Understanding knowledge as a mental state in normal and autistic children

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NUMEROUS ORIGINALS
IN COLOUR

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Declaration

The work contained in this thesis has been carried out entirely by the author. None of the material contained in this thesis has been used or submitted for a degree or similar purpose before.

Summary

This thesis examines the cognitive-psychological theory of autism, specifically the "theory of mind" account. According to this theory, autistic people lack the ability to attribute mental states to other people and this underlies their social communication difficulties. In the introductory chapters, autism is described, followed by a consideration of different theoretical accounts of the normal child's theory of mind and empirical evidence on the autistic child's theory of mind. Finally, the introduction discusses whether the different theoretical accounts can explain autism.

A series of experiments are then described which investigated normal and autistic children's ability to understand knowledge as a mental state. Experiment 1 established a baseline for the subsequent experiments and included three groups of normal children with mean ages of four years nine months, five years nine months and six years nine months. In this experiment the children's ability to differentiate the cognitive mental terms "know" and "guess" with reference to their own and another person's mental states was examined. Results of this experiment indicated that all three groups of children could differentiate "know" and "guess" in reference to their own and another person's mental state.

Experiments 2 and 3 compared the ability to differentiate "know" from "guess" with reference to their own and another persons mental state of high language level autistic children, low language level autistic children, children with Down's syndrome, four-year-old and five-year-old normal children. Results of these experiments showed that the high language level autistic children were able to refer to their and another person's mental state of knowledge. In addition the results were related to a number of measures of language ability.

Experiment 4 compared the ability to attribute knowledge and ignorance to themselves and another person of high language level autistic children, low language level autistic children, four-year-old and five-year-old normal children. In one task the experimental question involved the mental term "know", in another task, the term "could help" was used. Results of this experiment showed that all four groups of children performed significantly better in the "know" task than in the "help" task. Performances on the tasks was again related to the children's language skills.

The thesis reaches two main conclusions. First that autistic children do not totally lack a theory of mind, since high language level autistic children were able to refer to their and another person's knowledge state. Second, autistic children's language level is a strong predictor of their performance on theory of mind tasks. The thesis concludes by discussing a number of issues involved in autism research and indicating future directions for research.

1. CHAPTER ONE

General Introduction

Arthur S. Reber (1985) defines psychology as:

. . .what scientists and philosophers of various persuasions have created to try to fulfil the need to understand the minds and behaviours of various organisms from the most primitive to the most complex . As a distinct discipline it finds its roots a mere century or so back in the faculties of medicine and philosophy. From medicine it took the orientation that explication of that which is done, thought and felt ultimately must be couched in biology and physiology, from philosophy it took a class of deep problems concerning mind, will and knowledge. Since then, it has been variously defined as "the science of mind," "the science of mental life," "the science of behaviour " (underlining added to emphasize, p.593).

Psychological research can contribute greatly to our knowledge and understanding of some conditions which may still be a puzzle to medicine. One such condition is autism which is recognized by severe social communication difficulties and abnormal language patterns. Understanding the underlying cause or causes would have practical implications for the treatment and education of people with autism. While biological research aims to investigate what causes the autistic condition, and asks questions such as "Is it a hereditary condition?" "Do autistic people have an abnormal brain structure?" "Do autistic people have an abnormal brain chemistry or physiology?" etc., psychological research aims to investigate which cognitive mental processes are deviant in people with autism, and also to investigate whether any cognitive malfunctioning, which is specific to autism, can underlie the social communication difficulties of autistic children.

According to the current cognitive theory of autism which is known as "theory of mind", autistic children's inability to attribute mental states to themselves and others might be an underlying factor for their social communication difficulties (Baron-Cohen et al. 1985,

1986). The theory of mind account of autism proposes that if a child is unable to understand other people's mental states such as, what they know, think, believe etc., he/she will not be able to predict how other people will behave. In other words,

the social world would seem chaotic, confusing and may be therefore even frightening. At worst this might lead one to withdraw from it completely, but at the very least it might lead to very odd attempts at interaction with people, treating them as lacking 'minds', and therefore behaving towards them in a similar manner to the way one approaches inanimate objects. . .the behaviour of people with autism is often described in these terms ." (Baron-Cohen, 1990b, p.83).

Thus it seems that an investigation of the different aspects of the theory of mind ability in autism, may provide a better understanding of this condition. This thesis is an attempt to contribute further to our knowledge about autistic people and also to our understanding of normal children's development. Specifically, it focuses on autism, and involves the investigation of both autistic and normal children's understanding of knowledge as a mental state. In a series of experiments it aims to investigate, whether autistic children and adolescents can differentiate mental terms such as "know" from "guess", and "know" from "not know", in referring to their own and others' mental states.

Since this thesis is primarily about the theory of mind explanation of autism, in the following five chapters firstly, autism will be described, then the theoretical approaches to the child's "theory of mind" will be reviewed, and finally in the light of empirical evidence, how these accounts explain autism will be discussed. The content of the five chapters is as follows:

Following this introductory chapter the second chapter, will familiarize the reader with autism. This chapter begins with a section on "What is autism?". This section explains how and who first recognized the autistic condition. The following section considers the question "Is Asperger's Syndrome on a continuum with Kanner's Autism ?", discussing whether autism and Asperger's syndrome are different conditions, or alternatively whether

autism is a continuum and Asperger's Syndrome falls at the top end of this continuum. It seems important to report this recent dispute -whether the difference between the two conditions of autism and Asperger's Syndrome is qualitative or quantitative- since some of the autistic subjects included in the experiments in this thesis, were highly able autistic children and adolescents and therefore possibly Asperger's Syndrome.

A number of diagnostic criteria are available which researchers could use to define their autistic sample. In the next section which is "Diagnosis of autism today", the most frequently referred diagnostic criteria for autism will be reported. Then in the "What causes autism?" section the findings from biological research which strongly suggest that autism is a biologically caused condition will be considered briefly.

In chapter three, the cognitive psychological explanations of autism will be outlined. The first section reminds reader of the important advances in the understanding of autism with the progressing psychological research up to now. Then in the following section the current cognitive psychological theory of autism, the "theory of mind" account will be introduced.

In chapter four, the different theoretical approaches to the theory of "theory of mind" will be outlined. Firstly the term "theory of mind" is defined, then the outline of theory of mind research with normal children is given. Then, in the following three sections, theoretical accounts due to Perner, Leslie and Wellman which agree on the view that children develop a theory of mind, will be explained. Next the theoretical accounts of Harris and Hobson, which argue against the theory of "theory of mind", will be reported.

The major part of chapter five considers the empirical evidence on whether autistic children lack a "theory of mind", and in the final part of this chapter the research on autistic children's understanding of emotions will be reported.

Chapter six discusses whether these theoretical accounts can explain the theory of mind impairment in autism.

In this thesis, in order to investigate autistic children's understanding of knowledge as a mental state, their differentiation of mental terms "know" and "guess" is tested. Thus, in chapter seven firstly, normal children's production and comprehension of cognitive mental terms will be explained, followed by a discussion of when normal children begin to understand knowledge as a mental state.

The following four chapters (8-11) report four experiments which were carried out to investigate firstly at what age normal children can differentiate "know" from "guess" with reference to their and to other people's mental states, and then whether autistic children are able to differentiate these mental terms with reference to their own and to other people's mental states.

Finally, chapter twelve discusses the findings (from a total of 33 autistic children across the experiments) in relation to the theory of mind account of autism and the various methodological issues of the research in this area.

2. CHAPTER TWO

Introduction to autism

2.1. What is autism?

Autism is a developmental disorder which was first defined by Kanner (1943) who identified a peculiar pattern of behaviours. He presented case studies of 11 children and argued that despite the individual differences in these cases, they all had common characteristics distinctive from children with mental handicap or with childhood schizophrenia. These characteristics were as follows:

language - some of these children had no speech, or if speech was developed, they were unable to use it communicatively;

excellent rote memory -they could memorize numbers, poems, lists of names, and nursery rhymes;

delayed echolalia -they repeated the utterances they heard and stored in the previous days;

literalness -they had an inability to use words other than as originally used;

personal pronouns repeated as heard -they were unable to use personal pronouns according to the changing speaker;

inability to relate themselves to other people -they showed an inability to develop relationships with other people, they seemed to be unaware or ignorant of other people;

extreme autistic aloneness -they had a tendency to ignore anything coming from outside which could threaten self preservation;

obsessive desire for the maintenance of sameness -they showed resistance to change of familiar routines or environment;

cognitive potentialities -they had an intelligent facial appearance;

physically -they had normal physical appearance.

A year after Kanner's paper was published, Asperger published very similar account. Asperger (1944)[1] provided detailed case descriptions and discussed the common features of these cases. Like Kanner, Asperger also argued that although there were individual differences, all these cases had strongly distinct features which were present from the second year of life. These characteristics were as follows:

autistic intelligence -these children were not able to follow what was required from school for learning; on the other hand they might show excellent memory skills and be very good or knowledgeable in the area that they developed exceptional interest; they displayed superb abstraction abilities; they could spontaneously invent original expressions or words which were well suited to the situation;

physical appearance and expressive characteristics -the use of gaze for communication appeared to be absent in these children, although they might show stereotypic movements they did not display any facial or bodily gestures and they avoided looking at people, their use of language seemed to be odd and unnatural as if they were not speaking to people but to space;

social relationships -they showed an inability to develop normal relationships with people, they tended to ignore other people and other activities, but appeared engrossed in their own activities;

drive and affect -they might comply with their sexual or sadistic urges regardless of the acceptability of these acts, and they were unable to show any affection to people;

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[1] Translated by Uta Frith (1991)

relation to objects their relations to objects appeared to be odd too, they might ignore toys totally but develop an obsession with one object. Asperger called the existence of these distinct features autistic psychopathy or autistic personality type.

Kanner (1943) and Asperger (1944) both listed distinctive behavioural features which they observed over the years in two groups of children, which were common within each group despite the individual differences. They both emphasized as main features of autism an inability to develop normal relationships with other people, communication difficulties, unawareness or ignorance of outside world but exceptional interests and superior skills. However there seem to be some differences between the two accounts. While Kanner stated that some children had no speech, or if speech had been acquired these children displayed delayed echolalia and reversal of personal pronouns, Asperger reported the presence of odd and unnatural language but did not mention any case without any speech.

Although Kanner (1943) and Asperger (1944) are both recognized now as the pioneers of autism, for a long time researchers have referred to Kanner's work but not to Asperger's (Frith, 1989). Today, after the revisions of their accounts by the original authors and by other researchers there is an ongoing debate whether the Asperger Syndrome is different from autism, or whether autism is a continuum and Asperger Syndrome is the top end of this continuum. This issue is important in the evaluation of research in autism because if there is a qualitative difference between the two conditions, than autistic samples included in autism research should be clearly defined. In the next section the reviews and the studies which argue the similarities and differences between autism and Asperger's Syndrome will be reported.

2.2. Is Asperger's Syndrome on a continuum with Kanner's Autism ?

Some studies have suggested that Kanner's autism (early infantile autism) and Asperger's Syndrome (autistic psychopathy) are two different syndromes. For instance, Van Krevelen (1971, cited by Wing 1991) argued that early infantile autism (Kanner's autism) and autistic psychopathy (Asperger's Syndrome) were clearly different entities. He listed the

major differences as follows: early infantile autism is present by the age of one; a child with autism has none or retarded speech and fails to use language communicatively; he/she starts walking before he/she starts speaking; a child with autism displays poor eye contact which is due to his/her autistic aloneness, and their social impairment show poor prognosis. In contrast, autistic psychopathy is a personality trait and not present before the age of three, a child with autistic psychopathy starts speaking before he/she can walk and makes attempts to communicate even if it is not appropriate, and their social impairment shows good prognosis. Furthermore Szatmari et al. (1986) argued that the available evidence is not sufficient to conclude that autism and Asperger's Syndrome are the same entities. They suggested that the term Asperger's Syndrome should be maintained until studies prove that autism and Asperger's Syndrome have comparable "*etiology, prognosis, and response to treatment* " (p.517).

Other studies have looked closely at the similarities and differences between autism and Asperger's Syndrome, and have suggested that these two entities should be seen as on the same continuum. For instance Bowman (1988) reported a family of four brothers and a father who all displayed features of autism or Asperger's Syndrome and suggested that the difference between autism and Asperger's Syndrome "*could be explained on the basis of severity* " (p.381). Further, Bowman (1988) argued that looking at the diagnostic criteria of autism today (Rutter, 1978), Asperger's original features (Asperger, 1944), and Wing's (1981) diagnostic criteria for Asperger's Syndrome, it does not seem that there is a clear-cut difference between autism and Asperger's Syndrome.

Similarly, Tantam (1988) highlighted the close relationship between the infantile autism and Asperger's Syndrome. He regarded the two conditions as falling into the autistic spectrum, and suggested that it would be right to use the term Asperger's Syndrome to refer to autistic children who a) are willing to be social but unable to develop relationships with people, b) are clumsy c) are unable to change their language "*to fit different social contexts or the needs of different listener* ", d) are impaired in their use of non-verbal expressions like facial, gestural and posture and e) who have odd obsessive interests.

Gillberg & Gillberg (1989) conducted an epidomological study in Göteborg in 1977 and screened all 6 year old children who did not have mental retardation. They found 14 children showing motor clumsiness and attention perception deficits. They followed up these children and found that 8 of the 14 children showed autistic type behaviours at the age of 7, 4 children had all the diagnostic criteria for Asperger's Syndrome and the remaining four children fulfilled either three or four of these criteria. In the light of these results Gillberg & Gillberg (1989) suggested a hypothetical continuum from severely mentally retarded "*triad patients* " at one end (Wing, 1981b, cited by Gillberg & Gillberg, 1989), then Kanner's autism, then Asperger's Syndrome and then children with attention, perception deficits.

In a recent book on autism and Asperger's Syndrome edited by Frith (1991), Gillberg described six cases of Asperger's Syndrome and argued that all six cases had features which are common to autism. These characteristics were: inability to attribute mental states of thinking and feeling to other people, showing difficulties in the areas of pragmatics, semantics and comprehension of language and having stereotypic motor movements in childhood but later they learn to control these behaviours. He emphasised the motor clumsiness as the main differentiating feature between autism and Asperger's Syndrome. In conclusion Gillberg noted that there is a close link between the two entities. Some children demonstrate features of autism in their childhood, but later in life their condition might change so that they then fulfil the criteria for Asperger's Syndrome. Also some children with autism could be initially diagnosed as having Asperger's Syndrome. However there are some cases of Asperger's Syndrome which do not fulfil the features of infantile autism or autistic disorder.

In the same book Wing (1991) reviewed a number of studies which either claimed that Kanner's autism (early infantile autism) and Asperger's Syndrome (autistic psychopathy) were definitely two different syndromes or claimed that there is a strong relationship between these syndromes. From the existing evidence Wing concluded that Kanner's autism and Asperger's Syndrome should be considered on the same continuum of "*social*

impairment but characterised, at least in the earlier years of childhood, by somewhat differing profiles of cognitive, language and motor functions " (Wing,1991, p.115). Wing (1991) further noted that while the intelligence of a person with Asperger's Syndrome ranges from mildly retarded to superior, a person with Kanner's autism displays severe retardation on general intelligence scales but their non-verbal intelligence would be in the range of mildly retarded to superior. In addition she argued that although some more able autistic children in their adult life may show features similar to Asperger's Syndrome, retaining the term Asperger's Syndrome in the autism continuum, rather than referring to it as high functioning autism, would lead to further research to investigate the underlying causes.

Wing (1991) argued for the practical advantages of keeping the term Asperger's Syndrome. She noted that the term autism could be thought of as the severe form of the condition, for some families it would be easier to accept that their child has a condition called Asperger's Syndrome which is towards the top end of autistic continuum. Secondly, the use of Asperger's Syndrome among other professionals like psychiatrists, may bring about an understanding that even though a child is not diagnosed as autistic later in their life, they may be referred for special help with autistic like deficits. However Scopler (1985) suggested that the term Asperger's Syndrome should not be used since there is not enough evidence to support a clear difference between Asperger's Syndrome and high functioning autism. Similarly Volkmar et. al. (1985) argued that existing evidence was not sufficient to differentiate autism from Asperger's Syndrome clearly.

There is further evidence to suggest that high functioning autism is not different from Asperger's Syndrome. To investigate the role of familial psychopathology for the etiology of autism, DeLong & Dwyer (1988) collected the family histories of 51 people who had autism or pervasive developmental disorder. They concluded that high and low functioning autism have different etiologies. Low functioning autistic people tend to show neurological pathology, whereas high functioning autistic people have familial etiology. They further argued that high functioning autistic people could be diagnosed as having Asperger's

Syndrome, thus high functioning autism and Asperger's Syndrome are basically the same entities both with familial etiology.

Recently some studies have compared people with high functioning autism to people with Asperger's Syndrome, in order to investigate whether the two entities could be clearly differentiated. Szatmari et al. (1989, cited by Ozonoff, Rogers and Pennington , 1991) found that Asperger's Syndrome people differed from the high functioning autism group not only in their early histories but also in their outcome. People with Asperger's Syndrome showed less impairment in communication, social responsiveness and circumscribed interests, furthermore their need for special education was less than high functioning autistic people. In a further study by Szatmari et al. (1990, cited by Ozonoff, Rogers and Pennington , 1991), the differences between the two groups on intelligence, neuropsychological and achievement tests were not marked enough to conclude that autism and Asperger's Syndrome are different entities.

However, Ozonoff, Rogers and Pennington (1991) found significant differences between people with high functioning autism and those with Asperger's Syndrome. High functioning autistic people were inferior to people with Asperger's Syndrome on theory of mind and verbal memory tests. However executive function, which is defined by Ozonoff Pennington and Rogers (1991) as "*the ability to maintain an appropriate problem solving set for attainment of a future goal* " (p.1083), was a deficit shared by both high functioning autism and Asperger's Syndrome groups. Ozonoff, Rogers and Pennington (1991) argued that the reason for the Asperger's syndrome children's ability to pass theory of mind tasks was that they might be using different strategies to solve these tasks, and the authors noted that more sensitive tasks should be developed to test the theory of mind ability. Ozonoff, Rogers and Pennington (1991) further suggested that perhaps executive function and theory of mind deficits are primary to the autism continuum.

In sum, all the studies mentioned in this section seem to suggest that there is a very close link between autism and Asperger's Syndrome. It appears that most authors agree with the

idea of an autistic continuum and they seem to see Asperger's Syndrome as a subgroup of autism which includes more able autistic people. In addition, while some researchers want to retain the term "Asperger's Syndrome", others argue that there is no need for this term. To date, the evidence does not seem to be sufficiently clear to justify any conclusions. More neuropsychological and medical research is needed, to clarify whether the difference between the Asperger's Syndrome and autism is qualitative or quantitative.

In the next section, the international criteria for the diagnosis of autism will be described.

2.3. Diagnosis of autism today

Rutter's (1978) criteria, the Diagnostic and Statistical manuals (DSM-III and DSM-III-Revised) of the American Psychiatric Association and the International Classification of Diseases (ICD) of the World Health Organization (9th and 10th) editions are the most commonly referred diagnostic criteria used by researchers in autism. Table 2.1. lists these criteria.

Table 2.1. Diagnostic criteria for autism

Rutter's (1978) four criteria of autism

Rutter argued that to call a person autistic, it has to be clearly shown that all the diagnostic features are not the consequences of the child's mental age. Rutter's four criteria are as follows:

1. Impaired social relationships. E.g. a lack of attachment behaviour, absence of normal use of eye-to-eye gaze, inability to empathise and understand other people's feelings, inability to develop friendships.

2. Delayed and deviant language development. E.g. reversal of personal pronouns, immediate echolalia, delayed repetition of stereotyped phrases, inability to use speech for social communication.

3. Insistence on the sameness. E.g. unusual obsessional interests, resistance to changes in the environment, limited play patterns, developing attachments to odd objects.

4. Age of onset before 30 months.

Diagnostic criteria of infantile autism DSM-III (APA, 1980, p.89-90)

In DSM-III infantile autism is classified under the general category of pervasive developmental disorders which were identified with the deficiencies of attention, perception and motor movements.

A. Age of onset before 30 months.

B. Pervasive lack of interest and responsiveness to other people.

C. Gross deficits in language development.

D. If speech present, peculiar speech patterns such as immediate and delayed echolalia, metaphorical language, pronominal reversal.

E. Bizarre responses to various aspects of the environment, e.g., resistance to changes in the environment, attachment to odd objects, peculiar interests.

F. Absence of schizophrenic symptoms.

Diagnostic criteria of autistic disorder DSM-III-R (APA, 1987, p.38-39)

In the revised version of DSM-III, due to invalidation of age of onset, the two categories of Infantile Autism and Childhood Onset Pervasive Developmental Disorder were combined into one category of Autistic disorder under more general category of Pervasive developmental disorders.

A. Qualitative impairment in reciprocal social interaction as manifested by at least two of the following features:
1. marked lack of awareness of the existence or feelings of others;
2. no or abnormal seeking of comfort at times of distress;
3. no or impaired imitation;
4. no or abnormal social play;
5. gross impairment in ability to make peer friendships.

B. Qualitative impairment in verbal and nonverbal communication, and in imaginative activity by at least one of the following features:

1. no mode of communication, such as communicative babbling, facial expression, gesture, mime, or spoken language;
2. markedly abnormal nonverbal communication, as in the use of eye-to-eye gaze, facial expression, body posture, or gestures to initiate or modulate social interaction;
3. absence of imaginative activity, such as play-acting of adult roles, fantasy characters, or animals; lack of interest in stories about imaginary events;
4. marked abnormalities in the production of speech, including volume, pitch, stress, rate, rhythm, and intonation;
5. marked abnormalities in the form or content of speech, including stereotyped and repetitive use of speech;
6. marked impairment in the ability to initiate or sustain a conversation with others, despite adequate speech.

C. Markedly restricted repertoire of activities and interests, as manifested by at least one of the following features:
1. stereotyped body movements e.g.hand flicking;
2. persistent preoccupation with parts of objects or attachment to objects;
3. marked distress over changes in trivial aspects of environment;
4. unreasonable insistence on following routines in precise detail;
5. markedly restricted range of interests and preoccupation with one narrow interest.

D. Onset during infancy or childhood.

Diagnostic criteria of childhood autism ICD-10 (WHO, 1987)

1. Qualitative impairments in reciprocal social interaction;

2. Qualitative impairments in communication;

C. Restricted, repetitive, and stereotyped patterns of behaviour, interests and activities;

D. Developmental abnormalities must have been present in the first 3 years for the diagnosis to be made (quoted from Gillberg, 1990, p.103).

Although these different sets of criteria for autism seem to differ in terms of details, they all emphasize impairments in social relationships with people, qualitative impairment in language and communication, and stereotypic patterns of behaviours and interests as the

main features of autism. The only difference between the DSM-III-R and the other diagnostic criteria is the criterion about the age of onset. In DSM-III-R age of onset is not restricted to the first 3 years of life.

2.4. What causes autism?

Early theories of autism suggested that autistic children come to the world potentially normal, but the environment they were brought up in caused their abnormality (Wing, 1983). However, it is now known that autism has multiple biological causes.

Kanner (1943) originally suggested that autistic children "*have come to the world with innate inability to form the usual, biologically provided affective contact with people*" (p.516-517, cited by Rutter, 1983). Then in his following papers he changed his argument from autism as an innate deficit, and suggested that autistic children's social communication difficulties were a response to their cold parents. As a result they ignored other people and sought peace by social withdrawal (Kanner 1946, 1949 cited by Rutter, 1983). Other authors also emphasised parental qualities as the cause of autism (Eisenberg, 1957b; Bettelheim, 1967; Despert, 1951 cited by Wing, 1983). However, a study by Rutter et. al. (1971) (cited by Wing, 1983) compared the parents of autistic children with that of the parents of children with developmental receptive "aphasia", and found no differences between the parents of these two groups in terms of psychiatric illness, enthusiasm, empathy, obsessionality and the emotional warmth towards the child (Wing, 1983). Wing (1954) reported that Kanner (1954) argued that the parents of autistic children used abnormal, rigid child rearing practises. Studies which have compared the parents of autistic children with that of parents of children with Down's syndrome or children with brain damage, in terms of their child rearing practices such as strictness, over-protectiveness, rejection and objectivity, have concluded that theories suggesting the parental factors as the cause of autism cannot be supported (Pitfield and Oppenheim, 1964; Gillies et. al., 1963; DeMyer et. al., 1972c; cited by Wing, 1983).

Other authors have proposed that it is an interaction between abnormalities (vulnerability) autistic children already have and environmental factors which cause the autistic condition (Wing, 1983). For instance, Wing (1983) reports that Tinbergen and Tinbergen (1972) argued that, like every infant, an autistic child has a fear of others; if the parents of an autistic child are not sensitive to the needs of their child and fail to protect him/her from too much exposure to strangers, this chronic fear could lead to autism. However, this proposal lacks any experimental evidence and it is highly unlikely that chronic fear could lead to a condition characterized by qualitative language impairment, stereotyped behaviour as well as social communication difficulties.

In sum, early theories suggesting that autism had psychological causes -such as parental abnormalities (parents are cold, detached, formal, unsociable and belonging to a higher social class); or abnormal child rearing practices; or parental pathology - cannot be supported from the available evidence (Wing, 1983). On the contrary, it has been accepted by the majority of authors that autism is a disorder with multiple biological causes (Gillberg, 1990; Frith, 1989; Folstein & Rutter, 1988).

2.4.1. Genetic evidence

The role of genetic factors in autism has been shown by recent studies. One of the difficulties in genetic studies of autism is that it is very rare for autistic people to have children. For this reason, working with the siblings of autistic children appears to be the best way to investigate the possibility of familial inheritance in autism (Silliman et. al., 1989). A study of an autistic twin population included twin pairs where at least one of the twins met the criteria for autism which was "*a serious impairment in the development of social relationships, delayed or deviant language development, and also stereotyped, repetitetive or ritualistic play and interests* " (Folstein & Rutter, 1977, p.299). The results of this study has shown that in monozygotic pairs the concordance rate of autism was 36% whereas in dizygotic pairs it was 0%. In addition in monozygotic twins the concordance rate for general cognitive abnormalities was 82% whereas in dizygotic pairs it was 10%

Folstein & Rutter (1977) concluded that the difference of concordance rate between the monozygotic and dizygotic twin pairs indicate the role of genetic factors in the aetiology.of autism. Furthermore it has been argued that more general disorders such as low intelligence and language and reading problems seem to have higher rates of occurrence in the families of autistic people (Bartak et al., 1975, cited by Folstein & Rutter, 1988 ; Folstein & Rutter, 1977). Folstein and Rutter (1988) suggested that if the more general language and intellectual deficit is inherited, that could explain the relation between the birth complications and the occurrence of autism. They suggested that since among the monozygotic twins who were not concordant for autism, the twins who had autism tended also to have birth complications, whereas their co-twin who had a general cognitive deficit did not have birth complications. Thus perhaps the inheritance of a general language-cognitive deficit combined with birth complications leads to autism.

Among the other genetic factors, single gene disorders have been suggested to be related to autism. For instance, fragile-X syndrome, tuberous sclerosis, neurofibromatosis, phenylketonuria (reported by Folstein & Rutter, 1988; Silliman et. al.,1989 and Steffenburg & Gillberg, 1989) have been implicated.

2.4.2. Pre- Peri- and Neonatal factors

Pre-, peri- and neonatal complications seem to be more frequent in autistic children than in their siblings or in control groups. Both the prenatal factors (bleeding in pregnancy, especially early and mid-trimester; birth order especially first, fourth and later born; older mother; use of medication) and perinatal factors (meconium in the amniotic fluid) appear to have higher incidences in autistic children whose autistic features are present from the birth. In addition, it has been suggested that neonatal factors such as respiratory distress and septicemia or meningitis, which are both cerebral infections, are related to autism manifested after a normal developmental period (Tsai, 1987 and 1989). However, although pre- peri- and neonatal complications seem to be associated with autism, the

available evidence is far from suggesting that there is single path between these complications and the incidence of autism.

2.4.3. Infectious Diseases

It has been suggested that congenital rubella, congenital cytomegalovirus and herpes may be associated with autism. However further extensive research is necessary to establish a cause-effect relationship (reported by Frith, 1989; Tsai, 1989 and Steffenburg & Gillberg, 1989).

2.4.4. Neuropathological studies

Very few neuropathological studies have been reported. The most important one seems to be a single case study of a 29 year old autistic man compared to an age and sex matched person by Bauman & Kemper, 1985 (cited by Golden, 1987). They found increased cell picking in the amygdala, reduced size of neurons, a lamina desicans in the entorhinal cortex, and a loss of Purkinje and granule cells in the cerebellum. The loss of purkinje cells in the cerebellum in autistic people has been found also by Ritvo et. al. (1986, cited in Tsai, 1989).

2.4.5. Neuroradiological evidence

Studies using computerized tomographic (CT) scanning have not being able to detect consistent abnormalities which were not related to other neurological diseases. However studies using midsagittal magnetic resonance imaging (MRI), found that the fourth ventricle was larger and the brain stem was smaller in autistic people. In addition MRI scanning showed that in comparison to normal people, high functioning autistic people had neocerebellar damage (reported by Tsai, 1989 and Steffenburg & Gillberg, 1989).

2.4.6. Neurochemical evidence

At present the neurochemical evidence does not seem to be sufficient to come to any conclusions about the etiology of autism. However there are some studies indicating that

autistic people are significantly different from control samples "*in platelet serotonin uptake, free blood trytophan, urinary HVA -creatinine ratio, circulating antibodies to 5HT 1A receptors or myelin basic protein* " (p.277, Yuwiler & Freedman, 1987). Further research is needed in order to understand the role of neurochemical factors in autism.

2.4.7. Neurophysiological evidence

Neurophysiological research in autism seems to suggest dysfunction both at the brainstem and at the cortical level. Results of EEG studies appear to indicate that autistic people have abnormal cerebral lateralization which supports the cortical-dysfunction hypothesis of autism (Tsai, 1989). In addition it has been found that autistic people have smaller P3b responses (indicating cognitive responses to stimuli) in comparison to controls. (P3b is "*a component occurs 300-900 ms after stimulus which represents purely cognitive functions* " , Tsai, 1989, p.94). Tsai, (1989) argued that all these findings indicate "*a diminished or altered capacity for selectively channeling information for further internal attention and processing, as well as that differential hemispheric involvement in the attentional deficits* " (p.95) in autistic people. Furthermore studies of vestibular function, autonomic responses, and auditory brainstem responses seem to support, the hypothesis of brain stem dysfunction in autism (reported by Tsai, 1989 and Steffenburg & Gillberg, 1989).

In sum, present evidence seem to suggest that a number of factors: neurobiological, genetics, pre- perinatal complications, infectious diseases, appear to play some role in the causation of autism. Although it is clear that autism has definite biological causes not psychogenic, it is not possible to suggest a single cause which leads to the autistic condition.

2.5. Summary

This chapter started with an account of autism and then the similarities and differences between autism and Asperger's Syndrome were reported. The following section dealt with diagnoses of autism, and the different sets of diagnostic criteria for autism were listed.

Finally, the evidence from biological research have been mentioned briefly. The evidence strongly suggests that autism has biological causes. However, whatever the cause (or causes), it is effecting certain brain systems which may be responsible for the autistic behavioural features or more specific cognitive ability. For instance, recent cognitive psychological research indicate that autistic people are impaired in their theory of mind ability -the ability to attribute mental states to oneself or to others, which has been suggested as the possible reason for autistic people's communication difficulties.

In the next chapter firstly, the cognitive psychological explanations of autism prior to the theory of mind account will be reported. Then a brief outline of the theory of mind explanation of autism will be given.

3. CHAPTER THREE

Cognitive approaches to autism

3.1. Cognitive explanations pre-dating theory of mind

Since the first recognition of autism by Kanner 1943 our understanding of this condition has greatly expanded. With the increase in empirical research into autism and also into normal child development, researchers have increasingly sought a cognitive understanding of autism. Thinking has changed from a view that psychological factors, such as cold parents, are the primary underlying cause of autism, to a view which proposes cognitive impairments as the primary underlying factor.

Researchers who have taken the cognitive approach to autism have emphasized various cognitive impairments as the primary basis of the social impairment of autistic people. These areas include, general intellectual skills, language, information processing skills, memory, coding processes and symbolic use.

The use of standardized intelligence tests in the investigation of autistic children's general cognitive functioning, seems to be important in two ways. First, the general intelligence tests measure two types of cognitive functioning, information storage and cognitive processes, so autistic children's performance on the specific subtests indicate the nature of their impairment (Sigman et al., 1987). Second, the relationship between general cognitive ability and social functioning should indicate, whether or not general cognitive functioning is the primary underlying factor in autism.

Studies have shown that autistic children are impaired in both cognitive processes and stored knowledge (Sigman et al., 1987). To investigate the nature of the autistic impairment, children with Kanner's autism were compared with mentally retarded children. It was found that autistic children were unimpaired on the performance scales, they scored high on the object assembly and block design scales of WISC-R; but low on the verbal

scales of comprehension, vocabulary and similarities subtests. Non-autistic mentally retarded children had similar scores on the verbal and performance scales (reported by Sigman et al., 1987).

Several studies have indicated both that the social impairment in autism can not account for the impairment in general intellectual skills, and that the general cognitive deficit can not cause the impairment in social skills, since there are autistic children with normal intellectual abilities and there are mentally handicapped children, such as children with Down's Syndrome who do not show the social impairments characteristic of autism (Rutter & Lockyer, 1967; DeMyer et al., 1974 cited by Rutter, 1983). However the general cognitive abilities of autistic children do seem to predict the level of social impairment. For instance, Bartak & Rutter (1976) (cited by Shah & Wing, 1986) found that autistic children who had nonverbal IQs below 70, displayed severe social impairment in comparison to the autistic children with IQs above 70. Other studies have found similar results, reporting that overall IQ was the best predictor of autistic children's social adaptation level (DeMeyer, 1976; Rutter, 1970; Lotter, 1974; Dawson & Everard, 1984, cited by Shah & Wing, 1986 and Rutter, 1983). Epidemlogical study by Wing & Gould (1979) (cited by Shah & Wing, 1986) showed that autistic children's varying levels of cognitive abilities were related to their communication and social adaptation levels. However the same study also showed that this relation was applicable to other mentally retarded children. In addition Shah & Wing, (1986) reports Wing's (1981a) suggestion that differing degrees of overall intelligence was related to qualitatively differing degrees of social adaptation. For instance, while severely mentally handicapped autistic children were "*completely aloof and indifferent to others and who really could be described as "treating people like objects* " " (p.155), intellectually normal autistic children were willing to socialize with people, were aware of the social environment but had subtle social cognitive problems, "... *shown in the naive and one-sided approaches made to others and a tendency to talk on and on about a limited range of special interests* " (p.155), and autistic children with mild mental retardation showed differing degrees of social impairment, they "*passively accepted, and*

quite enjoyed, social approaches made by others, but " they "*rarely or never initiated approaches themselves* " (Shah & Wing,1986, p.155).

In sum, findings from several studies seem to suggest that there is a relation between the severity of autism and general cognitive ability, but this does not indicate a cause-effect relationship. In other words, general cognitive impairment cannot be the underlying factor in autism.

The commonality of language deficiencies among autistic children led some researchers to hypothesize that perhaps faulty cognitive processes related to language and underlay the impaired social characteristics of the autistic condition. Researchers such as Rutter (1965) and Churchill (1972) (cited by Prior, 1984) emphasized the similarities between developmental dysphasic children and autistic children. While Rutter (1965) suggested that "*an aphasic-type disorder is probably a central element in the development of many cases of autism* " (Prior, 1984, p.7), Churchill (1972) argued that both conditions had the same language disorder but that the difference between autism and developmental dysphasia was in the degree of severity (reported by Prior, 1984). However a later study compared the language of autistic children and dysphasic children, and showed that the difference between these conditions was qualitative, autistic children, compared to dysphasic children, had abnormal language features such as echolalia, pronomial reversal, and inferior comprehension of language and use of social language, and also inferior understanding of gestures (Bartak et al., 1975, cited by Prior, 1984 and Rutter, 1983). It was concluded that receptive language disorder (dysphasia) could not account for autism. Besides the abnormal language patterns, autistic children also had a cognitive deficit which is not found in dysphasic children, so " *...language deviance as much as language delay .. was characteristic of autism* " (Rutter, 1983, p.523). Rutter (1983) noted that even those autistic people who develop spoken language tend to use "stereotyped statements" rather than having conversations with other people. This feature has been emphasized also by other researchers showing that autistic children have pragmatic deficits, failing to use

appropriate language in a given context (Tager-Flusberg, 1981 cited by Shah & Wing, 1986).

In sum, it appears that receptive language impairment can not account for autistic social impairment, it is clear that autistic children's impaired language is qualitatively different than dysphasic children's. Research findings suggest that language impairment is an essential part of autism, even if autistic children develop certain level of spoken language, they still seem to fail to have conversations which require pragmatic as well as language skills. However one thing still seems to be unknown whether language impairment specific to autism has any underlying effect on the social impairment of these people.

Information processing skills is another important area which has been investigated in autism research. Hermelin and O'Connor (1970) compared autistic, normal and mentally handicapped children in series of experiments, and reported that although autistic children's performance in these experiments was related to their intellectual level, autistic children showed perceptual abnormalities especially in response to auditory stimuli. They also displayed shorter fixation times to visual stimuli. In other experiments these authors presented the three groups of children with lists of words which were either randomly or non-randomly ordered. They found that autistic children did equally well in recalling these lists while normal and mentally retarded children did better if the list was not random but meaningful. Hermelin and O'Connor (1970) suggested "*the inability of autistic children to encode stimuli meaningfully as their basic cognitive deficit*" (p.129).

Furthermore Hermelin (1983) argued that it is not the selective perceptual impairment but an impairment in the processes involved in storing the information independently from its modality which appears to be central to autism. She noted that autistic children show good short term memories but that what seems to be missing is the processing and coding of this information in these children. If the child cannot code and store incoming information, with an increasing amount of information the short term memory system would break down and may cause inappropriate behaviour. In sum, Hermelin (1983) concluded that,

"This cognitive pathology seems to consist largely of an inability to reduce information through the appropriate extraction of crucial features such as rules and redundancies. The impairment in these processes imposes well remembered, stereotyped and restricted behaviour patterns, which become increasingly inappropriate as the requirements for complex, flexible codes increase. It is in the areas of language development and social interaction, which are governed by such complex and flexible rules, that the autistic child's cognitive impairment becomes most evident" (p.167-168).

Another area of cognitive research is discrimination learning. It has been shown that autistic children are unable to solve problems which involved two-dimentional symbolic stimuli. However, when autistic children were presented with concrete three dimensional stimuli they were able to solve the problems. The conclusion was that autistic children had problems with symbolic material which differentiated them from the mentally handicapped children (Prior, 1977 and Prior & McGillivray, 1980 reported by Prior, 1984). Further studies have shown that autistic children were also impaired in their symbolic play skills, which led researchers to conclude that autistic children with varying degrees of intellectual abilities, have *"a syndrome-specific problem with symbolic material"* (Prior, 1984, p.11).

In sum, evidence seem to suggest that autistic children show impairment in their information processing skills and discrimination learning. However one thing still seems to be unknown whether these impairments are specific to autism, and have any underlying effect on the social impairment of these people. For instance, Hermelin and O'Connor (1970) found that autistic children's performance on the information processing tasks was related to their intellectual abilities which may suggest that there were some autistic children who could perform well on those tasks.

The most recent cognitive psychological theory of autism is the "theory of mind" account. The following section outlines this theory.

3.2. Introduction to the "theory of mind" account of autism

The theory of mind account proposes that autistic children's inability to attribute mental states to themselves and others underlies their specific social communication difficulties. It is argued that: If a child is unable to understand other people's mental states he/she will not be able to predict the social behaviour of others and this could make the world a confusing place for the child (Baron-Cohen, 1990b).

The theory of mind view of autism began with studies by Baron Cohen et al. (1985, 1986) which showed that autistic children were significantly worse than 4-year-old normal children and verbal MA matched Down's syndrome children, in their ability to attribute a false belief to a story character. Baron Cohen et al. (1985) concluded that autistic children had a specific cognitive deficit in their theory of mind. Several other studies have supported the findings of Baron-Cohen et al. (1985) that autistic children lack a "theory of mind" (Perner et al., 1989; Leslie & Frith, 1988; Baron-Cohen, 1989a; Russell et al., 1991).

Around the same time Leslie (1987) formulated the theoretical model of a representation mechanism (decoupler). According to this model, the decoupler mechanism produces secondary representations which are representations of representations - for this reason Leslie called them metarepresentations. Leslie (1987) emphasised that autistic children were impaired not only in their theory of mind but also in pretend play which both require metarepresentational skills. Thus the decoupler mechanism underlies both the child's theory of mind and pretend play skills. In other words Leslie (1987) suggested that autistic children's specific cognitive deficit could be due to an impaired decoupler mechanism which is responsible for metarepresentational skills. This model will be explained in detail in chapter 4.

In summary, the theory of mind account of autism proposes that the impaired decoupler mechanism is the underlying factor for in autistic child's impaired theory of mind which itself underlies the autism specific social communication difficulties.

In the next chapter the different theoretical approaches to the theory of "theory of mind" will be described. A number of theorists including Perner, Leslie, Wellman and Harris have formulated views on this topic in the light of empirical evidence. Although Perner, Leslie and Wellman agree that normal children around the age of four acquire a theory of mind and become able to attribute mental states to themselves and others, their formulations of how children come to develop a theory of mind seem to be slightly different as will be explained in the next chapter. In addition two other theorists (Harris and Hobson) who claim that children do not develop a theory of mind. While Harris's view seems to be very similar to those theorists' who are in favour of the theory of mind account, Hobson proposes affective-connative interpersonal relations as the origins of social and cognitive development. In the second part of chapter four, Harris's and Hobson's accounts will be described.

4. CHAPTER FOUR

Theoretical approaches to the theory of "theory of mind"

4.1. What is "theory of mind"?

The term "theory of mind" was introduced by Premack & Woodruff (1978) in their study of a chimpanzee, to refer to the ability to attribute mental states to oneself and to others. Their aim was to investigate whether the chimpanzee had a "theory of mind" ability similar to that humans, by asking whether she could predict an actor's behaviour by attributing mental states to him. They called this ability a "theory" for two reasons. One was that mental states are not directly observable and the other was that one can make predictions about the behaviour of others on the basis of these mental states. This term was soon taken up by developmental psychologists. There is now a rapidly expanding body of research to investigate when and how children develop a theory of mind, and what are the origins and the factors underlying this ability. Different theorists have proposed different explanations for the origins of theory of mind. In the following sections these theoretical accounts will be reported in detail. However, before the theoretical accounts, a brief account will be given of the main areas of research in the investigation of the child's theory of mind.

The leading experimental paradigm which has been used to study children's theory of mind ability is the false belief task. The false belief task requires children to predict the behaviour of a person who holds a false belief about a situation because they are unaware of a change in the world. For instance, in the original study by Wimmer & Perner (1983) children were presented with a story which was enacted with doll characters. In this story Maxi puts some chocolate in the *green* cupboard and goes out to play. In his absence his mother takes the chocolate from the *green* cupboard and uses some for the cake that she is baking. Later she puts the remaining chocolate back in the *blue* cupboard. Maxi comes back from the playground hungry and wants to have some chocolate. Children were asked where Maxi will look for the chocolate. An awareness that Maxi should had a false belief

will lead children to expect Maxi to look in the green cupboard, even though the children themselves know that the chocolate is in the blue cupboard.

After Wimmer & Perner's (1983) original study investigating children's understanding of another person's false belief, a number of other studies followed which addressed the same question but used a variety of different tasks: Perner, Leekam & Wimmer, (1987), Hogrefe, Wimmer & Perner, (1986), Gopnik & Astington, (1988), Zaitchik (1990), Freeman, Lewis & Doherty (1991), Mitchell & Lacohee (1991), Siegal & Beattie (1991) and Sullivan & Winner (1991). Children's understanding of their own false beliefs has also been studied by Gopnik & Slaughter (1991) and Wimmer & Hartl (1991).

Research on the child's theory of mind has not been limited only to the study of false belief. For example, children's ability to attribute second-order beliefs has been investigated by Perner & Wimmer (1985). Children's understanding of deception has been investigated by Chandler, Fritz & Hala (1989), Hala, Chandler, & Fritz (1991) and Sodian, Taylor, Harris & Perner (1991). Children's understanding of the appearance-reality distinction has been investigated by Flavell, et al. (1983) and Flavell, et al. (1987).

Independently of the first false belief studies, other authors have looked at children's spontaneous language production to investigate when they start to use mental terms (such as know, think, believe, guess, remember and forget) in order to attribute mental states to themselves and to others (Bretherton & Beeghly, 1982; Bretherton, et al,1981 and Shatz et al. 1983). These authors have argued that children's production of mental terms to refer to people's mental states can be taken as an early indication of theory of mind ability. This literature is reported in detail in chapter 7.

Furthermore, children's ability to pretend, and to understand pretence in others, has been argued to be an early manifestation of theory of mind, since both pretence and theory of mind require metarepresentational ability - the ability to represent representations (Leslie, 1987). However Perner (1991) argues strongly against pretence requiring metarepresentational ability.

In addition to these investigations of the normal child's theory of mind, there is another body of research which looks at autistic children's theory of mind. After reporting the theoretical views on theory of mind, the research in autism and theory of mind will be reviewed.

4.2. Theoretical views on the child's theory of mind

This section will consider, first, Perner's account of children's developing understanding of mind and representation, second, Leslie's view on representation and the theory of mind, and third, Wellman's account of theory of mind. Finally, two other accounts which are opposed to the theory of mind, namely Harris' and Hobson's accounts, will be reported.

4.2.1. Perner

4.2.1.1. Definition of representations

Perner (1991) unhelpfully defines representation as "*.. something that stands in a representing relation to something else* " (p.18). According to Perner a representation can be external, such as pictures or language, or it can be mental, such as thoughts. Perner clearly distinguishes representation (representational medium, e.g. a picture) from representational content (e.g. content depicted by that picture) and he defines representational relation as "*representing something as being a certain way* " (p.40). Perner calls representations which represent things in the world primary representations - what Leslie (1987) calls, simply, representations. Perner argues that misrepresentations may occur when primary representations represent the world. These may be a result of either a perceptual error or a malfunctioning system.

Perner (1991) adds that secondary representations represent "*not how the things are, but how they could be* "; they are "*detached or 'decoupled' from reality* ". According to

Perner, secondary representations are copies of primary representations and they allow us "*to think of the past and the possible future, and even the nonexisting, and to reason hypothetically* ". The existence of secondary representations depends on the existence of primary representations which depends on the existence of reality in the world. This seems to be adequate for many purposes but it is extremely difficult to apply when the referents are themselves fictional; a substantial physical problem is involved but it would take us beyond this thesis.

Another term Perner (1991) describes is metarepresentation, which is "*the ability to represent that something (another organism) is representing something* " (p.7) (see figure 4.1.). According to Perner metarepresentation requires the understanding of the difference between "*what is represented (referent) and as what it is represented (sense)* " and he argues that secondary representation is the only way to understand the difference between the referent and sense. He also characterises metarepresentation as a model that "*models the representational relationship between a model and the environment (or whatever is being modelled)* " (p.41). He adds that in order to understand misrepresentation one must understand that a primary representation which has been formed at a certain time could be different from what a primary representation should be according to the external situation. Perner claims that in order to contrast "*what happened with what should have happened* " it is necessary to metarepresent, and a representation of what should have happened is a secondary representation since it is a hypothetical situation (see figure 4.2).

Figure 4.1. Perner's view of representational levels

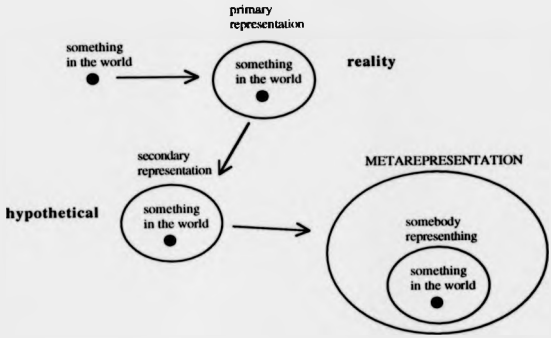
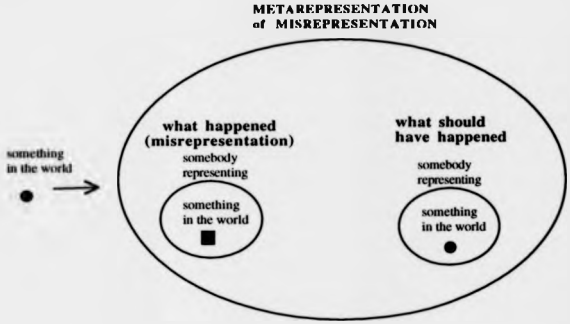


Figure 4.2. Understanding misrepresentation at the metarepresentational level



4.2.1.2. Children's understanding of representational levels

According to Perner children go through three developmental levels in their understanding of representations. In the first year of life infants can represent only what is out there in the world as it is: Perner calls these "primary representations". From the second year onwards infants begin to create multiple models (secondary representations) which enable them to compare past with present (e.g. past "I was two years old", present "I am three years old") or real with hypothetical (e.g. real "this is a banana", hypothetical "this is a phone") (see figure 4.3.), and enable them to pretend play, to understand external representations like language and pictures and to empathize with others. Perner names children at this stage as "situation theorists". From the age of three children begin to have representations of representations, which indicates that they have a metarepresentational ability. Metarepresentational ability enables children to distinguish appearance from reality, to

understand misrepresentations and false belief. Perner calls children at this level "representation theorists".

Perner argues that at first infants have "*a single model of the world* ", later, at the age of one to one and a half years, they start developing "*multiple models* ". As an example of when infants start to use multiple models, Perner refers to Haake &Somerville's (1985) invisible displacement task. He reports that in the experimental setting there were two pieces of cloth (used as covers) separate from one another. To start the task infants are shown an object in the experimenter's palm, then the experimenter closes his hand, covering the target object. The experimenter then puts his hand through the first cover, keeps it there two seconds, then takes his hand out. He then stops his hand between the two covers and opens it. Next he closes his hand and moves it under the second cover and out the other side. Then he opens his hand showing it to be empty. If the experimenter had the object in his hand when he opened it between the covers, the infant should look for the object under the second cover. However if he did not have the object in his hand when he opened his hand between the covers, the infant should look for the object under the first cover. Perner reports Haake &Somerville (1985) found that at 15 months, 67% of the time infants searched in the right location. From these results Perner concludes that at the age of 15 months infants are able to have at least two models at the same time - one to show how the situation is now, the other to show how the situation used to be - which allow them to think about the past.

Another example of infants' usage of multiple models appears to be pretend play. Perner (1991) argues that in order to claim that a child's play is pretend play, rather than functional play, a child should be aware that there are two models. In a "reality model" a child should realize what the object is in the real world [(Perner's example)"*for real "this object is a piece of cloth"* "] and an "as-if model" where a child pretends it to be something else [(Perner's example)"*for fun "this object is my pillow"* "] (p.54). According to Perner if a child is able to change his/her actions between two situations of reality and pretence, this

indicates that the child is aware of the distinction between real and pretend, and he/she is not making a mistake. In this case the child's play is pretend play.

Perner highlights three points about pretend play:

1) In pretend play modelling two different situations at the same time, a "real situation" and a "hypothetical situation", does not indicate that one situation represents the other.

2) Pretend play involves substitution, where one object "stands in for" another object. However, one object does not "stand for" another object in the sense of being a representation. Thus pretend play should not be seen as a symbolic activity "*in the sense that some substituted object represents what it has been substituted for*" (p.59).

3) Creating multiple models is sufficient for pretence. According to Perner pretend play does not require metarepresentational ability. Perner criticizes Leslie's argument that "*pretend representations are not representations of the world but representations of representations*" (Leslie, 1987, p.417 quoted by Perner, 1991, p.59). However, Perner argues that "*pretend representations are not representations of the world as it is but of the world as it might be*" (Perner, 1991, p.59).

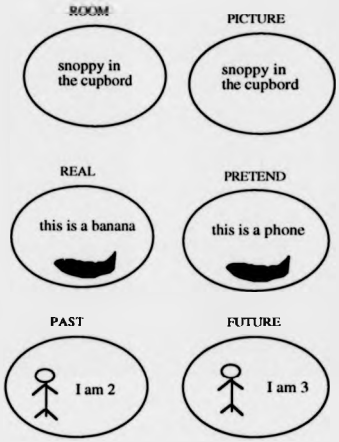
According to Perner, with the acquisition of the ability to form multiple models, around the age of two, a child also becomes able to understand the use of symbolic input (pictures or language). Perner argues that at this stage children begin "*to understand representations as a special kind of represented situation in which the same people, objects, and relations occur as in real life but in which they behave and exist in a quite different,"nonreal" way*" (p.71). Perner calls children at this stage situation theorists. For instance, around the age of one and a half years children become able to interpret their mirror image. While younger infants treat the mirror image of themselves as another person, later on they begin to recognize themselves in the mirror which, according to Perner, requires the child to have two models: one to represent him/her in reality and the other to represent him/her in the mirror.

Another example of children's use of multiple models is their understanding of pictures. Perner notes that around the age of one children do not show an interest in pictures; they cannot appreciate them because they have only a single model of reality. However, in the second year of life children begin to understand that objects have different properties in pictures than in reality. This is why one and a half year old children do not bite the picture of an apple (Perner, 1991). According to Perner children at this stage are able to understand that a picture of daddy may present daddy in a different situation than in real life. Children also understand that there is only one daddy, but that he can be in two different situations.

Another ability that appears to be acquired by children just before the age of three is an understanding of correspondence. Perner reports Deloache's (1989) correspondence task, in which children were shown two rooms, one large and one small, with identical furniture in each. Children were told that the large room was Daddy Snoopy's and that the small room was Baby Snoopy's room. They were also told that Baby Snoopy likes to do whatever Daddy Snoopy does. After placing Daddy Snoopy in the cupboard in the large room, the experimenter asked the child "where is Baby Snoopy?" Children between the ages of two and half to three were able to understand the correspondence between the two rooms. According to Perner, the situation theorist can understand the correspondence by seeing the two rooms as two different situations (see figure 4.3.).

Figure 4.3. Representational ability of situation theorist.

Situation theorist



Perner notes that in the second year of life "*children have implicit understanding of representations ...they can use them as representations*" (p.72). But children at this age have not developed an explicit understanding of representations, thus they cannot "*model the representational relationship between picture and depicted or model the fact that a picture needs to be interpreted*" (p.73).

Perner argues that explicit understanding of representations, which is an ability to model representational relationship, emerges between the ages of three and four. For instance, by the age of four children can understand that people looking from different angles can give different interpretations to the same picture. Perner gives Flavell et al.'s (1981) visual

perspective-taking task as an example. In this task children were shown a drawing of a turtle. If the turtle's feet were pointing towards the child, the turtle was standing on its feet, but when the turtle was rotated 180°, facing the other way, it was lying on its back. While three-year-old children had no difficulty saying whether the turtle was standing or lying on its back, they did find it difficult to interpret that, if the turtle was standing on its feet from their point of view, to the experimenter who was sitting opposite to the child, the turtle was lying on its back. However, four-year-olds could understand that the experimenter might give a different interpretation to the same picture, which according to Perner indicates that these children have metarepresentational ability. Perner argues that the ability to understand alternative interpretations requires an ability to model "*the relationship between a representation (picture) and what it represents (the turtle's position)*".

Furthermore, four-year-old children seem to be able to understand misrepresentations in their verbal statements. According to Perner, understanding misrepresentations requires metarepresentational ability, which enables children to differentiate referent (what is represented) from sense (as what it is represented). Perner, (1991) gives Wimmer & Perner's (1990) task as an example: in this task a child was given a familiar chocolate box and a puppet asked them what was in the box. All the children answered that there was chocolate in the box, but when they opened the box they found a car. Then the children were asked: "When the puppet asked you what was in the box what did you say was in the box?" While only a very small number of three-year-olds could answer this question correctly, most of the four-year-olds had no difficulty giving the right answer. Perner argues that these results show the four-year-old child's ability to metarepresent. They could pass this task because they could remember that they misdescribed the real situation (referent) as different (sense) from what it really was.

Children around the age of four also become able to differentiate appearance from reality which, according to Perner (1991), also requires metarepresentational ability. Perner argues that four-year-old children's success in Flavell et al.'s (1983) task is because they have a concept of misrepresentation. In this task children were shown a piece of sponge

that looked like granite, then they were asked two questions of reality "*what is this really, really? Is it really, really a rock or is it really, really a piece of sponge* ?" and appearance "*when you look at this with your eyes right now, does it look like a rock or does it look like a piece of sponge* ?". While 3-year-old children had difficulty in this task 4-year-olds were able to say that it looks like a rock but it is really a piece of sponge. Perner argues that this is because 4-year-old children can understand that when the representational content (sponge) has a deceptive appearance (rock), its sense (looks like a rock) differs from its referent (sponge).

According to Perner, alongside the child's developing understanding of "external means of representation" (from understanding pictures and mirror images as depicted situations to understanding that the same picture can be given different interpretations by different people, and understanding that verbal statements can misrepresent reality and that appearance can be different than reality) there are also advances in the child's understanding that mind is representational (from understanding of behaviours like emotional expressions to the understanding that these behaviours are caused by mental states; at this stage children can talk about mental states, and show empathic behaviour to others, and to the next level understanding that mental states have a representational function).

4.2.1.3. Children's understanding of mind

Perner states three criteria for mentality: inner experience - understanding mental states because of personal experience; theoretical constructs - using mental states to explain behaviour; aboutness - which has three features of 1) nonexistence (understanding of mental states as nonexistent entities), 2) aspectuality, and 3) misrepresentation.

Perner argues that infants' early social interaction does not indicate their understanding of mental states. In other words it does not indicate that they have an "*implicit theory of mind*". For instance, according to Perner, one could not conclude, from infants' social referencing behaviour in the visual cliff task, they have an implicit mental representation

that their mother's fearful face is caused by fear. Perner argues that an infant's recognition of its mother's fearful face could be just innate recognition for the purpose of survival, or it could be a learned behaviour as a result of experiencing the consequences.

Perner also argues that infants' behaviour of following their mothers' gaze, or pointing to an object to gain their mother's attention and to check whether she is looking, does not necessarily require the understanding of an underlying mental mechanism of attention. It could be that they are just manipulating their mother's look. He adds that even the infants' "protodeclarative" pointing - which is to get mother's attention in order to share his/her experience - does not show that "*they understand attention as a mental state* " (p.131).

Perner claims that children begin to understand mental states around the age of two. According to Perner (1991) 2-year-old children's empathic behaviour towards other people's distress suggests that they use their own experiences to understand others. To do that they need to hold two models, one of reality - how the person feels - and one which is hypothetical - how they would feel in the same situation (Perner, 1991). Perner argues that this helping behaviour could not be a learned behaviour since children show that they are touched by the other person's distress. But it must be that children understand distress as a "*hypothetically constructed state that is assumed to be analogous to the children's own inner experience of sadness* " (p.135).

Around the age of four with the acquisition of the concept of representation (which is "*representing something (referent) as being a certain way (sense)* "), children's understanding of knowledge changes from theory of behaviour to representational theory of knowledge (Perner,1991). They begin to understand knowledge as a mental representation. While at younger ages children tend to judge whether or not a person knows something on the basis of success - such as whether the person found the object - by the age of four children begin to understand that it is the informational access which is the necessary factor for the knowledge formation. Perner reports Wimmer et al.'s (1988) study which showed that although three-year-old children could tell whether or not

they knew what was in the box if they were told or shown, when they were asked "How do you know ?" they had difficulty answering the question. However, four-year-old children could tell how they knew what was inside the box.

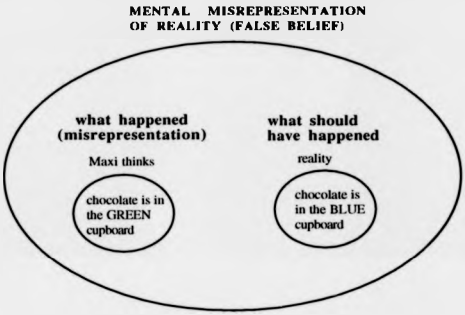
Perner argues that from the age of four children begin to appreciate the crucial role of informational access in knowledge formation. The best way to test this is a lucky guess task, where the subjects were made to find the object although they did not have any informational access to it. If children said they knew where the object was, this would imply that they were judging their knowledge on the basis of success. However, if they found the object to which they had no visual access, and said that they were guessing, this would imply that children were judging their knowledge on the basis of informational access. Perner reports that the results of this study suggested that children between the ages of four and five develop an understanding that informational access is the crucial factor in knowledge formation.

Perner argues that with the acquisition of theory of knowledge children also become able to understand the aspectuality of knowledge. For instance, children between the ages of four and five begin to understand that to find out the object's colour one has to look at it, but to find out the weight of the object one has to feel it (Perner, 1991).

According to Perner, with the acquisition of representational theory of mind, children become able to understand that a person is (mentally) misrepresenting reality (false belief). Perner argues that the way to test children's understanding of representational theory of knowledge is the lucky guess task, in which one can compare whether children act on the basis of informational access or success. Similarly, asking a child to show where a person will look for an object on the basis of what the person is thinking, may indicate "*whether children understand that thinking influences action* ". However, to test whether children understand thinking as an indication of belief, or in other words whether children understand "*thinking as a representational activity* " (p.177), the task should contrast the prediction of the person's action on the basis of belief, with the prediction based on "*other*

well established rules of how people act " (p.177). This is the false belief paradigm which was first studied by Wimmer and Perner (1983) using the "Maxi" task that was described at the beginning of this chapter (see also figure 4.4.). According to Perner, understanding false belief indicates that children understand belief as a representational state of mind.

Figure 4.4. Understanding False belief at metarepresentational level.



Young children have difficulty not just in understanding another person's false belief, but also in understanding their "own false belief" (Perner, 1991). This has been investigated by Gopnik and Astington (1988) (reported by Perner), who used the smarties task which was originally developed by Hogrefe et al. (1986) to test children's understanding of other people's false beliefs. Perner reports that in this task Gopnik and Astington had shown a closed tube of "smarties" to children and asked them what was in the tube, to which all the children answered "smarties". Then the children were shown that the tube contained a pencil and not smarties. Children's own false beliefs were tested by asking them what they thought was in the box when they were first shown the tube. For

thought was in the box when they were first shown the tube. For children younger than 4 years it was difficult to understand their own false belief (Perner, 1991). Perner argues that "false belief" requires the understanding of belief "*as a misconception of reality* ", a child needs to differentiate "*belief's referent (reality)* " from "*its sense (what really is represented as)* ", which could be achieved by the acquisition of metarepresentational ability.

In parallel to the understanding of false belief from the age of four, children begin to be able to manipulate other people's belief so as to cause a false belief of reality (i.e. in deception) (Perner, 1991). Perner reports an experimental situation in which children were told that there is a puppet which likes to get whichever sticker the child likes to get. In this task most of the 5-year-olds and some of the 4-year-olds pointed to the sticker they did not want, so as to deceive the puppet who would leave the stickers that the child really wanted. Perner argues that the child's ability to affect competitors' beliefs indicates that they have a representational concept of mind.

In sum Perner claims that "*By conceptualizing the mind as a system of representations, the child switches from a* ***mentalistic theory of behaviour****, in which mental states serve as concepts for explaining action, to a* ***representational theory of mind****, in which mental states are understood as serving a representational function* " (p.11, bold added to the original since in the original these phrases were in italics).

4.2.2. Leslie's Metarepresentational theory of pretence

Leslie (1987) defines an internal representation of some aspect of the world as a primary representation. He also names the capacity for representing such representations as primary representation. According to Leslie, in pretence there are two representations: one is representing the real situation or the object as it is perceived, and the other is the pretend representation representing what it is pretended to be. Leslie argues that both representations, pretend and real, refer to the same object or situation - if they are both taken as primary representations this may cause a representational abuse. For example,

consider the pretence that "this banana is a phone"; if the child does not have the underlying mechanism to pretend and to understand pretence in others he/she would be confused if a banana were referred to as a phone.

Leslie (1987) notes that "*pretence affects the normal reference, truth, and existence relations of the representations it uses* " (p.415), and for this reason he suggests that pretend representations are not the representations of the world (like primary representations) but are secondary representations which are copied from the primary representations. This is in agreement with Perner (1991). Leslie (1987) suggests that in pretence a decoupling mechanism copies primary representations into a metarepresentational context within which these secondary representations, unlike the transparency of primary representations, become opaque. In the second order metarepresentational context, reference, existence, and truth relations of the representation are suspended. Furthermore, in contrast to Perner (1991), Leslie (1987) claims that secondary representations are the representations of representations, and for this reason he calls them metarepresentations. For instance, in pretending that "a banana is a phone", a banana is representing a phone which is itself a representation.

Leslie (1987) further argues that pretence requires metarepresentational ability just as do the understanding of false belief, ignorance, and the appearance-reality distinction. Thus Leslie suggests that the common factor between pretence and these other manifestations of theory of mind ability is metarepresentation.

Leslie (1987, 1988) notes that there are three types of pretence: 1) object substitution - for example, pretending that "a banana is a phone"; 2) attributions of properties - for example, pretending that "doll's face is dirty"; and 3) imaginary objects - for example, pretending that "the empty cup contains water". Leslie (1988) suggests that pretence distorts "*the normal reference, truth and existence relations of primary representations* " (p.25).

Leslie (1987, 1988) argues that there is "*a deep isomorphism* " between pretence distortions and mental state reports. First, a mental state term "*suspends normal reference relations* " (1987, p.416). This is called *referential opacity* and it corresponds to object substitution in pretence (deviant reference). As an example of referential opacity Leslie gives the following "*[Sarah-Jane believes that the prime minister of Britain lives at Number 10 Downing Street] in no ways entails the truth (or falsehood) of [Sarah-Jane believes Mrs. Thatcher lives at Number 10 Downing Street]. In a mental state context one can no longer "look through" terms to see what they refer to in deciding such issues.* " (Leslie, 1987, p.416). A second point about mental state reports is *entailment of truth (or falsehood)*, which corresponds to the attribution of pretend properties in pretence (deviant truth pretend). For instance, "*John believed that the cat was ill* " (Leslie, 1988 p.26) could be true or false. The last point is *nonentailment of existence (or nonexistence)*. Leslie's example is that "*John believes the king of France is bald* " (Leslie, 1988 p.27) does not necessarily imply the existence of the king of France. This corresponds to imaginary objects in pretence (deviant existence).

Leslie (1987, 1988) suggests that the reason for this deep isomorphism between types of pretence and mental state reports is that they both have the same kind of internal representations. Leslie suggests that this internal representation, which he calls meta-representation, has three components. The agent represents people, an expression refers to a primary representation but if "expression" is in quotation marks it refers to a decoupled secondary representation. The third component is the informational relation which has the function of relating decoupled secondary representations in a special way to primary representations, for instance to pretend, to think. Leslie (1988) suggests that this mechanism develops pretend representations such as "*I pretend 'this empty cup contains water '*" (p.28) which, according to Leslie, has the same underlying representation as mental state reports.

In sum, Leslie (1987, 1988) suggests that pretence and theory of mind ability both require metarepresentational ability. The same decoupling mechanism is the underlying factor for

both of them. Thus, he suggests that early pretend play is the first manifestation of theory of mind. However there is a two year gap between the emergence of pretence and the ability to understand false belief. Leslie (1988) suggests that perhaps early on young children have a causal view of the world. They understand that behaviours are caused by concrete objects or events. They also have a metarepresentational ability to pretend and to understand pretence in others. However by the age of four these two capacities start working together, so enabling the child to understand that mental states could be both "*causes of behaviour and effects of perceptual exposure to a situation*" (Leslie, 1988, p.38).

4.2.3. Wellman's view of theory of mind

Wellman's (1990) account of when children acquire a theory of mind seems to be based on two major developmental changes. One appears to be around the age of three when there is a chance from simple-desire psychology to belief-desire psychology. The other is from "*an initial copy theory of mind to a later interpretative-homuncular theory*" (p.315). Wellman (1990) argues that the three-year-old's transition from simple desires to belief-desire psychology "*marks the onset of an understanding of representational states of mind*" (p.244). He claims that at this stage three-year-olds have an initial theory of mind. However, he notes that three-year-olds do not understand "*the interpretative quality of mental representations*" (p.244). This understanding, according to Wellman (1990), is acquired around the age of four or five. Wellman proposes that the infant's ability to understand people as agents is the precursor for the understanding of simple desires, which is in turn the precursor for the understanding of beliefs.

According to Wellman (1991) beliefs are representational - the child understands that another person has the representation of an object or situation in his/her mind. However, simple desires do not require the child to understand that another person is representing something. A simple-desire psychology involves the relation between an external state of wanting, but belief-desire psychology involves the representations of the "*truths about the*

world " (p.29). Wellman suggests that while two-year-old children have simple-desire psychology, three-year-old children develop belief-desire psychology.

For instance, Wellman (1991) reports results from Wellman & Woolley's (1990) study, in which two-year-old children were able to predict whether a person searching for an object (which could be in one of two locations) would continue to search for it after finding it in the first location. Also, they were able to predict whether a person would be happy if she/he were to find the object they wanted to find. Thus Wellman (1990) concludes that two-year-old children are able to predict action and emotions on the basis of desires. However, Wellman argues that two-year-old children fail to predict actions on the basis of beliefs. Wellman (1990) reports the results of Wellman and Woolley's (1990) study. In this experiment two-year-old children were given four tasks. In the not-own belief task a character was looking for an object and thought that it was in one location, although the object was in another location. Children were asked where the character would look for the object. In the not-own desire task children were asked to choose one of two activities as their own preference, then told that the character wanted to do the other activity. Children were asked where the character would go. For the discrepant belief task a character was looking for an object which could be found in both locations, but the character thought it was only in one location. Children were asked where the character would look for the object. Finally, in the no preference desire task children were told that the target object was in both locations and the character wanted to get the object. Then children were asked where the character would look for the object. Results showed that while two-year-old children could pass not-own desire and no-preference desire tasks, they failed on the not-own belief and discrepant belief tasks. Wellman (1990) concludes that understanding of desires which are nonrepresentational comes before the understanding of beliefs, which are representational mental states. Wellman's suggestion that nonrepresentational understanding comes before the understanding of representational mental states is in agreement with Perner (1991).

Furthermore, Wellman (1990) claims that the emergence of belief-desire psychology at the age of three suggests that children have acquired "theory of mind". According to Wellman (1990), acquiring the belief-desire psychology which allows three-year-olds to predict action on the basis of beliefs, suggests that children at this age understand "*the causal aspect of mind*" (p.234). He also claims that three-year-old children can differentiate mental entities from real objects. However he does not claim that young children have an adult understanding of the mental / real distinction. For instance, children may understand that by seeing things you know about them or you can imagine things, but they do not necessarily understand how thoughts work.

Furthermore Wellman (1990) argues that three-year-olds have "*a representational understanding of mind*", for instance they understand that beliefs, dreams and ideas are representational. He describes three-year-olds' "*representational understanding of reality oriented representations* " as "*a copy understanding* " (p.249). According to Wellman what four- to five-year-olds acquire is the understanding of mental representations as "*interpretative entities* " (p.249). He argues that three-year-old children do not understand representations as interpretative entities but they misunderstand them as being direct copies of reality. Wellman (1990) suggests that three-year-olds have a hit-or-miss understanding of representations. For instance, they can understand that another person has a true belief of reality in his/her head when the person hits (e.g. sees) the target object. They can also understand that the other person has ignorance or incomplete knowledge of reality when the person misses (e.g. does not see) the target object. According to Wellman, the three-year-old's understanding of misrepresentations such as ignorance or incomplete knowledge could be explained by the copy mechanism. For instance, if the copy mechanism completely misses the target this leads to ignorance, whereas if it misses the target partially this leads to incomplete knowledge.

Wellman (1990) argues that with the interpretational understanding of representations four- to five-year-old children should be able to understand that two people could have diverse representations of one thing on the basis of their ideas and likes. He further argues that

young children with the copy view of representations would make errors of two types, one is to attribute proper representation to a person when he/she does not have it. For instance, Wellman cites Taylor's (1988) study, in which young children aged between three and four judged that by seeing only a small un-identifiable part of an object a person could tell what the object was. Wellman suggests that this is because, for the copy theorist, a representation is formed by exposure to that object. However with the interpretational understanding of representations, five-year-old children were able to judge that the person could not tell what the object was. According to Wellman, three-year-old copy theorists' second type of error would be to say that a person does not have a representation when actually they do. For instance, he reports Sodian and Wimmer's (1987) study as experimental evidence of this type of error. In this study a child and another character were presented with a bag with red markers in it. Then one marker was taken from the bag and put into a box. The child and the character did not have visual access to this transfer. When four-year-old children were asked whether they knew the colour of the marker in the box they answered "red". However when they were asked whether the other character knew the colour of the marker in the box, four-year-old children replied that other person did not know because he/she had not seen the transfer. However, five- to six-year-old children were able to judge that the other person could infer the colour of the marker. Wellman (1990) concludes that between the ages of three and six children begin to understand inference and interpretation with the development of an interpretative understanding of representation.

Wellman argues that the three-year-old copy theorist could understand true beliefs but fail on false belief tasks. According to him true beliefs are reality-oriented representations, they are direct copies of reality. Thus when a child is asked a question like "what does Joe think is in the box?", according to Wellman the child is being asked about Joe's belief of reality which is reality. So a child could answer this question on the basis of what she/he knows reality is. If the reality in this situation is that there is a ball in the box then a child could say "Joe thinks a ball is in the box" and pass the true belief task.

However, according to Wellman a copy theorist fails on the false belief task. An example of such a task is one involving a character who saw a chocolate in the kitchen but did not see that someone took it to the dining room. When a three-year-old child is asked where the character thinks the chocolate is, a copy theorist would answer the question on the basis of reality, since beliefs are copies of reality. Since in reality the chocolate is in the dining room, the copy theorist's answer would be "the character thinks the chocolate is in the dining room". Wellman (1990) also accounts for the three-year-old child's failure to pass appearance/reality tasks on the basis of the copy theorist view. According to him, Flavell's (1983) task in which a three-year-old copy theorist is presented with a piece of sponge that looks like a rock, they "*say (correctly)'It is a sponge', and (incorrectly), 'It looks like a sponge'*" (p.267). This is because, for the copy theorist, a representation is a copy of reality. Wellman notes that with the interpretative understanding of representations children between the ages of four and six begin to make a distinction between what the object looks like and what it really is.

Furthermore, according to Wellman, around the age of four or five there are two transitions, one from understanding representations as direct copies of reality to the interpretive understanding of representations; the other is the transition in children's understanding of mind from "*a passive registry of reality* " to "*something on the order of an active construer and processor of information* " (p.268). Wellman suggests that while three-year-olds' theory of mind is understanding mind as "*containerlike* " the adult theory of mind which is acquired between the ages of four-to-six, is "*homunculuslike* ". For instance, young children with the containerlike understanding of mind refer to dreams and imaginations as "they are in your head", or they might say "you can't see the picture in my head but you can make one in your head". However, four- to five-year-old children begin to see mind as not only responsible for mental states like thinking and dreaming but also responsible for walking, hearing and seeing which implies an understanding of mind as interdependent with other senses. Older children also talk about mind "*by personifications*"

for instance "*the mind tells your legs where to go* " (p.271, Wellman, 1990, reporting results from Johnson &Wellman (1982)).

In sum, what Wellman (1990) argues is that three-year-old children have an initial theory of mind because they can differentiate what is mental from what is real. They can also predict human action on the basis of belief-desire psychology, so that a person would act not only to satisfy her/his desires but do this according to his/her beliefs. However, their belief-desire psychology is not as sophisticated as an adult; what they have is a copy understanding of representations and a copy view of mind. They have a hit-and-miss view of representations. With this level of understanding three-year-olds are able to understand true beliefs, ignorance and incomplete knowledge, but they fail to understand that representations may occur with inference, and exposure to only one part of an object may not always create a correct representation of that object. In addition, three-year-old children fail to understand false beliefs and the appearance / reality distinction. According to Wellman, what develops around the age of four or five is an interpretative understanding of representations and an understanding of mind as an active information processor. With this development a child reaches the adult-like homuncular theory of mind.

Wellman's (1990) view on children's acquisition of theory of mind has similarities and differences from Perner's (1991) view. For instance Wellman's description of representation is similar to Perner's (1991). Wellman defines representation as "*a separate representational entity that depicts or stands for some other entity altogether, based on the establishment of certain relationships between representation and referent (between representational- and thing entities)* " (p.246). Wellman argues that reality-oriented representations are direct copies of reality. What Wellman calls reality-oriented representations are what Perner (1991) call primary representations.

However, Wellman's proposal that around the age of three children begin to understand representational mental states like beliefs, contradicts Perner's (1991) suggestion that

understanding mental states as representational emerges around the age of four, such as attribution of knowledge and false belief.

4.3. Alternative to the theory of "theory of mind"

4.3.1. Harris's proposal: Mental simulation

Harris (1991) argues against the view that children develop a theory of mind. According to him it is not the theory of mind that allows children to predict and understand human action on the basis of mental concepts like beliefs and desires. He suggests instead that what children have is "*an increasingly sophisticated process of mental simulation that allows them to make quasi-theoretical predictions*" (p.283). According to Harris, mental simulation requires the imagination of having a belief or a desire, and also the imagination of likely emotions and actions which would emerge due to having that specific belief or desire. Then, with this imagination, a child can take the role of another person and attribute specific beliefs or desires to the other person.

According to Harris (1991), children's imaginations work with existing default settings. He suggests that these default settings refer to the current state of the world and current state of the intentional self. For instance, one of the existing default settings would be the child's own current desire of, e.g.wanting to get X; another would be the current state of the world, e.g.where X is. Harris claims that if the child imagines something different from the current default settings, there will be a need to adjust these default settings.

In pretence: Harris (1991) argues that in all types of pretence (imaginary objects, object substitution or the attribution of pretend properties) reality needs to be set aside. This is similar to Leslie's (1987) and Perner's (1991) suggestions that pretence representations are copied from primary representations. However Harris argues against the existence of a decoupling mechanism in pretence (Leslie, 1987, 1988). Instead he suggests that in pretence an "*increasingly complex set of adjustments*" (p.285) is at work. In pretence

what a child needs to do is to adjust the existing default setting which corresponds to reality.

In mental state attribution: Harris (1991) argues that to understand that other people may want, like, know or expect different things from themselves, children need to adjust one of their default settings. They need to consider current reality as it is, but imagine taking the other person's "*intentional stance* " towards reality, which is different from theirs. Harris argues that with the adjustment of the default setting from the child's own intentional stance to another person's stance, three-year-old children can understand that the other person may see something that they can not see, or the other person may not know what is in the box even though they do, or understand that while finding one object makes one person happy, it may not make another person happy.

Harris (1991) further argues that simulation of mental states could vary in difficulty. For instance, while imagining another person's ignorance requires the alteration of one default setting, imagining another person's false belief requires the alteration of two default settings. In order to understand the other's false belief, the child needs to keep in mind the actual real situation, and imagine a counterfactual situation to the reality which is standing for the real situation. In addition to this, while keeping her/his intentional stance to the counterfactual situation in mind, he/she needs to take another person's intentional stance to the counterfactual situation (Harris, 1991). For instance, in the "smarties" false belief task a child is shown, to his/her surprise, that the smarties box contained a pencil and not smarties. Then he/she is asked what the other child will think is in the box. In order to say that the other child will think there are smarties in the box, while keeping in mind that the smarties box contains a pencil (in current reality), the child also needs to imagine the counterfactual situation to the current reality (smarties in the box). In addition, the child needs to keep in mind that the box contains a pencil, but should be able take the other person's stance to the counterfactual situation (seeing a smarties box). Harris (1991) suggests that with the ability to alter both default settings (reality and personal intentional stance to reality), four-year-old children can understand that another person can have a false

belief about something while they know what the thing is in reality, and can also understand that because of their different viewpoint another person can give a different interpretation to the same object.

In sum, as an alternative to the theory of "theory of mind" Harris (1991) suggests that by mental simulation children can predict other people's actions, emotions and thoughts. He argues that "*simulation calls for a working model of the other person but not a theory*" (p.299). According to Harris children have a working model of other people from birth. By using analogies to their own minds they can make predictions about other people.

In comparison with Leslie (1987) Harris does not see understanding of other people's pretence as an early form of the ability to attribute mental states to other people. Instead he explains pretence in terms of mental simulation. In contrast to Perner, Harris suggests that three-year old children, with the adjustment of one of their default settings (from their intentional stance to another person's) can understand that other people may want, like, know or expect different things to themselves. With this argument Harris, sees three-year-old children as more able than Perner. However, Perner (1991) argues that around the age of four children develop the representational ability, and with the representational view of mind four-year-old children can understand other people's false beliefs. But according to Harris (1991), what happens around the age of four is that children become able to adjust both default settings, so that they can imagine taking another person's intentional stance not towards reality but towards the counterfactual situation.

4.3.2. Hobson's view: Affective-conative interpersonal relations as the origins of social and cognitive development

Hobson (1991) argues against the view that children entertain a theory of mind. According to him what children acquire through their interpersonal experiences is the knowledge that people have minds. Hobson (1991) argues that children come into world with the innate biological propensities which enable them to "*perceive and relate towards the bodies of*

others " (p.44). This innate ability to perceive people's emotions, feelings, bodies and attitudes is "*essential to our understanding of persons with subjective mental life* " (p.45).

According to Hobson (1990b), from very early on infants can recognize people with certain perceptual properties and respond to them in an affective-conative way. This perception does not only involve the recognition of bodies (in a depersonalized way); infants can recognize people with feelings, from their bodily expressions. Hobson argues that an infant's capacity for this personal relatedness is present even before he/she acquires the concepts of 'self' and 'other selves'.

Hobson (1991) claims that acquisition of a 'self' concept is necessary for one to be able to "explore one's own mind" and to understand other people's minds. According to Hobson (1990b) in order for an infant to develop self-awareness, the infant has to have a capacity to understand that other people are separate persons with alternative viewpoints "toward the world and toward itself", and this requires the understanding of "commonality" and difference between self and other people.

In other words, with this innate biological ability an infant can differentiate himself/herself from others, can interact with people in an affective-conative way which enables him/her to develop the concept of persons. With the availability of a concept of persons, the infant can develop self-awareness, which is itself a precondition for the conceptualization of his/her own mental states and for the use of an analogy between self and others in order to understand the mental states of others (Hobson, 1990b & 1990c).

In sum, Hobson (1991) proposes that, "*direct perception of bodily anchored 'personal life', and with this the experience of personal relatedness, is the source of an infant's developing awareness of persons and the grounding for the young child's socially endorsed knowledge of minds. The crux is that it is only through the experience of personal relations, that children can come to acquire a concept of persons with minds* " (p.45-46). "*Once a child has acquired a grasp of body-anchored and 'outer-directed' subjectively experienced mental states on a largely if not exclusively non-inferential basis,*

then the child can employ inferences or other intellectual strategies to learn more about its own and 'others' minds vis-a-vis reality 'as represented' " (p.47).

4.4. Summary

While Perner, Leslie and Wellman all agree that children develop a theory of mind, Harris and Hobson argue against this view and suggest alternative accounts.

However, although accounts such as Perner's, Leslie's and Wellman's agree that around the age of four children develop a theory of mind, their explanations of how children reach that development seem to differ. In comparison to Leslie and Wellman, Perner's account appears to be the most extensive. Perner (1991) explained how children's understanding and usage of representations develops, from primary representations to metarepresentations. He also explained how children begin to understand the mind "*as a system of representations* ". He proposed that children's understanding shifts from "*mentalistic theory of behaviour* " (being able to explain behaviour on the basis of mental states) to a "*representational theory of mind* " (being able to understand representational function of mental states).

Leslie's account focuses on the similarities of pretence and mental state attribution and suggests that they both have the same underlying factor, namely the usage of secondary representations. In addition, Leslie proposes an organic base for the production of secondary representations which he names a "decoupler". However, Leslie's account lacks a clear explanation of why there is a two year time lag between the emergence of pretence and mental state attribution in children.

Wellman's view focuses on two major changes in children's understanding. One is from simple-desire psychology (predicting a person's behaviour on the basis of that person's desire) to belief-desire psychology (predicting a person's behaviour on the basis of that person's belief). The other change is from a copy theory of mind to an interpretative theory of mind. According to Wellman's formulation, while simple-desire psychology is

nonrepresentational, belief-desire psychology is representational. Furthermore, while a copy theory of mind seems to imply the usage of primary representations, an interpretative theory of mind seems to suggest an understanding of the representational function of representations. Wellman's account does not seem to focus on the nature and creation of representations. In addition, in contrast to Perner and Leslie, Wellman does not mention the emergence of pretence in children's development.

Although Harris (1991) claims that children do not develop a theory of mind, his view seems to be similar in certain respects to both Perner's and Leslie's views. For instance, what Harris calls default settings seem to correspond to primary representations (in Perner's and Leslie's terms), what Harris calls adjusting default settings seems to correspond to secondary representations and what he proposes as imagining current reality and the counterfactual situation to the current reality seems to correspond to metarepresentational level (in Perner's terms). However, Harris's account appears to lack any explanation of the underlying factors for the development of these imaginings.

Finally, Hobson's theory appears to have a totally different perspective from the previous theories. He argues that children's mental state attribution originates in their affective-conative interpersonal relationships. Although he provides an extensive description of his account it appears to be mostly abstract and theoretical, and seems to lack any strong empirical evidence to support specifically the very early stages of the understanding of emotions.

5. CHAPTER FIVE

Empirical evidence on the autistic child's "theory of mind"

If a person lacks a theory of mind, - which is an ability to understand another person's mental states such as what a person knows, intends, believes etc., that person would not be able to predict other people's actions which could lead him/her to have social communication difficulties. Autism is a condition which is identified with impairments in social communication. Thus, it makes sense to examine theory of mind ability in autism.

Investigating whether or not autistic children have a theory of mind might have two important conclusions. Since Leslie (1987, 1988) argued that a biologically based cognitive mechanism ('decoupler') underlies theory of mind, a lack of this ability in autism might suggest that the social communication difficulties experienced are due to lack or impairment in the biologically based cognitive mechanism. Secondly such a finding would support the theory that there exists a biologically based innate mechanism, responsible for normal children's theory of mind ability. In this chapter the studies which have investigated whether autistic children demonstrate the theory of mind ability in various experimental paradigms will be reviewed.

5.1. Do autistic people lack the theory of mind ability?

If autistic children are impaired in their theory of mind, in the sense that Premack and Woodruff (1978) described - one's ability to attribute mental states to oneself and to others, then one would expect that they would have difficulties on all the tasks which require mental state attribution. For instance, they would have difficulties in attributing knowledge, ignorance, false belief and deception to others.

5.1.1. Failure to attribute false belief

While the Wimmer and Perner's (1983) study was the pioneering work in the investigation of normal children's theory of mind, Baron-Cohen, Leslie & Frith (1985, 1986) were the first researchers to ask whether autistic children had these abilities.

In the very first experimental study, the Sally-Anne paradigm was used to test autistic children's ability to attribute false belief to others in comparison to normal and verbal MA matched Down's Syndrome children (Baron-Cohen, Leslie & Frith, 1985). In this task there are two characters Sally and Anne. Sally has a basket and Anne has a box. First Sally puts her marble in the basket and goes out for a walk. While she is away, naughty Anne takes the marble from the basket and puts it in her box. Then Sally comes back. The results showed that all three groups of children passed the control questions of "Where is the marble really?" and "Where was the marble in the beginning?". However, in response to the test question "Where will Sally look for her marble?" whereas 85% of normal children and 86% of Down's Syndrome children correctly predicted that Sally would look in the basket where she left her marble, 80% of autistic children failed to appreciate Sally's false belief about her marble's location, and indicated that Sally would look in the box where the marble really was. The authors argued that passing the test was not dependent on the general mental ability since the children with Down's Syndrome could pass the task. They concluded that the autistic children had a specific cognitive deficit in employing theory of mind ability. The autistic children failed to attribute the mental state of false belief to the story character, which required metarepresentational ability - representing somebody else's mental state.

The same authors conducted another study to test whether they could replicate the results of the first study using a different method (Baron-Cohen, Leslie & Frith, 1986). In this study, a picture sequencing task was used to compare the performance of autistic children with normal and verbal MA matched Down's Syndrome children using three different story types.

The "mechanical" story type *depicted physical-casual relations* . e.g."*Man with rock, pushes rock, rolls down hill, fall in water* " (p.117).

The "behavioural" story type depicted *people engaging in various activities and interactions*, e.g. "*boy eats ice-cream, girl sits down, girl takes away ice-cream, girl eats it* " (p.117).

The "intentional" story type which required an understanding of the mental state of the story character, that is, it required the theory of mind ability, eg. "*boy puts choc in box, goes out to play, mum eats chocolate, boy sees choc gone* " (p.117). In this study the children were presented with picture cards and were asked to make a story with them. After they had ordered the cards they were asked to tell a story about the pictures. The authors hypothesized that the autistic children would have specific difficulty with the third story type which required the understanding of the story character's mental states. The results showed that autistic children were not impaired in their performance on the mechanical and behavioural stories in neither the sequencing nor verbal account of the story. However their performance on the intentional stories was not better than chance level. In addition in their story making the autistic children used significantly less mental terms in comparison to the other two groups. The authors concluded that the results of this study supported their previous findings, namely that autistic children have a specific cognitive deficit in that they are unable to show theory of mind.

Autistic children's difficulty with the false belief task has been replicated by one of Leslie & Frith 's (1988) tasks. They compared autistic children with a specific language impaired (SLI) control group matched according to verbal mental age (MA). In the false belief task there were three hiding places and a pound coin. To start the task the second experimenter hid a pound coin in one of the three locations, then he/she left the room. In his/her absence the first experimenter asked the child "Where did [experimenter 2] hide the coin?". Following a correct answer, the first experimenter took the coin from where the second experimenter had previously hid it, and hid it in another location. Then the child was asked

several questions: "Does [experimenter 2] know the coin is in here?" (knowing question). "When [experimenter 2] comes back, where will she look for the coin?" (prediction question). "Where did [experimenter 2] put the coin in the beginning?" (control question 1), "Where is the coin now really?" (control question 2) and "Where does [experimenter 2] think the coin is?" (think question). They reported that while only five autistic children passed the prediction and thinking questions, all the specific language impaired control group children passed the both questions with the exception of one child who failed the thinking question. The difference between the two groups was significant. Leslie & Frith (1988) concluded that autistic children are unable to attribute false belief to others. They argued that this inability could not be due to language impairment since a language impaired control group was included in this study.

Furthermore, Perner, Frith, Leslie & Leekam (1989) used Perner, Leekam & Wimmer's (1987) smarties task to test autistic children's ability to attribute false belief to themselves as well as to other people. In the smarties task children were shown a smartie tube and asked what was in the tube. All the children answered with 'smarties' or 'sweets'. Then the experimenter opened the tube, all the children were surprised to see that it contained a little pencil. The experimenter put the pencil back and shut the tube, then asked the child "What is in here?" and "When I first asked you, what did you say?". Then the child was told that the next child, who had not seen the box was about to come to play the game. The child was asked "What will [name] say?" when the experimenter shows the box to the next child, and "Is that really what is in the box?", "Do you remember, when I took the box out of my bag and asked you what was in it, what did you say?". The results showed that 14 of the 22 autistic children could correctly remember what they said, the first time they saw the smartie tube and were asked what was in the tube which suggests that high proportion of the autistic children was able to refer to their own false belief. However only four of these children passed the prediction question by answering that the other child would say there were smarties in the tube, which is comparable to the results of Baron-Cohen et al (1985). In comparison to severe language impaired children, the autistic children performed

significantly worse in response to the prediction question (attribution of false belief to others). These results support the previous findings that autistic children have difficulty in attributing false belief to others.

In order to conclude that autistic children are impaired in their theory of mind ability, it is necessary to test all types of mental state attributions. For instance, it is necessary to test not only the ability to attribute false beliefs to others but also deception and attribution of knowledge and ignorance.

5.1.2. Failure to deceive

It has been argued that children's ability to deceive another person indicates that the child is able to understand other people's mental states, since deceiving someone is a deliberate act to lead the other person to have false beliefs about reality (Chandler, Fritz & Hala, 1989; Hala, Chandler, & Fritz, 1991; Sodian, Taylor, Harris & Perner, 1991).

Russell, Mauther, Sharpe & Tidswell (1991) found that in a competitive game where it was in the child's interest to point to an empty box, autistic children, like three-year-old normal children, repeatedly pointed to the box which contained a chocolate. In this study four groups of children took part: three and four-year-old normal children; children with Down's Syndrome and autistic children. The task involved two phases and in both phases the children were competing with the second experimenter. In the practise phase each child was given 15 trials in which the child was asked to point to one of two boxes. If the child pointed to the box which was empty she/he got a chocolate, but if the child pointed to the box which contained a chocolate the second experimenter won the chocolate. In the second phase two boxes which had windows facing towards the child's side, so that the child could see the contents of both boxes were used. Each child was given 20 trials. As in the first phase, if the child pointed to the box which was empty she/he got the chocolate, but if the child pointed to the box which contained a chocolate the second experimenter won the chocolate. The results showed that while 62.5% of the four-year-olds and 84.6% of the Down's Syndrome children pointed to the empty box on the first trial, only 18% of the

autistic and 5.8% of the three-year-old children did so. In addition while 64% of the three-year-olds and 63% of the autistic children pointed in all 20 trials to the box which had the chocolate in it, none of the four-year-olds and none of the children with Down's Syndrome did so. From these results it is possible to conclude that autistic children failed to deceive, or in other words they failed to lead another person to have a false belief.

5.1.3. Failure to attribute knowledge and ignorance

It has been shown that autistic children are also impaired in their ability to attribute knowledge and ignorance. One of the aims of Leslie and Frith's (1988) study was to investigate autistic children's ability to attribute knowledge and ignorance. In one of the tasks they administered (limited knowledge), the first experimenter hid a red counter in one of three possible locations while the child and the second experimenter watched. Then the second experimenter left the room and in his/her absence the first experimenter produced a second red coin which was identical to the first one and asked the child to hide it somewhere different. Then the child was asked several questions: "Where did [experimenter 2] see me hide a counter?" (control question), "Does [experimenter 2] know there is a counter under here?" (knowing question). "When [experimenter 2] comes back in, where will she look for a counter?" (prediction question).

Leslie and Frith (1988) reported that in the limited knowledge task, 11 of the 18 autistic children completed the task by correctly identifying whether the second experimenter knew that there was a counter in the second location (where the child hid the second identical coin). However only 8 of the 18 autistic children passed both the knowing and prediction questions (where the second experimenter would look for the counter when she came back). Leslie & Frith (1988) concluded that autistic children not only fail to attribute false belief to others, but also fail to attribute knowledge to others, which supports the metarepresentational deficit hypothesis.

One of the limitations of this study is that Leslie and Frith (1988) did not report the performance of the control group on the limited knowledge task. However, the evidence

from studies of normal children (e.g Wimmer et al., 1988) suggests that, 4-year-old children are able to make knowledge attribution, and given that the control group had a mean verbal MA of 6;09 one would expect them to be able to pass a limited knowledge task. Nevertheless this needs to be confirmed.

More evidence of autistic children's failure to attribute knowledge comes from a study by Perner et al (1989). One of the tasks in this study involved the main experimenter choosing one of several objects from a box and putting it into a cup. The transfer was made out of sight of the child and the second experimenter. In the other ignorant condition the experimenter let the child see what was in the cup, in the subject ignorant condition the experimenter allowed the second experimenter to have a look into the cup. The child was then asked several questions,

other-knows: "Does [name of the experimenter] know which thing I put into the cup?"

justification: "Why does [name] not know that?"

other-seen: "Did I let [name] look into the cup?"

self-knows: "Do you know which object I put into the cup?"

justification: "Why do you know that?"

self-seen: "Did I let you look into the cup?" (p.693)

The results showed that nearly 75% of the autistic children answered the seeing questions correctly whether or not they or the second experimenter had looked in the cup. However only 10 out of 23 (43%) of the autistic children could attribute knowledge to the other person, and 13 out of 23 (56%) could attribute knowledge to themselves. Perner et al (1989) concluded that some aspects of theory of mind are easier than others. For instance, autistic children's performance was higher in the knowledge attribution task (43%) than their performance on the false belief task (17.5%) in the same study.

One of the shortcomings of this study was that no controls completed the task. In addition some of the autistic children who were included in this study had verbal mental ages below

4 years. Since studies of normal children (e.g Sodian and Wimmer, 1987) have suggested that the ability to attribute knowledge develops around the age of four, children with lower verbal mental ages might be expected to fail in this task.

5.2. Do autistic people have a delay in their theory of mind ability?

Although the majority of the autistic children failed on the original theory of mind tasks (Baron-Cohen et al. 1985 and 1986) some of the autistic children passed the same tasks. It is therefore difficult to conclude that theory of mind ability is totally missing in autistic children. In the light of this Baron-Cohen (1989a) has proposed that rather than a specific deficit, perhaps autistic children have specific delay in the development of theory of mind, since a minority of autistic children can pass the first order belief attributions (eg. false belief, knowledge).

5.2.1. Failure to attribute second order beliefs

In order to investigate whether autistic children had a true delay in their theory of mind ability Baron-Cohen (1989a) tested autistic children's ability to understand 'second order belief attributions' e.g. "Marry thinks John thinks the ice-cream van is in the park". Three groups of children - autistic, normal and Down's Syndrome - who had passed first-order-belief attribution (e.g. Sally thinks the marble is in the basket) were included in this study. The children were presented with a toy village and the experimenter told a story while moving the toy characters around the village setting. The story went as follows "John and Mary are playing in the park. John wants to buy ice-cream but he does not have any money. The ice-cream man tells John that he will be in the park all afternoon, so John goes home to get some money. While John is away the ice-cream man tells Mary that he is moving his van to the church to sell ice-cream there. On the way to the church John sees the ice-cream man and asks him where he is going. The ice-cream man tells John that he is now going to the church. Mary goes home. Then Mary goes to John's house, John's mother tells Mary that John has gone to buy ice-cream". The children were asked several questions to ensure that they were able to follow the story, knew where John went to get an

ice-cream and where the ice-cream man was in the beginning. They were also asked the second-order-belief test question "Where does Mary think John has gone to buy an ice-cream?". The results showed that none of the autistic children could pass the second-order belief attribution, whereas 90% of the normal language matched children and 60% of the Down's Syndrome children passed this question. Baron-Cohen (1989a, p.293) concluded that "*the autistic children who have developed a theory of mind at the lower level are nevertheless specifically delayed in the acquisition of a more complex theory of mind*".

In summary, all the aforementioned studies seem to suggest that autistic children are impaired or specifically delayed in their ability to attribute mental states, such as knowledge and false beliefs to others, which require metarepresentational skills. Thus it has been argued that autistic children have a metarepresentational deficit (Baron-Cohen et al. 1985, 1986; Leslie & Frith, 1988; Perner et al. 1989). However, in order to conclude that autistic children have a metarepresentational deficit one has to consider, both the ability to attribute mental states to oneself and others, and also abilities which have been suggested to require metarepresentational skills, such as the appearance-reality distinction, pretend play and the ability to understand non-mental representations e.g. photographs. Furthermore one has to consider autistic children's performance on the cognitive tasks which do not require metarepresentational ability such as visual perspective taking. If it is the case that autistic people fail on the tasks which require metarepresentational skills, but pass other cognitive tasks which do not require metarepresentational skills, then one could reasonably conclude that autistic people have a specific metarepresentational deficit.

5.3. Understanding of the appearance-reality distinction in autism

The understanding of the appearance-reality distinction appears to be another way of testing children's metarepresentational skills. In order for a child to differentiate what an object looks like from what it actually is, he/she should be able to aware that "*even though something may be only one way out there in the world, it can be more than one way up here in our heads, in our mental representations of it*" (Flavell, 1988, p.246). Perner

(1991) argues that understanding the appearance-reality distinction requires metarepresentational ability since it is a misrepresentation of the referent. For instance when a child is presented with a sponge which looks like a rock, in order for a child to say that it is really a sponge, and that it looks like a rock, he/she should be able to understand that e.g.when the representational content (sponge) has a deceptive appearance (rock), its sense (looks like a rock) differs from its referent (sponge).

Autistic children have been found to have difficulties the with appearance-reality distinction which may support the hypothesis that they have a metarepresentational deficit. In his study Baron-Cohen (1989c) gave four appearance-reality tasks to autistic, mentally handicapped and normal children. In one task, the colour task, children were shown a milk bottle and asked what is the colour of the milk. Then the bottle was moved behind an orange filter and the child was asked what colour the milk looked, and what the colour really was. In another task, the size task, children were presented with a penny and a ten pence on the table and asked whether the penny was smaller or bigger than the ten pence. Then the penny was made to look bigger than the ten pence by holding a magnifying glass over it, and the child was asked how the penny looked, whether it was smaller or bigger than the ten pence. Also the child was asked what the size of the penny really was, bigger or smaller than the ten pence. In the third task, the material task, children were presented with a chocolate made of plastic. First the child was asked what it was, after answering chocolate, the child was allowed to feel the chocolate, and asked what it was made of. The child was then asked what it looked like and what it really was. In the fourth task, the identity task, children were presented with an egg which was made of stone. As in the material task, at first the child was asked what it was, after answering that it was an egg, the child was allowed to feel it until she/he found out what it was made of. Then the child was asked what it was made of, what it looked like, and what it really was. The results showed that while 78.9% of the mentally handicapped and 81.3% of the normal children could pass the appearance-reality distinction, only 35.3% of the autistic children passed the

task by responding correctly on at least three of the four tasks. These results seem to support the hypothesis that autistic children have a metarepresentational deficit.

5.4. Pretend play in autism

Theoretical views on whether pretend play requires metarepresentational ability appear to be conflicting. The link between theory of mind ability and pretend play has been argued extensively by Leslie (1987) (see chapter 4). Leslie's (1987, 1988) main point appears to be that pretend representations are the representations of representations and are therefore metarepresentations. He argues that both mental state attribution and pretend play require metarepresentational ability, and the same decoupling mechanism is responsible for these abilities. However Perner (1991) criticized Leslie's view that pretend representations are metarepresentational. Perner agrees with Leslie that pretend representations are secondary representations in that they are copied from the primary representations. However Perner argues strongly against the view that these representations are metarepresentational (see chapter 4).

Recently, Baron-Cohen (1987) criticized previous studies which concluded that autistic children are impaired in their ability to pretend. His main criticisms were: an unclear definition of pretend play; children's spontaneous play was not tested and some studies did not include control groups. Baron-Cohen (1987) defined the criteria for the occurrence of pretend play as "*a) the subject is using an object as if it were another object, and/or b) the subject is attributing properties to an object which it does not have, and/or c) the subject is referring to absent objects as if they were present*" (p.140). In his own study Baron-Cohen (1987) compared autistic children's spontaneous play with that of both children with Down's Syndrome and normal children. The children's play was video recorded and assigned to the four play categories of sensorimotor, ordering, functional, and pretend play. It was found that while only 20% of the autistic children showed spontaneous pretend play, 90% of the normal children and 80% of the Down's syndrome children did. The differences between the autistic and the control groups were significant. Baron-Cohen

(1987) adopted Langer's (1942) definition of symbol as "*a symbol is a representation of a concept (which itself refers to an object)* " (p.146), and stated that "*a symbol is a representation of a representation, or is a second order representation* " (p.146). Furthermore Baron-Cohen (1987) highlighted the link between the child's theory of mind ability which also requires second order representations, and concluded that autistic children are impaired in their capacity to produce symbols or, in other words, second order representations.

In contrast to this study, Lewis and Boucher (1988) reported that relatively able autistic children can produce pretend play, when they were presented with toys and some junk material and asked "What can you do with these?" In this study Lewis and Boucher (1988) examined spontaneous, instructed and elicited play, and used toy-toy or toy-junk pairs to elicit play. Lewis and Boucher (1988) hypothesized that, if the symbolic deficit account is right, when children are given toy-toy pairs and instructed what to do, they should be unimpaired in producing functional play (defined by Baron-Cohen, 1987 as play with the objects appropriate to their real function e.g. pretending to drink water from a miniature toy cup), but when they are given toy-junk pairs, and instructed what to do they would be impaired in producing symbolic play. In addition they also hypothesized that if autistic children's impaired pretend play is due to motivational factors (conative hypothesis), they would be impaired in their production of functional as well as pretend play in the spontaneous condition but not in the elicited condition when they are presented with toy-toy or toy-junk pairs and asked "*What can these do* ?, *Show me what do you do with these* ?"

The results showed that there was no difference between the autistic, learning impaired and normal children, in the production of symbolic play in response to instructions. Similar results were obtained in the elicited play condition, there being no difference between the groups in the production of symbolic play with either the toy-toy pairs or the toy-junk pairs. Lewis & Boucher (1988) argued that unimpaired instructed and elicited symbolic play suggest that relatively able autistic children have "*a good capacity for symbolic play* " (p. 335). In addition, in the spontaneous play condition the autistic children produced less

functional play in comparison to controls. However symbolic play production did not differ between the groups in either terms of duration or the quantity of symbolic acts. From these results the authors suggested that "*the paucity of pretend play in autism may have a conative, as well as a cognitive, cause*" (p.336).

Lewis & Boucher's (1988) findings seem to suggest that autistic children have the necessary capacity for pretend play. In relation to the child's metarepresentational ability, these results could be interpreted in two ways. One is that pretend representations do not require metarepresentational ability, as Perner (1991) claims, contrary to Leslie's (1987, 1988) argument. The other interpretation is that pretend play does require metarepresentational ability, as Leslie (1987, 1988) claims, and that the autistic children's ability to produce symbolic play in this study was due to their higher verbal MAs (measured by British Picture Vocabulary Scale). The mean BPVS score of the autistic children in this study was 5;09 years, and the range was 4;04-9;00. In Baron-Cohen's (1987) study the mean BPVS score for the autistic children was 4;09 years, and the range was 2;03-10;02.

5.5. Ability to understand non-mental representations

Perner (1991) (see chapter 4) has argued that there are two types of representations, mental i.e. thoughts, and external i.e. language or pictures. A false belief is a very good example of the misrepresentation of reality in the mental sense. For instance, in the classic task where a character Sally puts an object in location X, then leaves the room and in her absence Anne moves the object to location Y. Children are then asked to predict where Sally will look for the object when she returns. In order for the child to point to the location X (the correct answer), he/she needs to mentally represent (thought) what Sally has in her mind (thought) about the object's location, which is the case of a representation of a representation, - metarepresentation (in the mental sense). Children's metarepresentational ability has been also tested in the non-mental sense (Zaitchik, 1990). In the task children were shown how to use a polaroid camera, and were then asked to take

the picture of an object in location X then, while the photo was developing the object was moved to the location Y. Children were asked where the object would be in the photo. In order for a child to say that the object in the picture will be in location X, he/she has to have an "*understanding of the representational relationship between the photograph and what it depicts (hence requiring metarepresentation)*" (Leekam & Perner, 1991, p.6).

Leekam and Perner (1991) adopted Zaitchik's (1990) task to test autistic children's performance. In their study, the children were first shown how to use the polaroid camera. They were then asked to take a picture of a doll named Judy wearing a red dress. While the film was developing the doll's dress was changed to a green one. The children were asked what colour Judy's dress would be in the picture. The results showed that while 95% of the autistic children gave the correct answer, only 51% of the normal control group could pass the test. In comparing the groups, the autistic children performed significantly better than normal children on the photograph task. The authors concluded that since the task required metarepresentational ability and the autistic children could pass the test, the claim that autistic children fail theory of mind tasks because they have a metarepresentational deficit, could not be a general one. Instead they suggest that "*either autistic children have problems with mental states for some other reason not connected to the representational aspect of mind or alternatively that autistic children do have a metarepresentational impairment, but one which is specific to the mind*" (p.15).

5.6. Visual perspective taking in autism

It has been shown that autistic children are able to appreciate another person's visual perspective (Hobson, 1984; Baron-Cohen, 1989b and Leslie & Frith, 1988). Hobson (1984) gave a series of visual perspective taking tasks to autistic, normal and Down's Syndrome children. He found that the autistic children were able to change a doll's position so that the doll could see either both the child and the experimenter, or only the experimenter, and also they were able to say that when the doll faced the experimenter the doll was seeing the experimenter. In another task, autistic children were able to position a

miniature figure appropriately on the different trials so that one or more seekers could not see it. Autistic children were also able to state a doll's visual perspective of the sides of a cube which had either different colours or different pictures according to the child's age. The results of this study suggested that the autistic children's performance is related to their mental age rather than being autism specific.

Similarly, Baron-Cohen (1989b) found that autistic children are unimpaired in visual perspective taking ability. In this task the children were seated opposite the experimenter, and six objects were placed around and above the subject on a shelf. Then the experimenter, with his eyes closed, changed his eye orientation towards one of the target toys, and then opened his eyes. The children were asked which toy the experimenter was looking at. The results showed that 92.5% of the autistic children, 94.4% of the normal children and 89.3% of the children with Down's Syndrome passed this perceptual perspective taking task. Baron-Cohen (1989b) concluded that autistic children are unimpaired in their visual perspective taking ability, "*they understand the role of another person's eyes in seeing, and appreciate that other people stand in a particular relationship to a perceived environment*" (p.117).

The ability to understand what another person can or cannot see is a level 1 visual perspective taking ability and does not require metarepresentational skills. However it is a necessary step in the development of level 2 cognitive perspective taking which is an understanding that a person who sees an object being hidden, is the person who knows what or where the object is. The results of the reported studies Hobson (1984) and Baron-Cohen (1989b) suggest that autistic children have an intact visual perspective taking ability. Since this ability does not require metarepresentational skills, these results support the metarepresentational deficit account (theory of mind explanation of autism), which argues that autistic children would not have difficulties in tasks where metarepresentational skills are not required.

Furthermore it has been found that autistic children are able to recognize simple relationships like mother-child, father-child, peer, and husband-wife. They are able to show simple reciprocity, for instance, while they are sitting opposite to the experimenter they can correctly identify their own right hand, their own left hand, and also the experimenter's right hand and his/her left hand. In other words, they are able to distinguish their own left and right from another person's left and right. It has also been found that autistic children are able to distinguish animate objects from inanimate objects (Baron-Cohen, 1991b). Baron-Cohen concluded that "*none of these skills, at this basic level, require mental state attribution. On this assumption, the present results are therefore consistent with the hypothesis that the deficit in the development of a theory of mind in autism is highly specific* " (p.311).

5.7. Precursors for a theory of mind

As was reported in chapter 2, different theoretical accounts of children's developing understanding of mind seem to be in agreement that, with a fully developed theory of mind around the age of four children become able to attribute mental states such as knowledge, false belief, deceit etc. to themselves and others. However, different authors have identified various factors as precursors to this ability. For instance, Wellman (1990) has suggested the child's ability to differentiate mental from physical entities as an initial theory of mind ability. Baron-Cohen (1989b) has proposed the child's understanding and production of protodeclarative pointing as a precursor to theory of mind. Bretherton and Beeghly (1982) and Bretherton, McNew & Beeghly-Smith (1981) have suggested children's use of mental terms in their spontaneous speech as an initial theory of mind ability. In this section I will review the empirical evidence concerned with whether autistic children, who it is suggested lack theory of mind skills, could be said to have an initial theory of mind.

5.7.1. Understanding mental-physical distinction

Wellman (1990) argued that three-year-old children have an initial theory of mind since they can differentiate mental from physical entities. For instance, they are able to understand that dreams and imaginations occur in your head, and they are able to attribute mental functions to the brain such as thinking and dreaming. However, between the age of four-to-five children's understanding becomes more sophisticated, they begin to attribute motor functions as well as mental functions to the brain. Thus, according to Wellman's account, if autistic children can differentiate mental from physical entities, they could be said to have an initial theory of mind ability.

Autistic children have been found to have difficulties in distinguishing mental and physical entities, and in recognizing the mental function of the brain (Baron-Cohen, 1989c). For instance, when autistic children were told stories like "*This is Sam. He likes biscuits. He is hungry, so his mother gives him a biscuit. This is Kate. She is hungry, but she is alone. She is thinking about a biscuit*" (p.584), and asked questions like "Which child can eat the biscuit?", "Which child can touch the biscuit?", only 23.5% of the autistic children correctly answered these type of questions. However 78.9% of the normal children, and 68.8% of the learning disabled subjects passed the questions. Baron-Cohen (1989c) concluded that autistic children are impaired in their ability to differentiate mental from physical entities. In addition, the autistic children were asked questions about the location and the function of their brain, for example, "Where is your brain?", and "What does your brain do?" While 23.5% of the autistic children referred to mental functions of the brain such as thinking, dreaming and remembering, 70.6% of them referred to motor functions of the brain such as running, and walking. In contrast, 84.2% of the normal children and 68.8% of the children with learning difficulties referred to the mental functions of the brain and only after prompting did 31.3% of the learning disabled children and 31.6% of the normal children mention the motor functions of the brain. On the basis of these results Baron-Cohen (1989c) concluded that autistic children are impaired in their understanding of mental unobservable events.

5.7.2. Joint attention behaviours in autism

It has been reported that autistic children show fewer joint attention behaviour than normal and learning disabled children who are matched on the basis of mental age and mothers' education level (Mundy et al.,1986 and Sigman et al., 1986). Mundy et al. (1986) defined joint attention behaviours as "*behaviours involve the use of procedures (e.g. showing a toy) to co-ordinate attention between interactive social partners with respect to objects or events in order to share an awareness of the objects or events* " (p.657). In this study the child sat opposite the experimenter at a table. There were toys on the table and balloons and posters were located around the room out of the child's reach. The children's play with the experimenter was video-recorded. From analyzing the video recordings the children's responses were classified into three categories of social interaction, joint attention and requesting. All these categories were scored separately for response and initiation. For example, if the child looked when the experimenter pointed to one of the posters on the wall, this behaviour would be scored as a response to joint attention, but if the child pointed to an object to direct the experimenter's attention this would be scored as an initiation of joint attention. The results showed that autistic children displayed significantly fewer responses to joint attention than the normal and Down's syndrome children, and also they initiated significantly fewer joint attention behaviours. However, the autistic children were not different from the controls "*on following simple commands and on combining eye contact and gesture (reach or give) to elicit aid in obtaining a toy or reactivation of a toy* " (p.666).

Similar results were obtained when autistic children were video-recorded while they were playing with their primary caregivers (Sigman et al., 1986). In this study, as in Mundy et al.'s (1986) study, the children's behaviours were classified into the three categories of social interaction, joint attention and requesting. The results showed that the autistic children produced significantly fewer joint attention behaviours than the normal and learning disabled children. In other words, they were less likely to initiate joint attention with their caregiver.

Recently, Baron-Cohen (1989b) conducted a study to investigate autistic children's comprehension and production of pointing behaviour. He stated that, with protoimperative pointing, which is to "*use another person to obtain an object*" (p.117), an infant aims to effect another person, but does not aim to effect the other person's mental states. However, with protodeclarative pointing when "*the infant points in order to comment or remark on the world to another person*" (118), an infant aims to influence the other person's mental state. Baron-Cohen (1989b) hypothesized that autistic children would be impaired in their ability to understand or use protodeclarative pointing, since it is used to influence another person's mental state, but they would have intact protoimperative pointing since this type of pointing does not seem to function to influence another person's mental state. He investigated this by studying autistic children's ability to comprehend, and produce protoimperative and protodeclarative pointing.

In the comprehension task the experimenter told the child that he was going to use his finger to say something. In the protoimperative pointing comprehension task four toy animals were placed near to the child, the experimenter faced to the child, pointed to one of the four toy animals and then asked the child what he was "saying". The child passed if he/she picked up the toy and gave it to the experimenter, or if she/he asked the experimenter whether he wanted that toy. In the protodeclarative pointing comprehension task the experimenter told the child that he was going to say something else with his finger, and asked what he was saying. He walked to the window, looked up and pointed to the sky, then looked at the child while still pointing at the sky. This action was repeated by pointing to different locations. Children passed if they looked in the direction that the experimenter was pointing, or asked the experimenter what he was looking at, or asked the experimenter whether he wanted him/her to look at something. The results showed that while 70% of the autistic children passed protoimperative pointing comprehension task, only 10% of them passed protodeclarative pointing comprehension task. Although they had higher verbal and nonverbal MAs, in comparison to normal and Down's Syndrome children, the

autistic children were significantly inferior to both control groups on the protodeclarative pointing comprehension task.

Baron-Cohen (1989b) also investigated autistic children's production of the two types of pointing. Children in each group were separately video-recorded for 45 minutes while they were playing. Any pointing which occured was scored by independent judges as protodeclarative or protoimperative. The results showed that while 90% of the normal children and 70% of the children with Down's Syndrome produced protodeclarative pointing none of the autistic children did. Although the percentage of the autistic children who produced protoimperative pointing seemed to be less than the both normal children and children with Down's Syndrome, the difference was not significant. The percentages of children who produced protoimperative pointing was 40%, 70% and 80% respectively. In sum, the results suggest that while autistic children are able to understand and produce protoimperative pointing, they seem to be unable to comprehend and produce protodeclarative pointing. Baron-Cohen (1989b) suggested that impaired protodeclarative pointing in autism may be taken as a precursor of their impaired theory of mind ability, since protodeclarative pointing requires the attribution of mental states. In support of this conclusion, he further noted that autistic children are unimpaired in their perspective taking ability, and so understanding "*shared attention may not be the critical aspect of protodeclarative pointing that autistic children fail to understand*" (p.125).

In a subsequent paper Baron-Cohen (1989d) elaborated his argument that impaired protodeclarative pointing behaviour in autism may be taken as a precursor of the autistic child's impaired theory of mind. In this paper he argued that joint attention behaviours (showing, giving, referential looking, offering etc.) involve "*attention diagnosis*" which is an understanding that another person is interested in an object. This understanding, according to Baron-Cohen, requires the representation of whether the other person can see the object, and also whether that person is "*interested in (i.e., prefers to attend to) that object*" (p.187). In order to achieve this, the child needs to represent that the other person has a positive or negative representation of that object, which requires metarepresentation

(Baron-Cohen, 1989d). Based on this reasoning Baron-Cohen (1991a) suggested a developmental account of theory of mind ability. According to this theory, an understanding of attention in normal children develops around the age of 9 months, then, around the age of 4 years, children begin to understand beliefs, then when they are 7-years-old children develop an understanding of beliefs about beliefs (second order belief attribution). According to Baron-Cohen (1991a)

"Autism may be case of specific developmental delay in the acquisition of a theory of mind, with different autistic children delayed at different points in this developmental sequence ." (p.248). *"In terms of their theory of mind, most autistic children of less than four-years-old (in producing no joint attention behaviours) may be similar to normal six-month-olds. After this, some autistic children may develop protodeclarative pointing and pretend play, although its late emergence means it remains impoverished. And years later still, some autistic children may progress beyond this level and succeed at understanding beliefs,...."* (p.249).

5.7.3. Spontaneous mental term production in autism

Another approach to the origins of a theory of mind, is to investigate children's use of mental state terms to refer to their own and other people's mental states in their spontaneous speech production. It has been shown that normal children around the age of two start to produce mental terms, but they use them in idiomatic or conversational ways, then around the age of three they start to use mental terms to refer to mental states (Bretherton & Beeghly, 1982; Bretherton, McNew & Beeghly-Smith, 1981; Shatz et al., 1983). These studies will be reviewed in the next chapter. However if, as has been suggested, children's use of mental terms to refer to mental states can be taken as an indicator to their theory of mind ability (Wellman, 1990), then investigating autistic children's spontaneous language may inform us about their early theory of mind skills.

Tager-Flusberg (in press) noted the importance of studying autistic children's language acquisition to investigate their understanding of mind since *"unlike experimental tasks*

which are either passed or failed in an all-or-none fashion, data from naturalistic language are more graded or continuous. We are able to investigate degree of impairment which ultimately must provide a more realistic picture of the deficits in this domain of functioning for autistic children " (p.7).

There is only one study which has investigated autistic children's use of mental terms in their speech. In this recent study Tager-Flusberg (1992) compared spontaneous speech samples from six autistic children to those of six language and age matched Down's Syndrome children. The children's spontaneous speech was recorded while they were interacting with their mothers and analyzed according to their reference to the psychological states of desire, perception, emotion and cognition. In addition, all the mental state terms were then scored for their functional usage given the context. Tager-Flusberg (1992) reported that while the autistic children did not differ from the children with Down's Syndrome in their spontaneous use of desire, emotion and perception terms, relation to children with Down's Syndrome they produced significantly fewer cognitive mental terms such as believe, know, guess, forget etc., to refer to mental states. Tager-Flusberg (1992) argued that these data support the experimental findings that autistic children have difficulties in their understanding of knowledge, beliefs, pretence, deceit, or in other words in their theory of mind ability.

In sum, autistic children seem to be impaired in their ability to differentiate mental from physical entities, they appear to be impaired in their understanding and production of protodeclarative pointing which it is proposed requires the understanding of other minds, and also they produce significantly fewer cognitive mental terms to refer to their own and to other people's mental states in their spontaneous speech. All these abilities, which are present prior to a fully developed theory of mind in normal children, appear to be impaired in autistic children. This might indicate that a certain mechanism which is responsible for the full development of theory of mind ability, is also responsible for the initial theory of mind skills. In addition, an absence of these initial theory of mind skills might contribute to the early diagnosis of autism.

5.8. Factors contributing to the autistic child's performance on theory of mind tasks

The majority of studies show that autistic children seem to lack the ability to attribute mental states to themselves and to others, and also that they seem to be impaired on tasks which require metarepresentational skills. In addition, autistic children seem to lack the initial theory of mind skills. All these findings seem to support the metarepresentational theory of autism that autistic children have a deficit in their metarepresentational skills which may suggest that the biologically based decoupler mechanism, suggested by Leslie (1987), is not functioning in autism. However other findings fail to support this hypothesis. First, it has been found that autistic children are unimpaired in their understanding of non-mental representational changes (Leekam & Perner, 1991); second most studies have reported that some autistic children pass at least first order mental state attributions. More recent findings have led to a shift from the view that autistic children have a specific deficit in their theory of mind to the view that autistic children have a specific delay in the development of their theory of mind ability.

It has been shown that factors such as verbal MA and chronological age, relate to autistic children's performance on theory of mind tasks. For instance, Prior, Dahlstrom and Squires (1990) reported that autistic children who pass the knowledge attribution and false belief tasks had a minimum chronological age of eight years, and verbal mental age of six years. Leslie & Frith (1988) demonstrated that autistic children who passed the false belief task were more likely to be older than those who failed. In addition, Baron-Cohen (1989a) reported that autistic children who met the inclusion criteria which was to pass the false belief task, had a minimum chronological age of 11 years and higher verbal MAs than those who failed. Furthermore Baron-Cohen (1991b) argued that the performances of children with autism and children with Down's Syndrome on the animate-inanimate distinction seemed to be related to their CAs and MAs. In addition Eisenmajer and Prior (1991) reported that the autistic children who passed the false belief task had significantly higher verbal MAs, and comprehension and pragmatic skills than the children who failed.

However, the passers and failers did not differ in terms of their chronological ages and their vocabulary scores. This suggests that certain factors may be more important than others.

In sum, it seems that verbal MA is a factor frequently associated with autistic children's success on theory of mind tasks. However, studies have also shown that, although there was a tendency for the passers to have higher verbal MAs, there were some children who had high verbal MAs and still failed the task. This suggests that there are other factors effecting their performance. One possibility is the severity of their autism (Eisenmajer and Prior, 1991).

Thus far in this chapter, the studies which investigate the autistic children's theory of mind or their other skills which may underlie their theory of mind ability (e.g. metarepresentational skills) has been reviewed. In the final part of this chapter studies of the autistic child's understanding of the expression of emotions will be reviewed.

5.9. Understanding the expression of emotions in autism

According to Hobson (1991) (recall chapter 4) children come into the world with an innate ability to recognize other people's emotions and feelings from their body movements and facial expressions, and to respond to other people in an affective-conative way. Through this affective-conative personal relatedness, children develop an understanding of other people's mental states. If Hobson's theory is right, one would expect that autistic children would be impaired in their understanding of emotions. However, the evidence on autistic children's understanding of emotion is inconclusive.

It has been shown that compared to MA matched normal and non-autistic learning disabled children, autistic children are impaired in their ability to match expressions of emotion (happy, unhappy, angry and afraid). In Hobson's (1986a) study, autistic, normal and non-autistic learning disabled children were played a series video sequences, showing, 1) a person in different situations which would cause different emotions, 2) a person displaying

a series of gestures, and 3) a person uttering a series of vocalizations. Following each video sequences the children were asked to choose either photographed or drawn face to go with the person's emotional expression. The autistic children performed significantly less well than the MA matched normal and non-autistic learning disabled children in matching emotionally expressive photographs and drawn faces to those emotions presented on the video. In another study (Hobson, 1986b) children were asked to match drawings of gestures to video sequences displaying different emotions either facially or vocally. Similar results were obtained from this study, the autistic children performing significantly less well than, the CA and non verbal MA matched non-autistic learning disabled children. Hobson (1986b) concluded that autistic children are impaired in their recognition of emotions expressed facially, vocally and gesturally.

Furthermore autistic children have been found to be insensitive to the facial expressions of emotions (Weeks & Hobson, 1987). In this study, children were given pairs of photographs of people who could differ in terms of facial expression, age, sex and the type of hat they were wearing, and were asked to sort the photographs. While the majority of the autistic children sorted the photographs according to the type of hat worn, the non-autistic children sorted according to facial expression. The authors suggested that these results support the view that autistic children lack "*a biologically based attentiveness and emotional responsiveness to certain of the bodily features of others, including features of emotional expression*" (p.148). Weeks & Hobson (1987) also argued that autistic children's inability to differentiate different expression of emotions may cause an inability to comprehend these emotions in others.

A further study indicated that autistic children have qualitatively different emotion recognition, in comparison to chronological age and verbal MA matched non-autistic children (Hobson et al., 1988a). In this study, children were asked to sort three sets of photographs: one set showed a full face, the other two sets only showed the parts of a face, either a face with the mouth blanked out, or a face with the mouth and forehead blanked out. In one task children had to sort the photographs according to emotional expression, in

the other task according to the identity of the person. The results showed that autistic and non-autistic learning disabled subjects' performance on the identity sorting task declined comparably from the full-face photograph condition to the blank-mouth-and-forehead condition. However, when the children were presented with the same photographs upside down the autistic children performed significantly better than the control group both on the identity and the emotion sorting tasks. The authors concluded that in face recognition, autistic children use different strategies than non-autistic learning disabled subjects.

Furthermore it was found that while autistic children could match non-emotional photographs (e.g. a bus, or a vacuum cleaner, or a person walking on a pavement) with the relevant sounds, they had difficulties in matching photographs of emotionally expressive faces (happy, sad, fear, angry) with corresponding emotional sounds (Hobson et al., 1988b). However when the autistic children were compared to non-autistic learning disabled children matched on the BPVS, their performance did not differ on the emotion task.

Similarly, when autistic children were compared with BPVS matched learning disabled children, and were asked to name the emotion expressed in the photographs and audiotaped sounds, they did not differ from the learning disabled children (Hobson et al., 1989). In the same study, children were also asked to name the photographs of the emotion-unrelated objects and their corresponding sounds. Across the two task, the autistic children were specifically impaired in the emotion naming task. Although this finding supports the previous evidence of the autistic child's impaired ability to understand the expressions of emotions, no significant difference could be found between the autistic and BPVS matched learning disabled children on the emotion naming task, which casts doubt on the view that autistic children have a specific impairment in their understanding of the expression of emotions.

Ozonoff et al. (1990) also found that, when autistic children were matched with control children for verbal MAs (BPVS), the children did not differ in their ability to sort

photographs with respect to either facial identity or the emotion displayed. In addition, the autistic children did not differ from the control subjects on the crossmodal matching task requiring them to match emotionally expressive photographs (of happiness, sadness and anger) of different people with the corresponding emotional sounds. However when the autistic children were matched with a control group on the basis of non-verbal MAs, group differences were found on the identity / emotion sort task. Ozonoff et al. (1990) concluded that "*While it appears that there may be some impairment in affect perception abilities in autism, the evidence for the primacy of this deficit is not convincing* " (p.358).

Furthermore, recent research suggests that autistic children have some understanding of situational causes of simple emotions at least . For instance, Tan and Harris (1991) told children about two negative situations (e.g. going to bed early) and two positive situations (e.g. getting nice things to eat), and asked them whether they would feel "*very happy* " or "*not so happy* " in these situations. The autistic children did not differ from verbal MA matched normal and learning disabled children in the correct number of replies to these situations.

Similarly, Baron-Cohen (1991c) demonstrated that autistic children could understand situations and desires as the causes of emotions but not beliefs. For instance the autistic children were able to identify how a story character felt if she was having a birthday party, or if she fell down and cut her knee. The autistic children were not different from verbal MA matched learning disabled children in their understanding of desires as the causes of simple emotions (e.g. happy and sad). For instance, overall, 57.4% of them were able to identify whether a person is happy or sad in situations when that person gets what she likes, or when that person gets something she does not like. However, the normal children were better than both the group of autistic children and the group of children with Down's syndrome in their understanding of desires as the causes of emotions.

In the same study it was found that the autistic children were significantly worse than learning disabled and normal children in their understanding of beliefs as the causes of

emotions. For instance only 17.6% of the autistic children were able to identify how another person would feel, (I) when he/she believes he/she has what he/she wants (e.g. a girl likes rice crispies and is given a closed rice crispies box (which actually contains coco-pops) how would she feel) and (II) when another person believes she has something she does not want (e.g. a girl does not like coco-pops and, is given a closed box of coco-pops (which actually contains rice crispies) how would she feel). Baron-Cohen (1991c) interpreted these results as supporting the metarepresentational theory of autism. He concluded that autistic children are able to understand simple situations and desires as the causes of emotions since they do not require metarepresentational skills. However, they are impaired in their understanding of belief as the causes of emotions since beliefs require metarepresentation.

In summary, the evidence from emotion recognition studies seem to suggest that autistic children may have some difficulties in understanding the expressions of emotions in other people. However the evidence is not sufficient to conclude that autistic children fail to understand emotions totally, since some studies were shown that they can understand simple emotions; nor it is sufficient to conclude that this impairment is specific to autism since some studies have demonstrated that, when autistic children are matched with control subjects on the basis of verbal ability, their performance did not differ from that of the non-autistic learning disabled children.

The next chapter will discuss whether the theoretical accounts outlined in chapter 4. can explain the evidence on the autistic child's theory of mind.

6. CHAPTER SIX

How do the theoretical accounts explain a lack of "theory of mind" in Autism?

6.1. Accounts in favour of theory of mind

6.1.1. Perner's view

According to Perner (1991, see chapter 4.) children go through a series of developmental stages before they develop a full representational understanding of mind (with the acquisition of metarepresentation skills). In the first year of life infants have single models of the world (primary representations) and during the second year of life they begin to create multiple models of the world (secondary representations). At this stage children can compare past with present, real with pretend, and also they begin to understand pictures and language "*as special kind of represented situation* ". Perner describes children at this stage "situation theorists". Between the ages of three and four children develop an explicit understanding of representations; with this understanding they begin to differentiate appearance from reality, begin to understand knowledge as a mental state and to understand misrepresentation in other people (false belief) These all require metarepresentational skills.

Although Perner has carried out some studies with autistic children, unlike Leslie (1987) he has not formulated his theory (on the normal children's theory of mind) in order to explain autism. However, like Leslie he has suggested that multiple models are secondary representations and they are copied from primary representations, but he has not included a biologically based copying mechanism (or, in Leslie's terms, a decoupler). Perner's account also differs from Leslie's in respect to metarepresentation. According to Perner pretend representations are secondary, but they are not metarepresentations. However, Leslie (1987) argued that pretend representations are metarepresentations and he suggested

this as the link between the impaired pretend play and impaired mental state attribution observed in autism.

Although Perner's (1991) theory was not formulated to account for findings in autism, his careful analysis of children's developing understanding of representations and their understanding of mind as a representational entity, is very valuable for autism and theory of mind research, because the theory clearly states when a metarepresentational skill is acquired and in which circumstances it is necessary for a child to have this skill.

From the empirical evidence reported in the previous chapter, it is clear that autistic children do not seem to have a general metarepresentational deficit. First it has been shown that autistic children are able to pass non-mental misrepresentation task which require metarepresentation (Leekam & Perner, 1991) (using the task originally designed by Zaitchik, 1990). Second although Perner argues that pretend representations are not metarepresentations, even if an autistic child shows impaired pretend play this would not necessitate that he/she has impaired metarepresentational skills. However, impaired pretend play in autism according to Perner's formulation, may suggest that the child is unable to create multiple models or unable to compare the two available models of real and pretend. At this point Perner's account becomes similar to Leslie's proposal of an impaired decoupler mechanism, and inability to produce or hold two models at the same time.

6.1.2. Leslie's account

As described in chapter 4., Leslie (1987, 1988) emphasised the similarities between the pretence and mental state attribution. According to him, both pretence and mental state attribution require secondary representations which are copied by the "decoupler mechanism" from the primary representations. Leslie also argued that pretend representations are metarepresentational as are the mental state attributions such as false belief and ignorance. On the basis of evidence from Baron-Cohen et al. (1985 and 1986) which demonstrated that autistic children are unable to attribute false belief to others which require metarepresentation, and other studies which suggested that autistic children are

impaired in pretend play, Leslie (1987, 1988) proposed that autistic children have an impaired decoupler mechanism. Furthermore, he argued that "*malfunction of this component would lead to specific abnormalities of development that might show themselves in a characteristic pattern of social and communicative behaviour* " (Leslie and Frith, 1990, p.122), as in the case of autism.

Recently, as a result of other studies in autism (such as Leslie and Frith (1988) who showed that autistic children are also impaired in attributing knowledge to others and Perner et al. (1989) who argued that autistic children are impaired in their attribution of true and false belief to others and also in their ability to refer to their own mental state of knowledge) Leslie (1991) argued that autistic children "*are severely impaired on tasks which tap their ToM* " (p.70). Furthermore on the basis of the fact that some autistic children do pass some theory of mind tasks but fail on the other tasks such as higher-order false belief tasks, Leslie (1991) suggested that "*high ability autistic children are specifically and grossly delayed in their ToM understanding, relative to their own general intellectual functioning* " (p.71).

6.1.3. Wellman's account

Wellman (1990, see chapter four) argued that before children fully developed a representational understanding of beliefs they have a simple-desire psychology which enables them to predict another person's behaviour on the basis of that person's simple desires. Around the age of three children develop a belief-desire psychology which enables them to begin to predict behaviour in relation to a person's belief as well as in relation to a person's desire. According to Wellman, at this stage children have an initial theory of mind; they can also understand that dreams and ideas are representational. However according to Wellman children at this stage do not have a fully developed understanding of mental representations, rather they have a copy understanding (or hit-or-miss understanding). At this stage children can understand that if a person hits (sees) the target he/she holds a true belief about it. However, three-year-old children cannot understand

false belief, the appearance-reality distinction, nor can they understand that two people may have different interpretations of the same object. This understanding develops between the ages of four and five which Wellman calls interpretive understanding of representations and mind.

Like Perner (1991), Wellman's (1990) account was not developed specifically to explain autism. However a part of his formulation has been tested on autistic children by Baron-Cohen (1989c). In this study it was found that autistic children have difficulties in differentiating mental from physical (e.g. while a character who has a biscuit can eat it, another character who is thinking of a biscuit cannot eat it). Since Wellman argued that the ability to differentiate mental from physical required an initial theory of mind, Baron-Cohen (1989c) concluded that autistic children also lack an initial theory of mind.

6.2. Accounts against theory of mind

6.2.1. Harris: Autism as a failure to adjust default settings

Harris (1991) argues against the view that autistic children lack a "theory of mind". Instead he claims that although autistic children are slower than normal children, they have some understanding of the way the mind works. According to Harris, autistic children's performance on theory of mind type tasks can be explained on the basis of the adjustment of default settings. For instance, in one task in Harris & Muncer, (1988 reported by Harris, 1991) autistic children were told what the story character wanted to get e.g. A but not B, and then they were asked whether the character would be happy if he gets A (match condition), and if he gets B (mismatch condition). In the mismatch condition the autistic children were less likely than the normal children to judge that the character would not be happy to get B. However some of the autistic children made very few errors on this task and when Harris & Muncer (1988) followed up this study with higher level autistic children "*many autistic children (11 out of 20) performed without error*" (Harris, 1991 p.297). Similarly Harris reports that Baron-Cohen (forthcoming) found that when the autistic children were asked to judge a character's emotion on the basis of what he wanted

and what he got - which according to Harris requires a single default adjustment - they performed less well than the normal children but their performance was similar to the learning disabled children. In a more difficult task, children were asked to judge what the character would feel when he was misled about the outcome. For instance when the character wanted box A and is given box A, but box A actually contained something different from what he wanted. In this task children need to keep in mind what box A actually contained but imagine what the character wanted and what he (mistakenly) thinks he will get. In this task the autistic children did less well than the normal and learning disabled children. Harris (1991) concludes that "*autism does not completely block the normal development of psychological understanding, rather it is a deficit that slows development in that domain* " (p.298).

6.2.2. Hobson: Autism as a social affective deficit

Hobson (1989b) based his theory of autism on one of the characteristic features of autism, namely "disturbances of affective contact", which was described by Kanner (1943). According to Hobson (1990c) autistic children lack the biological capacity (in particular the sensory-motor-affective capacity) to develop affective-conative interpersonal relations. This affective relationship involves the recognition of feelings and emotions in other people from their bodily expressions, as well as the affective responsiveness to other people. The absence of a biological capacity for interpersonal relationships prevents the child from developing a concept of 'self' and of 'people' and, from understanding the commonality and difference between themselves and others. With the inability to understand people with their own subjective attitudes toward the world and toward themselves, autistic children fail to develop an understanding of mental states (Hobson, 1990c). In addition autistic children's lack of experience of interpersonal relationships also results in them failing to develop symbolic thinking and abstraction (Hobson, 1989b).

In sum Hobson (1989b) proposes that: " *(1) Autistic children lack such constitutional components of action and reaction as are necessary for the development of reciprocal*

personal relations with other people, relations which involve feelings. (2) Such personal relations are necessary for the "constitution of an own and common world" with others (Bosch, 1970, p.115). (3) Autistic children's lack of participation in intersubjective social experience has two results which are especially important-namely, (a) a relative failure to recognize other people as people with their own feelings, thoughts, wishes, intentions, and so on; and (b) a severe impairment in the capacity to abstract and to feel and think symbolically. (4) The greater part of autistic children's characteristic cognitive and language disability may be seen to reflect either lower-order deficits that have a specially intimate relationship with affective and social development, and/or impairments in the social-dependent capacity to symbolize." (Hobson, 1989b, p.23).

The difference between the cognitive "theory of mind" account of autism and Hobson's social-affective account seems to be that the former claims that autistic children lack the innate cognitive mechanism which is responsible for metarepresentational ability that is required in mental state attribution whereas the latter claims that the primary deficit in autism is the affective-connative personal relatedness. In other words, according to the theory of mind account, the inability to attribute mental states to other's such as beliefs and desires is the underlying reason for autistic children's social communication difficulties, whereas according to Hobson's social-affective account autistic children lack this ability due to impaired innate biological capacities. Thus, as a result of an inability to form affective personal relationships from the early years of life, autistic children, according to Hobson, fail to acquire knowledge of people with minds and knowledge of mental states. However, despite their differences both accounts emphasize some sort of biological impairment.

In the last section of this chapter an account which argues the role of both cognitive and affective factors in order to explain theory of mind impairment in autism, will be described.

6.3. Autism as an affective and cognitive disturbance

Mundy & Sigman (1989a, 1989b) have explained the impaired joint attention behaviours observed in autism in terms of both affective and cognitive factors. They developed their account by assuming that the impaired joint attention behaviours could be regarded as an early manifestation of autism. Mundy & Sigman (1989a) point out that the cognitive metarepresentational account suggests that "*pretend play skills reflect the earliest developments of this cognitive capacity* " (p.176) and these skills emerge between 14-and-18 months of age. However joint attention behaviours are present between 6-and-12 months of age in normal children. Thus metarepresentational theory cannot "*easily explain joint attention deficits in autism* " (Mundy & Sigman, 1989b, p.214).

According to Mundy & Sigman (1989b), through experience, children learn that their smile has an effect on others especially on their caregivers. "*This association plays a role in the child's developing sense of relatedness to the caregiver and becomes codified in the cognitive scheme [I smile --> other smiles]* " (p.215). They argue that a child's disturbed expression of affect may lead to impaired affective social relationship with the caregiver. This impoverished experience, combined with impaired cognitive representational factors, may cause disturbances in the child's cognitive scheme development. In other words, they suggest that the interaction between the child's impaired social affective responses and delayed cognitive systems may lead to "*specific cognitive deficits in autism* " (p.216).

In sum, Mundy & Sigman (1989b) proposed that "*atypical experiences with affect in social interaction,.. in combination with compromised representational skills, may give rise to atypical social-affect scheme formation in the young autistic child. To the degree that these provide a foundation for aspects of subsequent cognitive development, a new developmental path of the disorder may emerge. ..since affect is an important early source of information about the covert aspects of others (e.g. feelings), a disturbance of ontologenically early affect scheme could inhibit the development of subsequent complex*

representations about the covert mental states of others. This process may be related to aspects of delay in the development of a theory of mind module...." (p.216).

7. CHAPTER SEVEN

Normal children's understanding of knowledge and their understanding of mental terms

In this thesis, in order to investigate normal and autistic children's ability to attribute mental states to themselves and to others, their ability to differentiate mental terms like "know" and "guess" have been tested in a series of experiments. This chapter reviews relevant studies carried out with normal children. First, studies investigating normal children's understanding of mental terms, particularly "know" and "guess", will be reviewed. Second, the normal child's understanding of "knowledge" will be described.

7.1. Children's production and comprehension of mental terms

It has been argued that the child's pre-verbal communication with his/her caregiver indicates that the child can attribute "*an internal state of knowing and comprehending to the mother as he or she communicates, and must have what Premack and Woodruff (1978, p.515) have called a 'theory of mind'* " (Bretherton et al., 1981, p.225). With the acquisition of language, it becomes easier to study the child's ability to attribute internal states to self and to others (Bretherton et al., 1981). According to Bretherton et al. (1981) an infant's understanding of self and other as psychological beings, becomes explicit in different aspects of language after the first emergence of intentional communication. Children begin to refer to others as physical beings, first, naming body parts, later on referring to themselves and others by personal names, and then using mental terms to attribute mental states to themselves and others.

In the investigation of children's understanding of mental terms, observational studies have focused on the child's production of mental terms to refer to their own and to other people's mental states. Experimental studies have investigated the child's comprehension of mental terms in various experimental paradigms. These are reviewed below.

7.1.1. Observational studies

Bretherton, McNew & Beeghly-Smith (1981) demonstrated that infants begin to use internal state words in their second year of life. While perceptual words (e.g. see, cold, hurt, hear), physiological words (e.g. hungry, thirsty, sleepy) and emotional words (e.g. happy, funny, love, nice, scary) were used in children's spontaneous speech between the ages of 11 to 20 months, cognitive words (e.g. think, remember, believe, understand, pretend) did not appear in the children's speech before the age of 26 months. The earliest used cognitive term was "know" at the age of 15 months. Similarly, Bretherton & Beeghly (1982) showed that at 28 months, the most commonly used words in the infants' spontaneous speech were volition (e.g. want, can, need), physiological (e.g. thirsty, tired, sleep), and perceptual (e.g. see, look, hurt). The least common words in the 28 month old infants' speech, accounting for 13% of their speech, were cognitive mental terms (e.g. think, remember, forget, understand, pretend and guess). The evidence from both these studies seems to suggest that children begin to use several internal state words in their second year of life, and start to use cognitive mental terms before the age of 3.

However, Shatz et al. (1983) have argued that children's spontaneous production of mental terms does not necessarily reflect their ability to infer mental states, since such verbs are likely to be used for conversational functions. In order to investigate when children begin to use mental terms to refer to mental states, Shatz et al (1983) examined samples of a child's spontaneous speech. Words were coded as mental state words on the basis of context and function, and whether or not they were produced to refer to people's knowledge, memories or thoughts. They also examined the use of contrastives which strongly indicate the child's ability to discern mental states from the observable reality e.g. "*Before I thought this was a crocodile; now I know it's an alligator*" (Shatz et al. 1983, p.307). Finally they assessed children's competence at producing appropriate linguistic forms to infer mental states. Shatz et al. (1983) found that when mental terms first appear in the child's speech they are not used to refer to mental states but rather used to direct interaction. However, a few months after the first mental terms are produced, children

begin to use these terms to refer to mental states. The authors concluded that mental reference begins to appear in the second half of the third year.

Thus the evidence from observational studies suggests that from the second year onwards children start to produce mental terms (Bretherton & Beeghly, 1982; Bretherton et al., 1981), and by half way through the third year these terms are used to refer to mental states (Shatz et al., 1983).

7.1.2. Experimental studies

Various aspects of children's comprehension of mental terms have been studied in experimental studies. Some studies have explored when children begin to understand mental processes, such as remembering and forgetting, by looking at children's comprehension of the mental terms "remember" and "forget" (Wellman & Johnson, 1979), while others have demonstrated children's understanding of the semantic difference between various mental terms. Further experiments have investigated children's understanding of cognitive mental states implied by mental terms, and children's understanding of differential degrees of certainty implied by mental terms.

To date the experimental evidence indicates that at around the age of four to five children begin to differentiate mental terms such as know, think, guess, remember, pretend, forget etc. this is later than the first appearance of these mental terms in children's spontaneous speech.

Macnarama et al. (1976) demonstrated that four-year-old children understand the presuppositions implied by mental terms. For example, "*Tom was pretending he was sick*" (p.62) presupposes that Tom was not sick; "*Harry forgot to bring the truck*" (p.63) presupposes that he was expected to bring the truck; "*John said that Mary knows that the mouse is dead*" (p.62) presupposes that John believes that what he says is true. The results of Macnarama et al.'s (1976) study indicated that while four-year-old children could understand presuppositions implied by the mental terms "pretend" and "forget", their

understanding of the presupposition implied by "know" was not as good. However, the task used to test the children's understanding of the presupposition implied by "know", appears to be more difficult than the "pretend" and "forget" tasks, which raises questions about their conclusion.

Johnson and Maratsos (1977) showed that four-year-old children are able to understand that, while knowing presumes the truth, thinking could be mistaken. Children were told stories in which there were two characters, one was the hider, the other was the seeker. In a story, one character (the hider) hid something in location A and told another character (the seeker) that she had hidden the object in location B. The children were then asked several questions about the hider and the seeker. Four-year-old children, unlike three-year-olds, were able to indicate that the hider knows where the object is (the truth), while the seeker thinks they know where the object is. These results indicated that four-year-old children are able to understand the presupposition implied by "know", contrary to the results of Macnarama et al.'s (1976) study. In Macnarama et al.'s study the four-year-old children's relatively poor understanding of the presupposition implied by "know" seems likely to have been caused by difficulty of the task.

Johnson and Wellman (1980) found that four-year-old children could differentiate their mental states from external states. In this study, after children had watched the experimenter hide an object in one of two boxes, the object's location was changed, without the child seeing the change so that when they were asked to point to where the object was, they would point to the incorrect location. In other words, the children had previous knowledge about the object's location which at the time of pointing, was incorrect. Although the four-year-old children saw that their performance was incorrect, when they were asked whether they had known, remembered or guessed where the object was, the children affirmed that they knew, remembered, and guessed the object's location. This finding suggests that 4-year-old children do not always interpret mental terms on the basis of external states or the perceived outcome, but that they can interpret mental terms on the basis of their mental states.

In the same study (Johnson and Wellman, 1980) the children carried out two further tasks. In one the children saw where the experimenter hid an object (prior knowledge), and in the other they did not (no information). In other words the difference between the two tasks was that in one the children had prior knowledge, in the other they had no information, and in both tasks they did not find out whether their performance was right (no information on present performance). They were then asked several questions about whether they knew, remembered or guessed where the object was. Preschool children aged between four and five tended to give indifferent answers in both conditions indicating that they did not understand that while knowing and remembering require a knowledge base, guessing does not. Johnson and Wellman (1980) argued that preschool children's affirmative answers - saying that they knew, remembered and guessed - in the condition where they neither had prior knowledge about the object's location (no prior knowledge) nor found out whether their performance was right (no information on present performance), indicates that "*children are interpreting the terms with respect to their act of choosing rather than the outcome of performance* " (p.1100). Furthermore, the results on these two tasks showed that understanding of the difference between know, remember and guess on the basis of presence or absence of prior knowledge develops from the age of five onwards.

In another set of tasks in Johnson and Wellman's (1980) study, the children did not see where the experimenter hid the object. In the (guess right) task it was ensured that the children found the hidden object (both locations contained an object). In the (guess wrong) task it was ensured that the children did not find the hidden object (none of the locations contained an object). The difference between the two tasks was whether the children's present performance was correct or incorrect. However, in both tasks the children did not have any prior knowledge. The four-year-old children were more likely to judge their correct performance, but not their incorrect performance, as knowing, remembering and guessing, which suggests that they were basing their judgments on their performance. By the age of five, the children ascribed guessing to both tasks whether their performance was right or wrong, but still judged remembering and knowing on the basis of their

performance. By the age of six, the children were able to differentiate guess from know and remember on the basis of prior knowledge, but not on the basis of their present performance.

Johnson and Wellman (1980) concluded that "*children first interpret mental terms with respect to variable contexts of use. From such uses, children gradually acquire a more categorical understanding of the definitively mental features of the terms* " (p.1102).

Similarly, Wellman and Johnson (1979) showed that children's understanding of the mental terms "remember" and "forget" progresses from an understanding based on search for the correct location (present performance) at around the age of four, to an understanding based on underlying cognitive mental states (previous knowledge) between the ages of five and seven).

Furthermore Miscione et al. (1978) demonstrated that the crucial period for the development of the semantic understanding of "know" and "guess" occurs between the ages of four and five and a half. In this study, children either watched the experimenter hide shapes in one of three boxes or they did not (they closed their eyes). After the experimenter had hidden a shape the child was then asked to choose a box which he/she thought the shape was in. Then the child was asked whether he/she knew or guessed the location of the shape. In some conditions the children were asked the questions before they found out whether their performance was right or wrong. In other conditions, they were asked the questions after they saw whether the box they chose contained the shape. Miscione et al. (1978) found that the younger children differentiated "know" and "guess" according to external results. While they associate know with correct activity, guess is associated with incorrect activity. Gradually children acquire the semantic knowledge for both words. From the age of five and a half the children showed an understanding that "know" implies prior knowledge and leads to a successful outcome, while "guess" implies a lack the knowledge and leads to different outcomes which may or may not be successful.

Moore et al. (1989) who looked at children's ability to differentiate the mental verbs "know", "think" and "guess" in terms of differential degrees of certainty. In this study children were told they could get help from two puppet monkeys when they were finding a hidden sweet. Each puppet made a statement which contrasted with the other puppet's statement. For instance, for the know-guess contrast one monkey said "*I know it is in the blue/red box*" (p.169) while the other monkey said "*I guess it is in the blue/red box*" (p.169). There were three contrasts which were know-guess, know-think and think-guess. The results showed that by the age of four years children had some understanding of the distinction between "know" and "guess", 73.25% of their choices being correct, and between "know" and "think", 78.5% of their choices being correct. The understanding that "know" gives a better indication of the realibility of a statement over "guess" and over "think" appears to be complete by five years of age. By the age of five, 94.75% of the choices in the know-guess contrast and 91% of the choices in the know-think contrast were correct.

In sum, evidence from the experimental studies indicate that children around the age of four begin to differentiate mental terms such as "know" and "guess" based on the outcome (present performance), and from the age of five based on the underlying cognitive mental states.

7.2. Children's understanding of knowledge as a mental state

The experiments in this thesis focus on children's understanding of the mental state "knowing" versus "guessing" or "not knowing" so in this section studies examining the normal child's developing understanding of the sources of knowledge will be reported.

7.2.1. Understanding perception as a source of knowledge

Wimmer, Hogrefe & Perner (1988) studied children's understanding of perception and communication as sources of knowledge. In this study, two children were seated opposite each other. On each trial, while one child had informational access to the content of a box (either being shown or being told what was in it) whereas the other child did not. Then the subject was asked whether the other child knew or did not know what was in the box, and also whether the subject himself/herself knew or did not know what was in the box. The results indicated that children younger than four-years of age did not understand informational access as a source of knowledge. In addition, three-year-old and four-year-old children found it easier to assess their own knowledge than to assess the other child's knowledge. In a second experiment Wimmer, Hogrefe and Perner (1988) altered the task, so that the subject and the other child had the same informational access. The children's responses did not change. Thus, it was concluded that young children tend to neglect informational access in their assessment of another person's knowledge even when they know what the other person has access to. However, in a third experiment four-year-old children were also asked whether the other child looked into the box (to check knowledge of perceptual access). It was found that the children had no difficulty assessing the other child's perceptual access but had difficulty assessing the other child's resulting knowledge. Wimmer et al. (1988) concluded that children younger than 4 or 5 have no understanding of the origins of knowledge, but that children begin to understand informational access as a source of knowledge at around the age of 4 years.

Similar results were obtained from studies of children's conceptual perspective taking ability by Marvin et al. (1976) and Mossler et al. (1976). In these studies children played a game with their mother and the experimenter. In Marvin et al.'s study the game involved two of them choosing a toy as a secret, while the third one closed his/her eyes. Then children were asked who knew and who did not know the secret. The four-year-old children were able to identify who knew the secret and who did not, on the basis of that person's visual access (Marvin et al. 1976). Thus they were able to differentiate their own

conceptual perspective from that of the others' regardless of sharing either the same or a different perspective with the others. In Mossler et al.'s study (1976) while their mother was in another room the child was shown video clips and told something that the story character wanted or somewhere he was going. Then the same video clips were shown to the child and his/her mother together with the sound of video turned down so that it was not obvious where the story character was going or what he wanted. The child was then asked whether their mother knew where the story character was going or what he wanted, and also why their mother knew or did not know. It was found that the four and five year old children were able to take their mothers' perspective and say that she did not know what the character wanted and where he was going. However, the children's ability to justify their mothers' absence of knowledge appeared somewhat later between the ages of five and six.

These results from Marvin et al. (1976) and Mossler et al. (1976) suggest that, from the age of four children begin to differentiate their own knowledge and the absence of this knowledge in another person on the basis of informational access. From five years onwards, children begin to justify the presence or absence of this knowledge in another person.

However, other studies have shown that three-year-old children are able to judge whether another person or they "know" or " do not know" something on the basis of perceptual information (Pillow, 1989; Pratt & Bryant, 1990). In Pillow's (1989) study, the task involved the transfer of either a small plastic dinosaur or a small toy car, from a bag (which contained different coloured items) to a plastic opaque container out of sight of to the child and a puppet who acted as another person. Then, either the child or the puppet looked into the container. On each trial the children were asked whether the child knew the colour of the dinosaur or the car in the container, whether the puppet knew the colour of the dinosaur or the car in the container, whether the child saw the dinosaur or the car in the container and whether the puppet saw the dinosaur or the car in the container. The results showed that both three-year-old and four-year-old children could attribute knowledge or ignorance to

themselves and to the puppet on the basis of visual access. They were also able to judge whether or not the puppet or themselves had seen the object in the container. Pillow (1989) concluded that by the age of three to four children are able to understand perceptual experience as a source of knowledge.

This conclusion contrasts with the findings from other studies (Wimmer et al., 1988; Mossler et al., 1976; Marvin et al., 1976) which have suggested that children younger than four-years of age are not able to understand that seeing leads to knowing. However, Pillow's study differed from the others in three ways: 1) the children were tested individually; 2) puppets rather than real people (an adult or another child) were used as the other person; and perhaps the most important of all, 3) the children were asked about the colour of the hidden object which is a perceptual quality which may have helped children in their performance.

Similarly, Pratt and Bryant (1990) also found that if simpler questions are asked, children as young as three-years-old are able to attribute knowledge or ignorance to a person on the basis of that person's visual access. In this study there were two assistant children. On each trial while the subject watched, one of assistants looked into a box which contained an object and the other assistant lifted the box up without looking into it . The subject was then asked, depending on the condition, either "Who knows what is in the box - John or Fiona (the assistants' names)?" or "Who can tell what is in the box - John or Fiona?". The results indicated that three-to-four year old children can understand the role of visual access in knowledge formation. In another experiment investigating the role of test questions on children's performance, Pratt and Bryant (1990) directly compared simple with complex questions. In this task, one child looked into a box while the other child did not. In one condition children were then asked simple single-barrelled questions (e.g. "Emma, does Lucy know what is in the box?" and "Do you know what is in the box?"). In the other condition double-barrelled questions were asked as in Wimmer et al. (1988), (e.g. "Emma does Lucy know what is in the box, or does she not know what is in the box?" and "Do you know what is in the box, or do you not know what is in the box?"). The results

showed that both the three and four-year-old children found the single-barrelled questions easier than the double-barreled questions and the four-year-olds were better than the three-year-olds in responding correctly to both types of questions. This evidence seems to suggest that in Wimmer et al.'s (1988) study, three-year-old children's inability to understand the role of informational access in knowledge formation was due to complex test questions.

In sum, while some studies have shown that children around the age of four begin to understand the role of perceptual access in knowledge formation, recent studies used different tasks and simpler experimental questions. These studies have shown that three-year-old children are able understand the role of perceptual access in knowledge formation.

7.3. Chapter summary

From the second year onwards, children start to produce mental terms and by half way through the third year, they start to use them to refer to mental states. However, it is not before the age of five that children begin to differentiate cognitive mental terms on the basis of the mental states they refer to.

8. CHAPTER EIGHT

Experiment 1

Normal children's ability to differentiate "know" and "guess" with reference to self and others

8.1. Introduction

The main aim of this thesis was to explore the "theory of mind" explanation of autism by examining children's understanding of "knowledge" as a mental state.

In investigations of children's "theory of mind" reported in the literature have employed tasks which have involved the use of various scenarios either with real people or with puppets, and children have been asked questions involving the use of mental terms (eg. believe, know, think). In addition, other studies have investigated children's use of these mental terms to refer to mental states in their spontaneous speech, and suggested that use of mental terms indicates the child's implicit theory of mind ability. Other researchers have studied children's comprehension of mental terms and proposed that *"the acquisition of mental terms may be taken as indicating an understanding of mental state and therefore reflects the development of the concept of mind in children (Johnson, 1982)"* (Moore et al. 1989, p.167).

The main aim of the first experiment was to investigate the age at which normal children can differentiate the mental terms "know" and "guess", and in so doing to establish a baseline for subsequent experiments. Children's ability to differentiate these mental terms can be taken as a marker of their understanding of the related mental states, "knowing" and "guessing". While knowing requires an evidential basis (informational access) and presumes the truth, guessing lacks such a base and could be wrong. There is evidence that by the age of 4 children begin to understand that "know" gives better index of realibility than "guess" (Moore et al., 1989) and that from five-years onwards children begin to differentiate "know" from "guess" on the basis of prior knowledge but not on present performance (Miscione et al., 1978; Johnson & Wellman, 1980).

Furthermore, evidence from studies investigating children's understanding of sources of knowledge, indicates that children around the ages of 4 and 5 acquire an understanding that

perceptual access is the crucial factor in knowledge formation (Wimmer et al., 1988; Marvin et al., 1976; Mossler et al., 1976 and Hogrefe et al., 1986).

According to Perner (1991) (see chapter 4) children's ability to judge a person's knowledge on the basis of informational access (eg. whether or not that person had seen the experimenter hide an object) rather than success (eg. whether or not that person found the hidden object) indicates that a child has developed an understanding of knowledge as a mental representation.

In order therefore to ensure that the child is basing her/his judgement on the person's mental state rather than the successful outcome, it is necessary to ask the experimental question before the child has seen the outcome (i.e. whether the box to which they pointed contained the hidden object). This procedure was adopted in experiment 1.

The second aim of the experiment 1 was to investigate whether children's ability to differentiate "know" and "guess" differs when they are referring to their own mental states and when they are referring to another person's mental states. Observational studies such as Bretherton & Beeghly (1982) and Bretherton, McNew & Beeghly-Smith (1981) have shown that children tend to refer to their own mental states earlier than they do to others'. However a subsequent observational study as demonstrated that the lag between the production of mental terms used with reference to self and with reference to others was minimal (Shatz et al., 1983). In this study once a child had started to produce mental terms she/he did not seem to restrict their use to refer to themselves for very long.

Contrary to this last study experimental studies have suggested that children seem to find it easier to refer to themselves than to others. For instance, in Wimmer et al.'s (1988) study three and four year-old children found it easier to judge their own knowledge than to the another child's knowledge. In this task either the subject child (self) or the helping child (another) had seen or been told the content of a box and the subject child had to judge his/her own knowledge and another child's knowledge about the content of the box.

Given this lack of consensus it is perhaps not surprising that studies of the children's understanding of their own false belief and false belief of others' have produced conflicting results. While some investigations have suggested that children can recognize false belief in themselves before they can recognize it in others (Perner et al., 1987; Hogrefe et al., 1986), other studies seemed to indicate that the understanding of one's own previous false belief and the ability to understand another's false belief emerged simultaneously (Wimmer & Hartl, 1991; Gopnik & Slaughter, 1991 and Sullivan & Winner, 1991).

Thus in summary, the evidence appears to be inconclusive as to whether children's ability to attribute mental states to themselves and to others emerge simultaneously or whether one follows the other. Theoretically, if Harris's (1991) view of mental simulation, which is based on imaginations and analogy from the child's own states to others, is right, then children should find it easier to refer to their mental states than to refer to others. However if Perner (1991) is correct in that children around the age of four acquire a representational theory of mind in which they understand the representational function of mental states, then children should become able to understand their own and other people's minds at the same time.

Experiment 1 examined whether or not children start to attribute mental states to themselves and to others at the same time by comparing the child's ability to judge his/her own mental state (attribution of knowing and guessing to self) and another person's mental state (attribution of knowing and guessing to another person).

The third aim of the experiment 1 was to investigate whether there was an age trend in the differentiation of "know" from "guess", children with the mean ages of 4;9, 5;9 and 6;9 were tested.

8.2. Method

8.2.1. Subjects

A total of 121 children between the ages of 4;05 and 7;08 recruited from two local primary schools were included in this experiment. They were divided into three age groups as follows: the youngest group (n=54) had a mean age of 4;09 (4;05-5;05) and the middle group (n=43) with a mean age of 5;09 (5;06-6;05) and the oldest group (n=24) with a mean age of 6;09 (6;06-7;08).

8.2.2. Material

Two wooden boxes (16 x 11 x 7 cm), and a yellow coloured wooden cube (3 x 3 x 3 cm) (For a photograph of the materials see appendix 1.).

8.2.3. Procedure

All the children were tested in a quiet area outside their classroom in their school. The experimenter began the task with two children, one being the subject and the other being the helping child. When the first subject had finished the task he/she was asked to stay for two more turns (to be a helping child) with the next child. The children were told that they were going to play a game in which they would have to find a cube hidden in one of two boxes. They were also told that they would take turns, sometimes they would be asked to close their eyes, sometimes they would be allowed to see where the experimenter hid the object. There were two conditions "own" and "other". For administrative reasons all the subjects were tested in both conditions in the order "own", "other". However a more adequate procedure has been reported in section 9.2.3.1.

8.2.3.1."Own" condition

In this condition each child was given two trials. On one trial the children saw the experimenter hide the object ("know" trial) and on the other trial they were asked to close their eyes while the experimenter hid the object ("guess" trial). After the experimenter had

hidden the object she asked the child the following questions "Did you see where I put the cube?" "Can you point to the box that contains the hidden object?", "Do you know it is there or do you guess it is there?". If the child had seen the experimenter hiding the cube the correct answer was KNOW, whereas if the child had his/her eyes closed while the experimenter hid the object the correct answer was GUESS. The order of the know and guess trials and the order of "know" and "guess" in the experimental question were counterbalanced.

8.2.3.2. "Other" condition

In this condition the helping child (other) was given two trials: a "know" trial in which the helping child watched the experimenter hide the object and a "guess" trial in which the helping child had his/her eyes closed while the experimenter hide the object. The subject had his/her eyes open during both trials. After the experimenter had hidden the object she asked the helping child first "Did you see where I put the cube?" and "Can you point to the box that contains the hidden object?", while the helping child was pointing to one of the two boxes, the experimenter turned to the subject and asked "Does she/he know it is there or does she/he guess it is there?" Clearly, if the helping child had seen the experimenter hiding the cube the correct answer was KNOW, whereas if the helping child had his/her eyes closed while the experimenter hid the object the correct answer was GUESS. Table 8.1. summarises the conditions, trials and experimental questions in the "hidden object task".

Table 8.1. The hidden object task: Conditions, trials and questions.

"OWN" CONDITION

TRIALS	QUESTIONS
KNOW (subject sees)	Did you see where I put the cube? (control Q. to the subject)
	Can you point to the box that contains the hidden object? (to the subject)
	Do you know it is there or do you guess it is there? (experimental Q. to the subject)
GUESS (subject does not see)	Did you see where I put the cube? (control Q. to the subject)
	Can you point to the box that contains the hidden object? (to the subject)
	Do you know it is there or do you guess it is there? (experimental Q. to the subject)

"OTHER" CONDITION

TRIALS	QUESTIONS
KNOW (other child sees)	Did you see where I put the cube? (control Q. to the helping child)
	Can you point to the box that contains the hidden object? (to the helping child)
	Does she/he know it is there or does she/he guess it is there? (experimental Q. to the subject)
GUESS (other child does not see)	Did you see where I put the cube? (control Q. to the helping child)
	Can you point to the box that contains the hidden object? (to the helping child)
	Does she/he know it is there or does she/he guess it is there? (experimental Q. to the subject)

8.2.4. Scoring

The children's responses were scored independently for the two conditions of own and other. In each condition the children were scored as passing if they got both know and guess trials right, that is they differentiated know and guess successfully. If they got one trial or both trials wrong they were scored as failing.

8.3. Results

All the children answered the initial questions correctly that is they were able to say whether or not they had seen where the experimenter had hidden the object. This indicates that all three groups of children had no difficulty in perceptual perspective taking for themselves.

The first aim of experiment 1 was to investigate the age at which age children can differentiate the mental terms "know" and "guess". Clearly, in the experiment there were four possible response patterns:

a "know" on know trial, "know" on guess trial;

b "know" on know trial, "guess" on guess trial;

c "guess" on know trial, "know" on guess trial;

d "guess" on know trial, "guess" on guess trial.

Response pattern b was scored as a pass the other patterns were scored as fails. With these four possible patterns of responding, it might seem that the chance level of passing the task was 25%. However, this ignores the likelihood of inter-dependence between the two trials for each child. For example, it seems likely that a child who was not fully competent at performing the task might be biased towards know (responding with "know" on both trials), or towards guess (responding with "guess" on both trials). The possibility of such biases makes it difficult to calculate chance rates of passing the test, and likely that a chance level of 25% is not a reliable estimate.

An alternative strategy is to test whether the frequency of responding with "know" in the "know" trial is greater than responding with "know" in the "guess" trial. With repeated measures across trials and a dichotomous outcome, McNemar's test is the appropriate statistical procedure, and two-tailed probabilities from the exact (binomial) version of this test are reported below. It should be noted that although we are comparing the frequency of "know" responses across the two conditions, this is simply the mirror image of the corresponding comparison focusing on the alternative response of "guess".

For all the three age groups the difference between the "know" responses in the "know" trial and "know" responses in the "guess" trial was significantly different for both conditions of "own" and "other" ($p<.001$ for all the calculations, excluding the youngest group for the "own" condition $p<.01$). These results are detailed in appendix 2. This suggests that even the youngest children with a mean age of 4;09 did successfully differentiate "know" from "guess" when referring to their mental states and to the mental states of others. However, only a minority of the youngest children got both of these right and some of the youngest children got both wrong.

The data were further analyzed for the effects of conditions and age independently.

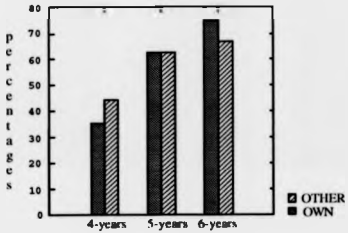
8.3.1. Comparison of "own" and "other" conditions

A second aim of experiment 1 was to investigate whether children's ability to refer to their own mental states is different from their ability to refer to another person's mental states. A separate McNemar test (exact binominal procedure) for each age group was performed to compare "own" and "other" conditions. None of the differences were significant. Inspection of the percentages supports the overall interpretation of no differences between the conditions age by age, or in terms of trends across age. Table 8.2. and Figure 8.1. show the percentages of children's correct responses for "own" and "other" conditions.

Table 8.2. The percentages of the children's correct responses in the "own" and "other" conditions for the different age groups.

N	AGE (range)	MEAN (age)	OWN	OTHER
54	4;05 - 5;05	4;09	35.1 %	44.4 %
43	5;06 - 6;05	5;09	62.7 %	62.8 %
24	6;06 - 7;08	6;09	75 %	66.6 %

Figure 8.1. The percentages of the subjects' correct responses in the "own" and "other" conditions.



8.3.2. Age effects

The third aim of the experiment 1 was to investigate whether there was an age trend in the differentiation of "know" from "guess". There was a significant difference in percentage of correct responses across the three age groups in the "own" condition [χ^2 (2) =13.194, p<.001] but not in the "other" condition [χ^2 (2)=4.806, p<.090] (see table 8.2. for the percentages of children's correct responses for "own" and "other" conditions). Tukey-type pairwise comparisons at p=.05 indicated that, for the "own" condition, the youngest age group was significantly different from each of the older groups. Thus the five-year-old and six-year-old children were significantly better than the four-year-old children in their ability

to differentiate "know" from "guess" in referring to their own mental states. The two older groups were not significantly different from one another. Tukey-type tests across ages on the "other" condition revealed that the difference was not significant for any pair-wise comparison.

8.4. Discussion

The main aim of experiment 1 was to establish a baseline for the subsequent experiments. Thus the first question was, at what age can children differentiate "know" from "guess" in reference to mental states. Several studies have shown that children at first start to differentiate mental terms on the basis of outcome (e.g. whether the person found the hidden object), then later they start to base their judgements on that person's mental state (Johnson & Wellman, 1980; Wellman & Johnson, 1979; Miscione et al., 1978). Because the object of the present experiment was to examine children's understanding of the underlying mental states implied by the mental terms "know" and "guess", in each trial the experimental question had been asked before the child found out about the outcome whether the box pointed at actually contained the hidden object. The first analysis showed that all the children gave significantly more "know" answers in the "know" trials then "know" answers in the "guess" trials indicating that children between four and a half and seven and a half are able to differentiate these mental terms on the basis of relevant mental states "knowing" and "guessing". Furthermore, children's ability to differentiate "know" from "guess" was getting better as the children got older; while 35 % to 44 % of the 4;09 year-old children differentiated "know" from "guess" in reference to self and other respectively, the percentages of correct differentiation rose to 62 % and 62 % by 5;09 years and 75 % and 66 % by 6;09 years for self and other respectively.

These results are comparable with previous evidence from two different bodies of research - research on children's ability to differentiate mental terms on the basis of mental states and research on children's understanding of the role of informational access in knowledge formation. These studies have shown that children around the age of four-years begin to

understand the role of visual access in knowledge formation and they start attributing knowledge to people (Wimmer et al., 1988; Marvin et al., 1976; Mossler et al., 1976 and Hogrefe et al., 1986). For instance, in Wimmer et al.'s (1988) study, 93% of the four-year-old and all of the five-year-old children were able to attribute knowledge to themselves, and 56% of the four-year-old and all of the five-years-old children were able to attribute knowledge to another person. The children's performance in Wimmer et al.'s (1988) study is better than that of the children in the present experiment. However the present experiment used stricter criteria requiring the children to pass both "know" and "guess" questions.

Similarly, previous research on children's ability to differentiate mental terms with reference to mental states has demonstrated that from the age of five-years children begin to differentiate "know" from "guess" on the basis of prior knowledge rather than present performance (Johnson & Wellman, 1980; Miscione et al., 1978). Miscione et al.'s (1978) study involved two conditions somewhat similar to the present experiment. In one condition the children had visual access to hiding a shape, whereas in another condition they did not. After the children had pointed to the box which they thought contained the hidden shape, they were asked whether they knew or guessed that the shape was in the box. The main difference between Miscione et al.'s study and the present experiment were that in the former the children only referred to their own mental states and trials were repeated five times. Miscione et al.'s (1978) results showed that the children aged between four and a half and five and a half gave correct "know" answers 4.1 times out of five trials and correct "guess" answers 3.1 times out of five trials; the children aged between five and a half and six and a half gave correct "know" answers 4.8 times out of five trials and correct "guess" answers 4.4 times out of five trials. In comparison to these results, the children taking part in the present study seemed less able to attribute "know" and "guess". However, again this is more likely to be a consequence of the strict criteria adopted which required the children to pass both the "know" and the "guess" questions.

The second aim of experiment 1 was to investigate whether children's ability to differentiate "know" and "guess" differs when they are referring to their own mental states and when they are referring to another person's mental states. The results indicate that there was no difference between the conditions. This suggests that children's ability to judge their own knowledge (knowing) and the absence of this knowledge (guessing) and their ability to judge another person's knowledge and the absence of this knowledge in another person, may emerge simultaneously. This finding fail to support evidence from some observational studies which have indicated that children use mental terms first to refer to themselves and only later to refer to others. However the children in the present study were a lot older than the children included in the observational studies, and one would expect them to be at the level where they can use mental terms to refer to other people. Furthermore, Shatz et al. (1983) argued that the lag between children's ability to use mental terms to refer to their own mental states and to other people's, is fairly small.

Furthermore the present results have failed to support the findings of Wimmer et al. (1988) which showed that children find it more difficult to attribute knowledge to other people than to themselves. However the absence of any difference between self and other reference in experiment 1 accords with other studies which found that children's ability to attribute the mental state of false belief to themselves and to other people emerges simultaneously (Wimmer & Hartl, 1991; Gopnik & Slaughter, 1991; Sullivan & Winner, 1991).

Theoretically, if children use analogy to their own mind to make predictions about other people's mental states, as Harris (1991) argues, then children should find it easier to refer to their mental states than to refer to others'. The present results failed to support this view. However if Perner (1991) is right that with the acquisition of a representational theory of mind at around the age of four, children start to understand the representational function of mental states, then children should become able to understand their own and other people's minds at the same time (Astington & Gopnik, 1991b). The present results are in line with Perner's view (1991). In the present experiment children were asked the experimental question "Do you know it is there or do you guess it is there?" or "Does (the

other child) know it is there or does (the other child) guess it is there?" before they looked into the box to see whether it contained the hidden object (found out the outcome). This ensured that the children based their judgement on their or another child's mental state, depending on the condition. The child's correct performance on this task, according to Perner (1991), indicates his/her understanding of knowledge as a mental state. Even the youngest group in this experiment differentiated "know" and "guess" with reference to their own and to another child's mental state which suggests that the children were able to understand knowledge as a mental state.

Furthermore, Perner (1991) argued that representing someone else's representation requires metarepresentational skills, which are acquired around the age of four.

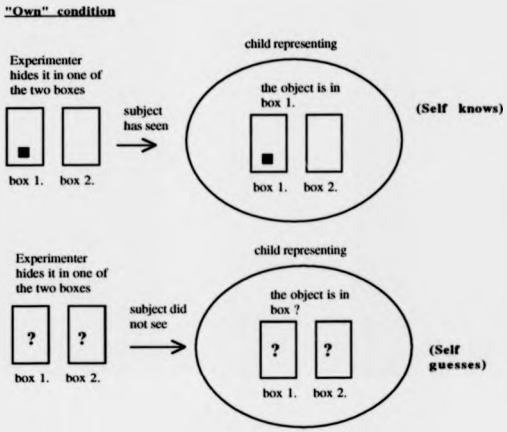
In experiment 1 when the children were asked to judge their own knowledge by answering the question "Do you know it is there or do you guess it is there?" all they needed to do was to check their mental representation of where the hidden object was which should not require metarepresentation skills. This is illustrated in figure 8.2. If the child saw the experimenter hiding the object in one of the two boxes, he/she should have a representation of the location of the object, and by referring to this representation, the child could give the correct answer which is "I know". If the child did not see the experimenter hiding the object, the child could not have formed a representation of the location of the hidden object and, on the absence of this knowledge he/she could give the correct answer "I guess". So one would expect the ability to refer to one's own knowledge state to be within the four-years-old child's ability range in terms of representational skills. This was confirmed in this experiment.

However, when the children were asked to judge another child's knowledge by answering the question "Does he/she know it is there or does he/she guess it is there?, they had to refer to the other person's mental state which does require metarepresentational skills (see figure 8.2.). All the children in the present experiment were above four and a half or older and therefore it is reasonable that they would have no difficulties on the "other" condition,

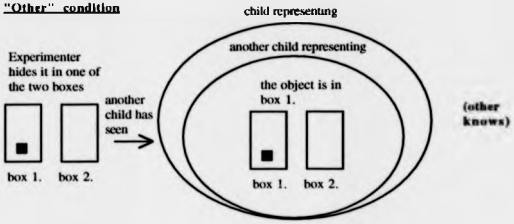
since children around the age of 4 years acquire the necessary metarepresentational skills (Perner, 1991). All three groups of children were able to attribute "know" and "guess" to another person which again supports Perner's (1991) argument. In addition, this also explain why the children's ability to refer to themselves and to others did not differ in this experiment. If the children were able to pass the "other" condition, they would be expected to pass the "own" condition which did not require metarepresentational skills (see appendix 2 Cross tabulation tables which show that majority of children who passed the "other" condition also passed the "own" condition).

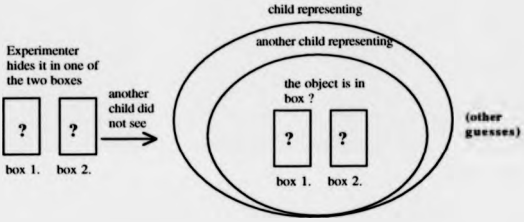
Furthermore, as can be seen from Figure 8.1, as children get older they seem to be getting better at differentiating "know" and "guess" in both conditions. There was a significant age effect in the "own" condition, the older children were better than the younger children at differentiating "know" from "guess". There is no good evidence that the age trend was different for the two conditions, that is, there is little evidence of an conditions x age interaction, even though this is difficult to test with such data. Nonetheless in the "other" condition there was no significant difference between the age groups. One possible explanation for this is that in this experiment the "own" condition was always presented before the "other" condition. It is possible that this may have facilitated performance in the "other" condition, especially in the youngest group. Thus in the following experiments it was decided to counterbalance the order of the conditions.

Figure 8.2. The representational skills required in experiment 1.



"Other" condition





9. CHAPTER NINE

Experiment 2.

Autistic children's ability to attribute "knowing" and "guessing" to themselves and to others

9.1. Introduction

Recently, a number of studies have suggested that autistic children are specifically impaired in their ability to attribute mental states to themselves and to others (e.g. Frith, 1989). Several aspects of mental state attribution in autism have been investigated. Research in this area was initiated by studies examining the autistic child's ability to attribute false belief to others which demonstrated that autistic children are impaired in this ability (Baron-Cohen, Leslie & Frith 1985 and 1986). It has also been shown that autistic children are impaired in their ability to attribute knowledge to themselves and to others (Leslie & Frith, 1988; Perner, Frith, Leslie & Leekam, 1989), and are impaired in engaging deception (Russell, Mauthner, Sharpe and Tidswell, 1991). All these tasks are believed to require metarepresentational skills, that is the ability to represent someone else's representation (Perner, 1991).

In most of the studies, autistic children's performance has been compared to either verbal MA matched children with Down's syndrome or children with specific language impairment. These studies have demonstrated that children with Down's syndrome and children with specific language impairments are able to attribute mental states to themselves and others. This finding has led researchers to suggest that the impairment is specific to autism and is independent of any other mental handicap or language impairment.

Furthermore, it has been suggested that autistic children's inability to attribute mental states to themselves and others (the theory of mind impairment) might be an underlying factor for their social communication difficulties (Baron-Cohen et al. 1985, 1986). The theory of mind account of autism proposes that if a child is unable to understand other people's mental states (e.g., what they know, think, believe etc.), he/she will not be able to predict other people's behaviour. This could make life very confusing and may result in the person withdrawing from it (Baron-Cohen, 1990b).

Theoretically, it has been argued that metarepresentation (which is required by mental state attribution) requires the use of secondary representations (Perner, 1991; Leslie, 1988). According to Leslie (1987, 1988) a decoupler mechanism is responsible for the production of these secondary representations. Thus, an impaired decoupler mechanism could be the underlying factor in autism and could explain the inability of the autistic child to attribute mental states to him or herself and to others, and could lead to the autistic child's social communication difficulties.

Understanding of knowledge is a mental state attribution, and it is important because people's knowledge state is a strong underlying factor of their behaviours. Thus it is important to investigate whether autistic children are able to attribute mental state of knowledge to other people. Primarily, the present experiment aimed to investigate autistic children's and adolescents' ability to attribute knowledge, and ignorance to people. The two studies in the literature have investigated autistic children's ability to attribute knowledge to themselves and to others (Leslie & Frith, 1988; Perner, Frith, Leslie & Leekam, 1989; for an account of these see chapter 5). In one of Leslie and Frith's (1988) tasks the child and the second experimenter watched the first experimenter hide a red counter in one of three possible locations and then the second experimenter left the room. While he was out of the room, the first experimenter produced another red counter and asked the child to hide it somewhere different. The child was then asked several questions: where the second experimenter saw the first experimenter hide the counter; whether the second experimenter knew the location of the second counter that the child had hidden, and where the second experimenter would look for the counter when he came back. Leslie and Frith (1988) reported that 11 of the 18 autistic children successfully answered the knowing question of whether the second experimenter knew there was a counter in the second location (where the child had hidden the second counter). However Leslie and Frith (1988) adopted a strict criterion, according to which the child had to pass not only the knowing question, but also the prediction question, in order to pass the knowledge attribution task. Only 8 of the 18 autistic children passed both questions. Therefore Leslie and Frith (1988)

concluded that autistic children fail to attribute knowledge to other people. The prediction question required the child to judge where the second experimenter would look for the counter and it seems possible that this was especially difficult, since to succeed the child had to predict a person's behaviour on the basis of that person's knowledge state (this issue will be taken up in chapter 11).

One of the limitations of Leslie and Frith's (1988) study was that they did not report the performance of the control group on this particular task. However, given that studies of normal children's ability to attribute knowledge to others have demonstrated that four-year-old children are able to do this (e.g. Wimmer et al., 1988) and given that the control group children had a mean verbal MA of 6;09, it seems likely that the control children would have passed the knowledge task. Nevertheless this needs to be tested.

Similarly, Perner, Frith, Leslie & Leekam (1989) reported that autistic children had difficulties in attributing knowledge to people. In one of the tasks in their study the first experimenter transferred one of several objects from a box to a cup out of view of both the child and a second experimenter. Then either the child (self knows) or the second experimenter (other knows) looked into the cup. The child was then asked several questions: whether the child had looked into the cup; whether the second experimenter had looked into the cup, whether the child knew which object was in the cup, and whether the second experimenter knew which object the first experimenter put into the cup. The results showed that only 43% of the autistic children could attribute knowledge to the other person although 56% of them could attribute knowledge to themselves. Again, in this study Perner et al. (1989) did not report the performance of the language impaired control group children on the knowledge attribution task. In addition, this study involved some autistic children with verbal MAs as low as 3 years 1 month who would be expected to fail the knowledge attribution task given that this ability has been shown to develop around the age of 4 in normal children (e.g. Wimmer et al. 1988).

Although Leslie & Frith (1988) and Perner et al. (1989) have not reported the performance of the control groups, their results seem to suggest that autistic children have difficulties in attributing knowledge to themselves and to others.

Further evidence from another body of research has demonstrated that, in comparison to children with Down's syndrome, autistic children produce significantly fewer cognitive mental state terms such as know, think and remember in their spontaneous speech (Tager-Flusberg, 1992). As reported previously (see chapter 7) it has been argued that children's use of mental terms to refer to mental states such as knowing, thinking or believing, can be taken as one of the early manifestations of their theory of mind ability (e.g. Bretherton et al., 1981; Bretherton & Beeghly, 1982; Shatz et al., 1983). Following these studies, Tager-Flusberg (1992) compared autistic children's spontaneous speech samples with that of children with Down's syndrome who were matched according to their chronological age and mean length of utterance. A functional analysis of the psychological state terms showed that the autistic children produced significantly fewer terms referring to cognitive mental states (including knowing) than the children with Down's syndrome. Tager-Flusberg (1992) reported that whereas the children with Down's syndrome produced 41 examples of mental state attribution, only 4 examples were produced by the autistic children. Although Tager-Flusberg (1992) did not report the frequency of the particular mental term "know", used to refer to the mental state of knowing, overall these results support the evidence from experimental studies that autistic children are specifically impaired in their ability to attribute cognitive mental states.

The first aim of experiment 2 therefore was to compare autistic children's and adolescents' ability to differentiate the mental terms "know" and "guess" on the basis of relevant mental states (i.e. having specific knowledge about something and lacking that specific knowledge), to that of children with Down's syndrome and normal children. Since previous evidence has suggested that children's ability to attribute knowledge develops from four-years onwards, the inclusion criterion for experiment 2 was that children had to

have language scores at the four-years level and above on at least two of the three language tests administered.

Although a number of studies have suggested that autistic children are impaired in their ability to attribute mental states to others, a proportion of autistic children do pass the theory of mind tests in most of the studies. Autistic children who are able to attribute mental states are tend to be older and have higher verbal MAs. For instance, Prior, Dahlstrom and Squires (1990) reported that autistic children who could attribute knowledge and false beliefs to others had a minimum chronological age of 8, and a minimum verbal mental age of 6. Furthermore, Baron-Cohen (1989a) reported that autistic children who passed the first order false belief task had higher verbal MAs and they were over 11 years of age.

Therefore, the second aim of experiment 2 was to investigate whether children's language level is an important factor for their success on the experimental task. In other words the second aim was to investigate whether performance on the task improved with higher language level. In order to test this question, the autistic children were divided into two groups, one of low verbal ability, and the other of higher verbal ability. Similarly, two groups of normal children were included, namely four-year-olds and five-year-olds. For the learning impaired control group this was not possible, since none of the children with Down's syndrome performed high enough to form a high verbal ability group. Therefore there was only one learning impaired control group which was comparable to the low verbal ability autistic children and the four-year-old normal children.

In addition to the high/low language level factor it has also been suggested that while some language skills are strongly related to the autistic child's ability to attribute mental states, other language skills are not (Eisenmajer & Prior, 1991). In this study autistic children who passed the false belief task had higher verbal MAs (PPVT scores), better comprehension and pragmatic skills than the children who failed. But the autistic children who passed and who failed the false belief task did not differ in terms of vocabulary scores

and chronological age (Eisenmajer & Prior, 1991). Therefore a third aim of experiment 2 was to investigate the relationship between the autistic children's ability to attribute knowledge and different aspects of language.

The fourth and final aim of the experiment 2 was to investigate whether referring to the child's own mental state was easier than referring to another person's mental state. Tager-Flusberg (1992) found that both autistic children and children with Down's syndrome were more likely to refer to their own cognitive mental states than those of other people's. In addition, in Perner et al.'s (1989) study although the autistic children's ability to refer to their mental state and to refer to other people's mental state was not significantly different, 13 of the 23 autistic children successfully attributed knowledge to themselves, but only 10 of the 23 attributed knowledge to another person.

The method of experiment 2 differed from that of experiment 1 in two ways. First, a second experimenter acted as another person rather than a second child acting as the other person. This was done in order to overcome possible difficulties of maintaining the cooperation and attention of two children with learning difficulties or with autism. Although it was possible with normal children, it was assumed that this would be difficult with autistic children. Second, children were asked about the colour of the hidden object rather than the location of that object, since Pillow (1989) has suggested that asking about the colour of an object, which is an perceptual quality, highlights the perceptual experience and may facilitate the child's performance.

9.2. Method

9.2.1. Subjects

Five groups of children were included in this study: two groups of autistic children, one with low language scores on the British Picture Vocabulary Scale (N=14) and one with higher language ability (N=14); two groups of normal children, four-year-olds (N=17) and

five year-olds (N=22) and one group of children with Down's syndrome (N=17). The autistic children were attending to special education schools or to units for autism in Birmingham, Oxford, Evesham, Milton Keynes, Temple Balsall and Stoke-on-Trent, and they all met the diagnostic criteria for autism (DSM-III-R, 1987). The children with Down's syndrome were attending to special education schools in Coventry, Leamington, Warwick, Rugby and Coleshill. Normal children were attending to a primary school in Warwick. All the subjects were recruited by contacting the school they were attending.

All five groups of children were administered the British Picture Vocabulary Scale (Dunn, Dunn, Whetton, and Pintilie, 1982), and the Renfrew Action Picture Test (Renfrew, 1988). In addition the autistic children and the children with Down's syndrome were given the Test of Reception of Grammar (Bishop, 1982).

The inclusion criteria for this experiment were:

Autistic children and children with Down's syndrome with language levels above four years, on two of the three language tests administered (BPVS, TROG and RENFREW Action Picture Test), were selected. Forty autistic children were sampled initially, five children who failed to meet the inclusion criteria and were excluded from the study. Then autistic children were divided into two groups on the basis of their BPVS scores. The autistic children with BPVS scores between 4;06 and 5;06 were assigned to the low language level group, and the autistic children with BPVS scores above 5;06 were assigned to the high language level group. Further seven autistic children who either was uncooperative or moved from the area, were excluded from the study.

For the learning disabled control group twenty four children with Down's syndrome were sampled. Seven of these children failed to meet the inclusion criteria and were excluded from the study.

For the normal control groups the inclusion criteria was to have four years above language level on the BPVS. Thirty one four-year-old children and twenty six five-year-old children

were sampled. Eleven of the four-year-olds and three of the five-year-olds failed to meet the inclusion criteria and these children were excluded from the study. Further three of the four-year-olds and one of the five-year-olds children who failed to complete the experimental task were excluded from the study. Table 9.1. shows the details of the five groups.

9.2.2. Materials

The materials consisted of three small tubular shape plastic food containers (coloured green, red and blue respectively) each containing marbles of the same colour as the container, and four small match-boxes wrapped as present (gift) boxes (see appendix 3.)

9.2.3. Procedure

The children were always seen individually outside their classroom in a quiet area of their school. On the first visit all the children were given the British Picture Vocabulary Scale and the Renfrew Action Picture Test. This helped to ensure that the main experimenter was equally familiar to all of the children. On the second visit the experimental task was administered. The autistic children and the children with Down's syndrome were seen on a third occasion when the Test of Reception of Grammar was administered.

Table 9.1. Means and ranges for chronological age and language ages of the five groups of subjects

		AGE	RENFREW *		TROG	BPVS
			Information	Grammar		
AUTISM LOW n=14	mean	10;08	6;06-6;11	4;00-4;05	5;09	4;11
	range	(7;07-14)	(4;06-8;05)	(3;06-7;11)	(4;03-8)	(3;08-5;06)
AUTISM HIGH n=14	mean	13;00	7;00-7;05	5;11-6;02	7;03	9;06
	range	(7;02-18;07)	(4;00-8;05+)	(3;06-8;05+)	(4;03-11+)	(6;04-15;11)
DOWN'S n=17	mean	11;08	5;06-5;11	3;06-3;11	4;11	5;05
	range	(8;05-18;02)	(3;06-8;05)	(-3;06-6;11)	(4;00-5;09)	(4;00-7;05)
4 YEARS n=17	mean	4;06	6;06-6;11	4;11-5;00	not	4;11
	range	(4;02-4;11)	(4;06-8;05)	(3;06-8;00)	administered	(4;02-6;03)
5 YEARS n=22	mean	5;09	7;00-7;05	5;11-6;00	not	6;03
	range	(5;02-6;02)	(5;00-8;05)	(4;00-8;00)	administered	(4;11-9;00)

* For the Renfrew Action Picture Test the mean raw scores were calculated and converted to the age equivalent.

9.2.3.1 Task

The experimental task involved two experimenters. The first experimenter, who was familiar to the children, began by asking the child whether she/he would like to play a game called "Which is the present?" The child was then introduced to the second experimenter and told that she was going to take turns with him/her. Then the first experimenter gave the following instruction: "Look I have three boxes of marbles, look this is a blue box full of blue marbles and this is a green box full of green marbles and look the other is a red box full of red marbles. I am going to give a marble to each of my friends as a present. This is a box to put the marble in (selecting one of the four gift boxes). When I have decided what colour marble I will give to my friend I am going to put it in this box. When it is your turn sometimes I will ask you to close your eyes; on other occasions I will let you see what colour marble I choose as a present. Then I will ask you whether you know or you guess the colour of the marble I chose. When it is (second experimenter's [name]) turn, you need to watch very carefully because I will ask you whether she knows or she guesses the colour of the marble I chose. Now could you show me the box with the blue marbles ? Could you show me the box with the red marbles ? Could you show me the box with the green marbles ?" Provided that the child could correctly identify the three colours the experiment began.

There were two conditions, "own" and "other", and in each condition there were two trials (a "know" trial and a "guess" trial). In the "own" condition the child either watched the experimenter choose a marble and put it in one of the gift boxes "know" trial) or closed his/her eyes while the first experimenter choose a marble and put it in a gift box ("guess" trial). The child was then asked two questions: "Did you see me choosing the marble?" (control question) and "Do you know or do you guess what colour marble I chose?" (experimental question).

In the "other" condition each child was reminded to watch carefully because the first experimenter was going to ask them whether the second experimenter knew or guessed the

colour of the marble chosen. The second experimenter then either watched the first experimenter choose a marble and put it in one of the gift boxes ("know" trial) or closed her eyes while the experimenter choose a marble and put it in a gift box ("guess" trial). The child was then asked two questions: "Did (the second experimenter's name) see me choosing the marble?" (control question) ; "Does (the second experimenter's name) know or does she guess what colour marble I chose?" (experimental question). Table 9.2. summarizes the conditions, trials and questions in "Which is the present?" task.

Table 9.2. "Which is the present?" task: Conditions, trials and questions

"OWN" CONDITION

TRIALS	QUESTIONS
KNOW (subject sees)	"Did you see me choosing the marble?" (control question)
	"Do you know or do you guess what colour marble I chose?" (experimental question)
GUESS (subject does not see)	"Did you see me choosing the marble?" (control question)
	"Do you know or do you guess what colour marble I chose?" (experimental question)

"OTHER" CONDITION

TRIALS	QUESTIONS
KNOW (second experimenter sees	"Did (the second experimenter's name) see me choosing the marble?' (control question)
	"Does (the second experimenter's name) know or does she guess what colour marble I chose?" (experimental question)
GUESS (second experimenter does not see)	"Did (the second experimenter's name) see me choosing the marble?" (control question)
	"Does (the second experimenter's name) know or does she guess what colour marble I chose?" (experimental question)

The order of the conditions (own and other), trials within each condition (know and guess) and questions (either know before guess or vice versa) were counterbalanced. The colour of the marble chosen was random.

9.2.4. Scoring

The children's responses were scored separately for the two conditions of own and other. In each condition the children were scored as pass if they answered both the know and the guess trials correctly (i.e. answered with know to the question on the know trial, and with guess on the guess trial). If they responded incorrectly on one trial or both trials they were scored as fail.

9.3. Results

All the children answered the control questions correctly, that is whether the child or the second experimenter had seen the experimenter hide the object. This suggests that all the children included in this study had no difficulty with perceptual perspective taking for themselves or for another person.

The first aim of experiment 2 was to compare autistic children's ability to differentiate "know" from "guess" on the basis of corresponding mental states (having specific knowledge about something or lacking that knowledge), to that of normal children and children with Down's syndrome. As in experiment 1, given that there are four possible ways of responding to the experimental questions it might be thought that a child could pass 25% of the time by chance. However it is possible that if the child was not able to differentiate "know" and "guess" in reference to their own and to another person's mental state, he/she might use either a know bias (tending to respond with "know" on both trials), or with a guess bias (tending to respond with "guess" on both trials). Thus, comparing actual performance with chance levels appears to be problematic. For this reason McNemar's tests were calculated to test whether the frequency of responding with "know" in the know trial was greater than responding with "know" in the "guess" trial. This is the

same analysis as carried out in experiment 1. For a more detailed explanation of the reasoning behind the use of this method see section 8.3.

For the five-year-old mainstream children the difference between the "know" responses in the know trial and "know" responses in the guess trial was significantly different for both conditions of "own" ($p<.0005$) and "other" ($p<.0005$). Similarly, the high language level autistic children gave significantly different "know" responses to the know and guess trials for both conditions of "own" ($p<.05$) and "other" ($p<.001$). In contrast, the "know" responses of the low language level autistic children, the children with Down's syndrome and the four-year-old mainstream children were not significantly different between "know" and "guess" trials for either condition - "own" or "other" (see appendix 4). In sum, these findings suggest that the high language level autistic children are similar to the five-year-old mainstream children in their performance on the differentiation of "know" from "guess". These two groups successfully differentiated "know" from "guess" when referring to their mental states and to the mental states of others.

In order to examine the effect of language level on the ability to differentiate the mental terms "know" and "guess" the performance of the autistic children was compared to that of the control groups of normal children and children with Down's syndrome. Therefore, the data were analysed for the effect of group and condition independently. Table 9.3. and figure 9.1. show the percentages of children in each group passing the "own" and "other" conditions. In the comparison of the five experimental groups there was a significant overall difference both in the "own" condition [χ^2 (df 4) = 12.70, $p<.013$] and in the "other" condition [χ^2 (df4) = 19.46, $p<.001$]. Tukey-type pairwise comparisons were performed for both conditions.

In the "own" condition, in which the subject attributes "knowing" or "guessing" to himself/herself, the five-year-old mainstream school children were significantly better at differentiating "know" from "guess" than both the children with Down's Syndrome [$q=4.194$, $p=.02$] and the low language level autistic children [$q=4.511$, $p=.01$]. In

addition, the high language level autistic children were better (but not quite significantly so) than the low language level autistic children [q=3.742, p=.06].

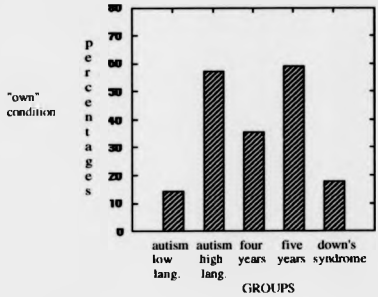
In the "other" condition, in which the subject attributes "knowing" and "guessing" to the other person, the higher language level autistic children were better at differentiating "know" from "guess" than the children with Down's syndrome [q=6.008, p=.0002], the low language level autistic children [q=4.335, p=.01] and the four-year-old mainstream school children [q=4.466, p=.01]. In addition the five-year-old main stream school children were better (but not quite significantly so) than the children with Down's Syndrome [q=5.268, p=.001] and the four-year-old mainstream school children [q=3.690, p=.06].

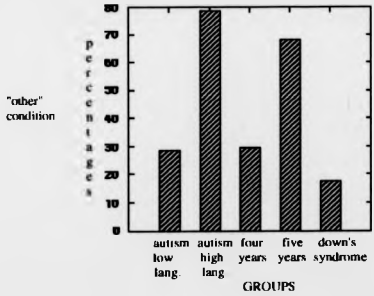
These results appear to support previous research indicating that verbal mental age plays an important role in autistic children's performance on theory of mind tasks requiring the ability to attribute mental states to oneself and others (Prior et al., 1990; Baron-Cohen, 1989a; Eisenmajer & Prior, 1991).

Table 9.3. Correct differentiation of "know" and "guess" in the own and other conditions in percentages and the number of children who passed and failed

	AUTISM (4;11)	AUTISM (9;06)	4 YEARS	5 YEARS	DOWN'S
N	14	14	17	22	17
OWN					
pass	2	8	6	13	3
fail	12	6	11	9	14
% pass	14.2 %	57.14 %	35.29 %	59.09 %	17.64 %
OTHER					
pass	4	11	5	15	3
fail	10	3	12	7	14
% pass	28.57 %	78.57 %	29.41 %	68.18 %	17.64 %

Figure 9.1. The percentages of correct differentiation of "know" and "guess" in the "own" and "other" conditions for the five groups: low language level autistic children, high language level autistic children, four-year-old and five-year-old normal children, and children with Down's syndrome.





The third aim of this experiment was to test the relationship between the autistic children's ability to attribute knowledge and different aspects of their language proficiency. To test whether different aspects of language competence were equally likely to predict the children's performance on the differentiation of "know" from "guess" for self and others, point biserial correlation coefficients were calculated between each of the language scores and the pass/fail dichotomy for the "own" and "other" conditions. For this analysis, the two autistic groups were combined into a single group, as were the two normal groups, so that the full range of language skills could be considered.

Table 9.4. Point Biserial correlations between the different language scores and the pass/fail dichotomy for own and other conditions for the groups of autistic, normal and Down's syndrome children. (TROG scores were not available for the normal children).

	"OWN" Condition		
	Autistic	**Normal**	**Down's syndrome**
Information[1]	.345	.009	.207
Grammar[1]	.629***	.131	.510*
BPVS	.604***	.396*	.116
TROG	.559**	--	.200
	"OTHER" Condition		
	Autistic	**Normal**	**Down's syndrome**
Information[1]	.144	.257	.047
Grammar[1]	.504**	.214	.160
BPVS	.447**	.249	.075
TROG	.475*	--	.182

*** $p<0.002$ **$p<0.01$ *$p<0.05$

1. Renfrew Action Picture Test

As can be seen from table 9.4, the Renfrew Action Picture Test grammar scores, the BPVS scores and the TROG scores predicted the Autistic children's performance on the differentiation of "know" and "guess" for both conditions. However a very different picture emerged for the normal and Down's Syndrome groups. For the normal children a significant correlation was obtained between the BPVS scores and performance in the own condition, and for Down's Syndrome children significant correlation was obtained between the Renfrew Grammar scores and performance in the own condition. There were no significant correlations for either of these groups in the other condition.

In order to examine what the various language tests were measuring, further correlation coefficients were calculated between each of the language tests for the groups of autistic, Down's syndrome and normal children. These are shown in table 9.5.

Table 9.5. Pearson correlation coefficients between BPVS, TROG and RENFREW INFORMATION and GRAMMAR scores for the groups of autistic, normal and Down's syndrome children. (TROG scores were not available for the normal children).

	Autistic	Normal	Down's
Inform.- Gram.	.659***	.140	.232
BPVS - Gram.	.638***	.423**	.237
TROG - Gram.	.663***	--	.136
Inform.- BPVS	.398*	.222	.498*
TROG - BPVS	.687***	--	.667**
Inform.- TROG	.430*	--	.484*
	*** p<0.002	**p<0.01	*p<0.05

The results show that for the autistic children all the correlations between the different language tests are highly significant. In contrast, for the normal children, the only significant correlation was between the Renfrew Grammar scores and BPVS scores. For the Down's syndrome children the Renfrew Information scores were significantly correlated with the BPVS scores and TROG scores and the BPVS scores were correlated with the TROG scores.

The fact that it was only in the autistic group that highly significant correlations were found between the different language scores and the pass/fail dichotomy for the "own" and "other" conditions, and between the different language tests seems to indicate that these language tests were perhaps measuring a general language competence for the autistic group but not for the normal children. The pattern of correlations among the Down's Syndrome children is more difficult to interpret. They seem to be intermediate between the autistic and the normal groups, but the analysis is based on a smaller sample size.

There was a significant difference in differentiating "know" and "guess" in both conditions of "own" and "other" between the high and low language ability autistic children. The two groups of autistic children were set up on the basis of their performance on the British Picture Vocabulary Scale which tests the child's receptive vocabulary. Since the BPVS is highly correlated with the TROG and the two scores from the Renfrew test, any of these language scores can predict the autistic children's performance on the differentiation of "know" from "guess".

Why were the language tests less successful at predicting the four-year-old and five-year-old normal children's performance on the task? We looked at two possible reasons for this. First, Hobson & Lee (1989) claimed that autistic adolescents were significantly worse on the emotional items than the non emotional items of the BPVS when compared to adolescents with learning difficulties. It is therefore possible that the emotional items in the language tests which were the predicting factor for the autistic children's performance on differentiating "know" and "guess" in the present study. Second, we investigated whether

the high correlations found in the autistic group were due to the wider range of BPVS scores for this group.

9.3.1. Hobson - Lee Effect

To investigate whether the emotional items in the BPVS were the predicting factor for the autistic children's ability to differentiate "know" and "guess", partial correlations were calculated between the BPVS scores and pass/fail dichotomy for each condition of "own" and "other", partialling out the effect of emotional items. Following Hobson and Lee, the following were taken to be emotional items: horror, delighted, disagreement, surprise, greeting, snarling, embracing and tranquil. The children received a score out of eight, for this subset of items, and this was used as the partialling variable. The partial correlation coefficients between the BPVS scores and the pass/fail dichotomy were significant for the "own" condition [partial $r=0.393$, $p=0.001$] and for the "other" condition [partial $r=0.2871$, $p=0.01$]. Therefore we can conclude that it is not just the performance on the emotional items that predict autistic children's performance on the "know" /"guess" task.

Furthermore, to test whether we could replicate Hobson and Lee (1989) finding with these data, a retrospective analysis was carried out on the BPVS items, comparing performance on the emotional versus the non-emotional items of the autistic children with that of the mainstream school children. Hobson and Lee's (1989) method was used in this further analysis. Children were scored pass or fail on the eight emotional items (horror, delighted, disagreement, surprise, greeting, snarling, embracing and tranquil). For a contrasting set of non-emotional items, usually the two items previous to each emotional item and two after it were scored as pass and fail. The scores were divided by 4 to give a maximum score of 8 for the non-emotional items comparable to the score for the emotional items. Table 9.6. shows the means and adjusted means for the emotional and non-emotional items for the groups of autistic and normal children.

Table 9.6. Means for the emotional and non-emotional items passed for normal and autistic children, with means adjusted for the effects of covariates.

		Emotional (maximum 8)	Non-emotional (maximum 8)
Autism	mean	4.036	4.125
	adjusted mean	3.743	3.920
Normal	mean	3.000	3.378
	adjusted mean	3.210	3.526

Table 9.7. A two way repeated measures analysis of variance table

	SS	DF	MS	F	P
Group	6.754	1	6.754	6.107	.016
Error	69.678	63	1.106		
emotion vs nonemotion	4.681	1	4.681	7.159	.009
Interaction	0.152	1	0.152	0.233	.631
Error	41.196	63	0.654		
Covariates					
emotional attempted	5.506	1	5.506	4.979	.029
non-emotional attempted	9.290	1	9.290	8.400	.005
Error	69.678	63	1.106		
em. vs non-em. x em. attempted	3.208	1	3.208	4.906	.03
em. vs non-em. xnon-em. attempted	1.580	1	1.580	2.416	.0125
Error	41.196	63	0.654		

A two way analysis of variance was carried out, groups (normal versus autistic) by items (emotional versus non-emotional), with repeated measures on the second factor. The numbers of emotional and non-emotional items attempted varied between the subjects since the number of items attempted reflects the general level a child reaches on the test e.g. the

number of words presented to a child before stopping the test. Therefore these two variables (the number of items attempted and the number of items passed) were entered into the analysis as covariates (see table 9.7). The main effect of group was significant [$F(1,63)=6.107$, $p=0.016$] with the autistic children scoring significantly higher than the normals. The subset of items examined emotional and non-emotional, thus seems to be easier for the autistic children, even though the total number of items passed has been partialed out. The main effect of items (emotional versus non-emotional) was also significant [$F(1,63)=7.159$, $p=0.009$] with the scores being higher on the non-emotional items.

The interaction between items (the emotional versus non-emotional passed) and group was not significant [$F(1,63)=0.233$, $p=0.631$]. Thus there was no evidence to support the hypothesis that the autistic children had particular difficulty with the emotional items. One of the covariates, the number of emotional words attempted, interacted with emotional versus non-emotional items passed [$F(1,63)=4.906$, $p=0.030$]. This means that the number of emotional items attempted was positively correlated with the difference between the emotional items passed and non-emotional items passed. This suggests that the more emotional items children attempt, the higher up they get on the test and the more likely they are to pass the emotional items. These results therefore failed to support Hobson & Lee's (1989) findings that autistic children have specific difficulty with the emotional items in the British Picture Vocabulary Scale.

9.3.2. Possible effect of the range of BPVS scores on the correlations

The higher correlations involving language scores for the autistic children might be explained by the normal children having a narrower range of language scores than the autistic children. As can be seen from the first and third columns of figures in table 9.8 ranges and SD's tend to be higher in the autistic group. This is also evident from a comparison of figures 9.2. and 9.3. which show the distributions of BPVS scores in autistic and normal children respectively, according to whether they passed or failed on the

know/guess task. To examine the possibility that it was the restricted range of scores in the normal sample which was responsible for the differences in the patterns of correlations, the autism sample was trimmed by removing the children with the five highest BPVS scores. The effect of this on ranges and SD's is evident in the second coloumn of figures in table 9.8., and its influence on the distributions can be seen in figure 9.4.

Table 9.8. Maximum, minimum, mean, range and standard deviations of the language test scores for the normal, Down's syndrome children and for the autistic children before and after the exclusion of five children who had very high scores on the BPVS.

		AUTISM high range (before trimming)	AUTISM low range (after trimming)	NORMAL	DOWN'S SYNDROME
INFO[1].	max.	40	37	38	36
	min.	27	27	28.5	22
	mean	34.	33.5	34.2	32.3
	range	13	10	9.5	14
	SD.	2.7	2.5	2.2	3.4
GRAM[1].	max.	33	30	30	27
	min.	12	12	15	8
	mean	22.2	20.7	23.2	14.5
	range	21	18	15	19
	SD.	6.1	5.6	4.2	4.7
BPVS[2]	max.	15;11	8;09	9;00	7;05
	min.	3;08	3;08	4;00	3;10
	mean	7;02	5;10	5;08	5;05
	range	12;03	5;00	5;00	3;95
	SD.	3.2	1.4	1.2	1.3
TROG[2]	max.	11;00	11;00	--	5;09
	min.	4;03	4;03	--	4;00
	mean	6;06	5;11	--	4;11
	range	6;97	6;97	--	1;09
	SD.	2.1	1.7	--	.5

[1] Renfrew Information and grammar raw scores are reported

[2] BPVS and TROG age equivalents are reported

Figure 9.2. Plot of BPVS age equivalencies in months for autism group for the conditions of "own" and "other".

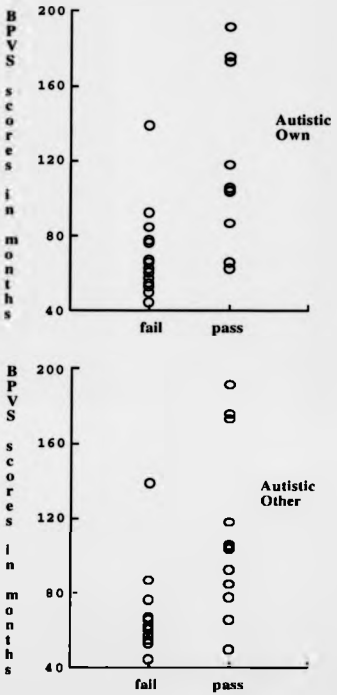
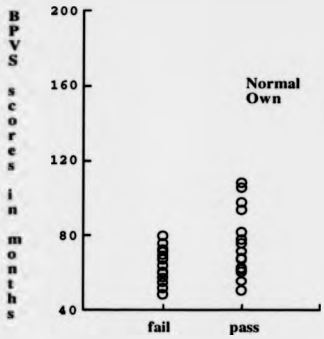


Figure 9.3. Plot of BPVS age equivalencies in months for normal children for the conditions of "own" and "other"



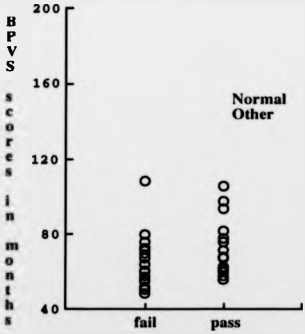
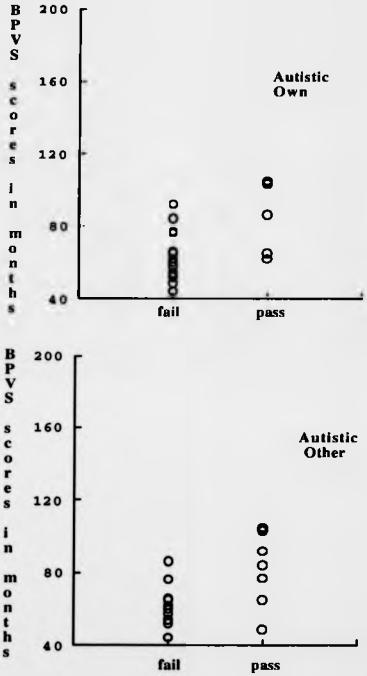


Figure 9.4. Plot of BPVS age equivalencies in months for the autistic group for the conditions of "own" and "other" after excluding five children with the highest BPVS scores



Further point biserial correlation coefficients were calculated between each of the language tests and the pass/fail dichotomy for the own and other conditions for the autistic group using the trimmed range of BPVS scores. Table 9.9. shows the correlations between the language tests and pass/fail dichotomy for the own and other conditions for the autistic group with the low and high range, and for the normal and Down's syndrome children. As can be seen from the table 9.9. reducing the range of the BPVS scores for the autistic group had little effect on the correlations. The ranges and SD's of language scores in the "trimmed" autism group are still not precisely the same as in the normal group, but it is quite clear from figure 9.4. that the worst effects of extreme values have been removed. (To trim away more of the autistic group would mean that the point biserial correlations could not meaningfully be calculated.)

Table 9.9. Point biserial correlations between the different language scores and the pass/fail dichotomy for the own and other conditions for the autistic, normal and Down's syndrome groups before and after excluding five children from the autistic sample who had very high scores on the BPVS.

	"OWN" Condition			
	Autism high range (before trimming)	**Autism low range** (after trimming)	**Normal**	**Down's syndrome**
Information[1]	.345	.207	.009	.207
Grammar[1]	.629***	.558**	.131	.510*
BPVS	.604***	.572**	.396*	.116
TROG	.559**	.504**	--	.200

	"OTHER" Condition			
	Autism high range	**Autism low range**	**Normal**	**Down's Syndrome**
Information[1]	.144	.036	.257	.047
Grammar[1]	.504**	.476*	.214	.160
BPVS	.447**	.534**	.249	.075
TROG	.475*	.499**	--	.182

*** $p<0.002$ **$p<0.01$ *$p<0.05$

[1] Renfrew Action Picture Test

Further correlation coefficients were calculated between the different language tests for the autistic group using the low range on the BPVS scores. Table 9.10. shows the correlations between the different language tests for the groups of normal, Down's syndrome children and for the autistic group with the high and low range.

Table 9.10. Pearson correlation coefficients between BPVS, TROG and RENFREW INFORMATION and GRAMMAR scores before and after excluding five children from the autistic sample who had very high scores on the BPVS.

	Autism high range	Autism low range	Normal	Down's
Inform.- Gram.	.659***	.589**	.140	.232
BPVS - Gram.	.638***	.529**	.423**	.237
TROG - Gram.	.663***	.541**	--	.136
Inform.- BPVS	.398*	.237	.222	.498*
TROG - BPVS	.687***	.367	--	.667**
Inform.- TROG	.430*	.256	--	.484*

*** $p<0.002$ **$p<0.01$ *$p<0.05$

After trimming the sample of autistic children for very high BPVS scores, the correlations between Renfrew Information and BPVS, Renfrew information and TROG, and between BPVS and TROG scores ceased to be significant. Not surprisingly, the correlations involving BPVS scores show the biggest effect of removing the extreme BPVS scores, but the effect on the correlations involving TROG scores is also quite marked - presumably because the standard deviations of the TROG scores (relative to the means) was quite markedly affected by the trimming procedure (see table 9.8.). The correlation showing the biggest change is that between TROG and BPVS scores. These effects are just what would be expected for reducing the range of scores. They contrast with the general lack of an effect of the trimming procedure on the point biserial correlations between the language scores and the performance on the experimental task. These latter correlations therefore do not seem to be due to a statistical artefact.

Finally, to establish whether the "own" and "other" conditions differed in difficulty (the fourth aim of the experiment), McNemar's test (exact binominal procedure) was performed for each group to compare "own" and "other" conditions. None of these differences reached significance. Nor was the comparison significant when the data were pooled across groups.

9.4. Discussion

The first aim of experiment 2 was to investigate whether autistic children can differentiate the cognitive mental terms "know" and "guess" in reference to their and to another person's mental states. In experiment 2 as in experiment 1, on each trial children were asked the experimental question before they found out the outcome (i.e. by looking into the gift box to see what colour marble was in it). This ensured that the child was basing his/her judgement (whether he/she or the second experimenter knew or guessed the colour of the marble the first experimenter had chosen) on either his/her or another person's mental state. Thus, a successful differentiation of these mental terms, in reference to corresponding mental states, can be taken as evidence that the child is able to understand the underlying mental states of having specific knowledge and lacking that knowledge.

The first sets of analysis (McNemar tests) showed that while high language level autistic children and five-year-old normal children were able to differentiate know and guess in reference to their own and another person's mental states, low language level autistic, four-year-old normal children and children with Down's syndrome were not. This finding suggests, first that mental state attribution is not absent completely in all autistic children, since the high language level autistic children successfully differentiated know and guess on the basis of relevant mental states. Second, it seems that the children's ability to pass the present task was related to their language levels. This was supported with further analysis. In comparing the groups, high language level autistic children (with mean BPVS score age equivalent of 9;06 and TROG age equivalent of 7;03) were superior (approaching

significance p=.06) than low language level autistic children (with mean BPVS age equivalent of 4;11 and TROG age equivalent of 5;09) in their ability to differentiate know from guess in reference to their own mental states. In addition, the five-year-old normal children (BPVS age equivalent of 6;03) were significantly better than the low language level autistic children and children with Down's syndrome (BPVS age equivalent of 5;05 and TROG age equivalent of 4;11) in their ability to differentiate know from guess in reference to their own mental states.

In reference to another person's mental states, the high language level autistic children were significantly better than the other three groups with lower language scores, namely low language level autistic children, children with Down's syndrome and four-year-old normal children, in their ability to differentiate know from guess. The five-year-old normal children were significantly better than 4-year-old normal children and children with Down's syndrome.

These findings indicate that autistic children are able to attribute knowledge (know) and the lack of that knowledge (guess) to themselves and others, depending on their language level. These findings extend what is known from the previous studies in the literature. Perner et al.'s (1989) study was similar to the present experiment in that the child was to judge either his/her or the second experimenter's knowledge on the basis of whether the person had visual access to the critical information. Perner et al.'s results showed that 56 % of the autistic children were able to attribute knowledge to themselves and 43 % to another person. As can be seen from table 9.11, the autistic children's language level in their study fell between the levels of the two autistic groups included in the present study, and one would therefore expect them to perform at the level between the two groups in the present study. The performance of the subjects in Perner et al.'s study was intermediate between that of the two groups in the present study, although it was closer to that of the high language level autistic children in the present study. This could be explained by the different criteria adopted in the two studies for passing the own and other conditions. In Perner et al.'s study, the child was scored as passed if he/she answered one knowing

question for self ("Do you know which object I put into the cup?") and one for the other person ("Does the [name of the second experimenter] know which thing I put into the cup?"). In the present experiment a child had to pass both know and guess questions in order to be scored as pass for self.

Table 9.11. A comparison of the results of experiment 2 with those of previous studies

	Language level (BPVS)	Self	Other
Perner et al. (1989)	(mean=6;02 [3;01-12;08])	56%	43%
Leslie & Frith (1988)	(mean=7;02 [4;05-12;08])	not applicable	61%
Experiment 2	(mean=4;11 [3;08-5;06])	14.2%	28.57%
	(mean=9;06 [6;04-15;11])	57.14%	78.57%

In one of the tasks in Leslie and Frith's (1988) study, the child and the second experimenter watched the first experimenter hide a red counter in one of three locations and then the second experimenter left the room. In the absence of the second experimenter the child was asked to hide a second red counter in a different location. The child was then asked whether the second experimenter knew the location of the second counter that the child had just hidden, and where the second experimenter would look for the counter when she came back. 61% of the autistic children were able to answer the knowing question, but only 44% were able to answer both the knowing and the prediction questions. Although Leslie and Frith (1988) adopted a strict criterion in which the child had to answer both questions correctly to be scored as pass for knowledge attribution, in table 9.11. only the percentage of children who passed the knowing question is included. Since it seems likely that the prediction question is harder than the knowing question. The prediction question requires a child to predict the person's behaviour on the basis of that person's knowledge state rather than directly testing the child's ability to understand whether the person has specific knowledge.

In considering only the pass rate for the knowing question in Leslie and Frith's (1988) study (61%), the autistic children's performance seems to be comparable to the results of the present study. In Leslie & Frith's study the autistic children had a mean language level of 7;02 years and in experiment 2 the high language level autistic children had a mean language level of 9;06, and 61 % and 78.5 % of children were able to make knowledge attribution in their and in the present study respectively (see table 9.11.).

Furthermore, correlations between the children's ability to differentiate "know" from "guess" in reference to their and to another person's mental states, and their performance on the different language tests was highly significant for the autistic children but not for the normal children and the children with Down's syndrome. This difference between the groups could not be explained as a statistical artifact such as a restriction in the range of scores in the normal group, since when the range in the autistic group was reduced, the picture was largely unchanged. In addition, following Hobson & Lee's (1989) finding that autistic adolescents have specific difficulties on the emotional items of the BPVS, further correlations were calculated by partialling out the effect of the emotional items. The relationship between the children's performance on both conditions of "own" and "other" in the present experiment and their BPVS scores remained to be significant. Thus, it appears that the relation between the autistic children's language level and their performance on the task is strong and cannot be explained by other factors.

This finding supports and strengthens the previous studies which suggested that the higher the autistic child's verbal mental age the more likely that she/he will succeed on theory of mind task (e.g. Leslie & Frith, 1988; Baron-Cohen, 1989a; Eisenmajer & Prior, 1991; Prior, Dahlstrom & Squires, 1990).

In experiment 2 when the children were asked to judge their own knowledge with "Do you know or do you guess what colour marble I chose?" all they need to do was to check their mental representation of the colour of the marble in the gift box (see figure 9.5), which does not require metarepresentational skills. If the child saw what colour marble the

experimenter choose and put in the gift box, he/she should have a representation of the colour of the marble in the gift box and, by referring to this representation, the child could give the correct answer which is "I know". If the child did not see the experimenter chose a marble, the child could not have formed a representation of the colour of the marble in the gift box and, on the absence of this knowledge, he/she should give the correct answer "I guess".

In contrast, when children were asked to judge the second experimenter's knowledge with "Does she know or does she guess what colour marble I chose?", they needed to refer to other person's mental state. This requires metarepresentational skills (see figure 9.6). High language level autistic and five-year-old normal children were able to answer these questions which indicates that they had the required metarepresentational skills, that is the ability to represent someone else's representation.

The findings of experiment 2 have important implications for the theory of mind account of autism which suggests that autistic children lack these metarepresentational skills. In this experiment, while low language level autistic children were unable to refer to their own or to another person's mental states, high language level autistic children were able to do so. Furthermore, the strong relation between their performance and their language levels seems strongly to suggest that the metarepresentational deficit is not a primary one, and also not specific to autism since the children with Down's syndrome performed at a similar level to the low language level autistic children. This finding conflicts with the findings of previous studies where children with Down's syndrome have been shown to be able to attribute mental states to others (Baron-Cohen et. al., 1985 and 1986). For instance, in Baron-Cohen et. al.'s (1985) study, 85% of the Down's syndrome control group, who had a mean verbal mental age on the BPVS of 2;11 (range 1;08-4;00), passed the false belief task which required metarepresentational skills. It seems difficult to explain the high performance of the children with Down's syndrome in their study, since metarepresentational skills are normally acquired around the age of four. Similarly, in Baron-Cohen (1989a) the children with Down's syndrome had mean verbal MA of 4;07,

and 60% of them were able to make second order belief attribution which has been shown to developed around the age of 7 in normal children. Somewhat differently, in Baron-Cohen et. al.'s (1986) study the Down's syndrome children with a mean BPVS verbal mental age of 2;09 (range 1;08-4;00), performed less well than normal 4;05 year-old children on a task testing their ability to attribute a false belief to a story character. This result is consistent with their verbal MA level. However, returning to the performance of the children with Down's syndrome in the present experiment (BPVS age equivalent 4;00 to 7;05), their performance on the task was comparable to that of the four-year-old normal children who also failed to pass the task.

Finally, the results of experiment 2 have indicated that children's ability to differentiate "know" and "guess" in reference to their own mental states was similar to their differentiation of these mental terms in reference to another person's mental states (for all five groups included in this experiment). Following the results of experiment 1, children who are able to attribute mental states to another person should be able to attribute mental states to themselves, since it seems that referring to one's own mental states is easier since it does not require metarepresentational skill (see figure 9.5). This could explain the absence of any difference in the high language level autistic and five-year-old normal children's performance in the own and other conditions. However, for the four-year-old normal children, children with Down's syndrome and the low language level autistic children, one might expect them to be able to refer to their own mental states since this does not seem to require metarepresentational skills. In other words even if they have not reached the stage of being able to attribute mental states to others (which requires metarepresentational skills according to Perner, 1991) they should be able to refer to their own mental states.

It is clear that this task, both the own and the other conditions, was hard for the four-year-old normal children but it was within the five-year-old children's ability range. There may be a number of reasons for this. First, the question form may have made the task harder for the younger children. For instance, Pratt and Bryant (1990) demonstrated that double-

barrelled questions are harder than single-barrelled questions. In experiment 2 the experimental questions were double barrelled e.g. "Do you know or do you guess what colour marble I chose?". Therefore in experiment 3 single-barrelled experimental questions were used.

Another possible explanation could be that adopting a strict criterion in which the child had to pass both know and guess questions influenced the results. In the next experiment each experimental question was repeated twice and the data analysed in two ways, according to the strict criterion and by considering each of the correct responses for each experimental question.

Finally, a number of studies investigating children's understanding of the difference between "know" and "guess" as mental terms (e.g.Johnson & Wellman, 1980; Miscione et al., 1978 and Moore et al., 1989) have considered that "know" implies the existence of specific knowledge while "guess" implies the lack of that specific knowledge. In other words, while "know" presumes the truth, "guess" can either be true or false. Although it was ensured that children answered the experimental questions before they found out about the outcome (i.e. the colour of the marble in the gift box), it is possible that "guess" was not the most appropriate word to refer to the mental state of lacking a specific knowledge. Therefore, in experiment 4 children were made to refer to their own and to another person's mental states using "know" and "does not know" questions. Perner (1991) argued that the best way to test the child's understanding of knowledge as a mental state is the lucky guess task. In this task a child is asked to find a hidden object even if she/he did not have visual access to the hiding of that object and is asked whether she/he knew or guessed that the object was in that specific location. This method ensures that the child basis her/his judgment on his/her mental state rather than on the outcome. However, it seems that asking the experimental question before letting the child find out about the outcome, is a perfectly adequate way to ensure that the child is basing her/his judgement on the relevant mental state rather than on the outcome.

Figure 9.5. The representational skills required in the own condition of experiment 2.

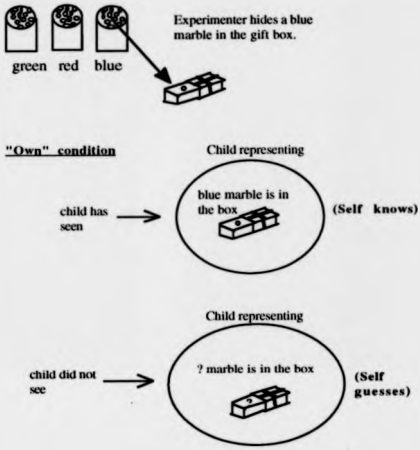
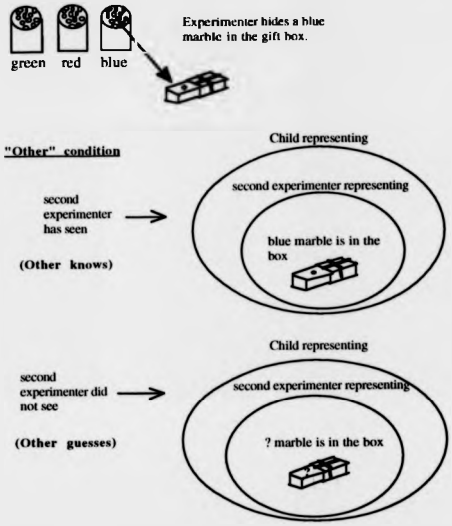


Figure 9.6. The representational skills required in the other condition of experiment 2.



10. CHAPTER TEN

Experiment 3.

Testing the replicability of the findings from experiment 2 using a different task

10.1. Introduction

The results of experiment 2 indicated that autistic children are able to attribute the mental state of knowledge to themselves and to others. This finding suggests that not all autistic children have a metarepresentational deficit, which contradicts the theory of mind account of autism. In order to examine whether the results of experiment 2 were task specific, another paradigm was designed. Thus, the first aim of experiment 3 was to replicate the findings of experiment 2 using a different task. The present task differed from the previous one in three ways. First, a simpler single-barrelled experimental question was used to test whether this would result in an improvement in the children's ability to differentiate "know" and "guess". Second, the main experimenter took the part of the "other" person to overcome the practical difficulty of finding a second experimenter. Third, each test question was repeated twice to enable the use of a 2x2 analysis of variance to examine condition effects ("own" versus "other" responses), group effects and the interaction effects. In addition a practice trial was included to ensure that children understood the task.

10.2. Method

10.2.1. Subjects

Five groups of children were included in this experiment: two groups of autistic children, one of children with low language scores on the British Picture Vocabulary Scale (N=13) and one of children with higher language scores (N=12); two groups of normal children, four-year-olds (N=25) and five-year-olds (N=18) and one group of children with Down's syndrome (N=17).

Apart from one child with autism and one child with Down's Syndrome, all the children had previously participated in experiment 2. Since the time lag was less than three months between the two experiments, the language tests (British Picture Vocabulary Scale, Renfrew Action Picture Test and Test of Reception of Grammar) were not repeated. The inclusion criteria for experiment 3 were the same as experiment 2. Autistic children and

children with Down's syndrome who had language levels of four years and above on two of the three language tests were included in experiment 3. Then autistic children were divided into two groups on the basis of their BPVS scores. The autistic children with BPVS scores between 4;06 and 5;06 were assigned to the low language level group, and the autistic children with BPVS scores above 5;06 were assigned to the low language level group. Table 10.1. shows the details of the five groups.

10.2.2. Material

The materials consisted of a wooden box (16x11x7cm), a bag made of red opaque material and five small plastic animals (cow, duck, pig, horse, sheep) (see appendix 5.).

10.2.3. Procedure

The children were seen individually outside their classrooms in a quiet area of their school. Each child was asked whether she/he would like to play an animal hiding game. The task began by telling the child she/he was going to take turns with the experimenter to hide an animal in the box. The child was then shown all the animals and asked to name each animal to check that she/he could identify them. Then the child was told that, when it was his/her turn, the experimenter would close her eyes and the child would choose one animal from the bag and hide it in the box and tell the researcher to open her eyes. When it was the experimenter's turn she would choose one animal from the bag and hide it in the box while the child closed his/her eyes.

All the children were given a practice trial to ensure that they understood the procedure and could cope with the structure of the question. In the practice trial the experimenter always closed her eyes while the child choose an animal from the bag. Then, the child was asked "Who chose the animal, you or me ?" and "Who closed their eyes, you or me?" Provided that the child passed the practice trial she or he was told that they would start the game.

Table 10.1. Means and ranges of chronological ages and the language scores of children with autism and children with Down's Syndrome on BPVS, RENFREW and TROG.

		Chronological AGE	RENFREW * Information	RENFREW * Grammar	TROG	BPVS
AUTISM LOW n=12	mean	10;06	6;06-6;11	4;00-4;05	5;10	5;01
	range	(6;08-14)	(6;00-7;11)	(3;06-7;11)	(4;06-9;00)	(4;06-5;06)
AUTISM HIGH n=13	mean	13;04	7;00-7;05	5;06-5;11	7;05	9;06
	range	(7;04-19;02)	(5;00-8;05+)	(3;06-8;05+)	(4;03-11+)	(6;04-15;11)
DOWN'S n=17	mean	11;07	5;09-6;02	3;06-3;11	4;10	5;03
	range	(8;05-18;02)	(3;06-8;05)	(-3;06-6;11)	(4;00-5;03)	(4;00-7;02)
4 YEARS n=25	mean	4;04				
	range	(3;10-4;09)				
5 YEARS n=18	mean	5;00				
	range	(4;10-5;03)				

* For Renfrew Action Picture Test the mean raw scores were calculated and the mean raw score converted to the age equivalent.

The children were given four trials in which either the experimenter (2 trials) or the child (2 trials) was the hider, i.e. either the experimenter or the child knew which animal was in the box while the other person guessed which animal was in the box. After an animal had been hidden the child was asked "Who knows which animal is in the box, you or me?" and "Who guesses which animal is in the box, you or me?" To avoid problems caused by children with personal pronoun reversal (there were three such children in the autistic sample) the experimenter either pointed to the child and said "you", or pointed at herself and said "me", this encouraged children to point to the person while they said "you" or "me".

The order of the trials (child hides or the experimenter hides), questions (who knows-who guesses), and the order of person (you or me) was counterbalanced across the groups. Table 10.2. shows one possible order of the trials and the questions.

Table 10.2. Animal hiding task: trials and questions.

TRIALS	QUESTIONS
Practice	"Who chose the animal, you or me ?"
	"Who closed their eyes, you or me?"
1. Child hides	
	"Who knows which animal is in the box, you or me ?" **(self-knows)**
	"Who guesses which animal is in the box, you or me ?" **(other-guesses)**
2. Experimenter hides	
	"Who knows which animal is in the box, you or me ?" **(other-knows)**
	"Who guesses which animal is in the box, you or me ?" **(self-guesses)**
3. Child hides	
	"Who knows which animal is in the box, you or me ?" **(self-knows)**
	"Who guesses which animal is in the box, you or me ?" **(other-guesses)**
4. Experimenter hides	
	"Who knows which animal is in the box, you or me ?" **(other-knows)**
	"Who guesses which animal is in the box, you or me ?" **(self-guesses)**

10.2.3. Scoring

Each correct answer to each of the eight experimental questions was given a score of 1. The correct answers for the trials shown in Table 10.2 were: self knows (me trials 1 and 3; know questions); self guesses (me trials 2 and 4; guess questions); other knows (you trials 2 and 4; know questions); other guesses (you trials 1 and 3; guess questions).

10.3. Results

All the children passed the practice trial indicating that they understood the task and they had no difficulty with the question structure particularly the phrase "you" or "me". Two different types of analysis were carried out.

10.3.1. Chi-Square Analysis

In order to test whether the results of experiment 2 were replicable, scores of self knows, self guesses, other knows and other guesses were combined to give a score for "own" (whether they could differentiate know from guess when referring to their own mental states) and a score for "other" (whether they could differentiate know from guess when referring to another person's mental states). The following criteria were used. If a child passed the questions of self knows and self guesses on both relevant trials she/he was given the score of 1; if she/he failed both questions of self knows and self guesses she/he was given the score of 0; if a child passed both self knows and only one of the self guesses questions or if a child passed both of the self guesses and only one of the self knows questions he/she was given the score of 0 for own. Identical criteria applied to the "other" responses.

The data were analysed for the effect of group and condition independently. When the five experimental groups were compared there was a significant overall difference for "own" [$\chi^2(4)=13.369$, $p=.01$] and for "other" responses [$\chi^2(4)=15.227$, $p=.004$]. Table 10.3. and Figure 10.1. show the numbers and percentages of children in each group passing the "own" and "other" responses. Tukey-type pairwise comparisons were performed for both "own" and "other" responses.

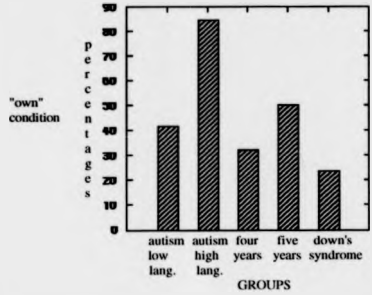
Table 10.3. Number of children, and percentage of each group, who correctly differentiated "know" and "guess" in the own and other conditions.

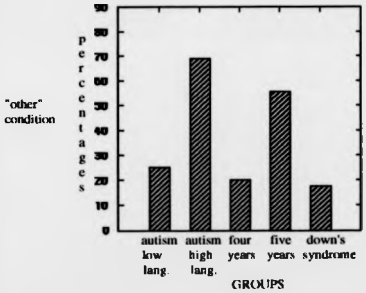
	AUTISM low lang. level	AUTISM high lang. level	4 YEARS	5 YEARS	DOWN'S
N	12	13	25	18	17
OWN					
pass	5	11	8	9	4
fail	7	2	17	9	13
% pass	41.66 %	84.61 %	32 %	50 %	23.52 %
OTHER					
pass	3	9	5	10	3
fail	9	4	20	8	14
% pass	25 %	69.23 %	20 %	55.55 %	17.64 %

The post hoc tests showed that for "own" responses, in which the subject attributes "knowing" and "guessing" to herself/himself, the high language level autistic children were significantly better at differentiating "know" from "guess" than both the children with Down's syndrome [q=6.019, p=.0002] and the four-year-old mainstream school children [q=5.437, p=.001]. No other pairwise differences were significant.

A similar pattern of results was obtained for "other" responses, in which the subject attributes "knowing" and "guessing" to another person. The high language level autistic children were significantly better at differentiating "know" from "guess" than both the children with Down's syndrome [q=4.620, p=.009] and the four-year-old mainstream school children [q=4.612, p=.009]. No other pairwise differences were significant.

Figure 10.1. The percentage of correct differentiation of "know" and "guess" for the own and other responses for five groups: low language level autistic children, high language level autistic children, four-year-old and five-year-old normal children, and children with Down's syndrome.





10.3.2. Comparison of performance for "own" and "other" responses with chance levels

There were four questions which referred to the child's own mental state and four questions which referred to the other person's mental state. Since there was a forced choice answer of "me" or "you", by chance the children would pass two of the four experimental questions, when referring to self and similarly two questions when referring to the other person. In addition, if the child had a response bias such as to give "me" answers throughout the task he/she would pass all the questions which referred to self, and if the child had a response bias to give "you" answers throughout the task he/she would pass all the questions which referred to the other. Inspection of the data showed that none of the children had such biases in this experiment. However there were two other bias types which some children adopted. One bias type was to say the hider "knows" which animal is in the box, and the hider "guesses" which animal is in the box (type 1); and the other was to say that the person who was not the hider "knows" and "guesses" (type 2) Table 10.4 shows the number of children in each group who demonstrated these biases. With a bias type 1, a child would get know questions right, and with bias type 2, a child would get the guess questions right. Thus the child who showed one of these biases would pass 2 of the 4 questions referring to self, and 2 of the 4 questions referring to the other person . This is the same as passing these self and other reference questions by chance.

Table 10.4. The number of children who showed two the types of response bias in each group

GROUP	TYPE 1 BIAS PERSON WHO IS THE HIDER "knows" and "guesses"	TYPE 2 BIAS PERSON WHO IS NOT THE HIDER "knows" and "guesses"
4-year-olds	4	3
5-year-olds	1	3
Down's syndrome	5	3
High language level autistic	0	1
Low language level autistic	0	0

To investigate whether the children's performance exceeded chance levels, paired t tests were carried out for each group and for each response type (in reference to self and in reference to another person) separately, using the number of correct responses versus the number of correct answers expected by chance (2).

When referring to the child's own mental state, the high language level autistic children [t(12)=8.12, p<.0005] performed better than chance, as did the children with Down's syndrome [t (16)=2.04, p<.05], the four-year-old normal children [t (24)=2.97, p<.007] and the five-year-old normal children [t (17)=5.35, p<.0005]. The performance of the low language level autistic children approached significance [t (11)=2.01, p<.06]. This indicates that except for the low language level autistic children, all the children were able to attribute knowing and guessing to themselves better than chance level.

When referring to another person's mental states, the high language level autistic children performed better than chance level [t (12)=4.18, p<.001], as did the four-year-old normal children [t (24)=3.05, p<.005] and the five-year-old normal children [t (17)=5.5, p<.0005] This indicates that those children were able to attribute knowing and guessing to another person better than chance level.

To compare whether the passing rate for the "own" and "other" responses differed McNemar's tests (exact binominal procedure) were performed for each group. None of these comparisons reached significance. Nor was the comparison significant when the data were pooled across the groups. This result is also consistent with the finding from the experiment 2 that there is no evidence to support the view that differentiating "know" from "guess" when referring to the child's own mental states is easier than when referring to another person's mental states.

10.3.3. Analysis of variance

It should be noted that the strict criteria for passing "own" and "other" questions may underestimate the children's performance since those who failed only one of the two know or one of the two guess questions for either own or other were given a score of 0 for the own or other responses respectively. For instance, a child who passed both the self knows questions, but only one of the self guesses questions, was given a score of 0 for own responses.

For a more fine-grained analysis, scores for self knows, and self guesses were summed. This would give the total score of "own" responses ranging from 0 to 4. Similarly the scores of other knows and other guesses were summed to give the total score of "other" responses ranging from 0 to 4. Table 10.5. shows the mean scores of "own" and "other" responses calculated in this way for five groups of children.

A two-way analysis of variance, groups x own versus other with repeated measures on the second factor, was performed. This showed that there was a significant difference between the groups [$F(4,80)=5.039$, $p=.001$], but that the difference between the response types of "own" and "other" was not significant [$F(1,80)=1.79$, $p=.185$]. The interaction was also non-significant [$F(4,80)=.301$, $p=.877$]. These results confirm that there is no difference in the children's ability to differentiate "know" from "guess" with reference to their own mental states and to another person's mental states.

Table 10.5. Mean scores for the own and other responses for five groups of children (maximum score is 4).

	AUTISM low lang. level	AUTISM high lang. level	4 YEARS	5 YEARS	DOWN'S
N	12	13	25	18	17
OWN	2.75	3.69	2.64	3.16	2.52
OTHER	2.41	3.38	2.56	3.22	2.29
group means	2.58	3.53	2.6	3.19	2.40

Tukey post hoc tests showed that the high language level autistic children were significantly better at differentiating "knowing" from "guessing" with respect to their own and to another's mental states than the low language level autistic children [q=4.03, p=.04], the four-year-old mainstream children [q=4.62, p=.01] and the children with Down's syndrome [q=5.21, p=.004]. In addition the five-year-old mainstream children were better than the children with Down's syndrome [q=3.97, p=.04] at this differentiation. These results support the previous findings that higher verbal mental age has an important role in determining children's performance on theory mind type of tasks which require the ability to attribute mental states to oneself and others.

Interestingly, giving each child a score between 0 and 4 based on the number of questions correctly answered, seems to be more sensitive to subtle differences between the performances of the different groups.

10.4. Discussion

The main aim of experiment 3 was to replicate the results of experiment 2 by using a different task. The main difference was that in experiment 3, the children were asked single-barrelled questions which it has been suggested are easier than double-barrelled questions (Pratt and Bryant, 1990). Thus, it was predicted that overall all the groups in this experiment might perform better than in experiment 2. Although the children did seem to find the question type easier in experiment 3 than in experiment 2 it was not possible to examine this statistically because of other differences in procedure between the two experiments, and because some but not all of the subjects took part in both experiments.

Group comparisons showed that the high language level autistic children were significantly better than the low language level autistic children, the children with Down's syndrome and the four-years-old normal children in the ability to attribute knowing and guessing to themselves and to another person. In addition the five-year-old normal children were significantly better than the children with Down's syndrome in their ability to attribute knowing and guessing to themselves and to another person. These groups differences are similar to the findings of experiment 2, and support the conclusion that the child's verbal abilities are an important determinant of their performance on theory of mind type tasks. This experiment also showed that autistic children, depending on their verbal MAs are able to attribute mental states to themselves and to another person. Although in this experiment the relations between the language scores and the children's performance on the task have not been calculated, the differences between the high and low language level autistic children, between the high language level autistic children and the children with Down's syndrome, between the high language level autistic children and the four-year-old normal children, between the five-year-old normal children and the children with Down's syndrome support the findings of experiment 2 that children's language ability appears to be important factor for their performance on tasks requiring mental state attribution.

Thus overall, the results of this experiment support the results of experiment 2 and suggest that the findings are not confined to a particular task.

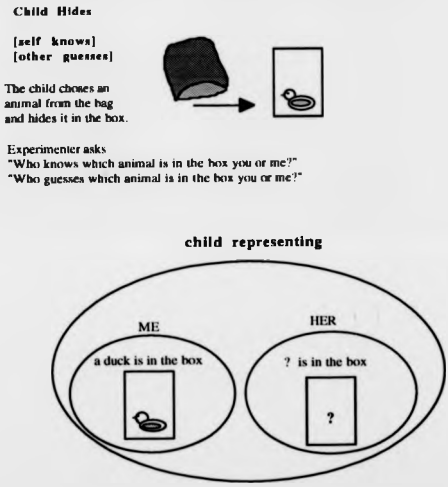
However there appear to be some problems with the task used in experiment 3. One of the possible shortcomings of this study was giving both questions of "who knows" and "who guesses" on each trial. This may have led children to give the opposite answer to the second questions without the child realising that this was necessarily the correct answer. For instance, if a child answered the "who knows" question with "me" he/she may answer the second question "who guesses" with "you". This was remedied in the next experiment when the children were asked only one question per trial.

Furthermore, the question type in experiment 3 may have required higher level representational skills. For instance, in order to answer the experimental question "Who knows which animal is in the box you or me?" the child needs to choose the person who had the relevant knowledge (has the relevant mental state) which might have required a comparison of his/her mental state with that of the experimenter's mental state (see figure 10.2). Thus, in both cases where the correct answer referred either to the child's own mental state (e.g. child knows) or the experimenter's mental state (e.g. experimenter knows), the child needed to have metarepresentational skills to pass the task. Therefore the questions referring to the child's own mental states should be as difficult as the questions referring to the experimenter's mental states. In other words one would not expect a difference between own and other responses. The results confirmed this, showing that the children's ability to refer to their own mental states did not differ from their ability to refer to another person's mental states.

A second shortcoming of this task was that the child may answer the experimental questions not on the basis of her/his or the experimenter's mental state but by associating knowing with hiding and guessing with not hiding. For instance, in a trial where the child chose one animal from the bag and hid it in the box, the child could answer the "who knows" question correctly simply by basing his/her answer on who physically hid the

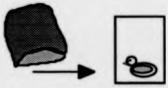
animal rather than basing his/her judgement on that person's mental state which is formed because hider has seen the action and (so the hider knows). It not possible to test whether the children did base their answers on the hiding activity, or on the person's mental state. Thus, in experiment 4 a second experimenter acted as the other person and either the child or the second experimenter watched the first experimenter hide a coin in one of two boxes.

Figure 10.2. Representational skills required in experiment 3.



Experimenter Hides

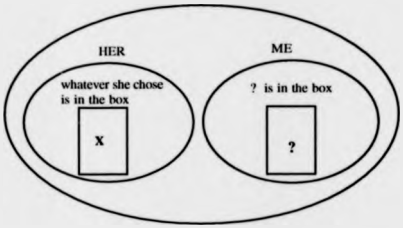
[other knows]
[self guesses]



The experimenter choses an animal from the bag and hides it in the box.

Experimenter asks
"Who knows which animal is in the box you or me?"
"Who guesses which aimal is in the box you or me?"

child representing



11. CHAPTER ELEVEN

Experiment 4.

Is it more difficult for autistic and normal children to refer to one's mental state if the experimental question involves a mental term?

11.1. Introduction

The previous experiments were designed to investigate whether autistic children can differentiate "know" and "guess" when referring to their own and to other people's mental states. It was argued that children's ability to differentiate these mental terms can be taken as a marker of their ability to differentiate the related mental states of "knowing" and "guessing". In the previous experiments understanding of the difference between "know" and "guess" was tested in tasks in which if a person had visual access to a hidden object that person was acknowledged as the person who knew where or what the object was. If the person did not have visual access to the hidden object that person was acknowledged as the person who must guess where or what the object was. As was argued in the discussion section of experiment 2 (see 9.4), while "know" presumes the truth, "guess" can either be true or false. In other words, while "know" implies the existence of specific knowledge and leads to correct performance, "guess" implies a lack of specific knowledge, but still could lead to correct performance. Although in the previous experiments the children were asked the experimental questions before they found out the outcome to ensure that they based their judgements either on their own or on another person's mental state, it is possible that "guess" is not the most appropriate way to refer to the mental state of lacking specific knowledge. Therefore, in experiment 4 "guess" was replaced with "does not know". Thus the comparison of mental states was between "knowing" and "not knowing".

The first aim of experiment 4 was to investigate whether the children's understanding of the mental states of "knowing" and "not knowing" is easier than naming these mental states with mental terms such as "know" or "does not know". In other words, the first aim of this experiment was to test whether normal and autistic children's ability to refer to their own and to another person's mental state of having or lacking specific knowledge is more difficult when the experimental question involves the cognitive mental term "know". Two tasks were designed to test this question.

In both tasks the first experimenter hid a coin in one of the two boxes while either the subject or the second experimenter watched her. Thus, in both tasks a person's knowledge depended on whether or not that person had visual access to the hiding of a coin. In the "know" task the experimental question involved the use of a cognitive mental term "know" in order to elicit the existence of specific knowledge "Who really knows where the coin is, you or Allan [name of the second experimenter]?", and "does not know" to elicit the absence of specific knowledge "Who does not really know where the coin is, you or Allan?". In the "help" task another character, a teddy bear was introduced. The teddy who liked collecting coins, did not have visual access to the hiding of a coin throughout the trials. In the "help" task "know" replaced with "help" in the experimental question "Who could really help teddy find the coin, you or Allan?" or "Who could not really help teddy find the coin, you or Allan?".

The second aim of experiment 4 was to compare the performance of autistic children with that of normal children on these tasks. In experiments 2 and 3 a group of children with Down's syndrome was included in order to control for the effect of general mental ability on the children's performance on the experimental tasks. In the literature, studies have demonstrated that children with Down's syndrome, matched for verbal MAs with autistic children, are able to attribute mental states to others while the autistic children fail to do so (e.g. Baron-Cohen et al., 1985 and 1986). This led researchers to conclude that the theory of mind impairment is independent of mental handicap and specific to autism. However, in experiment 2 and 3 the performance of the low language level autistic children, the children with Down's syndrome and the four-year-old children were similar. Therefore, in experiment 4, children with Down's syndrome were not included as controls.

The third aim of experiment 4 was to compare the attribution of mental states to self and to others. Finally, the results of experiment 2 showed that autistic children's language level was a strong predictor of their performance on the experimental task which required mental state attribution. Thus the final aim of experiment 4, was to investigate whether the

children's performance on these two tasks was related their nonverbal ability, to their performance on a classic false belief task as well as to their verbal ability.

The task in this experiment differed from that used in experiment 3 in two ways: first, on each trial only one experimental question was asked; second, while the first experimenter hid a coin either the child or the second experimenter watched, rather than either the child or the experimenter hiding the object (the difference between the knowledge and non-knowledge depended on visual access rather than the hiding action itself).

11.2. Method

11.2.1. Subjects

Four groups of children were included in this study: two groups of autistic children, one of children with low language scores on the British Picture Vocabulary Scale (N=9) and one of children with higher language scores (N=13); two groups of normal children, four-year-olds (N=13) and five-year-olds (N=20).

The inclusion criteria for this experiment were as follows.

Autistic children with language levels below four years on the British Picture Vocabulary Scale (Dunn, Whetton, and Pintilie, 1982) and on the Test of Reception of Grammar (Bishop, 1982) were excluded from this study. Then the autistic children were divided into two groups on the basis of their BPVS scores. The autistic children with BPVS scores between 4;00 and 6;02 were assigned to the low language level group, and the autistic children with BPVS scores above 6;02 were assigned to the high language level group.

For the low language level control group, four-year-old normal children with language levels above four years on both the BPVS and TROG, and below five years five months on the BPVS were selected. For the high language level control group, five-year-old

normal children with language levels above five years on both the BPVS and TROG were selected.

For the control groups, 27 four-year-old reception class children and 26 five-year-old first year children were sampled. Twelve of the four-year-olds and, six of the five-year-olds failed to meet the inclusion criteria and these children were excluded from the study. Further 2 autistic children and 2 four-year-old normal children who failed the negative control question for any tasks (see table 11.2. and table 11.3.) were excluded from the study. Furthermore all the children were given RAVEN's progressive matrices (Raven, Court and Raven, 1990) to assess a non-verbal ability. Table 11.1. gives the mean chronological ages, language MAs and non verbal ability scores the four groups of children.

Table 11.1. Means and ranges of chronological age, verbal MAs and nonverbal scores for the four groups.

		chronological AGE	TROG	BPVS	RAVEN*
AUTISM LOW n=9	mean range	10;06 (7;00-14;07)	5;01 (4;06-6;00)	5;00 (4;00-6;02)	17.33 (9-25)
AUTISM HIGH n=13	mean range	12;06 (8;00-16;11)	7;03 (5;06-11+)	9;04 (6;07-15;11)	27.84 (19-33)
4 YEARS n=13	mean range	4;07 (4;04-5;01)	5;02 (4;03-6;00)	4;08 (4;00-5;05)	14.15 (7-18)
5 YEARS n=20	mean range	5;10 (5;05-6;04)	7;04 (5;00-11+)	6;06 (5;03-9;09)	19.01 (14-32)

* The means and the ranges of the Raven raw scores are reported.

11.2.2. Materials

The materials consisted of two wooden boxes (16x11x7), four toy plastic 50p coins, a teddy bear and an individual portion box of Kellogg's Corn Flakes filled with smarties (see appendix 6).

11.2.3. Procedure

The children were always seen outside their classroom in a quiet area of the school. On the first visit all the children were administered the BPVS, and the TROG. On the second visit each child was seen by the first and the second experimenters and the false belief task and either the "know" or the "help" task was administered. The order of these two tasks was balanced across children in order to eliminate possible order effects. On the third visit the child was given the second of the two tasks mentioned above followed by the Raven's Coloured Progressive Matrices.

11.2.4. Tasks

11.2.4.1. False belief task

The one-portion Kellogg's Corn Flakes box full of smarties was used in this task. The first experimenter, who was familiar to the children, asked each child whether she/he would like to play some games with the experimenter and her friend. Then the child was introduced to the second experimenter and told that he and the child were going to take turns at the game. To start the game the child was told that the second experimenter (Allan) would go out of the room for a minute while they began the game. When the second experimenter had left the room, the first experimenter took the closed Corn Flakes box from her bag and showed it to the child and asked "what is in here?" Answers such as "corn flakes", "cereal", "breakfast" were accepted as correct. Then the first experimenter opened the box and showed it to the child, and said "no there are smarties". She then closed the box and asked again "what is in here?". This question was asked to check that the child could remember the content of the box. Then the child was asked "when I first

asked you, what did you say was in the box?" (own belief). Next, the child was told that Allan (the second experimenter) had not seen this box and that when he came in, the first experimenter would show him the box and ask "what is in the box?" The child was asked "what will Allan say?" (other's false belief).

11.2.4.2. The "know" task attributing knowledge and ignorance

This task involved the use of the two wooden boxes and a plastic coin. To start the game each child was told that they were going to play a hiding game and that she/he would take turns with the second experimenter (Allan). The child was shown the two boxes and a coin and told that the first experimenter was going to hide the coin in one of the two boxes, and that sometimes the child and sometimes the second experimenter were going to close their eyes.

There were four trials in this task. On two trials the child, and on two trials the second experimenter, saw in which box the coin was hidden. There were two types of experimental questions. One of these was in a positive form "Who really knows where the coin is, you or Allan ?" and one was in a negative form "Who does not really know where the coin is you or Allan?" On each trial the child was asked one experimental question. The order in which the four trials were presented to each child was determined by a random selection from a 4 by 4 latin square.

The task began by the first experimenter giving the following instruction (either to the child or to the second experimenter) "Now it is your turn to close your eyes while I hide the coin, then I will ask you to show me where the coin is". When the coin had been hidden, the child was asked three control questions. The first was to check whether she/he had any difficulty with negative questions. This question was only asked on the first trial and it was designed to be as close as possible to the negative experimental question. The negative control question was modified for each child according to their clothing and the clothing of the second experimenter, and took the form "Who does not have a red (blue, white) jumper (shirt, t-shirt) on, you or Allan?" Then two further control questions were asked to test

whether the child understood visual access "Did you see where I put the coin?" "Did Allan see where I put the coin?" Finally, one of the experimental questions was asked, either "Who really knows where the coin is, you or Allan?" or "Who does not really know where the coin is, you or Allan ?" Table 11.2 summarises the details of the trials and questions.

Table 11.2. Trials, control and experimental questions for the "know" task

Self sees trial 1	**(Child watches)**
(control negative)	"Who does not have a red jumper on you, or Allan (second experimenter)?"
(control question)	"Did you see where I put the coin?"
(control question)	"Did Allan see where I put the coin?"
(experimental quest.)	"Who really knows where the coin is, you or Allan?"
Other sees trial 1	**(Child has eyes closed)**
(control question)	"Did you see where I put the coin?"
(control question)	"Did Allan see where I put the coin?"
(experimental quest.)	"Who really knows where the coin is, you or Allan?"
Self sees trial 2	**(Child watches)**
(control question)	"Did you see where I put the coin?"
(control question)	"Did Allan see where I put the coin?"
(experimental quest.)	"Who does not really know where the coin is, you or Allan?"
Other sees trial 2	**(Child has eyes closed)**
(control question)	"Did you see where I put the coin?"
(control question)	"Did Allan see where I put the coin?"
(experimental quest.)	"Who does not really know where the coin is, you or Allan?"

11.2.4.3. The "help" task -using "could help" instead of "know"

This task differed from the "know" task by having another character - a teddy bear. It also differed in the question structure. Those children who were given the "help" task after the "know" task were told that they were going to play a game very similar to the one they played on the previous visit, however this time teddy would be playing with them as well. Children given the "help" task before the "know" task were told that they were going to play a hiding game and she/he and a second experimenter would take turns. The child was shown the teddy and told that teddy liked collecting coins and he wanted to get as many coins as he could during the game. When they were playing the game teddy was going to stay under the table so that he could not see them. Then the child was shown the two boxes and a coin and told that the first experimenter was going to hide the coin in one of two boxes and that sometimes the child was going to close his/her eyes and other times the second experimenter was going to close his eyes. Then teddy was going to come up and join them and he was going to ask for help to find the coin either from the child or from Allan (second experimenter).

There were four trials in this task: on two trials the child, but not the second experimenter, saw in which box the first experimenter hid the coin and on the other two trials the second experimenter, but not the child saw in which box the first experimenter hid the coin. There were two types of experimental question, a positive question "Who could really help teddy find the coin, you or Allan ?", and a negative question "Who could not really help teddy find the coin, you or Allan?" On each trial the child was asked one of the experimental questions. The order in which the four trials were presented to a child was determined by a random selection from a 4 by 4 latin square.

The task began by the main experimenter giving the following instruction "Now we are starting the game, teddy goes under the table and stays there. Now it is your turn (to the child or to the second experimenter) to close your eyes while I hide the coin". When the coin had been hidden, the child was asked four control questions. One was to check

whether she/he had any difficulty with negative questions "Who could not really see where I put the coin, you or Allan (second experimenter)?" Then three further control questions were asked to test whether the child understood visual access: "Did you see where I put the coin?", "Did Allan see where I put the coin?", "Did teddy see where I put the coin?" Finally, the child was asked one of the experimental questions, either "When teddy comes up , who could really help teddy find the coin, you or Allan?" or "Who could not really help teddy find the coin, you or Allan?" Table 11.3. summarises the details of the trials and questions.

Table 11.3. Trials, control and experimental questions for the "help" task

Self sees trial 1	**(Child watches)**
(control negative)	"Who could not really see where I put the coin, you or Allan (second experimenter)?"
(control question)	"Did you see where I put the coin?"
(control question)	"Did Allan (second experimenter) see where I put the coin?"
(control question)	"Did teddy see where I put the coin?"
(experimental quest.)	"When teddy comes up, who could really help teddy find the coin, you or Allan?"
Other sees trial 1	**(Child has eyes closed)**
(control question)	"Did you see where I put the coin?"
(control question)	"Did Allan see where I put the coin?"
(control question)	"Did teddy see where I put the coin?"
(experimental ques.)	"When teddy comes up, who could really help teddy find the coin, you or Allan?"
Self sees trial 2	**(Child watches)**
(control question)	"Did you see where I put the coin?"
(control question)	"Did Allan (second experimenter) see where I put the coin?"
(control question)	"Did teddy see where I put the coin?"
(experimental quest.)	"When teddy comes up, who could not really help teddy find the coin, you or Allan?"
Other sees trial 2	**(Child has eyes closed)**
(control question)	"Did you see where I put the coin?"
(control question)	"Did Allan see where I put the coin?"
(control question)	"Did teddy see where I put the coin?"
(experimental quest.)	"When teddy comes up, who could not really help teddy find the coin, you or Allan?"

11.3. Results

11.3.1. Performance on the "help" task versus performance on the "know" task

The first aim of this experiment was to test whether normal and autistic children's ability to refer to their own and to another person's mental state of having specific knowledge or lacking that specific knowledge is more difficult when the experimental question involves the cognitive mental term "know" or "does not know" than it does not. In the "know" task the experimental questions involved the mental term "know" or "does not know", whereas in the "help" task the mental terms in the experimental questions were replaced by "could help" or "could not help". For both tasks there were four experimental questions (see tables 11.2 and 11.3) and the children were given a score of 1 for each correct answer. Thus each child could get a score of between 0 to 4 for each of the two tasks. Table 11.4. gives the mean scores for the both tasks for four groups of children.

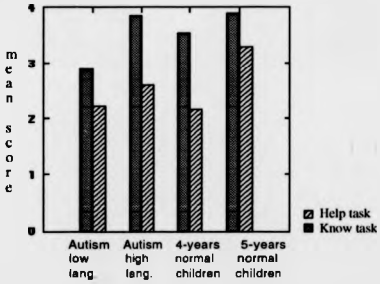
The second aim of this experiment was to compare the performances on the tasks of low language level autistic children, high language level autistic children, four-year-old and five-year-old normal children.

A two way groups x task analysis of variance, with repeated measures on the task factor, showed that there was a significant main effect of task [$F(1,51)=28.987$, $p<0.0005$]; across the groups the children were better at the "know" task than the "help" task. There was also a significant difference between the groups [$F(3,51)=6.878$, $p<0.001$], however the interaction between the task and group was not significant [$F(3,56)=.603$, $p=0.616$].

Table 11.4. Mean scores for the "know" task and for the "help" task for the four groups of children

	AUTISM low lang. level	AUTISM high lang. level	4 YEARS	5 YEARS	overall task means
N	9	13	13	20	
KNOW TASK	2.889	3.846	3.538	3.900	3.636
HELP TASK	2.222	2.615	2.154	3.300	2.691
overall group means	2.555	3.230	2.846	3.6	

Figure 11.1. Bar chart of the mean scores for the "know" and "help" tasks for four groups of children



Tukey post hoc tests were calculated for pairwise comparisons among the overall group means. These confirmed that five-year-old normal children were better at the two tasks than both the low language level autistic children [$q=5.764$, $df=51$, $p<0.001$] and the four-year-old normal children [$q=4.7$, $df=51$, $p<0.009$]. In addition the difference between the

high and low language level autistic children was approaching significance [q=3.455, df=51, p<0.08].

11.3.2. Performance on the "know" and "help" tasks compared with chance levels

In each task there were four experimental questions with a forced choice answer of "me" or "Allan", and therefore by chance children could pass two of the experimental questions (0.5x4=2). Further, even if there was a response bias such as always giving either the answer "me" or the answer "Allan" across the four questions, the children would pass two of the questions. Therefore to investigate whether the children's performance exceeded chance levels, paired t tests were carried out for each group and for each task separately, on the number of correct versus the number of correct answers by chance (2).

On the "know" task, all four groups of children performed better than chance: low language level autistic children [t (8) =3.411, p<.009]; high language level autistic children [t (12) =17.725, p<.0005]; four-year-old normal children [t (12) =8.402, p<.0005]; five-year-old normal children [t (19) =27.606, p<.0005]. This indicates that all four groups of children were able attribute the mental states of "knowing" and "not knowing" to themselves and to the other people (see figure 11.2).

Figure 11.2. Bar chart of the mean scores for the "know" task compared with chance level

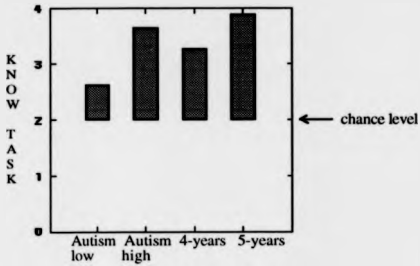
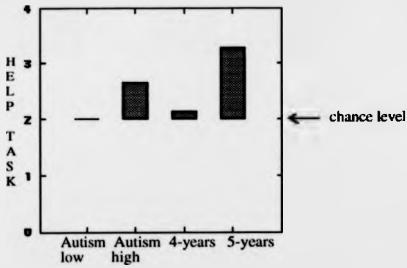


Figure 11.3. Bar chart of the mean scores for the "help" task compared with chance level.



However on the "help" task, only the five-year-old normal children performed significantly better than chance, [t (19) =4.951, p<.0005] (see figure 11.3.).

The different pattern of results for the "know" and "help" tasks reflects the significant main effect of task revealed by the ANOVA. Overall, the children were better at the "know" task

than the "help" task. In the "know" task all four groups of children performed above chance level. However in the "help" task only the five-year-old normal children performed above chance level.

11.3.3. Comparison of reference to self versus reference to the other

The third aim of this experiment was to investigate the question of whether attributing mental states to oneself is easier than attributing mental states to other people. Each of the two tasks, the "know" task and the "help" task, involved four experimental questions, two required the child to refer to his/her own mental state, and two required the child to refer to another person's (second experimenter) mental states. Thus in total across the two tasks four questions referred to self, four referred to another. Table 11.5 and figure 11.4 show the mean numbers of questions passed with reference to self and other. A two-way analysis of variance was performed comparing the self and other scores across the four groups self versus other was a repeated measures factor. The main effect of self versus other was not significant [$F(1,51)=.404$, $p<.528$], nor was the interaction between the group and self/other [$F(3,51)=.363$, $p<0.78$]. The main effect of group was significant [$F(3,51)=6.878$, $p<0.001$]. But this is the same effect as previously reported in the group x task analysis (in the section comparing the "know" and "help"tasks).

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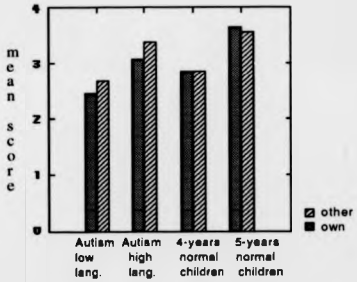
Table 11.5. Mean numbers of questions passed with reference to self and others for four groups of children

	AUTISM low lang. level	AUTISM high lang. level	4 YEARS	5 YEARS	overall means
N	9	13	13	20	
OWN	2.444	3.077	2.846	3.65	3.127
OTHER	2.667	3.385	2.846	3.55	3.200
overall means	2.555	3.230	2.846	3.6	

Figure 11.4 Bar chart of the mean numbers of questions passed with reference to self and other by the four groups of children (max=4).



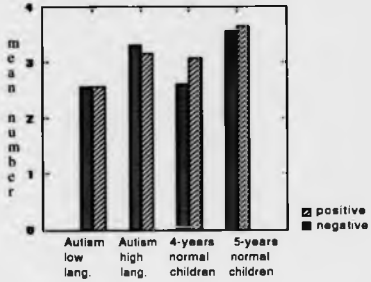
11.3.4. A comparison of positive versus negative questions

Each task included a control question which involved a negative and children who failed the negative control question were excluded from the study. However it could be argued that it is harder for children to answer negative questions than positive questions. Within the two tasks there were four positive and four negative questions. Therefore each child could score between 0 and 4 for correct answers to the negative and to the positive questions. Table 11.6 shows the mean numbers of the correct answers to both question types for the four groups of children. To investigate whether the negative questions were more difficult than the positive questions, a two way analysis of variance was carried out groups x negative versus positive with repeated measures on the second factor. The main effect of question type (positive/negative) was not significant [$F(1,51)=.661$, $p<0.42$], nor was the interaction between group and question type [$F(3,51)=1.095$, $p<0.36$]. The main effect of group [$F(3, 51)=6.878$, $p<0.001$] is the same effect as previously reported.

Table 11.6. Mean numbers correct answers to the positive and negative questions by the four groups of children.

	AUTISM low lang. level	AUTISM high lang. level	4 YEARS	5 YEARS	overall means
N	9	13	13	20	
POSITIVE	2.556	3.154	3.077	3.65	3.109
NEGATIVE	2.556	3.308	2.615	3.55	3.218
overall means	2.556	3.231	2.846	3.6	

Figure 11.5 Bar chart of the mean numbers of correct answers to the positive and negative questions for the four groups of children



11.3.5. False Belief Task

When the ability of the four experimental groups to attribute a false belief to another was compared, a significant difference was found [χ^2=12.471, df=3, p<.006]. For pairwise comparisons, Fisher Exact tests were calculated with significance levels adjusted according to the Bonferroni procedure. With 6 pairwise comparisons the criterion for significance was set at $p<\frac{.05}{6}=.008$.

The five-year-old normal children were significantly better than the low language level autistic children in their ability to attribute false belief to another p<.002. None of the other comparisons reached the .008 level. Table 11.7 shows the number and percentages of children passing the false belief task for the four groups.

Table 11.7. Numbers and percentages of children passing the false belief task, for the four groups

	FALSE BELIEF		
	N	pass	percentage
AUTISM LOW	9	2	22.22 %
AUTISM HIGH	13	7	53.85 %
4-YEARS	13	10	76.92 %
5-YEARS	20	17	85.00 %

11.3.6. Are the normal and the autistic children's performance on the 'know' and 'help' tasks related to their verbal ability, their non-verbal ability, and to their performance on the false belief task?

The final aim of this experiment was to investigate whether the children's performance on the "know" and "help" tasks was related to their verbal ability, their nonverbal ability and to their performance on the classic false belief task. To test whether different aspects of language competence and non-verbal ability predicted the children's performance on the "know" and "help" tasks, Pearson correlation coefficients were calculated between the BPVS scores, the TROG scores, the Raven's scores and the children's performance on the "know" and "help" tasks. For these analyses in order to encompass the whole range of language ability, the two autistic groups were combined into a single group, as were the two normal groups. Table 11.8 shows the pearson correlation coefficients between BPVS, TROG and RAVEN scores and "know" and "help" tasks for the autistic and the normal children. From this table it can be seen that the BPVS, TROG and Raven scores were related to the autistic children's performance, but not the normal children's performance, on the "know" task which required the attribution of "knowledge" and "ignorance" to people. However, none of the language and non-verbal scores were related to the "help" task in either group.

Table 11.8 Pearson correlation coefficients between BPVS, TROG and RAVEN scores and the "know" and "help" tasks for the autistic and normal children

	AUTISM	NORMAL
	RAVEN	
"Know" task	.485**	.157
"Help" task	-.062	.249
	BPVS	
"Know" task	.490*	.234
"Help" task	.247	.264
	TROG	
"Know" task	.510**	.237
"Help" task	.114	.331

**p<0.01 *p<0.05

In order to compare performance on the "know" and "help" tasks with performance on the false belief task point biserial correlations were calculated between the pass/fail dichotomy on the false belief task and on the "know" and "help" tasks. Table 11.9 shows point biserial correlations between the pass/fail dichotomy on the false belief task and "know" and "help" tasks for the normal and the autistic children. None of these correlations were significant.

Table 11.9 Point Biserial correlations between the pass/ fail dichotomy on the false belief task and the "know" and "help" tasks for the normal and the autistic children

	AUTISTIC	NORMAL
	FALSE BELIEF	
"Know" task	.373	-.231
"Help" task	-.006	.074

Autistic children were divided into the groups of low language level and high language level, on the basis of their performance on the BPVS which tests the child's receptive vocabulary. In order to examine whether the results of this study would have been different, if the autistic children were divided into two groups on the basis of their scores on TROG or on the RAVEN's progressive matricises, Pearson correlation coefficients were calculated between the BPVS, TROG and Raven scores. Table 11.10 shows the correlation coefficients between the BPVS, TROG and RAVEN scores for the normal and the autistic groups. The correlations between the BPVS and TROG, the RAVEN and BPVS and between the RAVEN and TROG scores were highly significant for both groups of children.

Table 11.10 Pearson correlation coefficients between BPVS, TROG and RAVEN scores for the groups of autistic and normal children

	AUTISTIC	NORMAL
RAVEN - BPVS	.711***	.750***
RAVEN - TROG	.622***	.849***
BPVS - TROG	.817***	.919***

*** $p<0.002$ **$p<0.01$ *$p<0.05$

11.3.7. Children's understanding of visual access

In both the "know" and "help" tasks the children were asked control questions to check whether they understood visual access (see Tables 11.2 and 11.3). In the previous experiments (2 and 3) all the children passed the visual access questions. However, in experiment 4 some children failed these questions. Most of these children were in the low language level groups: either low language level autistic children or four-year-old normal children. In the literature it has been suggested that there is a strong relationship between the pass rate for seeing questions and children's performance on knowledge questions (Perner et al., 1989). In experiment 4, both in the "know" and in the "help" tasks high language level autistic children, four-year-old and five-year-old normal children successfully judged whether they had seen the first experimenter hid a coin (table 11.11). However only 44 % (in the "know" task) and 56 % (in the "help"task) of the low language level autistic children were able to judge whether they had seen the first experimenter hide a coin. This pass rate is lower than in Perner et al.'s study in which 69 % of the autistic children were able to judge their own visual access. However, closer inspection of the children's language levels reveals that this difference is likely to be due to differences in the language levels of the children in the two studies. Since while the low language level autistic children in the present studies had a mean verbal MA equivalent of five years, in Perner et al.'s study the autistic children had a mean verbal MA equivalent of six years and two months.

In the "know" task all the high language level autistic children, 95% of the five-year-old and 84% of the four-year-old normal children were successful in judging whether the second experimenter had seen the first experimenter hide the coin. In the "help" task all the four and five-year-old normal children and 92% of the high language level autistic children were successful in judging whether the second experimenter had seen the first experimenter hide the coin (see Table 11.11). However in both tasks, only 56% of the low language level autistic children were able to judge whether the second experimenter had seen the first experimenter hide the coin. In Perner et al.'s study, 73% of the autistic children were able

to judge another person's visual access. This difference again can be explained by the difference in the children's language levels between the two studies.

Table 11.11 Numbers and percentages of children in each group passing the visual access and the experimental questions in the 'know' and 'help' tasks

	AUTISM LOW		AUTISM HIGH		4-YEARS		5-YEARS	
N	9		13		13		20	
	pass	percent	pass	percent	pass	percent	pass	percent
"KNOW" TASK								
Self sees	4	44.44 %	13	100 %	13	100 %	20	100 %
Other sees	5	55.56 %	13	100 %	11	84.62 %	19	95 %
task passed	2	22.22 %	11	84.62 %	8	61.54 %	18	90 %
"HELP" TASK								
Self sees	5	55.56 %	13	100 %	13	100 %	20	100 %
Other sees	5	55.56 %	12	92.31 %	13	100 %	20	100 %
task passed	1	11.11%	6	46.15%	1	7.69%	13	65%

As can be seen from Table 11.11, in all groups more children passed the visual access questions than passed the task. This is similar to the results of Perner et al.'s (1989).

11.4. Discussion

The first aim of experiment 4 was to investigate whether children find it more difficult to refer to their own and to another person's mental states of having specific knowledge or lacking that knowledge when the experimental question involves the cognitive mental term "know". In order to test this question, two tasks were designed. In the "know" task either the child or the second experimenter watched the first experimenter hide a coin in one of two boxes, and the children were asked either "Who really knows where the coin is, you or Allan (second experimenter)?" or "Who does not really know where the coin is, you or Allan?" In the "help" task there was an additional character (teddy) who liked collecting coins. As in to the "know" task, either the child or the second experimenter watched the first experimenter hide a coin in one of two boxes, and the children were then asked either "Who could really help teddy find the coin, you or Allan?" or "Who could not really help teddy find the coin, you or Allan?" It was assumed that if a child is able to judge her/his and another person's knowledge state, he/she should be able to identify the person with knowledge of where the coin was hidden, as the person who could help teddy. However, the results showed that relative to the "know" task, children found it more difficult to identify the knowledgeable person as the helper. While all four groups of children were able to attribute knowledge to themselves and to another person on the basis of that person's mental state, only the five-year-old normal children were able to identify the knowledgeable person (who had visual access to the hiding) as the helper.

One of the differences between the two tasks is that, in the "help" task, the experimental question involved the modal term "could" which may have affected the children's performance. However, in the investigation of certainty implied by mental terms or modal terms Moore et al. (1990) found highly significant correlations between these terms. They argued that children's developing understanding of mental states of relative certainty is independent of whether the experimental question involves mental terms or modal terms.

This suggests that the children's difficulty with the "help" task was perhaps not due to the modal term "could" in the experimental question.

A second possible explanation for the children's difficulty with "help" task could be that, while both tasks required metarepresentational skills (see figure 11.6), in addition the "help" task required the child to make a prediction about behaviour on the basis of mental state. In other words, while in the "know" task the child needed to identify the person who had visual access to the hiding of the coin as the person who knew where the coin was, and identify the person who did not have visual access to the hiding of the coin as the person who did not know where the coin was. However, in the "help" task the child needed to identify the person who had visual access to the hiding of a coin, as the person who could help teddy (who did not have visual access to the hiding) find the coin, and identify the person who did not have visual access to the hiding of the coin as the person who could not help teddy find the coin. It is possible that the "help" task was more difficult because to identify the person as the person who could help teddy find the coin, required an additional step in children's mental state attributions:

rather than	in the "know" task		he has seen (visual access)	>	he knows (knowledge attribution)
and	in the "help" task		he has seen (visual access)	>	he could help teddy (knowledge usage)

in the "help" task

as	he saw (visual access)	>	he knows (knowledge attribution)	>	he could help teddy (knowledge usage)

The present results suggest that although four-year-old and five-year-old normal children and both high and low language level autistic children are able to attribute knowledge to the

person who had visual access, only five-year-old normal children are able to infer that this knowledge could be used to help teddy.

It seems that if the children's difficulty is to infer another person's behaviour from their own mental state (e.g. in this experiment that a person could help if he/she has the knowledge), children would find similar tasks difficult. One such task could be the classic false belief task in which the child needs to predict a character's behaviour on the basis of that person's knowledge or ignorance. It has been shown that 4-year-old normal children are able to pass these tasks while autistic children fail (Baron-Cohen et al., 1985; Leslie & Frith, 1988; Perner et al., 1989; Baron-Cohen, 1989a). In experiment 4, all the children were also given false belief task. Correlations between the children's performance on the false belief task and the "help" task were not significant. Furthermore, inspection of the percentages of children passing the "help" and false belief tasks does not seem to suggest a clear relation between the tasks in terms of difficulty (see Table 11.12). The low language level autistic children performed poorly on both tasks, and although the high language level autistic children performed well on the "know" task (84.6%), they performed less well on the "help" and false belief tasks (46.1% and 53.85%) respectively. However, the "help" task seems to be more difficult than the other two tasks, even for the five-year-old normal children.

Table 11.12 Percentages of children passing the false belief task, the 'know' and 'help' tasks

	AUTISM LOW		AUTISM HIGH		4-YEARS		5-YEARS	
N	9		13		13		20	
	pass	percent	pass	percent	pass	percent	pass	percent
False Belief	2	22.22 %	7	53.85 %	10	76.92 %	17	85 %
"Know" Task	2	22.22 %	11	84.62 %	8	61.54 %	18	90 %
"Help" Task	1	11.11%	6	46.15%	1	7.69%	13	65%

Furthermore, in Pillow's (1989) study, one task involved the use of two puppets where only one of them had visual access to the container after the transfer of a small dinosaur or a toy car. In this task, three-year-old children were asked who could tell them what the colour of the dinosaur was - whether John (puppet's name) could tell or Bob (puppet's name) could tell them. The results indicated that three-year-old children could identify the knowledgeable puppet, on the basis of perceptual access at above chance level but that their performance was less good than in a task in which they had to attribute knowledge either to themselves or to the puppet on the basis of perceptual access. In comparison to the "help" task in the present experiment, in Pillow's study the question type seems similar, as does the likely difficulty of the tasks; in other words, both require the child to infer a person's behaviour from a person's mental state. However, whereas in Pillow's study three and four-year-old children were successful, in experiment 4 only five-year-old normal children were able to identify the knowledgeable person as the helper.

The only difference seems to be that in experiment 4, the experimental question involved the word "help" ("who could help" rather than "who could tell") and this may have made extra demands on the children. The autistic children's inability to pass the "help" task could be explained in terms of Baron-Cohen's (1991b) argument that "*more complex forms of social reciprocity (eg. sharing, helping) are likely to entail mental state attribution, and these would be expected to be impaired in autism* " (p.308). However, the author has not come a cross any study in the literature investigating this question in normal children. It would be interesting to examine the age at which normal children acquire an understanding that a person who can help needs to be knowledgeable in different experimental tasks.

The second aim of experiment 4 was to examine autistic children's ability to attribute knowledge to themselves and to others, compared to language level matched normal children. The results indicated that all four groups of children were able to attribute knowledge and ignorance to themselves and to others on the basis of each person's mental state. The "know" task required the child to compare his/her mental state with the second experimenter's mental state in order to identify that person as the one who knows or who

does not know where the coin was. Referring to another person's mental state requires metarepresentation. Both groups of autistic children, whether of high language level or low language level, performed better than chance on the "know" task. This indicates that they have metarepresentational skills which contradicts the findings of previous studies (e.g. Baron-Cohen et al., 1985 and 1986; Leslie & Frith 1988; Perner et al., 1989). However, this finding supports Leekam & Perner's (1991) conclusion that autistic children's difficulty with theory of mind tasks cannot be due to a general metarepresentational deficit. In their study, Leekam & Perner adopted Zaitchik's (1990) task in which children took a picture of a doll in a red dress with a polaroid camera and while the photograph was developing the doll's dress was changed to a green one. The children were then asked what colour the doll's dress would be in the photograph. The autistic children passed this task, again demonstrating metarepresentation skills. For further details of this study see chapter 5.

In the present study the results showed that the five-year-old normal children performed significantly better than the four-year-old children and the low language level autistic children on both tasks. In addition, the difference between the two autistic groups approached significance. This picture is similar to the results from experiment 2 where the group's language level seemed to be an important predictor of their performance on the task.

The fourth aim of experiment 4 was to test whether children's performance on the experimental tasks was related to their verbal and nonverbal skills and to their performance on a false belief task. The results showed that the autistic children's receptive vocabulary level (measured by the BPVS), their receptive grammar level (measured by the TROG), and their nonverbal abilities (measured by the Raven Progressive Matrices) were significantly correlated with their performance on the "know" task. This finding supports the results of experiment 2, which indicated a strong relation between the autistic children's language level and their performance on the experimental task. On the basis of the results of experiment 2, it was suggested that autistic children's performance on theory of mind

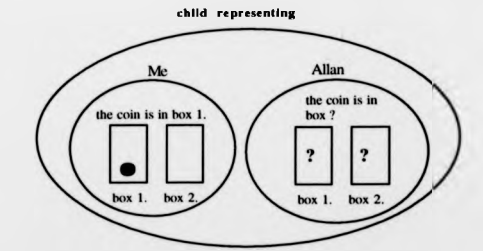
type of tasks is related to their general language skills. In addition to language tests, in experiment 4 children were also given non verbal ability test; results indicated that children's performance on the "know" task was related to their nonverbal abilities too. Thus, it seems that autistic children are able to attribute knowledge and ignorance to themselves and to others provided that they have a certain level of language and non-verbal skills. It seems that this relationship is not specific to the particular task employed in experiment 4, since similar results were obtained in experiment 2 when a different experimental task was used. However none of the correlations between the children's performance on the "help" task and their verbal and nonverbal skills were significant. This finding suggests that the strong relationship between the autistic child's verbal and nonverbal abilities, and the attribution of knowledge and ignorance to people, perhaps cannot be generalized to other theory of mind tasks. However there may be two possible explanations for these results. One is that the task in experiment 2 and the "know" task in experiment 4 included the cognitive mental term "know" in the experimental question while the "help" task in experiment 4 included the word "help". The strong correlations with performance on the "know" task may therefore have been due to the inclusion of the cognitive mental term "know". The second likely explanation is that it seems that referring to a mental state is easier than predicting behaviour on the basis of that mental state. It may be that the more able the autistic child is, the more likely that the child can refer to people's mental states, but he/she is still not able to make predictions on the basis of those mental states.

Furthermore, highly significant correlations were obtained between the TROG, BPVS and Raven scores for both the autistic and the normal children. In experiment 4, the autistic children were assigned to two groups of high language and low language level on the basis of their BPVS scores but if the autistic group had been divided into two groups on the basis of TROG or Raven scores, results from this study would not have been very different.

Finally, the third aim of experiment 4, was to test whether referring to one's own mental state is easier than referring to another person's mental states. The results indicated that

self reference was not different from referring to another. This is not surprising since, in this experiment in order for a child to answer any self reference question and any other reference question, he/she needed to compare his/her own mental state with the other person's mental state. Thus both self and other reference required metarepresentational skills (see figure 11.6). The lack of any difference between the attribution of mental states to oneself and to others supports the findings from experiment 1, 2 and 3.

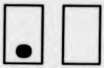
Figure 11.6 Representational skills required in experiment 4.



"KNOW" TASK

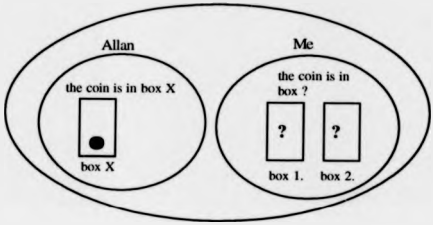
The second experimenter watches

The second experimenter
watches while the subject
closes his/her eyes and the first
experimenter hides a coin in
one of the two boxes.



Then the experimenter asks
"Who really knows where the coin is you or Allan?"
OR
"Who does not really know where the coin is you or Allan?"

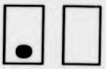
child representing



"HELP" TASK

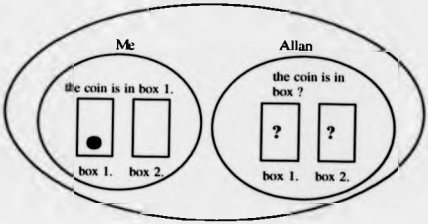
Subject watches

the second experimenter closes his eyes and the first experimenter hides a coin in one of the two boxes.
(Teddy stays under the table)



Then the experimenter asks
"When Teddy comes up, who could really help tedy find the coin, you or Allan?"
OR
"When Teddy comes up, who could not really help tedy find the coin, you or Allan?"

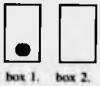
child representing



"HELP" TASK

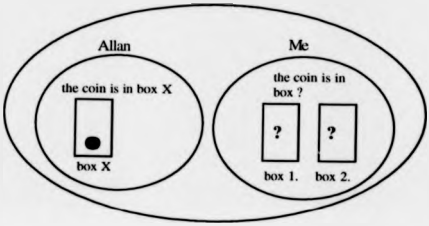
The second experimenter watches

The second experimenter watches while the subject closes his/her eyes and the first experimenter hides a coin in one of the two boxes. (Teddy stays under the table)



Then the experimenter asks
"When teddy comes up, who could really help teddy find the coin, you or Allan?"
OR
"When teddy comes up, who could not really help teddy find the coin you or Allan?"

child representing



12. CHAPTER TWELVE

General discussion

The primary aim of this thesis was to investigate one aspect of theory of mind ability in autistic children, namely understanding of knowledge as a mental state. As has been pointed out a number of times throughout the thesis, the theory of mind account of autism proposes a cognitive deficit as a primary cause for the social communication difficulties in autism. Empirical evidence suggests that autistic children are impaired both in their ability to attribute mental states to themselves and others, and in their pretend play skills (Baron-Cohen et al., 1985, 1986; Baron-Cohen, 1987). Leslie (1987) has accounted for these findings by arguing that both mental state attributions and pretend play require second-order representations which are copied from primary representations by a mechanism which he called a "decoupler". On the basis of evidence from autism research, Leslie (1987, 1988) proposed that autistic children have an impaired decoupler mechanism, or in other words a metarepresentational deficit. This account opened a new perspective for autism research and a number of studies, including those reported in this thesis, have been conducted to test this theory.

12. 1. Can the theory of mind account explain autism?

If an impaired theory of mind ability in autism is the primary underlying factor for autistic people's social communication difficulties, this explanation should be able to account for the behaviour of all children who are diagnosed as autistic. More specifically, if the impaired decoupler mechanism in autism underlies autistic characteristics, all autistic people should show a metarepresentational deficit. However, the evidence does not support this view since in all studies with autistic children, some of the children are able to attribute mental states to others, an ability which requires metarepresentation. For instance, 20% of the autistic children in Baron-Cohen et al.'s (1985) study were able to attribute false belief to a story character; 43% of the autistic children in Perner et al.'s (1989) study and 44% in Leslie & Frith's (1988) study were able to attribute knowledge to other people; 18% of the

autistic children in Russell et al.'s (1991) study were able to lead another person to have a false belief; 35% of the autistic children in Baron-Cohen 's (1989c) study were able to differentiate what something looks like from what it really is (the appearance-reality distinction); 95% of the autistic children in Leekam & Perner's (1991) study were able to pass a non-mental representation task (Zaitchik's, 1990) which all require metarepresentation.

Furthermore, the results of the present thesis showed that autistic children are able to attribute mental states to another person and that this depends on their language ability. For instance, in experiment 2, 28.5 % of the low language level autistic children with a mean verbal age equivalent measured by the British Picture Vocabulary Scale of four years 11 months and 78.5 % of the high language level autistic children with a mean verbal age of nine years six months, were able to differentiate "know" from "guess" when referring to another person's mental state. This requires metarepresentation. In addition, in experiment 3, 25 % of the low language level autistic children with a mean verbal age of five years one month, and 69 % of the high language level autistic children with a mean verbal age of nine years and six months were able to attribute knowing and guessing to another person. Finally in experiment 4, 22 % of the low language level autistic children with a mean verbal age five years, and 84 % of the high language level autistic children with a mean verbal age of nine years and six months were able to attribute knowledge to themselves and another person. Thus, the theory of mind account cannot explain the performance of all people with autism since there are some autistic children who show metarepresentational skills. Moreover, children who passed these metarepresentational tasks tend to have higher verbal mental ages, as has been shown in the literature with other theory of mind tasks (Prior et al., 1990; Leslie & Frith, 1988; Baron-Cohen, 1989a).

12. 2. Investigating the role of language ability

In the present thesis, two approaches have been adopted in order to investigate the relationship between the autistic children's verbal MA level (or language level) and their

ability to understand knowledge as a mental state. One was to have two groups of autistic children, one of low language level and the other of higher language level, and to compare the performance of these two groups in each experiment. The second approach was to administer a variety of standardized language and non-verbal ability measures to obtain a more detailed picture of the relationship between certain aspects of language and the performance of the autistic children on the experimental tasks.

Formal contrasts between high and low language groups of autistic children were not always statistically significant, but the overall picture is quite consistent. The results of experiment 2 showed that the high language level autistic children were significantly more able than the low language level autistic children to differentiate "know" from "guess" when referring to another person's mental state. In addition, the difference between the high and low language level autistic children's ability to differentiate "know" from "guess" when referring to their own mental states approached to significance. Similarly, in experiment 3, the high language level autistic children were significantly superior to the low language level autistic children in their ability to differentiate "know" from "guess" with respect to their own and to another person's mental state. In experiment 4, the difference between the high and low language level autistic children's ability to attribute mental states of knowledge and ignorance to themselves and to another was not significant, but it did approach significance. The non significant results in experiment 4 may have been due to the higher performance of the low language level autistic children in this experiment compared with the previous experiments. This may be a consequence of the easier question type used in experiment 4.

In addition to the significant differences between the high language level and low language level autistic children's performances, the correlations between the different language tests and the autistic children's pass rate for the tasks were highly significant. In experiment 2, the autistic children's receptive vocabulary level, as measured by the BPVS, their receptive grammar level as measured by TROG and their use of grammar as measured by the Renfrew Action Picture test were all significantly correlated with performance on the

experimental task or, in other words, with their ability to differentiate "know" from "guess" when referring to their own and to another person's mental states (see chapter 9).

These findings were supported by those of experiment 4. Here autistic children's receptive vocabulary level measured by BPVS, their receptive grammar level measured by TROG and their non-verbal ability level measured by the Raven Coloured Progressive Matrices were significantly correlated with their ability to attribute knowledge and ignorance to themselves and to another person. However, neither the language scores nor the non-verbal ability scores were correlated with the autistic children's ability to identify the knowledgeable person as the helper, or to identify the unknowledgeable person as the person who could not help. As was discussed in chapter 11 (see 11.4), the experimental questions used in the knowledge attribution tasks involved cognitive mental terms such as "know" and "guess" (in experiment 2) and "know" (in experiment 4). It may therefore be that the high correlations reflected the relationship between the different language skills and the ability to understand cognitive mental terms as linguistic entities. However, this cannot explain the significant correlation between the autistic children's performance on the "know" task and their non-verbal ability level in experiment 4.

It is also necessary to account for the low correlations between the autistic children's language abilities and their performance on the help task in experiment 4. One possibility is that the use of the word "help" in the experimental question tapped something different than the ability to refer to a mental state, such as the ability to understand a complex form of social reciprocity.

In addition the autistic children's inferior performance on the "help" task in comparison to the "know" task is perhaps that the "help" task was more difficult than the "know" task, because it required the child to make an additional inference from a person's mental state. While the "know" task only required the child to identify whether a person had specific knowledge about something (the existence or non-existence of knowledge as a mental state), the "help" task required the child to identify a person as the helper on the basis of

that person's mental state (inferring behaviour from a mental state). If this inference was a problem for the autistic children in the "help" task, they should find similar tasks which require the prediction of a behaviour on the basis of mental states equally difficult. For instance, their performance should be poor on the false belief task, which required the child to predict another person's behaviour on the basis of that person's mental states. In chapter 11 this was argued to be a weak explanation on the basis of the performance of normal children. The percentage of normal children who passed the help task was lower than the children who passed the false belief task. While 76.92% of the four-year-old children and 85% of the five-year-old children passed the false belief task, only 7.69% of the four-year-old and 65% of the five-year-old children passed the help task. However, when only autistic children's performance is considered it seems to be a plausible explanation. In experiment 4, whereas 84.62% of the high language level autistic children passed the knowledge attribution task, 53.8% passed the false belief task, and 46.15% passed the help task. Thus, it seems that the autistic children found the false belief and help tasks equally difficult.

In sum, the first conclusion to be drawn from the studies reported in the present thesis is that some autistic children do show metarepresentational skills in that they are able to refer to their own and to another person's mental states. This appears to contradict the theory of mind account of autism which argues that autistic children have a metarepresentational deficit. The second conclusion is that autistic children's language abilities (verbal MAs) seem to be a strong predictive factor of their performance on theory of mind tasks. This finding supports previous studies which suggested that autistic children who pass theory of mind tasks tend to have higher verbal MAs than those who fail.

Furthermore, while the theory of mind account of autism focuses on the autistic child's ability to attribute mental states to themselves and others, namely their metarepresentational skills, it seems that some of the theory of mind tasks require other cognitive skills in addition to metarepresentation. For instance, some of the theory of mind tasks, such as the various false belief tasks used by Baron-Cohen et al. (1985), Leslie & Frith (1988),

Perner et.al. (1989) and Baron-Cohen (1989a), and also the help task in experiment 4, seem to involve an additional inference about behaviour on the basis of a person's mental state. Thus, in order to clarify whether this specific aspect of some of the theory of mind tasks is effecting the performance of the autistic people, and also to clarify if they find these tasks more difficult, whether their difficulty is a general inference problem or one which is specific to predicting behaviour on the basis of mental states, in future research, studies should include a control task to test the role of an additional inference in theory of mind type of tasks.

If it is the case that autistic children's difficulty is not a general inference problem but one which is specific to predicting behaviours from mental states, this would retain a part of the explanation which has been put forward by the theory of mind account of autism. This is that a difficulty in predicting someone's behaviour on the basis of their mental state may be the underlying factor in autistic people's social communication difficulties.

A further question raised by the findings is whether the difference between the autistic children who pass and those who fail the theory of mind tasks is quantitative or qualitative. In other words, are the autistic people who fail the theory of mind tasks delayed in their development of theory of mind, or do the autistic people who pass the theory of mind tasks belong to a subgroup of autism e.g. Asperger's Syndrome. It was reported in chapter 2 that Ozonoff, Rogers and Pennington (1991) found that high functioning autistic people differed from individuals with Asperger's Syndrome on theory of mind tasks. People with Asperger's Syndrome were more likely to pass on the theory of mind tasks than high functioning autistic people. However, Ozonoff, Rogers and Pennington (1991) concluded that perhaps people with Asperger's Syndrome were using different strategies to solve theory of mind tasks and that more sensitive tests should be developed to examine whether the absence of theory of mind ability differentiates high functioning autistic people from people with Asperger's Syndrome. Ozonoff et al.'s study seems to suggest a possible qualitative difference between the two groups, but further studies are needed in order to clarify whether the difference is qualitative. In addition, as was discussed in detail in

chapter 2 (see 2.2) a number of authors seem to agree that Asperger's Syndrome is a quantitatively distinguished subgroup of autism which falls at the top end of the autism continuum and includes more able autistic people. Thus, given the available evidence, it is not possible to conclude that autistic people who pass theory of mind tasks form a qualitatively different group from those who fail.

12. 3. Cognitive dysfunction and social impairment

If the theory of mind account of autism is correct, and an inability to understand other people's mental states underlies the social communication difficulties, then autistic people who pass theory of mind tasks should show better social communication skills, or milder autistic features. Although the available evidence does not indicate a very strong relationship between autistic people's ability to pass theory of mind tasks and their social adaptation or social communication skills, there is some evidence which suggests the existence of such a relationship.

For instance, Einsmajer & Prior (1991) demonstrated in their study that the autistic children who passed the false belief task were more likely to show a better developed understanding of social interpersonal relations than those who failed. In addition, Dawson and Fernald (1987) found significant relationships between the severity of autism (measured with the Childhood Autism Rating Scale) and both conceptual role-taking skills (not specifically tested with one of the theory of mind tasks) and social behaviour (measured by the Vineland Social Maturity Scale). Furthermore, Oswald and Ollendick (1989) reported significant correlations between autistic children's performance on a false belief task and a social competence scale, and also between the autistic children's performance on a recursive thinking task (*"to think about what another is thinking about what I am thinking "* p.121) and two social competence scales (Vineland Adaptive Behaviour Scales and the Social Performance Survey Schedule). However, correlations between the social competence scales and autistic children's performance on the picture sequencing task (as used originally by Baron-Cohen et al. 1986) were not significant.

In sum, the available evidence seems to suggest that there is a relationship between autistic people's social communication skills and their performance on both conceptual perspective taking and some false belief tasks. This seems to support the theory of mind account of autism. On the basis of this evidence it could be argued that autistic children who show theory of mind ability, also have better social understanding and social communication skills. However, it is not possible to conclude that there is a cause-effect relationship, since the autistic children who pass theory of mind tasks are higher functioning than those who fail, and so they may have developed other strategies to solve the theory of mind tasks. It is also possible that their social communication skills are learned using unusual strategies. Therefore, in order to draw any clear conclusions, it is important that researchers investigating theory of mind in autism control those factors which may contribute to the performance of autistic people. These factors are discussed in the next section .

12.4. What factors need to be controlled in studying theory of mind ability in autism?

As any researcher or clinician who works with autistic children is aware, autism is a condition diagnosed on the basis of behavioural symptoms rather than on the basis of a certain etiology. Although qualitative impairment in social interaction, abnormal language patterns and stereotyped patterns of interests or activities are the main diagnostic features of autism, individual differences between autistic people are marked. Furthermore, the clinical picture of an autistic person may change with age (Bishop, 1989). While a child around the age of four or five may show a number of autistic features, and be diagnosed as autistic, by the time he/she is in his/her teens some of these features may have disappeared.

Another major dimension in autism is mental retardation since 70% to 80% of autistic children are also learning disabled (Ungerer, 1989), a fact which contributes to the difficulty of establishing the precise nature of children's difficulty in cognitive tasks.

Variation in the comprehension of language is a further factor which may contribute ambiguity to the results of a study of autistic people.

Furthermore, as we saw in section 12.2, the tasks that are used to test mental state attribution may involve additional cognitive demands which may determine the performance of the autistic child. Thus many complicating factors are present in autism research. What needs to be done to control the affect of those factors? These will be discussed in the following subsections.

Severity of autism: It has already been emphasised that individual differences between autistic people are marked, and also that the autistic features of an individual may change with age. Therefore if the research aim is to investigate whether a cognitive element may underlie autistic features, such as impaired mental state attribution, it would be informative to use standard measures to define the sample in terms of their autistic characteristics. In other words, including a standard autism scale would give a clearer picture of the autistic sample. It would then be possible to look at the interaction between the performance of the group on various cognitive measures (e.g. passing or failing on theory of mind tasks) and the expression of autism (e.g. the quality of social interaction, the quality of language and stereotypic behaviours).

If it is established that autistic children who pass theory of mind tasks have better social communication skills then those who fail, then one may want to look at whether there is a parallel change in both areas over time. In other words, a longitudinal study could be carried out to investigate whether autistic children who fail theory of mind tasks and show severe social communication difficulties, with age become able to pass these tasks and also show better social adaptation.

General mental ability level: One strategy that has been adopted by researchers to overcome the difficulty that autistic children's general mental ability level may crucially influence their performance, is to study autistic people who have higher general abilities, in the hope that, with this approach, the results of research could point to factors specific to autism. Most of

the researchers in the theory of mind area have taken the approach of using high functioning autistic subjects. As well as focusing on higher ability autistic children, researchers have also included learning disabled control groups in order to control for the effect of general mental ability on performance.

Language level: The results of the present thesis strongly suggest that language abilities of autistic children are strong predictors for their performance on the verbal knowledge attribution tasks. It would be particularly useful to investigate how language ability relates to performance on the other theory of mind tasks.

The specific cognitive demands of the tasks: Researchers investigating the development of theory of mind ability in autism have devised ingenious experiments and have included a number of control questions to ensure that the children are able to follow the task. However, one question which arose from the present thesis is whether the autistic children's difficulty in predicting another person's behaviour on the basis of that person's mental state is simply due to their difficulty with making an inference. Thus, it is important to control for the possibility that a task which is used in the investigation of a specific cognitive ability of an autistic child, is actually measuring only that skill.

12.5. Conclusions

There are two main conclusions to be drawn from the results of the studies reported in this thesis. The first is that autistic children do show some metarepresentational skills, contrary to the theory of mind account of autism. The second is that autistic children's language abilities are a strong predictive factor of their performance on theory of mind tasks.

Furthermore, since autism is a condition with impairments in the areas of language and social interactions combined with stereotyped behaviours, and in addition the majority of autistic people have learning disabilities, it seems unlikely that there is a single factor accounting for this very complex condition. What seems to be necessary, therefore is to take a multifactorial approach to identify the interaction between the different factors

involved. This does not mean that searching for a primary underlying factor is not useful, on the contrary, it is valuable because it may initiate new avenues of research. Once sufficient data are collected to suggest that a factor seems to underlie certain autistic features, then one can take the next step of looking to see how that factor fits into the overall picture. Currently there appears to be sufficient data to suggest that autistic people have some difficulties in understanding other people's mental states, which may partly account for their social communication difficulties.

What seems to be necessary next, is to investigate the relation between the autistic child's general mental ability, language comprehension, severity of autistic features expressed and performance on a number of different mental state attribution tasks in order to establish whether inability to understand other people's mental states can account for the social communication difficulties independently from general mental ability and other language skills.

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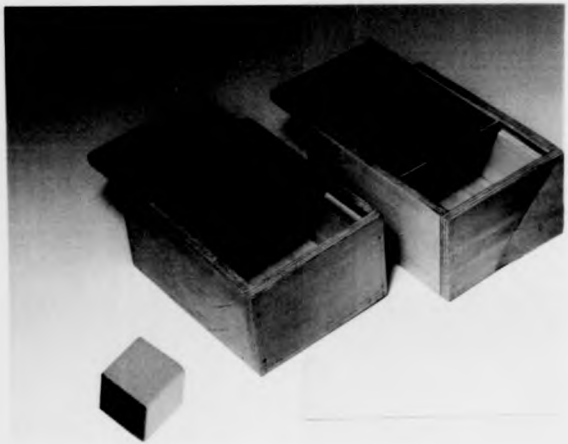
APPENDICIES

Appendix 1. Materials of "Hidden object task"



Appendix 2. McNemar's exact (binomial) Tests experiment 1.

Oldest Group: (6;06-7;08)

"OWN" condition

guess trial

	ANSWERS	Know	Guess		
know trial	Know	0 (0)	18 (.75)	18	
	Guess	1 (.04)	5 (.20)	6	
		1	23	24	(p<.001)

"OTHER" condition

guess trial

	ANSWERS	Know	Guess		
know trial	Know	2 (.083)	16 (.66)	18	
	Guess	1 (.04)	5 (.20)	6	
		3	21	24	(p<.001)

Cross tabulation of response frequencies in the "own" and "other" conditions

The four response patterns are denoted a,b,c and d corresponding to cells in the McNemar tables above.

		guess trial	
	ANSWER	know	guess
know trial	know	a	b
	guess	c	d

"OTHER" condition

	response pattern	a	b	c	d	total
	a	0	0	0	0	0
"OWN" condition	b	2	13	0	3	18
	c	0	0	0	1	1
	d	0	3	1	1	5
	total	2	16	1	5	24

Middle Group: (5;06-6;05)

"OWN" condition

guess trial

	ANSWERS	Know	Guess		
know trial	Know	1 (.023)	27 (.62)	28	
	Guess	4 (.093)	11 (.25)	15	
		5	38	43	(p<.001)

"OTHER" condition

guess trial

	ANSWERS	Know	Guess		
know trial	Know	4 (.093)	27 (.627)	31	
	Guess	6 (.139)	6 (.139)	12	
		10	33	43	(p<.001)

Cross tabulation of response frequencies in the "own" and "other" conditions

The four response patterns are denoted a,b,c and d corresponding to cells in the McNemar tables above.

			guess trial	
		ANSWER	know	guess
know trial		know	a	b
		guess	c	d

"OTHER" condition

	response pattern	a	b	c	d	total
"OWN" condition	a	0	1	0	0	1
	b	2	18	3	4	27
	c	0	2	0	2	4
	d	2	6	3	0	11
	total	4	27	6	6	43

Youngest Group: (4;05-5;05)

"OWN" condition

	ANSWERS	guess trial Know	Guess		
know trial	Know	8 (.14)	19 (.35)	27	
	Guess	6 (.11)	21(.38)	27	
		14	40	54	(p<.01)

"OTHER" condition

	ANSWERS	guess trial Know	Guess		
know trial	Know	11 (.20)	24 (.44)	35	
	Guess	5 (.09)	14 (.25)	19	
		16	38	54	(p<.001)

Cross tabulation of response frequencies in the "own" and "other" conditions

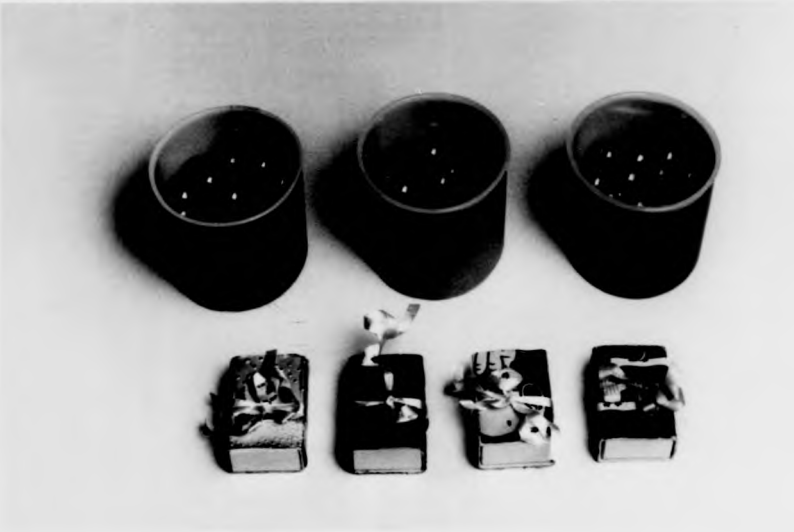
The four response patterns are denoted a,b,c and d corresponding to cells in the McNemar tables above.

	ANSWER	guess trial know	guess
know trial	know	a	b
	guess	c	d

"OTHER" condition

	response pattern	a	b	c	d	total
"OWN" condition	a	2	4	1	1	8
	b	3	13	1	2	19
	c	3	1	1	1	6
	d	2	7	2	10	21
	total	10	25	5	14	54

Appendix 3. Materials of "Which is the present?" task



Appendix 4. McNemar's exact (binomial) Tests experiment 2.

Autistic low language level (mean BPVS age equivalent 4;11)

"OWN" condition

guess trial

	ANSWERS	Know	Guess		
know trial	Know	3 (.214)	2 (.142)	5	
	Guess	0 (0)	9 (.642)	9	
		3	11	14	(p=.5)

"OTHER" condition

guess trial

	ANSWERS	Know	Guess		
know trial	Know	3 (.214)	4 (.285)	7	
	Guess	1 (.071)	6 (.428)	7	
		4	10	14	(p=.37)

Cross tabulation of response frequencies in the "own" and "other" conditions

The four response patterns are denoted a,b,c and d corresponding to cells in the McNemar tables above.

		guess trial	
	ANSWER	know	guess
know trial	know	a	b
	guess	c	d

"OTHER" condition

	response pattern	a	b	c	d	total
"OWN" condition	a	1	1	0	1	3
	b	1	1	0	0	2
	c	0	0	0	0	0
	d	1	2	1	5	9
	total	3	4	1	6	14

Autistic high language level (mean BPVS age equivalent 9;06)

"OWN" condition

guess trial

	ANSWERS	Know	Guess		
know trial	Know	4 (.285)	8 (.571)	12	
	Guess	1(.071)	1 (.071)	2	
		5	9	14	(p<.039)

"OTHER" condition

guess trial

	ANSWERS	Know	Guess		
know trial	Know	0 (0)	11 (.785)	11	
	Guess	0 (0)	3 (.214)	3	
		0	14	14	(p<.001)

Cross tabulation of response frequencies in the "own" and "other" conditions

The four response patterns are denoted a,b,c and d corresponding to cells in the McNemar tables above.

		guess trial	
	ANSWER	know	guess
know trial	know	a	b
	guess	c	d

"OTHER" condition

	response pattern	a	b	c	d	total
"OWN" condition	a	0	3	0	1	4
	b	0	7	0	1	8
	c	0	1	0	0	1
	d	0	0	0	1	1
	total	0	11	0	3	14

Children with Down's Syndrome

"OWN" condition

		guess trial			
	ANSWERS	Know	Guess		
know trial	Know	3 (.176)	3 (.176)	6	
	Guess	1 (.058)	10 (.588)	11	
		4	13	17	(p=.625)

"OTHER" condition

		guess trial			
	ANSWERS	Know	Guess		
know trial	Know	1 (.058)	3 (.176)	4	
	Guess	4 (.235)	9 (.529)	13	
		5	12	17	(p=1)

Cross tabulation of response frequencies in the "own" and "other" conditions

The four response patterns are denoted a,b,c and d corresponding to cells in the McNemar tables above.

		guess trial	
	ANSWER	know	guess
know trial	know	a	b
	guess	c	d

"OTHER" condition

	response pattern	a	b	c	d	total
"OWN" condition	a	0	2	1	0	3
	b	0	1	1	1	3
	c	0	0	1	0	1
	d	1	0	1	8	10
	total	1	3	4	9	17

4-years-old children

"OWN" condition

guess trial

	ANSWERS	Know	Guess	
know trial	Know	8 (.47)	6 (.352)	14
	Guess	1 (.058)	2 (.117)	3
		9	8	17

(p=.125)

"OTHER" condition

guess trial

	ANSWERS	Know	Guess	
know trial	Know	6 (.352)	5 (.294)	11
	Guess	2 (.117)	4 (.235)	6
		8	9	17

(p=.45)

Cross tabulation of response frequencies in the "own" and "other" conditions

The four response patterns are denoted a,b,c and d corresponding to cells in the McNemar tables above.

		guess trial	
	ANSWER	know	guess
know trial	know	a	b
	guess	c	d

"OTHER" condition

	response pattern	a	b	c	d	total
"OWN" condition	a	4	2	1	1	8
	b	1	3	1	1	6
	c	1	0	0	0	1
	d	0	0	0	2	2
	total	6	5	2	4	17

5-years-old children

"OWN" condition

guess trial

	ANSWERS	Know	Guess	
know trial	Know	2 (.09)	13 (.59)	15
	Guess	0 (0)	7 (.31)	7
		2	20	22

($p<.0005$)

"OTHER" condition

guess trial

	ANSWERS	Know	Guess	
know trial	Know	1 (.045)	15 (.68)	16
	Guess	0 (0)	6 (.27)	6
		1	21	22

($p<.0005$)

Cross tabulation of response frequencies in the "own" and "other" conditions

The four response patterns are denoted a,b,c and d corresponding to cells in the McNemar tables above.

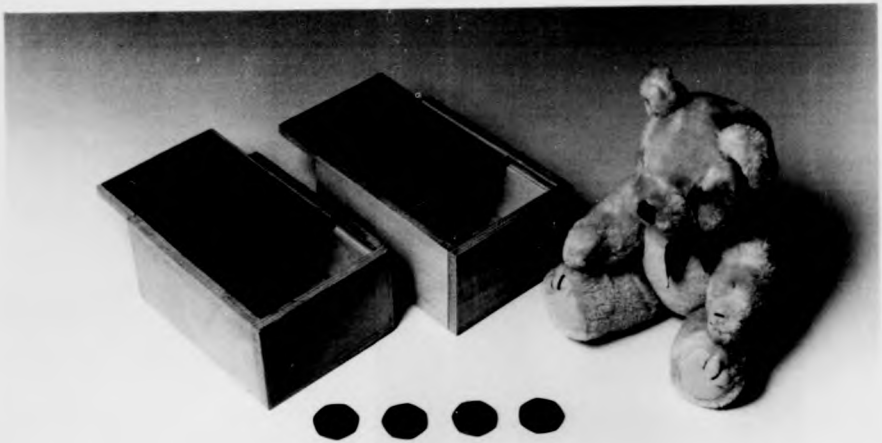
		guess trial	
	ANSWER	know	guess
know trial	know	a	b
	guess	c	d

"OTHER" condition

	response pattern	a	b	c	d	total
"OWN" condition	a	0	1	0	1	2
	b	1	12	0	0	13
	c	0	0	0	0	0
	d	1	2	0	4	7
	total	2	15	0	5	22

Appendix 5. Materials of "Animal hiding" task

Appendix 6. Materials of "Know" and "Help" tasks



APPENDIX 7. Raw data for experiment 1.

Group	Self knows	Self Guesses	Other knows	Other guesses
1	1	0	1	0
1	1	0	0	0
1	1	0	1	1
1	1	0	1	0
1	1	0	1	0
1	1	0	0	0
1	1	0	1	1
1	1	0	1	0
1	0	0	0	1
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2	0	1	0	0
2	1	0	1	0
2	1	0	1	0
2	0	0	1	1
2	0	0	1	1
2	1	0	1	0
2	1	0	0	0
2	0	0	1	0
2	1	1	1	0
2	1	0	0	1
2	0	1	1	0
2	1	0	1	1
2	1	0	1	0
2	0	0	0	1

2	1	0	1	0
2	1	0	1	1
2	1	0	1	0
2	0	1	1	0
2	1	0	0	0
2	0	0	0	1
2	0	0	1	0
2	1	0	1	0
2	1	0	1	0
2	1	0	1	0
2	0	0	1	0
2	1	0	1	0
2	1	0	0	1
2	0	0	0	1
2	1	0	0	0
3	0	0	1	0
3	1	1	1	1
3	1	1	1	1
3	0	1	1	0
3	1	0	1	0
3	1	1	1	0
3	1	1	0	1
3	0	1	1	1
3	0	0	1	0
3	1	0	1	0
3	0	0	0	1
3	1	0	0	0
3	1	0	1	0
3	1	0	1	0
3	0	0	0	0
3	0	1	1	1
3	0	0	0	0
3	0	0	1	0
3	1	0	1	0
3	0	0	0	0
3	1	0	1	0
3	1	1	1	0
3	0	0	1	0
3	1	0	0	0
3	0	0	0	0
3	0	0	0	1
3	0	0	0	0
3	1	0	1	1
3	1	0	1	1
3	1	0	1	0
3	1	1	1	0
3	0	0	0	0
3	1	1	0	0
3	1	0	1	0
3	0	0	0	0
3	0	0	1	0
3	1	0	1	1
3	1	0	1	0
3	0	0	1	0
3	0	1	1	1
3	1	0	1	1
3	1	0	1	0
3	0	1	0	1

3	1	0	0	1
3	0	0	1	0
3	0	0	0	0
3	0	0	0	0
3	1	0	1	0
3	0	1	0	0
3	1	0	1	0
3	0	0	1	1
3	1	1	1	0
3	0	0	0	0
3	0	0	1	1

Group 1. is the oldest group with the mean age of 6 years and 9 months
Group 2. is the middle group with the mean age of 5 years and 9 months
Group 3. is the youngest group with the mean age of 4 years and 9 months.

APPENDIX 8. Raw data for experiment 2.

Group	Self knows	Self Guesses	Other knows	Other guesses
1	0	0	0	0
1	0	0	1	1
1	1	1	1	0
1	0	0	0	0
1	1	0	1	0
1	0	0	1	0
1	1	0	1	1
1	0	0	0	0
1	0	0	0	0
1	0	0	1	0
1	0	0	0	1
1	1	1	1	1
1	0	0	0	0
1	1	1	0	0
2	1	1	0	0
2	1	1	1	0
2	1	0	0	0
2	1	0	1	0
2	1	0	1	0
2	1	1	1	0
2	1	0	1	0
2	1	0	1	0
2	1	0	1	0
2	1	1	1	0
2	0	1	1	0
2	0	0	0	0
2	1	0	1	0
2	1	0	1	0
3	1	0	1	0
3	1	1	1	0
3	0	0	0	0
3	1	1	1	1
3	1	0	1	0
3	1	0	1	1
3	0	1	1	1
3	1	1	0	1
3	1	1	0	0
3	1	1	1	1
3	1	1	1	1
3	0	0	0	0
3	1	0	1	0
3	1	0	0	1
3	1	1	1	1
3	1	0	0	0
3	1	1	1	0
4	1	0	1	0
4	1	0	1	0
4	1	0	1	0
4	1	0	1	0
4	0	0	1	0
4	1	1	0	0
4	1	0	1	0

4	1	0	1	1
4	0	0	0	0
4	0	0	0	0
4	1	0	1	0
4	1	0	1	0
4	1	0	1	0
4	1	0	1	0
4	0	0	0	0
4	0	0	0	0
4	1	0	1	0
4	0	0	0	0
4	1	0	1	0
4	1	0	1	0
4	1	1	1	0
4	0	0	1	0
5	0	0	1	1
5	0	0	0	0
5	1	0	0	0
5	0	0	0	0
5	0	0	0	0
5	1	1	1	0
5	1	0	0	1
5	0	0	0	0
5	0	0	0	0
5	1	1	1	0
5	0	0	0	1
5	1	0	1	0
5	0	0	0	0
5	0	0	0	0
5	1	1	0	1
5	0	0	0	0
5	0	1	0	1

Group 1. is the low language level autistic children
Group 2. is the high language level autistic children
Group 3. is the 4-year-old normal children
Group 4. is the 5-year-old normal children
Group 5. is the children with Down's Syndrome.