The Development of a Theory of Mind in Autism: Deviance and Delay?

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AUTISM AND THE THEORY OF MIND HYPOTHESIS

In 1985, my colleagues and I asked the question: Does the autistic child have a "theory of mind"?[16] We borrowed the phrase "theory of mind" from Premack and Woodruff,[55] two primatologists, who defined it as follows:

> In saying that an individual has a theory of mind, we mean that the individual imputes mental states to himself and others . . . A system of inferences of this kind is properly viewed as a theory, first because such states are not directly observable, and second, because the system can be used to make predictions, specifically about the behavior of other organisms (p 515).

We asked this question with an answer in mind because we hypothesized that in autism there might be a specific impairment in the development of the child's theory of mind. This hypothesis seemed plausible because of the claim that a theory of mind is essential both to understand and predict much of human behavior[23,71] and for competence in communication.[2,35,60,64] Because social and communicative abnormalities comprise two key symptoms in autism,[24,41] the idea that there might be an impairment in the development of the child's theory of mind seemed a parsimonious candidate hypothesis.[3,5,30,44]

We tested this hypothesis using an adaptation of Wimmer and Perner's test of children's understanding of *false belief*.[72] This test is shown schematically in Figure 1. The critical event in the story is that Sally is not present when Anne moves the object from A to B. When asked where on her return Sally will look for the object, a normal 4 year old correctly answers location A because this is where she origi-

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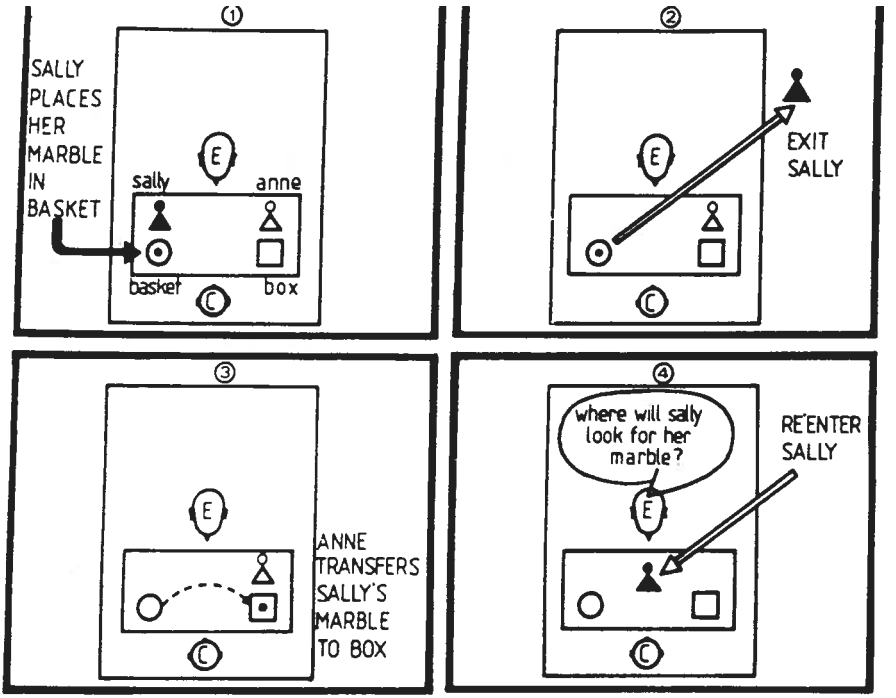

Figure 1. Scenario of a simple test of a theory of mind. (*From* Baron-Cohen S, Leslie AM, Frith U: Does the autistic child have a "theory of mind"? Cognition 21:37–46, 1985; with permission.)

nally put it and where she therefore still *believes* it is. We gave this test to subjects with autism, as well as to a group with mental handicap (all with the diagnosis of Down's syndrome) and a group of normal children. We found that 86% of the subjects with Down's syndrome and 85% of the normal children passed this test, but only 20% of the subjects with autism did so, and this was so despite this group having a higher mental and chronological age than the two comparison groups.[16] Instead, 80% of the subjects with autism indicated that Sally would look for the object at location B, where the object really was.

This result lent preliminary support to the hypothesis that in autism there is a failure to develop a theory of mind. Over the last 5 years, this pattern of results on false belief tests has been replicated and extended.[6,7,17,37,40,43,46,48,53,57,58,61,63,66]

THE THEORY OF MIND DEFICIT IN ITS WIDER CONTEXT: SOCIAL COGNITION AND SOCIAL BEHAVIOR

Recent research into social cognition (or the study of those cognitive processes involved in understanding the social world) in autism has

a large number of domains that are *intact*. These include person permanence,[62] visual perspective-taking,[8,38,46,67] mirror self-recognition,[3,21,27,28,49,65] and gender recognition.[1,70] Similarly, subjects with autism pass tests of face recognition, although they appear to use unusual strategies.[32,39,42,69] Finally, relationship perception, the animate-inanimate distinction, and simple reciprocity are also all unimpaired.[13]

Given this growing list of intact areas of social cognition in autism, the theory of mind deficit appears to be highly specific. It seems to correlate with, on the one hand, their abnormal social behavior[31] and, on the other, their abnormal pragmatic competence in language.[26,53] These correlations suggest that this cognitive deficit may indeed underlie these behavioral abnormalities.

IS THEIR UNDERSTANDING OF ALL MENTAL STATES IMPAIRED?

One outstanding question is whether the theory of mind deficit is restricted to understanding beliefs or extends to understanding other mental states (e.g., desire, intention, pretence, knowledge, thinking, imagination, attention, and perception). Understanding of some of these other mental states has been tested in autism, and the results are briefly reviewed next.

In tests of understanding knowledge, autism-specific deficits have been found,[46] although understanding knowledge seems to be slightly easier than understanding belief. Pretence also seems particularly impoverished in autism,[4,68,73] although this has been measured only in the production of play, and production may differ from comprehension. Understanding of thinking also seems to be impaired,[7] as does understanding of attention, insofar as this can be inferred from specific preverbal gestures such as "protodeclarative pointing."[8–10]

Understanding of desire seems to be within expected mental age levels[13,67] in that no autism-specific deficit has been found. Similarly, comprehension of perception has been found to be within expected mental age levels and is therefore not specifically impaired.[8,38,46,67] Understanding of imagination and intention have so far not been tested.

To summarize, in autism there are severe deficits in understanding belief, knowledge, thinking, pretence, and attention, whereas comprehension of desire and perception appears to be relatively intact. However, none of the studies have tested comprehension of a large range of mental states in the same subjects, so it is difficult to draw firm conclusions about the relative comprehension difficulty of one mental state over another for subjects with autism. Mental and chronologic age differences among samples prevent any simple comparison among studies.

Because in autism there appears to be *some development* of a

theory of mind, albeit after a severe delay, it seems important to establish whether understanding different mental states follows a clear developmental sequence in a single sample of subjects with autism. That is, do mental states fall into different levels of complexity for them, as they do with normal children? And if so, do they fit a developmental sequence similar to that seen in normal children, or is there deviance as well as delay?

There are good reasons for supposing deviant development as well as delay occurs in autism, in that children who fail false belief tests are not simply like young normal children. However, such statements are based only on clinical impression; systematic evidence is needed to document the nature of any development of a theory of mind in autism. The experiment reported later tests understanding of a range of mental states in the same group of subjects with autism, in order to begin to answer these questions.

THE DEVELOPMENT OF A THEORY OF MIND IN NORMAL CHILDREN

A study that investigated understanding of a range of mental states within a single group of normal subjects was reported by Gopnik and Slaughter,[34] whose experimental paradigm we adapted for use with our clinical groups. Their study suggested a three-stage model of development:

Stage 1: Pretence, perception, and imagination
Stage 2: Desire and intention
Stage 3: Knowledge and belief

Stage 1 states are thought to be easiest, Gopnik and Slaughter argue, because they are nonrepresentational. Stage 3 states are thought to be the most difficult because they are representational states with *truth conditions*. Stage 2 states are thought to be of intermediate difficulty because they are representational states with *conditions of satisfaction* rather than truth conditions. This distinction between Stage 2 and 3 states is nicely summarized by Gopnik and Slaughter:

> In spite of the similarities between beliefs and desires there are also important differences between these two states. Searle[60] has described these differences by saying that desires and intentions have a "world to mind" direction of fit while beliefs have a "mind to world" direction of fit. That is, in the case of belief we alter our minds to fit the way the world is, while in the case of desire and intention we alter the world to fit the way our mind is. [And in an earlier draft of this paper, they added, "A belief is satisfied if it is true, a desire is satisfied if it is fulfilled."]

As mentioned earlier, the autism studies reviewed above lead to the prediction that deviance (as well as delay) should characterize any development of a theory of mind in autism. Specifically, although au-

[illegible] might find perception easier to understand than desire, and desire easier than belief (thus mirroring normal development in sequence if not in timing), one might predict that in autism understanding of imagination and pretence would be more difficult than understanding of perception and desire.

In the experiment reported below, the number of mental states tested was limited to five (perception, desire, imagination, pretence, and belief), as this seemed to be the maximum number that the subjects could be tested on without losing concentration. Important mental states not tested include intention, attention, and knowledge. (Comprehension of intention in autism is currently being investigated by Wendy Phillips at the Institute of Psychiatry.) The experiment tested the prediction that subjects with autism would show the deviant and delayed pattern of development described above. A subsidiary prediction was that, on the basis of previous findings, significant differences between subjects with autism and other subjects would appear on tests of comprehension of imagination, pretence, and belief. Whether subjects without autism but with mental handicap would conform to the Gopnik and Slaughter three-stage model for normal development was an open question. Finally, the experiment allowed us to test whether the Gopnik and Slaughter three-stage model for normal development could be replicated with a new sample of normal children.

THE EXPERIMENT

Subjects

Each subject was tested in a quiet room in his or her school. There were 15 subjects with autism who met our inclusion criteria (see below), all of whom had been diagnosed according to established criteria[24] and were attending a special school for autism. In addition, there were 15 subjects with mental handicap but without autism who also met our inclusion criterion. These were tested in order to control for mental age (MA) and chronologic age (CA). Finally, there were 20 clinically normal children (10 three year olds, and 10 four year olds), in order to collect comparison data. The sex ratio in the normal group and in the group with mental handicap was approximately 1 : 1, whereas in the group with autism it was approximately 3 : 1 (m : f). Details of the subjects are summarized in Table 1.

The first inclusion criterion for the clinical subjects was a verbal MA of at least 3 years, matching the youngest age at which normal children have been reliably tested on these procedures.[34] The second inclusion criterion was that subjects could pass a control task, which is described later. Although a minimum verbal MA of 3 years old was required, in fact the mean MA of both clinical groups was over 5 years (see Table 1), and the group with autism had a mean nonverbal MA significantly higher than that of the mentally handicapped group ($t =$

Table 1. *Subject Variables: Means, Standard Deviations (SD), and Ranges of Chronologic Age (CA) and Mental Age (MA)*

DIAGNOSTIC GROUPS	N		CA	NONVERBAL MA*	VERBAL MA†
Autism	15	Mean	15.3	7.9	6.2
		SD	2.4	1.7	1.7
		Range	12.8–18.0	5.0–11.2	3.4–9.4
Mental handicap	15	Mean	15.44	5.3	5.0
		SD	1.9	0.8	1.6
		Range	11.9–18.3	4.0–7.6	3.1–6.8
Normal	20	Mean	4.1		
		SD	0.7		
		Range	3.2–5.2		

*Ravens Matrices
†BPVS

5.24, 28df, $p < 0.001$). The group with autism also had a higher verbal MA, and this approached statistical significance ($t = 1.97$, 28df, $p < 0.058$). This selection of MA controls ensured that any deficits emerging on experimental tasks by subjects with autism could not be due to low MA.

Nonverbal MA was higher than verbal MA for both clinical groups, markedly so in the case of the group with autism, reflecting typical discrepancies in the IQ profile.[22] Verbal MA was assessed using the British Picture Vocabulary Scale.[25] Nonverbal MA was assessed using Raven's Coloured Progressive Matrices.[56] Our normal control group had a mean CA of 4.1 years, ranging from 3.2 to 5.2, making them broadly comparable to the normal subjects used in Gopnik and Slaughter's sample. We assumed that for the normal group, MA would roughly correspond to CA.

Procedure

The procedure used was adapted from tests of mental state changes used by Gopnik and Slaughter.[34] These tests begin by establishing that a particular mental state is held by the subject, after which a manipulation is made to that mental state. The subject is then asked to recall his or her original mental state. In this sense, the tests probe awareness of the subject's own mental state rather than that of somebody else.

1. Control Task. All the subjects first received a control task to ensure that they understood the questions and could remember past events. As was mentioned earlier, this was an additional inclusion criterion for the rest of the experiment, and two subjects with autism and two subjects with mental handicap were excluded because they failed this control task. The final sample size, after these subjects had been excluded, was 15 in each of the two groups.

In the control task, subjects were presented with a change in an object and were asked to recall the previous state of the object. Thus, subjects were shown a black box and the lid was then removed, revealing a small green wooden brick inside. The experimenter then replaced the lid and asked what was inside the box and the subjects replied "a green brick." The experimenter then said "Let's take the green brick out and put this yellow one in." Again the lid was replaced and the subjects were then asked, "Now what's in the box?" All of them replied "a yellow brick." They were then asked the control question "When I first showed you the box, before we opened it, what was inside then? (Was there a yellow brick or a green brick?)" Notice that the Control task functions not only as a control for memory factors, but as a linguistic control for the wording of the test question. It mirrors the test question of the other tasks in every way except for the inclusion of a mental state term. (The prompt question is put in brackets throughout this procedure section to indicate that it was asked only if the subject did not respond spontaneously to the test question. Most subjects needed no prompting at all.)

Following this task, the five mental state tasks were administered. In each task, two confirmation questions were asked, one to confirm that the subject did indeed have the initial mental state (original state question) and another (after the state had been changed) to confirm that he or she now had the new mental state (changed state question). Finally, the subject received the test question, which asked the subject to report his or her initial state. In each case the test question had the same form as the question in the control task: "When I first asked you, before we did x, what did you (think, want, pretend, see, etc)?" The complete list of confirmation and test questions is shown in Table 2. In each case, if a subject failed to answer, he or she was presented with a forced choice. The order of presentation of the different tasks was randomized, as was the order of presentation of the forced-choice alternatives.

2. Belief Task. Subjects received a belief task similar to the one developed by Perner et al.[54] The subject was shown a milk carton (very familiar to British children) and was asked the confirmation question, "What do you think is inside this?" All the subjects said milk. The box was then opened and the subject was shown that it really contained a small green ball. They were then asked the second confirmation question, "Now what do you think is inside this?" All of them said a ball. The carton was then closed up again and the subject was asked the test question, "When I first asked you, before we opened the carton, what did you think was inside? (Did you think there was a ball inside, or did you think there was milk inside?)"

3. Pretend Task. Subjects were presented with an empty cup and were asked "Can you pretend there's orange juice in this cup?" Some prompting was needed to get the subjects with autism to carry this out. Indeed, for many of these subjects, this first instruction simply produced the reply, "There's no orange juice in the cup. It's empty." So

Table 2. *Test Questions*

TASK	ORIGINAL STATE	ORIGINAL STATE QUESTION	CHANGED STATE	CHANGED STATE QUESTION	TEST QUESTION
Control	Green brick in box	What's in the box?	Yellow brick in box	Now what is in the box?	When I first showed you the box, before we opened it, what was inside then? (Was there a yellow brick or a green brick?)
Belief	Thinks milk is in the carton	What do you think is inside this?	Thinks ball is in the carton	Now what do you think is inside this?	When I first asked you, before we opened the carton, what did you think was inside? (Did you think there was a bal or some milk inside?
Pretend	Pretends orange juice is in cup	What are you pretending is in the cup?	Pretends milk is in the cup	Now what are you pretending is in the cup?	When I first asked you, before we poured anything out, what did you pretend to drink? (Did you pretend to drink orange juice or milk?)
Desire	Wants to open box A	Which box do you want to open?	Wants to open box B	Now which box do you want to open?	When I first asked you before we opened any boxes, which bo: did you want to open? (Did you want to open this one or this one?)

Level 1 perception	Sees picture A	What picture do you see?	Sees picture B	Now what picture do you see?	When I first asked you before I turned the card over, what picture did you see? (Did you see a bike or a clock?)
Level 2 perception	Sees Mickey Mouse upright?	How do you see Mickey Mouse? Sitting up or upside down?	Sees Mickey Mouse upside down	Now how do you see Mickey Mouse? Sitting up or upside down?	When I first asked you before I turned the picture around, how did you see Mickey Mouse then? (Did you see him upside down or sitting up?)
Imagination	Thinking about a white teddy	What are you thinking of?	Thinking about a red balloon	Now what are you thinking of?	When I first asked you to make a picture in your head, what were you thinking of then? (Did you think of a white teddy or a red balloon?)

the experimenter then added, "Show me how you pretend to drink orange juice." Including the verb seemed to be an important prompt.*

The subject was then asked, "What are you pretending is in the cup?" When the subject had replied "orange juice," the experimenter then said, "Let's pour out all of the orange juice" and mimed emptying the cup and then said, "Now can you pretend there's milk in the cup?" (Again, prompting was needed for some subjects.) The subject was then asked, "Now what are you pretending is in the cup?" When the subject had replied "milk," the test question was asked, "When I first asked you, before we poured anything out, what did you pretend to drink? (Did you pretend to drink orange juice or milk?)"

4. Perception Tasks. The first perception task was modeled after Flavell et al's level 1 perspective-taking task[29]: A piece of cardboard standing upright was put in the middle of the table, with only one side visible to the subject. On one side of the card was a picture of a bike, and on the other side was a picture of a clock. The subject was first shown the picture of the bike and was asked what picture he or she could see. All subjects answered this correctly. The card was then turned around so that the subject could see the picture of the clock. He or she was then asked, "Now what picture can you see?" Again, all subjects reported they could now see the clock. Finally, the experimenter asked the test question: "When I first asked you, before I turned the card over, what picture did you see? (Did you see a bike or a clock?)"

The second perception task was modeled after Flavell et al's level 2 perspective-taking task.[29] The subject saw a picture of Mickey Mouse sitting up and was then asked "How do you see Mickey Mouse? Sitting up or upside down?" When the subject had replied "sitting up," the experimenter then turned the picture upside down so that Mickey Mouse appeared to be standing on his head. The subject was then asked "Now how do you see Mickey Mouse? Sitting up or upside down?" All subjects replied, "Mickey Mouse is upside down." They were then asked the test question: "When I first asked you, before I turned the picture around, how did you see Mickey Mouse then? (Did you see him upside down or sitting up?)"

5. Desire Task. In the desire task the subject formed a desire, and the desire was then satiated so that it changed. Subjects were shown two boxes, of equal desirability from the outside, and were asked which one they wanted to open. After they had looked inside their first choice, and played with the toy it contained (a yoyo or a spinning top), that box was closed again and they were asked to choose again. All

*Interestingly, with prompting and direct instructions of this kind, all of our subjects with autism were able to put the empty cup to their lips, and some even made pretend drinking noises. Their pretend actions were all very limited, however, in comparison to those of the control subjects, who often elaborated the gesture as part of a "story" (e.g., saying "I'm thirsty!" or "Nice cup of milk!"). Nevertheless, this degree of "instructed pretence" confirms results from Lewis and Boucher[47] and contrasts with the significant lack of pretence during spontaneous play by children with autism.[4] The full significance of this requires further research, but see refs. 11, 18, 36, and 44.

subjects chose the alternative box. The experimenter then immediately asked the test question: "When I first asked you, before we opened any boxes, which box did you want to open? (Did you want to open this one or this one?)"

6. Imagination Task. The experimenter said, "Now I want you to close your eyes and think about a big white teddy. Make a picture in your head of a big white teddy bear. Can you see the white teddy?" Interestingly, most subjects confirmed that they could. If they couldn't, the experimenter asked "What can you see, when you close your eyes?" and then worked with the subject's spontaneous image. Four subjects with autism could not make a mental image at all and were therefore scored as failing this condition. For those who succeeded in making a mental image, the experimenter then asked "What are you think of?"

When the subject had informed the experimenter of his or her current mental image, the experimenter then said, "Now close your eyes again, and this time think of a big red balloon. Make a picture in your head of a red balloon. Can you see the red balloon?" Again, subjects who could not create a red balloon image were asked simply to think of something else. The experimenter then asked "Now what are you thinking of?" When the subject had informed the experimenter of his or her changed mental image, the experimenter then asked the test question: "When I first asked you to make a picture in your head, what were you thinking of then? (Did you think of a white teddy or a red balloon?)"

Scoring

Subjects were scored as passing a test if they correctly reported their original state on the test question. They were scored as failing if they said that they had originally been in their subsequent state. The number of subjects in each group passing each test was analyzed.

Results

Responses to the confirmation questions indicated that subjects possessed the initial mental state and that their mental state changed following the experimental manipulation in each trial. As mentioned earlier, the exceptions to this were on the pretence task, where several subjects required considerable prompting to enact drinking and to be reminded of the pretend contents of the cup, and on the imagination task where four subjects with autism said they were unable to "see" anything with their eyes closed. These latter subjects were conservatively scored as failing this test. Since passing the control task was an inclusion criterion for the rest of the experiment, failure on any of the other questions was unlikely to be due to memory factors per se. We begin by reporting the number of subjects in each group passing each test in Table 3.

Results from the Normal Children and Subjects with Mental Handicap. From Table 3 it is clear that these two groups did not differ on any of the tasks. In addition, both groups performed at ceiling on both perception tasks and on the imagination and pretence tasks. Both of

Table 3. *Results on Test Questions: Number of Subjects in Each Group Passing*

DIAGNOSTIC GROUP	N	SEE	WANT	IMAGE	PRETEND	BELIEVE
Autism	15	15	12	9*	7*	4*
Mental handicap	15	15	13	15	14	10
Normal	20	20	17	20	20	14

*$p < 0.05$

these groups found the desire task slightly more difficult than the perception, imagination, and pretence tasks, and showed their worst performance on the belief task. The results for these two groups are illustrated in Figure 2.

Results from the Subjects with Autism. The subjects with autism also found perception easiest (all subjects passed at both levels 1 and 2) and desire the next easiest mental state to recall. However, unlike the other two groups, imagination and pretence were not as easy as perception for subjects with autism, and indeed were more difficult than desire. Furthermore, pretence was more difficult than imagination. Belief was the most difficult mental state. Fisher Exact Tests showed that significant group differences occurred only on the imagination, pretence, and belief tasks, the group with autism performing significantly worse on these than either of the other two groups ($p < 0.05$ for all three tests). The pattern of results from the subjects with autism is illustrated in Figure 3.

Analysis of the role of CA and MA in the group with autism revealed that the subjects who passed the belief test were not significantly older ($t = 0.19$, 13df, $p = 0.84$), nor did they have a higher verbal MA ($t = 0.76$, 13df, $p = 0.46$) or nonverbal MA ($t = 0.14$,

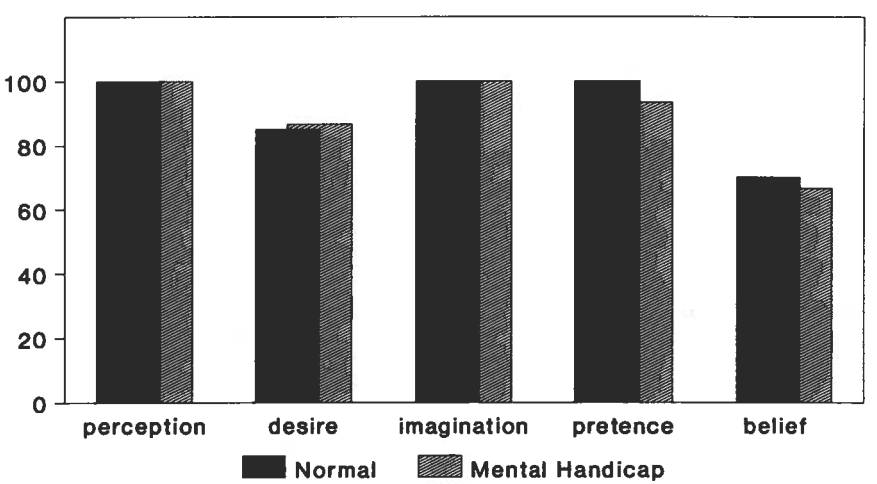

Figure 2. Percent of control subjects passing each mental state test.

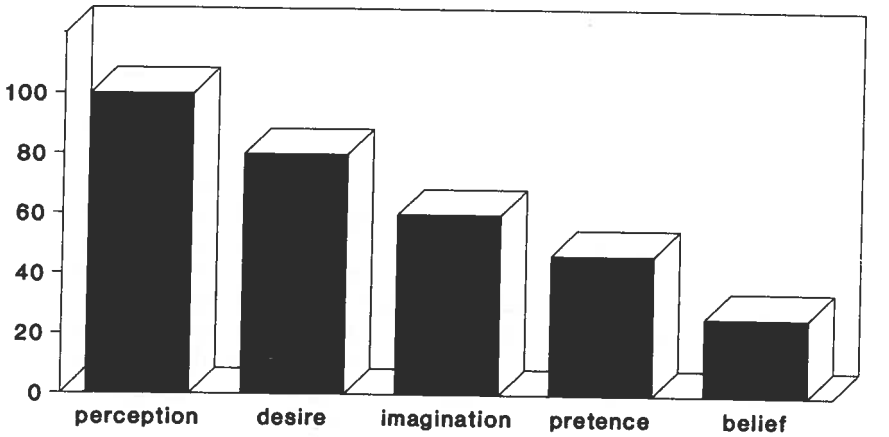

Figure 3. Percent of subjects with autism passing each mental state test.

13df, $p = 0.89$) than the subjects with autism who failed this test. Nevertheless, although neither CA nor MA emerged as a sufficient factor in accounting for those subjects with autism who passed the belief test, CA did appear to be a necessary factor, in that all of these subjects had CA greater than 9.9 years (and three of the four subjects had CA greater than 15 years).

Discussion

In this chapter, data are reported that allow us to begin to answer the question of whether different mental states differ in the degree of comprehension difficulty they pose for subjects with autism and whether there is deviance as well as delay in the development of their theory of mind. Each subject's recall of five different mental state terms was tested, these being perception, desire, imagination, pretence, and belief. The repeated measures design of this experiment enabled a comparative analysis of the relative difficulty of these mental states for each group, information not available from previous experiments in this area. The order of these mental states, as just listed, reflected the increasing difficulty that different mental states pose for people with autism. All subjects with autism were able to recall their prior perception, whereas only 26% were able to recall their prior belief. Progressively fewer subjects with autism could recall the other mental states listed between these. Thus, 80% recalled their prior desire, 60% their prior imagination, and 46.6% their prior pretence.

Group differences appeared only in the tests of imagination, pretence, and belief, the group with autism performing significantly worse than both the normal group and the group with mental handicap. The pattern of difficulty of the different mental states for the normal children and the subjects with mental handicap was different from the pattern seen in the group with autism. Thus, the normal and mentally

handicapped groups appeared to fit the three-stage model described earlier, replicating and extending Gopnik and Slaughter's results,[34] whereas subjects with autism deviated from this.* The crucial difference seems to be that for subjects with autism, representing pretence and imagination is distinctly more difficult than representing perception, whereas for subjects without autism, these are all equally easy.

The finding that all subjects in our group with autism understood perception, both at level 1 and level 2, replicates other studies.[8,38,46,67] Similarly, the relatively high proportion of subjects with autism who understood desire also confirms earlier experiments.[13,67] Nevertheless, it is clear that even understanding desire is difficult for about 20% of people with autism, despite both their CA and MA being higher than that which is normally sufficient for such understanding to develop. Deficits in the ability to represent imagining something had not been documented in autism before, while the demonstrated deficits in understanding pretence and belief replicate other studies.[4,16,53,68,73]

Delay and Deviance?

Evidence for delay in the development of a theory of mind comes from the background data of those subjects with autism who passed the belief test. The youngest was almost 10 years old. That this is almost 6 years later than the age at which normal children understand belief is evidence of substantial delay. It is even delayed relative to their MA. (The lowest verbal MA of a subject with autism who passed the belief test was 6 years). But insofar as the group with autism progressed through a different *sequence* in understanding mental states to that seen even in the group with mental handicap, this is evidence of additional deviance in the development of their theory of mind.

The experiment reported here may provide a method with which to assess the point an individual with autism has reached in the development of his or her theory of mind. Whether any specific treatments for children with autism can be developed from these findings is a question we are currently evaluating.[15] It also remains to be seen if there is a natural ceiling on development in this domain in autism. Certainly, some people with autism do reach the stage of understanding belief, at the level equivalent to that of a normal 4 year old. The exact proportion who do varies in different studies from 20% to 35% (in the present study it was 26%). However, of these 20% to 35%, none reached the level of a normal 6- or 7-year-old child in being able to understand more complex beliefs, such as beliefs about beliefs.[6,40] This may or may not represent a ceiling on their theory of mind; longer follow-up studies are needed to answer this question.

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*Of interest, within the normal group, 100% of 4-year-olds, but only 40% of 3-year-olds, passed the belief questions (Chi Square = 5.95, 1df, $p < 0.01$), matching results from other studies.[34]

Why should the normal and mentally handicapped groups fit the three-stage model and the group with autism deviate from this? One possibility is that understanding pretence and imagination may involve different cognitive mechanisms from those necessary for understanding perception, and that in normal development these different mechanisms do not become apparent because of temporal overlap in their development. In autism these mechanisms are revealed as separate from each other because one is dysfunctional whereas the other is intact.

Such an explanation still begs the question of the nature of such mechanisms, but it nevertheless has intuitive appeal in that perception seems to be a very different sort of state (a "bottom-up" state—i.e., driven by perceptual input) from pretence and imagination (which are both "top-down"—i.e., driven by thought). Leslie[44,45] suggests that the crucial mechanism might be the capacity for *metarepresentation*, which he defines in terms of the ability to represent an agent's mental representations. Recent studies show that in tests of representing nonmental representations, such as photographs[43] and drawings,[19] subjects with autism show no impairment. Such studies support Leslie's theory in suggesting that the difficulty is indeed restricted to their understanding of *mental* representations and does not extend to representing *all* representations. In Perner's terms, they seem to have a specific inability to understand the "representational mind," i.e., to understand the mind as something that can represent (and therefore also misrepresent) the world.[51] A related possibility is that the dysfunctional mechanism in autism is one that normally allows "truth-suspension," in that the three mental states that pose difficulty for subjects with autism (imagination, pretence, and belief) all share this quality, whereas the others (desire and perception) do not. Specifying and testing these mechanisms more precisely and explaining the origins of these deficits are goals for future research.

If pretence and imagination do require a different mechanism to that involved in understanding perception, this would illustrate how abnormal populations can be used to understand and uncover hidden processes in normality. Thus, just as the understanding of normal biochemical processes has been advanced by the exploitation of medical pathology, so the study of normal psychological development can be advanced by exploiting the "natural experiments" of autism and other forms of neuropsychopathology.

Elsewhere I have described autism as a specific cognitive disorder of "mindblindness."[12] This metaphor is intended to convey the gulf that I imagine must exist between our own effortless access to mental states and the lack of this access for people with autism. However, the data reported in this paper make clear that insofar as they suffer mindblindness, this is not total. Even in autism, some mental states are more accessible than others. Nevertheless, the data reported here are

consistent with the hypothesis that in all cases of autism there may be specific delay and deviance in the development of a theory of mind.

SUMMARY

Subjects with autism show severe impairments in the ability to attribute beliefs to themselves and others, i.e., in their "theory of mind." An experimental investigation of the relative comprehension difficulty posed in representing different mental states is reported in this chapter, revealing that certain mental states are easier to recall than others, for all subjects. For example, *see* and *want* are easier than *believe*. But whereas for normal children *imagine* and *pretend* are as easy as *see* and *want*, for people with autism they are significantly more difficult. Gopnik and Slaughter's three-stage model of normal development of a theory of mind[34] is replicated in the present experiment and found to fit the pattern of results for people with mental handicap but not the data from autism. Instead, the data from autism seem to fit a hypothesis of both deviance and delay in the development of a theory of mind.

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