = 10.06$, $p < 0.01$. Additionally, the analysis revealed a significant interaction between type of trial and age, $F(2, 45) = 5.15$, $p = 0.01$. Pairwise comparisons revealed a significant difference between the mean score at ages 2 ($M = 2.16$) and 4 ($M = 3.75$), $p < 0.001$. Additionally, at age 4, there was a significant difference between the evidence ($M = 4.75$) and the less evidence trials ($M = 2.75$), $p = 0.001$ (see Figure 1).

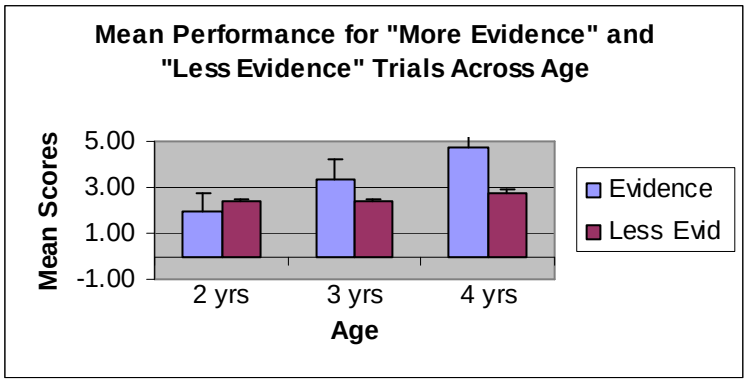

Figure 1

In order to test children's performance against chance, three t-tests were performed separately for each age group. These analyses were based on children's overall scores with the "more evidence" and "less evidence" scores combined (out of a total possible score of 10). The results suggested that at ages 2 and 3, children's mean scores did not differ from chance (*ps* =0.25 and 0.12) but at age 4, their performance was significantly above chance ($p < 0.01$). Interestingly, their performance in the "more evidence" trials was significantly above chance (M=4.75) but not their performance in the "less evidence" trials (M= 2.75).

A d' analysis was conducted to examine whether there were biases in children's responses, that is, whether they were more likely to overextend *think* to "more evidence" contexts or more likely to overextend *know* to "less evidence" contexts. Hit rates, false alarm rates[5] and d' values were calculated for the "more

[5] The false alarm for the "know" trials refers to the instances of children responding with "know" when they should be responding with "think" and the false alarm for the "think" trials refer to instances of children responding with "think" when they should be responding with "know."

evidence" (know) and the "less evidence" (think) trials at each age (see Table 2). The results were in parallel with the results of the analyses discussed above. The d' values for the 2- and the 3-year olds were closer to 0, indicating that their performance was at chance. The d' value for the 4-year olds in the "more evidence" trials (d'= 2.29) was higher than the d' value in the "less evidence" trials, suggesting a greater sensitivity to contexts during which children have visual access to what the object is or how it works. Additionally, the false alarm rates at age 4 for the "more evidence" trials were higher (*M*=0.26) than the false alarm rates for the "less evidence" trials, which suggests that children were more likely to respond with *know* in the "less evidence" (think) trials than they were to respond with *think* in the "more evidence" (know) trials.

Table 2
Mean hit rates, false alarm rates and d' values per trial at each age

Trial		**Hit**	**FA**	**d'**
"know" (more evidence)	**2 yrs**	0.39	0.36	0.08
	3 yrs	0.69	0.36	0.85
	4 yrs	0.95	0.26	2.29
"think" (less evidence)	**2 yrs**	0.48	0.40	0.20
	3 yrs	0.45	0.31	0.37
	4 yrs	0.55	0.08	1.53

It was also of interest to examine the frequency distribution of scores for each game (see Figure 2) and to test whether this distribution differed from chance at each age.

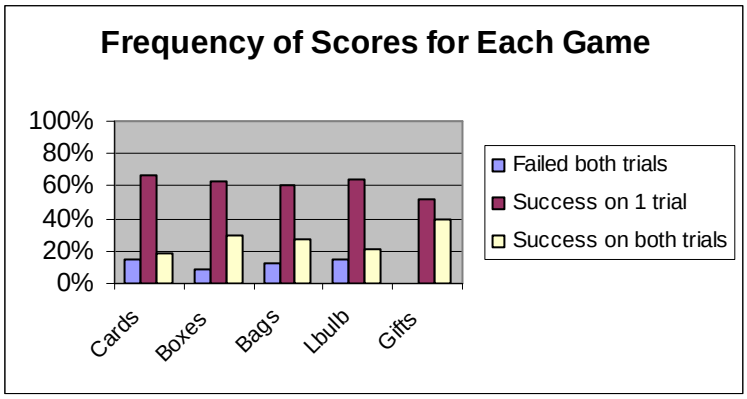

Figure 2

In order to test whether there was any particular game that presented difficulties to children a two-way repeated measures ANOVA was conducted with age (2 ½, 3 ½, 4 ½) as the between-subject factor and game (cards, books, bags, light bulb, gifts) as the within-subject factor (See Table 3 for mean scores at each game). The Huynh-Feldt test[6] revealed that the effect of game was significant, F (3.8, 172.6) = 2.72, p = 0.03. Pairwise comparisons indicated that the only significant difference was between the mean score in the cards game (M= 1.04) and the mean score in the gift game (M= 1.31), p= 0.04.

Table 3
Mean scores per game (age collapsed)

	N	Mean	SD
Cards	48	1.04	0.58
Boxes	48	1.21	0.58
Bags	48	1.15	0.62
Lbulb	48	1.06	0.60
Gifts	48	1.31	0.62

[6] The Huyn-Feldt test is more conservative but it corrected for the violation of the sphericity assumption present in the analysis.

Finally, Chi-square tests were conducted to compare the frequency of scores (0, 1 and 2) for each game and at each age. In a random distribution, the scores of 0 and 2 should occur 25 of the time and the score should occur 50 r The score of 1 was expected to occur twice more asfrequently because there were two possible ways through which children could receive this score: by succeeding in the “more evidence” trial or by succeeding in the “less evidence” trial. The results of the Chi-square analyses suggest that at age 2, children are performing randomly on all five games (all *ps* > 0.05). At age 3, CChi-square values did not differ from chance for any game, with the exception of the light bulb game, χ^2 (2, *N*= 16) = 12.38, *p* = 0.002. At age 4, all Chi-squares differed significantly from chance (all ps < 0.05), with the exception of the card game, χ^2 (2, *N*= 16) = 5.5, *p* = 0.064.

Discussion

The main goal of Study 1 was to test whether children could show a rudimentary understanding of the conceptual distinction between *think* and *know* before age 4. Children's performance at age 4 was significantly above chance for the "more evidence" trials but, contrary to my predictions, their performance at ages 2 and 3 were not different from chance for both types of trial. Having a task during which children were asked about their own mental states, rather than being asked about the mental states of a third person (e.g., a puppet) as was done in prior research, did not help to improve children's performance.

The fact that 2- and 3-year-olds did not perform above chance in this task does not necessarily indicate a complete absence of an understanding of "think" and "know." In three of the five games, children were presented with containers (i.e., boxes, bags, gifts) with an object inside. During these games, several participants attempted to look inside the containers in the "less evidence" trials, that is, when they could not see what was inside. Although their behavior seemed to indicate that they were not sure about what was inside the containers, their verbal response was "I know there is a … inside." Therefore, there is still the possibility that there is a rudimentary or implicit understanding of the concepts underlying these mental state words that is not being grasped by the tasks used in current research.

Several recent studies have produced findings that point to the existence of implicit knowledge that is not revealed by children's verbal responses. Goldin-Meadow, Alibali and Church (1993), for example, propose a model to explain discrepancies between children's verbal responses and their gestures, suggesting that such mismatches signal a state of transitional knowledge during which the child is "ready to learn."

In the realm of false-belief understanding, Perner and Clements have been investigating discrepancies between looking behavior and verbal responses of children in false-belief tasks (Clements & Perner, 1994; Perner and Clements, 1998; Clements, Rustin & McCallum, 2000). They argue that although 3-year-olds' verbal responses suggest they have not yet developed an understanding of false-belief, their looking behavior suggests the existence of implicit knowledge.

In their first study, Clements and Perner (1994) had participants (ages ranging from 2;5 to 4;6) listen to one story that had two versions: a false belief and a true belief (control). In the false belief version, Sam the Mouse put some cheese into a box (location A) but when he was asleep, his friend moved the cheese to another box (location B). In the true belief version, Sam actually sees his friend moving the cheese before he goes to sleep. The vast majority of children looked at location A in the false belief version when asked where Sam would look for the cheese, even though almost half of them gave the wrong verbal response: that Sam would look for the cheese in location B. One could argue that

children looked at A in the false condition because they were merely retracing with their eyes the sequence of story events. Clement and Perner (1994) argue, however, that if this were true, then children should look at A in both true and false-belief conditions. As predicted by them, children looked at A in the false-belief condition but looked at B in the true-belief condition, which was interpreted as a sign that they expected Sam to look for his cheese in location A. Moreover, their looking behavior is interpreted by these researchers as a sign of an implicit understanding of false belief.

In a more recent study, Clements et al. (2000) focused on how they could promote the transition from an implicit understanding of false belief to an explicit understanding through training. Children were assigned to three different conditions: a practice condition in which children were presented with different examples of false belief; an explanation condition in which they were also given an explanation about the stories and a third, control, condition in which the two stories being presented were not related to false belief. Their results suggest that providing children with an explanation leads to improvement; however, training was only helpful when children displayed implicit understanding of false belief in a pre-test measure (i.e., their looking behavior indicated the correct response although the verbal response was incorrect).

The idea of transitional knowledge seems to fit well with the story of how children acquire mental state concepts. For many years, researchers have only

worked with the notion of competence, “the logical knowledge needed to solve a task” (Sophian, 1997, p.281) which has indeed promoted important advances in developmental research. However, as Sophian (1997) claims, competence approaches to cognitive development are also limited in a number of ways. For example, Sophian argues that competence models emphasize successful performance and disregard the fact that children may “have knowledge that is not manifested in their performance” (p.294). Importantly, they fail to address the questions that, as Siegler (1997) suggests, developmentalists should be asking themselves all the time: how does developmental change take place? What are the mechanisms of change? How can we explain the variability we find in children’s thinking?

Karmiloff-Smith’s (1992) model of representational redescription also embraces this idea of a transition from implicit to explicit knowledge. In her own words, “representational redescription is a process by which implicit information *in* the mind subsequently becomes explicit knowledge *to* the mind, first within a domain and then sometimes across domains” (p.18). In the case of language acquisition, for example, Karmiloff-Smith proposes that children initially have linguistic representations that are used for “comprehending and producing their native tongue,” which could be translated into implicit knowledge that gradually becomes explicit.

The question to be raised then is whether we could apply this notion of transitional knowledge or implicit versus explicit knowledge to the acquisition of mental state concepts. One could raise the possibility that the development of an understanding of “mental states” is a gradual process, mediated by several attempts on the part of young children to understand all the nuances of a concept of mental states. At one point, children are able to contrast their own mental states with those of other people. At a later point, they may be able to understand the distinction between *know* and *think* as indicating two different degrees of certainty. However, it could also be that children have some transitional or implicit knowledge about mental states early on and the tasks we have developed so far are not good measures of such knowledge. At this point in time, we still have no test of whether children possess an implicit understanding of mental states before the age of 4. Such a test is needed if we want to understand more about the developmental process through which children acquire an understanding of mental states.

Another problem one could raise concerning studies investigating the acquisition of mental states is that they often include only children who are 3 or older. It is important to remember, however, that children start producing words like *think* and *know* earlier, right after the second birthday (Barstch & Wellman, 1995; Shatz et al., 1983). One problem with testing young children is that we still have not developed good methods to test 2-year-olds.

As every researcher who has attempted to conduct research with younger children probably knows, there are several obstacles: their attention span tends to be short and it is hard to keep them focused on one task for a period of time; there is great variability in vocabulary and other linguistic skills; and finally, they may have little experience with social scenarios such as the one presented to them in an experiment, in which an adult is testing them or asking them to perform a certain task. Two-year-old children may be very shy at first, taking a long time to "warm-up" or, at times, refusing to participate at all. Because of these limitations, tasks have to be designed so that they are not too demanding linguistically (e.g., requesting behavioral responses, such as pointing to objects, rather than requesting a verbal response).

This is where our greatest challenge lies: creating experiments that are appropriate for children as young as 2 and that are, at the same time, good tests of their understanding early in development. We have two choices: we can either choose not to run studies with 2-year-olds and just assume that they have no knowledge whatsoever of what mental state words refer to or we can insist, persist and keep thinking about ways to improve our methods so they can become better measures of what goes on in the mind of these 2-year-old children.

In sum, if one wants to pursue the question of how an understanding of mental states develops, more attention should be devoted to what happens early in development, that is, at around age 2 which, in turn, could reveal changes that will

gradually lead children to a more sophisticated understanding. Having evidence for the existence of implicit knowledge about mental states may also enlighten us about what exactly is changing or transforming in children's thinking about mental states.

One possible future direction is to examine children's looking behavior (e.g., the number of attempts at looking inside the box or bag) in contrast to their verbal responses. As previous research suggests, this strategy may be a helpful resource in identifying an implicit understanding of these mental state terms (Clements & Perner, 1994; Perner and Clements, 1997; Clements, Rustin & McCallum, 2000).

Consistent with previous findings (Bassano, 1985; Johnson & Wellman, 1980; Moore et al., 1989), it is only at the age of 4 that children display a complete understanding of the verb *know*. 4-year-olds are good at matching *know* with situations in which they have certainty as is evidenced by their almost ceiling performance in the "more evidence" trials (M= 4.75) but they still have difficulties differentiating *think* from *know* when there is ambiguous information or less certainty about the identity of the target object. The performance of 4-year-olds in the "less evidence" trials (when they have less evidence about the target object) is not significantly above chance. One possible interpretation for children's poor performance in the "less evidence" trials is that children are overapplying *know* to situations when they do not have enough evidence. On the

other hand, it was also possible that children are overapplying *think* to situations for which they do have enough evidence. The false alarm rates among the 4-year-olds in the "more evidence" trials, that is, responding with "know" when they should be responding with "think," are higher (*M*= 0.26) than their false alarm rates in the "less evidence" trials, that is, responding with "think" when they should be responding with "know" (*M*=0.08) which suggests that when children make errors, they are more likely to overapply *know* to "less evidence" contexts than to overapply *think* to "more evidence" contexts.

One interesting future direction will be to examine how 5-year-olds perform in this task and test whether they are less likely to respond with *know* in contexts during which uncertainty is present. Previous studies (O'Neill, Astington & Flavell, 1992; O'Neill & Gopnik, 1991; Pillow, 1989; Woolley & Bruell, 1996) have shown that it is in the period between 3 and 5 years of age, that children come to identify possible sources of knowledge. Preschool children seem to recognize that seeing and feeling something or being told about it leads to a state of knowledge (O'Neill, Astington & Flavell, 1992; O'Neill & Gopnik, 199; Pillow, 1989). The only exception is with regard to inferences. It is only at the age of 6 that children can identify inference as one possible source of knowledge (O'Neill & Gopnik, 1991; Pillow, Hill, Boyxe & Stein, 2000; Sodian and Wimmer, 1987; Woolley & Bruell, 1996).

The results of Study 1 in combination with prior research suggest that the age of 4 may be an important period in the development of an understanding of mental states, specifically, KNOW. At the age of 4, children succeed in the task of applying the word *know* to contexts in which sufficient evidence is provided. Children are gradually discovering what events and circumstances lead to knowledge. Moreover, they are learning which of these events provides sufficient evidence for them to claim that they *know* something, that they are certain about it. The question, once more, is why preschool children still encounter difficulties with "think." Bassano (1985) argues that *think* is initially encoded as having the properties of certainty and at the ages of 4 and 5, children are gradually differentiating *think* from *know*. As discussed above, Bassano presented children with four dolls, two of which had their eyes open and two of which were blindfolded. When asked about which doll had uttered the statement "I think I have a fish," participants tended to include the doll that had her eyes open (and had a fish) as one of their options.

One possible interpretation is that an understanding of *think* requires an additional task from young children. Not only do children have to identify the type of evidence leading to the belief but they also have to make a decision about whether this type of evidence suffices for them to claim certainty. For example, when presented with a box that contains an object (that cannot be seen) and hearing music coming from inside, children have to make two realizations: (1)

this music could be played by a telephone and (2) I have not seen what is inside so I do not know if the box contains a telephone or another object (e.g., a toy piano). In other words, one has to contemplate the possible sources of a belief and decide whether there is enough evidence confirming the belief.

Another factor may have also contributed to the difference found between the “more evidence” and the “less evidence” trials. The literature on the development of achievement motivation suggests that preschoolers tend to rate their own abilities more positively than is warranted and that this “positivity bias” declines with age (Schuster, Ruble & Weinert, 1998; Stipek & Mac Iver, 1989).

Although achievement motivation studies did not include children younger than 5, these findings could have implications for Study 1. If young children are prone to overestimate their knowledge, then we might expect them to be inclined to say that they *know* .the contents of a container even when they have insufficient information. Therefore, another possible explanation for the results is that 4-year-olds understand the difference in meaning between *think* and *know* but they respond with *know* rather than *think* because they are overly optimistic about their abilities to know the contents of a container even without sufficient information..

Finally, it remains unclear whether the poor performance of 4-year-olds in the “less evidence” trials is the result of a semantic issue, that is, a difficulty in understanding the meaning of the word *think* (or a difficulty in contrasting the words *think* and *know*) or whether it reflects a cognitive issue, for example, an

inability to identify events that lead to uncertainty or a lack of an understanding of uncertainty. As Acredolo and O'Connor (1991) point out, the methods currently utilized in cognitive development research are rarely designed to reveal when children are uncertain about the answers they provide. Investigations including implicit evidence (e.g., measures of looking behavior as well as verbal responses) or studies including a measure of how certain children are about their responses (e.g., Woolley & Van Reet, 2004) may contribute to the field by identifying when exactly children start displaying uncertainty and when they achieve an understanding of uncertainty and the situations that lead to it.

In summary, the results of Study 1 suggest that a complete conceptual distinction between *know* and *think* does not emerge before age 4. However, these results should not be interpreted as evidence that there is no implicit understanding of mental states before age 4. Future research should use different measures, for example, looking behavior, in an attempt to reveal a possible implicit and transitional understanding of these mental state terms. Finally, an interesting future direction for this study would be to conduct a comparison with speakers of languages other than English, for example, speakers of Portuguese. As discussed in the introduction, Portuguese makes fine-grained distinctions between different senses of *know* and *think* and these cross-linguistic differences could potentially affect children's developing understanding of these two terms. An important question (and one that remains unanswered) is whether the

developmental pattern towards an understanding of *think* and *know* observed in Study 1 is universal or whether it varies across languages.

IV. Study 2

The general purpose of the second study was to test whether there are differences between English-speaking U.S. and Brazilian children in their understanding of particular senses of *think* and *know*. More specifically, the goal of Study 2 was to address the question of whether there are differences across languages in children's understanding of the two different senses of *think* (i.e., *pensar* and *achar*) and the two different senses of *know* (i.e., *saber* and *conhecer*) that are explicitly marked in Portuguese.

Little work concerning the semantic distinctions between *saber* and *conhecer* and between *achar* and *pensar* has been conducted. Interestingly, other Romance languages also make similar distinctions. For example, Spanish has the equivalent terms *saber* and *conocer* and a similar fine-grained distinction between the two *think* verbs: *creer* and *pensar*. French has the two terms *savoir* and *connaitre* mapping onto these senses of *know* and *penser* and *croire* mapping onto the two senses of *think*. There is no work yet, however, investigating these semantic distinctions in any of these Romance languages and whether these cross-linguistic differences have any effect on the development of an understanding of mental states. An investigation of possible differences between English and Portuguese in how these two languages express mental states could prove to be very informative, for example, of the role of semantics in children's

understanding of mental state concepts. Moreover, it helps to fill a gap in the Romance literature concerning these semantic distinctions.

Method

Participants

Pilot data suggested that the task in which children were asked to make these finer grained distinctions of *think* and *know* was too difficult for 2- and 3-year-old children. One possibility is that the task required some metalinguistic abilities that are not present at those ages. Consequently, participants for the second study were children at 4-, 5-, and 6- years of age.

Ninety-six Brazilian Portuguese-speaking and ninety-six English-speaking children in the U.S. participated in this study with equal numbers of children participating at each of the three different age groups (16 boys and 16 girls in each age group). Children in the U.S. were recruited using the database at the Children's Research Lab. As for Study 1, parents of children of the appropriate age for the study were contacted by letter and, several days after they received the letter, were contacted by phone and asked whether they would be interested in having their child participate in the study. Brazilian children attended three schools in Belo Horizonte, Brazil. The principal investigator, who is a native speaker of Brazilian Portuguese, contacted the three different schools and met with the directors and coordinators to explain the details of the study. In each of

the three schools, the experimenter was introduced to the teachers and their students by the director (in one case) or by the pre-school coordinator (in the two other schools). The teachers distributed a copy of the consent form; only the children who brought the consent form signed by their parents were allowed to participate.

As in Study 1, the consent form used both at the Children's Research Lab and at the Brazilian schools included an SES questionnaire. Only one parent in the U.S. group and three parents in the Brazilian group did not provide answers for the questionnaire. An independent t-test comparing the mean scores for the SES questionnaire of the Brazilian and U.S. groups revealed no significant difference between the two groups ($t(186) = 1.154$, $p = .122$). Both Brazilian and U.S. participants were classified as coming from upper-class families according to their mean scores (21.93 for the U.S. sample and 22.8 for the Brazilian sample).

Materials and Procedure

PPVT (Peabody Picture Vocabulary Test). Children's vocabularies were measured by the Peabody Picture Vocabulary Test- PPVT (Dunn & Dunn, 1997). The PPVT is a measure of receptive vocabulary in which children are shown a series of plates with a set of four pictures each. The experimenter shows a plate then says a word and asks the child to point to the picture of that word. The duration of the test generally is between 10 and 15 minutes. U.S. children were tested with the English version of this test. The Hispanic-American version of this

test, Test de Vocabulario en Imágenes Peabody – TVIP, has been translated and adapted to Brazilian Portuguese by Capovilla and colleagues (1997a, 1997b) and this standardized version provided us with the opportunity to use the same vocabulary measure with the two language groups.

Task. Children were presented with videotaped scenarios during which the two senses of *know* (i.e., "knowing a person" and "knowing a fact") and the two senses of *think* ("thinking about something" and "having a lesser degree of certainty") were used (see Appendix C for an example of a complete script). English and Brazilian-Portuguese versions of the videotape were created using the same bilingual actors. Participants were told about two boys, Paul and Jonas, who would be appearing on the television. The experimenter told them that one of them, Jonas, came from a place far away from here and although he could speak English (Portuguese) very well, he sometimes got "mixed up" and used some funny words in his own language, Nemesian. The experimenter then told participants that he/she needed their help to try to figure out what Jonas was really trying to say when he used these "funny words."

In order to get participants familiarized with the test question, the session began with a warm-up scenario. Children watched the following scene: Paul is jumping up and down. Jonas comes into the room and says "Paul, you're *doofing*. That looks like fun. I want to *doof* too." Jonas then begins to jump. After watching this scene twice and after answering a comprehension question, children

were told: “Jonas is using this funny word *doofing*. What is he really trying to say in English?” If a child could not provide an answer or provided an answer that was completely out of context such as “He’s trying to say *cooking*,” the experimenter said “That’s good” and presented the child with a forced-choice question: “But when he says ‘Paul, you’re *doofing*,’ is he trying to say *jumping* or is he trying to say *walking*?” If a child had not provided a correct answer for the forced-choice question, he/she would have been excluded from analyses. All children gave an appropriate response, at least to the forced-choice question, and therefore, no child had to be excluded for this reason.

Following the warm-up task, children were presented with two scenes during which the two senses of *think* were used and two scenes during which the two senses of *know* were used. The set-up was the same as the one used in the warm-up task. Jonas said a sentence that included a nonsense word that mapped onto one of the senses of *think* or one of the senses of *know*. Children were then told: “Jonas used this funny word …… What is he really trying to say in English?” For example, in one of the scenes, Jonas comes into the room and sees Paul playing with a boy. He looks at Paul and says: “Paul, I don’t *zop* this boy. Who is he?” And Paul replies: “He’s my cousin, Mark. And we’re playing together.” The experimenter then asks the child: “When Paul says ‘I don’t *zop* this boy, what is he really trying to say in English?”

For each of the four different test trials, children were encouraged to provide a spontaneous answer. If they failed to do so, a forced-choice question was given. For example, the child would hear: “When Jonas is saying ‘I don’t *zop* this boy,’ is he trying to say ‘he doesn’t *like* this boy’ or is he trying to say ‘he doesn’t *know* this boy’?” The order of the target words in the forced-choice questions was counterbalanced as was the order of the two different senses of each word and whether the “know” or the “think” scenarios came first.

After the two “think” scenes and after the two “know” scenes, children were presented with a question about the meaning of the “funny words” used in the previous two stories. For instance, after hearing a story during which the novel word “zop” was used to refer to “knowing a person” and another story during which the word “mek” was used to refer to “knowing a fact,” the experimenter said: “In this last story, Jonas used the funny word *mek*; in the story before this one, he used the funny word *zop*. Do these two words, *zop* and *mek*, mean different things? If so, what is the difference?”

It was expected that this question would present some difficulties even to the 6-year-olds because it required more advanced metalinguistic abilities than the primary task. Children were being asked to think not only about the meanings of two words, but also to compare them and provide a justification for why the words were different in meaning. Nonetheless, even if children could not provide a justification for why they had a same or different meaning, it would be

informative to examine whether children could recognize a difference between the two novel words in the “think” scenes and between the two words in the “know” scenes.

Half of the Brazilian participants and half of the U.S. participants were assigned to a 2-word-condition that was created to simulate the reality faced by Brazilian children, that is, having two different words for the two different senses of each target word. For example, children heard the word *zop* as referring to “knowing someone” and the word *mek* as referring to “knowing a fact.” The other half of the participants were assigned to a 1-word-condition designed to simulate the reality faced by U.S. children, in other words, having a single word that maps onto the two different senses of the target word. For instance, children heard the word *zop* both in the “knowing a person” and in the “knowing a fact” scenarios.

Results

There were two predictions for Study 2. Firstly, I hypothesized that having the distinctions marked in their language would help Brazilian children in the process of acquiring the conceptual understanding of the two senses of *think* and the two senses of *know*. As a result, Brazilian children would perform better in the task than the U.S. children. Secondly, I predicted that U.S. children would have some ability to understand the subtle differences between the two senses of *think* and the two senses of *know* that are marked in Brazilian Portuguese.

Coding was conducted in the following manner: children received a separate score (0 to 2) for the two "think" scenarios and another score (0 to 2) for the two "know" scenarios. In other words, if children were able to provide *think* responses ("pensar" and "achar" in the case of Brazilian children) spontaneously in the two "think" scenarios and *know* responses ("saber" and "conhecer") in the two "know" scenarios, they received a score of 4 (1 point for each question answered appropriately). Answers to the forced-choice question were not included in the initial analysis; children who failed to provide a valid response prior to the forced-choice question were given a 0 for that question.[7]

Responses to the question concerning a possible difference in meaning between the two novel words were coded in the following manner: If children said "yes, they are different," they received a score of 1. If they said "they are the same," they received a score of 0. As this question is asked twice (once after the "think" scenes and secondly, after the "know" scenes), the scores ranged from 0 to 2.

The design of Study 2 was a 3 (age: 4, 5 and 6) x 2 (language: Portuguese, English) x 2 (condition: one word, two words) between-subjects design. A series of preliminary analyses were conducted to test for influences of gender and

[7]The forced choice responses were included in an additional analysis, one for which the criterion for a correct response was more lenient Results from the analyses including the forced-choice answers yielded similar results to the analyses not including them. I decided, however, to maintain a more strict criterion and report only the results on children's spontaneous answers

counterbalancing. An ANCOVA was conducted with age, condition, language and gender as between-subjects factors and PPVT scores entered as a covariate. There was no main effect of gender, F (1, 167) = 1.121, *p*= 0.291, nor did it interact significantly with any other variable. Another ANCOVA was conducted with age, condition, language and order of scenes ("think" or "know" first) as between-subject factors and no main effect of order of scenes was found, F (1, 167)= 0.791, *p*=.375 nor any interactions. Lastly, an ANCOVA was conducted with order of trials (e.g., "zop" or "mek" first) added as a between-subject factor and again, no main effect was found, F (1, 167) = 0.989, *p*= 0.796 nor any significant interactions. Therefore, subsequent analyses are collapsed across gender and across orders of scenes and trials.

To test the primary prediction, that performance would differ across language samples, a three-way ANCOVA was conducted with age, language and condition as between-subject factors and PPVT scores as a covariate. PPVT scores were significantly related to children's performance in the task, F (1, 179) = 15.15, *p* = .000. There was no main effect of language, F (1, 179) = .278, *p* > .05, however, a significant main effect of age was found, F (2, 279) = 33.06, *p* = .000 as well as a significant age x condition interaction, F (2, 179) = 3.024, *p* = 0.05. Pairwise comparisons revealed that at age 5, there was a significant difference between the mean score in the 1-word-condition (*M*= 1.65) and the mean score in the 2-word-condition (*M*=2.47) but not at ages 4 and 6 (see Figure

3). There was a trend towards a language x age interaction, F (2, 179) = 2.538, *p* = .082. Pairwise comparisons revealed that the difference in mean scores between the two language groups was not significant at any of the three ages. However, this trend likely arises because Brazilians have a slightly (but not significantly) lower mean score than U.S. children at ages 4 and 6 and a slightly (but not significantly) higher score at age 5 (see Figure 3).

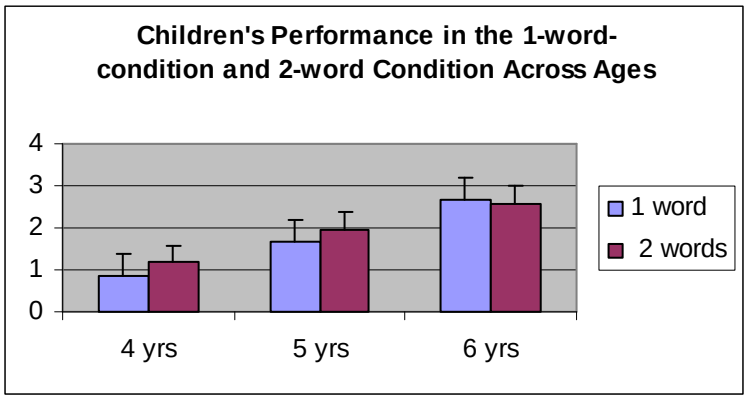

Figure 3

A 2 (language) x 3 (age) x 2 (condition) x 2 (type of trial) repeated measures ANOVA was conducted to examine whether there were differences in children's performance between the "think" trials and the "know" trials. There was a main effect of age, F (2, 179) = 33.06, *p*= .000 but no main effect of language, F (1,179)= 0.28, *p*=0.60 nor type of trial, F (1, 179) = 0.042, *p*=0.84. A significant interaction between the type of trial ("think" versus "know") and language was found, F (1, 179) = 10.43, *p*= .001 (see Figure 4). Pairwise comparsions indicated that there was a significant difference in performance

between the two language groups for the “know” trials (*M*= .96 for U.S. children and *M*=.74 for Brazilian children, *p*= .027) but not for the “think” trials (*p*=.22).

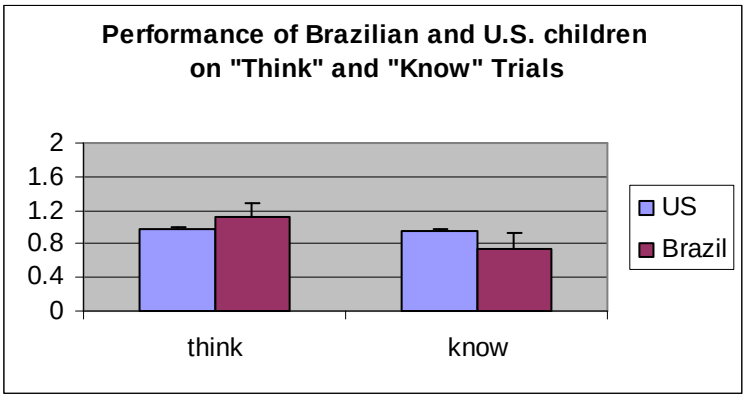

Figure 4

A trial (“think”, “know”) x language x condition interaction was also found, F (1, 179) = 4.25, *p*= .041. Pairwise comparisons revealed that for the “know” trials, in the one word condition, there was a significant difference between U.S. and Brazilian children. The mean score (out of 2) for the U.S. sample was 0.91 compared to 0.62 in the Brazilian sample, *p*= .003. However, U.S. children were not favored in all analyses. There was a trend towards a trial x language x age interaction, F (2, 179) = 2.67, *p*= .072 and pairwise comparisons indicated that at age 5, for the “think” trials, Brazilian children had a higher mean score (*M*=1.46) than U.S. children (*M*=.90). Additional analyses revealed that at age 6, there is also a significant difference between language groups (*p*= .043) for the “know” trials, with U.S. children having an advantage (*M*=1.4 compared to *M*=1.1 for Brazilians).

Another 3 (age: 4, 5, 6) x 2 (condition: 1-word, 2-word) x 2 (language: BR Portuguese, English) ANCOVA was conducted to examine children's responses to the question concerning a possible difference in meaning between the two senses of *think* and the two senses of *know*. For the purpose of clarity, it will be called the metalinguistic question. Once again, PPVT scores were entered as a covariate but they did not correlate significantly with children's responses to the metalinguistic question, F (1, 179) = .003, p =.957. A main effect of language was found, F (1, 179)= 4.02, p= .046 as well as an age x language interaction, F (2, 179)= 8.87, p =.000. Pairwise comparisons revealed that at all three ages, there was a significant difference between the English and the BR Portuguese groups (*ps*= .03, .03, .001 for ages 4, 5 and 6 respectively). At age 4, U.S. children have higher scores (*M*=1.34) compared to the Brazilian children (*M*= .94) and at ages 5 and 6, Brazilians perform better: *M*= 1.41 compared to 1.00 for U.S. children at age 5 and 1.69 compared to 1.03 at age 6 (see Figure 5).

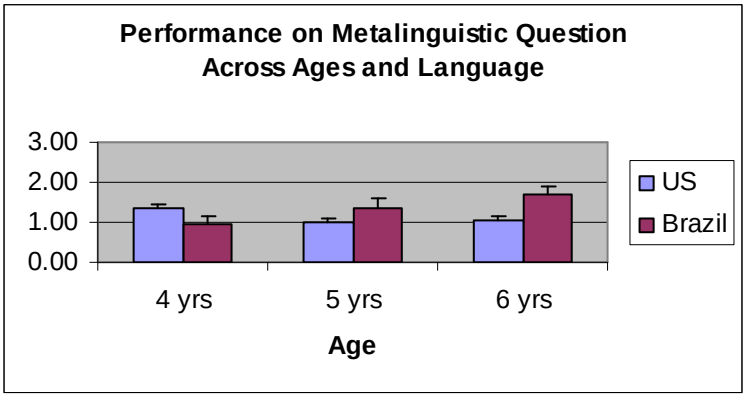

Figure 5

Discussion

The main prediction for Study 2 was that Brazilian children should have an advantage in the task of identifying the two senses of *know* and *think* because they are explicitly marked in Portuguese but not in English. Although the results of this study do not point to an overall advantage for Brazilian children, they reveal an interesting developmental pattern as well as some interesting similarities and differences between BR Portuguese and English speakers.

Firstly, the results suggest that some interesting changes are taking place at age 5. At this age, children from both language groups perform better in the novel word task in the 2-word condition than in the 1 word-condition; this pattern is not observed at ages 4 and 6 (see Figure 3 in the previous section). One interpretation of these findings is that age 5 represents a transitional point in the development of an understanding of these mental state words. It is possible that 5-year-olds are performing better in the 2-word condition because having a distinct external sign (i.e., a different novel word) mapped onto each one of these four senses is helpful at this age. Perhaps, at 6, children from both language groups already have their own "internal" concepts of the senses of *think* and *know* that correspond to *saber* and *conhecer* as well as *pensar* and *achar*, and having two words or one word no longer confers an advantage.

This interpretation is consistent with some of Vygotsky's (1978) ideas. According to him, external signs may be helpful at particular points in the developmental process but these signs subsequently become "internalized" and at that point are no longer needed.

> The developmental changes in sign operations are akin to those that occur in language. Aspects of external or communicative speech as well as egocentric speech turn "inward" to become the basis of inner speech. (1978, p.57)

Vygotsky supports his claim by providing evidence from memory experiments conducted in his laboratory. Whereas school-age children benefited from the availability of external memory aids, adults were successful regardless of whether external memory aids were available. Vygotsky argued that children needed external signs but adults no longer needed the external aids because they had been "internalized." Vygotsky also claimed that this process of internalization of external signs characterizes development more broadly and is responsible for influences of language on thought: words initially serve as external aids to thought but subsequently guide thought as "internal speech." This is consistent with the findings from Study 2. Five-year-olds who participated in the 2-word-condition, that is, those who heard two novel words used in the two "think" trials and two novel words used in the "know" trials, had higher scores than those who participated in the 1-word-condition (i.e., having one novel word used in the two

“think” trials and one novel word used in two “know” trials). At the age of 6, however, no significant differences were found between the scores of participants in the 1-word-condition and those of participants in the 2-word-condition. And this was true for both language groups as evidenced by the absence of a language x condition interaction.

Interestingly, being in the 2-word condition does not make children more likely to see possible differences between the two senses of each target word; there is no main effect of condition on their performance in the metalinguistic task (and condition did not interact significantly with language or age on that task). Therefore, having two words does not help children to recognize, on a conscious level, that there are differences in meaning associated with the concepts of “saber” and “conhecer” and of “pensar” and “achar.” However, there is a developmental shift in children’s performance in the metalinguistic task that may help to explain this finding. At age 4, U.S. children have higher scores than Brazilian children, but at ages 5 and 6, Brazilian children have higher scores. Perhaps being in the 2-word condition does not improve children’s performance in the metalinguistic task but speaking a language that highlights these differences does improve performance at a later point in the process. One possible interpretation of this pattern of results is that having the distinctions marked in the language initially makes it more difficult for children to reflect on the language

forms but ultimately increases children's awareness of the distinctions at a metalinguistic level.

Secondly, although there is not a significant difference between language groups concerning their performance on the novel word task (when age groups are combined), Brazilian children are performing significantly better than U.S. children on the "think" trials at age 5.

This pattern of results is unexpected because the prediction was that Brazilians would have an advantage on both types of trials. One possibility is that the development of an understanding of *pensar* and *achar* (i.e., *think*) comes earlier for Brazilian speakers than an understanding of *saber* and *conhecer* (i.e., "know"). It seems unlikely, however, that 5- and 6-year-olds in Brazil would not have an understanding of the uses of *saber* and *conhecer*.

One could argue that there was something specific about the "know" trials that was posing difficulties for Brazilian children. Perhaps the question "Do you *mek* (or *zop*) that elephants say hello by touching their trunks?" was too long and that increased the level of children's distraction from the task. That also seems unlikely for two reasons: the scene was played at least twice and the question was repeated at least once. If the child did show any sign of distraction or confusion, the experimenter rephrased the sentence or played the scene as many times as necessary; secondly, if there was something specific about this particular trial, U.S. children would also find difficulties with it because the complexity of the

sentence was comparable across English and Brazilian Portuguese but that was not the case.

Another possibility is that there is something more elaborate or complicated in the semantic scope of the two *know* verbs: *saber* and *conhecer* than the two *think* verbs, *pensar* and *achar*. It is true that they are not exclusively used in the contexts of "knowing a fact" and "knowing a person." Moreover, both sometimes can be used in the same sentence frame despite conveying different senses. For example, one can say in Portuguese, "Eu conheço essa música" ("I know this song") as referring to a recognition that "I have heard this song before." One can also say "Eu sei essa música" (same sentence frame) but the sense is now slightly different: knowing the lyrics or knowing how to sing it. On the other hand, there are certain contexts in which only one choice is appropriate. For instance, one can never say in Portuguese "Eu sei a Melissa" to express "having acquaintance with Melissa"; the appropriate word choice would always be "Eu conheço a Melissa." Conversely, one can never say "Eu conheço Matemática" as referring to "having the knowledge of mathematical concepts"; the correct choice would be "Eu sei Matemática."

Therefore, the task Brazilian children are faced with when trying to identify the different senses and uses of *know* is more complicated than one would expect at first. Not only do they have to identify which word goes with each sense of *know* but they also have to discover that under certain circumstances, both

verbs can be used in the same sentence frame (and nonetheless can produce two different meanings) whereas under other circumstances, only one verb and only one meaning are allowed.

The case of *think* is slightly different. *Pensar* and *achar* can be used interchangeably, sometimes producing the same meaning. For example, "Eu penso que essa idéia é boa" or "Eu acho que essa idéia é boa" can both be used to express "I think this is a good idea." The difference is that the first option is considered more formal and rarely found in colloquial speech, especially in speech directed to children. Therefore, *achar* and *pensar* can be used to express "having an opinion" or to indicate a lesser degree of certainty but "achar" is much more frequently chosen to express these senses of *think* than pensar.

On the other hand, when one wants to refer to the process of thinking as in "What are you thinking right now?" pensar is the only correct word choice – "O que você está pensando agora?" It is possible that the boundaries between these different senses of "think" are more clearly defined at least in speech directed to children than the boundaries between the different senses of *know*. *Achar* generally is used to indicate a lesser degree of certainty or to indicate an opinion and *pensar* is used to refer to the process of thinking (Ferreira, 1986; Fernandez, 1965; Ganho & McGovern, 2004; Prista, 1966).

If Brazilian children's lower scores in the "know" trials are a result of a more complicated semantic domain, one would expect that their errors would

convey a confusion between the appropriate uses of *saber* and *conhecer*. A closer look at children's responses do not reveal such errors, however. The type of errors made were one of two kinds: (a) children could not provide an answer to the question; (b) they provided a word that sounded like the novel word but that was unrelated to the intended meaning (e.g., one U.S. child said Jonas was trying to say "make" in the sentence containing the novel word "mek"). The first type of error was more frequent than the second type.

Not one single child, however, used *saber* when *conhecer* should have been used or vice-versa. The only exception perhaps was in the scenario in which Jonas says "I don't zop this boy. Who is he?" A few Brazilian children said he was trying to say "Eu não *sei* quem ele é" (I don't know who he is) instead of "Eu não *conheço* esse menino" (I don't know this boy). But in this case, children were using *saber* appropriately. It is a correct and acceptable sentence in Portuguese conveying a similar but distinct meaning. Future research should investigate whether there is a different time frame for the development of an understanding of *saber* and *conhecer* among Portuguese speaking children and if so, the underlying reasons for such a difference.

As can be seen, the results of Study 2 do not point to an overall effect of language on children's performance in the task of identifying different senses of *think* and *know*. It may be that performance in the novel word task did not tend to differ between languages because the two senses of *think* and *know* that were

tested are represented conceptually by U.S. children even if they are not marked in the language. In other words, U.S. children display an understanding of the subtle distinctions between *saber* and *conhecer* and between *pensar* and *achar* in spite of not having linguistic labels for themOn the other hand, having this distinction marked in Portuguese seems to help 5- and 6-year-old Brazilian children in being consciously aware of the differences between *saber* and *conhecer* and *achar* and *pensar*. Although the prediction that Brazilian children would perform better overall in the novel word task was not supported, these results point to some interesting effects of language.

Although the findings from Study 2 point to interesting similarities and differences between speakers of Brazilian Portuguese and speakers of English in their developing understanding of *think* and *know*, it remains unclear whether participants in Study 2 were being asked to make distinctions between different meanings of *think* and *know* or between different senses of these words. According to Vygotsky (1962),

> Meaning is only one of the zones of sense, the most stable and precise zone. A word acquires its sense from the context in which it appears; in different contexts it changes its sense. Meaning remains stable throughout the changes of sense. The dictionary meaning of a word is no more than a stone in the edifice of sense, no more than a potentiality that finds diversified realization in speech. (p.146)

The difference between meaning and sense is subtle. Vygotsky argues that a given word entails different senses when it is used in different contexts and the meaning of the word is merely one of the most stable and precise "zones" of sense; one that can probably be used across different contexts. Interestingly, U.S. children were able to make a distinction between *saber* and *conhecer* and between *pensar* and *achar* in spite of English not having linguistic labels for them. One could raise the possibility that making a distinction between *think* and *know* involves differentiating between two meanings but the differences between *saber* and *conhecer* and *pensar* and *achar* are actually differences between different senses of *think* and *know*.

Research on children's understanding of mental state terms has gained increasing attention in recent years, especially because of the significant contribution it may provide to the current knowledge on theory of mind development. More cross-linguistic work is needed, however, to test the universality in the development of such an understanding and to test possible effects of language on this cognitive domain. Study 2 contributes to the field by providing the first attempt at investigating closely differences between English- and Portuguese-speaking children and how these differences may affect children's understanding of specific mental state terms.

IV. General Discussion

Children's acquisition of a complete understanding of mental state terms like *think* and *know* is no small achievement. Not only do they have to recognize the possible different senses and uses of these terms but they also have to learn how appropriate each one of these senses is in different contexts. Moreover, languages differ in how the senses of *think* and *know* are marked linguistically; consequently, children may be faced with the task of learning specific terms for particular senses of *think* and *know*.

Results from Study 1 suggest that an explicit knowledge that "know" can be used to indicate "certainty" emerges only at age 4. An increasing ability to recognize different sources of knowledge at this age may lead to a more precise understanding of this sense of *know*. Moreover, the results from Study 1 indicate that 4-year-old children still cannot differentiate *think* from *know* as indicating two different degrees of certainty. This finding is consistent with previous research, which suggests that during the period between 4 and 5 years, children gradually become capable of making this differentiation (Bassano, 1985; Moore et al., 1989).

The period between 5 and 6 years of age reveals some interesting differences across languages. Results from Study 2 suggest that at age 5, Brazilian children perform better than U.S. children in a task during which they have to identify the two senses of *think* (one referring to the process of thinking and

another indicating less certainty). With regard to an understanding of the two senses of *know*, there is no difference in performance between the two language groups at this age. Interestingly, at age 6, for the "know" trials of Study 2, U.S. children outperform Brazilian children.

As discussed previously, one possible explanation for this pattern of results is that the two senses of *know* (*saber* and *conhecer*) present difficulties for BR Portuguese-speaking children as a result of peculiarities in their semantic scope. Conversely, the two senses of "think" seem to be more readily identified by Brazilian children than the two senses of *know*. Consequently, there may be differences in the developmental trajectory towards an understanding of *think* and *know* across languages. A possible future direction would be to conduct an investigation of Brazilian children's spontaneous speech (such as an analysis of CHILDES data) and identify the time frame during which these two senses of *know* and think emerge in their vocabularies.

The prediction that having two words for *think* and two words for *know* represents an advantage for Brazilian children in the novel word task of Study 2 was not supported, as evidenced by the absence of a main effect of language on children's overall performance. However, an effect of language was found on children's performance on the metalinguistic question, with Brazilian children having higher scores than U.S. children. Together, these findings seem to provide an interesting tale of children's developing understanding of the two mental state

terms, *think* and *know*. The initial task children are faced with is trying to identify all the possible senses of these two words. *Know* can be used to indicate certainty but it can also be used to indicate "being acquainted with someone" and "knowing a fact." *Think*, on the other hand, can be used to indicate uncertainty, a mental process as in "I'm thinking about chocolate" and finally, to express an opinion. Children also learn when and how to use them appropriately. Having more than one word for these different senses of *think* and these different senses of *know* does not help children in this initial task and may even make it more difficult; however, it helps them, at a later point in the developmental process, to be consciously aware of the differences among them.

Finally, one important question concerning these findings needs to be answered: did Study 2 provide a test of the role of language on cognition? It certainly did not provide a test of linguistic influences on non-linguistic cognition because of the nature of the tasks used in this study. However, these findings may lend support to Slobin's "thinking for speaking" hypothesis (2003) which states that effects of language may be found on cognition devoted to linguistic processes (or when there is a need for linguistic expression). The initial test question used in Study 2 required children to reflect on the meaning of a novel word: "What is Jonas really trying to say?" In order to provide an answer to this question, children had to be attentive to the linguistic context, the sentence frame, and the information provided in the video about Jonas' referential intent (e.g., Jonas is

trying to draw a picture for his grandmother but he has no ideas). Additionally, they were asked a metalinguistic question concerning a potential difference in meaning between two novel words. The task children are faced with in Study 2 is clearly one that demands "thinking for speaking," that is, one that demands cognition that is devoted to linguistic purposes (i.e., interpreting a verbal message). Interestingly, a clear effect of language was found on children's performance in the metalinguistic task with Brazilian children having higher scores than U.S. children. Having the different senses of *think* and *know* marked in the language ultimately may increase children's awareness of the distinctions at a metalinguistic level. In other words, the effect of language can be seen on children's ability to reflect on the language forms and to consciously identify the conceptual differences between these different senses of *think* and *know*.

In general, the findings of Studies 1 and 2 point to some interesting future directions. One possible direction would be to modify the task used in Study 1 in two important ways:. (a) including a measure that could potentially assess some implicit knowledge of *think* and *know* or reveal some level of uncertainty about children's verbal responses (e.g., examining the number of times participants attempt to look inside the containers) and (b) examining children's performance at age 5 to test whether there continue to be differences in performance between the "more evidence" ("know") and the "less evidence" ("think") trials. It will also be interesting to test whether the developmental pattern revealed in Study 1 is

universal or whether we can find differences across languages, in particular, languages like Portuguese that have different words for different senses of *think* and *know*. With regard to Study 2, it will be informative to examine whether the differences across languages in the metalinguistic question continue to be present at older ages.

V. Conclusion

The two studies discussed here provided an opportunity to investigate the development of mental state terms, specifically *think* and *know*, across a broad age range: from 2 ½ to 6 years. Study 1 examined U.S. children's developing understanding of the distinction between *think* and *know* as indicating two different degrees of certainty. Study 2 was aimed at exploring possible similarities and differences between Brazilian and U.S. children in their understanding of different senses of think and know that are explicitly marked in Brazilian Portuguese but not in English. Therefore, the two studies described here may have contributed important insights to the question of how and when this developmental process occurs and whether one may find differences in this process across languages.

The goal of these two studies, however, was not to examine the development of theory of mind among English- and BR Portuguese-speaking children. The goal was to examine children's developing understanding of "think" and "know" and, in Study 2, to test whether differences in how these two languages mark the different senses of *think* and *know* could have an effect on children's cognition about these mental states.

Although there is consistent evidence that children start using words like *think* and *know* early in life (Bartsch & Wellman, 1995; Shatz et al., 1983), the results of Studies 1 and 2 suggest that the development of an understanding of

think and *know* is a gradual and continuous process that extends at least until the age of 6. Some important achievements occur during the period between ages 4 and 5. For example, children acquire the understanding that one must have sufficient evidence in order to "know" something. Moreover, they are able to identify sources of belief, and make decisions about what can and what cannot be considered sufficient evidence, that is, which of these sources leads to certainty and, therefore, to knowledge.

One could argue that having such an understanding may help children in the process of acquiring a theory of mind. Theory of mind requires the ability to recognize that human beings have mental states, ideas, beliefs and a state of knowledge that may vary from person to person. It is interesting to note that the time frame during which children first display an an ability to apply *know* consistently in situations of high certainty coincides with children's success at false belief tasks (around age 4). Children succeed at false belief tasks if they did not have, at least, an initial understanding of the meaning of *know*, for example? One next step, perhaps, will be to investigate whether these linguistic differences have an effect on theory of mind. Could these cross-linguistic differences between Brazilian-Portuguese and English affect the development of false belief understanding? Such research would provide another opportunity to test the role of language on thought.

Finally, it is important to note that the work presented here is unprecedented. Similar distinctions between the two senses of *think* and the two senses of *know* are marked linguistically in other languages of the world. For example, French has the same distinction between the two senses of *know* (*savoir* and *connaitre*) and a similar distinction between the two senses of *think* (*penser* and *croire*)[8]. The same is also true of Spanish. Although German does not make a distinction between the two senses of *think*, it makes a distinction between the two senses of *know* (*kennen* and *wissen*). Study 2 was the first to explore these linguistic differences and whether they are associated with differences in mental state terms. More cross-linguistic work should be done, however, in an attempt to examine even finer-grained distinctions across languages and to isolate possible cultural confounds. Speakers of Portuguese may have more in common culturally with speakers of Spanish than, for example, speakers of German. As can be seen, the work presented here opens the door for interesting and important cross-linguistic research. Although several questions concerning children's developing understanding of the mind remain unanswered, my hope is that these two studies have contributed to the field by achieving two goals: (a) providing a glimpse of the developmental process by which mental state terms are acquired among speakers of a language other than English and (b) by revealing important

[8] These two senses of *think* can be used interchangeably in some contexts.

directions for future research devoted to children's understanding of the mental world.

Appendix A

SES questionnaire (adapted from "Questionário de Avaliação Sócio-Econômica do Departamento de Serviço Social da Universidade de São Paulo (USP)"

1. How many people are there in your family?

    a. 1 to 2.
    b. 3 to 4.
    c. 5 to 7.
    d. More than 7.

2. What's the father's education level?

    a. College (complete/ incomplete)
    b. High School (complete/ incomplete)
    c. Junior High School (complete/ incomplete)
    d. Elementary School (complete/ incomplete)
    e. Illiterate/ semi-literate

3. What's the mother's education level?

    a. College (complete/ incomplete)
    b. High School (complete/ incomplete)
    c. Junior High School (complete/ incomplete)
    d. Elementary School (complete/ incomplete)
    e. Illiterate/ semi-literate

4. What's the father's profession?

5. What's the mother's profession?

Appendix B

Description of Procedures for each game

Game 1 (Cards)

More evidence trial (seeing)
The experimenter holds two red cards in his/her hands but children cannot see what is on the other side of the cards. The child is told that the experimenter likes cats and dogs. One of the cards is turned around so the child can see there is a picture of a dog on that card. The child is asked: "What is it?"
Test question: Do you know that it's a …. (dog) or do you think that it's a….(dog)?

Less evidence trial (inference based on what experimenter likes)
Children are asked to guess what is behind the second red card (children cannot see what is behind this card). If they cannot provide an answer, the experimenter says: "Remember, I really like cats and dogs."
Test question: Do you know that it's a….(cat) or do you think that it's a ….(cat)?

Game 2 (Boxes)

More evidence trial (seeing)
Experimenter opens a blue box and showsthatthere is a rubber duck inside the blue box. The child is asked: "What is it?"
Test question: Do you think that it's a….(duck) or do you know that it's a ….(duck)?

Less evidence trial (hearing)
Experimenter shows a red box and tells the child that they cannot look inside the red box but he/she will let the child hear what is inside the box. Music comes out of a toy phone (it is not a typical telephone ring). The child is asked: "What is it?"
Test question: Do you think that it's a….(music box) or do you know that it's a ….(music box)?

Game 3 (Bags)

More evidence trial (seeing)
The child is shown a bag with holes all over it and sees there is a toy car inside the bag. The child is asked: "What is it?"
Test question: Do you know that it's a….(car) or do you think that it's a ….(car)?
Less evidence trial (feeling)

Child is shown a solid bag. She is told she cannot look inside the bag but she can put her hand inside the bag and feel what is inside (a beanie bag dog). Child is asked: "What is it?"
Test question: Do you think that it's a….(teddy bear) or do you know that it's a ….(teddy bear)?

Game 4 (Light bulb)
More evidence trial[9] *(seeing how a novel object works)*
Child is shown a lamp and sees the experimenter attaching a light bulb and turning the lamp on. Child is asked: "What is it?"
Test question: Do you know that it's a….(light) or do you think that it's a ….(light)?

Less evidence trial (seeing a novel object and touching it)
Child is shown a light bulb that is painted red and has plastic spikes coming out of it. She can touch the spikes if she wants to. Child is asked: "What is it?"
Test question: Do you know that it's a….(candle) or do you think that it's a ….(candle)?

Game 5 (Gifts)

More evidence trial (seeing)
Child is told that it is someone's birthday today and this person will get two presents. The experimenter hands one of the presents to the child and tells her she can open the present. The child can see there is a book inside the gift box. Child is asked: "What is it?"
Test question: Do you think that it's a….(book) or do you know that it's a ….(book)?

Less evidence trial (hearing/feeling)
Child is told she cannot open the second gift but she is allowed to shake the box. Child is asked about what is inside the box.
Test question: Do you think that it's a….(doll) or do you know that it's a ….(doll)?

[9] This trial always comes after the less evidence trial for this game.

Appendix C

Script

Experimenter: I want you to meet my friends, Jonas and Paul. (SHOW VIDEO of JONAS & PAUL) They are very friendly and nice. But Jonas comes from a place far, far away from here. It's a place called Nemes. And they don't speak English in Nemes. They speak a language called Nemesian. Do you want to hear him speak Nemesian? (SHOW JONAS SPEAKING NEMESIAN)

Comprehension questions:

1. So, tell me. Where is Jonas from again?

2. Do they speak English in Nemes? (No, they speak Nemesian)

Good job!

Now, Jonas is learning English and he can speak English very well, but sometimes he gets mixed up and uses words in Nemesian. So I want to show you some videos with Jonas and ask your help to try to figure out what Jonas is really trying to say when he uses these words in Nemesian, okay?

Warm-up Task

(Jonas' friend, Paul, is jumping up and down.)

Jonas: Hi Paul. You're "doofing." That looks like fun. I want to "doof" too.

Paul: Yes. That sounds like fun!

Comprehension question: What is Paul doing? ("jumping")

Now, let's pay attention again to what Jonas is saying.

(Play it again!)

Experimenter*: Jonas said he's doofing. What is he really trying to say?*

Note: If the child says "I don't know," you should ask him "Is he trying to say he's jumping or is he trying to say he's walking?

Story 1

Experimenter: Now, let's look at another conversation between Jonas and Paul.

(Jonas is looking at a piece of paper and he has a crayon on his hand. His friend Paul arrives.)

Paul: Hey Jonas, what are you doing?

Jonas: I want to draw a picture for my grandma. She lives in Nemes.

Paul: But you haven't done anything. What are you waiting for?

Jonas: I have no ideas. (Looking as if concentrating and with a pen pointed to his forehead). I'm just "pogging" right now. I'll decide later.

Comprehension questions: What is Jonas going to do? Who is he doing this for? But Paul says "You haven't done anything. What are you waiting for?" Let's see the video again and let's pay attention to what Jonas says, okay?

(Play it again!)

Experimenter: Jonas said he's pogging right now. What is he really trying to say? Good job!

Note: If the child says "I don't know," you should ask him "Is he trying to say he's thinking right now or is he trying to say he's sitting right now?

Now, let's look at another story with them…

Story 2

(Paul brings back a picture of a flower to show Jonas.)

Paul: Hey, Jonas, look!! I drew a picture. Do you want to see it?

Jonas: Sure, Paul. Oh, it's a flower!!

Paul: Yes, it's a flower. It's my favorite kind of flower. What is it?

Jonas: I "veeb" it's a rose but I'm not sure.

Paul: You're right. It is a rose!!

Comprehension question: What did Paul have in his hands? What is it a picture of? ("a flower")

Yes, and Paul says "Yes, it's a flower. It's my favorite kind of flower. What is it?" So let's pay attention to what Jonas syas.

Experimenter: Jonas is saying "I veeb it's a rose." What is he trying to say?

Note: If the child says "I don't know," you should ask him "Is he trying to say he sees it's a rose or is he trying to say he thinks it's a rose?

Question after "think" stories

Experimenter: What's the nemesian word he just used? (veeb) Do you remember the Nemesian word he used in the first story? (pog) Do these words mean different things? What's the difference?

Story 3

(Paul's cousin Mark is visiting him this week. Jonas comes to see Paul and finds him playing with Mark.)

Paul: Hi, Jonas.

Jonas: Hi, Paul. I don't "zop" this boy. Who is he?

Paul: This is my cousin, Mark. We're playing together.

Jonas: Hi, Mark. How are you?

Comprehension questions: Who is Paul playing with? Who is that coming in? Now let's pay attention to what Jonas says!

(Play it again!)

Experimenter: Jonas said: "I don't *zop* this boy. Who is he?" What is Jonas trying to say?

Note: If the child says "I don't know," you should ask him "Is he trying to say he doesn't know this boy or is he trying to say he doesn't like this boy?

Story 4

Jonas is reading a book. Paul shows up and says:

Paul: Hi, Jonas. What are you doing?

Jonas: I'm reading a book about elephants.

Jonas: It's neat. Do you *mek* that elephants say hello by touching their trunks?

Paul: That's interesting!

Comprehension question: What is Jonas doing? (reading a book) What is the book about? (elephants) Now, let's see the video again and pay attention to what Jonas says next.

Experimenter: Jonas asked Paul: do you *mek* that elephants say "hello" by touching their trunks? What is he really trying to say?

Note: If the child says "I don't know," you should ask him "Is he trying to say: do you pretend elephants say hello by touching their trunks or is he trying to say: do you know that elephants say hello by touching their trunks?

Question after "know" stories

What's the nemesian word he just used? (mek) Do you remember the Nemesian word he used in the first story? (zop) Do these words mean different things? What's the difference?

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Vita

Debora Hollanda Souza was born in Juiz de Fora, Brazil on July 12th, 1971, the daughter of Décio de Rezende Souza and Elizabeth de Hollanda Souza. After completing her work at Instituto Zilah Frota, Belo Horizonte, Brazil, in 1987, she entered Universidade Federal de Minas Gerais in Belo Horizonte, Brazil. During the year of 1993, she was a research assistant and received a merit-based scholarship for undergraduate research from CNPq (Conselho Nacional de Desenvolvimento Científico e Tecnológico) of the Ministry for Science and Technology of Brazil. She received the degree of Bachelor of Arts from Universidade Federal de Minas Gerais in July, 1993. In 1994, she continued at Universidade Federal de Minas Gerais, in the Master's program in Social Psychology where she received a scholarship for master's research based on merit from CNPq. At the same university, she was an Assistant Instructor at the Department of Education in 1995 and a lecturer at the Department of Psychology teaching an introductory course to Developmental Psychology in 1996. In May, 1997, Debora received the degree of Master of Arts from Universidade Federal de Minas Gerais. Following the receipt of her M.A. degree, in 1998, Debora was awarded a national award based on merit from CNPq to pursue her doctoral degee in the United States of America. In September, 1998, she started her graduate program in Developmental Psychology at the University of Texas at Austin. In August, 2002, Debora received the degree of Master of Arts from The University

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