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Autism and theory of mind : an examination of different modalities.

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AUTISM AND THEORY OF MIND: AN EXAMINATION OF DIFFERENT MODALITIES

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ABSTRACT

A specific deficit in Theory of Mind (ToM) abilities has been proposed to explain the distinct pattern of social/cognitive deficits in individuals with autism (Frith, 1989). Leslie and Frith (1988), Perner, Frith, Leslie and Leekham (1989) and Baron-Cohen and Goodhart (1994) have also indicated that children with autism have a specific difficulty in understanding the principle that "seeing leads to knowing". However, other studies designed to measure ToM abilities have reported weak mentalising skills in individuals with developmental language disorders (Shields, Varley, Broks and Simpson, 1996), deaf people (Peterson and Siegal, 1995) and individuals with intellectual difficulties (Shulman and Pilowsky, 1996). This study was designed to examine the developmental and cognitive correlates of one aspect of ToM. A method derived from O'Neill and Gopnik (1991) was adapted and children with autism (n = 17), children with intellectual difficulties of undifferentiated aetiology (n = 19) and normally developing children (n = 21) were compared on their ability to understand the principle that "SEEING, FEELING and TELLING" lead to knowing. As predicted, individuals with autism (88%) and children with intellectual difficulties (63%) had difficulty identifying the role of informational access in knowledge, whereas the normally developing group did not (14%). Logistic regression analyses revealed that group membership and verbal mental age, when measured by the Test for Reception of Grammar (TROG; Bishop, 1983), were the best predictors of task performance. Discussion focuses on the implications of the findings and emphasises the need to carefully consider what tasks actually measure as well as the specific aetiology of comparison groups when studying abilities and impairments of individuals with autism and intellectual difficulties.

SECTION 1

ETHICAL RESEARCH PROPOSAL

AUTISM AND THEORY OF MIND: AN EXAMINATION OF DIFFERENT MODALITIES.

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POTENTIAL VALUE OF ADDRESSING THIS ISSUE

The syndrome of autism is manifested in a variety of symptoms forming a specific triad of impairments in communication, imagination, and socialisation (American Psychiatric Association, 1994; Wing and Gould, 1979). Proponents of the Theory of Mind (ToM) hypothesis have claimed that one of the primary deficits in autism is a deficiency in the ability to attribute mental states to oneself and others (Baron-Cohen, Leslie and Frith, 1985; Frith, 1989; Hobson, 1993, 1990a, 1990b; Hughes and Russell, 1993; Leslie and Frith, 1988; Ozonoff, Pennington and Rogers, 1991; Russell et al., 1991). Within this theoretical framework the communication impairment can be understood as a problem in the semantics of mental states, the imagination impairment as a problem in attributing mental states that are contrary to reality, and the social impairment as an inability to understand the way in which mental states affect behaviour (Leslie, 1987).

This project will extend work already completed on ToM; extending the existing knowledge base will provide further information to general discussions of how best to educate individuals with autism (Hadwin, Baron-Cohen, Howlin and Hill, 1996; Holroyd and Baron-Cohen, 1993; Jordan and Powell, 1995; Powell and Jordan, 1992). Popular sources of information on autism now include references to theory of mind studies (Autism Research International, 1996). Some teaching materials are even being marketed with reference to ToM (Gray, 1995). Therefore, hopefully adding to the existing knowledge base will enable development of a repertoire of curricular materials that target several dimensions of one specific problem.

This is consolidated by Happe (1994) who suggested the appropriateness of using ToM research as a guiding principle in developing curricula for students with autism, given that this theory accounts for a variety of impairments across the social, communication and imagination triad used in diagnosing autism.

Moreover, several intervention studies have found that children with autism can show improvements in their ability to understand beliefs and emotions (Swettenham, 1995;

Ozonoff and Miller, 1995; Hadwin, Baron-Cohen, Howlin, and Hill, 1996). Identification of deficits in the area of knowledge and modality could be included in training packages specifically designed to increase the ability to mind read as a valuable addition.

BACKGROUND TO THE STUDY

Classification and characteristics

Autism is a pervasive developmental disorder that is usually apparent from early childhood (Volkmar, Stier and Cohen, 1985). It is characterised by profound deficits in communication and social understanding and by ritualistic and obsessional behaviours. The actual term "autistic" is derived from Bleuler (1908), who used the word to describe social withdrawal seen in adults with schizophrenia. Autism as a syndrome, however, was first described by Kanner in 1943. He delineated four essential features:

a) extreme isolation and an inability to relate to people;

b) a pathological need for sameness; applying both to the individual's own behaviour and to the environment;

c) mutism or non communicative speech;

d) onset in the first two years of life.

Many of Kanner's ideas remain essential to today's perspective of autism, however current views differ sharply with some of his observations. Kanner for example, created the psychogenic view perpetuated by later writers such as Bettleheim (1976), that cold emotionless parental behaviour caused the condition, referred to by Kanner as "refrigerator parenting".

Approximately 10 per cent of autistic individuals have savant skills. This refers to an ability which is considered remarkable by most standards. These skills are often spatial in nature, such as special talents in music and art. Kanner however, founded the myth of

"latent genius" which has caused great distress for family members and teachers who have nearly always failed to unlock the alleged genius. Howlin (1998) quoted research indicating that the majority (around 70-75 per cent) of individuals with autism have some associated learning disabilities and around 50 per cent have an IQ below 50. Those that have severe to profound cognitive impairments are unlikely to develop useful speech, and this group also tends to develop behaviours such as self injury, and almost always require specialist education and life-long care. Approximately 20 per cent of those with autism have an IQ within the "normal" range, for them outcome is seen to be more variable.

It is common for many of those with autism to respond in an unusual way to sensory stimuli, over-reacting to sounds and touch, or under-reacting to pain (Frith and Baron-Cohen, 1987). In addition, behaviour such as self stimulation and repetitive behaviours can extend for long periods and to the exclusion of other activities. Twirling, hand flapping, and rocking are common, especially in institutionalised children. Furthermore, autistic children can be anxious and obsessive about keeping surroundings completely the same. Toys for example in many cases often have to be in the same place, similar to non-autistic children at two and a half years of age. This suggests that the development of autistic children may be stalled at this point (Murray, 1996).

As with many individuals with learning disabilities, those with autism often have problems maintaining attention for long periods of time. Many autistic individuals also have a narrow or focused attention span, termed 'stimulus over-selectivity.' Basically, their attention is focused on only one, often irrelevant, aspect of an object. For example, they may focus on the colour of a utensil, and ignore other aspects such as the shape. In this case, it may be difficult for a child to discriminate between a fork and a spoon if he/she attends only to the colour. Since attention is the first stage in processing information, failure to attend to the relevant aspects of an object or person may limit one's ability to learn about objects and people in one's environment (Dunlap et al., 1981). This attentional pattern has caused many parents to suspect hearing impairment in very young autistic children. Moreover, attentional selectivity can augment existing social problems,

as appropriate responses to things one hears requires the excluding of irrelevant stimuli, and attendance to important details.

Interestingly, people with autism generally show very little inclination to use their skills outside the circumstances in which they were learned. For example, an autistic child may learn to read in class but fail to check the sign on the door of a lavatory before entering. As a result, therapeutic emphasis has gradually shifted from the classroom to the community (Horner, Dunlap and Koegel, 1988).

In autism, almost all aspects of communication and language can be impaired, such as the use and understanding of smiles, gestures and postures (Watson et al., 1989). Rutter (1978) pointed out that only about half of autistic individuals develop communicative speech. Even among those that do develop productive speech, prosody and pragmatics are likely to be severely impaired. Many of those with autism, and specifically those of lower intelligence, do not speak, or only make unrecognisable noises, or may speak only on rare occasions, during temper outbursts for example. However, others can speak clearly but merely repeat what they have heard. This repetition (known as echolalia) is a normal stage in the early development of language which remains in many cases of those with autism. Communication may be an initiation, a response, or an imitation, serving to express emotion, make a request or protest. Therefore the impact of this impairment can affect all facets of their life.

It is commonly stated that people with autism are not motivated to engage in educational or treatment programmes. However, this paper argues that it would be more accurate to say that they are motivated by things that most people would find unusual or odd. Age appropriate toys for example, may not hold interest, whereas isolated, repetitive manipulation or fascination with parts of objects rather than their function (e.g. spinning the wheels of a toy car rather than pushing it about) may be of high priority. Consequently this identifies the need for systematic assessment to determine what is reinforcing (Green et al., 1988).

Prevalence

As definitions of autism have changed, so have the figures of prevalence of the disorder, illustrated by Fombonne (1997) who found rates varying from 0.7 to 15.5 per 10,000. Further analysis indicated that although the average figure for "classic" autism appears to be around 5 per 10,000 the rates are much higher (91 per 10,000) if children within the wider "autistic spectrum" are included (Wing, 1996).

Causation

There are many ways to understand how our minds develop and work and consequently there are a myriad of ways of thinking about how a complex phenomenon like autism might begin. In recent years, methods of studying brains have advanced and have led many to pin their hopes for explaining and understanding autism on research into neuronal systems in the brain (Trevarthen and Aitken, 1994). In addition, new genetic and molecular-biological theories that seem to explain how inherited factors control normal and abnormal building of the tissues and organs of the brain, offer a much more fundamental explanation (Trevarthen, Aitken, Papoudi and Robarts 1998).

Most arguments regarding rival concepts revolve around the problem: is autism caused genetically or is it caused by an abnormal environment, either in the body or coming from stimuli and especially from the social world? However, regardless of which approach is taken, it should be remembered that autism is a condition that develops. Consequently, as with all developments in brain function, autism will be a result of interacting factors. These interacting factors will come from within (that is, inside the genetic growth programme), and from the environment. After all, it is the environment that stimulates and transforms the brain as it grows and connections are being established.

Theory of Mind (ToM)

Many researchers have taken the view that social inadequacies are the fundamental problem in autism. Walters et al. (1990), for example, reviewing studies on attachment,

recognition of emotions, play, social cognition, and neurochemistry concluded that Kanner was correct in asserting:

> "that social-affective deficits or deviations lie at the root of this disorder" (p. 320).

As Grandin (1992) noted, even among those who make the greatest progress, their communication and social problems continue to affect many aspects of their lives.

Autism is currently defined at the behavioural level, on the basis of impairments in socialisation, communication, and imagination, with stereotyped repetitive interests taking the place of creative play (DSM IV; American Psychiatric Association, 1994 - refer Appendix I). Psychological accounts of autism seek to explain this set of co-occurring symptoms in terms of underlying cognitive features. Wing and Gould (1979) proposed an association between deficits recognised in socialisation, communication and imagination.

Baron-Cohen, Leslie and Frith (1985) suggested that the triad of impairments identified by Wing and Gould result from autistic individuals lacking a 'Theory of Mind' (ToM). Here individuals are viewed as being impaired in their ability to understand mental states. This ToM refers to the ability to attribute mental states to the self and others. The ability to know about minds is required for many human interactions; it is necessary for understanding, explaining, predicting and manipulating the behaviours of others. According to Wellman (1993) this involves two components: the ontological aspect, that is the ability to distinguish between the real and the mental world, and the causal aspect, that is the ability to understand mutual causal relations between mental states and the physical behavioural world.

The acquisition of ToM abilities in non developmentally delayed children is viewed as one of the major developmental achievements of the first few years of life (Yirmiya, Erel, Shaked and Solomonica-Levi, 1998). Although there is some variation concerning the

exact age at which ToM is acquired most agree that it is in place around three to four years.

Proponents of the ToM hypothesis of autism suggest that the communication impairment can be understood as a problem in the semantics of mental states, the imagination impairment as a problem in attributing mental states that are contrary to reality, and the social impairment as an inability to understand the way in which mental states affect behaviour. As a result, individuals with autism do not understand social situations and interact inappropriately (Leslie, 1987).

If ToM is dysfunctional in children with autism, then it has been argued that they should have difficulty understanding the epistemic mental state of belief. Dennet (1978b) argued that the best way to test a child's understanding of belief is to investigate if someone could hold a false-belief. Baron-Cohen, Leslie and Frith (1985) designed a task to compare the ability of children with autism, children with Down's syndrome and non developmentally delayed children to recognise a character's false belief in the "Sally-Ann" task. Here the child sees a doll (Sally) hide a marble in her basket and leave the room, after which another doll (Ann) moves the marble to her own box. The child is then asked where Sally will look for the marble. The researchers found that 80 per cent of autistic participants did not answer correctly. That is, they would respond that Sally would look in the box where the marble really was. This was in contrast to most "normally-developing" 4 year olds and 86 per cent of a group of children with Down's syndrome, who correctly replied that Sally would look in the basket where she mistakenly believed the marble would be. This and other findings were taken as evidence for an autism-specific deficit in thinking about thoughts.

Seeing and knowing

As already suggested, the awareness of where knowledge comes from is viewed as vital for a normally functioning ToM. Gopnik and Graf (1988) stated that when people form a new belief about the world, they understand and often remember how they got that belief.

They usually know whether it is based on what someone told them, on an inference they made, or on something they saw with their own eyes. Being able to take account of mental states in self and others, and to understand that knowledge of an object may be gained by looking at it, are significant accomplishments and form the basis of much social interaction (Pratt and Bryant, 1990), thereby constituting a fundamental aspect of mind. Although we do not have a complete causal account of how our experiences lead to our current representation of the world, we do know that events such as perception, communication and inference can lead to beliefs, and much of the time we can identify which particular type of event led to a belief. Nisbett and Ross (1980) suggested that failure to consider the sources of knowledge may result in false impressions, interpretations, and beliefs that may have serious consequences.

A number of studies such as Pillow (1989) and Pratt and Bryant (1990) suggested that children develop causal accounts of the origins of beliefs between the ages of 3 and 6 years. These experiments have focused on understanding that visual perception leads to knowledge. Further research such as O'Neill and Gopnik (1991) has examined the ability of non developmentally delayed children to identify the sources of their beliefs using 3 modalities: touching, seeing and feeling. Again, they noted that this ability usually developed between the ages of 4 and 5 years.

Leslie and Frith (1988) found that only 44 per cent (Perner, Frith, Leslie and Leekham, 1989, found that only 35 per cent) of children they tested with autism could understand the role of visual access in knowledge formation. Baron-Cohen and Goodhart extended this research in 1994 by including a control group with learning disabilities. They found that 75 per cent of those with learning disabilities could pass this test compared to only 33 per cent of those with autism. They saw this ability as a "cornerstone principle of a theory of mind" (p. 397).

Moderating factors

However, considerable variance has been found in the proportion of children with autism

who pass ToM tasks. Meta-analyses conducted by Happe (1995) found proportions passing standard first-order ToM tasks varied from 15 per cent to 60 per cent. In some studies task performance was found to improve with higher chronological age (CA) (Baron-Cohen, 1991; Leslie and Frith, 1988), in others higher mental age (MA) or better linguistic skills (Eisenmajer and Prior, 1991; Leekham and Perner, 1991) and in yet another study with both higher CA and verbal mental age (VMA) (Prior, Dahlstrom and Squires, 1990).

Possible explanations for this variation in performance are poor test-retest reliability of ToM tasks (Mayes, Klin, Tercyak, Cicchetti, and Cohen, 1996) and the influence of developmental cognitive factors in determining social cognitive ability, in addition to or above diagnostic group status (Buitelaar, van der Wees, Swaab-Barnveld, van der Gaag, 1999). Furthermore, Buitelaar, van der Wees, Swaab-Barnveld and van der Gaag suggested that divergent findings may be due to using a single task such as the British Picture Vocabulary Scale (BPVS; Dunn, Dunn. Whetton and Pintilie, 1982) in many studies to measure verbal ability, and the failure to control for non-verbal mental skills in studies examining the influence of verbal ability.

In addition, the aetiology of the individuals comprising the learning disabled group are important, as the specific characteristics of any given comparison group may relate to the results and interpretation of any single study (Prior, Dahlstrom and Squires, 1990). Individuals with Down's syndrome, for example, are known to have higher empathic abilities and better social skills compared to other individuals with learning disabilities of unknown aetiology (Beeghly, Weiss-Perry, and Cicchetti, 1990; Kasari, Mundy, Yirmiya, and Sigman, 1990). Therefore, differences between individuals with Down's syndrome and autism in ToM abilities may indicate a specific strength of those with Down's syndrome and not a deficit in those with autism. Moreover, recent reports indicate that individuals with a learning disability of undifferentiated aetiology may also show deficits in ToM abilities compared to normally developing individuals (Benson et al., 1993,

Yirmiya, Solomonica-Levi, and Shulman, 1996; Yirmiya, Solomonica-Levi, and Shulman and Pilowsky, 1996).

Extending the research

The aim of this research project is to replicate and extend previous findings to determine whether ToM is a cross modal deficit for those with autism. In addition, this research will identify if ToM deficits are specific to autism. To do this a similar methodology to O'Neill and Gopnik (1991) will be adopted with the inclusion of an autistic group and mental age equivalent learning disabled group of undifferentiated actiology.

Given the possible effect of cognitive and developmental factors on ToM ability, this project also aims to investigate the impact of VMA and CA for all three groups.

HYPOTHESES

On the basis of the literature it is hypothesised that individuals with autism will perform less well than normally developing children or individuals with learning disabilities on ToM tasks regardless of modality.

RECRUITMENT OF PARTICIPANTS

There will be 3 groups of participants:

1. Those with a recognised diagnosis of autism (e.g. DSM-IV see Appendix I).
2. Those with a learning disability of undifferentiated aetiology.
3. Those from a mainstream school, not developmentally delayed; without a Special Educational Needs statement or going through the statementing process.

Power Analysis was used to determine the number of participants required to show a "real" experimental effect. Therefore, using the Baron-Cohen and Goodhart (1994) study where they compared the proportion of children with autism Vs children with disabilities who passed an experimental task (3 per cent Vs 75 per cent pass rate respectively) a two-sample comparison of proportions (with equal group sizes), with alpha (p) set at 0.05,

beta set at 0.2 (equivalent to 80 per cent power) was conducted. Assuming a 2 tailed test, would require 21 cases per group to find this difference in proportions.

The autistic population will be recruited from the

. The Educational Psychologist based at the has agreed to contact parents of children attending their centre with a diagnosis of autism to determine if they would be interested in taking part in this research project. Information and consent documents (refer Appendix II) will be forwarded to those parents giving details of the research and what it would involve, including the opportunity to contact the researcher for further information.

Those clients with learning disabilities but not autism will be recruited from a local school for children with moderate learning difficulties. The head teacher of School in has agreed to contact parents to determine if they would also be interested in taking part in this research project. Again, the information document will be forwarded giving further information. Likewise, the head teacher of a mainstream primary school in has agreed to contact parents in a similar manner.

Inclusion criteria

Inclusion criteria will be based on an attempt to match participants used in previous experiments (such as Baron-Cohen and Goodhart, 1994). Therefore, only participants meeting the full set of criteria of autistic disorder from DSM-IV or based on the Autism Diagnostic Interview-Revised (ADI-R; Lord, Rutter, and Le Couteur, 1994) will be included. In addition, all children will be characterised by their scores on the Childhood Autism Rating Scale (CARS; Schopler, Reichler, Devellis, and Daly, 1980), to ensure that individuals from the autistic group are in fact autistic, and that those with learning disabilities do not meet the criterion for autism.

Participants will also be assessed to ensure they reached inclusion criterion of a verbal mental age between 4 and 8 years; measured by the BPVS and Test for Reception of Grammar (TROG; Bishop, 1983).

RESEARCH DESIGN

A mixed quasi-experimental design will be employed; having both a between-participants component (Autism Vs LD Vs Control) and a within-participants component (modality of task).

The inclusion screen described previously will be employed. Following this, three experimental tasks will be conducted:

***Task (1)*:** A pre-test, control condition.

***Task (2)*:** To determine another's knowledge and identify its source.

***Task (3)*:** Identifying and differentiating the various component activities of seeing, feeling and listening.

PROCEDURES EMPLOYED

The participants will be screened by the investigator individually in a room without distractions at the schools concerned prior to the experimental tasks. For both screening and experimental testing the participant and investigator will be sat facing each other across a table. At no point will any comments be made regarding the correctness or otherwise of responses.

TASK (1): pre-test control condition

A pre-test task similar to that of Baron-Cohen and Goodhart (1994) will be administered to familiarise the participants with the general procedure of choosing one of the dolls and to eliminate participants who are unable to follow the simple procedure. First, the investigator will take out the two dolls and say to each participant: **"This is John and this is Sally".** The participant will then be asked the naming question: **"Which is John?**

Which is Sally?" Next the participant will be shown each of the objects and asked to name them. If participants answer correctly the investigator will then say: **"Let's give John the toothbrush and Sally a ball."** Having watched the investigator give each doll an object, the participant will then be asked: **"Who has the toothbrush, John or Sally?"** This last question constitutes a control condition to the main experiment, reported below, in comprising a story but entailing no knowledge formation. Six trials will be given to each participant, in which the object and order in which the dolls are mentioned will be randomised across trials. Responses will be marked on a recording form (refer appendix III). Again, participants will be required to answer correctly on at least five out of six trials, and therefore be permitted to participate in the second experimental task.

TASK (2): To determine another's knowledge and identify the source of that knowledge

The investigator will introduce the experimental task to the participant similar in nature to that of O'Neill and Gopnik (1991). They will begin by placing the tunnel on the table and saying: **"This is my tunnel, you can lift up the material and look inside. But when the material is down you cannot see what is inside. Now we are going to play a game. I am going to place things inside the tunnel and then I am going to ask you which of the dolls Sally or John knows what is inside the tunnel, and how they know what is inside?"** The participants will then receive 15 experimental trials, 5 for each of the 3 types of source information (Seeing, Feeling and Listening).

In the Seeing trial one of the objects will be placed into the tunnel using the scarf so that the participant cannot see what it is. The investigator will then make one doll lift up the material and "look" inside, and the other doll walk around the tunnel looking at the outside. Each action will be accompanied by a statement such as, **"John lifts up the flap and has a look inside. Sally walks around the tunnel and looks at the tunnel".** The participant will then be asked **"Who knows what is inside the tunnel John or Sally?"** The child's response will then be marked on the response sheet.

If the participant responds correctly to the identity of the doll they will then be asked the source question. This will first be done in the form of an open-ended question: **"How do they know what is inside"?** If the participant responds immediately, they will be scored as either correct or incorrect. If the participant does not respond immediately, the source question will be repeated and the participant presented with three forced-choice alternatives that specify the different possible sources of information (e.g., **"Because they felt inside, because they saw what was inside or because they were told what was inside?"**). The three alternatives will be presented separately and the participants required to respond **"yes"** or **"no"**. The answers will be counted as correct if presented in the appropriate order.

The Feeling trial will be much the same, except the investigator will make one of the dolls put a hand under the material and "feel" inside the tunnel, and the other doll lift up the tunnel and put it down again. Again each action will be followed by a statement such as: **"Sally puts her hand inside the tunnel and takes it out again. John lifts up the tunnel and then puts it down again".**

The listening trial procedure will be the same, except the investigator whispers the identity of the object to one of the dolls, whereas the other doll will be whispered the time. Again each action will be followed by a statement: **"I am going to tell John what time it is. I am going to tell Sally what is inside the tunnel".**

On each of the trials the order of the doll who looks, feels or is told, versus the other actions of lifting up the tunnel etc., and the order in which the two dolls are mentioned in the question will be randomised. Furthermore, the order of the forced choice alternatives will be counterbalanced. This means that the participant will remain ignorant of the contents of the tunnel, and therefore have to answer the questions purely on the basis of what can be ascribed to another character.

Participants will receive a score between 0-15 for the naming question and three scores each between 0-5 for the source question (either in open-ended or forced choice form).

TASK (3): Identifying and differentiating the various component activities of seeing, feeling and listening

The materials for this task will be identical to those described earlier. After completing the previous task the participants will be asked if they would help John to play a game, by helping him to find out what is inside the tunnel. The investigator will then place one of the covered objects into the tunnel. After this the participant will be told: **"John wants to know what is inside the tunnel".** This will be followed by one of three questions: **"Can you help John to see what is inside the tunnel?" "Can you help John to feel what is inside the tunnel?", or "Can you tell John what is inside the tunnel?"** The procedure will be repeated so that each question is asked twice, there being six trials in total. The order of the questions will again be counterbalanced. The individual will be scored as correct if:

(i) in the "see case," they lift up the tunnel or let John look under the material flaps.

(ii) in the "feel case," they put John's hand inside the tunnel.

(iii) in the "listening case," they tell John the identity of the object in the tunnel.

The whole procedure will be repeated until all participants have completed the tasks. A score between 0-6 will then be allocated to each individual.

MEASURES

The Autism Diagnostic Interview-Revised (ADI-R; Lord, Rutter, and Le Couteur, 1994)

The ADI-R will be used as a screening measure for autism. The ADI-R is commonly used in both clinical and research settings for performing standardised investigator based assessments (Fombonne, 1992). The ADI-R is a semi-structured, standardised diagnostic interview that includes questions relevant to past and current functioning. An ADI-R diagnosis of autism is conferred on the basis of an algorithm that is scored on three

dimensional clusters of items: *qualitative impairments in reciprocal and social interaction* (Dimension B), *impairments in verbal and non verbal communication* (Dimension C), *and repetitive behaviours and stereotyped patterns* (Dimension D). The algorithm specifies that a child must reach cut-off scores of 10 on Dimension B, a verbal score of 8 or a non-verbal score of 7 on Dimension C (verbal scores are only used for participants with a sufficient overall level of language), a score of 3 on Dimension D, and show evidence of abnormality before age 36 months, to receive an ADI-R diagnosis of autism. The ADI-R was validated against ICD-10 criteria by psychiatrists' blind ratings of 32 videotapes of unstructured interviews with mothers of autistic and non autistic mentally handicapped children aged 7-19 years, matched for IQ. Inter-rater agreement was 81-89 per cent (Trevarthen, Aitken, Papoudi and Robarts, 1996). A study by Cox, Charman, Baron-Cohen, Drew, Klein, Baird, Swettenham and Wheelwright (1999) found the ADI-R had good stability for detecting childhood autism.

The Childhood Autism Rating Scale (CARS; Schopler, Reichler, Devellis, and Daly, 1980)

All children will additionally be characterised by their scores on the CARS. The CARS was intended to broaden the classic conceptualisation of autism by including Kanner's criteria (1943), the nine diagnostic points of Creak (1964) and the National Autistic Society's definition. It consists of 15 scales, which are: impairment in human relationships, imitation, inappropriate affect, bizarre use of body movement and persistence of stereotypes, peculiarities in relating to non-human objects, resistance to environmental change, peculiarities of visual responsiveness, peculiarities of auditory responsiveness, near receptor responsiveness, anxiety reaction, verbal communication, non verbal communication, activity level, intellectual functioning and general impressions. There is a continuum of 7 scores for each of the above 15 scales, ranging from normal to severe abnormal behaviour. The rating depends on the child's age and the peculiarity, frequency and intensity of each behaviour. The development of CARS is based on direct observations of the children's behaviour rather than on a theoretical basis. The test was constructed on assessment of 537 children, who were distinguished into

three categories: non autistic, mild to moderate autistic and severe autistic. The CARS is highly reliable and has good validity (Trevarthen, Aitken, Papoudi and Robarts, 1996).

The British Picture Vocabulary Scale (BPVS; Dunn, Dunn, Whetton and Pintilie, 1982)

The BPVS provides a measure of verbal mental age, specifically of single word receptive vocabulary. It consists of 150 picture plates each with four pictures. There is one plate for each of the 150 words of the two equivalent word lists, arranged in order of difficulty. The child is shown a card with four line drawings on it and asked to point to one specified picture. Children can point or indicate by eye movements if physically disabled. The test covers the age range 2 years to 18 years 11 months, as such the BPVS spans both very low age ranges and levels of intellectual functioning and levels considerably above average adult ability. The test was standardised on 3,334 children (Berger and Yule, 1992).

The Test for Reception of Grammar (TROG; Bishop, 1983)

The TROG will be used as Buitelaar, van der Wees, Swaab-Barnveld, van der Gaag (1999) suggested the limitations of using a single task such as the BPVS to measure verbal ability, therefore allowing the possibility that type of test for evaluating VMA moderates ToM abilities to be examined. The BPVS is a multiple choice sentence picture matching test. This examines comprehension of syntax and is held to be a more conservative test of language comprehension than the BPVS, while employing a similar choice format (Cohen, Campbell, Karmiloff-Smith, Grant and Walker, 1995).

Toy Tunnel

A "tunnel" approximately 310 x 320 x 160 mm will be constructed and covered with felt. Both openings will be covered by felt flaps. Two dolls will be used, each approximately 39 cm tall, with one male (John) with short black hair, and the other female (Sally) with long blond hair. The objects used will be a toothbrush, a ball and a metal tea spoon. The

objects will be kept in a covered box, and when an object is transferred to the tunnel it will be covered by an opaque scarf.

Both verbal instructions and objects will be piloted and standardised in advance of the investigation.

QUALIFICATIONS OF THE INVESTIGATOR TO USE MEASURES

The investigator is a clinical psychology trainee in his second year of training and has experience of working with children and parents from all three groups both as a trainee and assistant. The trainee has had training in and used the BPVS, TROG, and CARS.

VENUE FOR INVESTIGATION AND DURATION

The venue for the investigation will be a quiet room within the child's school without distraction. The time period for the screening tasks (BPVS and TROG) will be approximately one hour. The experimental task should take approximately 35 minutes to complete.

DURATION OF THE STUDY

The data for the study will be collected over a maximum of six months.

DATA ANALYSIS

All names and other relevant details will be kept confidential. Data will be analysed using the computerised Statistical Package For The Social Sciences (SPSS). A series of one-way Analyses of Variance (ANOVA) [one between-participants factor, group, with three levels, autism, LD, control), using naming and source scores as dependent variables. To find specific between-group differences post hoc tests would be employed (for example Tukey-B). A series of one-way Analyses of Co-Variance (ANCOVA) will also be conducted controlling for BPVS, TROG and CARS scores to determine whether any between-group differences remain after controlling for these variables. In addition, to examine differences in responses to the three types of source question a 3x3 MANCOVA

will be conducted, with a between-participant factor (3 levels, autism, LD, control) and a within participants factor (3 levels, different type of source). This will allow examination of interaction effects between group and source. Furthermore, a MANCOVA will be used to covary with BPVS and TROG scores. Finally a one-way ANOVA (and ANCOVA) will be used for the total score in task 3.

POTENTIAL HAZARDS TO PARTICIPANTS/INVESTIGATORS

It is possible that fatigue could occur, therefore, if a person is showing signs of serious fatigue the session will be stopped.

POTENTIAL OFFENCE/DISTRESS TO PARTICIPANTS

There should be no part of the procedure which is potentially offensive or distressing. However, should any participant appear in any way distressed or offended through the study it will be immediately stopped with that individual and support will be offered to participants if the need should arise.

CONSENT ,

Following approval being gained from head teachers to contact parents, consent will be sought from the legal parents or guardians of participants (refer Appendix II).

INFORMATION FOR PARTICIPANTS

This is provided with the consent form (refer Appendix II).

APPROVAL OF RELEVANT PROFESSIONALS

Approval will be sought from head teachers and teachers prior to contacting parents.

PAYMENT

Taking part in the study will be on a purely voluntary basis and no payment will be available to either participants, their parents or schools involved.

EQUIPMENT

The equipment required will be provided by the Lancashire Doctorate in Clinical Psychology at Blackpool.

FEEDBACK

Following completion of the study all parents/guardians and teachers will be contacted by the researcher by post, to give feedback on the findings of the study and to answer any further questions that they may have.

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APPENDIX I

Diagnostic criteria for 299.00 Autistic Disorder

A. A total of six (or more) items from (1), (2), and (3), with at least two from (1), and one each from (2) and (3).

(1) qualitative impairment in social interaction, as manifested by at least two of the following:

a) marked impairments in the use of multiple non-verbal behaviours such as eye-to-eye gaze, facial expression, body posture, and gestures to regulate social interaction.

b) failure to develop peer relationships appropriate to developmental level.

c) a lack of spontaneous seeking to share enjoyment, interests, or achievements with other people, (e.g., by a lack of showing, bringing, or pointing out objects of interest to other people).

d) lack of social or emotional reciprocity (note: in the description, it gives the following as examples: not actively participating in simple social play or games, preferring solitary activities, or involving others in activities only as tools or "mechanical" aids).

(2) qualitative impairments in communication as manifested by at least one of the following:

a) delay in, or total lack of, the development of spoken language (not accompanied by an attempt to compensate through alternative modes of communication such as gesture or mime).

b) in individuals with adequate speech, marked impairment in the ability to initiate or sustain a conversation with others.

c) stereotyped and repetitive use of language or idiosyncratic language.

d) lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level.

(3) restricted repetitive and stereotyped patterns of behaviour, interests and activities, as manifested by at least two of the following:

a) encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus.

b) apparently inflexible adherence to specific, non-functional routines or rituals.

c) stereotyped and repetitive motor mannerisms (e.g. hand or finger flapping or twisting, or complex whole-body movements).

d) persistent preoccupation with parts of objects.

B. Delays or abnormal functioning in at least one of the following areas, with onset prior to age 3 years:

(1) social interaction.

(2) language as used in social communication.

(3) symbolic or imaginative play.

C. The disturbance is not better accounted for by Rett's Disorder or childhood Disintegrative Disorder.

APPENDIX II

INFORMATION SHEET

Dear Parent/Guardian

My name is Gerrard Burrell-Hodgson, I am in my second year of training to become a Doctor of Clinical Psychology, currently based at

. I am conducting a research project as part of my Doctoral Training.

WHAT IS THE RESEARCH PROJECT ABOUT?

This research is designed to investigate how the thought processes of people with autism are affected. This attempts to explain some of the social and communication difficulties experienced by those who have autism.

WHO WILL BE TAKING PART?

All participants in this project will be aged between 4-18 years, will either have a diagnosis of autism, have learning difficulties but not autism or not be developmentally delayed. Participation is ENTIRELY VOLUNTARY, and choosing not to take part will in no way affect the quality of service your child is receiving at school. Also, if you decide at first that you would like to take part, but then change your mind later, you will be free to withdraw from the study at any time, without giving reason.

WHAT WILL IT INVOLVE FOR MY CHILD?

The children will be required to complete some tasks examining their understanding of verbal instructions. Following this they will take part in a brief experiment observing two dolls and answering a number of questions relating to what the doll knows.

WHO CAN I ASK FOR MORE INFORMATION?

If you have any questions about this research- and what it involves, and what the point of it is, please do contact me:

telephone (Dept of Clinical Psychology Training).

or (Dept of Clinical Psychology -)

I would like to add that all information gathered during this study will be treated in the strictest confidence, and participation will be completely anonymous. If you agree to your child participating in the study please complete the form attached.

APPENDIX III

PARENTAL/GUARDIAN CONSENT FORM

(To be signed by the child's parent or legal guardian)

PLEASE DELETE AS NECESSARY

Have you read the Information Sheet? **YES/NO**

Have you had an opportunity to ask questions and discuss this study? **YES/NO**

Have you received satisfactory answers to all your questions? **YES/NO**

Have you received enough information about the study? **YES/NO**

Do you understand that you do not need to take part in the study and if you do enter you are free to withdraw:

- **at any time**
- **without having to give a reason for withdrawing**
- **and without affecting the service your child receives at school.** **YES/NO**

Do you agree to your child taking part in this study? **YES/NO**

.....

(PRINT CHILD'S NAME IN BLOCK LETTERS)

Signed:..... **Date:.....**

.....

(PARENT/GUARDIAN NAME IN BLOCK LETTERS)

Please return the completed form to your child's teacher, Thank you

APPENDIX IV
Score Sheet

Name		**Age**
School	**A( ) LD( ) MS ( )**	**VMA:-TROG ( ) BPVS ( )**
Pre-test	1. John has the object.	***Response*** **John \ Sally**
	2. Sally has the object.	***Response*** **John \ Sally**
	3. Sally has the object.	***Response*** **John \ Sally**
	4. John has the object.	***Response*** **John \ Sally**
	5. Sally has the object.	***Response*** **John \ Sally**
	6. John has the object.	***Response*** **John \ Sally**

John Seeing			
1A.Who knows what is inside the tunnel?	**1A.*Response*** **John \ Sally**		
1B.How do they know what is inside?	**1B.*Response***		
1C.Do they know what is inside because:	a. they felt inside?	**1C.*Response***	**Yes \ No**
	b. they saw what was inside?	**1C.*Response***	**Yes \ No**
	c. I told them what was inside?	**1C.*Response***	**Yes \ No**
Sally Feeling			
2A.Who knows what is inside the tunnel?	**2A.*Response*** **John \ Sally**		
2B.How do they know what is inside?	**2B.*Response***		
2C.Do they know what is inside because:	a. they saw what was inside?	**2C.*Response***	**Yes \ No**
	b. they felt inside?	**2C.*Response***	**Yes \ No**
	c. I told them what was inside?	**2C.*Response***	**Yes \ No**
John Told			
3A.Who knows what is inside the tunnel?	**3A.*Response*** **John \ Sally**		
3B.How do they know what is inside?	**3B.*Response***		
3C.Do they know what is inside because:	a. I told them what was inside?	**3C.*Response***	**Yes \ No**
	b. they saw what was inside?	**3C.*Response***	**Yes \ No**
	c. they felt inside?	**3C.*Response***	**Yes \ No**
Sally Feeling			
4A.Who knows what is inside the tunnel?	**4A.*Response*** **John \ Sally**		
4B.How do they know what is inside?	**4B.*Response***		
4C.Do they know what is inside because:	a. they saw what was inside?	**4C.*Response***	**Yes \ No**
	b. I told them what was inside?	**4C.*Response***	**Yes \ No**
	c. they felt inside?	**4C.*Response***	**Yes \ No**
Sally Seeing			
5A.Who knows what is inside the tunnel?	**5A.*Response*** **John \ Sally**		
5B.How do they know what is inside?	**5B.*Response***		
5C.Do they know what is inside because:	a. they felt inside?	**5C.*Response***	**Yes \ No**
	b. I told them what was inside?	**5C.*Response***	**Yes \ No**
	c. they saw what was inside?	**5C.*Response***	**Yes \ No**
John Told			
6A.Who knows what is inside the tunnel?	**6A.*Response*** **John \ Sally**		
6B.How do they know what is inside?	**6B.*Response***		
6C.Do they know what is inside because:	a. they saw what was inside?	**6C.*Response***	**Yes \ No**
	b. they felt inside?	**6C.*Response***	**Yes \ No**
	c. I told them what was inside?	**6C.*Response***	**Yes \ No**
John Seeing			
7A.Who knows what is inside the tunnel?	**7A.*Response*** **John \ Sally**		
7B.How do they know what is inside?	**7B.*Response***		
7C.Do they know what is inside because:	a. I told them what was inside?	**7C.*Response***	**Yes \ No**
	b. they saw what was inside?	**7C.*Response***	**Yes \ No**
	c. they felt inside?	**7C.*Response***	**Yes \ No**

Sally Feeling		
8A. Who knows what is inside the tunnel?	**8A.*Response*** **John \ Sally**	
8B. How do they know what is inside?	**8B.*Response***	
8C. Do they know what is inside because:	a. they felt inside?	**8C.*Response*** **Yes \ No**
	b. they saw what was inside?	**8C.*Response*** **Yes \ No**
	c. I told them what was inside?	**8C.*Response*** **Yes \ No**
Sally Told		
9A. Who knows what is inside the tunnel?	**9A.*Response*** **John \ Sally**	
9B. How do they know what is inside?	**9B.*Response***	
9C. Do they know what is inside because:	a. they saw what was inside?	**9C.*Response*** **Yes \ No**
	b. they felt inside?	**9C.*Response*** **Yes \ No**
	c. I told them what was inside?	**9C.*Response*** **Yes \ No**
John Feeling		
10A. Who knows what is inside the tunnel?	**10A.*Response*** **John \ Sally**	
10B. How do they know what is inside?	**10B.*Response***	
10C. Do they know what is inside because:	a. I told them what was inside?	**10C.*Response*** **Yes \ No**
	b. they felt inside?	**10C.*Response*** **Yes \ No**
	c. they saw what was inside?	**10C.*Response*** **Yes \ No**
Sally Seeing		
11A. Who knows what is inside the tunnel?	**11A.*Response*** **John \ Sally**	
11B. How do they know what is inside?	**11B.*Response***	
11C. Do they know what is inside because:	a. they felt inside?	**11C.*Response*** **Yes \ No**
	b. I told them what was inside?	**11C.*Response*** **Yes \ No**
	c. they saw what was inside?	**11C.*Response*** **Yes \ No**
Sally Feeling		
12A. Who knows what is inside the tunnel?	**12A.*Response*** **John \ Sally**	
12B. How do they know what is inside?	**12B.*Response***	
12C. Do they know what is inside because:	a. they saw what was inside?	**12C.*Response*** **Yes \ No**
	b. I told them what was inside?	**12C.*Response*** **Yes \ No**
	c. they felt inside?	**12C.*Response*** **Yes \ No**
John Told		
13A. Who knows what is inside the tunnel?	**13A.*Response*** **John \ Sally**	
13B. How do they know what is inside?	**13B.*Response***	
13C. Do they know what is inside because:	a. I told them what was inside?	**13C.*Response*** **Yes \ No**
	b. they saw what was inside?	**13C.*Response*** **Yes \ No**
	c. they felt inside?	**13C.*Response*** **Yes \ No**
Sally Seeing		
14A. Who knows what is inside the tunnel?	**14A.*Response*** **John \ Sally**	
14B. How do they know what is inside?	**14B.*Response***	
14C. Do they know what is inside because:	a. they felt inside?	**14C.*Response*** **Yes \ No**
	b. they saw what was inside?	**14C.*Response*** **Yes \ No**
	c. I told them what was inside?	**14C.*Response*** **Yes \ No**

Sally Told		
15A. Who knows what is inside the tunnel?	**15A.*Response*** **John \ Sally**	
15B. How do they know what is inside?	**15B.*Response***	
15C. Do they know what is inside because:	a. they saw what was inside?	**15C.*Response*** **Yes \ No**
	b. they felt inside?	**15C.*Response*** **Yes \ No**
	c. I told them what was inside?	**15C.*Response*** **Yes \ No**

Differentiation Task

1D. Can you help John to see what is inside the tunnel?	***Response***
2D. Can you help John to feel what is inside the tunnel?	***Response***
3D. Can you tell John what is inside the tunnel?	***Response***
4D. Can you help John Feel what is inside the tunnel?	***Response***
5D. Can you tell John what is inside the tunnel?	***Response***
6D. Can you help John to see what is inside the tunnel?	***Response***

APPENDIX V

Childhood Autism Rating Scale

LETTER CONFIRMING ETHICAL APPROVAL

SECTION 2

LITERATURE REVIEW

Prepared in accordance with notes for contributors for: Journal of Child Psychology and Psychiatry and Allied Disciplines

THEORY OF MIND IN AUTISM: A REVIEW

Gerrard Burrell-Hodgson and Chris Hatton, Doctorate in Clinical Psychology, Lancaster University, Institute for Health Research, Alexander Square, Lancaster

ABSTRACT

A specific deficit in Theory of Mind (ToM) abilities has been proposed to explain the distinct pattern of social/cognitive deficits in autistic individuals (Frith, 1989). However, the specificity of deficits in autism are beginning to be disputed. This paper reviews the available literature on ToM in people with autism alongside relevant research using other client groups. Preliminary evidence, backed by evidence from other groups, has indicated that impairments in ToM should no longer be considered unique to autism. Less information is known regarding the understanding of informational access and knowledge in autism, although research has indicated a specific difficulty in understanding the principle that "seeing leads to knowing". It is suggested that further research is needed to examine if deficits on informational access tasks are unique to autism. Moreover, previous work needs to be extended to identify conditions under which performance on informational access tasks may vary, thereby gaining a clearer understanding of any potential moderating factors.

INTRODUCTION

Autism is a pervasive developmental disorder that is usually apparent from early childhood (Volkmar, Stier and Cohen, 1985). Autism is currently defined at the behavioural level, on the basis of impairments in socialisation, communication, and imagination, with stereotyped repetitive interests taking the place of creative play (DSM IV; American Psychiatric Association, 1994). As definitions of autism have changed, so have the figures of prevalence of the disorder; studies reviewed by Fombonne (1997) report rates varying from 0.7 to 15.5 per 10,000. Further analysis indicated that although the average figure for "classic" autism appears to be around 5 per 10,000, rates are much higher (91 per 10,000) if children within the wider "autistic spectrum" are included (Wing, 1996).

In the past five decades since Kanner (1943) first described the syndrome of autism, researchers have been trying to describe and conceptualise the syndrome and identify its underlying causes. A number of hypotheses have been offered and tested experimentally in an effort to account for the pattern of deficits in autism. Wing and Gould (1979), for example, proposed an association between the deficits recognised in socialisation, communication and imagination. Baron-Cohen, Leslie and Frith (1985) suggested that the triad of impairments identified by Wing et al. (1979) resulted from autistic individuals lacking a Theory of Mind (ToM). ToM refers to the ability to attribute mental states to the self and to others (Premack and Woodruff, 1978). The ability to know about minds is necessary to infer what others are thinking, believing and desiring in order to explain and predict their behaviour. According to Wellman (1993) this ability involves two

components: the ontological aspect, that is, the ability to distinguish between the real and the mental world; and the causal aspect, that is, the ability to understand mutual causal relations between mental states and the physical behavioural world.

The strength of the ToM hypothesis is that it is well placed to explain many of the behavioural symptoms of autism. It is argued that social withdrawal is an understandable consequence of having ToM problems, that is, lacking the ability to explain otherwise confusing behaviour in terms of underlying mental states (Baron-Cohen, 1992). Similarly, one needs to understand that others have mental states that differ from one's own in order to be motivated to communicate (Sperber and Wilson, 1986). Finally, deficits in imagination or pretend play at least would occur as a result of a ToM deficit if pretend play requires the same representational processes as attributing beliefs to others. Leslie (1987) made exactly this argument, claiming that pretence, like the appreciation of beliefs, requires the representation of another's propositional attitude toward the state of the world.

Tasks Designed to Measure ToM

Children with autism, like normally developing three-year olds, often fail on various tasks designed to assess the understanding of mental states, including picture sequencing (Baron-Cohen et al., 1985) and appearance reality (Baron-Cohen, 1989; Perner, Frith, Leslie and Leekham, 1989). Researchers examining ToM abilities have also frequently examined false belief. The standard version of the false belief task presents the child with a character, Sally, who leaves a desirable object such as a chocolate in her basket, before

departing the scene. In her absence another character, Anne, removes the object and places it in a box. Children are asked to predict on Sally's return where Sally will look for the object. Children with autism have been shown to be significantly impaired in their ability to pass such tasks in comparison to the performance of children with Down's syndrome (Baron-Cohen et al., 1985), intellectual difficulties (Baron-Cohen, 1989; Reed and Peterson, 1990), emotional disturbance (Frith, Happe and Siddons, 1994) and specific language impairment (Leslie and Frith, 1988; Perner et al., 1989). Furthermore, the small number of individuals with autism who pass the task do not pass tasks requiring second-order mental attributions, in which they are asked to predict the belief of one agent concerning another agent's belief (Bowler, 1992). Failure at false belief tasks has therefore been considered to reflect some serious deficit in the individual's understanding of the mental lives of themselves and others.

Is a Mentalising Deficit Universal and Specific to Autism?

While most studies have demonstrated that the majority of participants with autism fail ToM tasks, performance has not been at floor. Variation in terms of the proportion of children with autism failing ToM tasks has been as low as 10% (Dahlgren and Trillingsgaard, 1996) to 40% (Prior, Dahlestrom and Squires, 1990) and as high as 85% (Reed and Peterson, 1990). However, the finding that any child with autism can pass ToM tasks has been seen by many as fatally damaging to the mentalising deficit theory of autism. If an inability to represent the beliefs and desires of others and self, leads to the triad of impairments which characterise autism, how can it be that individuals exist who pass tests of mentalising and yet are still autistic? Frith, Morton and Leslie (1991) argued

that although some people do pass ToM tasks, they do not in fact have the ability to mentalise. Rather, they suggest that these participants have found a task-specific strategy allowing them to "hack out" a solution to these artificial tests, but which does not (unlike true ToM) generalise to real-life social solutions. There has been support for this argument in the literature and some studies using a variety of methods have taught autistic children to pass ToM tasks (Hadwin, Baron-Cohen, Howlin and Hill, 1996; McGregor, Whiten and Blackburn, 1998; Starr and Baine, 1993; Swettenham, 1996; Whiten, Irving and McIntyre, 1993). However, although the majority of autistic children were successfully taught to pass tasks used in teaching, none of the approaches resulted in generalisation to those tasks which had not been taught. It was concluded that the children had passed the tasks by learning relatively context-specific rules, but with no evidence of a simultaneous gain in conceptual understanding.

There have been further criticisms with the suggestion that ToM is an autism specific deficit (Baron-Cohen, 1989b; Happe, 1995). Sigman (1994) proposed that for a deficit in ToM to be considered as primary or central to autism, it has to be universal (that is, manifested in all or almost all individuals with autism) and it has to be unique (that is, not manifested by most individuals with other clinical diagnoses). Weak mentalising skills have, however, been reported in individuals with schizophrenia (Corcoran, Frith and Mercer, 1995; Frith and Corcoran, 1996) and in children with profound pre-lingual deafness (Peterson and Siegal, 1995). Aside from the communication impairment associated with prelingual deafness, these children did not demonstrate autistic features.

- Peterson et al. (1995) attributed the finding of impaired ToM to the conversational

deprivation and subsequent lack of exposure to conversations about mental states experienced by the children in early life. Other reports indicate that individuals with intellectual difficulties of unknown (non-specific) aetiology also show deficits in ToM in comparison to normally developing individuals (Benson et al., 1993, Yirmiya, Solomonica-Levi, and Shulman and Pilowsky, 1996; Yirmiya, Solomonica-Levi, and Shulman, 1996). A meta-analysis of ToM studies by Yirmiya, Erel, Shaked and Solomonica-Levi (1998) revealed that in the studies they examined, all individuals with intellectual difficulties regardless of aetiology performed poorly on ToM tasks. Performance was not, however, as low as the autism group, although performance was particularly low for the group of unknown aetiology in comparison to those with Down's syndrome. Differences between individuals with Down's syndrome and those with autism on ToM tasks may in fact indicate a specific strength of those with Down's syndrome, and not a deficit in those with autism. This is supported by Beeghly, Weiss-Perry and Cicchetti (1990) and Kasari, Mundy, Yirmiya, and Sigman (1990), who both reported that individuals with Down's syndrome have been shown to have higher empathic abilities and better social skills, compared to other individuals with intellectual difficulties of unknown aetiology. These studies imply that the deficit in ToM is not unique to autism. What may be unique to autism is the severity of the impairment rather than the impairment itself.

Developmental and Cognitive Correlates

Recent studies have indicated that the influence of developmental and cognitive factors in determining social cognitive ability, in addition to or above diagnostic group status, needs

to be examined (Yirmiya et al., 1998). Both Baron-Cohen (1992) and Leslie et al. (1988) reported significant correlations between ToM task performance and chronological age (CA). Other studies by Charman and Baron-Cohen (1992) and Eisenmajer and Prior (1991), indicated significant correlations between performance on tasks and verbal mental age (VMA). Further research by Prior, Dahlstrom and Squires (1990) reported a significant correlation between task performance, VMA and CA. Moreover, studies have failed to find such correlations between performance on ToM tasks and non-verbal intelligence measures (Happe, 1993). Boucher (1989) has also suggested that using the British Picture Vocabulary Scale (BPVS: Dunn, Dunn. Whetton and Pintilie, 1982) to assess VMA is problematic as it only tests recognition of single words. While most individuals with autism have serious verbal communication difficulties, they do develop verbal knowledge of single words. It is plausible, therefore, that single word recognition is correlated differently with other aspects of verbal and general ability for various clinical groups.

Recently, studies have focused on specific areas of verbal ability that appear to link with ToM development in children with autism. Tager-Flusberg (1992), for example, noted in a longitudinal study that children with autism were differentiated from those with Down's syndrome on the basis that they rarely talked about attention and cognitive or epistemic mental states. Tager-Flusberg and Sullivan (1995) compared children with autism to those with intellectual difficulties and normal development on ToM and narrative tasks (requiring explanation of characters feeling states in a story). The children with autism were differentiated from the other two groups by poorer performance on both ToM and

narrative tasks. Further examination revealed a strong association between passing ToM tasks and talking about the cognitive states of characters. This is supported by Happe (1993) who demonstrated links between ToM development and comprehension of simile, metaphor and irony. Children with autism who failed first-order ToM tasks were able to comprehend simile but not metaphor or irony which, Happe argued, required appreciation of the speaker's intent and therefore ToM development. However, as Happe and Frith (1995) stated, although age and verbal ability may be necessary they are not sufficient to ensure success on ToM tasks. It is therefore not the case, as has been suggested, (Eisenmajer et al., 1991) that failure is simply due to lack of verbal ability. The age and ability of the children tested do, however, seem to be at the root of the slightly different proportions of participants found to pass in different studies.

Problems with ToM tasks

Tasks such as the Sally-Ann test have become important in the study of autism. However, the failure of young normally developing children and those with autism on ToM tasks has created a great deal of debate. Some argue that this finding illustrates the weakness of the task, as normally developing three-year olds are nothing like children with autism (Happe, 1996). Three-year olds are far superior with regard to communicative and linguistic skills, the ability to pretend and understand pretence of others. Clearly, tasks designed to tap the ability to represent mental states also involve other psychological abilities such as language and memory, and impairment in any one of these areas might lead to task failure which would not be a true indication of a mentalising deficit. Typically developing three-year olds might fail the task because of

general task demands, because they do not have a grasp of false belief, or both. But they surely have a ToM, in the general sense of having a sophisticated ability to reason about mental states; this is precisely why they differ from individuals with autism in the social, communicative and imaginative domains (Bloom and German, 2000). Russell, Mauthner, Sharpe and Tidswell (1991) have argued that difficulties on false belief tasks might result from children with autism having difficulty disengaging from the salience of the object. This theory finds some support in the work of Ozonoff, Pennington and Rogers (1991) where children with autism show deficits on executive function tasks. However, this explanation seems unable to explain why children with autism can disengage from the salient object in some tasks (e.g. Charman and Baron-Cohen, 1991) but not others.

As Bloom et al. (2000) stated, it is also important to realise that passing such tasks does not necessarily imply intact mentalistic or social competence in autism. This is supported by Happe (1994), who demonstrated variation in autistic performance and recognised that intact false belief task performance did not rule out severe handicaps in social understanding and social interaction in everyday life. Unfortunately, there is an almost universal tendency to equate test performance with underlying cognitive ability, and while researchers are often keen to show that there are many reasons for failing a test, they rarely consider that there may be quite as many ways of passing it. Happe (1995) argued that task performance should only be viewed as a distant measure of underlying competence. Therefore, any one task can be passed or failed for a number of different reasons - this is the distinction between the levels of cognition and of behaviour.

INFORMATIONAL ACCESS AND KNOWLEDGE

Wimmer, Hogrefe and Perner (1988) suggest that understanding informational access as a source of knowledge, also constitutes a fundamental aspect of our concept of mind. As Gopnik and Graf (1988) have indicated, knowing about the source of a belief plays a vital role in evaluating the belief, deciding how trustworthy or justified it is and how easily it should be discarded. If young children are unable to identify or remember the sources of their beliefs it may be difficult for them to make evaluative judgements, which potentially have serious consequences for their cognitive development. We do not have a complete causal account of how our experiences lead to our current representation of the world. However, we do know that events such as perception, communication and inference can lead to beliefs. As Gopnik et al. (1988) suggest, when people form a new belief about the world, they understand and often remember how they got that belief. They usually know whether it is based on what someone told them, on an inference they made, or on something they saw with their own eyes. This can be seen when children justify their own knowledge by referring to the source of their knowledge, or when they start inquiring about the source of another person's knowledge (e.g. "How do you know?"). Such understanding is evident when children correctly assess another person's knowledge, when the other's knowledge can only be inferred from that person's exposure to an informational source.

Age of Understanding

Young children from at least 30 months of age appear to understand what might be called the "laws of vision", that is to see something, their eyes need to be open and their line of

regard needs to be unobstructed (Lempers, Flavell and Flavell, 1977). There have been discrepancies in the exact age at which children understand informational access. In research by Wimmer et al. (1988) for example, children aged between three and five-years old observed another child who either had or did not have informational access (either verbal or visual) to the contents of a box. Results suggested that children up to the age of about four-years old did not understand the causal connection between informational access and resulting knowledge. They could not tell how they themselves had acquired a particular piece of knowledge. Additionally, they were incapable of assessing another person's knowledge on the basis of observing that person being deprived of, or being given informational access.

Pratt and Bryant (1990) suggested that the poor performance levels of three-year olds in Wimmer et al.'s (1988) study, could be accounted for by difficulties present in the verbal instructions. Therefore they simplified the experiment, using a simple forced-choice procedure. Children had then to judge which of two assistants knew what was inside a box, when one of the assistants had looked inside, and the other lifted it up. Pratt et al. (1990) compared this simpler questioning format to one that was more complex. Their findings indicated that the more complex format was considerably more difficult with resulting poorer performance. These results were taken to contradict the conclusions of Wimmer et al. (1988) in that children aged between three-years eight-months and four-years seven-months did appear to understand that looking leads to knowing. However, the mean age in Wimmer et al.'s (1988) study was three-years seven-months compared to

four-years two-months in the Pratt et al. (1990) study, which could account for some of the discrepancies in the findings.

O'Neill and Gopnik (1991) extended this research, investigating young children's ability to understand which experiences led to a belief across three modalities. Using a toy tunnel children found out about its contents in three different ways: they saw, were told about, or felt the contents of the tunnel. O'Neill et al. (1991) found that even using a simpler question format three-year olds (mean age three-years six-months) had difficulty identifying the source of their knowledge, whereas four and five-year olds did not. The results of the study are consistent with the results of Wimmer et al. (1988). O'Neill et al. (1991) suggested that poorer performance on their tasks in comparison to Pratt and Bryant (1990), was due to the difficulty of relating the events and the beliefs to which they gave rise. In the Pratt et al. (1990) task this relation was very simple. The event takes place or not, and the belief is formed or not. O'Neill et al.'s (1991) task involved a more complex relationship between experiences and belief. The child must realise that there are several different paths that might lead from experiences to beliefs, and they must evaluate which path led to the belief in that particular case. A number of researchers have suggested that children might shift from a simpler causal mode of belief formation, to a more complex one in this developmental period (Astington and Gopnik, 1991; Flavell, 1988; Gopnik, 1990; Pillow, 1989; Wellman, 1990; Wimmer, Hoegrefe and Sodian, 1988). Such a development might be responsible for these findings. In which case, these findings extend rather than contradict the Pratt et al. (1990) results.

Moore, Furrow, Chiasson and Patriquin (1994) found that use of terms 'think' and 'know', preceded the ability to comprehend distinctions between the terms at four-years of age. They proposed that production of terms occurred earlier, as they do not require full ability to represent mental states. In which case, reference to beliefs to explain and predict action, could precede the comprehension of the distinction among the terms that would require true representation of mental acts. Comprehension at this level would, therefore, co-occur with the later development of a theory of mind.

Informational Access and Knowledge in Autism

Thus far, the research has postulated that a fundamental aspect of ToM is developing an understanding of informational access as a source of knowledge. Moreover, given the proposed ToM deficit in individuals with autism, it might be expected that they would also be impaired in their understanding of informational access and knowledge. Kazak, Collis and Lewis (cited in Ziatas, Durkin and Pratt, 1998) compared the ability of children with autism, Down's syndrome and normal development to report knowing or guessing the location of a marble for themselves and for another, on the basis of seeing or not seeing. They found that children with autism classified as low VMA (BPVS) were unlikely to use 'know' and 'guess' to reflect knowledge state, despite being able to judge accurately whether they and the other had or had not seen the placement. However, those children classified as high VMA were able to use 'know' and 'guess' to reflect their knowledge states.

A further study by Ziatas et al. (1998) examined the relationship between the development of ToM and understanding the terms 'think', 'know' and 'guess'. Twelve children with autism were individually matched (by sex, chronological and VMA using BPVS and Test for Reception of Grammar- TROG; Bishop, 1983) with 12 children with specific language impairment and (matching by sex and VMA) 12 children with normal development. There were also 12 children with Asperger syndrome, matched (by sex, CA and VMA) to 12 children with specific language impairment, (by sex and VMA) and 12 children with normal development. All participants completed a false belief task as well as a belief term comprehension task, requiring children to identify the location of a smartie on the basis of clues given by two puppets. The clues contained contrasts of the terms 'think', 'know' and 'guess'. Participants also completed belief term expression tasks, in which they had to control the puppet and give clues to an experimenter in order that they could find the smartie, again using the same belief terms. The autistic group's performance on the false belief, belief term comprehension and belief term expression tasks were significantly poorer than that of the Asperger, language impaired and normal groups. Moreover, across the groups an association was found between false belief task performance and belief term performance. The results, therefore, suggest a link between the development of ToM and communicative competence in children with autism.

Oswald and Ollendick (1989) investigated deception in autism using a Penny Hiding Game. In this game one person either guesses or hides. Both try to win. The hider hides the penny in one hand and then invites a guess. This technique is useful in that it is virtually free of linguistic demands. Oswald et al. (1989) found not only that those with

autism had a significant inability to deceive on this task, but also that this correlated with false belief performance. This study suggests a lack in understanding of the "seeing-leads-to-knowing" principle. What is more, Oswald et al. (1989) failed to find evidence of autism-specific deficits on false belief tasks, finding that the control group with intellectual difficulties also had problems with the false belief task. However, given the previously identified relationship between VMA and ToM, this study can be criticised for failing to provide vital information on the relationship between performance on the deception task and VMA.

Baron-Cohen (1992) attempted to extend Oswald et al.'s (1989) experiment. He proposed that the game could be analysed in terms of what the hider attempts to occlude. The hider must ensure the guesser does not see the penny (object occlusion) and prevent any clues or access to information about where the penny might be (information occlusion- keeping the object's true location out of mind). Fifteen children with autism were compared with 15 children with intellectual difficulties (no information provided on aetiology) and 15 normally developing children matched for VMA (BPVS). Results indicated that 85% of the children with autism compared to 34% of those with intellectual difficulties and 16% of normally developing children were treating the game as if it were purely about object occlusion: keeping things out of sight but not out of mind. A relationship was found with VMA. Those children failing to show information occlusion in the control groups all had VMAs less than three-years four-months, significantly lower than those that succeeded. No such relationship was found in the autism group. With regards to false belief performance, 74% of those with autism failed, compared to only

33% with intellectual difficulties and 27% of normally developing children. Those passing were not significantly older in terms of VMA or CA. These findings are explained with reference to ToM ability and supported by the comparison between deception capacity and tests of false belief. This again supports the notion that a proportion of those with autism understand seeing (object occlusion), but not that seeing-leads-to-knowing (information occlusion).

Leslie et al. (1988) examined autistic children's ability to understand seeing, knowing and believing. They examined 18 children with autism and 12 children with specific language impairment (however, further diagnostic information on the specific language impairment group was not given). All participants had both CA and VMA (BPVS) above four-years. However, it should be noted they were not closely matched for either. A limited knowledge task was conducted to test the children's understanding of seeing and not seeing. The participant hides a counter in a container whilst another person is out of the room. They are then asked if the other experimenter knows that there is a counter under the container and where they will look when they come back in the room. Then a false belief task was used. Results suggested that only 35 % of the children with autism that they tested could understand the role of visual access in knowledge formation. Moreover, proper comprehension of the lexical terms 'know' and 'think' tended to go together with correct prediction of behaviour. The results suggest that, despite equal levels of verbal impairment, children with specific language impairment are demonstrating language development difficulties that are qualitatively distinct form the

language difficulties experienced by children with autism, providing further evidence for the specific nature of the communication impairment of children with autism.

Perner et al. (1989) compared 26 children with autism loosely matched for VMA (BPVS; three-years one-month to twelve-years eight-months) and 12 children with specific language impairment (VMA; six-years eleven-months to nine-years eleven-months). Initially, mistaken belief was examined. Children were shown a typical box of sweets. All participants found that the box contained something else, yet only four out of the 26 autistic children were able to anticipate that another child would make the same mistake in the same situation. Eleven of the 12 children with specific language impairment were able to successfully complete this task. The children with autism were also tested for their ability to infer knowledge about the content of a container, from having, or not having looked inside. All four children who had passed the belief task and an additional four performed perfectly, but most failed. The third task assessed children's pragmatic ability to adjust their answers to provide new, rather than repeat old information. Here too, most children with autism seemed unable to reliably make the correct adjustment. This provides some evidence that understanding 'knowing' in this way is a component of understanding false belief, since all four children who could understand false belief also understood the knowledge-ignorance distinction. However, there were another four children who demonstrated understanding of the knowing/not-knowing distinction without understanding false belief. Which in turn could suggest, that children with autism find this distinction slightly easier to understand. Baron-Cohen and Goodhart (1994) extended the research of Leslie et al. (1988) and Perner et al. (1989) by including a

group with intellectual difficulties (rather than specific language impairment). Therefore, it was argued that they could evaluate if this was an autism specific deficit, or simply a result of the accompanying intellectual deficit found in the majority of children with autism. Baron-Cohen et al. (1994) adapted the Pratt et al. (1990) technique, using dolls to examine the role of visual access in knowledge formation. Twelve children with autism were compared to those with a "mental handicap but not autism", all with language comprehension above three-years six-months (Reynell Developmental Language Scale; Reynell,1991; or TROG). It is unclear, however, as to which test was used for which participants. A pre-test task familiarised participants with the general procedure of choosing one of the dolls and eliminated those who could not follow the procedure. For the experimental tasks a counter was placed in a closed box. Participants then watched as one of the dolls either looked inside or picked up the box. Each action was accompanied by a statement describing what was happening. The participants were then required to answer which doll knew what was in the box. Results indicated that about a third of participants with autism passed the test (criterion five out of five trials correct) in comparison to three quarters of the group with intellectual difficulties. These results are consistent with findings of Leslie et al. (1988) and Perner et al. (1989) as well as performance by children on the Penny Hiding Game (Baron-Cohen, 1992; Oswald et al. 1989). Moreover, the research suggests that participants were not responding to the salience of the object (Russell et al., 1991) as the children were not permitted to see inside the box. Baron-Cohen et al. (1994) stated that results reveal a fundamental inability to understand that to know something one has to have informational access to it. What is more, they stated that the results indicate an autism-specific deficit.

CONCLUSION

The literature reviewed indicates that impairments in ToM are not unique to autism. What may, however, be unique to autism is the severity of the impairment rather than the impairment itself. Further, many studies have demonstrated variability in numbers passing tasks as well as clear effects of age and mental age on task competence, with older and more able participants with autism being more likely to pass (Happe, 1995). It is important to remember that passing ToM tasks does not necessarily imply an intact mentalisitic or social competence. As Happe argued, task performance should only be viewed as a distant measure of underlying competence.

Less information is known regarding the understanding of informational access and knowledge in autism, as the majority of the studies have been with normally developing children. The studies that have been conducted indicate that understanding informational access constitutes a fundamental aspect of ToM. Existing studies with autistic children have proposed an impairment in understanding the seeing-leads-to-knowing principle. Whether individuals with autism also fail to understand other implications of this principle, such as hearing-leads-to-knowing or touching-leads-to-knowing, remains to be established. In this respect, it would be of interest to test children with autism using O'Neill et al.'s (1991) methodology. Given the variability in the age of understanding informational access (Pratt et al., 1990; Wimmer, et al., 1988), the inclusion of participants with VMAs of three-years and four-months in Baron-Cohen et al.'s (1994) study is problematic. This is consolidated by O'Neill et al. (1991) who indicated that multi-modal tasks involve a more complex relationship between experiences and belief,

and require a higher CA to successfully complete. Moreover, Boucher (1989) identified the problematic nature of using the BPVS as a measure of VMA. Many of the studies have also been criticised for having low numbers of participants (Hobson, 1991) and the inclusion of individuals with Down's syndrome (Beeghly et al., 1990; Kasari et al., 1990).

To conclude, the ToM account of autism has been useful in understanding the communicative and social difficulties in children and adults with autism. The account has had less success, however, in explaining the non-social aspects of the disorder, which include repetitive behaviour, restricted interests and activities, and uneven cognitive profiles with islets of ability (Frith and Happe, 1994). The findings of this review challenge researchers to broaden the current viewpoint regarding ToM. It is suggested that impairments in ToM in autism and in other groups should not be conceptualised as an "all or nothing" phenomena. Research indicates that autistic individuals have difficulty understanding the seeing-leads-to-knowing principle. The paucity of research into other modalities suggests further research in this area. Furthermore, the need for work in this area is strengthened by evidence that ToM abilities in autistic children have been related to developmental factors, especially facility with language. Future studies could assist in clarifying which groups of individuals, at what CAs, and of which abilities, pass different tasks assessing various aspects of ToM.

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APPENDIX I

Journal of Child Psychology and Psychiatry and Allied Disciplines

Instructions for Contributors

SECTION 3

RESEARCH PAPER

Prepared in accordance with notes for contributors for: Journal of Child Psychology and Psychiatry and Allied Disciplines

AUTISM AND THEORY OF MIND: AN EXAMINATION OF DIFFERENT MODALITIES

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ABSTRACT

A specific deficit in Theory of Mind (ToM) abilities has been proposed to explain the distinct pattern of social/cognitive deficits in individuals with autism (Frith, 1989). Leslie and Frith (1988), Perner, Frith, Leslie and Leekham (1989) and Baron-Cohen and Goodhart (1994) have also indicated that children with autism have a specific difficulty in understanding the principle that "seeing leads to knowing". However, other studies designed to measure ToM abilities have reported weak mentalising skills in individuals with developmental language disorders (Shields, Varley, Broks and Simpson, 1996), deaf people (Peterson and Siegal, 1995) and individuals with intellectual difficulties (Shulman and Pilowsky, 1996). This study was designed to examine the developmental and cognitive correlates of one aspect of ToM. A method derived from O'Neill and Gopnik (1991) was adapted and children with autism (n = 17), children with intellectual difficulties of undifferentiated aetiology (n = 19), and normally developing children (n = 21), were compared on their ability to understand the principle that "SEEING, FEELING and TELLING" lead to knowing. As predicted, individuals with autism (88%) and children with intellectual difficulties (63%) had difficulty identifying the role of informational access in knowledge, whereas the normally developing group did not (14%). Logistic regression analyses revealed that group membership and verbal mental age, when measured by the Test for Reception of Grammar (TROG; Bishop, 1983), were the best predictors of task performance. Discussion focuses on the implications of the findings and emphasises the need to carefully consider what tasks actually measure, as well as the specific aetiology of comparison groups, when studying abilities and impairments of individuals with autism and intellectual difficulties.

INTRODUCTION

An extensive body of research investigating the psychological processes underlying autism has accumulated since Kanner (1943) first described the syndrome of autism. The theory of mind (ToM) hypothesis (Premack and Woodruff, 1978), a current and leading hypothesis in the field, posits that the social and communicative impairments in autism result from an impaired ability to understand mental states. ToM refers to the ability to infer what others are thinking, believing and desiring in order to explain and predict their behaviour (Baron-Cohen, Leslie and Frith, 1985). Children with autism, like normally developing three-year olds, have been shown to fail on a range of tasks designed to assess the understanding of mental states, including picture sequencing, false belief and appearance reality (Baron-Cohen et al., 1985; Baron-Cohen, 1989). One of the most influential developments in this area, has been the finding that children with autism are significantly impaired in their ToM ability, compared to the performance of children with Down's syndrome, intellectual difficulties, emotional disturbance and specific language impairment (Baron-Cohen et al., 1985; Baron-Cohen, 1989; Reed and Peterson, 1990; Frith, Happe and Siddons, 1994; Leslie and Frith, 1988; Perner, Frith, Leslie and Leekham, 1989).

Baron-Cohen and Goodhart (1994) described a child's understanding of the link between informational access and knowledge as a "cornerstone principle of a ToM". As O'Neill and Gopnik (1991) proposed, part of having a ToM is not only knowing that we know something, but also knowing how we know something. Knowing about the source of a belief plays a vital role in evaluating the belief, deciding how trustworthy or justified it is

and how easily it should be discarded. The age at which normally developing children understand this concept is believed to be between the ages of three and four years, although there is some discrepancy in the literature as to the exact age (see Wimmer, Hogrefe and Perner, 1988 and Pratt and Bryant, 1990).

Baron-Cohen (1992) examined deception in autism, finding that 85% of children with autism compared to 34% of those with intellectual difficulties, and 16% of normally developing children, were treating a penny hiding game as if it were purely about object occlusion: keeping things out of sight but not out of mind. Thus, the majority of individuals with autism understand seeing (object occlusion) but not that seeing-leads-to-knowing (information occlusion). Leslie et al. (1988) examined autistic children's ability to understand seeing, knowing and believing, compared to children with specific language impairment on a limited knowledge task. Results demonstrated that only 35% of children with autism could understand the role of visual access in knowledge formation. In a similar study Perner et al. (1989) found that only 44% of a group with autism understood the role of visual access in knowledge. Baron-Cohen et al. (1994) extended the research of Leslie et al. (1988) and Perner et al. (1989), by including a group with intellectual difficulties (rather than specific language impairment). Using a technique adapted from Pratt and Bryant (1990), they used dolls to examine the role of visual access in knowledge formation. Participants observed, as one of two dolls either looked inside, or picked up a closed box in which a counter had been placed. Results indicated that a third of participants with autism passed the test in comparison to three-quarters of the group with intellectual difficulties. Participants did not appear to be responding to the salience of the

object (contrary to the predictions made by Russell, Mauthner, Sharpe and Tidswell (1991) as the children were not permitted to see inside the box. The assertions from this paper were congruent with the prediction that children with autism experience significant difficulty in understanding that to know something one has to have informational access to it. Other studies (e.g. O'Neill et al., 1991) have examined different modalities in understanding informational access. However, the studies have tended to use normally developing children to determine the developmental age of ability, concluding that three-year olds had difficulty identifying the source of their knowledge, whereas four and five-year olds did not. Unfortunately, as yet, no studies have examined the effects of different modalities on informational access using participants with autism.

Theory of Mind: An Autism Specific Deficit?

Sigman (1994) argued that for a deficit in ToM to be considered as primary or central to autism, it has to be manifested in all or almost all individuals with autism, and it has to be unique, that is, not manifested by most individuals with other clinical diagnoses. However, considerable variation in the performance of children with autism on ToM tasks has been found. The proportion of children with autism passing standard first order ToM tasks varies from 15% to 60% (Happe, 1995). Less information is known about informational access tasks, although rates have varied from 15% to 44% (Baron-Cohen et al., 1994; Perner et al., 1989). Poor ToM skills have also been reported in individuals with schizophrenia (Corcoran, Frith and Mercer, 1995), profound prelingual deafness (Peterson and Siegal, 1995) and intellectual difficulties of non-specific aetiology (Yirmiya, Solomonica-Levi, and Shulman and Pilowsky, 1996). What is more, Beeghly,

Weiss-Perry, and Cicchetti (1990) and Kasari, Mundy, Yirmiya, and Sigman (1990) have proposed that differences between individuals with Down's syndrome and autism may indicate a specific strength of those with Down's syndrome, and not a deficit in those with autism. These studies imply that what may be unique to autism is the severity of the impairment rather than the impairment itself.

Developmental and Cognitive Correlates

Variation in task performance could be explained by the influence of developmental and cognitive factors in addition to, or above, diagnostic group status. Both Baron-Cohen (1992) and Leslie et al. (1988) reported significant associations between first-order ToM task performance and chronological age (CA). Charman and Baron-Cohen (1992) and Eisenmajer and Prior (1991), indicated significant associations between performance on tasks and verbal mental age (VMA). Further research by Prior, Dahlstrom and Squires (1990), reported significant correlations between task performance, VMA and CA. It is important to note (see Happe and Frith, 1995) that although age and verbal ability may be necessary they are not sufficient to ensure success on ToM tasks. Recent studies have further supported the important contribution of developmental and cognitive factors to successful performance on first-order ToM tasks in children with autism (Sparrevohn and Howie, 1995; Yirmiya et al., 1996). There is much less research on the influence of age and mental age as predictors of success on tasks assessing understanding of informational access and knowledge.

Insights into autism provided by the ToM account have proved useful. It is, however, important to remember that task success does not necessarily imply intact mentalising ability or social competence in autism. Happe (1994) demonstrated that intact false belief task performance did not rule out severe handicaps in social understanding and social interaction in everyday life. Unfortunately, there is a tendency to equate test performance with underlying cognitive ability, and while researchers are often keen to show that there are many reasons for failing a test, they rarely consider that there may be quite as many ways of passing it. Clearly, tasks designed to tap the ability to represent mental states, also involve other psychological abilities such as language and memory, and impairment in any one of these areas might lead to task failure. Happe (1995) therefore argued that task performance should only be viewed as an indirect measure of underlying competence.

Aims of the Present Study

Previous studies examining informational access and knowledge in autism have concentrated on the visual modality. The present study sets out to replicate and extend previous findings by examining whether impaired performance on tasks aimed at assessing understanding of informational access and knowledge, are cross modal in individuals with autism. Do children with autism understand that Seeing, Feeling and Telling lead to knowing? Moreover, the study investigates whether any deficits in understanding are unique to autism. It was felt that the most appropriate control groups would be individuals with intellectual difficulties of non-specific actiology and individuals with normal development. As it has been difficult to disentangle specific

ToM deficits from other variables, this study intends to explore the conditions under which performance on informational tasks may vary. Four potential moderator variables will therefore be examined, CA, VMA, degree of autism and gender. Based on previous research, it is predicted that a significant number of children with autism and children with intellectual difficulties will fail the tasks, whereas the majority of normally developing children will pass the tasks. Performance will therefore be in the following order: autism < intellectual difficulties < normally developing children.

METHOD

Design

A quasi-experimental, between-participants design was employed, comprising of three groups, children with autism, children with intellectual difficulties and normally developing children.

Participants

Included in the study were 17 children with autism (AUT; 15 boys, 2 girls), 19 children with intellectual difficulties of unknown aetiology and without autism (ID; 13 boys, 6 girls), and 21 normally developing children (ND; 11 boys, 10 girls). Details of participant characteristics are presented in Table 1. All the children with autism attended special schools and had been diagnosed (independently of the present study) by either an Educational Psychologist or a Paediatrician according to DSM-IV (American Psychiatric Association, 1994) or ICD-10 (World Health Organisation, 1992) criteria. All the children with intellectual difficulties attended one school for children with moderate learning difficulties. The normally developing children were selected from two Local Authority primary schools and were selected on the basis of achieving at least average levels for their age in school, and having no identified disorders or impairments. All participants had English as their first language.

One-way analysis of variance confirmed there was a significant difference between the groups in terms of chronological age ($F = 39.7$, $(2, 54)$, $p < .001$). Post hoc Tukey's B

tests confirmed that the ND children were significantly younger than the other two groups. Additionally, Chi Square analysis revealed that although there was a trend towards differences in gender across the groups this was not statistically significant (χ^2 = 5.590, (2), p = .061).

Table 1. Participant Variables (Mean, SD and Range)

VARIABLES	AUT (N=17)	ID (N=19)	ND (N=21)
Age (years)	9.7; 2.6	9.3; 1.0	5.7; 0.3
	(5.0 – 14.0)	(7.4 –11.0)	(5.0 – 6.3)
TROG	5.8; 1.6	5.2; 0.9	6.0; 1.0
	(4.0 - 10.0)	(4.0 - 7.0)	4.3 – 8.0
BPVS	6.1; 1.3	5.7; 1.0	6.2; 1.1
	(4.3 - 8.8)	(4.3 – 8.0)	(3.8 – 7.8)
CARS	29.9; 6.0	16.6; 1.2	15.0; 0
	(19.5 - 43.0)	(16.0 – 20.5)	(15.0 – 15.0)
Males:Females	15 : 2	13 : 6	11 : 10

Measures

Verbal Mental Age

Boucher (1989) suggested that using the British Picture Vocabulary Scale (BPVS; Dunn, Dunn, Whetton and Pintilie, 1982) to assess VMA is problematic in children with autism, as it only tests recognition of single words. While most individuals with autism have serious verbal communication difficulties, they do develop verbal knowledge of single words. It is plausible, therefore, that single word recognition is correlated differently with

other aspects of verbal and general ability for various clinical groups. Therefore, VMA was assessed using both the BPVS and the Test for Reception of Grammar (TROG; Bishop, 1983). To enable language age matching, inclusion criteria were set at between four and eight years on at least one test of VMA.

One-way ANOVAs were used to examine if there were differences between the groups in terms of VMA. Analysis revealed no significant differences between the groups on either the BPVS ($F = 1.316, (2, 54), p = .277$ or the TROG ($F = 2.377, (2, 54), p = .103$). To determine if there were any differences within groups, BPVS and TROG scores were compared using related samples t-tests. These revealed no significant differences with the AUT ($t = 1.29, (16), p = .217$); ID ($t = 1.52, (18), p = .146$); or ND groups ($t = .71, (20), p = .485$).

Childhood Autism Rating Scale

All children were characterised by their scores on the Childhood Autism Rating Scale (CARS; Schopler, Reichler, Devellis, and Daly, 1980). CARS rating enabled examination of degree of autism as well as ruling out autism in the other two groups. There was a significant difference in CARS scores between the groups (Kruskal Wallis = 52.786, (2) $p < .001$, as CARS data not normally distributed). Further analysis of CARS scores revealed that there were significant differences between AUT and ID groups (Mann Whitney $U = 1, n = 36, p<.001$) and between AUT and ND groups ($U = 0, n = 38, p < .001$), with the AUT group scoring highest. Additionally there was a difference

between ID and ND groups ($U = 0$, $n = 40$, $p < .001$), with the ID group scoring higher. Examination of mean scores revealed that the differences between ID and ND groups were small in comparison to differences between other two pairs.

Materials

A "Toy tunnel" approximately 310 x 320 x 160 mm was constructed and covered with fabric. Both openings were also covered with flaps of fabric. Two dolls were used, each approximately 39 cm tall, one male (John) with short black hair, and the other female (Sally) with long blonde hair, rather than two female characters (usually Sally and Anne) employed in some previous research (e.g. Baron-Cohen et al., 1985). It was hoped that this made it easier for the children to discriminate the characters and reduced the possibility of misunderstanding. Three objects were used: a key; a ball; and a toy car. The objects were kept in a covered box, and when an object was transferred to the tunnel it was covered with an opaque scarf. Participants' responses were recorded manually on a score sheet (see Appendix I).

Procedure

Written consent was received from all parents/guardians prior to children participating in the study. All participants were screened by the investigator individually in a room without distractions at the schools concerned. The CARS was given to the relevant teacher to complete following explanation. The BPVS and TROG were then administered, followed by Tasks 1, 2 and 3. For both assessment and experimental tasks

the participant and investigator sat next to each other at a table. No comments were made regarding the correctness or otherwise of responses.

Tasks

Task 1: Pre-test control condition. This task familiarised participants with the general procedure of choosing one of the dolls and eliminated participants who were unable to follow the simple procedure. First, the investigator took out two dolls and said to each participant: "This is John and this is Sally". The participant was then asked the naming question: "Which is John? Which is Sally?" Next participants were shown the three objects and asked to name them. All participants passed these questions. The investigator then said: "Let's give John the car and Sally a ball." Having watched the investigator give each doll an object, the participants were asked: "Who has the ball, John or Sally?" This last question constituted a control condition to the main experiment, reported below, in comprising a story but entailing no knowledge formation. Six trials were given to each participant, in which the object and order in which the dolls were mentioned were randomised across participants. Responses were recorded as Pass or Fail. Again, all participants answered correctly on all six trials and were therefore permitted to participate in the second experimental task.

Task 2: split into two parts (Naming Question and Source Question); to determine another's knowledge and identify the source of that knowledge. The investigator introduced the experimental task to the participant by placing the tunnel on the table and saying: "Look! This is my tunnel, you can lift up the material and look inside. But when

the material is down you cannot see what is inside. Now we are going to play a game. I am going to place things inside the tunnel and then I am going to ask you which of the dolls, Sally or John, knows what is inside the tunnel, and how they know what is inside?" The participants then received 12 experimental trials, four for each of the three types of source information (Seeing, Feeling and Telling).

In the Seeing trial, one of the objects was placed into the tunnel using the scarf to prevent the participant from seeing what was inside the tunnel. The investigator then made one doll lift up the material and "look" inside, and the other doll walk around the tunnel looking at the outside. Each action was accompanied with a statement such as, "John lifts up the flap and has a look inside. Sally touches the tunnel and looks at the tunnel". The participant was then asked "Who knows what is inside the tunnel, John or Sally?" The child's response was again marked on the response sheet. If the participant responded correctly to the identity of the doll they were then asked the source question. This was initially done in the form of an open-ended question: "How do they know what is inside"? If the participant responded immediately, they were scored as either correct or incorrect. If the participant did not respond immediately, the source question was repeated and the participant presented with three forced-choice alternatives that specified the different possible sources of information ("Because they felt inside, because they saw what was inside or because they were told what was inside?"). The three alternatives were presented separately and the participants required to respond "yes" or "no" to each. The answers were counted as correct if responded to in the appropriate order.

The Feeling trial was much the same, except the investigator made one of the dolls put a hand under the material and "feel" inside the tunnel, and the other doll touches the tunnel and put it down again. Again each action was followed with a statement such as: "Sally puts her hand inside the tunnel and takes it out again. John touches the tunnel".

The Telling procedure was the same, except the investigator whispered the identity of the object to one of the dolls, whereas the other doll was whispered the time. Again each action was followed with a statement: "I am going to tell John what time it is.

(Whispering) John it is ..... I am going to tell Sally what is inside the tunnel.

(Whispering) Sally there is a .....in the tunnel".

On each of the trials the order of the doll that looks, feels or is told, versus the other actions of touching the tunnel etc. were randomised. Additionally, the order in which the two dolls were mentioned in the question were randomised and the forced choice alternatives were counterbalanced. This meant that the participant remained ignorant of the contents of the tunnel, and therefore had to answer the questions purely on the basis of what can be ascribed to another character. Participants received three individual scores for the Naming tasks (Seeing, Feeling and Telling) and three individual scores for the Source tasks (regardless of either open-ended or forced choice format).

Task 3: Identifying and differentiating the various component activities of Seeing, Feeling and Telling. The materials for this task were identical to those described earlier. After completing the previous task the participants were asked if they would help John to play a

game, by helping him to find out what was inside the tunnel. The investigator then placed one of the covered objects into the tunnel and the participant was told: "John wants to know what is inside the tunnel". This was followed by one of three questions: "Can you help John to see what is inside the tunnel?" "Can you help John to feel what is inside the tunnel?" or "Can you tell John what is inside the tunnel?" The procedure was repeated in order that each question was asked twice, there being six trials in total. The order of the questions were counterbalanced. Individuals were scored as correct if:

(a) in the "see trial," they lifted up the tunnel or let John look under the fabric flaps, (b) in the "feel trial," they put John's hand inside the tunnel, (c) in the "tell trial," they told John the identity of the object in the tunnel.

RESULTS

Naming and Source Task

Table 2 summarises performance on the Naming and Source tasks. It is clear that performance of those participants with autism was worse in comparison to those with intellectual difficulties and normally developing individuals on both Naming and Source questions, regardless of modality.

Table 2.

Performance (Number, Mean and SD of participants passing trials) on the Naming and Source Task

	SEEING			FEELING			TELLING		
	AUT N=17	ID N=19	ND N=21	AUT N=17	ID N=19	ND N=21	AUT N=17	ID N=19	ND N=21
NAMING									
Trials passed									
0	1	0	0	3	1	0	0	1	1
1	1	2	1	3	1	0	1	0	0
2	4	0	0	3	2	1	7	0	0
3	6	3	0	3	2	0	1	4	0
4	5	14	20	5	13	20	8	14	20
Mean	2.8	3.5	3.9	2.2	3.3	3.9	2.9	3.6	3.8
S.D.	1.1	1.0	0.7	1.5	1.2	0.4	1.1	1.0	0.9
SOURCE									
Trials passed									
0	8	3	1	12	4	1	10	3	1
1	2	0	0	0	1	0	2	1	0
2	1	0	0	0	2	1	0	0	0
3	2	3	0	0	3	1	0	3	1
4	4	13	20	5	9	18	5	12	19
Mean	1.5	3.2	3.8	1.2	2.6	3.7	1.3	3.1	3.8
S.D.	1.7	1.5	0.9	1.9	1.6	1.0	1.8	1.5	0.9

As with previous research (e.g. Baron Cohen et al., 1985), and as indicated by the distribution of scores (see Appendix II), the children were required to answer the Naming question correctly on all trials, to be considered to have passed that particular modality. The probability of achieving this combined success criterion by guessing is .06. The same criterion was used for passing the Source question. Using this criterion, performance of those with autism was worse in comparison to those with intellectual difficulties and normally developing individuals, on both Naming and Source questions regardless of modality, as illustrated in Table 3.

Table 3. Total (Number, Percentage and Statistics) of Participants Passing[a] Each Task.

	AUT (N=17)	ID (N=19)	ND (N=21)	Between Group Analysis
NAMING:				
Seeing	5 (29.4%)	14 (73.7%)	20 (95.2%)	$\chi^2 = 19.206$ (2), $p < .001$
Feeling	5 (29.4%)	13 (68.4%)	20 (95.2%)	$\chi^2 = 18.358$ (2), $p < .001$
Telling	8 (47.1%)	14 (73.7%)	20 (95.2%)	$\chi^2 = 11.246$ (2), $p = .01$
Composite score	3 (17.6%)	10 (52.6%)	20 (95.2%)	$\chi^2 = 23.526$, (2), $p < .001$
SOURCE:				
Seeing	4 (23.5%)	13 (68.4%)	20 (95.2%)	$\chi^2 = 21.364$ (2), $p < .001$
Feeling	5 (29.4%)	9 (47.4%)	18 (85.7%)	$\chi^2 = 12.985$ (2), $p = .005$
Telling	5 (29.4%)	12 (63.2%)	19 (90.5%)	$\chi^2 = 15.055$ (2), $p = .002$
Composite score	2 (11.8%)	7 (36.8%)	18 (85.7%)	$\chi^2 = 21.874$, (2), $p < .001$
DIFFERENTIATION:	15 (88.2%)	19 (100%)	21 (100%)	

[a]Criterion for passing: correct on all trials.

Differentiation Task

Children were required to answer the Differentiation question correctly on all six trials to be considered to have passed the task. The probability of achieving this combined success criterion by guessing is .0014. As Table 3 illustrates, performance was almost at ceiling for all groups, with two people failing in the autism group (being correct on five out of the six trials). The results of the control task suggest that children had little trouble identifying the correct modality and differentiating between them.

Naming Question Analysis

Analysis within each group using Cochran's Q revealed no significant effect of modality: AUT (Q = 3 (2), p = .223); ID (Q = .286 (2), p = .867) and ND (Q = .000(2), p = 1). A composite score was calculated (this was the number of individuals passing all Seeing, Feeling and Telling questions). Chi square analysis (see Table 3) revealed significant between-group differences on all individual modalities and on the composite score. Mean scores revealed the order of performance to be AUT < ID < ND. Comparing pairs of groups, Fisher's exact probability revealed that there were significant differences in composite scores between AUT and ID (.041), between AUT and ND (< .001) and between ID and ND (.003) groups.

Source Question Analysis

Analysis within each group using Cochran's Q revealed no significant effect of modality: AUT (Q = .5(2), p = .779); ID (Q = 3.250 (2), p = .197) and ND (Q = 3.0(2), p = .223).

Between groups chi square analysis (see Table 3) revealed significant differences between groups on all individual modalities and on the composite score. Mean scores revealed the order of performance to be AUT < ID < ND. Comparing pairs of groups, Fisher's exact probability revealed that there were no significant differences in composite scores between AUT and ID groups (.128), but that there were significant differences between AUT and ND (< .001) and between ID and ND (.003) groups.

The role of CA, Gender, CARS, TROG, BPVS

Due to low numbers passing the tasks in the AUT group and so few people failing in the ID and ND groups, statistical comparisons of those who passed or failed tasks was limited. Logistic regression was therefore used to investigate the effect of potential moderator variables on composite Naming question performance. Table 4 shows that six variables, Age, Gender, CARS, TROG, BPVS and Group, were entered into the equation simultaneously. Group variable was converted into two dummy variables (AUT-NOT) (ID-NOT) with the ND group as the reference variable. Results indicate that 86.0% of cases were correctly classified using those variables. Group membership (both AUT and ID) and TROG scores were significantly associated with performance on the Naming task.

A logistic regression with composite Source question performance as the dependent variable, using the same set of independent variables (see Table 5) indicated that 78.9% of cases were correctly classified, and that Group membership (both AUT and ID) and TROG were again significantly associated with performance.

Table 4. Logistic regression with pass/fail on Naming task as the dependent variable

	Wald	Df	Sig	Chi-square model	Df	Sig	Overall % correct	-2 Log likelihood	Cox and Snell R Square
Age	2.963	1	.085	37.73	7	< .001	86.0	39.86	.48
Gender (1)	.832	1	.362						
BPVS	.309	1	.578						
TROG	3.907	1	.048						
CARS	.140	1	.708						
GROUPAUT (1)	5.637	1	.018						
GROUPID (1)	7.431	1	.006						
Constant	3.196	1	.074						

Table 5. Logistic regression with Pass/Fail on Source task as dependent variable

	Wald	Df	Sig	Chi-square model	Df	Sig	Overall % correct	-2 Log likelihood	Cox and Snell R Square
Age	1.766	1	.184	33.80	7	<.001	78.9	45.06	.45
Gender (1)	1.442	1	.230						
BPVS	.088	1	.766						
TROG	4.565	1	.033						
CARS	1.031	1	.310						
GROUPAUT (1)	6.827	1	.009						
GROUPID (1)	5.520	1	.019						
Constant	5.906	1	.015						

DISCUSSION

This study compared the performance of autistic children and children with intellectual difficulties and normally developing children on tasks aimed at assessing understanding of informational access and knowledge. The results support the hypothesis that individuals with autism perform poorly compared to both normally developing and intellectually disabled groups on such tasks. This research extends previous work in demonstrating that ToM deficits in understanding informational access and knowledge appear to be cross modal. Thus a significant number of participants with autism lack understanding of the Seeing, Feeling and Telling-leads-to-knowing principle. Autistic children's performance on single modalities was consistent with previous studies (e.g. Baron-Cohen et al., 1994; Leslie et al., 1988; Perner et al., 1989) as only a third of participants managed to pass these tasks. Overall performance, as demonstrated by the composite score, was worse, with 12% of participants with autism passing the whole task. A similar number of children with autism failed Baron-Cohen's (1992) Penny Hiding Game. The errors made, reveal a fundamental inability to understand the intent involved in hiding an object.

This pattern of results also reflects the variation in performance on other ToM tasks identified by Happe (1995). O'Neill et al. (1991) proposed that multi-modal tasks were more complex as a result of the need for differentiation between modalities. What is more, they found that such tasks required a higher chronological age in normally developing children. However, adopting a more conservative age range of above four

years as indicated by O'Neill et al. (1991) did not result in improved performance in the autism group.

Some additional conclusions can be drawn. The results are unlikely to have been due to the participant simply responding to the salience of the object, (as has been suggested by Russell et al., 1991), as participants did not see inside the tunnel or the identity of the object being placed in the tunnel. Additionally, deficits were unlikely to have been due to motivation or distraction as all participants were required to pass the pre-test task. What is more, the Identification/Differentiation task ensured that participants' results were not due to an inability to differentiate between modalities. Examination of potential moderator variables indicated that Group status and TROG score appeared to be the best predictors of task performance. This is in line with research that has suggested a relationship between ToM performance and verbal ability (Trillingsgaard, 1996; Happe, 1995; Sparrevohn and Howie, 1995).

These results replicate previous findings indicating that ToM ability is seriously impaired in individuals with autism. However, such accounts have also assumed an autism specific deficit, a view challenged by this study. As predicted, a significant number of participants with intellectual disabilities also failed the tasks, whereas performance of the normally developing children was in line with previous research, with almost all passing the tasks. The present findings support the notion that what may be unique to autism is the severity of the impairment rather than the impairment itself (Yirmiya et al., 1998). Researchers interested in autism have typically included individuals with intellectual

difficulties as their comparison groups. These findings suggest that comparison groups must be carefully evaluated and taken into account when interpreting data and inferring conclusions. Moreover, the common practise of including individuals with Down's syndrome as a comparison group, referred to as individuals with intellectual difficulties is problematic. Additionally, including individuals with Down's syndrome and individuals with intellectual difficulties resulting from other actiologies in one comparison group, may also not be the optimal approach.

Another puzzle for the ToM hypothesis arises from Peterson and Siegal's (1995) study of children with profound prelingual deafness. They found that in this group of children, all with normal intelligence, 65% failed a simple test of false belief. Aside from the communication impairment associated with prelingual deafness, these children did not demonstrate autistic features. The finding that individuals with intellectual difficulties and other disorders are also impaired in their abilities to pass tasks aimed at assessing ToM, does not exclude the possibility that distinct elements (empathic ability, various dimensions of cognitive ability, social relations, etc.) of this ability are differently impaired in various groups of individuals. For example, the studies of deaf children point to the importance of social learning or of an acquired element in ToM abilities, whereas studies regarding individuals with intellectual difficulties point to the importance of cognitive faculties. Furthermore, similar or poor task performance between the groups does not necessarily indicate similarities in the processes underlying task performance. They could be tackling the task in a fundamentally different way, or may not correctly understand the task. There is some evidence for this within the present study when

analysing some of the autistic children's responses. For example, instead of identifying a modality, one person replied "I think it is inside the tunnel" or by guessing what was in the tunnel "I think it is a key". There is an ongoing debate as to the appropriate method or methods of data collection regarding ToM ability. Only by examining the competence of different clinical groups on tasks aimed at assessing ToM abilities, will we enhance our understanding of its varying components and their origin.

This study is somewhat limited due to its size. Moreover, the difficulty associated with recruiting and studying rare syndromes such as autism has implications for the interpretation of any findings. Larger numbers would, however, enable greater generalisation of results and allow for fuller examination of potential moderator variables. It may be for example that the developmental trajectories of individuals with different aetiologies and mental abilities differ. Future studies could directly address this issue, considering inter-group analyses, ideally with large samples.

To conclude, the results of this study have replicated findings of a reduced ability in autism to understand the role of informational access as a source of knowledge. Furthermore, performance of those individuals with intellectual difficulties indicates that deficits in ToM ability are not unique to autism. Finally, the variability in performance on ToM tasks indicates that explanations may be more complex than suggested by existing theoretical models. Further work is necessary to delineate what these and other ToM tasks actually measure.

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APPENDIX I

Example of Score Sheet

NAME	DOB: AUT( ) ID( ) ND ( )

Task 1 Pre test

A. Hi I'm Gerrard and today I am going to ask you some questions. To help me I have 2 dolls; this is John (lift on table) and this is Sally (lift on table) John (touch) and Sally (touch). Can you show me which is John..... and now which is Sally?" "Well done!!."

B. *Place objects on table.* **"Now here are a few things can you tell me what they are called?" Well done.....**
(alternatively) **: "Can you point to the....."**

C. 1 Now let's give the ball to Sally and the car to John. Who has the car Sally or John?	**Sally**	**John**
2 Now let's give the car to John and the ball to Sally. Who has the ball Sally or John?	**Sally**	**John**
3 Now let's give the ball to Sally and the car to John. Who has the car Sally or John?	**Sally**	**John**
4 Now let's give the car to John and the ball to Sally. Who has the car Sally or John?	**Sally**	**John**
5 Now let's give the car to Sally and the ball to John. Who has the ball Sally or John?	**Sally**	**John**
6 Now let's give the car to Sally and the ball to John. Who has the car Sally or John?	**Sally**	**John**

Task 2.

This is my toy tunnel, you can lift up the material and look inside, but when the material is down you can't see inside. Now we are going to play a game. I am going to put things inside the tunnel and then I am going to ask you which doll knows what's inside the tunnel? ***Place object into the tunnel using scarf.***

1.A John Seeing **"Sally"** **Who knows what is inside the tunnel Sally or John?**		**Sally**	**John**
B. How do they know what is inside?	***Response***		
C. Do they know what is inside because:	They saw what was inside?	**Yes**	**No**
	They felt inside?	**Yes**	**No**
	I told them what was inside?	**Yes**	**No**
2.A. John Seeing **"John"** **Who knows what is inside the tunnel Sally or John?**		**Sally**	**John**
B. How do they know what is inside?	***Response***		
C. Do they know what is inside because:	They saw what was inside?	**Yes**	**No**
	I told them what was inside?	**Yes**	**No**
	They felt inside?	**Yes**	**No**
3.A. John Feeling **"Sally"** **Who knows what is inside the tunnel Sally or John?"**		**Sally**	**John**
B. How do they know what is inside?	***Response***		
C. Do they know what is inside because:	They felt inside?	**Yes**	**No**
	I told them what was inside?	**Yes**	**No**
	They saw what was inside?	**Yes**	**No**
4.A. Sally Feeling **"Sally"** **Who knows what is inside the tunnel. Sally or John?"**		**Sally**	**John**
B. How do they know what is inside?	***Response***		
C. Do they know what is inside because:	They felt inside??	**Yes**	**No**
	They saw what was inside	**Yes**	**No**
	I told them what was inside?	**Yes**	**No**

5.A. Sally Told "John" **Who knows what is inside the tunnel Sally or John?**		**Sally**	**John**
B.How do they know what is inside?	***Response***		
C.Do they know what is inside because:	I told them what was inside?	**Yes**	**No**
	They felt inside?	**Yes**	**No**
	They saw what was inside?	**Yes**	**No**
6.A. Sally Seeing "Sally" **Who knows what is inside the tunnel John or Sally?**		**Sally**	**John**
B.How do they know what is inside?	***Response***		
C.Do they know what is inside because:	I told them what was inside?	**Yes**	**No**
	They saw what was inside?	**Yes**	**No**
	They felt inside?	**Yes**	**No**
7.A.John Told "Sally" **Who knows what is inside the tunnel Sally or John?**		**Sally**	**John**
B.How do they know what is inside?	***Response***		
C.Do they know what is inside because:	They felt inside?	**Yes**	**No**
	I told them what was inside?	**Yes**	**No**
	They saw what was inside?	**Yes**	**No**
8.A.Sally Told "Sally" **Who knows what is inside the tunnel Sally or John?**		**Sally**	**John**
B.How do they know what is inside?	***Response***		
C.Do they know what is inside because:	They saw what was inside?	**Yes**	**No**
	They felt inside?	**Yes**	**No**
	I told them what was inside?	**Yes**	**No**
9.A. Sally Seeing "John" **Who knows what is inside the tunnel Sally or John?**		**Sally**	**John**
B.How do they know what is inside?	***Response***		
C.Do they know what is inside because:	They felt inside??	**Yes**	**No**
	They saw what was inside	**Yes**	**No**
	I told them what was inside?	**Yes**	**No**
10.A.John Feeling "John" **Who knows what is inside the tunnel. Sally or John?**		**Sally**	**John**
B.How do they know what is inside?	***Response***		
C.Do they know what is inside because:	They saw what was inside?	**Yes**	**No**
	I told them what was inside?	**Yes**	**No**
	They felt inside?	**Yes**	**No**
11.A. John Told"John" **Who knows what is inside the tunnel Sally or John?**		**Sally**	**John**
B.How do they know what is inside?	***Response***		
C.Do they know what is inside because:	I told them what was inside?	**Yes**	**No**
	They saw what was inside?	**Yes**	**No**
	They felt inside?	**Yes**	**No**

12.A.Sally Feeling "John" **Who knows what is inside the tunnel. Sally or John?**		Sally	John
B.How do they know what is inside?	*Response*		
C.Do they know what is inside because:	I told them what was inside?	Yes	No
	They felt inside?	Yes	No
	They saw what was inside?	Yes	No

Task 3 Differentiation	
1.Can you help John to see what is inside the tunnel?	*Response*
2.Can you help John to feel what is inside the tunnel?	*Response*
3.Can you tell John what is inside the tunnel?	*Response*
4.Can you help John Feel what is inside the tunnel?	*Response*
5.Can you tell John what is inside the tunnel?	*Response*
6.Can you help John to see what is inside the tunnel?	*Response*

APPENDIX II

Spread of scores across Task 2

		Frequency	Percent	Valid percent	Cumulative percent
NAMING:					
Valid	3.00	1	1.8	1.8	1.8
	4.00	2	3.5	3.5	5.3
	5.00	2	3.5	3.5	8.8
	6.00	3	5.3	5.3	14.0
	7.00	5	8.8	8.8	22.8
	8.00	3	5.3	5.3	28.1
	9.00	2	3.5	3.5	31.6
	10.00	2	3.5	3.5	35.1
	11.00	4	7.0	7.0	42.1
	12.00	33	57.9	57.9	100.00
	Total	57	100.00	100.00	
SOURCE:					
	.00	9	15.8	15.8	15.8
	1.00	4	7.0	7.0	22.8
	3.00	2	3.5	3.5	26.3
	6.00	1	1.8	1.8	28.1
	7.00	1	1.8	1.8	29.8
	8.00	3	5.3	5.3	35.1
	9.00	3	5.3	5.3	40.4
	10.00	2	3.5	3.5	43.9
	11.00	5	8.8	8.8	52.6
	12.00	27	47.4	47.4	100.00
	Total	57	100.00	100.00	

APPENDIX III

Journal of Child Psychology and Psychiatry and Allied Disciplines

Instructions for Contributors

SECTION 4

CRITICAL REVIEW

Prepared in accordance with notes for contributors for: Journal of Child Psychology and Psychiatry and Allied Disciplines

AUTISM AND THEORY OF MIND: AN EXAMINATION OF DIFFERENT MODALITIES

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INTRODUCTION

This paper reviews in detail the study, assessing understanding informational access and knowledge formation in children with autism, normally developing children and those children with intellectual difficulties. Firstly, the research findings will be examined in relation to other relevant studies. The uniqueness and specificity of deficits in autism will be considered, followed by discussion of the meaning of task failure and the implication of moderator variables. Methodological issues will then be examined in the light of future research. Finally, consideration will be made as to the contribution that this study makes to the understanding of autism, and conclusions drawn.

RESEARCH FINDINGS

The research supports the hypothesis that autistic individuals perform poorly compared to both normally developing and intellectually disabled groups on tasks assessing Theory of Mind (ToM; Premack and Woodruff, 1978). This research extends previous work in demonstrating that deficits in understanding informational access and knowledge appear to be cross modal. Thus, a significant number of participants with autism lack understanding of the Seeing, Feeling and Telling-leads-to-knowing principle (Baron-Cohen and Goodhart, 1994). Autistic children's performance on single modalities was consistent with the findings of previous studies such as Baron-Cohen et al. (1994), Leslie and Frith (1988) and Perner, Frith, Leslie and Leekham (1989). They found that about two thirds of children with autism seemed unable to understand the principle that to know something one has to have informational access to it. The performance of the non-

developmentally delayed group was as predicted by previous research; almost all of these children passed the tasks.

Moreover, the results elaborate on the nature of this difficulty. Even when given a question involving only three very simple alternatives, overall performance was substantially poorer than that of the normally developing children and those with intellectual difficulties. It would have been possible for children to be correct using a simple strategy of answering the "How do they know?" question, by referring back to the event that had just happened, even without understanding the significance of that event or its relation to the belief. Results would indicate that this was not the case.

The results of this study are also consistent with the performance by children with autism on the Penny Hiding Game (Baron-Cohen, 1992; Ollendick and Oswald, 1989). The errors made reveal a fundamental inability to understand the purpose of hiding – to occlude information and not just objects. More relevant to the present study, they also reveal a failure to understand that a guesser will know the location of an object if they are allowed to see where it is put. This pattern of results also appears similar to the development of other ToM tasks involving misrepresentation, such as false belief (Baron-Cohen, Leslie and Frith, 1985). Happe (1993) also found that impaired ToM ability was associated with impaired comprehension of figurative language.

A developmental sequence has been proposed to explain some of these findings. Judgement of visual access is argued to be relatively easy because it does not involve

understanding of mental states, but only the judgement of a physical relation between the other person's eyes and the object in the tunnel (Leslie et al., 1988, Perner, 1988). Attribution of knowledge however is considered more difficult, because the child has to understand how events in the real world (i.e. looking at something) cause a mental state of knowing (Wimmer et al., 1988). It is argued that this understanding of how events in the real world cause a mental state, is made particularly difficult if the content of the mental state is non-real, as is the case of a false belief (Leslie, 1988). The attribution of second-order false beliefs is even more difficult, because of the recursive nature of such attribution (Perner, 1988). It would, however, be premature to arrive at a conclusion in terms of the direction of the relationship between understanding informational access and false belief, further studies are required.

Uniqueness of autism

A second aim of this study was to examine whether deficits in understanding the role of informational access and knowledge are unique to autism. The performance of those with autism and those with intellectual difficulties confirm that the deficit in understanding informational access characterises individuals with autism, but is not unique to autism. This is in line with research demonstrating weak mentalising skills in other groups (Benson, Abbeduto, Short and Nuccio, 1993; Shields, Varley, Broks and Simpson, 1996; Yirmiya and Shulman, 1996; Yirmiya, Solomonica-Levi, Shulman and Pilowsky, 1996). Moreover, it has been suggested that the higher scores of individuals with Down's syndrome on previous studies investigating ToM, may indicate a specific strength of those with Down's syndrome and not a deficit in those with autism. Individuals with

Down's syndrome are known to have higher empathic abilities and better social skills, compared to other individuals with intellectual difficulties of unknown aetiology (Beeghly, Weiss-Perry, and Cicchetti, 1990; Kasari, Mundy, Yirmiya, and Sigman, 1990). This has implications for future research and emphasises the need for careful selection of control groups.

A related issue and one that deserves further exploration, is the type of errors made by a number of the children with autism. For example, instead of identifying how a doll knew what was in the tunnel, one child replied "I think it is inside the tunnel". Additionally, another child attempted to guess what was inside the tunnel "I think it is a key". Therefore, it could be argued that similar or poor task performance between the groups does not necessarily indicate similarities in the processes underlying task performance. As has been suggested by other authors such as Hobson (1991), participants could be tackling the task in fundamentally different ways or additionally misinterpreting what was expected of them and this is illustrated by a number of the responses.

What does task success and failure actually mean?

A further issue is the relationship between "normal" development of ToM and ToM in autism. A number of interventions have taught autistic children to pass tasks of false belief attribution. However, these children show little evidence of generalisation to other tasks in comparison to normally developing three-year olds who could be trained to pass the task and generalise to other false belief tasks (McGregor, Whiten and Blackburn, 1998). A substantial proportion of autistic children and normally developing three-year

olds generally fail on tests of false belief. Yet, three-year olds are not autistic, and adults with intellectual difficulties having a mental age of three years do not automatically show the triad of impairments. The differences between autistic individuals and three-year old children have been explored by a number of researchers such as Roth and Leslie (1991). From these studies it seems that autistic children and normally developing three-year olds fail ToM tasks for different reasons, as only autistic children were found to have a specific problem with mental representations. Therefore, further work to delineate what ToM tasks measure is needed. Furthermore, given the debate surrounding the age of developing ToM abilities in normally developing children, the type of task could be used in future studies as a potential moderator variable. The wide variety of contents and contexts examined in the different tasks raises the possibility that the various tasks may not be testing the exact same abilities and that some are easier than others.

Moderator variables

This study attempted to extend previous work by identifying the conditions under which performance on a task assessing understanding of informational access and knowledge may vary. As a result of the numbers passing and failing this task, statistical analysis was limited. However, logistic regressions did identify associations between Group status (autistim and intellectual difficulties) as well as the Test for Reception of Grammar (TROG; Bishop, 1983) and performance. This is in line with previous research indicating a relationship between ToM performance and verbal ability (Dahlgren and Trillingsgaard, 1996; Happe, 1995; Sparrevohn and Howie, 1995). Additionally, adopting a more

conservative age range of above four-years did not result in markedly improved performance in the autism group, compared to the study of Baron-Cohen et al. (1994).

PARTICIPANTS

Recruitment of individuals with autism

Recruitment of participants with autism proved problematic. Problems first became evident during the pilot study (see Appendix I and II). Initially, the study intended to recruit from one site. However, despite discussion with those at the site and reassurances of numbers fitting criteria, there were problems with insufficient diagnosis and varying use of diagnostic tools. Specifically, fewer participants than expected had actually been diagnosed as purely autistic according to DSM IV (American Psychiatric Association, 1994) or ICD-10 (World Health Organisation, 1994). Additionally, many children that had been diagnosed as autistic did not reach research criteria, in many cases not being verbal. Due to the difficulty in sourcing appropriate participants, the decision was made to use children in the pilot study having a diagnosis of autistic spectrum disorder. As a result, this would not reduce the number of purely autistic individuals available for the experimental sample.

Numbers

Despite these difficulties every effort was made to obtain the number of autistic individuals recommended by the power calculations. This meant using nine separate sites overall for the autistic population. Unfortunately, numbers were still slightly reduced for

the autism group (n = 17). However, studies such as Baron-Cohen et al. (1994) had lower (n = 12) or similar numbers (Leslie et al., 1988; n = 18). Larger numbers would, however, enable greater generalisation of results and allow for fuller examination of potential moderator variables. Future studies should focus on different clinical groups and include individuals of various abilities within each group.

Amount of research interest

The difficulty associated with recruiting and studying rare syndromes such as autism has implications for the interpretation of any findings. Many researchers who identify well-matched groups of participants may administer several tasks to the same group, or different researchers use the same participants. Given the potential for experiences on other tasks to have an effect on present findings, the homogeneity of any group studied and the generalisability of findings needs to be considered during interpretation. Future studies could directly address this issue, considering inter-group analyses, ideally with larger samples.

Measures

The research measures chosen (TROG; and British Picture Vocabulary Scale; BPVS; Dunn, Dunn, Whetton and Pintilie, 1982) proved non-problematic to administer; moreover participants across the groups appeared to treat it as a guessing game and enjoyed it. During the design of the study, when the initial site was chosen for the autistic sample, scores on the Autism Diagnostic Interview-Revised (ADI; Lord, Rutter, and Le

Couteur, 1994) were also to be used. Unfortunately, despite reassurances to the contrary, these scores were not gathered routinely and therefore needed to be abandoned.

Despite the Childhood Autism Rating Scale (CARS; Schopler, Reichler, Devellis, and Daly, 1980) being shown to have high reliability and good validity (Trevarthen, Aitken, Papoudi and Robarts, 1996), its use proved to be problematic. The CARS appeared clumsy and the categories were broad, encompassing a number of factors. A number of those conducting CARS assessments reported that the categories were in fact too broad, making appropriate selection problematic. This is supported by some of the literature. Howlin (1998) for example, stated that: " Judgements based on clinical diagnosis may not always agree with diagnosis based on formal diagnostic criteria, such as the ADI or CARS" (p.318). Despite these difficulties the CARS clearly differentiated between those individuals with and without autism, although it should be noted that a number of those receiving a diagnosis of autism fell slightly below threshold on the CARS. This paper argues that this was an artefact of the measure as diagnosis was double-checked. Other than improvements to the measure, future studies could use one clinician to diagnose and assess level of autism and use a further clinician for inter-rater reliability. Such measures were beyond the scope of this study.

PROCEDURE

The prior experience of the researcher working with individuals with autism proved invaluable. Given the need for routine and structure evident in many individuals with autism, careful planning of the experimental session was vital. Therefore, discussion

with those involved with the children ensured that a time was set aside that would not interfere with any set activities or other important routines. Moreover, the session was placed in advance on the individual's timetable as a set activity and a familiar room was used. This gave the children prior understanding of when it was going to be and approximately how long it would last, thereby maximising the chances of participation.

FEEDBACK

An important issue and one that was raised at the very beginning of the study when institutions were contacted, was feedback. Institutions were concerned that in the past researchers had failed to feedback findings to both institutions and other interested parties. This they stated made both parents and staff reluctant to participate in future studies. As a result each institution including other interested parties such as parents, were offered the opportunity to attend a number of seminars aimed at disseminating the results of the research. It is hoped that this will encourage participation in future studies and raise the profile of clinical psychology as a whole.

THE CONTRIBUTION TO UNDERSTANDING

This study contributes to the understanding of autism by extending previous research and identifying that deficits in understanding informational access and knowledge are cross-modal, and they can no longer be conceptualised as unique to autism. Findings suggest that comparison groups must be carefully evaluated and taken into account when interpreting data and inferring conclusions. Therefore, the common practise of including individuals with Down's syndrome as a comparison group, referred to as individuals with

intellectual difficulties is problematic. Additionally, including individuals with Down's syndrome and individuals with intellectual difficulties resulting from other aetiologies in one comparison group, may also be questioned. The finding that individuals with intellectual difficulties and other disorders are also impaired in their ToM abilities does not exclude the possibility that distinct elements (empathy, various dimensions of cognitive ability, social relations, etc.) of this ability are differently impaired in various groups of individuals. For example, studies of deaf children point to the importance of social learning or of an acquired element in ToM abilities, whereas studies regarding individuals with intellectual difficulties point to the importance of cognitive faculties (Peterson and Siegal, 1995; Shulman and Pilowsky, 1996). By further examining the ToM abilities of different clinical groups, we may enhance our understanding of its varying components and their origin.

This research provides further information to inform general discussions of how best to educate individuals with autism. Popular sources of information on autism now include references to ToM studies (Autism Research International, 1996). Temple Grandin (1995), a now famous individual with autism, has suggested that her method of dealing with impaired interpersonal skills involves compensating by replaying in her mind a videotape of images that she has collected in the course of her life time. It therefore would appear that there are ways to circumvent ToM difficulties. Moreover, several intervention studies have found that children with autism can show improvements in their ability to understand beliefs and emotions (Swettenham, 1995; Ozonoff and Miller, 1995; Hadwin, Baron-Cohen, Howlin, and Hill, 1996). Some teaching materials are even being

marketed with reference to ToM (Gray, 1995). Not unexpectedly, the generalisation to untrained aspects of ToM are poor. Nevertheless, even this limited success suggests that training packages specifically designed to increase social functioning could be an important and valuable addition to the educational curriculum for many children with autism (Howlin, Baron-Cohen, Hadwin and Swettenham, in press). This paper does not suggest that an impairment in ToM is unique to autism, or that it is the primary cause of autism, but rather that the idea of ToM is a potentially rich avenue through which to explore educational approaches.

CONCLUSION

Rutter (1998) stated that research was the lifeblood of clinical practice in all fields of medicine, including child psychiatry. This is reflected, for example, in the growing ascendancy of "evidence-based medicine". Nevertheless, there are dangers if individuals adopt too mechanical, and too simplistic, an interpretation of "evidence-based medicine". This paper argues that the essence of research lies in the process of problem solving and not in the mere provision of a set of factual answers. Research can be viewed as telling stories about how mechanisms in nature might be operating. Following this, experimental-type strategies are used to test the ideas expressed in the stories to compare alternative explanations. Thereby, in gradual, iterative fashion one moves progressively to what might be the truth. The most important thing therefore, is not to know which of our current methods are best, rather to have a means of moving forward to develop even better methods in the future. That can only happen if the research is devised to determine

what methods work in particular circumstances, and not just whether they are better than alternative approaches.

The investigations surrounding ToM caught the research world's imagination as, for the first time, it provided a possible means of directly linking a cognitive deficit with a social problem and that it did so in terms of an aspect of cognition known to follow a predictable developmental course. However, a number of problems remain to be resolved. If the cognitive deficit postulated to constitute the basis for autism is so narrow and highly specific, why is there such a strong association between autism and general intellectual difficulties (Rutter and Bailey, 1993)? Also, if a deficit in ToM is responsible, and yet is not seen to develop until the age of three or four years, why are the manifestations evident as early as twelve to eighteen months? Rutter (1999) suggested that it could be that autism arises from cognitive mechanisms that are precursors of the mentalising ability. So far, however, it has not been possible to unambiguously demonstrate a causal relationship between precursor and later ToM skills. Additionally, the relationship between ToM skills and language has not yet been adequately sorted out. The two have been associated (Happe, 1995) but the mechanisms involved have yet to be elucidated. Moreover, a percentage (around 20 - 30% in this study) of verbal children with autism pass tests aimed at assessing ToM. It therefore remains unclear whether they truly have ToM skills or whether they use alternative strategies to pass the tests. Finally, although it is not difficult to see how an impaired ability to understand other people's mental states might lead to social and communicative deficits associated with autism, it is

by no means clear how it could give rise to obsessive preoccupations and repetitive patterns of behaviour.

To conclude, clinicians today recognise the need to take into account the associations between educational difficulties, cognitive deficits and psychopathology (Rutter, 1987) as well as children's experiences at school and in the community. Clinical psychology has much to contribute to elucidating the processes involved in autism and the results of this study have contributed to the building and elaboration of knowledge and understanding in the field of autism.

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APPENDIX I

Journal of Child Psychology and Psychiatry and Allied Disciplines

Instructions for Contributors

GENERAL

SECTION 5

APPENDICES

APPENDIX I

PRE PILOT

In order to become familiar with the testing materials, timing and procedure a Pre Pilot test was carried out with a six-year old (male) normally developing child. Two sessions were scheduled that each lasted approximately 25 mins each. It became apparent during testing that some minor alterations were necessary before the pilot was conducted (refer to pilot proper for exact details):

1. The number of experimental trials quoted in the original ethics proposal were incorrect at 15. As a result, these were adjusted accordingly to 12 (4 trials for 3 conditions) for the pilot.

2. During the pre pilot it had also been noted that even after the objects were covered with the scarf that it was still possible for one to distinguish which object was the ball. Therefore, for the pilot the spoon and toothbrush were changed for a key and a toy car.

3. Additionally, during the pilot the procedure was altered to ensure that for each condition (Seeing, Feeling and Telling) that the dolls actions were similar to the doll being given access to what was in the tunnel. In the pre pilot Seeing trial, one doll lifted up the flap and looked inside, the other doll walked around looking at the tunnel. This was adjusted for the pilot to ensure that the other doll also touched the tunnel. In the pre pilot Feeling trial, one doll put their hand inside the tunnel while the other one lifted up the tunnel. For the pilot this was altered so that the other doll merely touched the outside of the tunnel.

APPENDIX II

PILOT

INTRODUCTION

Following the pre pilot, a pilot test was conducted to familiarise oneself with both the materials and procedure, and to check if the experiment appeared to answer the research question. This would be a much smaller test of the experiment proper, using children from all of the intended groups. The pilot would provide detailed information concerning the feasibility of what was proposed in terms of time, effort and resources, specifically:

1. Any difficulties involved in obtaining children matching the experimental criteria for each group.

2. The practicality of working with the different groups. For example, to determine how much time had to be spent with children before the experiment, to familiarise them with the investigator.

3. Usefulness and ease of application of each of the individual measures.

4. The understandability of both the instructions and experimental tasks for the children.

5. If the experiment actually answers the research question.

METHOD

Participants

Included in the study were seven children with autistic tendencies (five boys, two girls), seven children with intellectual difficulties of undifferentiated actiology and without autism (five boys, two girls), and seven normally developing children (five boys, two girls). All children with autism attended special schools and were included in the study if they had received a diagnosis by a clinician of autistic tendencies. The participants with intellectual difficulties attended one school for children with moderate learning difficulties. The seven normally developing children attending one of two Local Authority infant schools. All participants had English as their first language.

The inclusion criteria was a verbal mental age (VMA) of between four and eight years. VMA was assessed using the British Picture Vocabulary Scale (BPVS; Dunn, Dunn, Whetton and Pintilie, 1982) and the Test for Reception of Grammar (TROG; Bishop, 1983). In addition, all children were characterised by their scores on the Childhood Autism Rating Scale (CARS; Schopler, Reichler, Devellis, and Daly, 1980), to ensure that normally developing individuals as well as those with intellectual difficulties did not meet the criterion for autism. See Table 1 for descriptive data.

Table 1. Participant Characteristics

Diagnostic group	N	Gender			Chronological Age	Verbal Mental Age TROG	BPVS	CARS
AUT	7	Male	5	Mean	10.2	5.1	5.7	30.9
		Female	2	S.D.	2.3	0.5	0.8	6.2
				Range	6.3 - 12.5	4.3 - 5.8	4.9 - 6.8	22.5- 39.5
ID	7	Male	5	Mean	9.2	5.2	5.4	16.3
		Female	2	S.D.	1.4	1.0	1.0	0.8
				Range	7.5 - 11.0	4.3 - 7.0	4.3 - 6.5	16.0 - 18.0
ND	7	Male	5	Mean	5.6	6.6	6.4	15.0
		Female	2	S.D.	0.4	1.1	1.4	0
				Range	5.0 - 6.1	5.3 - 8.0	3.8 - 7.5	15.0 - 15.0

Materials

A "Toy tunnel" approximately 310 x 320 x 160 mm was constructed and covered with material. Both openings were covered by flaps of material. Two dolls were used, each approximately 39 cm tall, with one male (John) with short black hair, and the other female (Sally) with long blond hair. Three objects were used a key, a ball and a toy car. The objects were kept in a covered box, and when an object was transferred to the tunnel it was covered by an opaque scarf.

Procedure

A mixed quasi-experimental design was employed; having both a between-participants component (Autism Vs ID Vs ND) and a within-participants component (modality of task). Three experimental tasks were conducted:

***Task (1)*:** A pre-test, control condition.

Task (2) - split into two parts:

a. Naming Question. To determine another's knowledge

b. Source Question. To identify the source of that knowledge.

Task (3): Identifying and differentiating the various component activities of seeing, feeling and listening.

All participants were screened by the investigator individually in a room without distractions at the schools concerned, prior to the experimental tasks. For both screening and experimental testing the participant and investigator sat next to each other at a table. No comments were made regarding the correctness or otherwise of responses.

Task (1): **pre-test control condition.** A pre-test task familiarised participants with the general procedure of choosing one of the dolls and eliminated participants who were unable to follow the simple procedure. First, the investigator took out two dolls and said to each participant: **"This is John and this is Sally".** The participant was then asked the naming question: **"Which is John? Which is Sally?"** Next participants were shown three objects and asked to name them. All participants passed these questions. The investigator then said: **"Let's give John the car and Sally a ball."** Having watched the investigator give each doll an object, the participants were asked: **"Who has the ball, John or Sally?"** This last question constituted a control condition to the main experiment, reported below, in comprising a story but entailing no knowledge formation. Six trials were given to each participant, in which the object and order in which the dolls are mentioned were randomised across participants. Responses were recorded as Pass or

Fail. Again, all participants answered correctly on all six trials and were therefore permitted to participate in the second experimental task.

Task (2): **Parts a. and b. To determine another's knowledge and identify the source of that knowledge.** The investigator introduced the experimental task to the participant by placing the tunnel on the table and saying: **"Look! This is my tunnel, you can lift up the material and look inside. But when the material is down you cannot see what is inside. Now we are going to play a game. I am going to place things inside the tunnel and then I am going to ask you which of the dolls Sally or John knows what is inside the tunnel, and how they know what is inside?"** The participants then received 12 experimental trials, four for each of the three types of source information (Seeing, Feeling and Telling).

In the **Seeing trial** one of the objects was placed into the tunnel using the scarf to prevent the participant from seeing what was inside the tunnel. The investigator then made one doll lift up the material and "look" inside, and the other doll walk around the tunnel looking at the outside. Each action was accompanied by a statement such as, **"John lifts up the flap and has a look inside. Sally touches the tunnel and looks at the tunnel".** The participant was then asked **"Who knows what is inside the tunnel John or Sally?"** The child's response was again marked on the response sheet.

If the participant responded correctly to the identity of the doll they were then asked the source question. This was initially done in the form of an open-ended question: **"How do**

they know what is inside"? If the participant responded immediately, they were scored as either correct or incorrect. If the participant did not respond immediately, the source question was repeated and the participant presented with three forced-choice alternatives that specified the different possible sources of information (**"Because they felt inside, because they saw what was inside or because they were told what was inside?"**). The three alternatives were presented separately and the participants required to respond **"yes"** or **"no"** to each. The answers were counted as correct if responded to in the appropriate order.

The **Feeling trial** was much the same, except the investigator made one of the dolls put a hand under the material and "feel" inside the tunnel, and the other doll lift up the tunnel and put it down again. Again each action was followed by a statement such as: **"Sally puts her hand inside the tunnel and takes it out again. John touches the tunnel".**

The **Telling trial** procedure was the same, except the investigator whispered the identity of the object to one of the dolls, whereas the other doll was whispered the time. Again each action was followed by a statement: **"I am going to tell John what time it is. I am going to tell Sally what is inside the tunnel".**

On each of the trials the order of the doll that looks, feels or is told, versus the other actions of lifting up the tunnel etc. and the order in which the two dolls are mentioned were randomised. Furthermore, the order of the forced choice alternatives were counterbalanced. This meant that the participant remained ignorant of the contents of the

tunnel, and therefore had to answer the questions purely on the basis of what can be ascribed to another character.

Participants received three individual scores (one for each condition) between 0-4 for the naming questions and three scores each between 0-4 for the source questions (regardless of either open-ended or forced choice format).

Task (3): **Identifying and differentiating the various component activities of Seeing, Feeling and Telling.** The materials for this task were identical to those described earlier. After completing the previous task the participants were asked if they would help John to play a game, by helping him to find out what is inside the tunnel. The investigator then placed one of the covered objects into the tunnel and the participant was told: **"John wants to know what is inside the tunnel".** This will be followed by one of three questions: **"Can you help John to see what is inside the tunnel?" "Can you help John to feel what is inside the tunnel?", or "Can you tell John what is inside the tunnel?"** The procedure was repeated in order that each question was asked twice, there being six trials in total. The order of the questions again were counterbalanced. Individuals were scored as correct if:

(i) in the "see case," they lift up the tunnel or let John look under the material flaps.

(ii) in the "feel case," they put John's hand inside the tunnel.

(iii) in the "Tell case," they tell John the identity of the object in the tunnel.

RESULTS

The results of the Naming Questions are presented in Tables 2 and 3. It is clear from this data that the autistic group performance was worse than both the children with intellectual difficulties and normally developing children. Performance in the Telling condition was poorest with the autistic group scoring 11, compared to 24 for the children with learning difficulties and 28 for the mainstream groups.

Table 2. Number of trials passed for Naming Task.

Diagnostic group	Seeing		Feeling		Telling	
AUT	Trials Passed	Freq.	Trials Passed	Freq.	Trials Passed	Freq.
	0	0	0	0	0	0
	1	1	1	0	1	5
	2	0	2	2	2	1
	3	4	3	3	3	0
	4	2	4	2	4	1
	Total Passed	21	Total Passed	19	Total Passed	11
ID	Trials Passed	Freq.	Trials Passed	Freq.	Trials Passed	Freq.
	0	0	0	0	0	1
	1	1	1	0	1	0
	2	0	2	0	2	0
	3	0	3	2	3	0
	4	6	4	5	4	6
	Total Passed	25	Total Passed	26	Total Passed	24
ND	Trials Passed	Freq.	Trials Passed	Freq.	Trials Passed	Freq.
	0	0	0	0	0	0
	1	0	1	0	1	0
	2	0	2	0	2	0
	3	0	3	0	3	0
	4	7	4	7	4	7
	Total Passed	28	Total Passed	28	Total Passed	28

Table 3. Mean number of trials passed for Naming Task.

Diagnostic group		Seeing	Feeling	Telling
AUT	Mean	3.0	3.0	1.6
	S.D.	1.0	0.8	1.1
	Range	1.0 – 4.0	2.0 - 4.0	1 - 4.0
ID	Mean	3.6	3.7	3.4
	S.D.	1.1	0.5	1.5
	Range	1.0 – 4.0	3.0 - 4.0	0 - 4.0
ND	Mean	4.0	4.0	4.0
	S.D	0.0	0.0	0.0
	Range	4.0 – 4.0	4.0 - 4.0	4.0 - 4.0

The results from the Source task are presented in Tables 4 and 5. As can be seen, the autistic group did not pass any trials for either of the conditions. This is compared to scores of between 17 and 24 for the children with intellectual difficulties and 24 and 28 for the normally developing children. Moreover, all children from the three groups were able to correctly answer the final Differentiation Task for all six trials.

Table 4. Number of trials passed for Source Task.

Diagnostic group	Seeing		Feeling		Telling	
AUT	Trials Passed	Freq.	Trials Passed	Freq.	Trials Passed	Freq.
	0	7	0	7	0	7
	1	0	1	0	1	0
	2	0	2	0	2	0
	3	0	3	0	3	0
	4	0	4	0	4	0
	Total Passed	0	Total Passed	0	Total Passed	0
ID	Trials Passed	Freq.	Trials Passed	Freq.	Trials Passed	Freq.
	0	1	0	1	0	2
	1	0	1	1	1	0
	2	0	2	1	2	0
	3	0	3	2	3	0
	4	6	4	2	4	5
	Total Passed	24	Total Passed	17	Total Passed	20
ND	Trials Passed	Freq.	Trials Passed	Freq.	Trials Passed	Freq.
	0	0	0	0	0	0
	1	0	1	0	1	0
	2	0	2	1	2	0
	3	0	3	0	3	0
	4	7	4	6	4	7
	Total Passed	28	Total Passed	26	Total Passed	28

Table 5. Mean number of trials passed for Source Task.

Diagnostic group		Seeing	Feeling	Telling
AUT	Mean	0.0	0.0	0.0
	S.D.	0.0	0.0	0.0
	Range	0.0 - 0.0	0.0 - 0.0	0.0 - 0.0
ID	Mean	3.4	2.4	2.9
	S.D.	1.5	1.5	2.0
	Range	0.0 - 4.0	0.0 - 4.0	0 - 4.0
ND	Mean	4.0	3.7	4.0
	S.D	0.0	0.8	0.0
	Range	4.0 - 4.0	2.0 - 4.0	4.0 - 4.0

DISCUSSION

The results of the pilot were useful in establishing that the experiment was feasible and that it did appear to answer the research question. A number of points were worth noting, actually getting hold of a large enough sample of children with autism to be included in both the pilot and the actual experiment, who matched the criteria, was problematic. Therefore, the decision was made to include in the pilot those with a diagnosis of autistic tendencies, so as not to reduce the experimental group numbers. Additionally, the amount of time needed to get to know the children from all groups prior to testing was minimal. Moreover, if presented with enthusiasm the children actually seemed to like seeing it as a guessing game. Testing took on average fifty minutes. The instructions did not appear to hold any problems, neither did the experimental tasks. What is more, preliminary descriptive analysis of the findings were of great interest, tentatively appearing to support the initial hypotheses. The decision was made to continue with the experiment, taking into account the minor alterations identified in the pre-pilot.

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