Communicating Your Way to a Theory of Mind

The development of mentalizing skills in children with

atypical language development.

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The Beautiful Lie

He was about four, I think... it was so long ago.
In a garden; he'd done some damage
behind a bright screen of sweet-peas
- snapped a stalk, a stake, I don't recall,
but the grandmother came and saw, and asked him
"Did you do that?"

Now, if she'd said why did you do that,
he'd never have denied it. She showed him
he had a choice. I could see in his face
the new sense, the possible. That word and deed
need not match, that you could say the world
different, to suit you.

When he said "No", I swear it was as moving
as the first time a baby's fist clenches
on a finger, as momentous as the first
taste of fruit. I could feel his eyes looking
through a new window, at a world whose form
and colour weren't fixed

but fluid, that poured like a snake, trembled
around the edges like northern lights, shape-shifted
at the spell of a voice. I could sense him filling
like a glass, hear the unreal sea in his ears.
This is how to make songs, create men, paint pictures,
tell a story...

By Sheenagh Pugh, 2002

To Petter, William and Elsa with love

ABSTRACT

Falkman, W. Kerstin (2005). *Communicating Your Way To a Theory of Mind. The development of mentlizing skills in children with atypical language development.* Department of Psychology, Göteborg University, Sweden.

This thesis aimed to study the development of theory of mind (ToM) in two groups of children with atypical language development, using a longitudinal design. The two groups were children with cerebral palsy and severe speech impairment (SSPI) (aged between 5 and 7 years at the first data collection) and deaf non-native, early signing, children (aged between 7 and 10 years at the first data collection), the emphasis being on the deaf children. In *study I* a 2-phase longitudinal study was conducted in order to explore the developmental aspects of ToM in children with SSPI. Using a three-stage developmental model of theory of mind suggested by Gopnik and Slaughter (1991) the question of deviance versus delay in the development of theory of mind was also addressed. The aim of *Study II* was to investigate ToM skills in non-native signing children who were offered what seems to be very good conditions for developing their language, given the lack of a signing deaf person in the home. If delays in the development of theory of mind would be found even in this group it would constitute a further strong support for the importance of conversational experience in a language common for the child and the family/caretakers. It has been argued that linguistic complexity of ToM tasks might mask a child's underlying competence. In *Study III* therefore a ToM task less linguistically challenging was given to the same group of children as in study II in order to see if this would improve their results. A possible relationship between working memory, both verbal and visuo-spatial, and ToM performance was also explored. The aim of *study IV* was to examine the referential communication abilities in a group of non-native early signing, deaf children. A further aim was also to examine the possible role played by chronological and mental age, IQ, working memory and linguistic skill in the ability to complete the referential communication task. A comparison between referential communication and a standard theory of mind task was also done. Results from *Study I* indicated a non-deviant, but severely delayed ToM development in the children with SSPI. In *Study II* the results showed that the hearing children performed better than the deaf children on all ToM tasks and there was also very little development over time in the deaf group. Results in *study III* showed that lowering the linguistic demands of the ToM task did not help the deaf children. The deaf children's performance on the spatial and verbal backward recall working memory tasks matched that of the hearing children, but they did not perform as well as the hearing children on the verbal working memory task, forward recall. *Study IV* showed that the hearing children were more efficient than the deaf children in the referential communication task. They also provided more relevant information and were better at judging whether enough information had been provided or not. These differences were significant and were not affected when age (chronological and mental), memory (verbal and spatial) and theory of mind was controlled for. The results speak in favour of the crucial importance of early communication using a language common for both child and family for the typical developmental trajectory of mentalizing skills, providing support for the early social-interaction hypothesis for the development of ToM.
Keywords: cerebral palsy, deafness, early interaction, longitudinal design, mentalizing, theory of Mind .

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ACKNOWLEDGEMENTS

First and foremost I wish to express my sincerest gratitude to my supervisor professor Erland Hjelmqvist. For everything he has taught me, for his confidence in me, his wonderful sense of humour and for interesting talks on everything from science to soap operas.

Second, I would like to thank Docent Annika Dahlgren Sandberg, my dear friend and mentor, for endless generosity in sharing her time and knowledge with me. Annika was the one who introduced me to the field and has continued to inspire and support me throughout this work.

I would also like to thank all my friends and colleagues who have been there for me, providing moral support whenever needed, especially the following: Dr SvenOlof Dahlgren, Dr Ann Frisén, Dr Cecilia Jacobson, Maria Larsson, Dr Åsa K Johansson-Lundberg, all the members of the KOSA research group and the Health and Ageing Psychology research group as well as the technical and administrative staff at the department.

Furthermore I wish to thank Professor Mikael Heimann for carefully reviewing the manuscript and providing valuable comments on my work. I am also indebted to professor Linda Siegel for reading and providing valuable suggestions on an earlier draft of this thesis. I gratefully acknowledge contributions to data collection by Karin Mellberg, help with language assessment by Dr. Carin Roos and Göran Lindén as well as help with statistical analyses from Dr. Bengt Jansson. Thank you also to Professor Kristina Svartholm who used her great expertise to help us evaluate the translations of test-material from Swedish to Swedish sign language.

I am forever indebted to my loving and supporting family: My husband Petter (my very best friend in life, for your never failing love and encouragement, I could never have done this without you), my children William and Elsa, my sister Yvonne, my parents Katarina and Gavin Watson, Jan and Marian Falkman. Also in loving memory of my grandparents Harald and Valborg Allvin and Sophia Watson.

Last, but not least, I would like to thank all the participating children and their families for generously letting me into their lives and their homes, and also involved teachers and school administrations for their generosity and cooperation, making this research project possible

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Kerstin W. Falkman

Göteborg, January 2005

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INTRODUCTION

Relationships are the foundation of development. Since the late 1970's developmental psychology has stressed the importance of early interactions between caregiver and child in development of the child's personality. During the 1980's the circle of important relationships expanded to include also the importance of peers in the child's social, cognitive and linguistic development. Children need to be able to develop a social competence together with other children. According to Hobson (1993) children need to develop the ability to recognise the existence of other selves with whom they have much in common but from whom they are differentiated. Trevarthen (1987) concisely summarizes the relationship like this: "It is sharing that makes sense" (p.299).

Hartup (1989) argues that these two different types of relationships, the child-adult and the child-child relationships, both seem to be equally important to the child's development. He is also of the opinion that they have slightly different functions in this context. One of the relationship types, which he names the vertical one, is characterized by the communication partner, most often an adult, having more power and more knowledge than the child. It is within this type of relationship that the child starts to develop social competence. The other type of relationship, the horizontal one, is more equal in nature. Both parties, in this case always children, posses the same social power and position. It is within these relationships, the complexities of co-operation and competition are mastered and intimacy in social relations is first achieved. Of course a child-child relationship is not always horizontal, however, an older sibling, for example will most often have more power and more knowledge than a younger sibling.

The emergence of communication and language are fundamental in the child's forming of relationships of both types as well as in their development as a social being. A number of children, however, meet with difficulties in this respect. Cerebral palsy and severe speech impairment (SSPI) can be one such complicating factor for communication and language skills to emerge, hearing loss and deafness another. This thesis investigates children with SSPI and deaf children from a communicative and a social-cognitive point of view, with an emphasis on deaf children.

Social cognition

Social cognition could, very broadly, be defined as the way we think about other people. It is involved in all human interaction, which of course makes the development of an awareness and understanding of people's thoughts, emotions and behaviour extremely important for children to be able to function effectively in their social environment.

The study of the ways in which children understand what people think has its origins in Piaget´s work, which began over 70 years ago (e.g. Piaget, 1926). According to Piaget children begin development by being cognitively egocentric. By egocentricity Piaget meant the child's inability to imagine any way of experiencing the world other than his or her own. Children tend to regard things only from their own, limited, perspective. They are also thoroughly convinced that this is the only perspective possible, something that is also reflected in their use of the spoken language. Piaget argued that the child's egocentric thinking and speech, or the child's "centring on the self", which he later chose to call it, is an indication that the child does not try, or is not capable of, taking the view of the listener.

The success of all human social interaction is dependent of a "social intelligence", which has a number of different components, e.g. the ability to recognize conspecifics, to know one's place in society, to learn from others and to teach novel skills to others (Frith & Frith, 1999). More recent research into young children's understanding of the mind has come to focus mainly on one specific aspect of this social intelligence: the ability to impute mental states to oneself and to other people, and to understand that these mental states also influence how a person will act in a given situation, what is commonly referred to as children's "Theory of Mind" (ToM) (Tager-Flusberg, Baron-Cohen & Cohen, 1993). Understanding the intentions, feelings and actions of others and reacting accordingly is a powerful tool for explaining, predicting and manipulating the behaviour of others and is also crucial in helping people survive in a complex social world (Dunn, 1988). This capacity also reaches beyond the ability to manipulate the behaviour of others by direct instrumental action.

Theory of mind

The term theory of mind (ToM), as it is used within the field of psychology, originates from a landmark paper in primatology by Premack and Woodruff (1978), in which the main

aim was to investigate whether chimpanzees could be said to have anything like a theory of mind. While it is still an open question whether non-human primates possess such understanding or not (Call & Tomasello, 1999), both the question and the experimental paradigm were taken up, and extended, by developmental psychologists (Wimmer & Perner, 1983; Perner & Wimmer, 1985).

Research on theory of mind, sometimes also referred to as mentalizing, mind reading, folk psychology or belief-desire psychology, in children begun in the early 1980's and today interest in young children's understanding of their own and other's mental lives has become one of the most active and fastest growing areas of research in developmental psychology. It is currently dominating the research being done within the field of children's understanding of the mind. Theory of mind has been viewed as the foundation for our adultlike understanding of the social world. Our understanding of mental states is the foundation of our appreciation of literature, opera, drama and film. It animates our humour and helps us make sense of the complex patterns of social relationships that surrounds us, including acts of deception (Siegal & Varley, 2002).

The false-belief paradigm

Research on children's development of ToM has centred to a large extent around the question of when it is that children first are able to attribute false belief to others. In other words, at what point in development could children be said to first acquire the ability to understand that people will act according to their own beliefs, even when those beliefs are false (i.e. do not fit with reality)? The ability to understand false beliefs rapidly became accepted as the main indicator for whether a child has developed a ToM or not. The reason that false-belief understanding has been afforded this critical role is that beliefs are not direct copies of reality, they are only representations of it, and as such, they can always also be misrepresentations. Accordingly, unless we understand that beliefs can be false we cannot be said to grasp the representational nature of beliefs (Hala & Carpendale, 1997).

The procedures used by Premack and Woodruff (1978) in their work with chimpanzees, together with comments by philosophers such as Dennett (1978) and Pylyshyn (1978), were taken up by developmental psychologists Wimmer and Perner who, in 1983, published a landmark paper in which they introduced the now classic "Maxi" or so-called "unexpected

transfer" task. This is a story that is acted out for the child with the help of dolls and other toys (fig.1). Things are arranged so that the child's own beliefs are true, i.e. they reflect the way the world is, while the other participating person's beliefs are false. The child is then asked how that other person will act in a given situation. If the children can recognise that the other person will act according to his or her false beliefs, then we can be reasonably sure that they have the ability to attribute beliefs to the other (Astington & Gopnik, 1991). This procedure has subsequently been used in various forms by numerous others (e.g. Baron-Cohen, Leslie & Frith, 1985; Perner, Leekam & Wimmer, 1987; Gopnik & Astington, 1988).
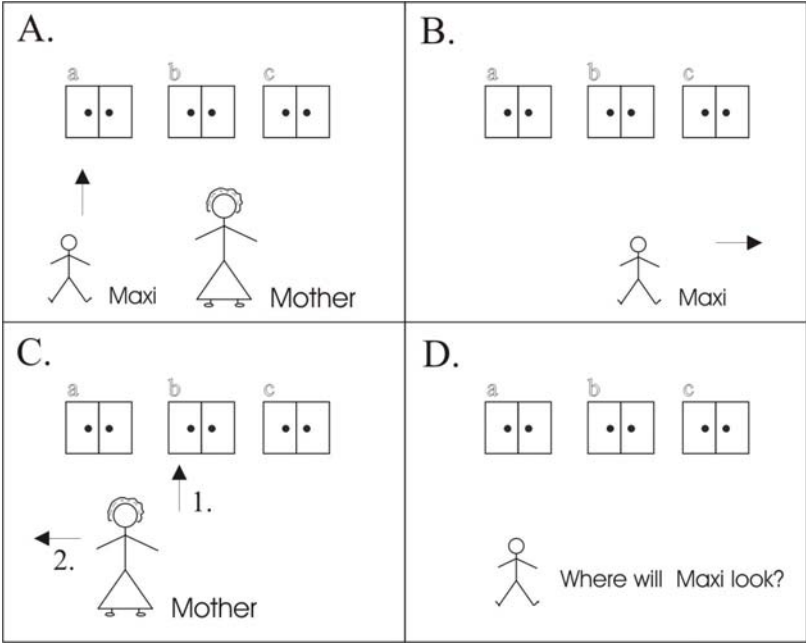
Figure 1. An adapted version of the unexpected transfer task (Wimmer & Perner, 1983).

A. Mother returns from her shopping trip. She has bought some chocolate for Maxi who loves chocolate. Maxi puts the chocolate away in cupboard A.

B. After Maxi has put the chocolate away, he goes out to play.

C. Mother takes the chocolate out of the cupboard and uses some of it for a cake. She then puts the chocolate back, not in cupboard A, but in cupboard B. She then goes out to by some more eggs for the cake.

D. Maxi comes back from the playground. He is hungry, and he wants some chocolate. Where will Maxi look for his chocolate?

The importance of false belief is essentially methodological. The false-belief task allows the subject and another individual to have different beliefs and for these to be explored experimentally. Results from the Wimmer and Perner study (1983) and from subsequent

research (Perner, Leekam & Wimmer, 1987; Sodian 1991 etc) showed that normally developing children are able to pass the unexpected transfer task, which is a so-called first order belief attribution task, by the age of 4, i.e. they have at that age developed the ability to think about someone else's thinking. It is thought that the reason 4-year-old children are able to pass the unexpected transfer task is that they fully understand about people's desires (Maxi *wants* to find the chocolate), beliefs (Maxi *thinks* the chocolate is where he left it last), and emotions (he is *surprised* when he does not find the chocolate where he left it last). Thus, by approximately 4 years of age children have an "adult-like" belief-desire psychology within which they can co-ordinate belief and desire to explain and predict behaviour (Bartsch & Wellman, 1995).

Major competing theoretical accounts of the development of theory of mind

The acquisition of understanding of false belief around four years of age is by now a highly robust and much replicated finding (Astington & Gopnik, 1991; Perner, Leekam & Wimmer, 1987; Wellman, 2001). The mechanisms underlying the development of theory of mind, however, are still the subject of considerable debate. Several theories have been put forward in an attempt to explain the development of children's understanding of the mind. The three most dominant, and most widely debated, theories of children's theory of mind so far have been the *theory theory*, the *modularity theory* and the theory of *mental simulation*.

Theory theory

Theory theory is perhaps the most dominant of the three main theories. Theory theorists argue that older children's and adult's knowledge of the mind consists of a theory and that development in ToM is essentially one of hypothesis testing. By a theory is not meant an actual scientific theory, but more of an informal theory, much in the same way as we can be said to hold informal theories about other domains such as physics. In our everyday conception of physics we do not attempt to provide a complete scientific account of why, for example when we kick a ball, it rolls away from us. Instead we simply understand that the impact of a moving object (our foot) upon a stationary one (the ball) sets the latter in motion (Hala & Carpendale, 1997).

The theory theorists thus argue that we make use of an informal theory, or a conceptual framework, that fits three criteria that are necessary for it to qualify as a theory (Wellman, 1988; 1990). First, we identify the constructs of a particular theory by making distinctions between those entities or processes that are part of the theory and those that are not. In the case of a theory of mind entities, or processes, such as beliefs, desires, and thinking are found only in the domain of the mental and thus satisfy the first criterion. The second criterion is that the framework has to be constructed from a set of concepts that are interrelated, i.e. in order to explain someone's actions we need to understand how beliefs, desires and intentions interconnect to produce a particular intention to act. Finally, there must be a causal-explanatory scheme for using these interrelated concepts. For a theory of mind this scheme involves combining the mental state constructs according to certain rules in order to predict and explain action. The model would thus predict that people form intentions to act on the basis of their beliefs together with their desires, and that these beliefs and desires are causally related to their subsequent actions (Hala & Carpendale, 1997).

This theoretical way of understanding mental life applies not only to the way in which we think about the mental states of other people, but also to how we understand our own mental states. According to theory-theory, we have no privileged access to our own mental states simply because they are our own. The finding that 3-year-old children are typically as bad at remembering their own prior belief when this belief is proven wrong as they are at predicting another person's false belief (Astington & Gopnik, 1991) has been put forward to support this.

Researchers within the theory theory have identified a number of milestones in children's development toward an adult ToM. One example is a study by Gopnik and Slaughter (1991), in which they investigated understanding of a number of different mental states in a single group of children, and suggested the following three-step model of development of ToM; Stage 1: Understanding of pretence, perception and imagination, Stage 2: Understanding of desire and intention, and Stage 3: Understanding of knowledge and belief. Stage 3 states are thought to be the most difficult because they are representational states with truth conditions. Stage 2 states are thought to be of intermediate difficulty because they are representational states with conditions of satisfaction rather than truth conditions. Finally, stage 1 states are thought to be the easiest because they, according to Gopnik and Slaughter, are non-representational.

Another example is a three-step developmental sequence of children's development toward an adult ToM suggested by Bartsch and Wellman (1995). They argue that children go through at least two fundamental theory shifts before they reach a fully developed belief-desire psychology. First, around the age of two, children acquire a simple *desire psychology*. This psychology includes an elementary conception not only of simple desires, but also of simple emotions and simple perceptual experience or attention. The conception is elementary in that although mentalistic, it is non-representational rather than representational. That is, the child understands that people are subjectively connected to things in the sense of having the inner experience of wanting, fearing and seeing them etc, but the child does not yet understand that people mentally represent these things, accurately or inaccurately as being in a certain way. Second, around age three, children begin to talk about beliefs and thoughts as well as desires, and they seem to understand that beliefs are mental representations that are not always consistent with reality, and that other people do not always hold the same beliefs as the child him- or herself. However, at this age children continue to explain their own, as well as other people's, actions in terms of desires rather than beliefs. Bartsch and Wellman (1995) refer to this second level of understanding as *desire-belief psychology*. Finally, at about age four, children begin to understand that what people think and believe, as well as what they desire, will have an affect on how they behave. That is, they acquire an adult *belief-desire psychology*, an understanding that beliefs and desires together determine behaviour.

Theory theorists argue that experience helps in shaping children's ToM development. They believe that experience provides young children with information that will eventually cause them to revise and improve their theory, i.e. desire psychologists will gradually become belief-desire psychologists by repeatedly seeing people behave in ways that require for their explanation a concept of belief as well as a concept of desire (Flavell, 1999). Essentially, according to this view, the process of development is one of hypothesis testing. Thus the role of experience is viewed as similar to that in Piaget's equilibration theory (Piaget, 1985): experience creates disequilibrium, and, eventually, a new, higher state of equilibrium (in this case a new theory) (Flavell, 1999).

Modularity theory

Other theorists (Baron-Cohen, 1995; Fodor, 1992; Leslie, 1994; Leslie, Friedman & German, 2004; Mitchell, 1994;) have different views about what is acquired in ToM development and how. Although differing in detail, the modularist approaches share the view that the emergence of a theory of mind, being too important an ability to be left to chance, is instead dependent upon the biological maturation of genetically based neurocognitive structures, or modules, of the brain.

Leslie (1994; Leslie, Friedman & German, 2004), for example, postulates the acquisition of ToM through neurological maturation of a succession of domain-specific and modular mechanisms for dealing with agents versus non-agent objects. A mechanism called Theory of Body (ToBY) develops early in the first year. It allows the baby to recognise, among other things, that agents have an internal source of energy that permits them to move on their own (Flavell, 1999).

The next two mechanisms, called Theory of Mind mechanisms (ToMM), deal with the intentionality of agents rather than with their mechanical properties. $ToMM_1$, which develops later in the first year, allows the infant to understand that people and other agents perceive the environment and pursue different goals. $ToMM_2$ begins to develop during the second year of life. This third mechanism allows children to represent agents as holding attitudes toward the truth of propositions - propositional attitudes. Propositional attitudes are mental states such as pretending that, believing that, imagining that, desiring that etc.

In addition to having the ToMM's children must, according to Leslie, also be equipped with a selection processor (SP). It is the SP that makes it possible for children to perform executive functions, such as inhibiting a pre-potent response on the false-belief task, i.e. not to blurt out the salient real location of the chocolate in the Maxi task when asked about the other person's belief about its content (Leslie, 1994; Leslie, Friedman & German, 2004).

Mental simulation

The theory of mental simulation follows from Descartes' claim that we have privileged access to our own mental states. According to simulation theory, children are introspectively

aware of their own mental states (note that this contradicts the claim made by the theory-theorists that it is no easier to access our own mental states than it is to access the mental states of another person) and can use this awareness to infer the mental states of other people through a kind of role-taking or simulation process (Hala & Carpendale, 1997).

Because of this ability to access our own mental states, simulation theorists argue, it is not necessary for us to apply any kind of theory to them. Other people's mental states are instead understood by the use of an analogous process. For example in the false-belief task (the "Maxi" task, see fig. 3), children would thus predict where the other person would think the chocolate was located by imagining, or mentally simulating, what they themselves would think if they were in his or her shoes.

What develops, according to the simulation theorists (Goldman, 1995; Harris, 1991; Johnson, 1988), is the ability to make increasingly accurate simulations of this kind. Experience is, however, also said to play an important role in that it is through practice in role taking that children improve their simulation skills. Platek, Keenan, Gallup and Mohamed (2004) present evidence suggesting that mental state attribution and self-processing share neural substrates, and argue that this further supports the mental simulation theory.

Language and Theory of mind

Several studies have demonstrated a close relationship between the ability to attribute false belief and results on language tests. For example children with autism show delayed or deviant language development, and also generally perform poorly on ToM-tasks (Frith, 1989; Tager-Flusberg, 1993). Those autistic children who do pass false belief tasks also score higher on a number of measures of linguistic skill than autistic children who fail these tasks (Eisenmajer & Prior, 1991).

There are many different ways in which language acquisition may play a role in the development of theory of mind and research has been conducted trying to establish which specific aspects of language that may be involved in the development of ToM as well as precisely what the relationship between ToM and language might look like. Several researchers have suggested that an understanding of people's mental states is both a prerequisite for and emerges out of the *pragmatics* of conversational communication, arguing

that the development of ToM is a socially mediated process, something that requires social interaction with other people (Harris, 1996; Peterson & Siegal, 1995; 1999).

Others propose that it is exposure to conversation about mental states in particular, rather than language in general, that is relevant in the development of theory of mind, focusing on the *semantics* of mental terms and the emergence of these lexical items in the language of the child to refer to both their own and others mental states. Olson (1988) argued that theory of mind development requires a language for talking about the mind, a metalanguage based on the semantic understanding of terms such as "think and know" for example. Advanced understanding of false belief is also found among pre-schoolers who frequently exchange mental state terms in conversations with siblings and friends (Dunn, 1994; Brown, Donelan-McCall, & Dunn, 1996), and those regularly exposed to sophisticated speakers, including adults and older children (Lewis, Freeman, Kyriadidou, Maridaki-Kassotaki, & Berridge, 1996).

Still others have argued that the relation between theory of mind, in particular false belief understanding, and language can be found at the *syntactic* level. The syntactic process of complementation allows for the embedding of one prepositional argument under another proposition, as is needed for the expression of prepositional attitudes such as beliefs and states of knowledge. Furthermore, in these sentential complement structures a false proposition can be embedded under a verb of mental state and the whole sentence nevertheless remain true, so the syntax of complementation may be uniquely suited to the conceptual representation of false beliefs (de Villier & Pryers, 2002; de Villiers & de Villiers, 2000).

The nature of the relationship between theory of mind and language is not clear and there is also a large body of research (e.g. Astington & Jenkins, 1999; Dahlgren, Dahlgren Sandberg & Hjelmquist, 2003; Meltzoff, 1999; de Villiers & de Villiers, 2000; de Villiers & Pyers, 2002) with the aim of trying to pinpoint what the relationship between language and theory of mind development might look like more precisely.

Performance on any cognitive task reflects at least two factors: competence (i.e. the conceptual understanding required to solve the problem) and performance (other cognitive skills required to access and express understanding, e.g. memory, attention and language). The idea that the child has developed a conceptual understanding of the mind, but still does not pass the theory of mind tests because performance might be masked by linguistic

complexity and pragmatic features of the linguistic instruction of the task has been referred to as a "weak" hypothesis about the role of language in ToM development. Language is seen as simply one of several possible performance variables that may constrain or limit the child's task performance. These performance variables are what Siegal and Varley (2002) call scaffolding. According to this theory language acquisition plays no fundamental or causal role in the conceptual changes taking place in the child's ToM: at best it has an indirect or peripheral effect through its impact on performance. Even when the language of the task does not itself involve an understanding of complex language about the mind, the child's language skills can be a major constraint on their performance.

Some researchers find it unlikely that this association between language and theory of mind is simply due to the linguistic demands of the task and offer a "stronger" version of the hypothesis, a theory that imputes a much more significant role to language development. Astington and Jenkins (1999) presented results suggesting that language plays a fundamental role in the development of theory of mind. A longitudinal study showed that earlier language ability predicted later theory of mind performance, but earlier theory of mind did not predict later language ability. As already mentioned, de Villiers and de Villiers (2000), also put forward the idea that language development provides children with the resources needed to promote false belief understanding, i.e. that language development has an effect on the child's competence (conceptual understanding) rather than simply having an effect on the child's performance on a certain test.

Yet another view on the way that language might facilitate social cognition and development of a theory of mind is that language focuses attention on mental explanations of behaviour. It is possible that access to language about mental events scaffolds the child's understanding in a more expedient way than observation of social interaction alone. Human children do not need to learn simply through observation because the people around them structure that understanding through talk (de Villiers & de Villiers, 2000). This view proposes that ToM is mediated by talk within the family, which also involves the idea that communicative fluency is what engenders the social relationships necessary to build a ToM. In the extreme, language could merely highlight pretence, desire, and false belief without explicitly representing them.

There are also those who promote the view that cognitive development leads the way, with a conceptual understanding of mental states emerging out of the interaction between maturing cognitive capacities and social awareness from interaction with others. Conceptual understandings of the mind might develop first and serve as the basis onto which language will map (de Villiers & de Villiers, 2000). More cognitive theories of ToM development have differently stressed innate modules and the role of maturation (Leslie, 1994), the cognitive development of different levels of representation (Perner, 1991), or more general cognitive skills such as working memory (Olson, 1993) and executive functions (Russell, 1996). More social theories have stressed the child's active participation in social interaction and the interpersonal context as the basis for the emergence of both concepts about other minds and language about the mind (Hobson, 1994).

Individual differences in ToM

Others have of course also proposed alternative, or perhaps complimentary, views on the development of ToM. Given the centrality of theory of mind as a construct in developmental psychology over the last 15 years, it seems natural that the field should turn to investigations of how it relates to other aspects of development, and there is indeed a substantial body of research that does just that. This research literature suggests that there are measurable individual differences in the mentalizing abilities of young children and that these individual differences are correlated in theoretically predictable ways with other variables (Slaughter and Repacholi, 2003). It is possible to identify at least three major classes of individual differences studies: those that examine the role of family variables in ToM development; those that link ToM with various social outcome measures; and those exploring the connection between theory of mind and other cognitive constructs. Studies that have linked theory of mind ability with family variables often focus on identifying predictors of mentalizing ability. This class of studies have demonstrated relations between theory of mind and such variables as family talk about mental states (Dunn, Brown, Slomkowski, Tesla & Youngblade, 1991; Meins, Fernyhough, Wainwright, Gupta, Fradley & Tuckey, 2002); number of siblings (Perner, Ruffman & Leekam, 1994; Ruffman, Perner, Naito, Parkin & Clements, 1998); socio-economic status (Holmes, Black & Miller, 1996); maternal education (Cutting & Dunn, 1999), parenting style (Ruffman, Perner & Parkin, 1999; Vinden, 2001) and attachment security (Meins, Fernyhough, Russel & Clark-Carter, 1998; Symons & Clark, 2000). In general these studies suggest that children's theory of mind development is

enhanced when their family environment somehow draws attention to the fact that people's behaviour is based on mental states and that such mental states are unique to individuals.

Mentalizing ability has also been shown to correlate with various cognitive constructs. Olson (1993), for instance, has argued that the acquisition of false-belief understanding is related to increases in children's working memory capacity. Carlson, Moses and Hix (1998) have proposed a link between children's ToM and their executive functions. That is, an inability to attribute false belief could in fact be due, not to a genuine lack of ToM, but an inability to inhibit a dominant ready-to-go response. Creativity (Suddendorf & Fletcher-Flinn, 1999), fantasy (Taylor & Carlson, 1997) and moral reasoning (Dunn, Cutting, & Demetriou, 2000) are other examples of cognitive constructs that have been linked to theory of mind. The most robust relation, however, replicated across numerous studies, is that between theory of mind and language which was discussed in the previous section (Astington & Jenkins, 1999; Cutting & Dunn, 1999, Hughes & Cutting, 1999). In general people who score highly on measures of theory of mind also perform positively on other cognitive measures.

Finally, there are also studies that have linked theory of mind to various social outcome measures, including social behaviour and other indicators of social competence. These studies demonstrated associations between mentalizing ability and variables such as socially competent behaviour (Lalonde & Chandler, 1995) and quality of children's peer relationships (Baron-Cohen, Tager-Flusberg & Cohen, 2000; Happé & Frith, 1996; Hughes, Dunn & White, 1998). This body of research suggests that children with relatively good mentalizing skills develop more successful social relationships than those who are less skilled mind readers. However, in recent years research has also shown that an advanced theory of mind is not a guarantee for social success (e.g. Sutton, Smith & Swettenham, 1999). Mentalizing skills can of course be used for antisocial purposes. Thus the relationship between theory of mind and social outcome measures is not a simple one.

Another way of categorising individual differences in the development of ToM is by using the framework created by Bartsch and Estes (1996) in which they suggest that such differences fall into three different categories: individual differences in antecedent causes; individual differences in the consequences of arriving early or late to a ToM; and the possibility of qualitative differences in ToM across individuals.

The biological basis of Theory of mind

A critical issue concerning the biological base of Theory of mind is whether mentalizing abilities are dependent on domain-specific neural processes supported by a distinctive neural circuitry specialized for social information, or if they are dependent on known mechanisms of memory, emotion, decision-making and other basic functions not exclusively earmarked for ToM (Bechara, 2002; Siegal & Varley, 2002). Failure on a specific task might be due to impairment of a "core" ToM system, but it might also be due to failure to recruit a component of a widely distributed neural system that is not exclusively dedicated to the computations of mental states, but helps to support performance in a particular cognitive modality (such as executive functioning, memory, or language). So far research in this area has not been able to provide any absolute answers. For example results from functional imaging studies implicate large areas of the cortex and sub cortical structures such as the cerebellum in the attribution of mental states (Siegal & Varley, 2002).

Specific impairments of mentalizing in both developmental and acquired disorders, however, do suggest that although performance on particular ToM tasks is supported by a widely distributed neural system, the functional components of which are co-opted for the computation of mental states, ToM ability is at the very core dependent on a dedicated and domain-specific system. Functional imaging studies implicate medial prefrontal cortex and posterior temporal sulcus as components of this system (Frith & Frith 1999). It has also been suggested that such a core system might be centred on the amygdala circuitry (Siegal & Varley, 2002; Stone, Baron-Cohen, Calder, Keane & Young, 2003). Happé, Malhi and Checkley (2001) reported a single case study of impaired ToM in a patient following a standard surgical procedure to treat bipolar affective disorder and found that an area of medial prefrontal cortex (the paracingulate cortex) was the only region uniquely activated by theory of mind tasks and not activated above baseline in the comparison stories or cartoons. Mental state attribution has also been associated with activation in the right superior and middle frontal gyrus, and left middle frontal gyrus and superior temporal gyrus/ temporal pole (Platek, Keenan, Gallup, Mohamed, 2004).

An intercultural perspective on ToM development

Even though research on theory of mind has been comparatively international with studies being conducted in Canada and Australia as well as in many European countries,

which outnumber the typically large U.S. contribution (Wellman, 1998), the evidence from non-Western cultures is still sparse and mixed, and no agreement has been reached as to whether there is such a thing as a universal theory of mind or not. Some studies claim that there is (Avis & Harris, 1991; Wellman et al., 2001) while others question the notion of a culture-general theory of mind (Whari & Johri, 2001). There are also those suggesting that the same developmental results can be reached in different cultures but by the use of different means. Vinden (2001), for example, showed a negative relationship between mentalizing skill and authoritarian parenting for Anglo-American children, while Korean American children whose mothers were generally more authoritarian, over all showed better performance on mentalizing tasks than their Anglo-American peers. Wellman et al. (2001) also argues that even though children from different cultures all seem to acquire mentalizing skills on roughly the same developmental trajectory, the pace in which they do so might be dependent on the cultural community and language system in which they grow up.

Development beyond the pre-school years

Does the child's theory of mind continue to develop beyond early childhood? To date, research has focused mostly on 3-5 year olds. This is the age when most children develop a so-called first order belief attribution. Few researchers have speculated about the changes that might occur in mentalizing ability during middle to late childhood. Perner and Wimmer (1985), however, have shown that typically developing 6-7-year-olds are also able to think about someone else's thinking about a third person's thinking, i.e. they have acquired what is known as second-order belief attribution. This shows that children progressively develop their ability to think about other's beliefs. For typically developing children above the age of 7 or 8, and for adults, there are as yet few assessments that reveal significant and meaningful individual differences in mind reading. One exception to this rule is a study by Baron-Cohen, O'Riordan, Stone, Jones and Plainsted (1999) in which they had developed a design in order to test the ability to detect faux pas in children 7-11 years old. The results showed that the ability to detect faux pas developed with age, and that development differed depending on the sex of the child, with the girls outperforming the boys.

An important ability that researchers also have identified as developing beyond early childhood is empathic accuracy (Eisenberg, Murphy & Shepard, 1997), which is an aspect of everyday mind reading that continues to develop into adulthood, particularly in the context of

close personal relationships (Ickes, 1997). Another area which requires a theory of mind and which continues to develop beyond early childhood is the attribution of communicative intentions to speakers. Understanding a speech act requires the listener to grasp what it is that the speaker intends to communicate. With literal messages this process is straightforward: speakers mean to communicate what they say. However, with nonliteral speech acts such as sarcasm or irony, listeners must recognize that the speaker intends to convey something other than what he or she is saying.

A study on theory of mind in normal aging (Happe, Winner & Brownell, 1998) also showed that performance on theory of mind tasks remains intact and may even improve over the later adult years.

Theory of mind in atypical populations

The issues raised by the work with non-human primates formed the basis for the experimental work by developmental psychologists on children with typical development (Wimmer & Perner, 1983). This in turn led researchers interested in atypical populations to ask the theory of mind questions of a variety of other populations, e.g. children with mental retardation and Down's syndrome (Baron-Cohen, 1989a), deaf children (Peterson & Siegal, 1995; 1999), congenitally blind children (McAlpine & Moore, 1995), and of children with autism (Baron-Cohen, 1995; Baron-Cohen, Leslie, & Frith, 1985). Corcoran (2000) also reviewed other atypical conditions including schizophrenia, psychopathology and epilepsy and reported delays also in these conditions.

Much of the early research on theory of mind was conducted within the field of autism, which is a brain-based developmental disorder (Baron-Cohen, Leslie & Frith, 1985). This research showed that children with autism have great difficulty solving tasks requiring a theory of mind. In order to investigate how specific deficits in theory of mind are to children with autism, other clinical groups have also been tested, e.g. children with Down's syndrome (Baron-Cohen et al, 1985) and children with mental disabilities of a mixed aetiology (Baron-Cohen, 1989a). These groups performed normally on the tests and this has led to proposals of a theory of mind module that is impaired or absent in autism, and that this impairment is also specific to the autistic spectrum. Since autism is a biologically based disorder the possibility of a biologically defined modular basis of theory of mind was obvious. A limitation of such

theories, however, is that diagnostic criteria for autism include the development of symptoms before the age of 3 (DSM-IV); i.e. children are already showing the disorder at an age when normally developing children also do not pass false-belief tasks (Steeds, Rowe & Dowker, 1997), i.e. the problems with mentalizing tasks are not specific for children with autism at very young ages.

Attempts to reconcile this conflicting evidence include the suggestions that theory of mind depends on a specific brain mechanism that is present from birth, but must mature before theory of mind can be manifested and that false-belief understanding develops out of other capacities that develop earlier, e.g. pretend play. For example Leslie (1994) states that the ability to pretend is an important prerequisite for the development of a theory of mind. This ability requires the child to be able to create and manipulate inner representations of mental states and to keep them separate from inner representations of physical states. The child is, for example, able to imagine that "mummy is pretending that a banana is a telephone" without being confused about what to do with real bananas or real telephones. This same metarepresentational ability is fundamental in the ability to attribute false belief according to Leslie.

The environmental account, on the other hand, claims that the rate and extent of development of theory of mind may be influenced by exposure to conversation about mental states and that the theory of mind impairment observed in autism might be due to the severe communication disorder, which prevents them from making adequate use of such conversation. If exposure to communication were important to the development of a theory of mind, then one would expect that children with other communication disorders would also be delayed in their theory-of-mind acquisition (Steeds, Rowe & Dowker, 1997). In accordance with this assumption recent studies have shown that children with other communicative disabilities have difficulties in solving tasks requiring a theory of mind. One example of this is studies of congenitally deaf children who have grown up in homes with hearing parents and without early exposure to sign language (Peterson & Siegal, 1995, 1999; Steeds, Rowe & Dowker, 1997; Russell, Hosie, Gray, Scott, Hunter, Banks & Macaulay, 1998). Other examples are children with visual impairments (MacAlpine & Moore, 1995) and children with developmental language delay (Iarocci, Della-Cioppa, Randolph & Wohl, 1997). A meta-analysis by Yirmiya, Erel, Shaked and Solomonica-Levi (1998) even suggest that individuals with mental retardation might have an impaired ToM.

It is also important, however, to remember that *just because different atypical groups show similar results on the ToM tasks, it is not to say that the same mechanisms underlie the success or failure on these tasks*. There is also a difference in the matter of delay versus deviance in the different clinical groups. The development of ToM in children with autism has proved to be both deviant and delayed (Baron-Cohen, 1991; Peterson, Wellman & Liu, 2004), while the development of ToM in children with other communicative impairments, e.g. children with cerebral palsy (Falkman, Dahlgren Sandberg & Hjelmquist, 2004) seems to be only delayed.

Prerequisites for the development of a theory of mind

How does the emergence of a theory of mind, specifically the understanding of beliefs, stand in relation to earlier developments in the understanding of people? Infants appear to come prepared to learn about people in some way that may be different from their learning about objects. At a very young age children already seem to understand a good deal about how people think and feel. From the very beginning in life they take part in social interactions by smiling, making eye contact, cooing, babbling, following the gaze of another person (so called joint attention) etc. Evidence has also been put forward that imitation exists in neonates and for imitation as an early social competence (Heimann & Ullstadius, 1999). It is, however, not easy to tell how much infants understand about other peoples thoughts and feelings. Some researchers (Bretherton, McNew & Beeghley-Smith, 1981) have argued that the infant's communicative abilities imply that they already have a theory of mind. It is not, of course, a question of stating that infants have a complete belief-desire theory of mind, capable of attributing mental states to other people. Rather it is described as an implicit theory of mind, in much the same way as a two-year-old can be said to have an implicit theory of grammar.

Around 9 months infants begin to communicate through gestures, for example reaching in the direction of an object out of reach in order to have an adult get the object for them (proto-imperative pointing) or shaking their head to refuse an undesired object or activity (Franco, 1997). This is considered by Wellman (1990) and others to be the infant's first efforts at symbolic (or more aptly; proto-symbolic: comment by Hala, 1997) communication. That is, these actions are seen to be attempts at communicating a desire to another person in order to have that desire fulfilled (Hala, 1997).

By around 9 to 12 months proto-imperative pointing (pointing in order to use an other person to obtain an object) has been joined by proto-declarative pointing. Infants now use pointing to get another to attend to something rather than to simply obtain an object. Not only do infants at this age use proto-declarative pointing but also they use it in ways that suggest that they have a grasp of what the effects of their actions would be upon the other person (Franco, 1997). Infants will, for example, often check to see if the other person is looking to the indicated referent, and to continue to point until the other person attends to what they are pointing to (Bates, Camaioni & Volterra 1975).

When symbolic representation begins to develop, this will in turn lead to two things that researchers within the field of theory of mind have paid special attention to, i.e. the ability to pretend play and the development of language. Spontaneous pretending emerges sometime between 18 and 24 months of age (Leslie, 1994; Piaget, 1951/ 2000). Emergence of pretence shows that the child can reason about hypothetical situations. Piaget (1951/ 2000, p.122) describes how his daughter at 20 months used all sorts of objects to telephone, for example using a leaf instead of a receiver. This shows that she can visually perceive the leaf in one way and yet think about it in another way. Within the area of language development, research has to a large extent focused on children's talk of inner states. It is possible to talk about inner states without talking about mental states, e.g. hungry, tired, hot etc. Talk about perceptions and emotions, e.g. see, look, taste, happy, love etc. are more difficult, but are still mastered by children as young as two years old. Cognitive concepts, such as know, think and remember for example, are generally not acquired until the age of three. It is also important to look closer at how children use mental state words, as the use can be purely idiomatic or conversational.

Together these early emerging behaviours suggest that, although they may not have the ability to attribute false belief, children do have some grasp of mental life well before their fourth birthday.

Communicative development

An infant's primary task is to ensure continuing care. Eibl-Eibesfeldt introduced the idea of "babyness" - a set of features (e.g. a relatively large head, large forehead in relation to the

rest of the face, large, and low-set eyes) that will trigger caring behaviours in the adult (in Cogher, Savage & Smith, 1992). These behaviours include social interaction. According to Stern (1977) most of us react in a rather stereotypic way to the sight of the baby. He calls these adult behaviours "infant elicited social behaviours" Interaction with a baby usually involves exaggerated facial expressions and extreme pitch changes, which hold the baby's attention and maximize learning.

The emergence of the first smile provides opportunities for the baby to learn such communicative prerequisites as turn taking and cause and effect. The baby also learns about initiating, responding to and maintaining social interaction, in that the smile firstly signals an invitation, or readiness, to interact, then that an interaction is going well, and, in the event of a breakdown, a desire to re-engage in the interaction. Babies are also predisposed to look at faces, their principal interest being in the eyes and mouth. This predisposition helps the baby to learn that important messages are sent by the face and that by using eye contact he or she can attract and hold the attention of adults.

Joint attention and reference (which are also considered important prerequisites for ToM development) have their roots in early months when parents watch the direction of the baby's eyes and reinforce the interest by moving the object closer and/or talking about it. Eye contact and eye-pointing thus rapidly become meaningful and communicative. The baby's appearance, smile and eye contact are thus all factors that play an important part in the development of communication and social interactional skills.

Although the baby learns to communicate efficiently, it is not until the first year or so has passed that he or she is expected to become linguistically capable. Through play with adults and objects, the child learns social and cognitive boundaries. During the early years the child's language becomes increasingly important in the development of the concept of self, and the development of relationships with adults and other children outside the family. Language is required in almost all important social situations. While the child's very early uses of language are mainly for fulfilling his or her own needs and regulating the behaviour of others (Halliday, 1975), already during the first years the child learns to use language to give and request information, express feelings and facilitate social contact. He or she also uses language during pretend play (also considered an important prerequisite for ToM), as previously discussed. As mentioned earlier communicative development and language has

been considered a strong factor in the development of Theory of mind in children. Therefore it is important to consider the implications of an atypical early communicative and language development. In this thesis I focus in two atypical conditions, cerebral palsy and deafness

Children with Cerebral Palsy

Diagnosis

The term "cerebral palsy" (CP) refers to a group of conditions resulting from a permanent, non-progressive defect or lesion of the immature brain acquired early in life, i.e. the damage occurs before or during birth or in the first two years of life. The prevalence of CP in Sweden is 2,49/1000 live births (Hagberg, Hagberg and Olow, 1993).

Cerebral Palsy is a non-specific diagnosis based on clinical observations. It can be defined as a non-progressive disorder of movement and posture due to a defect or lesion of the immature brain (Bax, 1964). The classification of CP subgroups is based on clinical signs clustered in to three broad syndromes: (1) Spastic syndromes, which include hemiplegia (a paresis of the left or right side of the body), diplegia (a paresis of both arms and legs, but more severe in the legs) and tetraplegia (also characterised by a paresis which affects all four limbs, but where the arms are at least as affected as the legs), (2) Atactic syndromes and (3) Dyskinetic syndromes. In the atactic and dyskinetic syndromes the motor dysfunction is caused by involuntary movements and incoordination (Hagberg, 1989).

The cause of the different CP-syndromes varies. B. Hagberg and G. Hagberg (1993) reported prenatally acquired brain damage to be the cause of CP in 14% of the cases, perinatal brain damage in 34% of the cases and the origin unknown in as many as 52% of the cases. The corresponding figures in a study by Krägeloh-Mann, Petersen, G. Hagberg, Vollmer, B. Hagberg & Michaelis (1995) were approximately 15%, 47% and 37%.

No studies have as yet been able to show any clear relationship between the location of the brain damage and the resulting motor behaviour problems. The problems can range from barely detectable to leaving the child almost completely physically helpless. As a result, even if two children may both be said to have cerebral palsy the differences between them, in terms of both linguistic and motor abilities, may be much greater than the similarities. Despite the

heterogeneity of the condition, cerebral palsy as a concept is still useful when it comes to management, habilitation and other socio-medical support in society (Hagberg, 1989).

According to the definition of CP, the deficit is non-progressive. The clinical symptoms of cerebral palsy, however, change in an individual with the occurrence of maturation, development and possibly repair. A progression of clinical signs with development is seen in all types of cerebral palsy (Cogher, Savage & Smith, 1992). It is difficult to predict what effects development, maturation and repair will have on individual children, which means that an early diagnosis of CP may need to be revised as the child matures. In more severely affected children a diagnosis of CP can perhaps be achieved already in the early months, whereas in less severely affected children caution in diagnosis must be exercised (Cogher, Savage & Smith, 1992).

Additional impairments

In addition to motor dysfunction as many as 60% of children with CP also have two or more additional impairments. There may be any or a combination of difficulties in vision, hearing, and intellectual ability, and 25% also suffer from epilepsy (Sanner, 1999). It is very important to note that cerebral palsy does not inevitably equal mental retardation. The percentage of children with mental retardation varies depending on the type of CP syndrome, with a range from 10% in children with dyskinetic syndromes to 100% in children with spastic tetraplegia (Sanner, 1999).

Speech impairment

As many as half of the children with cerebral palsy also suffer from some kind of speech impairment. This may be the result either of a paralysis of the speech producing organs causing anarthria (the inability to produce speech sounds) or dysarthria (difficulty in producing intelligible speech), or brain damage resulting in dysphasia (difficulty in using or understanding language) (Bergh & Bergsten, 1999).

Alternative and Augmentative Communication

Children who are severely affected by their physical disability may not be able to use oral communication to an effective extent. This is true for many children with cerebral palsy, and other modes of communication must therefore be provided as an alternative, or complement, to spoken language. These modes are with a common term called Augmentative and Alternative Communication (AAC). Examples of AAC are sign language, manual signs, gestures, facial expressions and different graphic systems.

Because of the accessibility and conventionality of sign language this is usually considered superior to other forms of AAC. Contrary to other forms of AAC, sign language is of course a natural language. Due to the severe motor dysfunctions described earlier, however, children with CP often lack the fine motor skills necessary to master sign language. Instead many have to resort to some form of graphic communication system. There is a variety to choose from. The pictures can be photographic or drawn, in colour or black-and-white. Some of the more widely used are the Swedish system "Nilbilder" (Nilpictures), the American system "Picture Communication Symbols" (PCS) and the Canadian system "Pictograms" (fig 2.). All three systems have in common that they are both concrete and easily interpreted since they to a great extent are iconic, i.e. there is a clear relationship between form and content.

Figure 2. Examples of three different graphic communication systems
(from the top): Pictogram, Nilpictures, and Picture Communication symbols (PCS).
Adapted from Bergh & Bergsten (1999). Symbols depicted are (from the left):
play, hungry, shop and chocolate drink.

In order to be able to communicate thoughts, emotions and ideas on a more complex level, however, a more advanced form of graphic AAC system is needed. One such system is the so-called "Blissymbolics" (Bliss) system. Bliss, created by Charles Bliss in the late 1940s, was originally intended as a communication system for international communication. Bliss never became the world-language that Charles Bliss had hoped for, but in 1971 the system was instead taken up by the Ontario Crippled Children's Centre (now known as the Bloorview-MacMillan Centre) in Canada and used as a communication aid for children with physical disabilities and speech production problems (McNaughton, 1998).

Usually the Blissymbols are depicted on a so-called standard chart that contains a vocabulary of approximately 500 symbols. By pointing to the symbols, one by one, the person encodes the verbal message. The system of Blissymbolics is composed of over two thousand graphic symbols, which can be combined and recombined to create new symbols (McNaughton, 1998). The symbols (although, as already suggested, some would prefer to refer to them as iconic signs rather than symbols due to their non-arbitrariness) differ in perceived relatedness between the symbol and its meaning, and component complexity, i.e.

25

the number of components that defines a symbol. There is also some morphemic representation and a rule system for combining symbols into "sentences" (Dahlgren Sandberg, 1996). An example of Bliss is given below (fig 3).
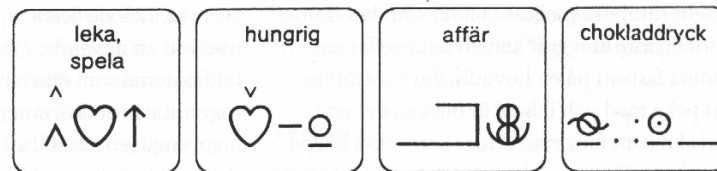
Figure 3. Example of Blissymbolics. Adapted from Bergh & Bergsten (1999). Symbols depicted are (from the left): play, hungry, shop and chocolate drink.

Many children with CP may well be able to make their basic needs known without an AAC, although by means usually interpretable only by close family. Therefore, the introduction of a more conventional symbolic communication system is vital early in the child's life in order to produce a need in the child to communicate specific ideas, thoughts and emotions. If the system is introduced too late, the child may be reluctant to abandon the simpler, but rather fast and efficient, attempts at communication for a system which is essentially much more difficult although ultimately more efficient (Cogher, Savage & Smith, 1992). As Bliss can be both time-consuming and difficult it is not unusual that long-term efficiency is sacrificed in order to reach short-term goals. Early introduction of AAC is also important in order to reduce the experience of failure and social isolation and to increase the children's motivation to communicate. It is, however, also important to try to achieve a balanced strategy where the child is given well functioning and easy-to-use communication modes while at the same time investing in the future by introducing a more advanced system such as Bliss (Mirenda & Mathy-Laikko, 1989).

Implications of cerebral palsy on communicative development

A baby born with cerebral palsy may have had to spend a considerable length of time in hospital, often attached to equipment that physically prevents or at least discourages parents from holding and taking active care of the baby. The opportunities for developing communicative rhythm may be further hindered by the very fact of the baby's illness and the parents grieving process.

A baby with cerebral palsy may be hypertonic to a degree where any attempt at action will cause extensor thrusting. Even a smile in response to the sight of a face will cause the baby's body to exhibit an extensor pattern such that the head will tip back and the eyes roll upwards, thus loosing visual contact with the original stimulus. Lacking the appropriate feedback, the "face" may move away and the baby will have failed to respond to and maintain a social interaction (Cogher, Savage, & Smith, 1992). A blank, or mistimed, response may have the same result and turn taking is therefore very difficult to establish. Similarly, the baby's attempts to locate objects of interest may be made difficult by poor head and eye control. The parents will consequently find it difficult to interpret these attempts, and opportunities to learn joint attention are missed.

There are many ways that language development can be compromised in the event of physical handicap. Severely delayed gross motor skills may make it more difficult for the child to build up knowledge of the world through play and interaction. Lack of control over the environment and the inability to try out new words to examine their semantic boundaries will affect the child's abilities to acquire language for use in communication. The use of expressive language enhances the development of comprehension (Clarke, 1974), which may equally be affected by the child's reduced ability to manifest his understanding. This may lower people's expectations of the child, with the result that he is not stretched linguistically or cognitively (Cogher, Savage & Smith, 1992). Slowed mouth movements may result in slurred speech which may, at best, be difficult for peers to understand and at worst be interpreted by teachers and others in the child's environment as a sign of intellectual impairment, and, as has been pointed out earlier, it is important to remember that cerebral palsy does not always implicate retardation.

Deaf children

Diagnosis

In Sweden approximately between 50 and 70 children are born deaf each year (Jorup & Preisler, 2001). Hearing disorders can occur as a result of damage to any part of the auditory pathway from the outer ear to the brain. A basic distinction can be made between hearing loss that is present at birth, i.e. prelingual deafness, and that, which is acquired postlingually, i.e.

after a language has started to be acquired. A distinction can also be made between conductive hearing loss, i.e. hearing loss caused by the dysfunction of structures of the outer or middle ear and sensory-neural hearing loss which arises as a result of inner ear (cochlear) dysfunction. The majority of early loss of 25dB hearing level or greater is sensory-neural in nature. The causes of acquired hearing loss range from common influenza type infections to cerebral tumours and to iatrogenic causes.

Sign language

Sign language is a visual-gestural language completely separate from the spoken language. It is also non-vocal, i.e. the voice serves no purpose. Signed languages are expressed through hand shapes, their position and movement. Facial expressions (e.g. movements of the mouth, eyes, eyebrows and head movements) convey regularly reoccurring lexical or grammatical markers, not in an arbitrary fashion, but in accordance with the syntax of the sign language itself (Bergman & Nilsson, 1999).

Sign language has a spatial as well as a temporal perspective. Several signs can be carried out simultaneously. Some signs are iconic (i.e. they look like the objects they describe) while others are not. There is also a manual alphabet used for example when spelling out names. The Swedish sign language, like other sign languages, lacks a written form. A few transcription systems exist, but these are used mostly for research purposes (Ahlström, 2000).

The Swedish sign language (SSL) became officially accepted as a language in its own right by the government in 1981. Before this, deaf children were mostly orally trained, i.e. they were taught to read lips and to use the spoken language. The claim that sign language would interfere with the development of spoken language seems not valid (Preisler & Tvingstedt, 2003; Mayberry, Locke, & Kazmi, 2002). On the contrary, research conducted over the past twenty years confirms a positive effect of sign language not only on the deaf child's language development in general, but also on the communicative, social, emotional and cognitive development. Mayberry et al. (2002) showed that early sign language had a positive effect on later learning of written English and early spoken language had a positive effect on later learning of sign language. Having no early experience of linguistic communication, be it spoken or signed, was detrimental to later learning of written English.

The debate that preluded the acceptance of sign language as an official language was intense and sometimes quite harsh. During the last half of the 1980's and the first half of the 1990's, however, things seemed to have settled, but then a new match was struck which once again kindled the debate within the deaf community – the use of cochlear implants in children.

Cochlear implants

Recent medical technology has made available a new kind of auditory prosthesis for deafness. More and more children (80 % of Swedish deaf children today) are given a so-called cochlear implant (CI). The CI bypasses the external ear and works on the principle of direct neural stimulation. An electronic device, programmed to decode signals from an external transmitter, is surgically implanted into the cochlea. By sending messages along the auditory nerve, hearing percepts are produced. When optimally successful the CI will enable large gains in pure auditory perception, and can facilitate speech recognition, boosting acuities to levels rarely reached with external amplification (Peterson, 2004).

This also means that parents will raise their hopes for and to try and create possibilities for their child to live his or her life as a hearing person (Preisler, Tvingstedt & Ahlström, 2003), something which has caused considerable debate in the deaf community. Having fought long and hard for sign language to be accepted, many now fear that the increasing number of CI operations will mean a step back to the previous oral tradition. The Swedish national board of health and welfare, however, recommends that the families of CI operated children learn sign language, as the child, when not using the CI is still deaf. There is no guarantee that the child will develop speech and speech perception to an extent where he or she will be able to communicate well within a speaking environment (National board of health and welfare, 2000). Therefore, in order for a deaf child to be considered for a CI operation in Sweden, the child's family must have "realised the role of sign language in their child's life as well as having begun their education in sign language" (National board of health and welfare, 2000). In actual practice, however, the fact that operations are undergone at an increasingly early age, results in the families not having had time to begin to learn sign language before the child undergoes the operation (Preisler, Tvingstedt, & Ahlström, 2003).

Implications of hearing loss on communicative development

The interpersonal communication of deaf children is clearly impaired when they are raised in a hearing environment. Even if the children acquire good sign language abilities, their parents often do not reach the sign level required making it a fully-fledged communication system (Vaccari & Marschark, 1997). It has been suggested that most physical disorders cut people of from things, but hearing loss cuts the sufferer off from people (Andersson & McKenna, 1998).

The deaf child, just like the hearing child, can take part in physical games, give-and-take and peek-a-boo with their parents. They explore objects, imitate their caregivers' actions and are able to participate in early pretend play. They show intentions and actively participate in dialog-like interactions (Preisler & Tvingstedt, 2003). The lack of auditory input seldom constitutes an obvious problem for communication up until the age when hearing children typically begin to talk. If habilitation of the deaf child at that point in time focuses on the child and parents using communicative signals based on speech and hearing, and therefore are difficult or usually impossible for the child to interpret visually, it becomes difficult for the child and caretaker to achieve mutual understanding. The result is commonly problems in communication, which in turn become a hindrance in the child's language development (Preisler, 1983; Preisler & Tvingstedt, 2003).

Deafness and theory of mind

Peterson and Siegal (1995) were the first to report that deaf children were delayed in their ability to attribute false belief. This study and many to follow suggest that delays in this respect could be expected among deaf children who do not have access to a deaf signing person from the very beginning, i.e. in practice are born into a hearing family (e.g. Woolfe, Want, & Siegal, 2002). These children have been referred to as late signers (Peterson & Siegal, 1995). In so-called native signers, i.e. deaf children who grow up with at least one other deaf, signing person, there is no delay in theory of mind development (Peterson & Siegal, 1995). On the contrary, some even claim that due to their extensive exposure to perspective taking, they exhibit superior performance on traditional false-belief tasks compared to hearing children (Courtin, 2000). Lack of exposure to, and experience of conversation about mental states has been put forward as a possible explanation of the low

performance of deaf non-native signing children on false-belief tasks (Figueras-Costa & Harris, 2001; Peterson & Siegal, 1995; 1999a,b; Siegal & Varley, 2002; Woolfe, Want, & Siegal, 2002).

SUMMARY OF STUDIES

General and specific aims

The general aim of this thesis was to study the development of Theory of Mind in two groups of children with atypical language and communication development, i.e. children with cerebral palsy and severe speech impairment (SSPI) and deaf children, with an emphasis being on the deaf children. The main research issues were the following:

a) Do children in the two clinical groups mentioned have problems solving tasks requiring a ToM?
b) Are possible problems due to the development of ToM being deviant, or simply delayed, compared to children with a typical development?
c) What are the potential relationships between participant characteristics and the ability to solve tasks requiring a ToM?

Study I

The aim of study I was more specifically to further investigate the mentalizing abilities of children with SSPI. A 2-phase longitudinal study was conducted in order to further explore the developmental aspects of ToM in children with SSPI, The participating children all had a mental age of 4 years or above, the mental age when children with typical development are expected to have developed a ToM. Using a three-stage developmental model of theory of mind suggested by Gopnik and Slaughter (1991) the question of deviance versus delay in the development of theory of mind was also addressed. Of special interest was also the possible relationship between the children's cognitive and linguistic abilities and their mentalizing abilities. Our hypothesis was that the children with SSPI would be delayed in their theory of mind development as measured with the tasks used by Gopnik and Slaughter (1991) in their three-stage developmental model, even when they were matched at group level for mental age to a comparison group of typically developing children. Our hypothesis was also that the children would follow the pattern from stage 1 to stage 2 and finally stage 3, i.e. that they would follow a normal pattern of development, but progressing more slowly than the typically developing children.

Study II

The aim of Study II was to investigate the mentalizing skills of non-native signing children who were offered what seems to be very good conditions for developing their language, given the lack of a signing deaf person in the home. If delays in the development of theory of mind would be found even in this group it would constitute a further strong support for the importance of conversational experience in a language common for the child and the family/caretakers. The hypothesis was of course that there would be a delay, but not only that, this delay would also be possible to study in a longitudinal design, starting at an age when the basic mentalizing skills already should have been developed. Furthermore, we expected that there would be an order of difficulty with part-whole being the easiest, then perception level 2, and finally the most difficult, the false belief tasks. In order to make sure that any problems with theory of mind tasks were due specifically to an impaired ability to represent mental states, rather than a more general inability to understand representation, a task of photographic representation was also included, the hypothesis being that any problems would be due to a specific impairment in representing mental states.

Study III

It has been argued that, in some cases, children may understand false belief but, because of the linguistic complexity of the tasks, they are unable to demonstrate their understanding. In short, a linguistic factor might result in a task performance that will mask their underlying competence. In order to test this, a group of deaf children were given a false belief task less linguistically challenging than the most commonly used standard tasks, in order to see if this would facilitate their ability to attribute false belief. Our hypothesis was that problems with mentalizing would remain despite using a less linguistically challenging false belief task. A possible relationship between working memory, both verbal and visuo-spatial, and theory of mind performance was also explored. Our hypothesis was that problems with working memory alone would not be able to account for any problems with theory of mind.

Study IV

The aim of study IV was to examine the referential communication abilities in a group of young, non-native early signing, deaf children. The hypothesis was that the deaf children would have more trouble completing this task compared to an aged-matched group of

typically developing hearing children as they have previously exhibited a delayed theory of mind development, theory of mind being a necessary requirement for the children to be able to play the referential communication game successfully. A further aim of this study was also to examine the possible role played by a number of background variables, i.e. chronological age, mental age, IQ, working memory and linguistic skill in the ability to complete the referential communication task. A comparison between referential communication and a standard theory of mind task was also done.

Method

Participants

Study I

Six children, one boy and five girls, participated in the study at two data collection times. The children all had a medical diagnosis of anarthria or dysarthria, and except for a few participants' ability to express "yes" and "no" through vocalisations, none of the children produced speech that was intelligible to unfamiliar listeners. The children ranged in age from 5 to 7-years-old at data collection Time 1 (T_1) and from 9 to 11-years-old at data collection Time 2 (T_2). A comparison group of six typically developing children also took part in the study. No statistically significant differences were found between the two groups with respect to either chronological age, $F(1, 10)=.002$, $p = .967$; $F(1, 10)=4.153$, $p = .07$ (T_1 and T_2 respectively), mental age as measured by Raven's Progressive Matrices, Coloured Version (Raven, 1965), $F(1, 10)=0.210$, $p = .656$; $F(1, 10)=1.669$, $p = .225$ (T_1 and T_2 respectively) or language as measured by SIT, a test of verbal comprehension, $F(1, 10)=2.079$, $p = .180$ (T_2) . A difference was found however between the two groups on the SIT at T_1, $F(1, 10)=7.571$, $p = .020$, the comparison group performing at a higher level. At T_1, the mean chronological and mental ages in the group of children with SSPI (severe speech and physical impairment) were 6:3 years and 5:7 years, respectively; in the group of typically developing children, the means were 6:2 and 6:6 years, respectively. At T_2, the mean chronological and mental ages in the group with SSPI were 10:2 years and 7:6 years, respectively; and in the comparison group, the means were 9:1 years and 8:9 years, respectively (Table 1).

Table 1

Chronological age, mental age and verbal comprehension. SSPI and comparison groups, Times 1 and 2

	SSPI (n=6) mean range	Comparison (n=6) mean range	p
Chronological age, T_1	6:3 5:1-7:6	6:2 4:7-6:4	.967
Chronological age, T_2	10:2 9:1-11:1	9:1 7:6-10:4	.070
Mental age, T_1	5:7 5:0-7:0	6:6 5:0-8:0	.656
Mental age, T_2	7:6 6:0-9:3	8:9 6:6-11:6	.225
Verbal comprehension, T_1[*]	38,33 30-42	40,67 30-46	.020
Verbal comprehension, T_2[*]	42,83 35-46	45,33 44-46	.180

[*] Max score 46

In study II, III and IV the participants in the deaf groups were all children from a Swedish school for the deaf. The same children participated in both study II and III. Some of the children from study II and III also participated in study IV, but not all. There were also children in study IV who did not take part in study II and III. For an overview of which children participated in which study see Table 2.

Table 2

Children participating in study II, III and IV

	Child number												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Sex	f	f	m	m	f	m	m	f	m	f	m	f	f
Study II		X	X	X	X	X	X	X	X	X	X		
Study III		X	X	X	X	X	X	X	X	X	X		
Study IV	X			X	X	X		X	X	X	X	X	X

Study II and III

Two groups of children participated in studies II and III, one group of severely or profoundly deaf children (n=10, 6 boys/ 4 girls) and a comparison group of hearing children (n=10, 6 boys/ 4 girls). The group of deaf children were drawn from two special schools, one day-school and one residential. They ranged in age from 7 years 1 month to 9 years 10 months at data collection time 1. One child had a deaf older sibling, apart from that all children had been born into families without a previous history of deafness. None of the participating deaf children had any additional disabilities (e.g. autism, mental retardation, visual impairment or cerebral palsy). The children in the comparison group all came from the same Gothenburg inner-city school. No statistically significant differences were found in chronological or mental age (as measured by Raven's coloured progressive matrices) between the two groups. $F(1, 19)=1.938$, $p = .180$; $F(1, 19)=.572$, $p = .459$. The background data for both groups regarding chronological and mental age are presented in Table 3.

Table 3

Background data for deaf and comparison groups regarding chronological and mental age

	Deaf group (*n* = 10) mean (SD) range	Comparison group (*n* = 10) mean (SD) range	*p*
Chronological age	8,44 (0,89) 7,08-9,83	8,94 (0,74) 8,08-9,75	.180
Mental age	8,55 (1,42) 7,00-11,50	8,98 (1,16) 7,50-11,50	.459

Study IV

Ten severely or profoundly deaf children took part in the present study. They were drawn from two special schools, one residential and one day-school. They ranged in age from 7:5 to 11:3, with an average of 9:5. Four of the children were cochlea implanted, but they all used Swedish Sign Language (SSL) as their primary mode of communication. Two of the deaf children came from families where one, or both parents were hearing-impaired, apart from that all children had been born into families without a previous history of deafness. None of the participating deaf children had any additional disabilities that might affect their level of functioning (e.g. autism, mental retardation, visual impairment or cerebral palsy).

A comparison group of ten typically developing hearing children, individually matched for mental age and sex, also took part in the study. Mental age was determined by Raven's coloured progressive matrices (Raven, 1965). No statistically significant differences were found in chronological or mental age between the two groups. $F_{(1, 18)}$=.010, p=.920; $F_{(1, 18)}$=.054, p=.819 The background data for both groups regarding chronological and mental age are presented in Table 4.

Table 4

Background data for deaf and comparison groups regarding chronological and mental age

	Deaf group (*n* = 10) mean (SD) range	Comparison group (*n* = 10) mean (SD) range	*p*
Chronological age	9,44 (1,31)	9,50 (1,29)	.920
	7,42 – 11,25	7,67 – 11.25	
Mental age	9,98 (1,54)	10,15 (1,66)	.819
	7,75 – 11,67	7,00 – 11,67	

Materials

Finding suitable test material is a major problem in the assessment of children with severe physical and communicative disabilities, and all test materials for the present studies were chosen with the aim that they should be possible to use with both the disabled and the non-disabled children alike. When standardised measures were used, an effort was made to find tests that demanded as few procedural adaptations as possible, thereby eliminating the risk of introducing entirely new task requirements. Information regarding which tests that were included in studies I, II, III and IV respectively can be found in Table 5.

Table 5

The tests included in each study.

Test	Study I		Study II				Study III				Study IV
	T_1	T_2	T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4	
Raven's matrices	X	X	X	X	X	X	X	X	X	X	X
SIT	X	X									
Digit span forward							X	X	X	X	X
Digit span backwards							X	X	X	X	X
Corsi blocks							X	X	X	X	X
Pretend play		X									
Perception level 1		X									
Perception level 2		X	X	X	X	X					
Part-Whole		X	X	X	X	X					
Desire		X									
First-order belief attribution	X	X	X	X	X	X	X	X	X	X	X
First-order belief attribution – pictorial							X	X	X	X	
Second-order belief attribution		X									
Non-mental representation			X								
Referential communication											X

Cognitive task

For matching purposes, and for assessing the children's cognitive level, nonverbal mental ability was assessed by the use of Raven's Progressive Matrices, coloured version (Raven, 1965). This test has been frequently used in previous studies with non-speaking participants (e.g. Baddeley & Wilson, 1985; Bishop & Robson, 1989; Dahlgren Sandberg, 2002; E. K. E. Hjelmquist, 1989) and is relatively easy to administer to disabled and non-disabled children alike.

Linguistic tasks

SIT (Språkligt Impressivt Test, Swedish; Hellquist, 1982) a test of Verbal Comprehension, Semantic Level, which corresponds to the Test of Reception of Grammar

(TROG) (Bishop, 1989). A story composed of 46 sentences was read to the children. A page with three pictures accompanied each sentence. The participant's task was to point at the picture that corresponded to the sentence. There were sentences with different word classes, inflections and variation in complexity. The test covers a mental age from 3 to 7 years. This test was used with the children with cerebral palsy.

When it came to the deaf children a highly experienced teacher of the deaf was instead given the task of rating each child's sign language ability, both receptive and productive, as there are no formal tests of sign language proficiency available in Sweden at present.

A video sequence of approximately ten minutes from the video recordings of each of the deaf children, showing as much spontaneous communication as possible, was chosen. The mentioned teacher of the deaf together with an experienced sign language interpreter, also used to working with children, then viewed each video sequence independently rating the children's sign language abilities.

Each of the deaf children was also shown a video of a story told in SSL and was immediately afterwards asked questions on the contents of the story. In addition to this, interviews were conducted with all classroom teachers. They were first asked to describe the criteria for typical sign language ability in the age group with which they worked. Then they were asked how they would characterize the sign language ability of each child in the light of the criteria offered for typical sign language development. This then resulted in each child receiving a rating of one (not yet reached the sign language ability expected for that particular age level), two (age equivalent sign language ability) or three (higher sign language ability than would be expected for that particular age level).

The same teacher of the deaf who rated the deaf children's sign language abilities also rated the sign language use of the deaf children's parents. This was done with the help of reports from journals and staff at the deaf unit of the county council and resulted in a scale from one to five being used (one – virtually no signing, two – some sign language ability, three – good sign language abilities, four – very good sign language abilities, and five – excellent sign language abilities).

Memory tasks

The Digit Span subtest of the WISC (Wechsler, 1977) was used as a measure of verbal short-term memory. The children with SSI repeated the numbers read out loud by the experimenter by pointing at figures printed on their Bliss charts, while the deaf children completed the test using SSL. The digit span task was done both forwards (study I) and backwards (only in study III and IV).

A visuo-spatial test of short-term memory was also included. This was the so-called Corsi blocks task (Rapala & Brady, 1990) where blocks were placed on a sheet of paper. The number of blocks placed on the paper started at four and continued up to nine blocks. The experimenter pointed at the blocks at a slow pace in random order. The children's task was to repeat the pointing.

Mental state tasks

The mental state tasks were selected for a number of reasons. One reason was that they would test the understanding of the mental states included in the Gopnik and Slaugther (1991) developmental model of understanding of mental states. Due to the children's severe physical and communication impairments it was not possible to include all mental states. This would have made the assessment sessions too long and would have been too fatiguing for the children, care was however taken to include mental states from all three levels in the model. The tasks were also selected on the basis that they have been widely used in previous ToM-research and would therefore more easily enable a comparison with data from groups previously tested.

Pretend play. (Study I, T_2). Parts of a design by Leslie (1994) was adapted and used. Two plastic cups were placed on the table in front of the child and two small teddy bears were introduced. The experimenter pretended to fill one of the cups with juice, and then said: "Look"!, picked up one of the cups and turned it upside down, shook it for a bit, then replaced it next to the other cup. In the first test question the child was then asked to point to the empty cup (both cups were of course really empty throughout). The experimenter then pretended to fill the empty cup again, but this time one of the teddy bears took the cup and poured the drink over the other bear. Following this it was suggested that she was now in need of a bath. The experimenter made movements suggesting the removal of her clothes and each time put

them down on the same part of the table. After having had a bath it was time to put her clothes back on and in the second test question the child was asked to point to wherever the experimenter had put her clothes ("Now teddy needs to put his clothes back on again. Can you remember where I put them"?).

Perception level 1. (Study I, T_2). The first perception task was modelled after Flavell, Everett, Croft and Flavell's (1981) level 1 perspective task, but asked about the child's own perception rather than the perception of another person (Gopnik & Slaughter, 1991). A piece of cardboard was shown to the child with only one side visible. On one side of the card was a picture of a car and on the other side was a picture of a plane. The subject was first shown one side of the card and was asked what picture he or she could see. The answer was given by pointing to the corresponding picture on another piece of cardboard put on the table in front of the child, which showed pictures of a car, a plane, a bird and a bicycle. The card was then turned around so that the child could see the other picture. He or she was then asked, "Now what picture can you see"? Finally, the experimenter asked the test question: "When I first asked you, before I turned the card over, what picture did you see? (Did you see a car or a plane?)".

Perception level 2. The first level 2 perception task was modelled after Flavell, Everett, Croft and Flavell's (1981) level 2 perspective task (Study I, T_2 ; Study II T_1 and T_2). The child was asked about another person's perception of a picture, as well as his/ her own. Sitting opposite the experimenter, the child was shown a drawn picture of a pig (the picture was laid down on the table, between the child and the experimenter) and was then asked: "How do you see this pig? Standing up or lying down"? followed by the question: "How do you think I see the pig? Standing up or lying down"? Answers were provided by pointing to the pig's feet or his back. The experimenter then turned the picture around so that the pig appeared to be lying on its back. The same two questions were asked once more and then the test question was asked: "When I first asked you, before I turned the picture around, how did you see the pig then? (Did you see him standing up or lying down?)".

In study II, T_3 and T_4, an experimental situation similar to that of Piaget's well-known mountain task (Piaget, 1954) was used. The child was shown a three-dimensional scene with a yellow cone, a red ball and a blue cube placed on a piece of white cardboard. A small doll was placed on the table in front of the child and was then subsequently placed at three different

angles and the child was asked to pick the one photograph (out of a set of five) that showed how the doll perceived the scene.

Part-Whole. Depending on what prior information they have obtained, people may acquire different information from the same perceptual experience. In order to assess the children's understanding of this an uninterpretable picture, so called 'droodles' (Perner & Davies, 1991) was used. In this case a black and white drawn picture of a cat was presented to the child (Study I, T_1; Study II, T_1 and T_2). The experimenter then covered the whole picture, except for the tip of the cat's tail, with a piece of paper. The child was now asked the following question: 'If your mum (or any other person not present in the room) was shown this picture, would she be able to tell that it was a picture of a cat'? If the child's answer was yes the questions 'Has she seen this picture before'? and 'Can she be sure that it is a cat'? were asked. At T_3 and T_4, in study II the same procedure was used, but the picture was exchanged for one depicting two elephants facing each other, their trunks meeting.

Desire. (Study I, T_2). In the desire task the participant formed a desire, and the desire was then satiated so that it changed. The children were shown two boxes and were then asked which one they wanted to open. After they had looked inside their first choice and played with the object it contained (a seashell or a small teddy bear), that box was closed and they were asked to choose again. The same procedure now followed with the second box, i.e. the child opened the box to look inside and was allowed to play with the content after which the box was closed and the experimenter asked the test question: 'When I first asked you, before we opened any of the boxes, which box did you want to open? (Did you want to open this one or this one?)'. There was no delay between the initial state and the subsequent state, the child's desire was immediately changed which meant that difficulties would not reflect a memory problem (Gopnik & Slaughter, 1991).

First-order belief attribution. Two different tasks were used to assess first-order belief attribution. At T_2 in study I, and at all four data collection times in study II an adaptation of the well-known smarties test (Perner, Leekam, & Wimmer, 1987) was used. A Winegum box was shown to the children. The children were first asked what they thought the box contained. After a look in the box they discovered that the box did in fact not contain wine gum but pencils. After the box was closed again the children were asked what someone who had not

looked inside would think it contained. This is a compelling way of demonstrating difficulties with false belief as the child experiences how the misleading situation creates a false belief in him/ herself before an attribution has to be made to the other person (Perner, Frith, Leslie, & Leekam, 1989). Finally the question: 'when I first asked you, before we looked inside, what did you think was in the box' was asked. After T_2 in study II the props were changed although the procedure remained the same. At T_3 the props consisted of a carton of juice, which really contained water and at T_4 it consisted of a box depicting a deck of cards, but really containing some band-aids.

At T_1 in study I and at T_1 and T_2 in study II, the test for first order belief attribution was an adaption of the classical Sally and Anne task (Baron-Cohen et al, 1985). Two dolls, Eva and Anna, are in a "room" together. Eva has a coin that she hides under one of three cups (the cups are all different colours, i.e. red, blue and green). She then exits the room. While Eva is out Anna moves the coin and hides it under one of the other cups instead. Eva then comes back into the room and the child is asked where she will look for her coin. In both these tasks control questions were also asked throughout the procedure to ensure that the child understands the instructions and also remembers what happens in the story.

At T_3 and T_4 in study II as well as in study IV the original Maxi-task developed by Wimmer and Perner (1983) was used. Mother returns from her shopping trip. She has bought some chocolate for Maxi. Maxi puts the chocolate away in cupboard A. After Maxi has put the chocolate away, he goes out to play. Mother takes the chocolate out of the cupboard and uses some of it for a cake. She puts the chocolate back, not in cupboard A, but in cupboard B. She then goes out to buy some more eggs for the cake. Maxi comes back from the playground. He is hungry, and wants some of his chocolate. The child is asked where Maxi will look for his chocolate. The following control questions were also asked: "Where did Maxi put the chocolate?" (after Maxi has put the chocolate away in cupboard A) "Where is the chocolate now?" (after Mother has moved the chocolate to cupboard B) and "Where did Maxi first put the chocolate?" (after the test question has been asked). If the child failed the actual test question he/ she was also asked if Maxi could know that his mother had moved the chocolate.

The thought bubbles task, used at all four data collection times in study III, followed the procedure of Woolfe, Want, and Siegal (2002). Before the actual test two pictures were

shown to the child, one depicting a boy thinking about a teddy bear and one depicting a boy holding a teddy bear. The child was first asked to point to the picture of the boy thinking about a teddy bear and then to the boy holding a real teddy bear. All children gave a correct answer to these questions. Subsequently four different so-called "thought pictures" were presented to the child. Two of the pictures involved the understanding of a central character's false belief (FB) and two pictures involved the understanding of a central characters true belief (TB). The four "thought pictures" were: (1) a boy fishing thinks he has caught a fish (TB=fish/ FB=boot), (2) a girl thinks she sees a tall boy over a fence (TB=tall boy/ FB=small boy standing on top of a box), (3) a man thinks he is reaching into a cupboard for a drink (TB=a drink/ FB=a mouse) and (4) a man thinks he sees a fish in the sea (TB=a fish/ FB=a mermaid). In each case a flap on which was depicted some plausible obstruction (for item 1-reeds, 2-the fence, 3-the cupboard door and 4- reeds) covered the critical object from the central character's sight.

For each thought picture the children were asked first to look behind the flap and then to identify what a character believed was behind the flap, and what was truly there. In order to emphasize the character's ignorance of the contents of the flap the children covered the central character with their hand when they lifted the flap. Once the children had viewed the picture and had lifted and replaced the flap they were shown a separate picture of the central character with a blank thought bubble above his or her head. Next to this picture were four small pictures. For the FB tasks two of these pictures were distracter items, one showed the content of the protagonist's belief and the other showed the actual object. In the TB condition, the true content of the belief was presented together with three distracters. The four thought pictures were presented in a counterbalanced order to the children and the selection of an individual thought picture as a FB or a TB item was randomised across subjects.

Second-order belief attribution. (Study I, T_2). In order to test the children's ability to make second-order belief attributions (i.e. their ability to think about another person's thinking about a third person's thinking) the so-called "church test" was used. The procedure was exactly the same as in the study by Baron-Cohen (1989a): The experimenter laid out a toy village on the table in front of the child, making sure that the child could see it properly. The experimenter then told the child a story, moving the dolls and other toys accordingly. As

in the first order belief attribution task, control questions were asked throughout the procedure, and the story ended with the actual test question being asked.

Referential communication task. (Study IV). The referential communication task used was based on the Glucksberg and Krauss (1967) paradigm. The child and the experimenter sat opposite each other at a table. Both had an identical set of 16 cards randomly laid out on the table in front of them. Between them they had a screen that was high enough to prevent them from seeing each other's cards, but not so high so that it hindered them to freely communicate with each other. The cards depicted faces drawn in black on a white background. They differed on four different dimensions with two values on each dimension (boy/girl, happy/sad, nose/no nose, large head/ small head). The child was told that this was a game where one of the participants were to choose a card and then verbally describe it in a way so that the other participant was able to pick up the same card. The child was asked to start. The child chose a card and then began describing it. When the child stopped, the experimenter asked the so called "adequacy question", i.e. the child was asked to judge if he or she had given enough information for the experimenter to be able to choose the correct card. The adequacy question was asked once, if the answer to the adequacy question was "yes" the experimenter picked up the card she thought corresponded to the description. If the answer was "no", the child was then allowed to add information if he or she wanted to. The procedure was repeated three times.

Test of non-mental representation. In order to make sure that any difficulty the children may have in solving the theory of mind tasks were due specifically to problems with mental representation, and not to representation in general, a test of physical rather than mental representation called the false photo task (Zaitchik, 1990) was also included in the study. The children were first shown a Polaroid camera with which they were allowed to take a photograph. The children then watched as the photograph developed. Next the children were shown a teddy bear placed on a white tablecloth in front of a white background. The teddy bear was holding a banana. The child was asked to take a photograph of the teddy bear holding the banana, using the Polaroid camera. This photograph was placed to develop face down and in the mean time the experimenter took away the banana, instead placing an apple in the teddy bears lap. The children were then shown two "ready-made" photographs, one of the teddy bear holding a banana and one of the teddy bear holding an apple, and were asked to

point to the "ready-made" photograph that would match the developing Polaroid photograph. Finally the control questions, "What was the teddy bear holding before?" and "What is the teddy bear holding now?" were asked.

All four studies included in this doctoral dissertation have been approved by a subcommittee for ethical issues at the Swedish Council for Social Research.

Procedure

Study I

The tests were given to each child individually at home or at school with a teacher, an assistant or a parent present. The parent or assistant was present partly to make the child feel more comfortable and partly in case the experimenter had trouble interpreting the child's communication. The tests were given without a time limit and presented to each child in approximately the same order. Because the children were spread geographically all over the country the researchers only had one or, at the most, two days in which to complete the testing process. This meant that a lot of work had to be done in a relatively short time and because of this there was a great risk of the children loosing interest or becoming too tired. Priority was therefore always given to factors such as avoiding fatigue and keeping up the child's interest.

In most tasks pointing to a preferred alternative or indicating, "yes" or "no" was sufficient. In those cases where a "yes" or "no" answer or pointing was not sufficient the non-speaking children were allowed to choose whatever means of communication they preferred. Mostly this resulted in them using Bliss or manual signs.

All sessions were video recorded so that they could be reviewed again at a later time. This made it possible for both the first and the second author to score the tests independently in order to obtain a reliability score. Having scored the tests independently the first and second authors disagreed on only one test item for one participant. A discussion between the two authors, together with an additional analysis of the video recording, however, resulted in full agreement being reached.

Study II and III

Data collection took place over the course of two years, with data being collected once every six months, resulting in four data collection times (henceforth referred to as T_1, T_2, T_3 and T_4 respectively). Each child was tested individually in a quiet room made available in the child's school. In order to avoid fatigue no session lasted for more than approximately 20 minutes. Instead, the children were asked back as many times as it took for them to complete the whole list of tasks included in the study. A female assistant fluent in SSL, but hearing so she was able to communicate directly with both the children and the experimenter carried out the testing of the deaf children. She was familiar to the children and had been given careful instructions in advance on how to carry out the different tasks. The experimenter was always present for the testing of the deaf children and the test sessions were also video recorded with two cameras (one pointed at the child and one pointed at the assistant carrying out the testing). The experimenter alone tested the hearing children.

Study IV

Each child was tested individually in a quiet room made available at the child's school. The experimenter acted as partner in the referential game situation, interacting with the children in SSL. A female interpreter fluent in SSL, but hearing so that she could communicate both with the experimenter and the children, was present when the deaf children were tested, in case the experimenter needed help interpreting the child's communication. The experimenter alone tested the hearing children. The test sessions with the deaf children were video recorded with two cameras in order for the interpreter to be able to later translate all Swedish sign language into written Swedish.

Methodological issues

Research conducted on such a heterogeneous and relatively small diagnostic groups as children with cerebral palsy and severe speech impairment and deaf children of course entails many methodological difficulties. A few of the more obvious problems are the following.

The experimental procedure

It has been argued that many ToM tasks are too dependent on children's linguistic skills. Children may understand false belief but, because of the linguistic complexity of the tasks, be unable to demonstrate their understanding in this context. From this point of view, the children's linguistic immaturity might result in task performance that masks their underlying competence. The standard tests of ToM used in this study, however, have a number of unique advantages when testing children without, or with very little, productive language skills. These advantages include: a) a readily comprehensible story line supplemented by the use of dolls or other props (smarties box, pictures etc). b) a simple vocabulary, and c) a completely nonverbal response mode. As Baron-Cohen (1992, p.10) has noted: "the beauty of this paradigm (i.e. false belief – *author's note*) is that although it requires a verbal mental age of about 4 years to comprehend the narrative, the test does not require any expressive language abilities". It is also important to keep in mind that crucial to the idea of studying ToM is that it should be possible to have a ToM, in particular a false belief, without having a language at all as the ToM tasks were originally developed for the study of mental capacities in nonhuman primates (Premack & Woodruff, 1978).

When assessing the children's ability to solve ToM tasks linguistic communication is of course used. The question of whether the children "comprehend" instructions is thus critical in this context. The task instructions that were used in the present studies used linguistic constructions covered by the SIT test (Hellquist, 1982). The child's answer to the ToM question was included in the analysis only if the child answered the control questions correctly. This because a correct answer to the control question shows that the child has a correct comprehension of some aspects of the verb 'think', i.e. the child understands the meaning of the verb deep enough to enable correct pragmatic use of it, at least in certain contexts, such as the test question used. One could say that the ToM task shows whether the child, in the same context, has an even more advanced understanding of 'think', to the extent that the child understands that a person can also think 'wrong', i.e. have a false belief. This constitutes the central part of the logic, and validity, of ToM tasks.

Some researchers have also argued that young children's failure on ToM tasks may be due to the tasks not being engaging enough to elicit optimal performance (Flavell & Miller,

1998). The children taking part in the present study, however, showed great motivation and very eagerly took part in the different tasks presented to them.

Heterogeneous groups

As pointed out earlier, cerebral palsy is not a homogeneous diagnosis, but a collective term used for a number of different syndromes. As a result the clinical signs may vary to a large extent from one child with CP to another. In order to reduce these differences as much as possible the inclusion criteria for participants in the present study were that the children were within normal range of intelligence at the time of the first data collection, and that they used Bliss as a major communication aid. Despite the variation in the medical diagnosis given, the children did not show any great variation in terms of speech impairment. The extent of the physical impairment differed within the group, but not severely. None of the children were independently mobile. The deaf children as a group were more homogenous.

Small sample sizes

The small sample sizes do of course present a severe problem in this line of research, especially considering the possibility to generalize. It is, however, impossible in a country like Sweden to obtain large samples, despite the fact that the children with SSPI in this study were pooled from all over the country. In the case of this study the inclusion criteria that were set up in order to reduce heterogeneity also resulted in the sample becoming even smaller.

Main results

Study I

The children in the comparison group performed at ceiling already at T_1 and there was a clear difference in the ability to solve tasks requiring false belief attribution between the children with SSPI and the comparison group. At T_1 this difference was significant ($p=.008$, Fishers exact test, one-sided), but at T_2 it was not ($p=.091$, Fishers exact test, one-sided), showing that there is some development taking place in the children with SSPI.

The results also fit well with the Gopnik and Slaughter developmental model of theory of mind (1991) in that all children with SSPI who passed the first order theory of mind task had passed the pretend play, perception level 1 and 2 and desire tasks, and only those who passed the first-order false belief task passed the second order task. This is an indication that development of ToM follows a typical pattern, only delayed.

Study II

The results showed main effects for group (hearing and deaf) on all four theory of mind tasks, i.e. part-whole, level 2 perception, unexpected content and change of location, even when controlling for chronological and mental age. The hearing children performed virtually at ceiling already at T_1.

The analysis showed very little development over the four data collection times on any of the four tasks, and there were no interaction effects.

Deaf and hearing children alike performed perfectly on the test of non-mental representation (i.e. false photo), and this test was therefore not repeated at the following three data collection times.

The children's sign language abilities were positively correlated with performance on the part-whole, unexpected content and change of location tasks at T_1, but not with perception level 2. Parental sign use, on the other hand, was not significantly correlated with the children's performance on any of the theory of mind tasks.

Study III

Lowering the linguistic demands of the false belief task did not help the deaf children. They performed significantly below the hearing children on the thought bubbles task as well as on the standard false belief task. They also performed more poorly on the false belief than on the true belief condition within the thought bubbles task.

The thought bubbles false belief condition was significantly correlated with the standard false belief task indicating that they were testing the same ability. Significant group effects on

the two different theory of mind tasks were maintained even when memory (spatial and verbal) and age (chronological and mental) was controlled for.

The deaf children's performance on the spatial and verbal backward recall working memory tasks matched that of the hearing children, but they did not perform as well as the hearing children on the verbal working memory task, forward recall. The contrast in performance on the forward versus the backward verbal working memory tasks was greater in the hearing group than the deaf group.

Study IV

The hearing children were more efficient than the deaf children in the referential communication task. They also provided more relevant information and were better at judging whether enough information had been provided or not. These differences were significant and were not affected when age (chronological and mental), memory (verbal and spatial) and theory of mind was controlled for. Total amount of information given did not differ between the deaf and hearing children, however, nor did amount of redundant or irrelevant information.

Each child was given three trials on the referential communication task. And while no increase in efficiency, ability to answer the adequacy question correctly or the amount of irrelevant or redundant information was detected, there was a significant increase in the amount of relevant, and therefore also in the total amount of information given across the three trials. Working memory and age, but not false belief, was significantly correlated with different measures of success on the referential communication task in both groups. There was also a positive, but not significant, correlation between false belief and efficiency in the deaf group.

GENERAL DISCUSSION

The main aim of this thesis was to study the development of Theory of Mind in two groups of children with atypical language and communicative development, i.e. children with SSPI (severe speech and physical impairment) and deaf children born into hearing families. Language and early communicative interaction is clearly impaired for both these groups of children. There is, however, one important difference concerning the communicative preconditioning between the children with SSPI and the deaf children that should be kept in mind. The difference is that the children with SSPI, although not active participants themselves, are constantly being exposed to spoken language and conversation of others around them. An interesting question is thus, whether or not being a passive recipient of language is enough for the normal trajectory of mentalizing skills.

Until recently theories of children's development of mentalizing skills have focused mainly on either cognitive maturation (i.e. modularity theory) or individual processes of theory formation (theory theory). An increasing number of studies however have pointed to the necessity of early social interaction for the development of theory of mind, one example being the studies of deaf children conducted by Peterson and Siegal (1995; 1999). Carpendale and Lewis (2004), take this one step further emphasizing the fact that concepts about the mind are not just passed on to children by their cultural and social environment, nor are they completely formed by individual child-theorists. Instead children gradually construct social understanding through the regularities they experience in interacting with others.

According to Carpendale and Lewis (2004) a problem within the ToM literature so far is that a majority of approaches are too individualistic. As an alternative they argue for a constructivist account of the development of mental state understanding that integrates the social and individualistic dimensions of development. They contend that the child not merely adopts a socially available knowledge. Rather within social interaction an understanding of mental states develops and is constituted. This leads to the important and interesting question of what implications the deaf (in a non-signing environment) and SSPI children's limited possibilities for a more complex early social interaction then have on their development of mentalizing skills? This is an important area of investigation both for practical understanding

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of children with atypical development and for theories of the development of social cognition and theory of mind more generally.

A striking result was the next to no development in the deaf children's mentalizing abilities in study II and III. After two years, starting between the ages of seven and nine, they still did not perform at ceiling. This should be viewed in contrast to the comparison group who performed at ceiling on all tasks already at T_1. In the group of children with SSPI there was a more evident development. The difference between the SSPI group and the comparison group that was significant at T_1, was no longer so at T_2. It could be argued that this development was due to the fact that the data collection times were over two years apart in the SSPI-study compared to every six months in the deaf studies (study II and III), but if we only compare the end-points in the deaf studies, i.e. T_1 and T_4, there is still little development. A possible explanation for the development taking place in the SSPI children, but not in the deaf children, could be the already mentioned fact that, although perhaps not participating themselves, the children with SSPI still experience language from birth and listen to other people talking about mental states. The lack of a clear positive change among the deaf children on the mentalizing tasks over a period of two years is a strong finding, since it is perhaps the first one using a longitudinal design.

All four studies also included a comparison group of typically developing children matched for sex, chronological and mental age. In previous studies, typically developing children of 4-6 years have often been used for comparison as this is the age when basic theory of mind reasoning skills are usually developed. However, we thought it important to use comparison children of the same chronological and mental age as the deaf and SSPI children since little is known about the ToM performance of typically developing children in a longitudinal perspective. In the literature there has been some concern about the consistency of performance across tasks, testing conditions and also age (Charman & Campbell, 1997; Mayes, Klin, Tercyak, Cicchetti, & Cohen, 1996). The comparison children in all three longitudinal studies (I-III) were, as expected, performing on a high level already at the first data collection point, but more importantly, there were no signs of regression in performance. There was some variation of the four data collection points in study II and III, but they seem more reasonably ascribed to random effects. In study I there was no variation at all in the comparison group. Even when using hearing preschool, rather than age matched, children there is a risk of encountering the problem of the comparison group performing close to

ceiling. One example is a recent study by Peterson (2004) where 71 per cent of the preschool children (mean age 5 years) performed no errors at all on a test battery consisting of five different standard false belief tasks.

The pattern of results shown in the present studies makes it highly unlikely that the findings do not reflect genuine problems with mentalizing tasks in the deaf children. On the non-mental (false photo) task the deaf children were just as fast and confident in their responses as the hearing children. In fact, the deaf children's answers were so unambiguous already at the first data collection time that we decided not to use the false photo task at the following data collection times. It is also important to note that *all children in all four studies (deaf, SSPI and comparison groups) answered all control questions correctly;* consequently no child was excluded from any of the studies due to a failed control question.

There is an ongoing debate as to whether poor performance on theory of mind tasks really is due to an impaired theory of mind or if it is a question of complex task instructions masking ability. The fact that none of the children, neither SSPI nor deaf, seemed to have any trouble understanding the test instructions (as mentioned earlier all children passed all control questions) together with the fact that the deaf children in study II had no trouble at all passing the task of non-mental representation (the instructions to which were at least as complex as the instructions for the standard ToM task), lead us to hypothesise that using a linguistically less challenging task would not help "unmask" a mentalizing ability in the deaf children who did not pass the standard theory of mind task. The results in study III supported this hypothesis. The hearing children were significantly better than the deaf children on the standard change of location task as well as the linguistically less demanding thought bubbles task across all four data collection times. There was also a significant difference in the deaf group between performances on false versus true belief within the thought bubbles task. The same difference could not be seen among the hearing children since, again, they were performing at ceiling in both conditions.

Working memory is another cognitive skill that has been suggested as a possible component of successful mentalizing (Gordon & Olson, 1998; Hughes, 1998). The significant group differences between the deaf and hearing groups on both ToM tasks in study III did however persist even when working memory, both spatial and verbal, was held constant.

Neither of the working memory tasks contributed significantly to the variation between the two groups.

Even though the working memory tasks could not explain the poor results on the mentalizing tasks in study III, the results on the memory tasks themselves are still interesting. Wilson, Bettger, Niculae, and Klima (1997) have argued for the modality specificity of working memory, i.e. that language modality shapes the architecture of working memory. Native signing deaf children in the Wilson et al. study proved to be just as good on backward as forward recall within a digit span test of verbal working memory, unlike hearing children who had greater trouble with backward recall. This might suggest that serial order information using sign language is stored in a form that does not have a preferred directionality (Wilson et al., 1997). In the same study by Wilson et al. (1997), the native signers performed better than the hearing children on both the backward recall of the digit span task as well as on a spatial working memory task. Non-native signers, however, showed lower results on backward recall than forward recall, just like the hearing children.

The deaf children taking part in study III were not native signers, but they had all been introduced to sign language at a relatively early age. All but one child had received their diagnosis by the age of two, one girl even as early as six months. This was considerably earlier than the non-native signers in the Wilson et al. (1997) study. In study III the hearing children outperformed the deaf children on the forward recall condition of the digit span task (verbal working memory), but not on the backward recall. A look at descriptive data on verbal working memory in the deaf versus the hearing groups in study III also shows that the difference between forward and backward recall was smaller in the deaf group compared to the hearing group. The difference between forward and backward recall was, however, still significant in both groups. The deaf children also performed equal to, but not better than, the hearing group on the spatial working memory task.

By introducing the referential communication task (Glucksberg & Krauss, 1967) in study IV, we expected to find some variation also in the comparison group. This is a widely used task and even 10 year olds have problems with correctly evaluating the verbal messages in the task (Brownell, Trehub & Gartner, 1988; Hedelin & E. Hjelmquist, 1998; Robinson & Robinson, 1977; Sonnenschein, 1986). In accordance with our hypothesis, even though the comparison group performed better than the deaf group in most respects on the referential

communication task, there was still some variation in the group. There was also a significant, or close to significant, positive correlation for both groups between age, both chronological and mental, and amount of relevant features given, correct answer to the adequacy question and degree of efficiency.

In contrast to the canonical theory of mind task the referential communication task is an instance of true verbal communication and invites the speaker to take own initiatives. A crucial difference is also that the referential communication task does not explicitly invoke false belief judgements, but requires true and relevant information to be conveyed and also irrelevant information to be withheld. Another important difference between the theory of mind task and the referential communication task is that in the ToM task the experimenter asks the child for specific information whereas the referential communication task requires the child to understand on his or her own what information that needs to be given in a certain situation, and to leave out information that is not relevant. Thus, despite the range and specificity of the conversation being limited by the cards and their features, the card-game will still have a higher degree of resemblance with a real-life communicative situation.

The deaf children who participated in the present study had all reached an age of between 7 and 11 years, an age when they could be expected to have reached good standards in referential communication skills (Hedelin & E. Hjelmquist, 1998). Despite this the group of deaf children were less efficient in their referential communication than the hearing group, they also provided less relevant information and were less able to make an adequate judgement when asked if they had provided enough information for the listener to be able to pick the right card. Even though the deaf children continuously provided more relevant information across trials, there was no corresponding decrease in the amount of irrelevant features provided, the result being that even if the total amount of communication increased, the communicative situation did not become more efficient across trials.

According to Lindblom (1990), in order for interpersonal communication to be successful the speaker has to have what is referred to as communicative empathy, i.e. the ability to take the point of view of the interlocutor, otherwise communication might break down. Essentially this would require the child to have developed a theory of mind. Indeed, the only child in the deaf group who performed perfectly on the referential communication task (i.e. provided information on all four relevant features while mentioning none of the

irrelevant) had also passed the false-belief task. There was also a positive correlation in the deaf group between theory of mind, as measured by a standard false-belief task, and efficiency on the referential communication task, this correlation was not significant however. This would indicate that theory of mind is a necessary but not sufficient prerequisite for successful referential communication.

Advanced understanding of false belief has been found among preschoolers who frequently exchange mental state terms in conversations with siblings and friends (Brown, Donelan-McCall, & Dunn, 1996; Dunn, 1994), and those regularly exposed to sophisticated speakers, including adults and older children (Lewis, Freeman, Kyriadidou, Maridaki-Kassotaki, & Berridge, 1996). Too often there is a lack of sufficient means of own initiated communication for the children with SSPI and together with the difficulties in communicating with the child often experienced among parents and other people close to the child lead us to suggest that an impoverished experience of communicative social-interaction is part of the problem. In a questionnaire that was handed out to the parents of the children with SSPI at T_1 the parents were asked to indicate the topics of their children's conversations (the alternatives given were: objects, people, activities, thoughts, and feelings). The answers showed that the children with SSPI talked less about "thoughts" and "feelings" compared to the other topics given as alternatives in the questionnaire.

Previous research has also shown that mothers who are "mind-minded", i.e. who think of their children in mentalistic terms, and therefore are likely to talk to their children about the psychological world, have children who are more advanced in social understanding than other children (Meins & Fernyhough, 1999). Due to both speech and physical impairments children with SSPI have trouble sending the kind of communicative signals that are usually expected from young children and parents might also have trouble interpreting these signals. Interaction between parents and children with SSPI is often slow and cumbersome and quite often marked by a lack of rhythm and timing. This might have an effect on the extent to which mothers think of their child in mentalistic terms. The extent to which parents can be cooperative and support their child's reasoning will partly depend on, and interact with, the child's own abilities and characteristics (Carpendale & Lewis, 2004). The child's developmental level may influence the nature of the relationship because children who are more advanced in language and social cognitive development may be easier to interact with in a cooperative manner. These factors will not only influence a child's ability to interact with

others, but also influence the nature of such interactions, and it is such interaction that is essential in social cognitive development (Carpendale & Lewis, 2004).

The difficulty of acquiring functional communication skills is a significant problem facing deaf children born into hearing families as well. Much of research, however, has concentrated on specific linguistic skills rather than on the combination of both linguistic and non-linguistic skills that together create a necessary foundation for successful communication (Mackay-Soroka, Trehub, & Thorpe, 1987). It is not enough, however, for the child to acquire a high level of sign language, it is also of great importance that families of deaf children are able to sign well enough for a complex and sophisticated bi-directional communication system to develop (Vaccari & Marschark, 1997; Woolfe, Want & Siegal, 2002). Considering the fact that parents of deaf children not only have to deal with their child having been given a diagnosis, but also have to start learning a second language, this is not easy to accomplish.

The ability to take someone else's perspective, to understand that other people's actions are governed by their thoughts, beliefs and feelings, is crucial in social interaction and communication between people, and interpersonal communication enhances this ability. Language, or communicative interaction, is the means through which children learn about other people's experience, but it is important not only to provide children with appropriate means for communication, but also to provide experiences and the tools with which to use communication in an efficient manner. If a child is not given the means to manifest his or her knowledge and emotions people may lower their expectations of the child, with the result that he or she is not stretched cognitively, social or otherwise. This is true for both deaf children and children with SSPI alike.

Siegal and Varley (2002) argue that impairments of ToM might have at least three different underlying causes. In some cases the impairments could be traced to abnormalities in the cognitive structures of the brain, referred to by Siegal and Varley as the core system. This could be the cause of ToM disorders in many people with autism (e.g. Baron-Cohen, Leslie & Frith, 1985). Impaired ToM could also, according to Siegal and Varley, result from the failure of a co-opted, or scaffolding, system (such as the language system or executive functioning) that is necessary for performance on a specific task.

The third possible cause suggested by Siegal and Varley (2002), is the absence of a trigger for the emergence of ToM, such as conversational experience. Lack of exposure to,

and experience of conversation about mental states has, in a number of previous studies, been put forward as a possible explanation of the low performance of deaf children on false-belief tasks (Figueras-Costa & Harris, 2001; Peterson & Siegal, 1995; 1999a,b; Siegal & Varley, 2002; Woolfe, Want, & Siegal, 2002). Daily social interactions provide opportunities for the child to learn about mental states and about the relationships between mental states and overt behaviour (Peterson & Siegal, 1995). Rich opportunities of this kind seem to be presented by, for example, play interactions in which the child shares and negotiates a pretend world with another; by arguments in which the child is faced with the different perspective of another; and by everyday conversations about various aspects of the social world, which can include reference to mental states (Dunn, 1996). This kind of opportunities, "testing the waters", bandying ideas with other children as well as adults do not present themselves as easily to children restricted by the lack of a language which they share with their social environment. It is within the context of development of ToM as a socially mediated process that children with atypical language development become a very important and interesting group.

One limitation of the present studies is of course the modest sample sizes. A strength on the other hand is the longitudinal design. Peterson, Wellman and Liu (2005) point to the importance of longitudinal data for answering crucial questions regarding developmental trajectories of mentalizing skills. The results from the two groups of children with severe restrictions on linguistic interaction and communication (i.e. non-speaking children with cerebral palsy and non-native early signing deaf children) speak in favour of the crucial importance of early communication using a common language for the typical developmental trajectory of mentalizing skills. This then also provides support for the early social-interaction hypothesis for the development of theory of mind and stresses the importance of early introduction of sign language for both child and parents/ caretakers in the case of the deaf children and a suitable AAC for the children with SSPI.

Interesting questions for future work include further longitudinal studies examining both in more detail what constitutes the early social interactions of both the children with SSPI and the deaf children growing up with hearing parents as well as a look at what happens later on in development. If we argue that the trajectory of mentalizing skills in the two groups seem to be delayed rather than deviated when, and how, do they finally catch up?

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APPENDIX

I.   Falkman, K. W., Dahlgren-Sandberg, A. & Hjelmquist, E. (2004). Theory of mind in children with physical and speech impairment: A longitudinal study. *Manuscript submitted for publication*.

II.   Falkman, K. W. & Hjelmquist, E. (2005). Mentalizing skills of non-native, early signers: A longitudinal perspective. *Manuscript submitted for publication*.

III.   Falkman, K. W. & Hjelmquist, E. (2005). Delayed performance on pictorial and standard false-belief tasks in non-native, early signers. *Manuscript submitted for publication*.

IV.   Falkman, K. W. & Hjelmquist, E. (2004). Do you see what I mean? Shared reference in non-native early signing deaf children. *Manuscript submitted for publication*.