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Language and Theory of Mind: What are the Developmental relationships?

Jill de Villiers
Smith College, jdevilli@smith.edu

A Introduction

In this chapter I will try to ground the claim, both theoretically and empirically, that false belief reasoning requires a sophisticated command of syntax. One of the oldest philosophical questions asks whether one can have thinking without language, and if so, what are its limits? In the domain of Theory of Mind this question achieves new significance. Is this, finally, what distinguishes us from the rest of the animal kingdom? Is this what language is good for? And not just words, but syntax?

The first section of the paper grapples with the fundamental issue of the contribution language makes, if any, to the formation of concepts. A tentative distinction will be drawn between concepts that require no language and concepts that are formed with the help of language. In that latter case, the question arises about whether language is strictly necessary, or just helpful in the normal course of development.

The second section of the paper considers phenomena under Theory of Mind, and asks how the categories and distinctions formed there connect to language. A brief review of the theoretical discussions of the connections of language and certain Theory of Mind developments will be undertaken, and then a specific alternative proposal is examined.

The third section is a summary of the empirical data related to the role of language, specifically syntax, in False Belief reasoning. Data are reviewed from the course of development in preschool children, and also from the delayed acquisition seen in deaf children who are learning oral language.

The fourth section of the paper points to some interesting new results in language acquisition, inspired and motivated by the work on theory of mind in child development. In this section, the focus of interest is the changes that become possible in language itself as a function of the child's ability to take on different speaker perspectives.

Finally, the implications of this framework for children with autism are discussed.

A Can language assist concepts at all?

The standard account of the relationships of concepts to language contends that concepts necessarily provide the foundation for linguistic meanings. We can form infinitely many concepts, and each language chooses a few tens of thousands of those to attach labels to. That is, language maps onto some non-linguistic concepts. How could it be otherwise? Fodor, beginning with his Language of Thought (1975), has argued cogently that we must possess a rich, symbolic and propositional representational medium for our thought, nothing less elaborate than a language of thought, and this we share with non-human animals, infants and other language-less beings, who need it in order to think at all. Furthermore, all the concepts within our language of thought must be innate, or made up by recombination of primitive and innate components. Concepts, according to Fodor, cannot be acquired by experience. In the face of this absolute framework, it is tempting to rattle the bars.

The theoretical point of this chapter is to argue that the acquisition of a natural language is foundational for the concept of false beliefs. To show why this is the case, it becomes necessary first to contrast other areas in which language and concepts might interrelate. Table 1 is a rough outline of a continuum of relationships between conceptual and linguistic development. As we shall see, the case of false beliefs is at one end of the continuum, and for good reason. Nelson (1991) makes a related case for proposing different levels of influence of language on cognition in considering the acquisition of time concepts.

Table 1 here

Fodor (1975) argued that the idea of language preceding concepts is conceptually incoherent. How could you possibly learn the word for something if you didn't have a way of forming the concept first? But one can have the capacity to discriminate among an infinite number of pairs, one taken from set A and one taken from set B, such that it is always the case that any A can be distinguished from any B. Thus, the ability to distinguish on the basis of the fundamental difference between A's and B's can be present. But the ability to discriminate is not necessarily the same as the ability to conceptualize A-ness versus B-ness. Even if A and B always differ, that does not necessarily mean that all A's <u>cohere</u> compared to all B's. That latter is what is meant by concepts: classing stimuli together by some dimension, not telling stimuli apart along that dimension. This difference can be illustrated by considering the following pairs: can you tell the difference between:

a jigsaw puzzle piece in its puzzle (A) and a frog in a tank (B).
a topped fountain pen (A) and a chocolate in a box (B).
a cassette in its case (A) and a mop in a bucket (B).
a telephone in its handset (A) and a man in a phone booth (B).

The task is a trivial one - there is no doubt you can respond differently to each. But now suppose I tell you that list A have something in common and list B have something in common. It isn't so obvious that you would naturally see the coherence, the commonality, among the instances of A and B that you have so willingly discriminated. In fact, the difference is that list A all involve the "tight fit" of pieces to wholes, whereas list B involves "loose fit". Once I give you the words, you can generate a thousand more examples. Do the words in fact matter, or could I simply reward you for always picking from list A until you get it right? In this case, no-one has tried the experiment, but the reinforcement procedure might work: you might be able to make the A-ness versus B-ness functional by this artificial means. The point here is to illustrate simply that making a reliable discrimination does not necessarily entail classification on the basis of that detectable difference. Let us agree with Fodor that differentiation of any A from any B on some basis is prerequisite for forming a concept, and must, logically, be language-independent. The real question is, is perceiving the <u>coherence</u> of A versus B always necessarily prior to language, or can language ever direct this classification?

Consider the evidence first on the acquisition of basic-level concepts in infancy. Surely in this case, one could argue for acquisition of the concepts prior to language for them, because basic object level kinds have behavioral as well as perceptual equivalence (Rosch & Mervis, 1975). Furthermore, research suggests laboratory pigeons have some ability to form perceptual equivalence classes of basic-object level natural kinds (Herrnstein, 1984). Some perceptual classification of such categories as dog, cat, horse has been observed with 3 to 6 month old human infants in habituation paradigms that consider looking time (Eimas & Quinn, 1994). However, Mandler & Donohough (1993) argue that detecting perceptual similarity alone does not prove conceptual classification. Mandler and McDonough (1993) found very poor ability to categorize at the basic object level among older infants of seven to eleven months. The difference is that Mandler & Donough studied how the babies picked up and handled toy objects, and compared their examination times in a habituation /dishabituation paradigm. For example, the babies might be handed a series of little animals and then an airplane, or a series of toy dogs and then a toy cat. Mandler and McDonough concluded that although babies probably “saw” the perceptual differences among say, cats and dogs, the differences were not important enough to cause them to handle them differently. Instead, Mandler and McDonough found evidence of “superordinate” classification - a differential treatment of animate versus inanimate things. Although one must question whether toy exemplars constitute an adequate basis for judging categorization in infants, the suggestion is that basic object level categories even of natural kinds may only be established at the perceptual level at the end of the first year of life. But much work remains to be done.

Next consider action categories, that slippery set of concepts encoding event structure, captured in our verb system. Simplifying enormously from the real state of affairs, consider behaviorally distinct actions such as jumping and running. To give evidence of coherence of either conceptual class, we require the infant to make some common response to all acts of jumping, regardless of actor, situation, motive, and so forth. Again, it seems unlikely that any natural contingency exists that would encourage the formation of such a similarity class, even though we may have no doubt that the infant could discriminate any particular act of jumping from any particular act of running. Why do adults detect any similarity? Language again has provided the common behavioral response, verbs have solidified the discriminable dimension into a symbol for a class of events. The philosopher Davidson (1995) has argued that because of our linguistic habits, we are prone to overlook the fundamental different between events which are particular, (e.g. a specific occasion of a man sitting down) and types, which are only present given language (e.g. the concept of sitting as an action). Is that empirically true? We should ask if there is there any event class, like basic object level categories for objects, towards which the infant might make a common response prior to labeling. Some possible candidates are feeding, reaching, pointing, sleeping, smiling, and crying. These classes have behavioral coherence as gestures, or as signals, and may indeed get organized prior to labels on that basis. Interestingly, they are also part of the infant’s own repertoire, and imitation might provide the foundation for the classification.

It is an empirical question of considerable importance to discover whether certain basic object level classes (natural kinds, primarily) are given to human infants, as well as certain behavioral classes, perhaps intentional acts that babies can mimic - the equivalent of “natural kinds” in action. On the basis of current literature and speculation, it is a reasonable guess that certain special categories exist prior to language.

But for which other categories can we find evidence for common responses prior to language, in the natural world of the child? For example, take a superordinate, such as fruit: is there any common response the baby makes to that class that they do not make to competing classes, like vegetable? Rosch found it unlikely that adults had common responses beyond the basic object level, so babies probably do not behave in distinctive ways to the class either, until labels arrive. It is labels that provide the behavioral signal that there is something to class: language invites the baby to form a category in the case of a superordinate. Indeed, the literature provides little evidence for superordinate classification in the first year of life, prior to labels. Mandler & McDonough (1996) find behavioral separation of vehicles and animals in a toy-based imitation task by 14 months of age, but neverthless argue that the term “global” is more appropriate than superordinate, since their subjects do not show behavioral evidence of hierarchical sub-class relationships under the global category (Mandler, Bauer & McDonough ,1991)

What of properties, such as color? There is ample evidence that infants perceive colors and can respond to them differentially in laboratory experiments, just as many species can be trained to do (Bornstein, 1985). In real life, colors are attached to objects, and it is possible that there are no natural contingencies that reward the infant for responding one way to all red things, and another way to all green things. That is, no natural contingencies except one - the use of labels. Labels provide an invitation to divide the world in a different way: not by thing-hood, but by property. It is not clear outside of the laboratory that any other invitation arises to so do.

Consider also spatial relations. Investigation of the myriad ways in which language of the world divide up and classify the space around us has provided a major challenge to writers who consider all concepts exist in full fledged coherence prior to labeling. So, for instance, even apparently widely shared notions like containment (in) and support (on) are quite distinctly marked in closely related languages such as Dutch, English and German (Bowerman, 1996). The evidence belies the claim that infants first form the concept then map a label onto it, because the labels map different classes, each of which feels "natural" to a member of that language community. Casting a wider net from European languages, Korean provides evidence that containment and support are not necessarily the most obvious basis for organizing spatial relations: Korean organizes space by the type of connection: by loose and tight fit (Bowerman ,1996). We are obviously capable of responding to that difference (remember the example above) but we don't use it to form a coherence class until pushed, by examples organized to test us, like the one above, or by learning a label. Nothing in our ordinary, non-Korean-speaking environment causes us to form that class.

In sum so far: certain basic object level categories of object, and certain significant human actions, are likely to form coherence classes based on behavioral equivalence witnessed and enacted by human infants. These form the stock of concepts prior to any labeling at all, and are quite likely shared with other species, at least relative to their own species' needs. There is a further level of classification: superordinate object classes, properties, actions, event sequences, spatial relationships, that infants can undoubtedly discriminate, and that under appropriate experimental presentation could form coherence classes, but for which the natural environment provides nothing by way of invitation. Nothing, that is, except labeling. Labeling is usually the mechanism by which the coherence classes get formed, though it is not necessary that language be the mechanism.

Let us take the argument a step further. Is there any concept for which language is NECESSARILY the mechanism? Premack (1979) argued yes: second order categories such as SAME or DIFFERENT rely on symbolic mediation for their formation, and are hence out of reach of symbol-less species. In fact, he argued that his chimps who acquired a symbol system (admittedly well short of a true language) were capable of forming these categories but chimpanzees who had not acquired symbols could not be trained to do so. A brief discursion on the categories is necessary to explain why they might extend the demands of behavioral response.

The most trivial case of responding to "same" is the classic match to sample procedure: the subject is given a sample, say a blue patch, and then a pair of patches, one blue and one red, and must find the "match" to the original sample. Once the procedure is established, the dimensions of similarity can be switched continually, and the subject just has to match to the sample e.g. a square versus a triangle with color constant, or plastic versus wood with color and shape constant...Isn't this all there is to demonstrating that the subject knows the concept "same"? Premack says no: it is at the level of discriminating, or detecting the dimension, but not forming a coherence class equivalent to seeing what the match to sample trials have in common. To do that, Premack argues, we need to probe with a further challenge. Having been trained on match to sample procedures, can the subject perceive the second-order relationship of same versus different? For example, can the subject answer the following type of question, namely which of the pair following it is more like the first stimulus?

AA

AB BB

That is, can the subject see that the relationship of the two A's is one of <u>sameness</u>, which is what is also the relationship is between the two B's? A response based just on resemblance, or overlapping attributes, would probably select AB as the nearest, though imperfect, match. To select BB requires seeing the second order relationship of sameness that AA and BB have in common. Premack argues that this requires a symbolic code, such as language, "a second order judgment - a judgment about the relation between relations- can only be made on items that are represented in the abstract code" (p.128)

What other second order relations might there be? Negation is one such case, i.e. NOT-A is hard to conceptualize without a symbol for NOT. As Fodor (1983) put it, try to form a picture of a man NOT scratching his nose, or a person not smoking a pipe. These pictures can only be recognized as such in connection with the symbol, they cannot stand alone. Other candidate second order relations might be "MORE THAN", "BIGGER THAN", "TO THE LEFT OF", "CAUSE" and the like (Spelke, 1998), but the question is an empirical one. Premack argued that second order relations require symbolic mediation: if proven true, this would be a powerful case for language not just being the usual form of invitation to form a category, but the only way.

The final case to consider brings us (finally) closer to the heart of the matter of concern for this chapter. The last case suggests that language is powerful because it can symbolize a class. This symbolic function provides the anchor around which similarities coalesce, and then this coalition of diverse stimuli can function economically within the reasoning system, united by the symbol. Even Fodor conceded in "Language of Thought" that language could serve this economical, mnemonic-type function for concepts, though he denied that concepts depended on language in any essential way, arguing as we have noted, that the only coherent position was that all concepts pre-date language.

But language does more than provide symbols. Natural languages also have rich syntax, grammatical devices that permit the construction of propositions, and those propositions can encode relationships that stretch beyond word meanings. Sentences extend the meaning-making to allow the differentiation and coalescence of concepts to an infinite degree: we have the component parts, and sentences allow us to play with these infinitely. We are not restricted to things we might have seen, so we can invent concepts as playful as five-legged pink frogs, or as profoundly unlikely as a universe the size of an orange. Language opens up possible worlds and holds them up for our imagination. But this function too, does not necessitate language: art can do the same thing. Whether art can do the same thing in the absence of language, is an important but unanswered question. Are mute artistic savants inevitably realists in their art?

The combinatorial potential of natural language is not, however, restricted to simple propositions. A certain class of linguistic constructions known as complements are embedded under main verbs of communication and mental state, allowing one proposition to be embedded within another, recursively:

The girl said she saw a pink frog
The girl thought she saw a pink frog

For such a sentence to be true, it is immaterial whether or not the girl saw a pink frog. In other words, the embedded proposition (she saw a pink frog) might be true or false without affecting the truth value of the whole. This class of sentence is somewhat unique, because in the usual case the falseness of part of a sentence renders the whole false (de Villiers, 1998). Consider the contrast among the following sentences, each of which has underlined a false proposition:

The girl laughed and saw a pink frog
The girl laughed before she saw a pink frog
When the girl laughed she saw a pink frog
The girl who saw a pink frog laughed

The falsity of the embedded proposition renders each of these whole sentences false, unlike the case of the complement. It is true that logical operators such as or, if ,then can and metalinguistic forms such as it is not the case that also have the requisite property, but they do not open worlds that are true in someone else's mind. It is the critical conjunction of word referring to mental state, together with the syntactic/semantic structure of a complement, that makes possible reference to false beliefs. The special embedded property of the complement under the verb also makes possible certain syntactic operations such as long-distance wh-movement, in which a wh-question refers to the lower verb. In a sentence such as:

Where did the girl think the train was going?

it is clear that the wh-question can connect to the verb going, but in a question such as:

Where did the girl sit when the train came?

the question has to refer to the place of sitting, not the train's movements. The complement is embedded under the verb and therefore in the right syntactic relationship for many syntactic and semantic operations that are blocked in other forms that are merely adjoined to a verb. Notice that this very property makes possible a distinction between things in the world and things that are thought, or talked about:

What did the girl say she caught?

Here the question explicitly asks for a distinction between what happened in reality and what someone said happened. To answer the question correctly means integrating the information across two verbs: not answering what was caught, but answering what the girl said was caught.

The complement structure invites us to enter a different world, the world of the girl's mind, and suspend our usual procedures of checking truth as we know it. In this way, language captures the contents of minds, and the relativity of beliefs and knowledge states. These sentence forms also invite us to entertain the possible worlds of other minds, by a means that is unavailable without embedded propositions. Pictures cannot capture negation, nor falsity, nor the embeddedness of beliefs-that-are-false, unless we have a propositional translation alongside. So this special property of natural languages allows the representation of a class of events- the contents of others' minds - that cannot be captured except via a system as complex as natural language.

Does that mean we can only think about false beliefs in natural language? Fodor argues that we must have a language of thought as representationally rich, and propositional and symbolic, as natural language, but distinct from it. How else, he argues, could infants and animals think? However, something must activate the diverse and very indirectly visible class of events that requires us to posit contents of other minds. Surely only natural language provides the invitation to form such a class, first via the verb labels for the events "think", "know", believe", forgot", then most importantly, for the structures that uniquely allow the representation of false propositions under those verbs.

Thus only the syntax of natural languages normally provides the anchor around which the concept of the propositional contents of other minds can coalesce, and that is not just the normal case, but the necessary case, given the properties the representational medium must have. This reasoning does not require that natural language <u>eventually</u> be the medium in which such ideas are represented, but it must be the medium that invites the formation of a coherence class (de Villiers & de Villiers, in press). Lacking access to that, infants and animals might in fact <u>not</u> think about other's false beliefs.

A Theories of Language and Theory of Mind

Other researchers and writers have argued about the connection between language of the mind and theory of mind, without making this exact connection between complement structures and the potential for an increase in representational power. In part that is because the various theories carry with them other ontological commitments concerning the nature of language, the nature of mind, and the role of the environment in shaping each. It can be argued that accounts of the relationship between language and thinking in the development of a mature theory of mind lie on a continuum between quite diverse philosophical viewpoints. In what follows I discuss the extreme versions each in turn, and try to spell out their implications and associated traditions. Then I suggest that compromise is possible between the extremes, and that more work needs to bring these very different traditions together to provide a convincing and coherent picture.

B Learning the discourse about mind

At one end of the continuum lies a tradition in which language is regarded as a part of the nexus of social communication skills that the child encounters as part of a particular society. In the spirit of (later) Wittgenstein, language is regarded as a game one learns to play in a shared network of communicators. On this view, talk about the mind is situated within a particular cultural framework, and the culture determines how appropriate it is to talk about desires, or feelings, or mental life in general. Growing up in a particular culture the child absorbs the folk philosophy of mind typical of that culture, and learns how to discuss behavior in this light. In our Western mainstream culture, we have a folk psychology/philosophy of mind that contends that behavior is guided by desires and beliefs, and that is the way we discuss motivations, reasons and so forth. The child absorbs that way of talking from the important people in his or her life, and learns the discourse of the culture. Accordingly, it is contended that there are cultures in which such talk is frowned upon, that it is not considered appropriate or necessary to invoke mental states or desires as explanatory devices for human behavior or anything else, and a child growing up in such a culture will not acquire such terminology.

Let us explore the implications and ramifications potentially, if not inevitably, attendant on such a position.

1) There is a belief in cultural diversity along the dimension of explanation of human behavior, for example in certain cultures such as Japan it is impolite to refer to other's states of mind. Sellars (1963) imagined a state of prehistory in which humans were restricted to a language that bore no marks of the mental - "Rylean" ancestors, after the philosopher Ryle (1949). But according to cultural relativists, our ancestors may be alive and living elsewhere.

2) The child in acquiring the appropriate talk about the mind is learning a form of discourse, a genre of discussion that helps him fit into the culture, but is not advancing along a developmental progression that takes him from an immature to a mature theory of mind, in any absolute, culturally independent sense. It could be argued that those of us who believe that Western four year olds have a more satisfactory theory than three year olds are just blinded by our cultural ethnocentrism.

3) Western folk psychology refers to hidden propositional attitudes- beliefs, desires, intentions - that are theoretical fictions, useful as explananda, rather than real causes of behavior. The child is not on this view getting better at inferences about these real but hidden causes, but learning to engage in the correct cultural discourse. Whorf (1956) may have been right about linguistic relativism, but on this view, talk is all there is.

Not all of these implications are drawn by the authors who associated with this tradition. Most of the writers concerned with the social discourse view of language have in fact taken English and Western cultural traditions as their domain of investigation, with a few exceptions. So for example, the work of Dunn (Dunn et al, 1991) and her collaborators can be seen within this tradition, and she has provided elegant demonstrations of how the individual cultural style within families can have effects on the development of the child's understanding of the world (see also Astington and Jenkins, 1995; Shatz ,1994). These authors do not fully accept the cultural relativist view, because they argue that learning to talk in this way, absorbing the cultural discourse about the mind, enhances the child's theory of the mind, and that more sophisticated theory allows him better prediction and control. The implicit assumption is that the child is developing the "right" theory partially by means of this talk.

B Propositional attitudes

Consider the other extreme on the continuum, stemming from the view that language is primarily a specialized cognitive module of the human mind (Fodor, 1983b) . Writers in this tradition stress that acquiring the language for the mind involves learning the terms that refer to mental contents, and the special structures that are involved with the verbs that refer to mental state. They emphasize that it is these concepts that the child must grasp before the words and structures can map onto them. Of course there are many competing accounts of how the concepts themselves are acquired, but the general assumption is that to understand human behavior universally requires positing hidden states of emotion, desire and belief, and using these propositional attitudes to figure out why and how people behave the way they do. On the simulation theory account (Harris, 1996), there is no need to posit representations of these attitudes in the child's head, just a means by which the child can imagine himself in that situation and simulate how he would feel or think or act . On the representationalist view, this has to be mediated by some explicit representation of the propositional attitudes, most likely in a "language of thought" that has the same structural and semantic power as any natural language. The debates concern whether that representational system is innate (Fodor, 1992), maturing (Leslie, 1994) or acquired (Perner, 1991). The associated implications are as follows:

1) There is a strong belief in cultural universality: everybody needs the kind of theory of mind that Western cognitive scientists have deemed adequate, and everybody naturally gets one, since either the data for forming such a theory are universal, as are children's capacities, or the theory comes as an innate part of the human mind (Fodor,1992). In addition, some argue that all languages have terms referring to the mind (Wierzbicka, cited in Bartsch & Wellman, 1995), and that mental state verbs have special properties that are universal (Gleitman, 1990). There is no room for Whorfian relativism on this point of view.

2) Talk about the mind reflects the child's development, rather than enhancing it or advancing the theories about it. The conceptual understanding is paramount, and if the human mind is considered modular, the growth of this module or specialized intelligence does not depend in any significant way on input from different modules such as language acquisition.

3) Propositional attitudes consist of two parts: a proposition, with contents, and an attitude towards that content, held by some subject e.g. (Olson, 1988)

Subject	Attitude	Proposition
I	think(s)	that the cake is in the fridge
He	remember(s)	that the girl has the sticker
	believe(s)	
	hope(s)	
	pretend(s)	

Intentionality theorists contend that propositional attitudes are real, and causally connected to behavior, not fictional or purely theoretical. The child must infer them in other people, and on different accounts uses either behavioral evidence, or self-reflection, or some of both, to succeed at these inferences.

The important work of Bartsch and Wellman (1995) can be seen from this point of view. In their exhaustive tally of the uses of mental language by young English-speaking children, they primarily see their work as uncovering the first natural reflections of the child's developing theory of mind, at an earlier point than standardized tests reveal. Bartsch and Wellman spend considerable time defending the children's early uses as genuine mental state references, rather than just empty uses reflective of cultural discourse. In fact, they argue that the consistent finding of earlier uses of desire terms than belief terms reflects the ontogeny of those concepts, and is not easily explained by invoking the style of discourse that the children heard.

Having pointed out the lines of tension and the different paradigms of approaching the language/thought issue, consider two theorists who have attempted a synthesis of these extremes.

B Attempted Syntheses

Olson (1988) argues, like many others, that the direction of change from infancy to age four years or so moves the child from a behaviorist to an "intentional stance" (Dennett, 1971). In infancy, Olson characterizes the child as engaging in sets of behavioral procedures such as "if A do B", or expectancies, such as "if A then B". In neither case it is necessary to invoke any kind of representational states such as beliefs or desires. However, the child who develops words and sentences must be credited with intentional states, according to Olson. So, "if they ask for x, they desire x, if they say that p, then they think that p". At the final stage of a theory of mind, they "begin to see their utterances as expressions of belief", "to distinguish beliefs from reality". How do they achieve this change? According to Olson, it is by learning the metalanguage of the culture, by learning to talk about the states of mind that have motivated the toddler in actual talk at a much earlier stage. In this way, the intentional states of the child are no longer merely part of the folk psychology of the culture used to explain behavior, they become real: "the child now possesses the structures that can serve as the objects of higher order representations" (p424). According to Olson, although one can infer intentional states in the child as soon as he learns to speak, the child develops a theory based on intentionality as he acquires the metalanguage, and he does that via participating in social discourse.

So Olson represents a compromise point of view as a representationalist who credits the social acquisition of language a providing the child a new metalanguage that allows him to represent the states of mind of other persons, and hence use these metarepresentations in a more developed theory of other minds. Olson thus sees language as causally related to the child's metarepresentations, but falls short of claiming that it must be so, and the precise mechanism remains mysterious.

Karmiloff-Smith (1992), like Olson, attempts a synthesis of a representationalist stance and a Vygostkyan view of language as social speech moved inwards to serve a cognitive function. Karmiloff-Smith borrows heavily from Perner's view that there is a representational change occurring at about age four, though in her own terminology. Perner (1991) was concerned to explain the two-year gap between the competencies that Leslie (1987) argues exist in pretense, and those that show up in false belief. The child seems to have the representational competence- a separation of reality from another possible world - in pretense, long before they demonstrate understanding of belief states. Perner argued that the child at age three can recognize two different propositional contents; one about reality, one about the pretend world, and can map these contents to two protagonists - one real, one imagined. The three year old tries to do the same thing with belief, namely to recognize the mismatch of two propositional contents. But the three year old cannot handle this information within a causal theory about knowledge, that is, cannot predict what it will mean for a person's behavior. But the four year old recognizes not just that the proposition is false, but that the holder of that attitude regards it as true. So the older child acknowledges not just propositional contents, but propositional attitudes. From this arises a representational theory of mind, in other words that people act according to their representations of the situations, not just the situations themselves. Perner considers this change at age 4 years critical in being a new representational stage that incorporates a causal theory of knowledge, not just invoking the same structures of propositional attitudes and propositional contents that pretend play does.

In Karmiloff-Smith's theory, cognitive development proceeds from purely procedural knowledge, to a form of representation she calls implicit knowledge, then to explicit (conscious) knowledge, the most developed form of which is usually verbal. She proposes that the movement to an explicit theory of mind equivalent to Perner's metarepresentational stage is due to a process of "redescription" into different representational formats. She argues that in this one domain at least, the acquisition of the terms themselves for mental states, desires and so forth, may be essential to this redescription process. In particular, she argues that linguistic representations may provide something of a privileged format for encoding propositional attitudes, and when children are not given a linguistic narrative about a complex behavioral event, they may fail to spontaneously generate one (Norris & Millan ,1991, cited in Karmiloff-Smith 1992).

This compromise position places language in a central role not just in exposing the child to the ways in which culture encodes mental events but more essentially, in providing the representational structures that enable the child to reason efficiently about human behavior. However, Olson and Karmiloff-Smith differ in their view of the mechanism by which language changes representations. Karmiloff-Smith argues that growth in false belief understanding reflects the child's increasing capacity for using and generating symbolic representations elaborate enough to overcome "otherwise compelling interpretations generated by direct experience". Because language "scaffolds" this symbolic representation, it is crucial. In her account, 3 year olds fail at standard tasks because their rudimentary symbolic representations are not sufficient to override "experience-based" interpretations.

Karmiloff-Smith's account suggests the relationship of false beliefs and language is at level 3 in Table 1. Language ordinarily, and necessarily, organizes experiences under a symbol that marks an abstract relationship. But above I have argued that "thinks that" is not the same kind of abstract relationship as "same as". The representation of the relation "X thinks p" is an order of magnitude more complex than representing second order relations like "same as" or "not", because it involves the embedding of propositions, and those propositions can be false. The power of language as a code lies not just in its symbolic function but in its syntax. In the next section the existing evidence is reviewed about how the necessary lexicon (symbols) and syntax develop, and how these developments connect to the child's abilities in reading minds.

A Naturalistic evidence on Language and Theory of Mind

The term Theory of Mind encompasses a wide range of phenomena, the culmination of which is generally considered to be the understanding of others' false beliefs (Premack & Woodruff, 1978). Which of these phenomena might be connected to language developments, and in which ways? Reading other's intentions has been discussed as one of the earliest manifestations of theory of mind, that is, following other's eye gaze, and following points, reaches and so forth (Baron-Cohen, 1991; Leslie, 1994). Within the first year of life, infants seem to follow another's intentions by following eyegaze, responding appropriately to points, and handing people objects towards which they are reaching. These achievements may be language-independent, though it is hard to tell in the normal case as rudimentary language acquisition - labeling and social rituals - is proceeding during the same interval. It is now clear that infants by the middle of the second year of life- around 18 months or so- begin using these intentional signals to figure out reference (Baldwin,1991,1993). Several researchers have now documented that toddlers narrow the possible meaning of new words by using signals such as eyegaze. They have also been shown to reject possible meanings when the person gives evidence that their intention was not met, e.g. when the object was not the expected one, or when the intended action backfired (Tomasello & Kruger, 1992). In this early realm of theory of mind development it seems evident that intentionality, perceived nonverbally, assists in the acquisition of early language, particularly reference. It is not completely clear whether language (here: speech) assists in the acquisition of intentionality, but if it does, it is probably facilitative but not necessary. The best guess would be that the relationship of the concept of intentionality to language is level 1 from Table 1.

Sometime in the third year of life, it is claimed that children begin to appreciate the different desires of another individual, and predict what a person will do on the basis of a desire (Wellman & Woolley, 1990) All the two year old really needs is the ability to read intention "on the fly" as another child reaches for a toy or grabs at food. Around the same time, the child's vocabulary begins to include meanings referring to these behavioral tendencies, such as "want", "like", "doesn't like" and so forth (Bartsch & Wellman, 1995). These relatively abstract terms are among the earliest lists of verbs (Dale, 1991). Notice that verbs of desire do not take full tensed propositions as arguments, but rather they take NP's:

I want an apple

or irrealis events or states, that have yet to occur, coded in English by infinitive forms:

I want to go home

I want her to like me

or states true at present or habitually, coded with a gerundive form:

I like Mom tickling me

In no case are the embedded forms "false" ,that is, referring to current states of affairs that conflict with reality.

It seems probable, though not empirically tested, that the linguistic terms facilitate the child's conceptual access to understanding behavior in these terms. That would place desire concepts and terms into a level 2 relationship: language is normally the way that the situations get tied together, but it doesn't have to be. Once language does encode these concepts, however, the child can acquire the information about another individual without having to undertake observation: the child can be told "I want that cup" or "He likes teddybears" and respond appropriately (or not, this being a two year old). So, language could "shortcut" sometimes elaborate inferencing.

Gopnik and Meltzoff (1997) propose that conceptual and semantic development may go hand in hand: at particular periods of development when children are actively engaged in solving specific conceptual problems (such as those to do with a theory of mind), their attention may be drawn to learning words that are relevant to those problems. The advances that we are most interested in occur in the fourth year of life, towards the end of which the child becomes capable of reasoning about the contents of other people's minds on standard and well-controlled tests. Yet it is still in the third year that the child has the first uses of mental terms such as think, and know, and forget. How do we account for the early uses of the mental verbs, before false belief understanding on standard tasks?

First, it is evident that the mental verb uses do not always reflect genuine mental reference (Bartsch & Wellman, 1995). In the beginning, these terms are most often used in what could be stereotyped routines e.g. "I don't know", in answer to a question. However, they begin to appear attached to propositions by at least the end of the third year, such as “I think p”. Bartsch and Wellman code their data very conservatively, yet find convincing evidence that the early use of these verbs has genuine mental reference. The majority of uses are self-referent rather than other-referent, and the vast majority of the mental verbs occur in front of propositions that are true, which raises the question as to whether they are “opinion-markers” rather than genuine references to mental contents. However, the verbs clearly do occur in every child transcript studied by Bartsch and Wellman in occasional sentences that refer to mistakes, and then one can be sure they do mark mental contents separate from reality e.g. “I thought p” where p is false. Some examples of contrastive uses of this sort are as follows:

Abe (2;11): I painted on them (his hands)
Adult: why did you?
Abe: I thought <u>my hands are paper</u>.

It is only on average one month later that the same children start talking about the false contents of others’ minds. Thus the spontaneous speech data, admittedly from a skewed sample of mostly privileged children, suggests that talk about false beliefs that seems genuinely motivated by understanding, comes in around the age of three. This is at least several months in advance of successful performance on standard false belief reasoning tasks found in experimental studies.

Our own work suggests that it is quite difficult for the average young three year old to formulate or understand a sentence that involves reference to another’s false beliefs, when the situation is a controlled experimental one (de Villiers & Pyers, 1997). By the end of the fourth year, children can do so much more reliably. There are two possible explanations for the discrepancy between spontaneous speech prowess and controlled situational testing. Note that in the spontaneous speech samples, the children were in familiar surroundings, with familiar interlocutors, and were free to speak or not as the mood or the competence struck them. In experiments, the interlocutors are relatively unknown, the situations are new, and usually some response is expected. Performance demands alone might create the discrepancy, but it is also probable that there is some meaning, even in the mental arena, to the notion of skill or productive mastery (see Karmiloff-Smith, 1992). That is, doing something once in a while when everything is right and you are in control, is a lot different than summoning the performance successfully every time. So the time discrepancy between consistent performance in controlled production and comprehension of the verbs, and performance on false belief tasks, may not be as drastic as spontaneous speech measures might lead us to believe.

Consider then how the acquisition of mental verbs and their complements might proceed. Very probably, the first mental verb uses are markers of uncertainty:

I think it’s in here

can be rephrased as:

It’s in here, I think.

(Shatz, 1994) and then it is revealed as an adjunct, not a genuine complement, equivalent to:

It’s in here, maybe.

The routinized forms:

I don’t know.
I think so

also enter the child's lexicon as markers of the speaker's uncertainty or stance towards some state of affairs, then develop into more genuine mental verbs as Bartsch and Wellman detail (1995).

It is likely that the earliest forms in production do not represent full productive mastery, that is, they might not be elicited in controlled circumstances in which the experimenter sets the scene. In addition, it is difficult to assess from the forms in production whether they are genuine complements with all the attendant syntactic/semantic properties that are evidenced in complements rather than adjuncts. These are best assessed via comprehension, and evidence from wh-question comprehension would suggest that children are in the process of mastering the complement/adjunct distinction between age three and four years (de Villiers, Roeper & Vainikka, 1990; Roeper & de Villiers, 1994). In particular, children in this age range still evidence difficulty with forms such as:

What did the girl say she bought?

to which they are prone to answer what she actually bought. Notice that this is not a question involving mental states at all, but overt acts of speech, and neither does it require any inferences about hidden mental processes, as the information is given overtly in the story. All the child needs to do is to interpret the structure correctly as a complement in which the question concerns the joint effect of two verbs: both saying and buying. As such, we regard it as a good index of whether the child really has the structure of complements in the grammar (de Villiers, 1998). The evidence of both command of the comprehension and controlled elicitation of complements jointly provide the best assurance of the mastery of the fundamental syntax of complements.

Notice that mastery of the verbs of communication has been a relatively neglected part of the story of "language of the mind" development, because the verbs are not ostensibly about the mind. Nevertheless, I have argued (de Villiers, 1995a,b) that the problem of acquiring the complement structures with mental verbs might be partially solvable by considering the parallels between the behavior of verbs of communication (say, ask, tell) and verbs of mental state(think, believe, guess). Verbs of communication can also be used entirely redundantly:

I say put your clothes on!

but also in discrepant situations where what is said does not match reality:

You said you ate your peas!

where the peas are still much in evidence. Fortunately in the case of "say", there is no inference required about covert states: saying is an overt act, and can be witnessed. So in principle, all of this machinery - that is of a matrix verb, that can take either a true or a false proposition, can be mastered with verbs of communication (or perception). Bartsch and Wellman give evidence that the order of development proceeds in this direction in three of the four children they studied intensively. Then verbs like "think" that refer to covert states of mind, can inherit the identical complement structures. By this process the child can achieve a mastery of the syntax/semantics interface of mental verbs, even before the contexts that require them are really recognized. A rough depiction of the parallels between communication and mental verbs is provided in Table 2, and of the steps to mastery in Table 3.

Table 2 here

Table 3 here

So with the mental verbs learned as referents to "invisible" states, perhaps even self-referential, and the critical complement structures learned by analogy with overt states of communication, the child has now acquired the representational structure for encoding states of false belief.

In de Villiers (1998) I argue that the final step in which the child acquires the representational structure for false complements, there is some formal property of the grammar that gets set (or re-set from a default). Many linguists have argued that factive verbs (know, forget) require some formal feature that reflects that their complements are obligatorily true: I argue that is necessary for the child to set a equivalent feature in the grammar to indicate that the complement of a non-factive communication or mental state verb can be false. The most obvious place to locate such a formal feature in the grammar is in the position called CP, which is where complementizers (*that, for, to, if, what*) are located between clauses. Every sentence and subordinate sentence is headed by a CP, and the CP site carries information relevant to such properties as quantification, questions, focus, topic, and most critically for our analysis, "point of view" - perspectives on time, place and reference (Kratzer, 1997). Acquisition of the formal properties of the CP may begin with the step of appropriately marking the complement of the verb as potentially false, with the other features then gradually accreting.

Linguistic details aside, it is argued that acquisition of the syntax for representing false complements is the step that allows the child to use and generate symbolic representations elaborate enough to overcome "otherwise compelling interpretations generated by direct experience", to borrow from Karmiloff-Smith (1992).

The claim made here can be reconciled with several other accounts of the changes occurring in the preschool years. For example, consider Perner's (1991) account of the stages of false belief development, which is an account in terms of the changing quality of representations. To Perner, the 2-year-old is a "situation theorist" who has no true representation of mental states, but is developing representations of e.g. pictures and drawings. The 3-year-old understands that others have minds but does not have a concept of mental representation. Such a child can form a representation of desired objects or states of affairs, but simply imagines the other person related to them but not representing them. By 4 years old, the child can represent the contents of other minds, a kind of metarepresentation: a concept of representation. Perner's argument that children's early representations are akin to regarding "belief" as equivalent to "thinking of x" rather than "thinking that p" is compatible with the idea that the full complement structure, rather than the incomplete representation of a mental verb as taking an NP argument, is what enables the more sophisticated metarepresentation.

Consider also Fodor's (1992) claim, that the 2-year- old has a full "desire-belief psychology" innately, but lacks the computational ability to resist certain inferences. Basically the child has two hypotheses, with H1 as the default:

H1= predict agent will act in such a way as to satisfy desires
H2 = predict agent would satisfy desires if his beliefs were true

The difference is that the 4-year- old can cancel the desire-based reasoning of H1, and take account of the agent's false belief via H2. The current proposal is not at odds with Fodor's argument that the child is unable to resist the desire/true belief reasoning, but instead of proposing a general change in "computational power", the present theory suggests that the ability to represent false complements linguistically is what boosts the child's computational skill up a notch.

There are also several theories with which the present account is less easily accommodated. Harris (1996), proposing a simulation theory approach to false belief reasoning, argues that the 2-year- old can simulate desire and belief in others on the basis of projection of what he might feel or think in such a situation. Harris predicts that understanding the self is easier than understanding others because the self is just directly experienced then reported, but the feelings or thought of another must be simulated, experienced, and then reported. In achieving this latter understanding, Harris claims that there are two default settings to be overcome: the child's own intentional states and the state of reality. Both can interfere with the output of this simulation process. Within a simulation theory account, it is not at all clear how a change in representational power could affect a greater resistance to default settings, since simulation theory disavows representations.

Bartsch and Wellman, (1995) argued that the linguistic capacity emerges much earlier, at just below age three, and that the change at age four is not in the ability to represent false beliefs so much as to recruit them reliably in the service of explaining human actions. As I have argued, it is not completely clear how long the gap is between successful use of mental verbs with false complements, and the use of such representations in false belief reasoning. There may well be some additional task demands involved in recruitment of the representations in the service of particular tasks, such as explanation, or narrative. But the gap may be less extreme than the spontaneous speech data suggest.

Second, this strong version of linguistic determinism is seriously discrepant with Leslie's maturational theory of false belief development. As we shall see below, the data from deaf children calls the maturational account into serious question, so no resolution of the discrepancy is yet evident. However, the early developmental stages of ToMM proposed by Leslie are not called into question at all by this account.

A Empirical studies of the direction of relationship

B Normally developing children

Several researchers have found that mastery of false belief reasoning tasks is related to measures of language ability, in both normally developing children and children with autism (Happe, 1995; Tager-Flusberg ,1996; Tager-Flusberg & Sullivan, 1994). Astington & Jenkins (1995) found with normally developing children that general false belief understanding assessed by summing across four standard tests of false belief reasoning, was significantly correlated with measures of syntactic and semantic maturity on the Test of Early Language Development (TELD), even when the effects of age were partialled out. The sophisticated use of sentence forms involving mental state verbs and their complements coincides roughly in time with the child's successful performance on standard false belief tasks (Astington & Jenkins, 1995; de Villiers, 1995a; Tager-Flusberg, 1996).

Correlational data of this sort fail to reveal the direction of the relationship between language and theory of mind, so two longitudinal studies have attempted to untangle the relationship between learning the language of the mind and passing false belief tasks, in normally developing preschool children.

Astington and Jenkins (1995) studied two cohorts of nursery school children longitudinally over the course of one year in school, using three standard theory of mind tasks (change in location, unexpected contents and appearance/reality) for a total possible score of 6. In addition, they gave the children a standardized language test, the TELD (Test of Early

Language Development) that assesses broad syntactic and semantic skills in this age range, using both expressive and receptive formats. In addition, Astington and Jenkins took spontaneous speech samples during pretend play for one of their cohorts, and looked specifically at the use of mental state verbs. Unfortunately they did not include any measure of complementation with mental verbs, just the overall use of the verbs and the general measure of vocabulary and syntax development. Their findings suggest a clear developmental relationship with language use predicting theory of mind scores over time: the correlations between time_n language and time_n theory of mind were robust and significant, but the reverse, the predictions from theory of mind at time_n to language at time_{n+1} were not significant and vanishingly small. Analyzing the spontaneous use of mental state verbs, they also reach the conclusion that language is "leading the way", in that the children who were still scoring quite poorly on the standardized tests showed at least occasional use of mental state verbs, and used apparently appropriately e.g.

> "She'll still think I'm a real person and I'm not a real person. I'll be not a real person."

Astington and Jenkins' study cannot settle the question of the relative contribution made by the verbs themselves versus their syntactic structures, nor can it decide the directionality of relationship between language and theory of mind. Is the developmental priority of the linguistic use just a function of the difference in task difficulty between occasional, child-controlled spontaneous use, versus experimenter-controlled tasks that require generation and inference? That is the argument familiar from Bartsch and Wellman's work: the spontaneous language may reflect perfectly good false belief understanding, but sporadically, compared to the mastery required by experimental tasks.

A study with a similar purpose was conducted by de Villiers and Pyers (1997) who also studied a group of children over the course of one year, from an average age of 3;4 years to 4;4 years, that is spanning the usual age of mastery of false belief reasoning. Our goal was to discover the temporal relationships between use of language about the mind, specifically complementation, and the development of false belief reasoning as indexed by three standard false belief tasks. The tasks we used as follows:

a) <u>Unexpected contents task</u> (Perner, Leekam & Wimmer, 1987).

On each round of testing we asked about a different familiar container: a CRAYOLA crayon box, a Playdo container, a Cheerios cereal box, and a small milk carton, and asked both about the child's own prior belief (Gopnik & Astington, 1988):

When you were sitting over there, what did you think was in the box? and their friend's likely belief, for a total of two points [1]:

What would (Sally) think is in the box?

b) <u>Unseen displacement</u> (Wimmer & Perner, 1983).

The child was told a story which is acted out in front of her, and in the story an object is moved without one character's knowledge. The child must then predict where the character will first look for that object. [2] We also asked the question "why will he look there?" and gave a point for a suitable explanation which did not have to use mentalistic vocabulary, so saying "because

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[1] We explicitly marked the child's prior belief with the following question form, "Before, when you were sitting over there, what did you think was in the box?"

[2] As suggested by Siegal and Beattie, 1991, we used the form of the question "where will the boy <u>first</u> look for the cake?"

he put it there" counted as a perfectly adequate answer. Thus this task gave a total of two points.[3]

c) <u>Explaining action</u> (Bartsch & Wellman, 1989)

For the third false belief task a combination of the above two scenarios was used, in which a puppet is deceived. While the puppet is asleep, the child is shown a familiar box, say an egg carton with eggs, and the eggs are removed from the container and hidden in another unmarked box. The puppet is then woken up and the child is told :

"You know what he likes to do when he wakes up? He likes to eat eggs!"

The puppet is then made to manipulate the (empty) egg box and the child is asked, "Why is he looking in there?" and "Why isn't he looking in that (other) box?" Again, mental explanations are not necessary for points on this task: saying, "because they were in there" is coded as a satisfactory explanation.

These three False Belief tasks thus each had a maximum score of two, for a total of 6 each round. The "passing" criterion was set at 5 or 6 out of 6.

In addition, in each of three rounds of testing the 19 children received several tests of language comprehension and elicited production that tapped knowledge of complements with mental and communication verbs, allowing us to develop measures of their complex syntax with and without complements. The comprehension test for complementation was basically trivial in its cognitive demands: could the child hold on to a sentence with a false complement and repeat it as an answer in a story? On each round, children received 12 sets of photographs or drawn pictures of brief stories in which a character was described as making a mistake, telling a lie, or having a false belief. Hence the child had no inferences to make about mental states, as they were provided in the narrative. Half the scenarios involved acts of thinking (verbs *think*, *believe*) and half involving acts of communication (verbs *say* and *tell*). For half of the events, the question asked for a report of the contents of the character's belief/statement, in which a whole sentence or complement+sentence is an appropriate response e.g.:

He thought he found his ring, but it was really a bottle cap.
What did he think?
Ans.: “that he found his ring”
*Ans.: “that it was a bottle cap”

She said she found a monster under her chair, but it was really the neighbor's dog.
What did she say?
Ans.: “she found a monster”
*Ans: “she saw the neighbor’s dog”

For the other half of the questions, the question form required simply a noun rather than the whole propositional content, but the right answer did require integration of the two verbs as discussed earlier:

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[3] It has since been pointed out to us that the scale created by this analysis has some unfortunate properties, since the child can only gain the second point by gaining the first. We have changed the scoring in our subsequent work to count as "passing" only if the child gets both points. However, since we wish to report on the earlier work in de Villiers and Pyers (1997) we have left the coding in place for this report. We checked and found that new coding would not in fact effect the coded status (pass/fail) of any of our subjects, because this is a sum across several tasks.

This girl saw something funny at a tag sale and paid a dollar for it. She thought it was a toy

bird but it was really a funny hat.

What did she think she bought?

Ans.: “a toy bird”

*Ans.: “a funny hat”

Memory for Complements had a total possible score of 12 and the criterion for passing was set at 10 or more out of 12.

The de Villiers and Pyers study also scored on the child’s spontaneous speech about silent videos, computer games, and stories spontaneously told in the sessions, then analyzed them using the IPSYN: Index of productive Syntax (Scarborough, 1990). The IPSYN basically considers the productivity of different syntactic and morphological forms in the transcript. The IPSyn demonstrates good reliability for child language corpora of as few as 50 utterances, and is more discriminating of normal syntactic development between the ages of 24 and 48 months than is mean length of utterance (MLU).

The IPSYN allowed us to develop two subscores of complex syntax, one reflecting the structures that did not involve that-complementation, i.e. the if-then clauses, relative clauses and other complex forms, and one that reflected propositional complementation (that-complements and wh-complements). We created several subtotals such as the total Sentence Structure score (SS), the total complex sentences (total complex IPSyn), the total score for complements (IPSyn comps), and the total complex minus complements (IPSyn complex no comps). These measures were entered into regressions to predict false belief reasoning, and the prediction was that complementation, not general syntax productivity, would predict false belief reasoning. We also tapped syntax sophistication via the traditional MLU measure.

More details of the results and analyses are contained in de Villiers & Pyers (1997) and de Villiers & de Villiers (in press). The score on the “memory for complements” task turned out to be a very robust predictor of how the children performed on false beliefs, and it also led success on the false belief tasks. The spontaneous speech measures and the memory for complements score were of course very highly intercorrelated, but we could tease them apart and test the directionality of relationships using a stepwise regression.

We chose Round 2 and Round 3 as our comparison points because they offered the greatest variance in scores. In Round 1, virtually no children passed anything, and by Round 4, almost every child passed the entire battery. The complete set of language measures at Round 2 predicted 55% of the variance in false belief on that round. The most significant predictor variable was production of sentential complements (IPSyn comps) (47% of variance, $p<.001$). No other language measure added significantly to the variance accounted for by this complement measure. We then performed a stepwise regression to predict "passing" false belief at Round 3 on the basis of language measures at Round 2. The whole set of language measures at Round 2 predict 38% of the variance in later False Belief. Once again, the analysis revealed that the most significant predictor variable was the production of sentential complements (IPSyn comps) at Round 2 (29% of variance, $p<.01$). Thus the other language measures add only slightly to the predictive power of complements.

So the mastery of complement structures in comprehension and in production turned out to be the best predictor of false belief reasoning both in a single round of testing (Round 2, chosen for its variability of performance) and across Rounds 2 to 3. The data were asymmetrical in that linguistic complements in Round 2 predicted false belief reasoning in Round 3, but false belief reasoning in one round did not predict linguistic complements in the next. The data are certainly in keeping with the model presented above, but correlational and regression studies, even longitudinal ones, are admittedly only weak support for such a case. Especially given the use of verbal false belief tasks, the correlations with language might reflect only the task requirements of the standard tasks. In addition, it is difficult to assess the direction of developmental influences when everything is changing together in such a short time span, and the possibility arises that differences in task demands could create the developmental orderings that we witness. To subject the hypothesis of linguistic influence to the most stringent test, we need a group of children who demonstrate greater variance in language skill over time, and ideally, non-verbal tasks of false belief reasoning should be used.

B Orally-taught deaf children

For these reasons, Peter de Villiers and I have undertaken work with language-delayed deaf children, who provide an important test population in this area of research. Unlike children with autism, deaf children do not have other associated handicaps such as socio-emotional disabilities, social withdrawal, or low intelligence. In all these areas deaf children commonly test in the normal range, though it is obvious that a profoundly deaf child who achieves no functional communication system will eventually demonstrate marked social and intellectual handicaps relative to his hearing peers. However, these effects are considered secondary to language deficiency caused by deafness, unlike the case of children with autism. In this case, the subjects of study are otherwise intellectually and socially normal children with a severe-to-profound hearing loss, congenital or acquired in the first year of life.

As a result of this deafness, the children have markedly reduced access to the spoken language of their caregivers, even with high quality hearing aids. Deaf children attend several kinds of educational institutions, including schools that expose them intensively and early to American Sign Language, but the subjects of concern for the present work attend oral schools for the deaf. In an oral school, the focus is on intensive auditory and speech training and sometimes training to lip-read, accompanied by increasing use of written text as the children learn to read, as the media for exposure to a first language. Though downplayed as significant by most oral schools, there is also considerable gestural support of speech by hearing people interacting with oral deaf children and by the children themselves. Most deaf children develop a fairly rich repertoire of iconic (pantomimic) gestures, pointing, and simple gesture "sentences" that they use in the home with hearing parents and siblings, who also use the same "Home Sign". A visit to any oral school for the deaf reveals considerable gesturing among the children, particularly out of the formal classroom setting. The nature of this Home Sign has been extensively documented for preschool children by Goldin-Meadow and her colleagues (Goldin-Meadow 1982; Goldin-Meadow & Mylander, 1985). A fair assessment of the linguistic sophistication of Home Sign in the preschool years is that it remains at about the equivalent expressive power of the average two-year-old conventional language user (de Villiers, Bibeau, Ramos & Gatty, 1993).

In terms of success in acquiring English, there is a huge range of success among oral deaf children that is not well predicted by their hearing loss or their IQ. However, the average six year old deaf child acquiring English as a first language is significantly delayed, both in lexical knowledge and, importantly, in grammar. The inflectional morphology of the language is seriously affected(Quigley & Paul ,1989; de Villiers, de Villiers & Hoban,1992; Mogford,1993

), with missing plurals, past tense, possessive markers and so forth, but the overall syntax is also markedly delayed. Even the word order of simple agent-action-patient sentences is less reliably marked by these children compared to hearing children at the same MLU (mean-length-of-utterance and they have particular difficulti4es with embedded clauses (de Villiers, de Villiers & Hoban,1992). Their narrative ability is impoverished, with much stringing together of simple sentences and often requiring great leaps of inference by the listener (de Villiers, 1991). On average, oral deaf children in the age range of 4 to 9 years perform on standardized tests such as the PPVT (vocabulary) and the CELF (syntax subscale) about 3 to 4 years delayed compared to hearing children.

At the same time, such children can perform in the normal or superior range on nonverbal tests of ability such as those involving spatial relational patterns, completing visual sequences, or memorizing action sequences. Oral deaf children are usually actively sociable, curious, friendly and eager to participate in social activities. Emotionally, they are reported to react appropriately to physical and social events. In sum, it is their language skills that are markedly delayed, and the language skills are paramount in predicting other areas of intellectual achievement (e.g. reading, school performance) and social adjustment.

From the point of view of our theory-of-mind testing, then, oral deaf children provide an excellent test population for theories of the role of language in false belief reasoning. Because they do not exhibit primary cognitive or socio-emotional problems, any problems that they face in false belief reasoning must be a function of their language delay. However, these problems could arise in one of three primary ways:

1) They could fail to understand the task, because they do not follow the narrative or the instructions or the questions being asked.

2) They might lack skill in encoding and interpreting events involving false belief because they have had insufficient exposure to situations in which language has highlighted these events. In other words, they have never had language "invite them to form a category", and nothing else in their environment can do that.

3) They might lack the ability to encode the events in language, hence fail to represent the distinction between the possible world (in someone's mind) and the actual world.

To test the first hypothesis that it is the language required in the standard false belief tasks that might cause problem for language-delayed children, we have used several non-verbal tests, or at least minimally-verbal tasks, that call upon the same reasoning skills. We test their equivalence against the performance of normally developing, hearing preschoolers, and check that they call upon the same general reasoning abilities. If deaf children fail these tasks as well as the standard tasks, it is a reasonable claim that their problems lie deeper than the language of the tasks.

Distinguishing between the second two hypotheses is more difficult and ultimately more rewarding for theoretical progress. Herein lies the heart of the Whorfian distinctions: is language weakly or strongly causal in this domain? Does language serve to call attention to certain concepts, highlight them, unite them under a symbol, and hence facilitate access to a mysterious domain, largely invisible and inferential in the case of other mind's contents? Or, it is even more than that: does it provide the representational means without which the very concept would be unattainable?

We cannot yet say that we have found the way to decide between the latter two alternatives, though we are actively researching them. At the very least, our research allows us to distinguish between having the words for mental events, and having the structures of complementation that allow representation of possible worlds. Suppose the real mechanism by which events are tied together and new concepts formed is simply via the words for thinking, knowing, wanting and so forth, in that they select and label situations requiring reference to hidden states of mind. Then we can check to see if a child with only the labels for mental states is capable of reasoning in nonverbal tasks. Command of the productive vocabulary demonstrates that the child has had "exposure' potentially sufficient to invite the formation of a concept. However, if the critical aspect is not the vocabulary but the syntactic structure that allows embedded propositions, such a child will not have the ability to reason about false beliefs. Only children who command the vocabulary and the structures should then be able to engage in false belief reasoning, even when the task itself requires no overt language.

At the time of writing, we have tested around 100 oral deaf children aged 4 to 9 years of age, on a variety of language, nonverbal IQ, and false belief tasks. Further details of a subset of these results are reported in Gale et al (1996), and in de Villiers and de Villiers (in press), and we refer here to the results from this published work.

These studies confirm one result very clearly: oral deaf children do experience considerable difficulty in the syntax of English, and the problems are not confined to morphology (Quigley &Paul, 1990; de Villiers, de Villiers & Hoban, 1993). As in the de Villiers and Pyers (1997) study, we took fairly extensive samples of spontaneous speech, elicited language using silent videotapes of cartoons and enacted events, and then subjected these to analyses of the syntax used. The measures of language were PPVT (for vocabulary), MLU (a rough measure of syntax) and IPSYN : a measure of IPSYN complements, and a measure of IPSYN Sentence Structure without complements, as above. There was enormous variability in the children's linguistic skill, and as usual, the degree of hearing loss was not a very adequate predictor of that variability.

As an indication of the impoverished nature of many deaf children's command of English syntax, consider their responses first to a set of silent videos we have created to try to elicit talk about the mind: instances of intention, desire, and false belief are enacted in these videos. In our ongoing work (de Villiers & Pyers, 1997; de Villiers & de Villiers, in press) we have shown the children silent videos in which events occurred that required positing intentional states to the characters to make sense of the story. Table 4 shows a sample of responses to a single such video from six low-functioning oral deaf children and six normally - hearing children two or three years younger in age. While it is true that the young normally-hearing children do not give perfectly adult descriptions of the events, it is obvious that their language and narratives contrast dramatically with those from the deaf children. These deaf children's descriptions not only contained markedly impoverished syntax, but also exhibited considerable difficulty in capturing an intentional description of the events. In fact, inspecting these descriptions closely suggests that these children do not conceptualize the events in the same way as the hearing children.

Table 4 here

Having established that oral deaf children can have profound delays in the area of syntax, sufficient to delay their acquisition of complementation and other complex forms, the groundwork is partially laid for testing their performance on false belief reasoning tasks. The second preparatory step was to find nonverbal tests of false belief reasoning that could be shown to tap the equivalent levels of skill in normally hearing children as the standard tasks. We have found two such tasks (see de Villiers & de Villiers, in press) and demonstrated that four year old hearing children can pass these tasks, and that their performance on the nonverbal versions is highly correlated with that on the standard false belief tasks. We should point out that we have found it virtually impossible to test either hearing or deaf children in complete silence, even if the tasks do not require language to present or understand. We use conversational language to encourage, draw attention, and direct the child's responses, and all of the children in the studies have been able to understand this level of language. Language is an inevitable part of human interaction, and it feels highly artificial to engage in silent tasks especially with the youngest children.

The first task is modeled on the one used by Povinelli and deBlois (1992) in their work with monkeys and chimpanzees, as well as three-and four- year old children. It is perhaps less categorizable as a false belief task, but rather as one involving the heuristic that seeing leads to knowing, and knowing leads to appropriate advice. In our version of the task, two "helpers" of the experimenter point to different boxes where a sticker has been hidden, and the child has to decide whose advice to take. One of the helpers saw where the experimenter hid the sticker, and the other helper did not, being blindfolded and in the same vicinity as the child, behind a screen. A sensible choice would be to choose the advice of the seeing-therefore-knowing helper. The child is first taught the basic structure of the game with a sticker hidden in one of four small identical white boxes behind a pull-down screen. At first the experimenter points to the appropriate box for the child to find the sticker, and once this is established as the game, the two helpers join in, one viewing and one blindfolded. After the experimenter hides a sticker, the screen is pulled up and each stooge points to a different box. Ten such trials are run, and the child is credited with "passing" if he succeeds on 8 out of the 10, or 6 trials correct in a row. The child cannot fix on the choice of a particular individual, as we randomly allocate which helper is blindfolded on each trial by a predetermined random sequence. The helpers give no facial or gestural clues to the child; they just look and point at the boxes.

The results from oral deaf children on this task are clear cut: the average age of passing was 7.3 years, compared to 4.4 years for the hearing control subjects (Gale et al, 1996). Furthermore, performance on the task was highly correlated with the performance on standard verbal theory of mind tasks[$r (18) = +.60$, $p<.01$], despite the overt language requirement of the standard tasks. Remarkably in contrast for the intuitive view that it is only the language-of-the task that might interfere with performance, there were no savings for the deaf subjects by using a nonverbal task. The average age of passers on the standard tasks was 7.41 years (unseen displacement), and 7.25 years (unexpected contents).

The predictions of the current theory were well supported: the best predictor of the deaf children's performance on the nonverbal theory of mind task was their skill at producing the language to explain actions in terms of cognitive states ($r = +.61$, $df=16$; $p<.01$). This language -of-the-mind measure was taken from the narratives children produced in responding to silent cartoons and video clips that contained mistakes and misconceptions. The children's spontaneous and prompted explanations of the characters' actions on the video clips were transcribed and scored for their reference to cognitive states such as beliefs, thoughts, knowledge, or ignorance, or desires and emotions. Points were assigned on the basis of the spontaneity and developmental sophistication of the explanations given. 3 points were assigned for producing at least one spontaneous explanation referring to the character's cognitive state, two points if cognitive state explanations were only given following prompts, and only one point if reference was made to desires or simple emotions but not to thoughts or knowledge (in keeping with

Bartsch & Wellman, 1995). A cognitive explanation of action in this task always involved an embedded complement construction.

The second task we have used (de Villiers & de Villiers, in press) requires the child to decide on the appropriate facial expression (surprised or not surprised) for a character in a cartoon story. The character either witnesses or does not witness some unusual object being placed in a familiar container, so it requires similar kinds of inferences to the standard unexpected contents task. For example, a frog gets placed in a Cheerios box. The child is shown the story and with the whole series laid out in front of him, asked to decide whether the character will be surprised or not surprised when the container is opened in the final scene. To succeed, the child must follow the story and figure out the individuals' states of knowledge, aided by the pictorial content and some pretraining that highlights tracking the characters from scene to scene. A pretest guarantees that they know the difference between surprised and not surprised facial expressions. The facial expressions themselves are on small transparencies, so they can be lifted onto the blank face of the character in the final scene - a task all of the children find delight in.

Six such stories constitute the task: three of them involve a character who should not be surprised, three involve a character who should be surprised. The design controls for bias in a particular story by having two sets of equivalent stories, though each child only receives one set of six. Five or six correct answers count as "passing" this task.

Four year old hearing preschoolers find this task moderately difficult, and slightly fewer children pass this "surprise face" task than pass the standard verbal false belief tasks (de Villiers et al, in preparation). Nevertheless it is well-correlated with standard false belief tasks [$r(26) = +.61$, $p < .001$] and the average age of passers of the surprise face task is 4.? years. Once again, for hearing children, complement syntax predicts performance on the surprise face task, but age makes a significant contribution in addition.

de Villiers et al (in preparation) tested twenty-seven moderate to profoundly deaf children in the elementary grades of an oral school for the deaf, none of them formally exposed to sign languages in their education. Their ages varied from 5:2 to 10:1, with a median of 7:0 years. We found that these oral deaf children passed the surprise face task at a slightly older age than for the standard unseen object displacement stories: at about 8.5 years of age, and the tasks are quite highly correlated ($r = +.58$, $p<.02$). Once more, using a relatively non-verbal task did nothing to improve the performance of the deaf subjects who might have been thought to be disadvantaged only by the language of the standard tasks.

Consider the relationship again to language measures, which we further refined for the "surprise face" study. Measures of the children's <u>syntax production</u> were determined from language samples varying in size from 51 to 111 utterances, with a mean of 67. The Index of Productive Syntax (IPSyn) was used to derive a quantitative measure of the grammatical complexity of the children's language (Scarborough, 1990), paralleling the work of de Villiers and Pyers (1997) described above. Our IPSyn scoring of the language samples from the deaf children focused on the Sentence Structure subscale. We derived two separate scores for each deaf child from the Sentence Structure (SS) subscale of the IPSyn: productive use of sentential complements (IPSyn SS-Comps), a score varying from 0 to 4; and the remainder of the Sentence Structure items (IPSyn SS-Other), a score varying from 0 to 36.

Multiple regression analyses allowed us to test the independent effects of the predictor variables on theory of mind performance, carried out for each of two dependent measures: 1) total verbal false belief reasoning score on three standard unseen displacement stories ("where look?" questions only); and 2) score out of six on the "surprise face" scenarios. Six predictor variables were entered into each regression: IPSyn SS-Comps, IPSyn SS-Other, PPVT-R verbal mental age (a vocabulary measure), TONI-2 nonverbal IQ, aided hearing loss, and age. As with the hearing preschoolers in de Villiers and Pyers (1996), the deaf children's IPSyn complement score emerged as the only significant independent predictor of performance on the standard false belief reasoning tasks, separable from the contribution of the more general language measures and background variables like nonverbal IQ, hearing loss and age[$R^2 = 62.2\%$; $F(6,16) = 4.39$, $p<.01$*; IPSyn SS-Comps: $t = 2.34$, $p=.032$] For the less verbal "surprise face" task, both the IPSyn complement score and age made significant independent contributions to the variance in the children's performance on this task [$R^2 = 67.0\%$, $F(6,16) = 5.42$;,$p<.005$; IPSyn SS-Comps $t = 2.73$, $p=.015$; Age: $t = 2.31$, $p=.035$]

In summary of these empirical studies, we have evidence suggesting two points about oral deaf children's performance on false belief reasoning:

a) it is delayed by several years, even with nonverbal tasks

b) performance on ANY false belief task, even the nonverbal, is predicted by command of complement syntax.

Togetrher these points suggest that it is specifically the linguistic problems that cause the delay for deaf children, since in all other respects - intelligence, active sociability, attentiveness - they are not initially impaired.

A number of other recent studies are compatible with the results presented on oral deaf subjects showing a strong relationship between language mastery and false belief understanding. Two other studies have shown a delay in deaf children's false belief understanding. In the first, Peterson and Siegal (1995) studied 26 deaf students aged 8 to 13 from Total Communication programs in Australia. They reported that on a slightly modified version of the standard change of location false belief story, only 35% of the students passed (average age 10:4). There were no significant age effects, nor was nonverbal IQ a predictor of which children passed and which did not. The authors conclude that their study shows that ToM mastery depends on fluent early conversational experience, presumably disrupted in these deaf children. However, Peterson and Siegal did not have any measure of their subjects' language abilities, and there were some shortcomings in their test procedures. The experimenters acted out the scenarios, but the children had to also follow a signed version of the story as well, and it is likely that the procedures seriously taxed the children's attention. The results are compatible with our work, but open to criticism. A second study of deaf children by Steeds, Rowe and Dowker (1997) in Britain, used similar standard false belief tasks - unseen displacement and unexpected contents- translated into British Sign Language. Most of their 22 subjects were considered to use British Sign language as their primary language, with some exposure also to Sign-Supported English. The children were in roughly the same age range as in Peterson and Siegal's study, aged 5-12 years, but they performed better, with approximately 70% success rate. Unfortunately there is one oddity: several of the children failed the memory check control questions, casting their false belief answers into some doubt. The memory check questions for the unseen displacement task followed the false belief question, which is not the order in which they are usually asked, and this order allows for no "correction" of the child's understanding by repeating the story again, with the questions, before the critical question involving false belief gets asked. The second major disadvantage from our point of view is that no measure of language or syntax was taken from the children, so we cannot gauge their linguistic proficiency in British Sign Language.

There is no reason to believe that deaf children who grow up in a community of supportive Signers, and who learn sign language from an early age, should have any deficit in their development of the vocabulary or complex structures necessary for false belief reasoning. In fact, two of Peterson and Siegal's successful subjects both had deaf parents who used the Australian sign language, Auslan, and Steeds et al credit the greater exposure to British Sign Language, a natural sign system, for the better performance of their group of subjects. In later work, Peterson & Siegal (1997) report that children who grew up with signing family members performed better than other deaf subjects on false belief tasks, but since their (five) Auslan signing subjects averaged nine years ten months at the time of the study, that finding can not provide convincing evidence of a normal timetable of development. We are actively researching the signing deaf population in our collaboration with Brenda Schick and Robert Hoffmeister, and intend to explore the relationship of linguistic knowledge of complementation and mental verb usage with false belief performance in this population..

B Children with Specific Language Impairment

A second group of children may be expected to show deficits in false belief reasoning by virtue of their language delay, namely children with Specific Language Impairment. By definition, children with this characterization are not cognitively impaired, nor do they have the associated socio-emotional difficulties of autism, so language delay is the primary disorder. Initial reports suggested that children with SLI show no impairment in false belief reasoning (Perner, Frith, Leslie & Leekam, 1989), but the SLI children had very high PPVT scores (average verbal MA 9.6) and the authors provided no corresponding measure of the children's syntactic mastery. However two other studies have recently suggested a delay in false belief reasoning in SLI that is concomitant with the children's syntactic development. Iarocci, Della-Cioppa, Randolph and Wohl (1997) and Cassidy and Ballaraman (1997) have results that suggest that language delay has associated cost in false belief reasoning. To date, the data from SLI subjects is not completely satisfactory for deciding the role of language in false belief reasoning, as it is somewhat inconsistent, and from the point of view taken here, uses inadequate language measures. It is at least possible that some SLI children suffer from only a limited morphological deficit without having associated difficulties in syntax, though this is still a matter of controversy (Rice & Wexler, 1996; Van der Lely, 1997; Van der Lely & Stollwerck,1997). If so, they may have sufficient syntax to handle complementation with mental verbs and show no particular deficit. Or, for children with SLI, language development may be on a delayed timetable but then show a rapid change around 5 or 6 years (Rice & Wexler, 1997), in which case there is an explanation for why the studies with younger SLI subjects show deficits, but the ones with older children suggest they have no difficulty. All these possibilities remain open.

It is important to mention again that the delay in false belief reasoning seen in oral deaf children and possibly also in children with SLI should not be construed as meaning the same thing as the deficits seen in children with autism. Here it is argued that the language of complementation is necessary as a representational tool for false belief reasoning, which is why the language-delayed children have a deficit. But children with only a language delay, unlike subjects with autism, should not be expected to show deficits in all the other aspects of "Theory of Mind" which are less dependent on sophisticated language. So, such important developmental steps as following eye-gaze, or interpreting its meaning, or negotiating shared attention, and teasing, and elementary forms of trickery, or emotional empathy, reading other's intentions and responding accordingly - all of these would be expected to proceed on a relatively normal timetable even in a language-delayed child. To the extent that they do not, it might suggest a role for language in also facilitating those aspects, but the case for that has not been made here. It is important to differentiate the more limited problems of the oral deaf child from the more severe and broad deficit in "Theory of Mind" commonly seen in autism.

A How theory of mind affects language

In this final section, I want to acknowledge that the developmental relationship between language and theory of mind is not just one-way. There are many phenomena that reveal the extent to which mature human language depends, critically, on an assessment of point of view - of the speaker, or the subject of a sentence, of a listener. Such concerns do not require us to stray far into pragmatics, into conversational rules, or politeness, or relevance theory. It goes without saying that the skills required for conversation, or narrative, call upon sophisticated understanding and monitoring of the listener. However, considering the appropriate use of sentence structures beyond the very basic forms leads us straight into considerations of mindreading. Once the door to other minds is open (and if we are right, language facilitates that entry), we might find that other linguistic phenomena that depend on getting certain points of view straight, then come into play in child language.

What is not clear at present is the role of other perspective -taking within language itself, in phenomena that may appear well before the command of mental state terms and complement structures. For example, deictic terms such as I/you, here/there, this/that are known to appear in children's speech and their comprehension (de Villiers & de Villiers, 1974) at an earlier age than complements with mental verbs. Could they be acquired without genuine point-of-view shifts, by means of some simpler heuristic? Or are they the real linguistic precursors? What about the use of definite and indefinite articles, that require the speaker to attend to the listener's state of knowledge, and whether the referent is known or unknown to the listener? Certainly command of articles appears early in language production (Brown, 1973), but the subtler tests of comprehension reveal some difficulties even at age four in keeping track of listeners' needs (Cziko,1986; Karmiloff-Smith,1982). Acquisition of these phenomena requires a more detailed examination before we can determine how they interrelate with the results discussed below, and the details promise to be illuminating about the relationship of language, mind and point of view. Here I give just one example.

One of the fundamental tenets of 100 years of semantics is that the meaning of sentences is somehow derived from the meaning of their parts, a property called compositionality. Without compositionality, every sentence meaning would be uniquely associated with a situation, and there would be no generativity possible, no way to derive the meaning of a new sentence that had not been spoken before. The basic idea of compositionality is that sentences are linked to situations, that terms in language refer to states of the world, and their truth value is assessed in connection to those states of the world. A sentence is true if the state of the world corresponds, so the meaning of a sentence , on this view, is the set of conditions in the world that make it true. The second fact about language is that we can have multiple terms to refer to the same thing: a particular object may be:

the rose
the flower
my date's corsage
that mess in the sink
some yellow thing down the disposal

Notice that a sentence containing any such term can be rephrased by substitution of the other terms and the truth value remains unaffected:

Phyllis is extricating the rose with a chopstick

Phyllis is extricating my date's corsage with a chopstick

Phyllis is extricating some yellow thing down the disposal with a chopstick

Hence truth value is maintained under substitution of terms with the same reference, a very desirable property for compositionality.

Unfortunately, it has been known for a hundred years now that the property doesn't work in intentional contexts (Frege, 1892, Quine, 1960). Consider the same situation as above, but suppose that the character Phyllis is ignorant of the disposal's contents. It might be true that:

Phyllis thinks some yellow thing is down the disposal

but not that:

Phyllis thinks my date's corsage is down the disposal

nor:

She thinks a flower is down the disposal

Why does substitution fail under these circumstances? It fails because to use reference appropriately in an intentional context requires one to calculate the subject's beliefs, not just one's own point of view. In the embedded clause, we enter the subject's point of view, so it no longer matters what we consider coreferential: it matters what Phyllis, the subject, considers coreferential. Notice that this effect is more subtle by far than the truth value switch required by the classic complement case discussed above. There is nothing objectively false about the complement "a flower is down the disposal" but we cannot attribute that belief to her unless she knows that the yellow thing is a flower! Hence, critically, successful use of intentional sentences involves keeping track of other's knowledge and beliefs, and permitting substitutions of terms only when the inference is warranted by the contents of the subject's beliefs (Larson & Ludlow, 1993).

Several recent studies have demonstrated that children do not pay attention at first to the contents of others' beliefs, and thus misjudge the truth value of sentences in which unwarranted substitutions have occurred (Russell, 1986; de Villiers & Fitneva, 1995; Apperley & Robinson, in press). In our work we find evidence that mastery of these judgments takes children some months following success on false belief tasks, which is not too surprising given the complexity and subtlety of the computations that must go on to use substitution appropriately (de Villiers, Pyers & Broderick, 1997). Other examples of phenomena that seem to await command of false belief understanding can be found in Perez-Leroux (1996) and Hollebrandse (1998), as well as Papafragou (1997).

A What are the implications for children with autism?

Children with autism have not been the focus here, but the implications for autism should be spelled out. I have proposed a continuum of language influences on cognition, ranging from the largely independent to the highly dependent. To the extent that autism can be seen as simply involving language deficits, we might expect differential problems in cognitive development as a function of the language-dependence of the concept, just as we might expect them for children with SLI, or language delay due to deafness. However, children with autism have problems that extend beyond language, a fact that differentiates these populations. Children with autism might manifest primary and profound problems in the area of "Theory of Mind" in general, not just the language-dependent false belief reasoning. We have no reason to suspect these broader problems with oral deaf children, or children with SLI. The possibility has been suggested that high-functioning subjects with autism who acquire enough language skill might even be able to "bootstrap" an adequate understanding of people's states of mind, desires and beliefs, to compensate for their primary disability (Tager-Flusberg, 1997, and this volume). That is, the language-dependency of false-belief reasoning may turn out to be a boon: it might give certain individuals a way intellectually to represent an understanding of other persons that didn't come naturally.

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Table 1: Concepts at different levels and their linguistic (in)dependence

level zero:	The difference between A and B can be detected (any A versus any B). Language is not necessary.
level one:	All A’s (versus all Bs) can be classed together because of their functional equivalence for some behavior. Language could accelerate this process, but is not necessary.
level two:	For all A’s, language is under normal circumstances the only functional behavior that ties them together, but it isn’t necessarily the only possible act that could do so.
level three:	Language is an example of a representational system that could capture the equivalence of all A’s , because it is symbolic and can therefore capture second order relations.
level four:	Language is the only representational system that could capture the equivalence, because it is not just symbolic but propositional, and can therefore capture falsity and embeddedness of propositions.

Table 2: Parallels between communication and mental verbs

Words for speech:	**Words for mental state**
say	think
ask	pretend
tell	guess
Structures for speech verbs:	**Structures for mental verbs:**
imperatives:	imperatives:
say p	*think p
ask X	pretend p
tell X	guess p (?restricted)
direct speech:	direct quotes
he says “X”	he thinks “X”
he says “p”	he thinks “p”
he asked/told her “p”	?he pretends,”p”
	?he guesses, “p”
indirect speech-true p complements	indirect speech-true p complements
he says (that) p	he thinks (that) p
he asked (p)	he pretends (that) p
he told Y (that) p	he guesses (that) p
indirect speech-false p complements	indirect speech-false p complements
he says (that) p	he thinks (that) p
he asked (p)	he pretends (that) p
he told Y (that) p	he guesses (that) p

Table 3: Proposed stages of mastery of complements of communication and mental verbs

Step 1: The child masters the basic sentence forms: a simple sentence is mapped onto a simple event. The child encounters true sentences that match reality.

situation	(matrix verb)	complement
x	-	x
dog on chair	-	dog on chair

Step 2: The child first encounters discrepancy between sentence and reality: the child learns to recognize pretense as well as mistakes.

situation	(matrix verb)	complement
x	-	y
dog on chair	-	cat on chair

Step 3: The child masters the first embedded structures under verbs of communication/mental state/desire: child acquires the fundamental syntax of embedding but makes no accommodation of meaning within that structure: the complement retains its truth value as a simple sentence independent of the matrix verb. This structure may or may not be available simultaneously for communication verbs and mental state verbs.

situation	matrix verb	complement
a, x	a	x
mother says something		
dog on chair	mother says	dog on chair
AND		
mother believes something		
dog on chair	mother believes	dog on chair

Step 4: The child first notices occasions with verbs of communication that suggest the complement can be false when embedded e.g. reports of lying, mistakes. The relation of statement to fact makes the semantic accommodation evident.

situation	matrix verb	complement
a, x	a	y
mother says something	mother says	cat on chair
dog on chair		

This development may have two parts:
i) Understanding the direct speech of the mother: "a cat is on the chair" despite what is actually true: i.e. that what the mother said is false.
ii) Understanding that it is true that the mother said that a cat is on a chair. So, a false clause can become part of a true statement, if and only if it is syntactically embedded.

Step 5: The special semantic accommodation of complements is extended to verbs of mental states: beliefs.

situation	matrix verb	complement
b, x	b	y
mother believes something	mother believes	cat on chair

dog on chair

Table 4: Elicited language about a mistake.

Typical adult description:

This girl is reading the newspaper and has her soda on the table next to her. A cleaner comes by and cleans the table, and takes away the soda. A little vase of flowers is now standing where the soda was. The girl wasn't looking so she picks the vase up and tries to drink the flowers!
Why did she drink the flowers?
Because she thought it was her soda.
What was she thinking?
I guess she thought it was her soda.

With the children, we prompted using 3 still pictures from the video to remind them of the event after the spontaneous narrative. We asked staged questions, continuing if we did not elicit a "mental" explanation:

1. **what happened?**
2. **why did the girl drink the flowers?**
3. **what was she thinking?**

Oral deaf subjects

<u>Question</u>	<u>Response</u>
Subject # 1 **Age 5;6**	
What happened?	Drink drink (gestures drink) (drink what?) drink.
E shows pictures:	
1st picture	drink.
2nd picture	clean (gestures wiping table)
3rd picture	drink (screws up face)
Why?	yuck.
What is she thinking?	think, think, think (mimics)
Do the flowers taste yummy?	(shakes head) no.
Subject # 2 **Age 5;10**	
What happened?	(gestures drink and makes gulping sound)
Drink what?	flower.
Why did she drink the flowers?	eew. That's crazy (mimics)
What's she doing? (E shows pictures)	
1st picture	juicexxx
2nd picture	wash...wash
3rd picture	(gestures drinking) drink flower
Why?	flower, flower, wash, wash (gestures putting away, drinking, shakes head) uh oh. wash, wash (gestures picking up) xxx up xx
What is she thinking?	flower
Subject # 3 **Age 6;4**	
What happened?	Flower. Flower. Flower.
What did she do with the flowers?	Flower (unintelligible?)
What's happening here?	

(E shows pictures)	
3rd picture	(gestures drinking flowers)
	Flowers. I know.
Why is she drinking the flowers?	Flowers. Flowers. (unintelligible)
What is she thinking here?	Flowers. Flowers.

Subject # 4 **Age 6;9**

What happened?	She's drinking. She's drinking juice (gestures drinking)
What'd she think?	Drink flower.
Why was she drinking the flowers?	It's dirty, yuck.
What happened here? (1st picture)	She's looking at the paper.
What happened here? (2nd picture)	No drinking flowers, dirty.
What happened here? (3rd picture)	It's dirty, flower.
Why is she drinking the flowers?	Because she drinks it.
What is she thinking?	Think flower.

Subject #5 **Age 7;2**

Spontaneous (during video)	xx xx
What happened?	The (a) girl xx drink the flower.
Why is she drinking the flowers?	The cup. The cup.
What happened? E shows pics)	Drink the flower.
What's she doing? (pics)	The cup.
Spontaneous (1st picture)	The maid xx clean wipe xx (wash) the table.
Spontaneous (3rd picture)	She smell.
She smell the flowers?	Yes.
Why did she smell the flowers?	The cup.
What is she thinking? (3rd picture)	She smell the flower.

Subject #6 **Age 7;4**

What happened?	Boy eat flower.
Why'd he eat the flowers?	Because it's yucky.
What happened here? (pics)	She drink.
Spontaneous (1st pictures)	Girl washing table.
Spontaneous (3rd picture)	He drink the flower.
Why is he drinking the flowers?	Because it's yucky.
What is he thinking? (3rd picture)	He thinking get up.
He's thinking what?	Get up.

Normally hearing subjects

Subject #1 **Age 3;6**

What happened?	The... her mom took her drink way and she picked up the flowers and she tried to drink that.
Why did she drink the flowers?	I dunno. That must be strange.

Subject #2 **Age 3;7**

What happened?(3rd picture)	She bump into it.
Why did she drink the flowers?	Cuz that wasn't her drink.
What thinking?	That think it was a drink.

Subject #3 **Age 3;7**

What happened? (1st picture)	She's... um... wiping it, wiping it.
Why did she drink the flowers?(3rd pic)	(shrug)
What is she thinking?	I don't know.
What is she thinking?	That she wants her soda back.

Subject#4 **Age 3;11**

What happened?	Mmmmm...
(E. shows pictures)	
Why did she drink the flowers?	I don't know.
Why did she drink the flowers?	Cause she thinks that's still her drink.

Subject #5 **Age 4;1**

(E shows pictures)	
What happened?	She's washing the table.
Why did she drink the flowers?	I don't know.
What is she thinking? (3rd picture)	She thinks, she thought it was soda.

Subject #6 **Age 4;2**

What happened?	Umm, he was drinking soda, but then, umm, a lady came and cleaned up the table and she moved the flowers and then he said, "Hmmm, so I guess I will take a drink," and then he almost drank the flower.
Why did she drink the flowers?	He thought that the drink was still there.