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The theory of mind deficit in autism: some questions for teaching and diagnosis

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In his scholarly review of the psychological literature on autism, Rutter (1983) included an account of his own clinical experiences with adults with autism. He wrote:

Several [adults with autism] have commented that they are distressed by their inability to understand what other people are thinking or feeling. One young man who has attended the clinic for a quarter of a century since he was first referred as a non-responsive non-speaking child put it most vividly when he came back a few years ago asking for help with his difficulties. He complained that he 'couldn't mind-read'. He went on to explain that other people seemed to have a special sense by which they could read other people's thoughts and could anticipate their responses and feelings; he knew this because they managed to avoid upsetting people whereas he was always putting his foot in it, not realizing that he was doing or saying the wrong thing until after the other person became angry or upset. (p. 526).

This account, by coincidence, picks up on the key impairment upon which this volume focuses: the theory of mind deficit, as it has since come to be known (see Baron–Cohen, this volume, Chapter 4 for a summary of the experimental findings relevant to this). Rutter's use of clinical description is, we think, a useful starting-point for setting this deficit into its everyday context. In this chapter, we begin by describing a set of examples drawn from our own clinical experience, so as to elaborate on Rutter's single case. We do this is in order to delineate the wide-ranging expression of the theory of mind deficit. This also stands as a backdrop against which to ask clinically relevant questions: First, what are the implications of the research on autistic children's theory of mind for teaching? In particular, can mental-state concepts be taught? If so, how would this affect the broad range of deficits listed in the clinical examples below? Secondly, could this research have any application for the diagnosis of autism, both in infancy and later?

THE THEORY OF MIND DEFICIT IN AUTISM: EXAMPLES FROM CLINICAL EXPERIENCE

In the following examples, our clinical anecdotes are presented under various categories of 'theory of mind' error. These have been taken from cases referred to the second author at the Maudsley Hospital.

1. *Insensitivity to other people's* **feelings**

Frederick is a twelve-year-old boy with autism. His parents were desperately anxious that he should be assimilated into his local secondary school, and were horrified to hear that in the first week he had approached the head teacher in Assembly and commented on how many spots he had on his face.

2. *Inability to take into account what other people* **know**

Jeffrey, an extremely able young man with autism who holds a responsible position in a computing company, is unable to appreciate that if he has witnessed an event, this knowledge may not be shared by others. He seems unable to comprehend that his experience is different to theirs, often referring to events without providing the essential background information necessary for his colleagues to understand what he is talking about.

3. *Inability to read* **intentions**

Samantha, a ten-year-old girl with autism attending a mainstream school, was deliberately teased by the children there, and frequently they would tell her to perform some unacceptable act, such as taking her clothes off in the playground. She was quite bewildered by the laughter that ensued (and the scolding by the teacher), believing that her compliance would result in them becoming 'her friend'.

4. *Inability to read the listener's level of* **interest** *in one's speech*

Robert, a twelve-year-old boy, also attending mainstream school, constantly irritated peers and teachers alike by his 'boring' monologues on the cubic capacity of Renault cars, structural details of the Severn Bridge, or albinoism. He would discuss just these three topics at length with anyone, and was quite unable to recognize that his enthusiasm for these arcane topics was in no way shared.

5. *Inability to anticipate what others might* **think** *of one's actions*

Joseph, although having done very well in many areas of his development, obtaining a university degree and various diplomas in computing, continued to have problems understanding what others might think of his actions. In particular, he had no sense of personal space, and would also tend to ask very intimate questions. Difficulties arose shortly after he started a job with a computer firm. He still showed no sense of personal space, and would hover over the desks of female employees or lean up against them in lifts or queues, etc. After some weeks of this the secretarial staff demanded his dismissal on the grounds of 'sexual harassment'.

6. *Inability to understand* **misunderstandings**

Michael, a young man with autism, was dismissed from his job after an incident in which he had attacked the cloakroom attendant. He showed absolutely no remorse for this, having hit her with his umbrella 'because she gave me the wrong ticket'. Being in the habit of doing everything meticulously himself, he simply could not understand that others might make mistakes. Long afterwards he still expressed bewilderment that he had lost his job whereas, by rights, he was convinced the cloakroom attendant should have lost hers.

7. *Inability to deceive or understand* **deception**

John, a twenty-five-year-old man with autism, had a job working in a jeweller's. Because his boss knew that he was absolutely honest and that he could be safely trusted with large quantities of money or valuables, he had access to the keys of the safe. However, his failure to understand deception left him open to exploitation by others, and a new night-watchman took advantage of the situation. Being asked casually for the keys one night John readily handed these over, and when the night-watchman, the keys, and the contents of the safe had disappeared, he was charged with being an accessory to the robbery. Although these charges were dropped, he could clearly no longer be employed in such a position of trust again.

8. *Inability to understand the* **motives** *behind people's actions*

David, a twenty-year-old man with autism and of normal intelligence, but with considerable social difficulties, was offered employment by his uncle. Taking into account David's particular pattern of social behaviour the uncle had, sensibly, found a niche for David in a quiet corner of the accounts office. Rather than being grateful for his uncle's efforts, David was outraged to learn that he had not instantly been made a managing director of the company. He walked out of the job after only a few days, and thereafter harboured intense resentment against the one person who had tried so hard to help him.

These instances of different theory of mind errors by no means exhaust the kinds of problems caused by a dysfunction in the development of a theory of mind, but they are sufficient to convey how people with autism often just 'miss the point' of another person's action or speech. What are the clinical implications of this deficit? In the next section, we consider this question with regard to the teaching of social understanding.

TEACHING SOCIAL UNDERSTANDING

We begin this section by reviewing existing methods for teaching social and communication skills in autism, and consider what they achieve. We then outline a new study that is under way, which adopts an approach to social-skills teaching aimed at facilitating the acquisition of mental-state concepts.

Social and communication skills teaching

A variety of approaches to social and communication skills teaching have been applied to autism. Most of these go under the heading of 'training'. We prefer the term 'teaching', as it avoids the implication of simply building in 'circus tricks'. In addition, teaching carries the implication of educating, that is, changing the child's understanding and way of thinking, and not just changing behaviour. In reviewing existing teaching methods, therefore, we also consider how far each of these does indeed change understanding, and not just behaviour.

Existing teaching methods include traditional behavioural techniques, advising caregivers, problem-solving, and role-playing techniques, group teaching, and the involvement of normal peers and siblings (see Schopler and Mesibov 1986; Groden and Cautela 1988; and Gaylord-Ross 1989). These approaches are summarized here:

i. Behavioural approaches

These employ techniques such as prompting, modelling, or shaping, together with differential reinforcement, to improve social and communication skills. They may concentrate on the teaching and development of socially appropriate behaviours, such as initiating or maintaining conversations, or increasing eye-contact, gesture, and facial expressiveness (Brady *et al.* 1987; Matson *et al.* 1988; Fantusso *et al.* 1989). Other programmes have focused on the removal of socially unacceptable behaviours by teaching basic rules (for example, not taking off clothing in public, not talking to strangers, not using inappropriate speech, etc). Teaching relaxation and self-control techniques, such as anger-management, has also been used to reduce difficulties resulting from confusion or anxiety in social situations (Favell 1983; Howlin and Rutter 1987).

ii. Advising caregivers

An alternative way of reducing the effects of the social deficit has been to educate caregivers about the specific ways in which autism affects social behaviour and development, and to advise them on methods of minimizing the problems that inevitably arise. The formulation of simple but explicit contracts with the person with autism, together with detailed timetables or work schedules, is used to ensure that basic rules are implemented and complied with and that tasks are completed within a set time or to a specified standard. Support of this kind seems particularly valuable when the goal is to maintain a person with autism in their school or job, when their social behaviour might otherwise have given rise to dismissal. It also provides important support for other members of the family (Howlin 1989).

iii. *Role-play and problem-solving techniques*

Role-play and drama techniques are sometimes used to teach new social skills (Dewey *et al.* 1988) or as a means of modelling and rehearsing strategies for dealing with difficulties (for example, teaching individuals with autism how to initiate and maintain conversations, or how to cope with teasing or anxiety, etc.). Video replay has also been used to provide feedback of, and attempt to reduce, abnormal behaviours such as inappropriate eye-gaze, facial grimacing, etc., which may cause other family members embarrassment, and affect social acceptance (Howlin and Rutter 1987). Because generalization to non-rehearsed situations is often limited, the teaching of more general problem-solving strategies is also used (Fagan *et al.* 1985; Plienis *et al.* 1987; Park and Gaylord-Ross 1989).

iv. *Group treatments*

The majority of studies of social-skills training of children with autism have been single-case investigations. Others, although involving larger groups, have provided only minimal data on the efficacy of treatment. Recently Williams (1989) used the social-skills training package developed by Spence (1980) with a group of ten children with autism. Three types of strategies were used (recreational games, role-play exercises, and modelling), with the emphasis being, on the development of effective social tactics rather than the learning of specific rules. This kind of programme represents an alternative to more rigid behavioural techniques.

v. *The involvement of normal peers*

A number of studies have explored the use of normal peers as 'social therapists' for children with autism (Strain *et al.* 1979; Brady *et al.* 1987). Most have focused on specific behaviours, such as the frequency of initiations, rather than on wider aspects of social interaction. Such approaches struggle with the difficulty of maintaining the enthusiasm of the normal children (Lord 1984), and with the difficulty of generalizing any changes to untrained peers (Breen *et al.* 1985). Schuler (1989) suggests that greater attention to the types of play activity involved may overcome some of these problems, by using more naturalistic interactions, and Lord's work confirms this.

What do such teaching techniques achieve?

Small sample-sizes and inadequate outcome measures have made it difficult to reach firm conclusions about the relative merits of these different procedures. The most common assessments used are *frequency* measures, focusing on decreases in perseverative or other inappropriate behaviours (Taras *et al.* 1988), increases in numbers of social interactions (Brady *et al.* 1987), or counts of specific behaviours such as smiles, eye-contacts, or utterances

(Fantusso *et al.* 1989; Matson *et al.* 1988). What has not been assessed is the pragmatic use of language and gesture (Howlin 1986).

Although there are a few programmes offering wider-ranging suggestions for developing social awareness and interactional skills (Mesibov 1984; Frankel *et al* 1987), these tend to lack objective outcome assessments. Williams' (1989) group study, mentioned earlier, is an exception to this, but relies on 'non-blind' teacher-evaluations that may affect the reliability of results. The potential of group-training studies remains to be fully explored, but doubts have been raised, for example, about whether a group exclusively comprising individuals with autism can be effective in increasing social skills when the group as a whole is so handicapped. The involvement of normal peers in structured but naturalistic settings may offer greater promise (Lord 1984; Schuler 1989).

It is clear that in order to evaluate the effectiveness of current treatment procedures, more socially valid, objective measures of outcome are needed. Nevertheless, despite these provisos, many studies do indicate that it is possible to increase specific behaviours, such as eye-contact or frequency of social interactions, using behavioural procedures. These are not insignificant achievements, as they help individuals to *appear* more 'normal', and this may affect how other people react to them. However, no studies have investigated if, when these specific behaviours 'improve', there is also an associated improvement in social *understanding*.

The outcome from verbal communication programmes suggests a similar picture to that emerging from studies of social interaction (Howlin 1989). That is, there has been moderate success in reducing inappropriate speech, increasing spontaneous utterances, building up vocabulary, and improving syntax, but no demonstrable improvements in the individual's understanding of what lies *behind* the other person's speech: the intended *meaning*. Given that problems in social understanding seem so central to autism, it is surprising that this has rarely been a major focus of either intervention or assessment in social and communication-skills training for this population.

Since cognition guides behaviour, it is of interest to ask whether teaching key aspects of social cognition is possible, and if so, whether such teaching affects social behaviour. In the next section, we describe an ongoing study which attempts to teach mental-state concepts to children with autism (Hadwin, Baron–Cohen, Howlin, and Hill, 1994). Whilst results are not yet available, we outline the framework we are using, in order to open discussion into these educational questions.

Can a theory of mind be taught?

Normal children do not seem to require explicit teaching in order to acquire a theory of mind. Indeed, they seem to develop this understanding irrespective of the particular form of parenting they receive (Avis and Harris 1991).

Whiten's (this volume, Chapter 17) thought-experiment into whether 'wild' children would develop a theory of mind pursues the same idea. However, it may be that a theory of mind can be explicitly taught to children who have failed to acquire it naturally. Such teaching might provide an alternative route into mentalistic understanding.

Consider the analogy with blind children learning to read: Braille gives an alternative way into the problem of learning to read written words. We are interested in whether there might be an alternative way into the problem of learning to 'read' minds. Clearly, this analogy is imperfect in at least one key respect: blind children have a sensory impairment, and also show some abnormalities in their language development, but there is no central cognitive deficit in their 'word recognition system'. Braille circumvents the sensory deficit, and since the necessary cognitive mechanisms for reading are not dependent on vision *per se*, reading can be achieved. In contrast, children with autism are postulated to have no sensory impairment, but to have a central cognitive deficit in their theory of mind. The task, then, in trying to teach them to employ a theory of mind, may be considerably harder than teaching a blind child to read, since changing understanding is involved.

The central questions our study is attempting to address are:

1. Can mental-state concepts be taught and, if so, which techniques facilitate this, how much teaching is necessary, and how long will such learning persist?

2. Are some mental-state concepts (for example, pretence, or desire) easier for children with autism to learn than others (for example, knowledge, and belief)? If so, are mental-state concepts only acquired in a strict sequence? That is, does acquisition of one concept (for example, pretence) *always* precede acquisition of another (for example, belief)? If so, is this because one is necessary for the other?

3. If mental-state concepts are acquired during understanding of particular examples of behaviour, do these generalize to allow the child to understand novel examples of behaviour? If so, are mental-state concepts that are acquired through explicit teaching used in the same way as those acquired more naturally?

4. Does acquisition of mental-state concepts lead to change in the child's own social and communicative behaviour, and, if so, which aspects of behaviour change?

5. Which factors might account for some children with autism acquiring mental-state concepts, and some not?

6. Finally, does teaching mental-state concepts have any incidental effects on the acquisition of concepts or reasoning?

One approach: teaching underlying principles governing mental states

Our study attempts to analyse mental-state understanding into simple *principles*, and then considers if these principles can be taught through intensive training with many examples, using a variety of media. This approach makes the assumption that mental-state understanding can indeed be reduced to simple principles. For a normal child, these principles do not appear to be explicitly taught, and they may not even be explicitly represented; but the good performance on tests of mental state comprehension provides evidence that they understand such principles (Wellman 1990). For children with autism, since they do not seem to acquire them naturally, such principles may need to be made explicit.

Examples of such principles for some fundamental mental states (know, desire, and pretend) are given here:

1. *Perception causes knowledge.* **A person will know x only if s/he saw or heard about x.** (Example: Snow White doesn't know the apple is poisoned because she didn't see the woman the poison into it.)

2. *Desires are satisfied by actions or objects.* **If a person wants x, s/he will look for or obtain x. Conversely, if a person doesn't want x, s/he will refuse or avoid x.** (Example: Hansel and Gretel want their father, so they look for him. They don't want the witch to catch them, so they run away when she comes.)

3. *Pretence involves object-substitution or outcome-suspension.* **When a person pretends x, s/he does x without the usual objects or consequences, just for fun.** (Example: Alan holds a banana to his ear. He is pretending to talk on the telephone.)

These are just some of the principles that govern different mental states. Others can be easily articulated by examining our own 'common-sense' folk psychology. Wellman (1990) gives a good survey of these. Such principles can be developed into more complex forms (for example, when you deceive someone *you make them think something false*; or, when you want something, you don't *always* try to obtain it *directly*.) We assume that a first attempt at teaching a theory of mind to children with autism should begin by teaching the principles in their *simplest* form, in as concrete a manner as possible, using a large number of examples, with the aim that each principle is learnt and generalizes to new instances. The examples sketched above give an idea of the form such simple principles might take.

In our study, we focus on teaching a range of mental states in this way, including belief, desire, knowledge, pretence, deception, and emotion. The principles governing each mental state are taught using a range of techniques, including doll-play, drama, language, pictures, and even computer-graphics,

following Swettenham (1992), in order to maximize the possibility of one of these media being motivating for any given child. Only children with autism whose verbal mental age is above three- and-a-half years of age are being given this intensive tuition, as most of the techniques are derived from the developmental literature from normal three-year to four-year-olds. We are therefore not attempting to answer the question of whether mental-state concepts can be taught to children with a verbal mental age lower than this.

Aside from the questions listed earlier, we are also particularly interested to see if acquisition of a principle acts as a cornerstone in the construction of a *theory* of mind—that is, do mental-state concepts, if they are acquired, take on theory-like properties for the child, as Wellman (1990) has argued occurs with normal children? Some initial studies (Armstrong and Whiten 1991; Starr 1992; Stromm 1991; Swettenham 1992) suggest that, at least when the mental-state concept of belief is taught to children with autism, some progress is seen, although these studies are insufficient to answer many of the interesting questions outlined earlier. Similar studies with normal children suggest too that such teaching can lead to acquisition of the concepts of belief and knowledge at earlier ages than is usually seen (Taylor 1988; Swettenham 1992). Our own study involves the teaching of a range of different mental-state concepts. Those interested in further details of this study, and its results, should contact the authors directly.

THE THEORY OF MIND DEFICIT: IMPLICATIONS FOR DIAGNOSIS

The second area of clinical relevance we consider is to what extent the experimental work in autism and theory of mind may aid diagnosis. In addition, we consider how it may inform theories about precursors to theory of mind development.

Current diagnostic techniques are based exclusively on the presence or absence of *behavioural* criteria. DSM-IIIR (1987) criteria, for example, specify precisely the numbers of items that must be present before the diagnosis of autism can be made. Thus, a total of at least 8 out of 16 symptoms must be identified, 2 or more of which must relate to social impairments, 1 or more to communication deficits, and 1 or more to the presence of obsessional or ritualistic behaviours. While this reliance on behavioural criteria has produced clearer operational rules for diagnosis (Rutter and Schopler 1987), it nevertheless raises a number of problems. For example, although it is relatively easy to identify delays or 'absences', it is much more difficult to judge when a behaviour is *qualitatively* abnormal. And since behaviours can resemble each other while having entirely

different cognitive bases, it also means that diagnostic systems that are exclusively behavioural in nature risk confusing apparently similar conditions.

It may be that these and other related problems could in part be overcome by using cognitive tests in conjunction with behavioural tests in diagnosis. Consider, for example, a child who is socially unresponsive. If we could determine the reason for the social unresponsiveness (is it due to anxiety, or prosopagnosia, or an impaired theory of mind, etc.?), this might add to diagnostic precision. Performance on a series of false-belief and other neuropsychological tests could be useful in this way (Prior and Hammond 1990; Ozonoff *et al.* 1991). It should be emphasized, however, that this is at present only a suggestion; at the time of writing no studies have attempted to include such specific cognitive (or neuropsychological) tests in psychiatric diagnosis. Nor have there been any studies on the sensitivity and specificity of theory of mind tests with different clinical populations, and these are much needed.

Of course, false-belief tests can only be used meaningfully with children whose mental age is above four years of age (Wimmer and Perner 1983; Baron–Cohen 1990). This does not rule out their diagnostic potential, but it reminds us that their role will be confined to relatively 'late' diagnosis. Since one aim of diagnosis should also be to improve early detection of disorders, it is of interest to consider if *precursors* of theory of mind deficits in infancy can also be used in early detection. In the next section we describe a recent attempt at this.

The use of 'theory of mind precursors' in detecting autism in infancy

Recent work has suggested that two possible precursors to the theory of mind deficit in autism are pretend-play impairments, and joint-attention deficits (see Leslie 1987; Baron–Cohen 1991; and see Chapters 4, 5, 9, and 18, this volume). In the case of pretend-play, this is identified as distinct from *functional* play, which is not specifically impaired in autism (Ungerer and Sigman 1981; Baron–Cohen 1987). In the case of joint-attention behaviours, these include gaze-monitoring, 'showing' gestures, and pointing (Sigman *et al.* 1986; Mundy *et al.*, this volume, Chapter 9.) One specific type of pointing, *protodeclarative* pointing, seems particularly impaired in autism, while *protoimperative* pointing is not (Baron–Cohen 1989).

Two important questions are: (a) Are pretend-play and protodeclarative pointing really precursors to a theory of mind? How can such claims about precursor status be tested? and (b) If such precursors do predict development of a theory of mind, do they also predict cases of autism? Baron–Cohen *et al.* (1992) investigated the second of these questions by employing a new instrument, the *Checklist for Autism in Toddlers (CHAT)*, shown in Fig. 21.1. This was administered by General Practitioners or Health Visitors

THE CHAT (Medical Research Council Project)

To be used by GPs or Health Visitors during the 18-month developmental check-up.

Child's name: .... Date of birth: .... Age: ....

Child's address: ....

SECTION A: ASK PARENT:

1. Does your child enjoy being swung, bounced on your knee, etc.?	YES	NO
2. Does your child take an interest in other children?	YES	NO
3. Does your child like climbing on things, such as up stairs?	YES	NO
4. Does your child enjoy playing peek-a-boo/hide and seek?	YES	NO
5. Does your child ever PRETEND, for example, to make a cup of tea using a toy cup and teapot, or pretend other things?	YES	NO
6. Does your child ever use his/her index finger to point, to ASK for something?	YES	NO
7. Does your child ever use his/her index finger to point, to indicate INTEREST in something?	YES	NO
8. Can your child play properly with small toys (e.g.: cars or bricks) without just mouthing, fiddling, or dropping them?	YES	NO
9. Does your child ever bring objects to you (parent), to SHOW you something?	YES	NO

SECTION B: GP or HV OBSERVATION:

i. During the appointment, has the child made eye-contact with you?	YES	NO
ii. Get child's attention, then point across the room at an interesting object and say 'Oh look! There's a (name a toy)!' Watch child's face. Does the child look across to see what you are pointing at?	YES[1]	NO
iii. Get the child's attention, then give child a miniature toy cup and teapot and say 'Can you make a cup of tea?' Does the child pretend to pour out tea, drink it, etc.?	YES[2]	NO
iv. Say to the child 'Where's the light?' or 'Show me the light.' Does the child POINT with his/her index finger at the light?	YES[3]	NO
v. Can the child build a tower of bricks? (If so, how many?) (Number of bricks: ....)	YES	NO

[1](To record YES on this item, ensure the child has not simply looked at your hand, but has actually looked at the object you are pointing at.)

[2](If you can elicit an example of pretending in some other game, score a YES on this item.)

[3](Repeat this with 'Where's the teddy?' or some other unreachable object, if child does not understand the word 'light'. To record YES on this item, the child must have looked up at your face around the time of pointing.)

Figure 21.1. The Checklist for Autism in Toddlers (CHAT). Reproduced from Baron-Cohen *et al.* (1992) with permission.

during the routine 18-month-old developmental check-up (taking about 20 minutes to complete).

As can be seen, this schedule checks for the presence of pretend-play and joint-attention behaviours, among other things. This study found that, while some of a group of randomly selected toddlers at 18 months ($n = 50$, age 17–21 months) still lacked protodeclarative pointing, and some lacked pretend-play, none lacked both. In this study, a group of siblings of already diagnosed children with autism ($n = 41$, age 18–21 months) were also screened with the CHAT, on the assumption that 2–3 per cent of them would, for genetic reasons, themselves develop autism (Folstein and Rutter 1988). The key point of interest is that four children in this *high-risk* group lacked both pretend-play and joint-attention at eighteen months, and these went on to receive a diagnosis of autism at the age of thirty months. Overall, of the 91 toddlers screened, the other 87 were free of any psychiatric problems at thirty months, and none of these 87 cases had failed on both pretend-play and joint-attention at eighteen months.

These findings offer support for the claims that pretence and joint-attention may be useful in the early detection of autism. A larger, epidemiological study is now under way (screening 16 000 eighteen-month-olds in the south-east of England) to evaluate the diagnostic and predictive power of these behaviours (Baron–Cohen, Cox, Baird, Swettenham, Nightingale, Morgan, Drew, and Charman, 1994.) Of critical importance is the fact that this larger study is also *longitudinal*—those infants at eighteen months who fail the CHAT will be followed up at the age of four to five, to determine if these behaviours do stand as precursors in the development of a theory of mind. Such a prospective, longitudinal design is essential in testing precursor relationships (Bradley and Bryant 1983).

CONCLUSIONS

The theory of mind hypothesis has been used as an explanatory tool for understanding fundamental cognitive deficits in autism. The present chapter explores some issues of clinical relevance from this work. In particular, it considers questions about whether mental-state concepts can be taught, the effects of such teaching, the role of such cognitive tests in diagnosis, and the investigation of early precursors of theory of mind deficit. Such clinical research is really still in its infancy; but we hope that this chapter may stimulate further research into these questions.

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REFERENCES

Armstrong, K., and Whiten, A. (1991). Training false-belief understanding in adults with autism. Unpublished MS, Department of Psychology, University of St Andrews.

Avis, J. and Harris, P. (1991). Belief–desire reasoning among Baka children: evidence for a universal conception of mind. *Child Development*, **62**, 46–7.

Baron–Cohen, S. (1987). Autism and symbolic play. *British Journal of Developmental Psychology*, **5**, 139–48.

Baron–Cohen, S. (1989). Perceptual role-taking and protodeclarative pointing in autism. *British Journal of Developmental Psychology*, **7**, 113–27.

Baron–Cohen, S. (1990). Autism: a specific cognitive disorder of 'mind-blindness'. *International Review of Psychiatry*, **2**, 79–88.

Baron–Cohen, S. (1991). Precursors to a theory of mind: understanding, attention in others. In *Natural theories of mind* (ed. A. Whiten). Basil Blackwell, Oxford.

Baron–Cohen, S., Allen, J., Gillberg, C. (1992). Can autism be detected at 18 months? The needle, the haystack, and the CHAT. *British Journal of Psychiatry*, **161**, 839–43.

Baron–Cohen, S., Cox, A., Baird, G., Swettenham, J., Nightingale, N., Morgan, K., Drew, A., and Charman, T. (1994). Screening for autism at 18 months of age. Unpublished MS, Institute of Psychiatry, London.

Bradley, L., and Bryant, P. (1983). Categorizing sounds and learning to read: a causal connection. *Nature*, **301**, 419–521.

Brady, M. P., Shores, R. E., McEvoy, M. A., Ellis, D., and Fox, J. J. (1987). Increasing social interactions of severely handicapped autistic children. *Journal of Autism and Developmental Disorders*, **17**, 375–90.

Breen, C., Haring, T., Pitts-Conway, V., and Gaylord-Ross, R. (1985). The training and generalisation of social interaction during breaktime at two job sites in the natural environment. *Journal of the Association of Persons with Severe Handicaps*, **10**, 41–50.

Dewey, D., Lord, C., and Magill, J. (1988). Qualitative assessment of the effect of play materials in dyadic peer interactions of children with autism. *Canadian Journal of Psychology*, **42**, 242–260.

DSM-IIIR (1987). *Diagnostic and Statistical Manual of Mental Disorders*, revised 3rd edn. American Psychiatric Association, Washington, DC.

Fagan, S., Gray, K., Factor, D. C. (1985). Foxx's 'Stack the Deck': teaching social skills to mentally handicapped adolescents. *Journal of Child Care*, **3**, 29–34.

Fantusso, J. W., Helgeson, D. C., Smith, C., and Barr, D. (1989). Eye-contact skill training for adolescents with developmental disabilities and severe behaviour problems. *Education and Training of the Mentally Retarded*, **24**, 56–62.

Favell, J. (1983). The management of aggressive behavior. In *Autism in adolescents and adults* (ed. Schopler E. and G. Mesibov). Plenum, New York.

Folstein, S. and Rutter, M. (1988). Autism: familial aggregation and genetic implications. *Journal of Autism and Developmental Disorders*, **18**, 3–30.

Frankel, R.M., Leary, M., and Kilman, B. (1987). Building social skills through pragmatic analysis: assessment and treatment implications for children with autism. In *Handbook of Autism and Developmental Disorders* (ed. D.J. Cohen, and A.M. Donnellan). Wiley, New York.

Gaylord-Ross, R. (ed.) (1989). *Integration strategies for students with handicaps.* P.H. Brookes, Baltimore.

Groden, J., and Cautela, J. (1988). Procedures to increase social interactions among adolescents with autism: a multiple-baseline analysis. *Journal of Behavior Therapy and Experimental Psychiatry*, **19**, 87–93.

Hadwin, J., Baron–Cohen, S., Howlin, P., and Hill, K. (1994). Concepts of emotion, belief, and pretence. To what extent can they be taught to children with autism? Unpublished MS, Institute of Psychiatry, London.

Howlin, P. (1986). An overview of social behavior in autism. In *Social behaviour in autism* (ed. E. Schopler and G. Mesibov). Plenum, New York.

Howlin, P. (1989). Changing approaches to communication training with autistic children. *British Journal of Disorders of Communication*, **24**, 151–68.

Howlin, P., and Rutter, M. (1987). *Treatment of autistic children*. Wiley, Chichester.

Leslie, A. (1987). Pretence and representation: the origins of 'theory of mind'. *Psychological Review*, **94**, 412–26.

Lord, C. (1984). Development of peer relations in children with autism. In *Applied Developmental Psychology* (ed. F. and D. Morrison Keating). Academic Press, New York.

Matson, J., Manikam, R., Coe, D., Raymond, K., and Taras, M. (1988). Training social skills to severely mentally retarded multiply handicapped adolescents. *Research in Developmental Disabilities*, **9**, 195–208.

Mesibov, G. (1984). Social skills training with verbal autistic adolescents and adults: a program model. *Journal of Autism and Developmental Disorders*, **14**, 395–404.

Ozonoff, S., Pennington, B., and Rogers, S. (1991). Executive function deficits in high-functioning autistic individuals: relationship to theory of mind. *Journal of Child Psychology and Psychiatry*, **32**, 1081–1106.

Park, H.S., and Gaylord-Ross, R. (1989). A problem-solving approach to social skills training in employment settings with mentally retarded youth. *Journal of Applied Behavior Analysis*, **22**, 373–80.

Plienis, A., Hansen, D., Ford, F., Smith, S., Stark, L., and Kelly, J. (1987). Behavioral small group training to improve the social skills of emotionally disordered adolescents. *Behavior Therapy*, **18**, 17–32.

Prior, M., and Hammond, W. (1990). Neuropsychological testing of autistic children through exploration with frontal lobe tests. *Journal of Autism and Developmental Disorders*, **20**, 581–90.

Rutter, M. (1983). Cognitive deficits in the pathogenesis of autism. *Journal of Child Psychology and Psychiatry*, **24**, 513–31.

Rutter, M., and Schopler, E. (1987, eds). *Autism: a reappraisal of concepts and treatment*. Plenum, New York.

Schopler, E., and Mesibov, G. (eds) (1986). *Social behaviour in autism*. Plenum, New York.

Schuler, A. (1989). The socialization of autistic children. Paper presented at the International Conference on Educational Issues in Autism, Mons, Belgium.

Sigman, M., Mundy, P., Ungerer, J., and Sherman, T. (1986). Social interactions

of autistic, mentally retarded, and normal children and their caregivers. *Journal of Child Psychology and Psychiatry*, **27**, 647–56.

Spence, S. (1980). *Social skills training with children and Adolescents*. NFER-Nelson, Windsor.

Strain, P., Kerr, M., and Rauland, E. (1979). Effects of peer-mediated social initiations and prompting/reinforcement procedures on the social behavior of autistic children. *Journal of Autism and Developmental Disorders*, **9**, 41–54.

Stromm, E. (1991). *Training false-belief understanding with autistic children*. Unpublished MA thesis, Institute of Education, London.

Starr, E. (1992). *Theory of mind and autism: teaching the appearance–reality distinction*. Unpublished Ph.D. Thesis, University of Alberta, Canada.

Swettenham, J. (1992). *The autistic child's theory of mind: a computer-based investigation*. Unpublished Ph.D. Thesis, University of York.

Taras, M., Matson, J., and Leary, C. (1988). Training social interpersonal skills in two autistic children. *Journal of Behavior Therapy and Experimental Psychiatry*, **19**, 275–80.

Taylor, M. (1988). The development of children's ability to distinguish what they know from what they see. *Child Development*, **59**, 703–18.

Ungerer, J., and Sigman, M. (1981). Symbolic play and language comprehension in autistic children. *Journal of the American Academy of Child Psychiatry*, **20**, 318–37.

Wellman, H. (1990). *The child's theory of mind*. Bradford Books/MIT Press, Cambridge, Mass.

Williams, C. (1989). A social skills group for autistic children. *Journal of Autism and Developmental Disorders*, **19**, 143–55.

Wimmer, H., and Pemer, J. (1983). Beliefs about beliefs: representation and constraining function of wrong, beliefs in young children's understanding of deception. *Cognition*, **13**, 103–28.