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Language and Understanding Minds: Connections in Autism

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Language and Communication Impairments in Autism

One of the key diagnostic features of autism includes "qualitative impairments in communication" (APA, 1994, p. 70). By definition children with autism show delays and deficits in the acquisition of language, which range from the almost complete absence of functional communication, to adequate linguistic knowledge but impairments in the use of that knowledge in conversation or other discourse contexts. Thus autism is considered by most researchers to involve primary impairments in pragmatic aspects of language, or in the ability to use language to communicate effectively in a range of social contexts (Lord & Paul, 1997; Tager-Flusberg, 1981, 1996; Wilkinson, 1998). For the past decade these pragmatic impairments have come to be viewed as intimately linked to deficits in theory of mind, which are considered to be at the core of the disorder (Baron-Cohen, 1988; Happé, 1993; Tager-Flusberg, 1993, 1997), and research on the relationships between pragmatics and theory of mind in autism has been highly productive. This view of autism has provided an important theoretical perspective on the nature of language functioning in autism because it is able to explain the unique and specific pattern of what is relatively spared and what is impaired in this population (Happé, 1994a; Tager-Flusberg, 1997).

At the same time, this emphasis on the pragmatic language impairment in autism has led to a relative neglect of other linguistic deficits that are found in most individuals with this disorder. While lexical and syntactic knowledge may be *relative* strengths, at least in verbal children with autism, they are, in the majority of cases, significantly delayed in development. Furthermore, it appears that in a significant number of older children and adolescents with autism lexical and syntactic knowledge remain delayed

relative to other areas of cognitive functioning (Lord & Paul, 1997). Thus, these non-pragmatic aspects of linguistic functioning also need to be considered in a comprehensive account in autism, even if they are not deficits that are unique to this syndrome.

To what extent are there important relationships in autism between theory of mind and semantic or syntactic aspects of language? In this chapter I provide an overview of how theory of mind deficits in autism may be intimately related to a broad range of language impairments, including not only pragmatics, but also lexical-semantics, and syntax. Research conducted over the past decade has highlighted some of these latter connections that may be considered at both general and more specific levels. These studies indicate that the relationship between understanding mind and language itself is much deeper than has previously been considered. Furthermore, the direction of this relationship is likely to be more complex when viewed from a developmental perspective. Throughout this chapter I consider the extent to which autism provides a window onto alternative ways in which mind and language may become connected over the course of development.

Pragmatics and Theory of Mind

Toward the end of the first year of life infants come to understand that people are intentional volitional beings whose experience and attention to the world around them may be different from their own view. This conceptual understanding, which may mark the emergence of an early understanding of mind, is manifest in the onset of intentional communication. Indeed, the motivation to communicate with others and thus to acquire language, is rooted in this view of people as intentional beings with whom to share one's own view of the world and learn about theirs (Baldwin, 1995; Locke, 1993). From the

outset infants' communications express multiple functions: social engagement, protoimperative requesting, and protodeclarative sharing or informing. These communicative patterns, which emerge at around 10 to12 months, reflect developmental connections between communication and social cognition (Carpenter, Nagell, & Tomasello, 1998).

Communicative Functions

The earliest manifestations of communicative impairment in autism may be found in selective deficits that reflect a lack of understanding of mind. Thus, both naturalistic and experimental studies have shown a selective paucity of protodeclarative communicative gestures in both preverbal and older verbal children with autism (Baron-Cohen, 1989; Mundy, Sigman, Ungerer & Sherman, 1986; Wetherby, 1986). Unlike protoimperatives, which may only involve an expression of the child's needs, protodeclaratives critically involve joint attention and entail an incipient understanding of intentionality, both of which are profoundly impaired in young children with autism (Loveland & Landry, 1986; Mundy, Sigman & Kasari, 1994). When language is acquired in autism, verbal communication continues to be primarily limited to the expression of instrumental functions, or simple labeling (Tager-Flusberg, 1996). While autistic children do use language to maintain some social contact (Wetherby & Prutting, 1984), they rarely comment on ongoing or past activity, use language to seek or share attention, provide new information, or express intentions, volition or other mental states (Tager-Flusberg, 1992; 1993; 1997). Thus, autism is characterized by significant limitations in the range of functions served by language; limitations that can be directly attributed to impaired understanding of other minds.

Conversational Competence and Intended Meaning

Children with autism exhibit significant difficulties in conversational contexts. They show impairments in their understanding of the speaker-listener relationship as illustrated, for example, in pronoun reversal errors (Lee, Hobson, & Chiat, 1994; Tager-Flusberg, 1994). These errors reflect difficulties in conceptualizing notions of self and other, as they are embedded in shifting discourse roles. Children with autism fail to distinguish between given and new information and do not conform to conversational rules (Ball, 1978; Baltaxe, 1977; Fine, Bartoclucci, Szatmari & Ginsberg, 1994). They cannot appropriately maintain an ongoing topic of discourse (Tager-Flusberg & Anderson, 1991); instead they introduce irrelevant comments or fail to extend a topic by adding new relevant information. One recent study found that there was a significant correlation in children with autism (but not controls) between performance on theory of mind tasks and the ability to respond to a conversational partner with contingent relevant new information (Capps, Kehres, & Sigman, 1998). Experimental studies also suggest that children with autism who fail theory of mind tasks do not adhere to Gricean maxims, which are concerned with conversational relevance (Surian, Baron-Cohen & Van der Lely, 1996).

Conversational deficits in autism reflect fundamental problems in understanding that communication is about the expression and interpretation of <u>intended</u> rather than literal meaning (Happé, 1993; Sperber & Wilson, 1986). Several studies have found that even older high-functioning people with autism have great difficulty interpreting non-literal or figurative speech (e.g., Happé, 1993; 1994b; Minshew, Goldstein, & Siegel, 1995). Research by Happé (1993) found that there was a close relationship between

understanding metaphor or irony and performance on theory of mind tasks. In a later study Happé (1994b) again found a strong relationship between the ability to explain a variety of non-literal messages (e.g., lies, jokes, pretence, irony, sarcasm, double bluff) and theory of mind. Across all the stories in her study, Happé (1994b) found that subjects with autistic had great difficulty providing mentalistic explanations for these non-literal utterances compared to matched controls (see also Baron-Cohen, 1997). Her findings are taken as strong support for relevance theory (Sperber & Wilson, 1986), which is concerned with the central role of intentionality in communication. Using a more structured task, Mitchell, Saltmarsh & Russell (1997) also found that children with autism had difficulty interpreting a speaker's intended meaning when presented in a conversational context. Unlike matched controls, the children with autism in their study interpreted utterances in a literal way instead of in relation to the speaker's stated desire.

Narrative Discourse

Communication in other, non-conversational, discourse contexts has also been investigated in children and adolescents with autism. Several studies have explored narrative discourse, particularly storytelling. Telling a good story that focuses on human experience entails the ability to weave together a sequence of events according to a hierarchical organizational structure (the 'landscape of action') with what Bruner (1986) refers to as the 'landscape of consciousness' – the motivations, thoughts and feelings of the main characters in the story. Baron-Cohen, Leslie and Frith (1986) were the first to show that, compared to control subjects, children with autism provided fewer mental state terms in their narratives for a sequence of pictures depicting a simple false belief scenario. In a more detailed study, Loveland and her colleagues asked their subjects to

retell a story presented in the form of a puppet show or video sketch (Loveland, McEvoy, Tunali, & Kelley, 1990). The children with autism were less able than controls to consider their listener's needs and produced more bizarre or inappropriate utterances. Some of the children with autism were unable to even understand the story as a representation of meaningful events, suggesting that they lacked a cultural perspective underlying narrative (Bruner & Feldman, 1993; Loveland & Tunali, 1993). Tager-Flusberg (1995) also found that children with autism told impoverished stories in response to a wordless picture book. Furthermore, none of the children with autism in this study provided any causal explanations for the events in the stories.

In general, these findings on narrative deficits in autism have been interpreted as reflecting deficits in theory of mind (Bruner & Feldman, 1993; Loveland & Tunali, 1993) However, only one study has directly explored the relationship between narrative and theory of mind performance (Tager-Flusberg & Sullivan, 1995). Using another wordless picture book, narratives were elicited from adolescents with autism and matched controls with mental retardation. Only for the subjects with autism, was theory of mind performance significantly correlated with a number of different narrative measures including length, number of connectives, emotion and cognition terms. In addition, in response to probe questions, the subjects with autism gave significantly fewer appropriate explanations for the emotional states of the story characters. These studies all confirm that autism involves particular problems in telling stories; problems that have been closely linked to the capacity to understand other minds (both the listener's and the characters within the story).

Pragmatic Impairment in Autism

This brief review confirms that pragmatic impairments in autism are found across different discourse contexts. These impairments include: a narrower range of functions served by language; problems understanding that communication is about intended rather than surface meaning; failure to view conversations as a means of modifying and extending the cognitive environment of a conversational partner; and failure to view narratives as a means for communicating about both events and psychological states. What is striking about these impairments in communication, is that they occur to some degree across the entire spectrum of autistic disorder. Across all ages, ability levels, and language levels, deficits are found in some or all of these aspects of pragmatics and communication. They are even considered to be one component of the broader autism phenotype, found among some proportion of first degree relatives of individuals with autism (Landa, Folstein, & Isaacs, 1991; Landa, Piven, Wzorek, Gale, Chase, & Folstein, 1992; Piven, Palmer, Landa, Santangelo, Jacobi & Childress, 1997). Thus, these deficits have come to be viewed as primary in the diagnosis of autism, and appear to be unique and specific to this disorder (Tager-Flusberg, 1996).

Across the studies discussed in this section the close connection between pragmatic knowledge and theory of mind has been highlighted. At both a theoretical (cf. Locke, 1993; Sperber & Wilson, 1986; Tager-Flusberg, 1993) and empirical level these domains seem to be inextricably linked together. Indeed, in some studies, the relationship between specific aspects of communicative competence and theory of mind ability was found to be significantly stronger among subjects with autism than among controls (e.g., Capps et al., 1998; Tager-Flusberg & Sullivan, 1995). This suggests that

there may be a somewhat different developmental relationship between these domains among individuals with autism. At the same time, however, although all researchers agree that pragmatics is closely tied to theory of mind, the direction of this relationship has not been clearly delineated. Some argue that some understanding of mind is a prerequisite for acquiring language (e.g., Locke, 1993; Tager-Flusberg, 1997) or communication (e.g., Sperber & Wilson, 1986). Others suggest that through verbal interactions with others children come to understand that people have minds with contents different from their own (e.g., Dunn, Brown, Slomkowski, Tesla, & Youngblade, 1991). These positions may not be incompatible; what is needed is a more detailed developmental model of how different components of a theory of mind might be causally related at different points in time to specific aspects of pragmatics, communication and discourse skills (cf. Charman & Shmueli-Goetz, 1998).

At the earliest stages, it is likely that theory of mind is an important precursor to the onset and progress in language acquisition. Research on the relationship between joint attention and language development demonstrates that for children with autism, as well as for other groups of children, there are strong developmental connections between these domains (Carpenter et al., 1998; Loveland & Landry, 1986; Mundy et al., 1994). The clearest evidence comes from Sigman and Ruskin's (in press) longitudinal study, in which they found that responses to bids for joint attention by toddlers and preschoolers with autism, predicted language gains several years later, particularly on measures of expressive language (Sigman & Ruskin, in press). This relationship between joint attention and later language was independent of IQ level and provides strong support for the view that joint attention is a crucial precursor of language acquisition in autism. Joint

attention is, as discussed earlier, is considered to be one of the earliest manifestations of theory of mind development (Baron-Cohen, 1995; Tomasello, 1995), emerging at the end of the first year. The ability to share attention with others entails the implicit understanding that people are intentional agents. To acquire language the child must interpret the words and communicative gestures of others as intentional acts; indeed early word learning depends on this interpretation, especially in contexts of ostensive definition (cf. Baldwin, 1993, 1995). Deficits in joint attention in autism may thus be causally linked to and explain the significant delays in language acquisition that are the hallmark of this disorder (Baron-Cohen, Baldwin, & Crowson, 1997). The developmental relationship between theory of mind and the acquisition of other aspects of pragmatic and discourse knowledge may not, however, be so clearly uni-directional. More longitudinal studies, of the sort that Sigman and her colleagues (Sigman & Ruskin, in press) have pioneered will be needed to address these issues in this future.

Lexical-Semantics and Theory of Mind

Research on the relationship between lexical-semantic knowledge and theory of mind ability has focused more specifically on the acquisition of a representational understanding of mind, marked by performance on false belief tasks. The majority of children with autism across all the studies that have been conducted fail false belief and other related tasks (see Baron-Cohen's review, this volume). In most of these studies subjects' lexical knowledge is measured using a standardized test of receptive vocabulary: the Peabody Picture Vocabulary Test (PPVT) or its British counterpart, the BPVT, and in general, significant correlations have been found between these measures and performance on theory of mind tasks. Happé (1995) conducted the most

comprehensive study of this relationship. She pooled the samples of children with autism, mental retardation and normal preschoolers who had participated in several different studies and found that for both the children with autism and preschoolers (but not the subjects with mental retardation) the correlation between BPVT scores and false belief performance was statistically significant, independent of age. Several other groups (e.g., Dahlgren & Trillingsgaard, 1996; Sparrevohn & Howie 1995) have reported similar findings, though it should be noted that not all studies do (Baron-Cohen, Leslie, & Frith, 1985; Perner, Firth, Leslie, & Leekam, 1989).

These findings are taken as evidence for a general relationship between lexical development and theory of mind ability, although the level of lexical knowledge needed to pass theory of mind tasks is significantly higher for children with autism than for normal children. Thus, Happé (1995) found that normally developing children had a fifty percent chance of passing false belief tasks at a lexical mental age level of 4 years, whereas for the autistic children the lexical level was over 9 years. Happé (1995) suggests that this difference between children with autism and normal children might be taken as evidence that children with autism rely on language more than other populations to help solve false belief and other theory of mind tasks. For individuals with autism verbal mediation may be their only way of 'hacking' out a correct solution to these tasks, which other children solve using non-linguistic cognitive mechanisms. This interpretation implies that language, as measured by lexical-semantic knowledge, may be causally related to theory of mind ability as measured on false belief tasks in autism, but perhaps not in other populations. We return to the role of language in the acquisition of false belief understanding in later sections of this chapter.

Cognition Verbs

At a theoretical level, it is not clear how general vocabulary size (as measured by the PPVT or BPVT) should be conceptually linked to a representational understanding of mind. In contrast, it is more obvious why one might expect specific connections between specific lexical terms, particularly verbs for mental states, and theory of mind ability. Studies of normal preschoolers have found a relationship between comprehension of semantic-pragmatic aspects of cognition verbs (*think, know, guess*) and the ability to pass false belief tasks (Moore, Bryant, & Furrow, 1989; Moore & Davidge, 1989). These studies used a task that tapped children's knowledge that these verbs denote different levels of certainty on the part of the speaker. In another study of preschoolers, the use of cognition verbs in spontaneous speech was found to be significantly correlated with theory of mind performance (Astington & Jenkins 1995).

Few studies have investigated this more specific link between lexical knowledge of cognition verbs and theory of mind in autism, though Tager-Flusberg (1992) found that young children with autism almost never used these terms in conversations with their mothers. Kazak, Collis, and Lewis (1997) found that for children with autism, knowledge of the verbs *know* and *guess* in relation to themselves and other people, was related to scores on the BPVT. And in another recent study Ziatas and her colleagues used the same procedures as Moore et al. (1989), and found a significant relationship between false belief performance and certainty judgements for cognition verbs, *think, know*, and *guess* for children with either autism or Asperger syndrome (Ziatas, Durkin, & Pratt, 1998). While they caution against using their correlational data to infer the causal direction of this relationship, Ziatas et al. (1998, p. 762) do state that "it is theory of mind

that acts as a precursor to communicative functions such as belief term development." Unlike Happé (1995), who argued that language (as measured by general lexical knowledge) was needed for theory of mind development in autism, these authors appear to conclude the opposite, at least for the more specific knowledge of the certainty dimension for cognition verbs.

In an unpublished study we have also explored the relationship between knowledge of cognition verbs and performance on a false belief task (Tager-Flusberg, Sullivan, & Barker, 1995). We gave a group of 16 children and adolescents with autism a modified version of Moore et al.'s (1989) certainty task, comparing the verbs *know* and *think* as well as a standard location change false belief task. The same tasks were given to 34 children with mental retardation who were of similar age and verbal ability as the autistic subjects, and 21 preschoolers. Our main findings replicated those reported by Ziatas et al. (1998): there was a significant correlation found between the language and theory of mind tasks for all three groups: autism: $r(14) = 0.76$, $p < .001$; mental retardation: $r(32) = 0.53$, $p < .01$; and preschoolers: $r(19) = 0.46$, $p < .05$.

We then analyzed whether the children in each group were more likely to pass the language or the theory of mind task. For both the children with mental retardation and normal preschoolers, the false belief task was significantly more likely to be passed than the language task (for the mentally retarded group, 24 children either failed or passed both tasks; 10 failed the language task but passed the false belief task and none failed false belief and passed language; for the preschoolers, 15 either failed or passed both tasks and 6 failed language but passed false belief). Thus for these groups it appears that false belief is acquired <u>before</u> this aspect of the semantics cognition verbs, as suggested

by Ziatas et al. (1998). In contrast, for the children with autism the findings were more equivocal: 5 subjects failed both tasks, 10 passed both tasks, and only 1 passed false belief but failed certainty. We conclude that for our autistic sample, linguistic knowledge of speaker certainty as denoted by cognition verbs is acquired at about the same time as theory of mind, indicating perhaps a more integral developmental connection between these kinds of linguistic and cognitive achievements in autism.

Syntax and Theory of Mind

Until relatively recently, the theoretical and empirical relationships between syntactic knowledge and theory of mind ability have been somewhat neglected (but see chapter by de Villiers, this volume). Tager-Flusberg and Sullivan (1994) were the first to include a standardized measure of syntactic comprehension in addition to IQ and PPVT measures, in a study of theory of mind abilities in subjects with autism and mental retardation. We chose as our measure of syntactic knowledge the Sentence Structure subtest of the Clinical Evaluation of Language Fundamentals (CELF-R), on which about half the test items include complex, multi-clause sentences. One of the main findings in this study was that for the subjects with autism the strongest predictor of performance on both false belief [$r(26) = 0.60$, $p<.001$] and explanation of action tasks [$r(26) = 0.64$, $p<.001$] was the measure of syntactic comprehension. Similar findings were obtained for the subjects with mental retardation on the false belief task [$r(26) = 0.67$, $p<.001$] but not the explanation of action task [$r(26) = 0.35$, n.s.]. These findings were taken as evidence that for individuals with autism there is a strong relationship between syntactic knowledge and overall theory of mind ability; in mental retardation the relationship seemed to be more specific to measures of a representational understanding of mind.

This relationship between theory of mind and language might be a general one, in that false belief tasks involve complex narratives and often include test questions that include complex syntactic constructions (e.g., *Does X know where Y is? Where does X think Y is?*). Thus one might interpret these findings as showing that children require the 'language of the task' in order to follow the narrative and answer complex test questions. Alternatively, the relationship between syntactic knowledge and theory of mind might be more specific, related to sentential complements.

Complementation and Representing Propositional Attitudes

de Villiers (1998; de Villiers & Pyers, 1997; de Villiers & de Villiers, in press; see also this volume) has pointed out that the cognitive architecture required to represent propositional attitudes, in which the content of the proposition could be marked true or false, is isomorphic to the linguistic representations needed for complement constructions, in which one clause is embedded in a matrix sentence (see also Tager-Flusberg, 1997). From an evolutionary perspective, those parts of the grammar (complementation and control) that allow for the embedding of one propositional argument under another proposition seem to be specially designed for the expression of propositional attitudes that are at the heart of a theory of mind (Pinker & Bloom, 1990; Tager-Flusberg, 1997). Indeed, the two primary classes of verbs that take sentential complements are cognition or mental state verbs (e.g., *Bobby <u>thought/ forgot/ knew</u> that the cake was in the cupboard)*, and communication verbs (e.g., *Dad <u>said/argued/whispered</u> that the cake tasted terrible*). Both these verb classes convey the attitude of the person holding the mental state or communicating.

Complementation involves special semantic and syntactic properties that are intimately linked to theory of mind developments (de Villiers, 1998; Tager-Flusberg, 1997). de Villiers (1998) claims that complementation is uniquely suited for representing false belief because the semantics of complements allow one to talk explicitly about a distinction between the way things are in the world and the way things are represented in the mind. Thus, non-embedded sentences simply represent the world as it is:

(1) Bobby baked a cake and went out to play.

In contrast, sentences containing complements may or may not be based on truth or reality:

(2) Bobby thought that the cake was ready.

(3) Dad said that the cake tasted delicious.

This kind of analysis would apply to any theory of mind task that requires the child to judge the truth content of a mental state against reality, or another person's mental state.

At the syntactic level, the subordinate clause appearing under verbs of cognition or communication is not merely an optional argument or independent clause (called an adjunct), but is selected for and embedded under the verb in an obligatory fashion (or as a complement). One crucial way in which adjuncts and complements work differently is that wh-questions can only be extracted from complements, not from adjuncts. For example, consider the following sentences:

(4) Why did Bobby think$_t$ that Dad put the cake away$_t$? (complement)[1]

(5) Why did Bobby say$_t$ Dad put the the cake away$_t$? (complement)

[1] In linguistic notation $_t$ denotes a 'trace' left by the moved wh-question; and * marks an ungrammatical interpretation or sentence.

(6) Why did Bobby leave$_t$ after Dad put the cake away$_t$*? (adjunct)

They can all be interpreted as having the wh-question derive from the initial, or main verb [i.e., why did Bobby *think* (4), *say* (5), *leave* (6)]. However, only in the complement constructions could the wh-question also be extracted from the embedded clause (i.e. why Dad put the cake away). For (6), the grammar does not allow the wh-question to be extracted from the adverbial clause, which is a kind of adjunct or optional argument. Thus, at the syntactic level, adjuncts and complements can be distinguished in the way they behave in complex wh-questions.

For both communication and cognition verbs, certain constructions do block the interpretation of the wh-question from the embedded clause. Contrast the following pairs of sentences:

(7) When did Bobby say$_t$ Dad put the cake away$_t$?

(8) When did Bobby say$_t$ where Dad put the cake away$_t$*?

and

(9) When did Bobby think$_t$ Dad put the cake away$_t$?

(10) When did Bobby know$_t$ Dad put the cake away$_t$*?

Across all these sentences, the question can be about the main verb of communication or cognition: When did Bobby *say, think*, or *know* X? This is called the short-distance interpretation. However, for communication verbs a medial wh-question (e.g., *where*) blocks the interpretation that the question is derived from the embedded clause – called the long-distance interpretation. Thus, in (8) the question cannot be interpreted as being about when Dad put the cake away, even though this interpretation is permissible in (7). Similarly for cognition verbs, verbs such as *know* (called factive verbs), block the long-

distance interpretation, whereas verbs, such as *think* (called non-factive), do not. Thus, (10) can only be interpreted as a question about when Bobby knew Dad put the cake away, whereas (9) can be about either when Bobby thought it, or when Dad put the cake away. Together, the syntax and semantics of complement constructions provide the means for representing propositional attitudes, which lie at the heart of false belief and other representational theory of mind tasks.

Experimental Studies on Complements in Autism

In a recent series of studies we have explored the specific connections between performance on false belief tasks and knowledge of complement constructions for both cognition and communication verbs in subjects with autism and mental retardation. The subject groups, each including 20 older children and adolescents, were matched on age, language (PPVT and Sentence Structure), and IQ. Each subject was given two trials of a standard location change false belief task that only included a simple test question (*Where will X look for Y?*). We used this simple question to ensure that any relationship found between false belief performance and knowledge of complements was not simply a confound due to the ability or inability to answer test questions containing cognition verbs with complements on the false belief task. Among the subjects with autism, 7 passed and 13 failed the false belief task; among the subjects with mental retardation, 9 passed and 11 failed. There were no significant differences between the groups on the false belief task, probably because they were closely matched on the standardized language measures (cf. Tager-Flusberg & Sullivan, 1994).

Study 1: Extracting Complements from Complex Wh-questions

The first experiment tested the subjects' knowledge of the embedding structure of sentential complements, following the methodology introduced by de Villiers and her colleagues (de Villiers, Roeper & Vainikka, 1990). In this study, we told the subjects brief stories accompanied by photographs, followed by a complex wh-question that contained either a communication or cognition verb. Following de Villiers et al. (1990), we took the subjects' ability to answer these test questions as evidence of their knowledge of complement constructions.

In one story, for example, a girl was riding home when her radio fell off her bike. On arriving at her house, she found out that the radio was broken after plugging it in a wall socket and seeing that it no longer worked. The story provided temporal information about when the radio broke (when it fell off the bike) and when the girl was convinced that it was broken (when she plugged it in at home). Thus both these pieces of information were available as potential answers to the test question:

(11) When did the girl *think/know* that she broke the radio?

In a different story, a boy went to the movies one afternoon, and left his umbrella there. He realized this after he had returned home that evening, and told his father about his loss. Again information was provided about when the umbrella was lost and when the boy told his father about it: The test question for this story was:

(12) When did the boy *say/say where* he lost his umbrella?

In all, there were 8 stories presented in random order: 4 with cognition verbs (*know* or *think*) and 4 with communication verbs (*say* or *say where*). As can be seen from the above examples, we systematically varied whether the test wh-question could be

extracted from the embedded clause. Thus for 2 of the stories with cognition verbs, *know* was used (which blocks the extraction of the test question from the embedded clause); for 2 stories *think* was used (which does not block wh-extraction). Similarly for 2 of the stories with communication verbs, there was a medial wh-question - *say where* (which also blocks the extraction of the test question from the embedded clause); for 2 stories there was no medial wh-question (thus permitting extraction of the wh-question). Stories and test questions were counterbalanced across the subjects: half the subjects heard the test questions above in the non-blocked versions (*think* or *say*) and half heard the stories and questions in the blocked versions (*know* or *say where*).

Subjects' responses were coded in the following categories:

Short – an answer to the main verb of cognition or communication.

Thus for (8), this would be: *When she plugged it in*. Or for (9): *When he came home that evening.*

Long – an answer to a question extracted from the embedded clause.

For (8) this would be: *When it fell off the bike*. For (9): *When he was at the movies*.

Other – any other answer.

Note that for the questions containing *know* or *say where* the long responses are blocked and therefore not grammatical, whereas for all the test questions, the short responses are permitted.

We divided each group into those who passed and those who failed the false belief task. Figure 1 presents the number of short and long responses provided by each group. Among both the subjects with autism [$F(1, 18) = 12.56$, $p<.002$] and mental

retardation [F (1, 18) = 17.72, $p<.001$], those who passed false belief gave significantly more short responses than did those who failed. For the long responses, among the subjects with autism there were no differences between those who passed and those who failed [F (1, 18) = 2.24, n.s.]. In contrast, there was a significant difference for the subjects with mental retardation [F (1, 18) = 11.37, $p<.003$]. There was also a significant interaction effect for the subjects with mental retardation between verb and false belief status [F (1, 18) = 5.07, $p<.04$] that was due to the subjects with mental retardation who passed false belief giving significantly more long responses to the cognition verb *think* than to other verbs. This finding suggests that the mentally retarded group was more knowledgeable about cognition verbs than the autistic group, giving more correct responses to them. Finally, for both the autistic [F (1, 18) = 18.99, $p<.0001$] and mentally retarded [F (1, 18) = 64.88, $p<.0001$] groups, the subjects who failed the false belief task gave significantly more other responses, indicating that these subjects had difficulty interpreting the complex wh-question. There was a marginally significant group-by-verb type interaction [F (1, 38) = 3.32, $p<.07$]. This was because the subjects with mental retardation gave fewer other responses to the mental verbs than the subjects with autism. The groups were equivalent on the communication verbs.

Taken together, these findings suggest that the subjects with mental retardation were more sensitive to the difference between the communication and cognition verbs, and overall performed better on the test questions with cognition verbs. A regression analysis of the data confirmed this difference between autistic and mentally retarded groups. For both groups performance on the false belief task was significantly correlated with the two standardized language measures (PPVT and Sentence Structure) and with

performance on the communication and cognition verbs in the experimental complementation task. When all these variables were entered into separate regression analyses for the two groups, only one predictor variable was found to be significant. For the mentally retarded group the single significant predictor was performance on the cognition verbs [$R^2 = 0.61$, F (1, 18) = 30.85, $p<.0001$], whereas for the autistic group the single significant predictor was performance on the communication verbs [$R^2 = 0.43$, F (1, 18) = 14.61, $p<.001$].

These findings indicate that there are strong close connections between knowledge of complementation as evidenced by responses to complex wh-questions, and ability to pass false belief tasks. At the same time, the findings reported here suggest that the connections may be different for individuals with autism in that they rely on knowledge of the syntax for communication verbs, whereas individuals with mental retardation rely on their knowledge of cognition verbs.

Study 2: Extracting Complements from Communication Verbs

We followed up these findings in a second study, in which we investigated the same subjects' ability to extract the content of a clause embedded under a communication verb (*say*) in different contexts, using a simpler test question. We borrowed a method used by de Villiers and Desjarlais (reported in de Villiers, 1998) to investigate preschoolers' ability to report lies, mistakes and true statements. In their study, even the youngest preschoolers had little difficulty reporting true statements, but their ability to report lies was closely linked to their performance on a false belief task. The children who failed false belief tasks were more likely to report what really happened rather than what was said. In our study brief stories were told to the subjects, in which a main

character made a statement about key events that, depending on the context, was true, a mistake, or a deliberate lie about the event. There were 2 stories for each context and a photograph of the main character accompanied each story. The 6 stories were presented in random order, and at the end of each story, the subjects were asked: *What did X say*? Here is an example of one of the lie stories:

> This is a story about a boy named David. His mother likes him to read a book every day. But today David isn't reading his book. Mom called up to David and asked him what he was doing. David said, "I'm reading my book." But really David was watching television. Later Mom called David down for dinner.
>
> Test Question: *What did David say?*

Responses to the test questions were coded as correct if the subject captured the gist of the statement or gave a verbatim report of the character's utterance. For the lie and mistake stories, incorrect responses were coded as reality responses, if the subject stated what really happened, rather than what was said. Responses that were neither correct nor reports of reality, were coded as other.

We again divided both the autistic and mentally retarded groups into those who passed and those who failed the false belief task. In Figure 2 the data for the true and lie stories are presented; findings on the mistake stories were essentially the same as for the lie stories but are not shown here. On the lie stories, for both groups, subjects who passed the false belief task gave significantly more correct responses [$F(1, 36) = 28.25$, $p<.001$]; thus replicating de Villiers (1998) findings with preschoolers. The subjects with mental retardation made significantly more reality responses on both lies and mistakes (about 20% of their responses) than did the subjects with autism [$F(2, 76) = 13.28$, $p<.001$].

Interestingly, almost none of the incorrect responses from the subjects with autism were reports of reality. On the true stories, as expected, for the mentally retarded group there were no differences between those subjects who passed or failed the false belief task. Their performance was consistently high – about 70% correct. In contrast, the subjects with autism who failed the false belief task gave fewer correct responses on the true stories [$F(1, 36) = 3.9$, $p < .06$). These findings suggest that children with autism who fail false belief tasks also have problems extracting the complement from a sentence with a communication verb independent of context, suggesting they have greater difficulty with the syntax of complements for communication verbs. This finding on the relationship between the ability to report what someone said in response to a simple wh-question and performance on false belief tasks appears to be unique to autism. The results of this study confirm that knowledge of complements for communication verbs seems closely tied to theory of mind ability in this population.

Study 3: Referential Opacity

The final study to be reported here explored a semantic property of cognition and communication verbs, referred to as referential opacity. Ordinary verbs, such as *move*, are never considered to be opaque; they always allow for substitutions of the main referent. Consider the following example, taken from de Villiers and Fitneva (1996). A mother prepared for her daughter Sarah a surprise birthday gift of a silver box containing candy. Under an ordinary verb like *move*, each of the following statements is equivalent:

(13) Mom moved the silver box (container)

(14) Mom moved the candy (contents)

(15) Mom moved the gift (function)

Thus, we can say that the ordinary verb *move* is referentially transparent, because the term for the referent (box/candy/gift) can always be substituted. In the examples here it would not matter whether Mom or Sarah (who does not know what is in the box or what it's for) moved the object. This is not true for verbs of communication or cognition, depending on the context. Verbs of communication generally do not allow substitution of referential terms, (unless one makes an interpretation of intended meaning). Continuing with the example introduced here, suppose that Sarah walked into the room, saw the box, and asked her mother why there was a box on the table. While it would be true to state:

(16) Sarah asked why the box was on the table.

One would not be able to substitute either *candy* or *gift* under the communication verb *ask*:

(17) Sarah asked why the candy/gift was on the table.*

Similarly, if the mother told Sarah not to touch the box, it would be true that

(18) Mom told Sarah not to touch the box.

But one could not substitute under the communication verb *tell*:

(19) Mom told Sarah not to touch the candy/gift.*

The situation is more complex for cognition verbs such as *know*. For Sarah, who is ignorant about the contents and function of the box, the referent (or complement under the verb *know*) is opaque. Thus whereas one could state:

(20) Sarah knew the box was on the table.

One could not state:

(21) Sarah knew the candy/gift was on the table.*

In contrast, because the mother did know about the gift of candy, we could state:

(22) Mom knew the box/candy/gift was on the table.

For the person who has access to the relevant knowledge, cognition verbs are not referentially opaque. This insightful analysis of role of pragmatics or context in the referential opacity of cognition verbs by de Villiers and Fitneva (1996) suggests that there should be close ties between understanding this linguistic property and theory of mind ability. Their work with normal preschoolers confirmed this hypothesis.

Our study with autistic and mentally retarded groups was modeled after the task introduced by de Villiers and Fitneva (1996). We told 4 stories similar the one sketched here. Each story was about a container, its contents and function. One person in the story knew the contents and function of the container, one did not. Each of the stories, that were presented in random order, was accompanied by a set of pictures, and included a series of yes/no questions. Half the questions referred to the person who knew (e.g., Mom), half to the ignorant person (e.g., Sarah). For each character in the story there were 2 questions with ordinary verbs, 2 with cognition verbs and 2 with communication verbs. Half these questions were about the container and half about either the contents or function. In addition two control probe questions were included on each story (e.g., *Does the box have money in it?*) to make sure the subjects were not biased or random in their yes/no responding.

We first examined the responses to the probe questions: 7 subjects with autism and 2 subjects with mental retardation made more than 1 error across the 8 probes (2 per story). These subjects were eliminated from further analyses, and the mentally retarded group was further pruned down to 13 subjects who matched the 13 remaining subjects with autism. We examined the data separately for each type of verb. Following de

Villiers and Fitneva (1996) we used a derived score that reflected the difference between responses to questions about the container (which were true under all verbs in all conditions) and questions about either the contents or function (which could be true under some verbs and in certain conditions). Using this derived score, a low score (maximum=4) meant that subjects did allow substitution, treating the verb as transparent, whereas a high score meant that subjects did not allow substitution, treating the verb as opaque.

The data for this experiment are presented in Figure 3. Looking first at the data for ordinary verbs, which should be treated as transparent (low score) for both the person who knows the contents or function and for the ignorant person, it is clear that there are interesting differences between the autistic and mentally retarded groups. The mentally retarded group was, surprisingly, somewhat more resistant than the autistic group to referential substitution even for ordinary verbs [$F(1, 22) = 6.11$, $p<.03$]. This was especially true for those subjects who passed the false belief tasks [$F(1, 22) = 8.35$, $p<.009$]. While it is not entirely clear how to interpret these findings for the subjects with mental retardation, one possibility is that they are treating some of the ordinary verbs (e.g., *take*) as if they had some implicit intentionality. On this view, the subjects with mental retardation are reading psychological causality into some of the ordinary verbs and resisting referential substitution, especially for the ignorant character in the story. de Villiers, Pyers and Broderick (1997) obtained similar findings from young preschoolers in a longitudinal study on the acquisition of referential opacity. In contrast, the subjects with autism were much less likely to make this mentalistic interpretation of ordinary verbs.

The data for the communication verbs show a striking effect of theory of mind ability. For the both the subjects with autism and mental retardation, those who passed the false belief task correctly resisted referential substitution treating these verbs as opaque, as denoted by their high derived scores [$F(1, 22) = 32.89$, $p<.0001$]. Those who failed the false belief task did not interpret these verbs as opaque. There was also a significant effect of false belief performance on the interpretation of cognition verbs [$F(1, 22) = 9.86$, $p<.005$]. The subjects with autism and mental retardation who failed the false belief task again treated them as transparent across all contexts. Those who passed false belief distinguished between the person who knew the contents or function of the container, allowing for referential substitution for this character, and the ignorant person, for whom the cognition verbs were treated as referentially opaque [$F(1, 22) = 18.68$, $p<.002$]. There was also a significant interaction between group and false belief status [$F(1, 22) = 9.86$, $p<.005$] indicating that the subjects with mental retardation who passed false belief tasks were more resistant to substitution that the subjects with autism on cognition verbs.

This study demonstrates that a representational understanding of mind is closely linked to knowledge that under certain conditions complements for both communication and cognition verbs are referentially opaque. These findings replicate for autism and mental retardation what de Villiers and Fitneva (1996) found for preschoolers. In addition, this study revealed that subjects with mental retardation were more sensitive than subjects with autism to the referential opacity of cognition verbs, and were more likely to interpret even ordinary verbs in an intentional or mentalistic way, as was found for normally developing preschoolers (de Villiers et al., 1997).

Complements and Representing Beliefs in Autism

The three studies summarized here revealed close connections between linguistic knowledge of complement constructions and a representational understanding of mind as evidenced in performance on false belief tasks. These connections were found not only for individuals with autism, but also for children and adolescents with mental retardation. And because the test questions in our false belief task contained no complements or cognition verbs, the findings are not simply due to overlapping measures. They replicate similar findings for normally developing preschoolers as well as oral deaf children who have normal intellectual and social abilities but limited language (de Villiers & de Villiers, in press; see also this volume; Tager-Flusberg, 1997). These specific connections between complements and false belief across so many populations suggest that there is something fundamental in the developmental relationship between these linguistic and cognitive achievements.

At the same time, these studies revealed interesting and potentially important differences between the mentally retarded and autistic groups. For the subjects with mental retardation there was a particular close connection between knowledge of the syntax and semantics of cognition verbs and theory of mind. In the first experiment, the subjects with mental retardation performed better on the cognition verbs than the subjects with autism. Furthermore, the regression analysis showed that their performance on the false belief tasks was uniquely predicted by knowledge of the syntax for cognition verbs. This analysis suggested that the relationship between language and theory of mind was specific to complements, because neither of the general language measures (vocabulary or general syntax) contributed any additional variance to the regression model. Finally,

in the third experiment the subjects with mental retardation were more likely than the subjects with autism to view cognition verbs as referentially opaque and to resist referential substitution for the ordinary verbs, suggesting that they treated at least some of these latter verbs as intentional or including a mentalistic semantic dimension.

In contrast, the subjects in the autistic group appeared to be less sensitive in these experiments to the linguistic properties of the cognition verbs; instead they showed closer links between the communication verbs and false belief performance. In both the first and second experiments difficulty in extracting the embedded clause from communication verbs (as evidenced by the higher percentage of other responses) was strongly related to failure on the false belief task for the autistic group. The regression analysis in the first study indicated that knowledge of complements for communication verbs was uniquely predictive of false belief performance; and again this relationship was due to specific rather than general linguistic knowledge. Overall, the subjects with autism appeared to be more impaired on the cognition verbs, which is not surprising given that they do not use these verbs in conversation or other forms of discourse (Baron-Cohen et al., 1996; Tager-Flusberg, 1992). In autism it does not appear that cognition verbs provide a developmental connection to theory of mind. Whereas in other populations such as preschoolers, oral deaf children and individuals with mental retardation (de Villiers & de Villiers, in press; this volume; Tager-Flusberg, 1997), close developmental links are found between a representational understanding of mind and linguistic knowledge of complements of cognition verbs, in autism parallel links are found with communication verbs.

What is the direction of these relationships between theory of mind and sentential complements? Because our studies are all cross-sectional it is not possible to answer this question directly using the findings reported here. Some clues, however, can be taken from de Villiers' longitudinal studies of preschoolers (de Villiers, 1998, this volume; de Villiers & Pyers, 1997; de Villiers et al., 1998) and work by de Villiers and de Villiers (in press) on oral deaf children. These studies suggest that the knowledge of the syntax of complements (treating embedded clauses as complements not adjuncts) as evidenced by use of these constructions to describe the contents of a person's beliefs, or to answer wh-questions containing embedded complements, precedes the ability to pass false belief tasks. Thus the language of complements appears to be important for the acquisition of a representational understanding of mind, according to de Villiers. At the same time, a representation view of mind appears to develop in children before they know that verbs of communication and cognition are referentially opaque under certain conditions (de Villiers et al., 1997), or that factive verbs of cognition block long distance extraction of wh-questions. Thus over the course of the preschool years, knowledge of language (complements) and cognition (representational theory of mind) exhibit mutually influencing developmental constraints, though it is suggested that the structure of complement constructions provides the initial step into representing beliefs in other minds.

In autism, the connections between the knowledge of complements, especially for communication verbs and theory of mind ability are especially strong. Because individuals with autism are less sensitive to cognition verbs in language and have less intuitive knowledge of mental states, they are likely to be even more reliant on the

structural relationship between complements and propositional attitudes to bootstrap their way into a representational understanding of mind (Happé, 1995; Leslie & Roth, 1993; Tager-Flusberg, 1997). The data presented here indicate that they may depend especially on complements for verbs of communication as their developmental entrance into the ability to represent false beliefs. At the same time, it should be noted that despite the ability of some older children with autism to pass false belief, which may be a product of their more advanced linguistic knowledge, they still lack mentalistic insight into their own or others' behavior and remain impaired in their everyday social interactions (Frith, Happé, & Siddons, 1994). Language may help them pass experimental tests of a representational mind, using alternate neurocognitive mechanisms that do not mirror the ways in which other children solve these tasks.

Connecting Minds to Language in Autism

Autism involves fundamental impairments both in understanding other minds and in language. Together, these cognitive deficits contribute significantly to the social difficulties experienced by all individuals with this devastating disorder. Research on autism has revealed that in this syndrome the development of language is even more closely connected to theory of mind and other aspects of cognitive functioning than for any other population (Lord & Paul, 1997; Tager-Flusberg, 1993, 1997). The work reviewed in this chapter illustrates how pragmatic, lexical and grammatical development all show uniquely strong relationships to theory of mind knowledge in children and adolescents in autism across all ages and levels of ability.

The details of many aspects of these relationships have yet to be uncovered. Nevertheless, research on pragmatic aspects of language suggests that they are connected

at all developmental points to the child's understanding of mind: from the emergence of communicative functions grounded in joint attention, to the development of advanced social cognitive constructs in middle childhood. These deep, pervasive, and complex connections between theory of mind and pragmatics, not only in autism but also for other children, may be taken as evidence that they are rooted in the same cognitive mechanisms. Connections between lexical and grammatical knowledge and theory of mind appear to be more constrained to a particular developmental stage when the child acquires a representational understanding of mind.

What can we say about the direction of the relationships, and the causal connections between language and theory of mind? The answer to this question is likely to be complex, depending on which components of language and which components of theory of mind we are concerned with at different developmental stages. At this point, we can only begin to sketch out a model of how these two domains may be inter-related over the course of development.

As discussed in a previous section of this chapter, the emergence of language and communication appears to be rooted in early theory of mind understanding, as evidenced in joint attention. Thus, the social-cognitive mechanisms that underlie joint attention, and related conceptual knowledge about the mentalistic nature of people, are crucially tied to the onset of communication and language. In autism, impairments in joint attention explain why language is delayed, and, in the extreme, may account for why a significant number of children with this disorder never acquire language. Deficits in an early understanding of mind account for many other aspects of the pragmatic impairments found in autism. Indeed, the literature on autism suggests that pragmatic development is

even more closely tied to theory of mind ability in autism than in other populations, suggesting that in this population (but maybe not others), these two domains may continue to depend on the same underlying neurocognitive mechanisms.

The acquisition of a representational understanding of mind, which takes place at around 4 years of age in normally developing children, marks a qualitatively different stage in theory of mind development. The capacity to understand that a person could hold a false belief depends on a more complex cognitive representational system than is needed to support the implicit understanding that people are mental beings. At this stage, language, specifically knowledge of the structure of complement constructions, may play a key role in this aspect of theory of mind development for all children (de Villiers & de Villiers, in press). We suggest that linguistic knowledge of complements may be even more crucial for children with autism for the ability to understand and represent false beliefs. Furthermore, the data presented in this chapter suggest that even though children with autism, like other groups of children, exploit the structural parallels between the language of complements and the representation of other minds, they do so in unique ways. Unlike other children, for children with autism it is linguistic knowledge about <u>verbs of communication</u> that provides the crucial link to false belief. Through listening and speaking about acts of communication (what people say), rather than thought (what people think), children with autism come to be able to represent that a person may hold a false belief. For people with autism language is thus causally connected to this aspect of a theory of mind in two ways: through talking about talk, and by using the parallel representational architecture for the syntax of communication verbs and propositional attitudes.

There is still much to be learned about the developmental pathways taken by children with autism and other disorders in their acquisition of language and a theory of mind. We have only begun to outline some segments of these pathways based on the evidence of how closely these domains are connected in different directions, at different developmental stages. Without longitudinal studies, however, we can still only speculate about the causal direction these relationships might take for specific aspects of linguistic and pragmatic knowledge and particular components of theory of mind.

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Figure Legends

Figure 1

Mean Number of Short and Long Responses to Complex Questions in Study 1.

Figure 2

Percentage of Correct, Reality, and Other Responses to the True and Lie Stories in Study 2

Figure 3

Referential Opacity Scores to Ordinary, Communication, and Cognition Verbs in Study 3