Mental Language in Children with Autism

Annette Watzema (3210936)

Universiteit Utrecht

MA Thesis Linguistics: Language and Speech: Processing and Disorders

First supervisor: drs. H.N.M (Hannah) de Mulder

Second supervisor: Prof. dr. F.N.K (Frank) Wijnen

Date: 06-06-2009

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1. Introduction

Autism is a developmental disorder that has much influence on behaviour towards other people. Persons with an autistic disorder react differently in social communication than persons without autism. It is a disorder that affects all of mental development. Autism affects development and, in turn, development affects autism (Frith, 2003). This means that symptoms are different at different stages of life, some of them disappear with time and development, others will only become apparent later.

One of the most characterizing elements of autism is the inability to form social relations in the normal way. Kanner (1943) was one of the first who published about this disorder. He wrote:

> "We must, then, assume that these children have come into the world with innate inability to form the usual biologically provided affective contact with people, just as other children come into the world with innate physical or intellectual handicaps."

Persons with autism have problems understanding the thoughts and feelings of other people, which has become known as a lack of everyday "Theory of Mind" (Frith, 2003). This Theory of Mind (ToM) refers to the ability to predict and explain others' behaviour on the basis of their emotions, intentions, desires, attitudes etc. By doing this, we can posit a mental state inside a person to explain behaviour that doesn't seem logical at first (de Villiers, 2007). An example of such behaviour: imagine that you witness a girl who brushes her teeth with hair gel. This will probably make you think: 'she thinks that the hair gel is a tube of toothpaste!'. The average observer would think this, because the option that she intentionally brushes her teeth with hair gel does not make sense, so you search for another reason that will clarify the situation.

ToM could also include interpreting 'mental language'. Mental language is, amongst other things, about pragmatics, like interpreting indirect requests. E.g. a woman is reading a book in her room, then her sister enters the room and leaves the door open: The reading woman could say: "it's cold!" The sister probably understands that this is a request to close the door. She understands that it is not just an informative remark, but that she is actually making a request. She understands this because her ToM allows her to 'read' the desire in her sister's mind.

It would be interesting to see whether children with an autistic disorder understand this sort of mental language. Does this type of language pose a specific problem for these children? If it

does, it becomes more probable that mental language is dependent on a having a fully functioning ToM, if it does not it means that there is something else that plays a more important role in the understanding of mental language. It could be that language ability is more important for the development of mental language than ToM. This is a possible option, because research has shown that a relationship between ToM and language ability is plausible (e.g. Peterson, 2003; Astington & Jenkins, 1999; Lohmann & Tomasello, 2003).

For this thesis, 10 autistic children were tested and compared to a typically developing control group. The tests that were performed served to find an answer to the question whether or not children with an autistic disorder have more problems than typically developing children with mental language. Mental language could be a problem for autistic children, because of their impaired Theory of Mind. However, it was found that although the autistic group had significantly more difficulty with the ToM tests, the mental language tests did not pose more problems for them than for the typically developing control group. It seems to be the case that ToM is not a necessary requirement for understanding mental language. The hypothesis that general language ability is more important than ToM for the comprehension of mental language is discussed.

First, I will describe what an autistic disorder entails. Next, I want to explain the concepts ToM and mental language more broadly. Then the relation between ToM, mental language and autism will be discussed. Finally, I will describe the study that I have conducted and I will discuss the results.

2. Autism

2.1 Characteristics

Autism is a developmental disorder that can appear in varying gradations and with different characteristics. There is a spectrum of autistic disorders (ASD; Autism Spectrum Disorders) in which at least some characteristics are always present. Children with an ASD have abnormal or impaired development in social interaction and communication. They are limited in their activities and interests and don't get attached to others. They do, however, often have a specific object that they prefer, like a toy train or a puzzle. To this preferred object the child gives disproportionally much attention. They fail to establish relations with other people and to participate in joint-attention activities (Goin & Myers, 2004). Joint-attention activities are activities that require a shared mental focus between two or more persons in order to achieve a goal. Examples of joint-attention activities are pointing or gazing to an object with the

intention to make someone else look at this object as well, throwing and catching a ball and taking turns in blowing bubbles. Another difficulty for children with ASD are changes in the routine of their daily life. They tend to display stereotyped and repetitive behaviour (Goin & Myers, 2004). There are three features that occur in autism which form a triad of types of impairment: 'The aloof', 'the passive' and 'the odd'.

'The aloof' is the child who totally withdraws and who does not respond to social events or to speech. This child doesn't use eye contact and refuses demonstrations of affection, like cuddles.

'The passive' is the child who accepts social approaches indifferently. Social contact is just part of daily routine. He seems very easygoing, but stress or changes of routine can result in intense emotional outbursts.

'The odd' is the child who likes being with other people. He likes to touch them and to be cuddled by them, even if he doesn't know them. He often approaches strangers and can't judge when this is unwanted or inappropriate (Frith, 2003).

These three types can arise in one and the same person in different phases of life (Frith, 2003). There are some differences between these types, however, the majority of the problems stay the same. There are often some language problems (see next paragraph) and their Theory of Mind remains impaired (see chapter 4.1).

2.2 Language

Much variation exists in the language skills of individuals with ASD. All of them have deficits in the pragmatic aspects of communication. Formal (syntactic) language deficits are not a core feature of ASD, however two subtypes of ASD with regard to language have been discovered; one with normal linguistic abilities and the other with language impairment. The latter group was found to experience language problems similar to those of children with Specific Language Impairment (SLI) (Tager-Flusberg, 2006). This language disorder is characterized by a delay and/or abnormal language acquisition in the absence of other sensory, cognitive or affective disorders. The main problem areas are phonological processing and grammatical morphology. Some studies have shown evidence for parallels between the language profiles of children with SLI and ASD, but whether these deficits come from the same underlying mechanisms or whether there is a real overlap between the two syndromes is not yet clear (Tager-Flusberg, 2006). A recent study by Whitehouse et al. (2008) shows evidence against the idea of an SLI subtype for autism, because there were too many differences between the two groups. The SLI group had a significantly poorer performance at

speech motor skills and sentence repetition than the autistic group. These impairments are very common in the SLI population and can be seen as psycholinguistic markers of this disorder (Whitehouse et al, 2008).

A recent study shows that adults with ASD also have some language problems. Lewis et al. (2007) have found that adults with ASD have difficulties with "those complex high level language skills that require a person to use and interpret language in a flexible, rational and goal-oriented manner in an ever-changing communicative environment". They have problems resolving ambiguity[1], understanding referential language[2] and the use of linguistic flexibility[3]. Other difficult areas for them are figurative language[4] and producing relevant speech acts[5]. All these aspects of language are (partially) in the field of pragmatics. That part of language clearly poses some problems for people with ASD.

Persons with Asperger syndrome, which is a variant of ASD in which one's intelligence is high, often have perfect syntax, but a strange prosody and abnormal pragmatics. If someone asks them: "Can you pass the milk?" they might simply answer yes, but not perform the action that was indirectly requested (Bloom, 2002).

3. ToM, Language ability and mental language

3.1 ToM and EF

Theory of Mind is the ability to interpret the mental states (like desires, beliefs and intentions) of another person. ToM allows people to understand others' behaviour (see also introduction). Not until they are about 5 years old, do young children have this (complete[6]) ToM. This ability makes it possible to understand other people, even if the mental states of those persons do not correspond to the observer's own knowledge or to reality, which is known as false belief understanding. (Bull et al. 2008). The development of this false belief understanding is

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[1] Ambiguity: an utterance that can be interpreted in more than one way, e.g. 'the duck was ready to eat.' Is the duck ready to eat or to be eaten (Example taken from Aitchison, 2003).

[2] Referential language: to what object or person does an utterence refer? E.g. 'Eric hits Peter. He starts to cry.' To whom does 'he' refer, to Eric or to Peter?'

[3] the ability to use in a creative way and understand language that is used creatively or not completely correct. E.g. 'I took the grabber' instead of 'the tongs' (example taken from Everhart & Marschark, 1988).

[4] non-literal language with unusual comparisons, e.g. 'He worships the ground she walks on'.

[5] saying things that have a communicative purpose at the time of utterance.

[6] The development of ToM starts before the age of 5, so they already have some parts of ToM when they are younger.

one aspect of ToM. The understanding of false beliefs is about appreciating that a person's own perception or belief is not necessarily shared by another individual. Young children don't understand that people with a mistaken belief are likely to take the wrong action in order to achieve their goal. Therefore, they are not very successful at manipulating other persons' behaviour by lying or deception (Perner & Lang, 1999).

Tasks that test false belief often involve a person that leaves the scene before the moment that a crucial change takes place. This change is often the change from one place to another place, for example, a marble that is replaced from a basket to a box. An example of a false belief test is the story of Max and his mother. In this test Max can, for example, place a chocolate bar in a green cupboard and leave the scene. Then his mother takes the chocolate bar from the green cupboard and she puts it in a blue cupboard. When Max comes back, the subject is asked where he thinks Max will first look for the chocolate bar. If the subject understands false belief he will mention the place where it was before the chocolate bar was moved by mother, i.e. the green cupboard. He understands that Max has a false belief that dictates his answers (de Villiers, 2007). A visual representation of this false beliefs test example can be seen in figure 1.

A cognitive process that is important for the working of ToM is Executive Function. Executive Function (EF) is a set of mental processes in which past experiences are connected with present action (e.g. opening the tap for water when you are thirsty, because you saw it before. Or being suspicious when there's smoke, because past experience tells you there might be a fire). EF is responsable for planning an action based on perceptual information, past experience and future goals (Roelofs et al., 2002). This allows persons to anticipate outcomes of certain actions and adapt to changing situations. It is necessary for maintaining a mentally specified goal and being able to complete this even when there are distracting alternatives (Perner & Lang, 1999). An example of a person without EF, and who, because of this, is unable to formulate goals for himself:

> "A surgeon who suffered cardiac arrest with secondary hypoxia during minor elective surgery drives a delivery truck for his cousin's business. He can make deliveries anywhere within his home town so long as he has explicit instructions about where to go and what to do, but he is unable to handle unexpected situations. When the family he lives with occasionally leaves him alone on a weekend, he may go for as long as two days without eating or drinking anything that requires even minimal search or preparation, although he can make coffee and simple meals when reminded." (example taken from Lezak, 1982)

Of course this example shows an extreme and quite rare version of lack of EF. However, milder versions in which persons have a less developed EF are more frequent, for example in young children. One aspect of EF that often needs some time to develop is the inhibition of a prepotent response. A prepotent response is a response that has the greatest immediately effective habit strength[7]. This means that the response that an individual is used to, and has been successful in the past, is likely to be chosen again in another situation, even when this is not correct. In false belief tests it is also important to inhibit a prepotent response. It is necessary to suppress one's own true belief while holding in mind the requirement to answer a question about what the protagonist of the story will do (Russell et al., 1999). It has been suggested that persons with autism have an impaired EF and that this explains their poor performance on false belief tests (Russell et al., 1999).

There are two different views on the developmental relationship between ToM and EF in children, the expression and the emergence account. The emergence account states that there is no correlation between ToM and EF. In this view is it emphasized that EF is important for the development of the understanding of other's people states of mind. When this process is completed, ToM and EF are no longer related to each other. The expression account, in contrast, emphasizes that there is a lifelong on-line contribution of EF to social reasoning. In this theory EF is necessary to perform ToM tasks. (McKinnon & Moscovitch, 2007).

Many studies have addressed the putative relation between ToM and EF. It has been shown, for example, that children with ASD have difficulty interpreting cues to mental states, but they were unimpaired at matched tasks that required the same EF capacity, but where no understanding of mental states was needed. An example of the latter is a test in which the subjects are shown pictures and items that correspond to the pictures. The experimenter hides a coin under one of the items without the subject watching. Then the experimenter points at the picture that corresponds to the item under which he has put the coin and says: 'the coin is under the suitcase' (for example). Then the child is asked to search for the coin where they think it should be. In order to pass this test the child has to be able to understand that an object can be seen as a thing itself and as a symbol of something else. The child needs to hold both identities in mind simultaneously. Autistic children do not have problems with these kinds of tasks (Charman & Baron-Cohen, 1995). This study can be seen as evidence for the independence of ToM and EF. The autistic children did not have problems with tests that required just EF, without the need of interpreting mental states. However, other studies that

[7] http://www.merriam-webster.com/medical/prepotent

have examined ToM and EF in children with ASD showed that there is in fact a correlation between the two (Bull et al., 2008)

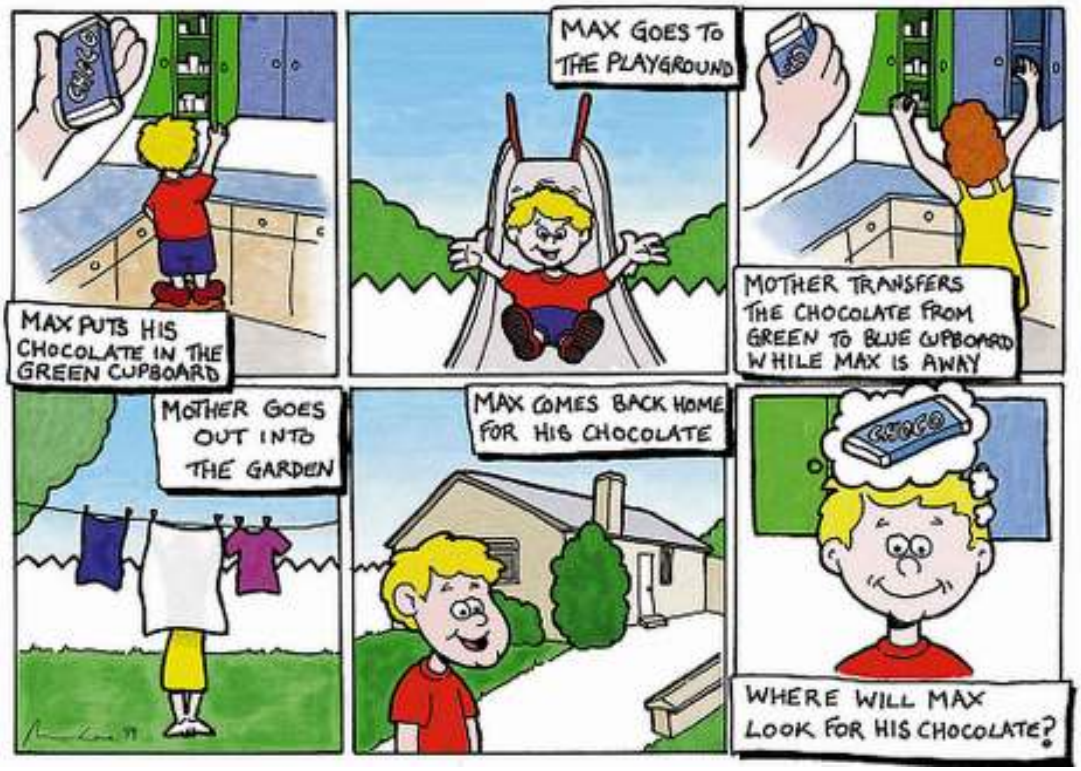
Also studies with older people were done. EF capacity declines with age, but ToM abilities varied with each study (e.g. Wecker et al., 2000). Patient studies involved patients with a functioning ToM, while suffering from EF impairments or vice versa.

These studies suggest independence of ToM and EF abilities (Bull et al., 2008). However, other studies contradict this view. McKinnon and Moscovitch (2007) used a dual-task interference, performed by older and younger adults, to test the correlation between ToM and EF. In this test the subjects had to perform two tests at the same time: an EF test and a ToM test. The researchers found that the older adults had more problems with ToM tasks because of their decline in EF ability (they needed (a part of) their EF capacity for the EF test). They concluded that EF keeps contributing to ToM tasks.

More evidence for the relationship between EF and ToM comes from lesion and neuroimaging studies. They indicate that the same part of the brain, the prefrontal cortex, is involved in both ToM and EF. This suggests that both processes might depend on a common neuroanatomical system (Bull et al, 2008).

In summery, there is still discussion about the question whether or not ToM and EF are related or not. Neither is it sure whether persons with autism have specific problems with EF. It is, however, useful to keep this possibility in mind whenever autism and ToM are examined.

Figure 1 An example of a false belief test (Perner &Lang, 1999)



3.2 Mental language

'Mental language' can be used to refer to those aspects of language that need an understanding of other people's mental states. Examples are mental state verbs (like know, think and guess) and indirect requests. Mental state verbs refer to an existing situation that cannot be perceived, therefore one needs to understand that these verbs make fine-grained distinctions between different mental states (Booth & Hall, 1995). Indirect requests can only be understood if the mental state of the speaker is considered, without that an indirect request will be interpreted too literally or as a remark. Later in this chapter mental state verbs and indirect requests will be discussed more broadly.

Mental language can be considered at a lexical and a discourse level. In this division, the lexical level is more grammatical and the discourse level is more communicative. For the former one needs to interpret the grammar of an utterance in order to understand what is meant, whereas for the latter the communicative context is important. At the lexical level mental language consists of aspects of language like modals and modal adjuncts. These modals say something about the speaker's certainty or uncertainty. Moore et al. (1990) have investigated children's understanding of the expression of speaker certainty and its relation to ToM. In their study, eighty children between 3 and 6 years old had to do a test in which they were supposed to guess the location of a candy that was hidden in either a red or a blue box

(hidden-object task). The children received help from two puppets who used the modal verbs 'must', 'might' and 'could' to imply a different degree of certainty. One puppet, for example, would say: "It must be in the red box", while the other would say: "It might be in the blue box". It was shown that from 4 years of age onwards children were able to find the candy on the basis of what they had heard. Three-year-old children could not differentiate between the modal contrasts that were presented. Another experiment was conducted to investigate whether performance on the certainty test described above was related to the child's ToM. In this experiment, children were presented with false belief tests and representational change tests. In the false belief test, the children were presented with an object that contained something different than one would logically expect (like a box of Smarties that contains crayons) or the object would be something different than what one would expect because of its appearance (like a candle in the shape of an apple). The children were shown what the object really contained or what it actually was, and they were then asked what they thought someone else would say if the same question were asked. It was emphasized that this person had never seen the object before. In the representational change test, the child was asked what he thought the object was or what was in it when he first saw it, so this test evaluates the child's own false belief instead of that of others.

The results showed that performance on all the tests that were studied (the hidden object, the belief and the representational change tests) were correlated. The authors conclude that at the age of four years old children develop a representational Theory of Mind. They state: "Children who understand the representational nature of mind are able not only to recognize the existence of false belief in others, and changes in their own beliefs, but also to recognize that others' beliefs may be held with more or less certainty." (Moore et al., 1990).

At the discourse level an important aspect of mental language is indirect requests. Indirect speech is often used in human communication and appears to be (almost) universal (Brown & Levinson, 1987). Why this is so is still not entirely clear, since it is inefficient and easier to be misunderstood. It seems to be necessary for reasons of politeness, like the maintenance of 'face' (Pinker et al., 2008). Indirect requests are a part of indirect speech and are often considered to be the polite way to ask for something. Somehow 'can you pass me the salt' sounds softer and friendlier than 'pass me the salt'. This is an indirect request in the form of a question; they also exist in a statement form. The utterance "I cleaned the floor" for example can be a request to take off one's shoes. In indirect requests the actual request is not uttered, it is only implied. It does not mention the desired action or the agent of the action. To understand how someone can interpret a request like this, one must comprehend what the

hearer knows and what the speaker thinks the hearer knows. Therefore, a deficit in decoding intentions like these might result in impairment in indirect request understanding. This can be seen in right hemisphere damaged individuals (Champagne-Lavau & Joanette, 2007), but also in young children who haven't fully developed their ToM yet. A study by Elrod (1987) demonstrated that younger children have more difficulty with indirect requests than older children. She examined three groups of children on their performance on indirect and direct requests. In the first group, the children were shown twelve stories that were presented as cartoons. Each story ended with the parent making a request of a child. This request was either indirect or direct. Then the examiner asked the child why the parent wanted the child to know that (E.g.: in a story where Scott wants to take a cookie and mother tells him that the cookies are for the guests tonight: Why does mother want Scott to know that the cookies are for the guests tonight?). Next the child was shown three pictures with a possible continuation of the story. The story child could either 'put the cookie back', 'say "these are for our guests" and eat one', or 'put down the crayon and eat the cookie'.

The procedure of the second group of children was like that of the first group, but the continuation of the stories was only verbal and not accompanied by pictures. The third group received only one larger cartoon drawing accompanied along with a short story description. The children were also divided in 'young' and 'old', the young children were younger than the median age and the old children were older.

The results of these tests showed that the young children had more problems understanding indirect requests than direct requests. There was a difference between the old and the young children in understanding indirect questions, but not in understanding direct ones. Another result was that the children in the third group did not score differently from the ones in the first and the second group. The third group did not receive any non-linguistic context, but this did not make a difference. So, it seems that children do not rely on non-linguistic context to understand what someone wants.

To conclude, it can be said that typically developing children use linguistic clues to understand what is meant by mental language and they seem to need a certain level of ToM to be able to understand mental language, on a lexical as well as on a discourse level. Chapter 4 will examine if the same is true for autistic children. First, we will take a closer look at a possible relation between ToM and general language abilities.

3.3 ToM and general language ability

There is some discussion about the question whether or not general language ability influences the development of ToM. Some studies show evidence for this theory.
It has, for example, been shown that deaf children with a delayed language acquisition, caused by the lack of a native speaker of sign language in their surrounding, have substantially delayed ToM development. In contrast, if deaf children do have a native speaker of sign language around, they don't have this problem, and perform like typically developing children (Peterson, 2003).
A longitudinal study with typically developing children showed that the language ability of 3 year olds predicted the ToM ability 7 months later, the reverse (ToM ability predicting language ability) was not the case (Astington &Jenkins, 1999).
Other evidence comes from children with SLI. They have a delayed or disordered language acquisition, while having a normal nonverbal ability. Tucker (2004, cited in Farrant et al., 2006) found that children with SLI between 5 to 6.5 years old have a delayed ToM of 12 – 18 months. The same conclusion was drawn in a study by Farrant et al. (2006). It could be argued that these results are due to the linguistic demands of the tasks. However, in the study of Farrant et al. (2006) the performance of the children with SLI on the control and memory questions that were used, did not differ significantly from that of the typically developing children in the control group. The authors propose that the demonstrated delay in ToM can be the result of poor processing of the sentential complements that were used in the tests. Sentential complements are mental verbs follow by a subordinate clause (e.g. Mary thought that Will had bought the flowers).
Gillot et al. (2004) examined the possibility that SLI children perform worse on ToM tasks than typically developing children because of the linguistic demands of the tasks. She performed Strange Story tests with typically developing, SLI and autistic children. In the strange story test the children are told stories that involve a character that says something that is not literally true (white lies, jokes, pretend, misunderstanding etc.). The child was then asked whether it was true what was said. Responses had to consist of a 'mental state' in order to be correct (e.g. 'he was just pretending'). The results of this study showed that the autistic and SLI children gave a similar amount of correct 'mental state' responses, which was lower than that of the typically developing group. The autistic group did produce more incorrect mental state responses than the SLI group (in the sense that they did give a mental state answer, but it didn't match the behaviour that was described). The SLI and the autistic

children were matched in communication skills, so that could not be an explanation for these results. The authors conclude that the SLI children experience difficulties with ToM tasks that closely resemble that of the autistic children. However, they state that these difficulties can come from differing impairments.

Last evidence comes from Lohmann and Tomasello (2003). They conducted a training study with 3 year old children with language and/or ToM. They wanted to see which type of training helped to improve false belief understanding. The false belief that was used in this experiment was an appearance-reality test (e.g. the children see an apple, but in reality it is an candle). There were 4 training conditions. (the discourse only training; sentential complement training; no language training; full training). The group that didn't receive any language training didn't show any significant improvement, in contrast to the other groups that did. The group that improved most is the group that received the full training. The training of the use of mental state verbs (i.e. the sentential complement training) alone, however, was already sufficient to improve false belief understanding. This could mean that mental language in important for the development of ToM, instead of the other way around. However, there was no significant difference between the group that received the sentential complement training and the group that received the discourse only training. It seems therefore to be the case that language was a necessary condition for improvement in false belief understanding.

4. Autism, ToM and Mental language

4.1 Autism and ToM

As said before, the primary deficit of persons with ASD seems to be their impairment of Theory of Mind. However, it has been shown that autistic persons with higher verbal mental ages can actually pass ToM tests. This is often true for children with Asperger syndrome who have a higher linguistic level than other groups in the autistic spectrum (Happé, 1995). Therefore, it could be that ToM is independent of language when the task is not linguistically demanding. Maybe the less linguistically skilled autistic persons perform badly on ToM tests, because the linguistic components of these tests were too high. To examine this possibility, Colle et al. (2007) studied the understanding of false belief in autistic children and children with SLI with little or no language. In their test they made sure that the verbal component was reduced to a minimum. They used the same ingredients for their false belief test as the ones often used in normal false belief tests, but less linguistically demanding. There were two identical boxes in which a sweet would be hidden. The sweet was hidden by a 'hider' without

the child being able to see it. A 'communicator' let the child know where the sweet was. Then the same test was done, but this time when the communicator left the room the child witnessed the hider change the position of the two boxes. When the communicator came back he gave a wrong indication as he didn't know anything about the switch. The child was asked to point to the box containing the sweet. In order to do this he had to ignore the indication of the communicator, even though he had been right all the time before. The child has to understand that now the communicator can't be right, because he had a false belief. These tests require a certain amount of joint attention and non-verbal social clues, which might make it again more complicated. However, this was controlled for by screening tests that examined these abilities.

They found that these children also showed a deficit in this less verbal ToM test. The SLI children did not have any difficulties with this test. It is therefore likely that persons with autism indeed have a ToM deficit.

Much research has focussed on the communication skills in children with autism. It was found that autistic children gave far less spontaneous information than the typically developing control group (Cunningham, 1968); that autistic children often fail to shift from the hearer role to the speaker role (Baltaxe, 1977); that their choice of words doesn't allow the hearer to differentiate between old and new information (Baltaxe, 1977); that they tend to ask embarrassing questions (Langdell, 1980, cited in Baron-Cohen, 1988) and that they have difficulties with turn-taking (Fay and Schuler, 1980) (for an overview see: Baron-Cohen, 1988).

4.2 Autism and mental language

Happé (1993) has examined the mental language abilities of autistic subjects by looking at figurative speech (similes, metaphor and irony). In a simile two unlike things are compared, often introduced by 'like' or 'as'. E.g. 'He was like a lion.' In a metaphor two unlike things are compared directly, without the use of 'like' or as', e.g. 'He was a lion.' Irony expresses the opposite of what is said literally, e.g. a phrase like 'well, that's very nice', uttered by someone who had run to the train station to catch his train and just before he wants to jump in, the doors close. Obviously, he is not pleased and the context makes sure that an utterance like 'that's very nice' is understood oppositely.

In Happé's study, autistic subjects and control subjects were tested with multiple choice questions, like the sentence 'Michael was so cold. His nose really was a….' And the sentence 'Ann always felt safe with Tom. He really was…' followed by 6 options (an icicle, a fox, a

safe harbour, a hat, a swan and a volcano. 'An icicle' and 'a safe harbour' being the right ones, respectively). Happé predicted that the subjects without ToM would not be able to understand metaphors, but that similes would not be problematic, since similes are literally interpretable and no ToM is necessary. Metaphors, on the other hand, do require understanding of the speaker's intention. Just the literal meaning is not enough for interpreting, i.e. literally interpreting a phrase like 'he is a lion' brings you to a wrong conclusion (namely, the 'he' in this phrase is not a human being, but rather a member of the family of big cats). In the simile 'he is like a lion', though, a literal interpretation is more likely to bring you to the correct conclusion, i.e. he has features that make him similar to a lion. When the 'like' part of the simile is left out, it becomes difficult for autistic people to interpret the sentence, because they are not able to understand the speaker's intention. Indeed, this was the outcome of the study. The same was true for irony. Research has shown that children up to 6 years of age often judge irony as deception (Happé, 1993). To understand irony, one has to recognise that some attributed thought is mentioned in a mocking way. In her study, Happé (1993) found that the autistic subjects did not recognise irony. She concludes that Theory of Mind is necessary to interpret irony correctly.

Paul and Cohen (1985) studied the comprehension of indirect requests in adults with autism and IQ-matched adults with mental retardation. The two groups were matched on non-linguistic IQ (63.3 for the autistic subjects and 69.2 for the mentally retarded subjects). They used direct and indirect requests. The subjects were asked in a direct or an indirect way to colour or not to colour a circle red or blue (e.g. direct: "please colour the circle blue", indirect: "does the circle really need to be coloured red?"). There was a structured and a pragmatic session. In the former, the subjects were told that they would have to colour some circles. In this session it was clear for the subjects that the statements of the examiner would be requests. In the pragmatic session the subjects were engaged in a conversation with the examiner and during this conversation the subject was encouraged to draw things. In this session, it was less clear to the subjects whether a statement was a request or not.

It was found that the performance of the mental retardation group remained stable for the two types of requests, whereas the autistic group did worse in the pragmatic session compared to the structured session. This result shows that persons with autism have problems with certain speech acts that require understanding of the speaker's intention when this intention is not made explicit.

Another study on mental language was conducted by Ziatas, Durkin and Pratt (1998). They tested four groups of children: one group with autistic children, one group with children with

SLI, another group with children with Asperger syndrome and a typically developing control group. The children with SLI were included in the study because they have grammatical problems and impaired social and pragmatic skills. On the other hand, they are able to pass Theory of Mind tests. The children with Asperger syndrome were included because they have social problems like persons with another form of autism, but they don't show a delay in language. Moreover, they are also able to pass Theory of Mind tests (Ziatas et al., 1998). In this study, the children were examined on Theory of Mind, belief term comprehension and belief term expression abilities. To test Theory of Mind ability, the children were tested with a Sally Ann false belief test (see chapter 3.1 and figure 1 for a similar test. The difference is that in this test there are two dolls called Sally and Ann, the chocolate bar is replaced by a marble which is put either in a box or in a basket). To test belief term comprehension skills, a test similar to that of Moore et al. (1990) was used (see chapter 3.2). The examiner hid a Smartie in one of two boxes. The child was told that two puppets had hidden the Smartie and that these puppets were going to give clues about the location of the Smartie. In order to win the Smartie the child had to listen to the puppets and then decide in which box it should be. The puppets used the belief terms 'think', 'know' and 'guess' contrastively. So for example, when one puppet said: 'I think the Smartie is in the green box', the other one would say: 'I guess the Smartie is in de red box'. These terms show a greater or lesser certainty of the speaker. To test the belief term expression skills, the role of the examiner and the child were reversed. The child had to hide the Smartie and make the puppets give clues about the location.

The results of this study showed that whereas the majority of the autistic children failed the false belief test, the opposite was true for the other three groups, in that the majority of the other groups passed the test. The autistic group also scored significantly lower than the other groups on both the belief term comprehension test as well as on the belief term expression test. These results are evidence for a relation between ToM and mental language. However, there is still uncertainty about this conclusion, since there was one child with Asperger syndrome who did not pass the false belief test, but who did pass the false belief comprehension test. Furthermore, there were five children (including two with autism and two with Asperger syndrome) who failed the false belief test, but passed the belief expression test. Therefore, it could be possible that in some cases the development of belief term knowledge happens differently, and ToM might not always be necessary.

5 Research design

5.1 Question

As we have seen in the previous chapters children with ASD have deficits in their ToM abilities and in the pragmatic aspects of language. It would be interesting to see whether they also have problems with language that requires understanding of other people's mental states. In other words, do children with ASD have problems with mental language? People with autism have an impaired ToM, which makes it hard for them to understand other people's desires and wishes. Therefore, also mental language, which seems to need this knowledge, should be impaired. What, however, if mental language does not need this knowledge? The major difference between children with ASD and typically developing children is their ToM abilities. There can also be a difference in EF (see chapter 3.1) and language abilities (see chapter 2.2). These factors, however, will be controlled for in this study. So then, if the ASD subjects score worse than the typically developing subjects on mental language tests, it seems reasonable to assume that the poor ToM in the ASD subjects causes this poorer performance. On the other hand, if the ASD subjects and the typically developing control subjects score the same, then it could be that ToM skills do not play a decisive role in understanding mental language. In that case, the development of mental language must be based on something else, for instance on general language abilities. There is some evidence for this theory, as can be found in chapter 3.3.

5.2 Participants

Table 1 Overview of the participants

	Autistic	Control
Number	10	19
Mean age (SD) y/m	6/11 (1/0)	6.5 (0/4)
Range	5.1-8.4	6.0-7.0

10 Dutch-speaking autistic children and one Dutch-speaking control group that consisted of 19 typically developing children were tested (see table 1) The autistic children came from four different schools in Schagen, Den Helder and Heerhugowaard in The Netherlands. All children were diagnosed as autistic (PDD-NOS or ASD). The control children came from a school in Rotterdam, the Netherlands. The autistic group had a mean age of 6.11 years old (SD=1, range: 5.1-8.4) which was 6.5 years for the control group (SD=0.4, range 6.0-7.0).

Levene`s test for equal variances was significant, taking this in consideration, the difference was not significant ($t(_{10.19})=1.43$, $p=.18$.
An important aspect to take into account in this study that remains is IQ. Unfortunately, the IQ of the control group is not known. The IQ of only 6 out of the 10 autistic subjects is known. The mean IQ of these children was 88. The range, however, is quite large (57 to 114).

5.3 Method

In order to answer the question whether children with ASD have difficulties with understanding mental language, I used some tests that have been used in previous studies about ToM and Mental language. I will use one test to examine executive function, two tests to examine ToM abilities, two tasks to test mental language and two general language tests.

The executive function test is an adaptation of the **False Sign Contents Change Task** (as described in Sabbagh et al. (2006)). This test is chosen, because it examines the children's EF ability. The child has to suppress his own true belief, in order to give the correct answer. The results of this test will show whether there are any differences in EF ability between the ASD group and the control group. This is important, because if there is a difference, the results can be due to this difference instead of to differences in ToM ability.

Materials

A Playmobil-figure called Paul, three animal figurines (a dog, a cat and a rabbit), three cards showing pictures of the animals that are used (a dog, a cat and a rabbit) a box and a holder for the pictures.

procedure

In this test, the child is introduced to Paul, who has a dog, a cat and a rabbit. There are also three cards on which each of the animals is presented and a holder for the cards. Paul also has a box in which the animals can rest a bit one at a time. When an animal is in the box, Paul places the card with the picture of that animal on it in the holder. This is what the child is told and the story continues with Paul who puts his dog in the box and puts the picture of the dog in the holder. After that, the remaining animals and Paul leave the scene in opposite directions. At this point the child had to answer a practice question: "What does the card say is in the box?" When they come back, Paul makes his cat go in the box and takes the dog out. He replaces the picture of the dog with the one of the cat. Again they all leave the scene. Then, only the rabbit comes back and goes into the box and makes the cat leave. The rabbit, however, doesn't change the card, so that the picture of the cat remains, even though the

rabbit is now in the box. When Paul comes back alone, the child is asked which animal the card says is in the box (false sign test question) and which animal is in the box (reality control question). The false sign test question is asked to examine whether the child understands that the sign is different than the actual content. The control question is added to check whether the child really knows which animal is in the box.

Exclusion criterion

Children who fail the practice question will be excluded from analysis.

Scoring

The maximum score of this test is one point, for passing the false sign test question. If the reality control question is answered incorrectly, the child will get 0 points for this test, even if the test question was answered correctly.

One of the ToM tests is the **False Belief Unexpected Contents** (modelled on Perner et al. 1987). This test is frequently used to examine ToM abilities. In order to pass this test the child has to understand false belief in others and he has to keep a past and present representation in mind to answer correctly a self-false belief question.

Materials

An egg box, an Ernie puppet, a toy race car.

Procedure

In this test the child is introduced to an Ernie puppet. After a small conversation with the child he says that he wants to go to bed, so he leaves the scene. Then the experimenter takes an egg box and asks the child what the box contains. After the child has answered with the logical response 'eggs', he is shown that instead of eggs there is a toy race car in the box. Then the child is asked what he first answered when he was asked what was in the box (self-false belief question). Then the child is asked the control question "what is really inside the box?". The prompt "an egg or a toy car" follows if the child does not respond to the questions. After the child is reminded that Ernie was away the whole time and that he has never seen the box before. Then the child is asked what Ernie would respond if he was asked what's in the box (other-false belief question). This is followed by an explanation question: "why will he say that?".

Exclusion criterion

The score of children that fail the control question is set to 0 points, even if they scored correctly on test questions.

Scoring

The maximum score of this test is 3 points; one point for the self-false belief question, one point for the other-false belief question and one point for the explanation question.

The other ToM test is the **False Belief Location Change** (modelled on Baron-Cohen et al 1985 and Siegal and Beattie 1991). This test is generally seen as the standard ToM test. If a child passes this test, it means that he is able to understand false beliefs. A justification question is added to control for guessing the test (prediction) question.

Materials

Two playmobil-figures of the opposite sex, called Paul (the boy) and Laura (the girl), a red box, a blue box, a marble.

Procedure

In this test, the child is introduced to Paul and Laura. They are standing between two boxes, a red one and a blue one. Laura has a marble and she puts it in the blue box, after which she leaves the scene. Then, Paul takes the marble out of the blue box and puts it in the red box. When Laura comes back, the child is asked where she will look for the marble (prediction question) and why she will look in that place (justification question). When the child has answered this he is asked where the marble really is, and were it was before (control questions). The prediction and the justification question show whether the child understands that Laura has a false belief, because she does not know that Paul changed the location of the marble. The control question checks whether the child actually knows himself where the marble is and where it was before.

Exclusion criterion

If the child fails one or both of the control questions the score of this test is put to 0 points.

Scoring

The maximum score is this test is 2 points; one for the prediction question and one for the justification question.

One of the mental language task used is the **Comprehension of Modals** (modelled on Byrnes and Duff 1989). This test will give information about the child's understanding of the modals 'must be', 'might be' and 'shall be'. The child can only pass the test if he understands the different levels of speaker certainty that these modals convey. Speaker certainty is a mental state. Therefore, to pass the test, the child needs to understand the different mental states

conveyed by these modals. In this way, this test provides information about children's understanding of mental language at a lexical level.

Materials

Stickers, an opaque blue box, an opaque red box, two puppets (a lion and a rabbit), an opaque screen.

Procedure

In this test, the experimenter tells the child that he can win some nice stickers. The experimenter will put the sticker in a blue or a red box while the child's sight is obscured by an opaque screen. In order to win the sticker the child has to say in which box it is. The child is told that he will be helped by two puppets, a lion and a rabbit. They will both tell the child something, after which the child has to decide where he thinks the sticker is. The puppets use the modals 'must be' (moet zijn), 'shall be' (zal zijn) and 'might be' (kan zijn). The child is told that if he listens carefully to what the puppets say, he will be able to find the stickers. In order to find the stickers he has to choose 'must be' over 'shall be' and 'shall be' over 'might be'.

This trial is repeated nine times. Before the actual test trials, two practice trials are done. In these practice trials the puppets give unambiguous clues about where to find the sticker ('the sticker is in the red box' vs. 'the sticker is not in the blue box'). The child is shown whether he was right or not and he is given the sticker if he chose the correct box. In the test trial this was not the case. After that, the child is told that if he pays attention to what the puppets are saying he can win more stickers, and that he will receive all the stickers he has won at the end of the game. To reduce the chance of disappointment for the child, the amount of stickers he actually receives is not related to the number of correct answers he gives.

Exclusion criterion

No exclusion criterion.

Scoring

The maximum score in this test is 9. For each sticker that is found the child receives one point.

The **Discourse-Pragmatics Task** (an adaptation of Elrod 1987 and Kelly 2001) gives information about the children's understanding of mental language at a discourse level. This is done by examining the child's understanding of indirect requests. In order to pass the test, the child has to compute the mental state underlying this type of requests.

Material

An Ernie puppet, 8 stories and 16 continuation stories (two per story) depicted in cartoon form.

Procedure

In this test, the child listens to several short stories together with the puppet Ernie. Ernie tells the child that he finds these stories quite difficult and asks him for a little help in understanding them. The stories are about a boy and a girl, named Jan and Karin, and their mother. Every story is accompanied by a picture of the situation. The child is told that the children are always very sweet and always do what mother tells them to do. In each story, the mother utters a remark that normally would be interpreted as an indirect request (e.g. Jan wants to enter the kitchen and mother says: 'Jan, I just mopped the kitchen floor!', a request for Jan not to enter the kitchen). After this request Ernie asks why the mother has said that (explanation question). If the child doesn't answer with the intention of the mother (e.g. 'because she does not want Jan to enter the kitchen'), the child is asked what he thinks will happen when mother says this (the intended consequence, e.g. 'Because otherwise the floor gets dirty again' (indirect) or 'otherwise she has to mop the floor again' (direct)). After that, the child is shown two different pictures that vary in two ways from the main picture. In these pictures two possible ways for the story to go on are depicted (the continuation of the story). An example: Jan wants to take a cookie from a plate of cookies that is standing on the table. Mother sees this and says to Jan: "those cookies are for our guests tonight!" In one picture, Jan puts the cookie back on the plate, in the other one, he eats it. The child has to choose which picture fits the story best (continuation question).

Exclusion Criterion

No exclusion criterion.

Scoring

The test consisted of two parts: the explanation questions and the continuation questions.
The explanation questions were correct if the child was able to describe mother's intention or the intended (direct or indirect) consequence of what mother had said.
The continuation questions were correct if the child had chosen the picture that follows from the indirect request.
The child got one point for each correct explanation question and one point for each correct continuation question. This brings the maximum score of this test to 8 points per part, so 16 for the whole test.

The two general language tests that were conducted are selected parts of the **Reynell test** (sections 8, 9 and 11 from van Eldik et al.,1997) to test understanding of complex syntax and the **Peabody Picture Vocabulary Test III** (PPVT III), Dutch version (Schlichting, 2005). Only some parts of the Reynell test were used, because administering the whole test would take too long. However, these parts should give a good overview of the child's comprehension of syntax. The PPVT test is a standardized and validated test to measure a child's receptive vocabulary.

5.4 Results

Table 2 Mean scores, standard deviations and range of scores of the autistic and the control group.

		Mean ASD	Mean Control	SD ASD	SD Control	Range ASD	Range Control
EF	False sign contents change	1.00	.95	0.00	.23	1-1	0-1
ToM	False belief location change	1.40	2.00	.84	0.00	0-2	2-2
	False belief unexpected contents	1.00	2.58	1.16	.77	0-3	1-3
General Language	PPVT	100.8	94.2	15.6	13.4	75-120	68-120
	Reynell	26.3	24.5	5.5	2.7	14-33	19-28
	Language ability (PPVT/Reynell)	0.63	-.04	2.4	1.5	-4.27-3.67	-3.04-2.69
Mental Language	Indirect Requests explanation	5.20	5.26	1.69	2.02	3-8	1-8
	Indirect Requests continuation	7.30	7.11	.82	.86	6-8	5-8
	Modal Comprehension	5.60	6.00	.97	1.70	4-7	3-9

Note. Maximum scores: false sign contents change = 1; false belief location change = 2; false belief unexpected contents = 3; no PPVT maximum; Reynell = 34; indirect request explanation and continuation = 8; modal comprehension = 9.

The purpose of this study was to answer the question whether or not 'mental language' is a problem for children with autism in comparison to typically developing children. In order to answer this question, the performance on the Indirect Requests test and the Modal Comprehension test of both groups was compared.

First, however, the groups were compared on language ability and Executive Function (for descriptive statistics see table 2). A t-test was performed on the results of the language ability

tests and the result was that autistic and non-autistic children did not differ in their scores on the PPVT, ($t_{(27)}$=-1.19, p=.25. On the Reynell test, the children of the two groups scored the same as well, ($t_{(27)}$=-1.20, p=.24. The scores of the two language tests have been united in one score by taking the z-scores of each test for each child and adding those. This score gives the general language ability of each child. The two groups do not score significantly different on this general language ability score, ($t_{(27)}$=.93, p=.36.

The false sign contents change test (the animal test) was inserted to test EF. Both groups scored equally on this test ($t_{(27)}$=-.72, p=.48. Only one of the children had problems with this test (in the control group). We can say that the results of the Mental Language tests are not due to any differences in Executive Function or general language ability.

Next, the performance of both groups on the Theory of Mind tests was compared. It is important to know whether the autistic subjects actually have an impairment in ToM. It was shown that the autistic group actually did perform worse on the Theory of Mind tests than the controls, as expected. Only in that case can any differences on the other tests be ascribed to differences in Theory of Mind. There was a significant difference between the two groups on the false belief unexpected contents trial (the egg container test) ($t_{(13.32)}$=3.89, p<.01.

The same tendency can be seen in the false belief location change trial (the marble test) ($t_{(9)}$=2.25, p=.051. Here I did not assume equal variances, because Levene's test was significant, p<.05. If equal variances are assumed the result is significant ($t_{(27)}$=3.15, p<.01.

Table 3 Correlations between age and ToM-, mental language-, and general language tests

	Age	PPVT	Reynell	Language ability	False belief unexp. contents	False belief loc. change
Reynell	.53**	.73***				
Language ability	.40*	.76***	.83***			
False belief loc. change			.40*	.42*	.55**	
Indirect request-cont.		.44*	.60***	.42*		.38*
Modal Comprehension.					.45*	

Note. *** p<.001, two-tailed; **p<.01, two-tailed; * p<.05, two-tailed

So far, we have seen that the two groups differ only in their performance on the Theory of Mind tasks. This corresponds to what was expected, since children with ASD generally have limited Theory of Mind abilities.

Now I will turn to the results of the 'mental language' tests. The indirect request test had two parts, the explanation part and the continuation part. The two groups did not differ significantly on both parts of the test; explanation ($t(_{27})$=.08, p=.93, continuation ($t(_{27})$=.58, p=.56.

Also on the modal comprehension test no difference between groups was ($t(_{27})$=.69, p=.50. A summary of the t-tests that were performed can be found in table 4).

Table 4 T-test autistic/control groups

	P-value Autistic group | Control group
Age	.18
PPVT	.25
Reynell	.24
Language ability	.36
False belief unex.p. contents	.00*
False belief loc. change	.05
False sign cont. change	.48
Indirect request expl.	.93
Indirect request cont.	.58
Modal comprehension	.69

Note. * significant on the .01 level

There was a positive correlation between the score on the PPVT and the score on the indirect requests continuation test ($r(_{.44})$=p<.05. The same is true for the Reynell test and the indirect request continuation test ($r(_{.60})$=p<.01. Also the combined general language ability score and the indirect request continuation test are correlated, $r(_{.42})$=p<.05 (see table 3). These results might be some evidence for the theory that general language abilities are important for the development of ToM (see the next chapter for a more extensive discussion).

Next, the children were divided into two different groups: passing or not passing the ToM tests (passing the ToM test was considered answering all test and control questions correctly). These groups were then compared on their performance on the mental language tests. The only significant result was on the Modal Comprehension test. The group with ToM scored significantly better than the non-ToM group $M_{(ASD)}$ =5.00, $SD_{(ASD)}$=1.04, $M_{(control)}$ = 6.67,

$SD_{(control)}$=1.40, ($t_{(27)}$=3.63, p<.001 (see table 5). There was one autistic child who passed the ToM tests and five control children who did not pass. Leaving those children out of the analysis did not change the results.

Table 5 T-tests No ToM/ToM groups

	P-value	
	No-ToM group	ToM group
Age	.71	
PPVT	.99	
Reynell	.96	
Language ability	.65	
False belief loc. change	.05	
False sign cont. change	.33	
Indirect request expl.	.37	
Indirect request cont.	.80	
Modal comprehension	.00*	

Note. * significant on the .001 level

After that, the hypothesis that Mental Language is more dependent on general language abilities was tested. The performance on the general language tests (PPVT/Reynell) and the performance on the mental language tests were compared. The children were divided into two groups, performing better (better-group) or performing more poorly (poorer-group) than average on the general language tests (cut off point at 0.19). There was a significant difference between the two groups. The children in the poorer-group performed worse on the Indirect Request Explanation test $M_{(good)}$=6.00, $SD_{(good)}$=1.73, $M_{(bad)}$=4.63, $SD_{(bad)}$=1.82, ($t_{(27)}$=2.1, p<.05. The same is true for the Indirect Continuation Test $M_{(good)}$=7.54, $SD_{(good)}$=.66, $M_{(bad)}$=6.88, $SD_{(bad)}$=.86, $t_{(27)}$=2.24, p<.05 (see table 6). The result for the Modal Comprehension Test was not significant.

Table 6 T-tests good/bad general language ability test

	General language ability better	General language ability poorer
Indirect Request Expl.	.049*	
Indirect Request Cont.	.033*	

Note. * significant on the .05 level.

5.5 Discussion

The results of this study have shown that the autistic group and the control group did differ significantly on the ToM test. The autistic group performed worse than the control group, as expected. They did not differ significantly on the executive function test and on the language tests. Also on the mental language test no difference between the groups was found. When the children were divided in a ToM and a no-ToM group, it was shown that the children who had passed the ToM test scored better on the Modal Comprehension test than the children who had failed. There were no other differences between those groups. The children were also divided according to their score on the general language ability tests. From this division, it was shown that whenever their general language ability score was low, also the score on the Indirect Request tests was low in comparison to the children who had a high general language ability score.

In this thesis I asked whether or not 'mental language' poses difficulties for children with an autistic disorder. It could be difficult for them, because of their poorly developed Theory of Mind skills. The results, however, show that this is not (entirely) the case. The autistic children do have more problems with the Theory of Mind tasks, but they score the same as the control group on the 'mental language' tasks. A possible explanation could be that 'mental language' is more dependent on general language skills than on the development of Theory of Mind. This idea is also supported by the correlation between the PPVT and the Indirect request continuation test. It seems that when the vocabulary is larger, the score on the understanding of indirect continuations is better. However, when the subjects are divided into having or not-having ToM it is shown that the non-ToM group scores worse on one of the mental language tests, namely the Modal Comprehension test. This could mean that for this part, the lexical part of Mental Language, a properly working ToM is important. It seems that

for the discourse part this is not the case. It could be that the discourse part of mental language is more influenced by general language abilities or that children with autism have some other compensating strategy to understand what is meant. The results from the comparison between the better-group and the poorer-group (according to their general language ability score) and the Indirect Request tests provide some more evidence for the importance of general language for the discourse part of mental language. Of course, it must be emphasised that I used a small group of autistic subjects. It would be useful to see whether the results from the present study remain similar when more subjects are used.

These results seem to be in contrast with previous research done by Ziatas et al. (1998, see chapter 4.2). This could be due to the fact that the autistic children in the study of Ziatas et al. had a lower language ability than the typically developing control group (PPVT age: 5.9 and 7.0 years respectively; TROG (comprehension) age: 6.3 and 7.4 years respectively). In this way, the worse performance of the autistic group could be the consequence of their lower general language ability instead of their lacking ToM. They state that the autistic group and the control group are controlled for mental verbal age, but judging by these numbers it does not seem to be the case. The Asperger group from the same study is much better matched to the typially developing control group (PPVT age: 6.4 and 7.0 years respectively; TROG age 7.3 and 7.4 years respectively). This could just be the difference that makes the results of the autistic group worse than those of the other groups.

Of course, there are also the studies that have been done with typically developing children, which show that older children have a better performance in mental language than younger children (e.g. Moore et al, 1990; Elrod, 1987. See also chapter 3.2). According to these studies it seems to be the case that children need to have a certain age, or more importantly, a certain ToM development, before they understand Mental Language. However, according to the study of Lohmann and Tomasello (2003, see chapter 3.3) the possibility exists that this in fact is the other way around. Maybe a certain development of language and possibly more specifically mental language is needed to develop a full ToM. In that case, children with autism do develop language and mental language, but maybe not to the degree that is needed for a fully functional ToM. This hypothesis is supported by data from this study. The children in the non-ToM group scored significantly worse on the modal comprehension test than the ToM group. This explains also why children with Asperger are able to pass ToM tests. Their language is so developed that they can understand for example false belief. This theory explains as well why children with SLI seem to have a delay in ToM, as can be seen in several studies (e.g. Tucker (2004); Farrant et al. (2006)) (See chapter 3.3). It is suggested that

they might show this delay because of the poor development of their sentential complements (which involves mental language). Also the study of Gillot et al. (2004, see chapter 3.3) shows that SLI children have similar problems with ToM tasks. Even though these difficulties might be caused by different impairments, it could mean that a certain degree of language development is necessary to have a fully functional ToM. However, this is a hypothesis that should be further tested. The present study provides some ground to examine this hypothesis more profoundly.

In this thesis I added to the discussion children with SLI, even though I did not include them in my study. I think it is interesting to include them, because they seem to have similar language problems as autistic persons. There are, however, some difficulties. There is still no consensus as to whether SLI children really do have ToM problems. Another problem with SLI, which exists as well for autism, is that children with these disorders can often be divided into different subgroups. The question is whether all these subgroups can be put together, and whether an effect can be generalised to all subgroups. For further research it could be interesting to examine the ToM abilities of the different subgroups of SLI children and compare them to those of autistic children.

Turning back to the research that was conducted in this study, I think that for future research it is important to use a bigger group of autistic children and match them very carefully to a typically developing control group. They should be matched on age, but looking at the results of this study, also on general language abilities. Another aspect that should be taken into account is IQ, which unfortunately could not be done is this study. It seems plausible, however, that this is also an important factor. In this study I assumed the two groups to be more or less equal in IQ, because the autistic children would have been in another type of school if their IQ had been too low (a school for children who experience great problems in learning). However, it can be expected that the IQ of the autistic group might be lower, but very unlikely higher, than the typical controls. In that case the results from this study are even more startling.

Acknowledgements

I would like to thank all the participating schools, that have been so kind to help me: *de Tender* in Schagen, *de Schoter Duijn* and *de Dijk* in Den Helder and *Bommelstein* in Heerhugowaard. They dedicated their time to select children for me who could be good subjects for my study and gave me the space to do the tests.

I'd like to thank also my supervisors, Hannah de Mulder and Frank Wijnen. Hannah de Mulder showed me how to use the tests that I used in this study and they both helped me with useful comments and information.

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