Social Cognition and Pretend Play in Autism.

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Abstract:

The literature surrounding the autistic child's social impairment is reviewed. It is proposed that an impairment in some aspect of autistic children's social cognition could account for many of the observed abnormalities in their social behaviour.

First, two "lower-level" aspects of social cognition are considered. These are mirror self-recognition and perceptual role-taking. The present sample of autistic children did not differ from MA control groups in either of these respects, confirming results from other studies.

A "higher-level" aspect of self-other differentiation is conceptual role-taking. This ability is also called a "theory of mind". This literature is reviewed and a hypothesis is proposed which suggests that autistic children have an impairment in their "second-order" representational capacity which has been argued to underlie a theory of mind. This hypothesis is explored by means of 4 experiments. These showed that autistic children's "first-order" representational capacity, as manifested in their understanding of physical causality, is intact whilst their second-order representational capacity, as manifested in their ability to attribute mental states to others, is impaired. This deficit was not found in controls. Furthermore, those few autistic children who passed a test of attribution of belief at the 4 year old level, failed at the ("third-order") 7 year old level, despite adequate MA.

Pretend play can be related to conceptual role-taking, since both may require a second-order representational capacity. The literature surrounding the autistic child's impairment in pretend play is reviewed and the final experiment confirms and extends previous results in this domain.

It is concluded that particular aspects of the social impairment and the impairment in pretend play can be seen as the result of a deficit in one cognitive mechanism. This deficit is discussed in terms of what has loosely been called an "impaired symbolic capacity".

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Chapter 1: The Autistic Child's Social Impairment.

1.1: Literature Review.

1.1.(i): Kanner's description of the social impairment.

The earliest descriptions of the social impairment in autism appear in the form of clinical impressions rather than experimental evidence. The language of these is, by modern Journal standards, unscientific. Nevertheless, many of these early clinical impressions have been supported by later experimental studies (Section 1.1.(ii)).

Kanner's (1943) first paper's main focus was, in fact, on the social impairment in these children, as is evident in it's title "Autistic Disturbances of Affective Contact". A close reading of this paper reveals that the social impairment actually spans a very wide range of behaviours. It is perhaps unfortunate that Kanner never specifically listed the features which comprise the social impairment in a form which could be easily confirmed or disconfirmed by others. In what follows, aspects of the social impairment mentioned by Kanner in his 1943 paper are identified, and an example of his clinical description is quoted so as to convey the flavour of his language, as well as to contextualize the isolated symptom. For this purpose 15 different aspects, drawn from the case descriptions, are listed overleaf. It should be noted that not all of these symptoms are found in one child. These are taken from his 11 original cases, which have been considered as prototypical of the new psychiatric category of autism since then.

I. Lack of positive emotional expression:

eg: "He has no apparent affection when petted. He ... never seems glad to see father or mother or any playmate." (p.2)

II. Withdrawal from people:

eg: "He seemed almost to draw into his shell and live within himself." (p.2)

III. Disinterest in people:

eg: "He paid no attention to persons around him. When taken into a room, he completely disregarded the people and instantly went for objects..." (p.5). Similarly,

eg: "She has no relation to children, has never talked to them, to be friendly with them, or to play with them. She moves among them like a strange being, as one moves between pieces of furniture in a room." (p.32)

IV. Non-social use of language:

eg: "The major part of his "conversation" consisted of questions of an obsessive nature. He was inexhaustible in bringing up variations: "How many days in a week, years in a century, hours in a day, hours in half a day, weeks in a century, centuries in half a millenium" etc, etc., " (p.7). Similarly,

eg: "He never used language as a means of communicating with people." (p.27)

V. Abnormal non-verbal communication:

eg: "...he did not use communicative gestures." (p.8)

VI. Non-social response to other people's language:

eg: "When he responded to questions or commands at all, he did so by repeating them echolalia fashion." (p.10)

VII. Responding to parts of people, and not wholes:

eg: "When a hand was held out to him so that he could not possibly ignore it, he played with it briefly as if it were a detached object." (p.11). Similarly,

eg: "When the Readers Digest was taken from him and thrown on the floor and a foot placed over it, he tried to remove the foot as if it were a detached and interfering object, again with no concern for the person to whom the foot belonged." (p.27)

VIII. Lack of differential response to people and objects:

eg: "He never looked up at people's faces. When he had any dealings with persons at all, he treated them, or rather parts of them, as if they were objects. He would use a hand to lead him. He would, in playing, butt his head against his mother as at other times he did against a pillow. He allowed his boarding mother's hands to dress him, paying not the slightest attention to her."

(p.15). Similarly,

eg: "People, so long as they left the child alone, figured in about the same manner as did the desk, the bookshelf, or the filing cabinet." (p.38)

IX. Preferential response to objects over people:

eg: "When with the other children, he ignored them and went after their toys." (p.15)

X. Inappropriate use of personal pronouns:

eg: "He never used the pronoun of the first person, nor did he refer to himself as Paul. All statements pertaining to himself were made in the second person, as literal repetitions of things that had been said before. He would express his desire for candy by saying " You want candy". He would pull his hand away from a hot radiator and say "You get hurt". " (p.15)

XI. Lack of eye contact:

eg: "When he is with other people, he does not look up at them." (p.26). Similarly,

eg: "He did not respond to being called, and did not look at his mother when she spoke to him." (p.27)

XII. Lack of behaviour appropriate to cultural norms:

eg: "At 2 years old, she was sent to a nursery school, where she independently went her way, not doing what the others did. She, for instance, drank the water and ate the plant when they were being taught to handle flowers." (p.30)

XIII. Selective attention to 'non-social' features of people:

eg: "(At the Child Study Home..) she soon learned the names of all the children, knew the colour of their eyes, the bed in which each slept, and many other details about them, but never entered into any relationship with them." (p.31)

Most of these features of the social impairment are reiterated in a later paper (Kanner and Eisenberg, 1956), with an additional 2 included:

XIV. Lack of empathy:

eg: "This amazing lack of awareness of the feelings of others, who seem not to be conceived of as persons like the self, runs like a red thread through our case histories. We might cite a 4 year old boy whose mother came to us with the account that on a crowded beach he would walk straight toward his goal irrespective of whether this involved walking over newspapers, hands, feet, or torsos, much to the discomfiture of their owners. The mother was careful to point out that he did not intentionally deviate from his course in order to walk on others, but neither did he make the slightest attempt to avoid them. It was as if he did not distinguish people from things, or at least did not concern himself about the distinction... The existence of feelings or wishes in other people that might not accord with the patients own autistic thoughts and desires seemed beyond recognition." (p.95)

XV. <u>Lack of 'savoir-faire':</u>

eg: "Even the relatively "successful" children exhibited a lack of social perceptiveness, perhaps best characterized as a lack of <u>savoir-faire</u> . This can be best illustrated by the following incident involving one of our patients who had made considerable progress. Attending a football rally of his junior college and called upon to speak, he shocked the assembly by stating that he thought the team was likely to lose - a prediction that was correct but unthinkable in the setting. The ensuing round of booing dismayed this young man, who was totally unable to comprehend why the truth should be unwelcome." (p.94)

It is likely that these 15 aspects do not comprehensively define what Kanner saw as the social impairment. Furthermore, the described behaviour could of course be categorized and 'chunked' in many different ways and, undoubtedly, there is overlap between these categories. For example, Items VII and XIII are clearly not mutually exclusive. Nor are Items III and VIII, since in each pair, one implies the other. Items VIII and IX appear to be contradictory, though both are consistent with Item III. Any contradictions probably reflect that the child's behaviour varies across different situations. Since the 2 papers from which these features are drawn (Kanner,1943; Kanner and Eisenberg, 1956) are in the form of case histories rather than diagnostic check-lists, such apparent contradictions are of no importance, since the aim of such histories is to provide detailed, concrete and accurate descriptions of actual behaviour, however changeable, rather than an abstracted list specifying necessary and sufficient, mutually exclusive, and non-contradictory diagnostic features.

Kanner (1943) summarized the social impairment as follows:

"The outstanding, "pathognomonic", fundamental disorder is

> the children's inability to relate themselves in the ordinary way to people and situations from the beginning of life...There is from the start an extreme autistic aloneness ..." (p.33)

Kanner further assumed that the social impairment dated from (or before) birth:

> "We must, then, assume that these children have come into the world with innate inability to form the usual, biologically provided affective contact with people, just as other children come into the world with innate physical or intellectual handicaps...We seem to have pure-culture examples of inborn autistic disturbances of affective contact." (p.43)

However, this nativist assumption is only an assumption, as neither Kanner nor any subsequent researcher to date has yet provided any conclusive evidence as to either aetiology, or exact time of onset of the social impairment. Indeed, in his later paper (Kanner and Eisenberg, 1956) an explicit statement is made rejecting any simplistic "hereditary versus environmental" antithesis (p.99). Regarding the course and outcome of the social impairment, Kanner (1973) documented that whilst some autistic adults can adapt sufficiently to live within society, their social impairment, though changed in that they are more participative, nevertheless persists into adulthood. Rutter, Greenfield and Lockyer (1967), in their follow-up study of the social outcome of 63 autistic children, also documented a very poor prognosis. Rutter (1978a) summarizes this problem:

> "By the time ..(the intelligent autistic children)..reach adult life most of them have good language skills, they have a normal level of intelligence, there is no thought disorder or psychotic disturbance, they want social relationships, and yet they still have marked and persistent social difficulties. Why?" (p.505).

In the final chapter (8) an attempt will be made to account for these 15 aspects of the social impairment in terms of a deficit in the autistic child's 'theory of mind'. This will itself be linked to a possible deficit in 'symbolic capacity'.

Some experimental studies into the autistic child's social impairment are reviewed in the next section. These have largely confirmed Kanner's account but have also given us a more detailed picture of the social impairment.

1.1.(ii): Empirical studies of social 'behaviour' in autism.

Hermelin and O'Connor (1963) were among the first to investigate experimentally Kanner's claims regarding autistic children's social behaviour. They confirmed that their autistic subjects (n = 12, mean CA = 9 yrs, severely retarded MA) responded less to a person than matched retarded controls, but this was also true of their response to toys. Since the autistic children, like their controls, still responded more to a person than to non-personal stimuli, Hermelin and O'Connor (1970) concluded that their social impairment might be part and parcel of a central cognitive deficit. This view will be discussed in more detail in Section 1.1.(v).

The next influential contribution to knowledge about the social impairment came from Wing and Gould (1979) who carried out an epidemiological survey within the defined geographical area of Camberwell (a South London borough with a population of 35,000 people under 15 years old). They set out to ascertain the prevalence and distribution of 3 types of abnormalities: (a) absence or impairment of social interaction; (b) absence or impairment of verbal or non-verbal communication; and (c) repetitive and stereotyped activities of any kind. Of 914 children under 15 years old who were known to the local health, education, or social services to have some kind of physical or mental handicap or behaviour disturbance, they identified 132 children who all possessed at least one of the 3 abnormalities and/or who were in the severely retarded intelligence range (IQ < 50). Of interest to this review was the children's social behaviour, which was grouped under one of 4 headings:

I. 'Social aloofness' - this was the most severe impairment of social interaction;

II. 'Passive interaction';

III. 'Active-but-odd interaction' - Wing and Gould designated behaviour in this category as inappropriate because it was undertaken mainly to indulge some repetitive, idiosyncratic preoccupation, showing no interest in and no feeling for the needs and ideas of others; and

IV. 'Appropriate interaction'.

Since this is one of the few epidemiological studies of social impairment, it will be discussed in some detail here:

Wing and Gould found that 44% of children's social interaction was appropriate for their mental age, and these were labelled the "sociable, severely retarded" group. The other 56% of the sample comprised the "socially impaired" group. 73% of the socially impaired group were male. Of the total sample, only one named syndrome could be reliably identified by 3 independent raters, and this was autism, <u>all the cases</u> of which fell into the socially impaired group. (It is of interest that 47% of the sociable, severely retarded group were Down's Syndrome, a fact which will be discussed later in relation to the selection of an appropriate experimental control group for autism).

It was found that the socially impaired group could be subdivided by

2 independent methods, namely, on quality of social interaction (categories I - III, above), and on presence or absence of a history of classic autism. 23% of the socially impaired group had previously been diagnosed as autistic. Of these, a large proportion (70%) fell into the 'aloof' group, and the others (30%) were found in the 'passive' and 'odd' groups. The 'aloof' group was more likely to have a low level of language comprehension. Of all socially impaired children, those with a history of typical autism tended to have somewhat higher intelligence levels than those without, even though the majority were in the severely retarded range. The autistic children made up only 10% of all children in this sample who had an IQ score below 50.

The overall finding was that 21.2 of every 10,000 children aged under 15 years in the area showed impairments of reciprocal interaction of the 3 types, described above. Of these, 4.9 had a history of typical autism. This study demonstrates the pervasiveness of the social deficit in <u>all</u> autistic children in this sample, thus suggesting, like Kanner, that the social impairment has the status of a <u>central</u> or key problem in autism. The study also draws attention to the fact that the social deficit is not unique to autism.

This study represents an important advance over Kanner's (1943) earlier description of autistic children's 'aloof' social behaviour, in distinguishing the 2 other types of social impairment. To reiterate, one was 'passive interaction', which describes those children who do not make social contact spontaneously, but who accept approaches, and do not resist if other children drag them into their games. Wing and Gould write that these children might sometimes be used by normal classmates as babies in a game of 'mothers and fathers', or as patients in a game of 'doctors and nurses'. The other new category of social impairment was 'active but odd interaction' - the authors remark that these children characteristically pester others. Wing (1978) emphasizes that these latter type of children have good speech and make social approaches and thus may appear, superficially, to have normal social interaction, but observation shows that their contribution to a social situation tends to be a recital of their own special preoccupation and not a two-way conversation.

There are 2 shortcomings of this study. First, the autistic subjects which fell into this geographical sample are typical only of the very retarded proportion of the autistic population: of Wing and Gould's autistic subjects, only 0.003% had an IQ in the normal range (IQ > 70), whereas in the autistic population in general, between 20-30% have IQ scores in the normal range (Lockyer and Rutter, 1970; Lotter, 1966; DeMyer, 1976; Bartak and Rutter, 1976). The Camberwell autistic population is presumably untypical because the selection criteria in this study specified low IQ children. This raises questions as to the generalizability of this data to other autistic samples. Secondly, 95.5% of the socially impaired group had an IQ score between 0 - 19, which is extremely low. One wonders whether the social impairment of people who are impaired in all their general cognitive skills so severely can be meaningfully compared to the social impairment of people whose general cognitive skills approach normality. ie: Is the category 'aloof', for example, too all-embracing to be informative? Are 'aloof' children with IQ's above 70 'equivalent' in terms of their social skills to 'aloof' children with IQ's less than 19? Unfortunately, epidemiological studies of the social impairment in higher IQ children are largely still lacking.

Wing (1978) reports that the full, classic picture of aloofness and detachment seems much more marked in the younger autistic child, of less than 5 years of age. However, many authors make the important point that one should be careful not to interpret any "remittance of withdrawal" seen in older autistic children as the onset of normal social behaviour, since it is possibly only a sign of shifting between the categories of social impairment.

The 3 types of social impairment have been found to be useful, by Hopkins and Lord (1981), as mutually exclusive categories to rate the social behaviour of autistic children towards non-autistic versus autistic peers. Their study also looked at the effect of peer-familiarity on the social behaviour. They observed 6 autistic children (CA = 10-12 yrs, Leiter IQ = 35-45) first individually matched with a same-sex normal child (CA = 5-6 yrs), then with a same-sex, same age normal child, in dyads of one normal and one autistic child. Each dyad was observed alone over 10 daily 15 minute sessions.

Their results showed that on day 0, all autistic children's social behaviour toward eachother was categorized as 'aloof'. By day 20, the 4 autistic children who were in a dyad where the non-handicapped peer was told to actively help the autistic child to play were found to have increased on all social behavioural measures, while the 2 autistic control children had not. The same age peers initiated interaction 5 times more often than the younger playmates, and were almost twice as likely to respond to the autistic child. These results were replicated in a second study by Hopkins and Lord

(1981), this time using 2 higher functioning subjects (Leiter IQ = 76 and 83), since the subjects in their first study were severely retarded.

However, these 'increases' on the social behavioural measures did not mean 'improvements', but only indicated that the social behaviour changed from one form of abnormality to another. Wing and Gould's 3 categories were found to be useful in describing the changes in these children: 'Aloof' children could be discriminated from 'passive' children on the basis of their frequency of interaction and their responsiveness to the other children's overtures. Similarly, 'odd' children could be discriminated from 'passive' and 'aloof' children by the number of initiations they made, and their ability to make some active contribution to sustaining an interaction. Hopkins and Lord's conclusion draws attention to the fact that the autistic children moved from one category of social impairment to another not only across time (eg: 'aloof' to 'passive', or 'passive' to 'odd'), but also moved between categories as a function of whom they were with in the room (ie: autistic versus non-autistic playmate). This study therefore suggests that it is unlikely that Wing and Gould's 3 categories are mutually exclusive for any one child. Lord (1984) instead proposes the categories may comprise a developmental progression from 'aloof' to 'passive' in responsiveness, and from 'aloof' to 'passive' to 'odd' in rate of initiation.

Hopkins and Lord's result is impressive both because the differences between the types of impairment were demonstrable even in a very small sample (n=6), and because the increases in social responsiveness (but not initiation) generalized from non-handicapped peers to autistic peers. However, to reiterate, the study only demonstrates that the social impairment can become more 'other-directed' as a function of type of playmate and degree of familiarity. The study does not demonstrate that the social impairment becomes alleviated.

Whilst Wing and Gould's 3 categories have here been shown to be discriminable independently, they are nevertheless open to the criticism that they are at a very general level of description. For example, Wing and Gould's study does not allow us to specify how the autistic socially 'odd' children differed from the non-autistic socially 'odd' children if, as we might expect, they did. Much finer grain descriptive categories are needed if we are to characterize these more subtle differences.

One important fact to emerge from Hopkins and Lord's (1981) studies is that autistic children, far from being totally socially unresponsive, do take account of the behaviour of other persons. This has also been shown in a number of other studies: Sussman and Sklar (1969) found that their sample of autistic children (CA range = 4-7 yrs, no MA reported) tended to comply significantly more frequently to teachers' commands that were spoken in a soft 'persuasive' manner than in a harsh, firm way. If autistic children were completely 'unaware' of the social world, one would have expected their responses to different kinds of social approaches to be random and unpatterned. Clearly, autistic children can discriminate these differing features in other people's behaviour, and show preferences.

Clark and Rutter (1981) identified 2 other factors which predict appropriate task-directed and adult-directed behaviour in autism.

These were amount of structure (ie: the extent to which the task objectives were made explicit) and amount of interpersonal demands (ie: the extent to which the adult tried to regulate the child's actions). These 2 factors were positively correlated with appropriate responses by the child. However, in both of these last 2 studies, degree of compliance is measured. This is not a particularly informative index of the autistic children's social relations, nor is it any indication that their social impairment is in any way reduced. It merely demonstrates that their social impairment is amenable to reshaping into socially more acceptable forms.

In a study by McHale, Simeonsson, Marcus and Olley (1980), other aspects of the social context were manipulated: They showed that overall, autistic children displayed significantly more communication in a 'Teacher Present' condition than in a 'Teacher Absent' one. In the Teacher Absent condition, almost 75% of the children's behaviour was asocial: they did not direct their actions towards the other children present. However in the absence of any non-autistic control group comparison, it is hard to evaluate what this 75% means.

This study can also be criticized on several other grounds: First, the results of the social manipulation are in no way surprising: one would expect autistic children to respond 'socially' more often when teachers are present than when they are absent, on the grounds that teachers would tend to initiate social behaviours with an autistic child far more often than autistic children would do towards one another. Secondly, autistic children's pushing and pulling of a teacher are labelled "motoric-gestural communicative behaviours";

however, pushing and pulling another person is not necessarily communication. The child might well have been acting on the teacher as another <u>physical object</u> (which one can also pull or push) rather than as a <u>social subject</u> with mental states. Pushing and pulling behaviours might more appropriately be termed 'instrumental' behaviours. Also, when words were used by the autistic children, these were scored as "symbolic, communicatory actions", despite the later observation by these authors that "even when autistic children produced words, they were as likely to use them asocially as they were to use them socially" (p.310).

McHale's (1983) study is subject to exactly the same criticisms: she reports that non-handicapped peers "were able to communicate with autistic children..." (previously described as socially impaired) "...and engage them in social interaction (for) 75% of observation time by week 10." (p.88). As in her earlier study, the definition of what constitutes 'social' behaviour is clearly inadequate. For example: "Children were scored as part of a group if they were judged to be within 5 feet of one another, or were playing on or with the same toy." (p.87). However, neither physical proximity nor action on someone else's object necessarily involve two-way, reciprocal, cooperative behaviour, which most definitions of 'social' would require. Damon (1979) and Frye (1981) have proposed a definition of social behaviour in terms of "mutually intentional relations", ie: both people's intentions are coordinated with each other. We will discuss this definition in detail in Chapter 3.2.(i).

The major problem, then, with the studies reviewed in this section [1.1.(ii)] is that, with the exception of Wing and Gould, they all lack any attempt to distinguish between whether autistic children's actions or utterances were 'truly' 'social', as compared to those which might have superficially appeared social but which need not have been at all. None of them propose any operational definition of normal social behaviour. Nevertheless, all of these studies confirm the earlier clinically reported descriptions of these children as being socially aloof and passive. They also highlight the need to devise new scoring categories into which 'behaviours directed toward another person' can be meaningfully divided in terms of how social the actions really are.

The category of "active but odd" social behaviour has been identified in another study, by Dewey and Everard (1974). They provided a non-empirical but immensely valuable collection of observations by a panel of parents and professionals with first-hand experience of autistic adolescents who had an IQ in the near normal range. Whilst this was not a study using quantitative methods, they reported that the panel agreed strongly that, despite the normal intelligence of these autistic individuals, their social abnormalities stood out strikingly. These were manifested for example in non-reciprocal speech, that is, extended monologues, showing no awareness that their listener is bored. This is what Rutter, Greenfield and Lockyer (1967) call lack of social "know-how". They write:

> "This lack of empathy or social perceptiveness sometimes led children to make outrageous or tactless remarks...For example, an intelligent 17 year old girl commented 'what a very ugly baby' when introduced to the newly produced offspring of a friend of the family. Typically, this remark was made without any sense of mischief...(Another example is of) an intelligent adolescent boy (who) came down completely nude when his parents were giving a party, in order to ask where his pyjamas were." (p. 1187).

Dewey and Everard (1974) add that these adolescents lacked awareness of such social dimensions as class and social status in other people. This could well do with experimental replication. These signs of social abnormality have been noted by Newson, Dawson and Everard (1984), and are pointed out in descriptions of Asperger's Syndrome (Wing, 1981; Asperger, 1979; Van Krevelen, 1971), which may well be closely related to autism. However, whilst these studies clearly indicate that the social impairment persists both over time and across all levels of intelligence in autism, it should not be assumed that all aspects of their social behaviour are impaired. For example, Sigman and Ungerer (1984a) have found that autistic children do show some attachment behaviours towards their caregiver, appropriate for their MA. In the next section, studies of autistic children's person perception are reviewed, some of which show areas of non-impairment as well as impairment.

1.1.(iii): Experiments on Person Perception in Autism.

There are now a number of independent studies confirming that autistic children's understanding of physical objects is in line with their MA (Wetherby and Gaines, 1982; Curcio, 1978; Sigman and Ungerer, 1981; Serafica, 1971; Hammes and Langdell, 1981). Some experiments have been carried out to see if autistic children's perception of people, as a special class of physical objects, might be impaired, as a way of explaining their social abnormalities.

The frequently described clinical phenomenon of 'eye gaze avoidance' was one of the first aspects of person perception studied with autistic children. Hutt and Ounsted (1966) compared fixation duration towards 5 faces drawn on card, and found least fixation towards the 2 human ones. They also found their sample of 8 autistic subjects (CA range = 3-6 yrs, no MA reported) looked at real people's faces less than controls, and this has been found by Richer (1976) and Castell (1970). However, this result was refuted by O'Connor and Hermelin (1967), who reported data to show that autistic children (MA = 5.3 yrs, CA = 11.4 yrs) do not look less at a person's face than at other objects, but they simply have shorter, more frequent fixations for all types of stimuli, compared to subjects. This finding was replicated by Davids (1974) and Langdell (1981). This underlines the importance of controlling for types of stimuli. O'Connor and Hermelin found that both autistic <u>and</u> normal children spent more time looking at a real face than at a photographed face, and spent equal amounts of time looking at a face with its eyes open and the same face with its eyes shut. On the basis of these results, O'Connor and Hermelin seriously questioned the very existence of the phenomenon of eye-gaze avoidance in autism.

Nevertheless, the matter remains controversial, since contradicting results were reported by Richer and Coss (1976): they found that autistic children (mean CA = 7.7 yrs, Vineland SQ < 70, no MA reported) look more at a face with one eye covered up, than at a face with 2 eyes exposed, and look even more at a face with both eyes covered up. They argue the difference between their results and those of O'Connor and Hermelin's (1967) may in part be due to the total time of exposure to the adult's face: O'Connor and Hermelin exposed the adult to their subjects for a total of only 20 seconds, whereas Richer and Coss did so for 8 minutes. However, Richer and Coss' results might simply reflect the fact that unusual stimuli (covered eye[s]) are more interesting and novel, but there was no control for this dimension in the experiment. Absence of eye contact has also been noted in home movies of infants as young as 6 months who were later diagnosed as autistic (Massie, 1980, 1978; Kubicek, 1980) but, again, control data is not included in these studies.

All of these early studies focussed on the quantitative aspects of eye-gaze, but this measure may be too crude to capture the social use of eye-gaze. A recently published pilot study by Mirenda, Donnellan and Yoder (1983) has raised the possibility that there is a qualitative rather than a quantitative difference between eye gaze use in autistic and normal children: Argyle (1972) observed that normal adults typically tend to look at another person's face more when listening than when speaking, and Mirenda et al have confirmed that this is true for normal children also. However, the results of their study comparing frequency and duration of eye-to-face gaze during monologue and dialogue situations found that overall autistic children (mean CA = 11.0 yrs, no MA reported) spent as much of the time engaged in eye-to-face gaze with an adult as did normal children, but that autistic children tended to look for longer periods of time and more frequently during monologues than did normal children. This study is reported only as at the pilot stage (n=4 autistic subjects) and therefore awaits further support. Argyle (1972) has suggested that one social and pragmatic function of eye-gaze is to regulate turn-taking during dialogue. Since the autistic children made more eye contact during monologues and the normal children exhibited more during dialogues, this suggests that autistic children are not conforming to this rule of social interaction. In Chapter 8, an account of this 'symptom' will be proposed in terms of autistic children's impaired 'theory of mind'.

Tiegerman and Primavera (1984) found that autistic children (CA mean = 4.9 yrs, no MA reported) gazed at the experimenter most when the experimenter imitated the child's actions, and that they showed least eye-to-eye gaze when the experimenter acted completely independently to the child's actions. It is clear that these authors have found a way of establishing eye-contact, but it is doubtful whether this would actually be useful in social interaction.

Langdell (1978) carried out systematic manipulations to investigate if normal, retarded, and autistic children, matched for both CA and MA or IQ, used the same or different facial features in identifying other people. He tested 2 age groups of each type of child (n=80) for their ability to recognize isolated facial features of known peers from photographs of their faces. Additionally, in order to test the hypothesis that autistic children may treat the face as a "pure pattern" rather than as a "social stimulus", a condition was included in which the subject had to identify peers from inverted photographs. A number of authors, reviewed by Ellis (1975), had previously found that a normal subject's recognition ability is reduced by the inversion of a face, compared to his or her ability to recognize other inverted stimuli. This could be due to the 'social aspects' of the face which lose their 'meaning' when inverted. Whilst this theory is frustratingly lacking in precision, Langdell argued this inversion phenomenon might not occur to the same extent in autistic children, due to their known social impairment.

He found 2 significant differences between the groups: first, the autistic children made fewer errors when the lower half of the face was shown, than the control groups; this suggests that they were less dependent on the information contained in the upper part of the face, perhaps the eye region, for recognition. Secondly, the older autistic children (mean CA = 14.1 yrs, sd = 1.1) had a significantly lower mean percentage error score for the inverted mode than all the other groups, although they too showed the inversion effect. Langdell (1981) established which hypotheses did not explain this inversion advantage: it was not because the autistic children were more practiced at focussing on the mouth rather than the eyes, since deaf children who depend on lip-reading did not show this inversion advantage. Nor was it simply that the autistic children were only 'mentally rotating' the mouth area and not the eyes (the former being arguably easier), because there was no difference in their ability to recognize a face if the upper half or the lower half was inverted only.

Langdell (1981) then proposed a deficit in 'perceptual integration': He found that autistic children were also better than ESN children matched for reading ability at recognizing inverted words. (Reading ability was tested by recognition of words correctly oriented). Langdell argued that since both words and faces may normally be perceived holistically, perhaps the autistic children's inversion advantage was due to their inability to integrate perceptions of specific features into a whole. The assumption here is that individual inverted items are easier to recognize than relationships between inverted items. Langdell's explanation needs more substantiation, but his results can be taken as evidence that autistic children have no particular problem with recognizing faces.

Hobson (1985) explored the question of the significance of facial expressions, as well as gestures and vocalizations, for autistic subjects. He proposed that while these are always used as indicators of inner emotional states by normal people, it may be that for autistic individuals they do not have the same impact, or are not perceived as carrying the same information. Using a matching paradigm, Hobson presented 3 different videotapes to autistic, retarded, and normal subjects. One videotape (1) was of 4 facial expressions showing the emotions of happiness, unhappiness, anger, and fear. For each, the child was asked to select a schematic drawing of a face "to go with this face". All subjects were trained to match these correctly.

He then showed the subject a videotape (2) of a person enacting in turn the gestures of each emotion, but with the face obscured by a balaclava. After each of these, the subject was given schematic drawings of a faceless figure with a 'frozen' gesture matching the final gesture on the videotape. (We must assume that Hobson believed that the effect of the film and drawings of faceless people would be equally undisturbing for all the groups of subjects, although this was not checked). The child was then presented with a choice of the same 5 drawings of faces, depicting the 4 emotions and a 'neutral' pose, and was asked to choose the one to complete the picture. A similar technique was employed with an audiotape of non-verbal vocalizations appropriate to each emotion, and also with a final videotape (3) of some 'contexts' which might lead the actor to feel happy, unhappy, and so on. There were also 2 comparison videotapes. In the first there were non-personal, non-emotional 'things' (a train, car, bird, and dog), each of which had a characteristic form, 'gesture', sound, and context. The other tape comprised personal but non-emotional stimuli, in the form of a man, woman, boy, and girl. These figures were depicted in gestures, vocalizations, and contexts characteristic of their age and sex. This last condition was to explore the question of whether autistic children's recognition of the person-variables of age and gender was normal.

Briefly, Hobson's results were as follows: All subjects were equally good at choosing the picture of the 'things' to match the non-personal videotape. However, the autistic subjects made significantly more errors in choosing the schematic faces for the emotional expressions tape for gesture <u>and</u> vocalization <u>and</u> context. They were also worse on the 'persons' age and sex tape, than their controls (both normal and non-autistic mentally retarded). One striking finding here is, of course, the 'normal' performance of the non-autistic mentally retarded children, who highlight the severity of the impairment in the autistic group. The latter group's failure to match the emotional expression drawings cannot have been due to an inability to integrate different features of a stimulus, since they could do this with 'things'; nor is it likely to have been due to an inability to discriminate the facial configurations, since Langdell (1981) has shown that, at least for older autistic children, to sort photographs of different faces according to the emotions expressed is significantly above chance level and does not differ significantly from matched ESN children. Thus, though the facial and non-facial stimuli obviously differ enormously in complexity, there is no reason to suppose that such complex stimuli per se pose particular perceptual problems for autistic children.

However, it is difficult to evaluate exactly which aspects of the tasks the autistic children might have had difficulties with: for example, are the 'task demands' in the 'things' videotape of 'gestures' (in which the child has to match the "hopping blurred image" of a bird with a picture of a bird) the same as those in the 'persons' videotape of gestures (in which the child has to match a person's gesture with a face)? It is likely that there are more differences than just the critical social ones. However, Hobson's interpretation is that the autistic children simply did not know that facial configurations are not merely "perceptual patterns" but are expressions, that is, signifiers, denoting inner emotional states. An investigation into autistic children's understanding of 'non-emotional' mental states such as beliefs will be reported in Chapter 4. Certainly, the autistic children's failure in Hobson's experiment appears all the more chronic when looked at next to Walker's (1982) finding that even 5-7 month old normal infants can recognize the correspondence between the visual and acoustic expressions of certain emotions. Consistent with Hobson's finding that there is a dissociation between autistic children's perception of social and non-social things, Jennings (1973) found that autistic children (n=11) prefer to sort photographs of faces according to non-affective stimuli (eg: hats) rather than by expressions, whilst matched normal and retarded controls show no preference.

Hobson (1983a; 1983b) retested autistic children's ability to discriminate people's sex and age, using card-sorting paradigms. Hobson (1983a) confirmed their failure to distinguish between children and adults consistently accurately, relative to their high ability to sort geometric figures, and old versus new non-personal objects. However, autistic children could discriminate people's gender (Hobson, 1983b) and this has been confirmed by others (Sherman, Sigman, Ungerer, and Mundy, in preparation). Abelson's (1981) study demonstrated more specifically that only very retarded autistic children have difficulty in recognizing gender identity, as tested with the Michigan Gender Identity Test (MGIT), and that this difficulty is not found among those of higher MA. Abelson and

Paluszny (1978) have also shown the strong correlation between MA and gender identity recognition in retarded subjects. Why autistic children should find difficulty with age-related discriminations between people, but not gender related features, has not been explained, but it is possible that this dimension does not carry the same importance or salience for autistic children, since they do not actively seek out peers in the normal way. It should be noted that Lewis and Brooks-Gunn (1979) and Brooks and Lewis (1976) have demonstrated that very young normal infants exhibit selective modes of responsiveness to other people who differ in the body characteristics associated with age and gender.

To summarize the present literature on person perception in autism, it appears that appropriate social use of eye-gaze is absent (Mirenda et al, 1983), face-recognition skill is present as normal (Langdell, 1978), as is gender-recognition (Hobson, 1983b; Sherman et al, in prep; Abelson, 1981), but that autistic subjects have difficulty in the recognition of emotional expressions (Hobson, 1985). This suggests that while the physical aspects of person perception are intact, social and emotional cues are nevertheless confusing for them. Hermelin and O'Connor (1985) have recently proposed the notion that these deficits are a result of affective as well as cognitive disturbances. Whilst the domain of affect is of considerable importance, and awaits further enquiry, only a cognitive account is considered here. Thus, in Chapter 3 an interpretation of these deficits is proposed in terms of an impairment in their ability to attribute mental states to others. However, in the next section more experimental evidence is reviewed for the autistic child's social deficit in the area of pragmatics.

1.1.(iv): Experiments on the social use of language (ie: pragmatics) in autism.

Hurtig, Ensrud and Tomblin (1982) analysed the question production of verbal autistic children which, among other things, has been described as lacking any relation to the immediate social context (Kanner, 1943). Cunningham (1968) has also reported that many of the questions autistic children ask are ones to which they already know the answer. Hurtig et al tested the hypothesis that higher functioning verbal autistic children (n=6, mean IQ=72) who ask many questions may often not be sincerely interested in gaining verbal information. They specifically assessed the degree to which listener response to questions produced by these children influenced the likelihood of conversational continuation. They found that a large percentage of questions (conservative estimate = 28%, lenient estimate = 64%) produced by autistic children were not necessarily intended as requests for information, as the children possessed the information already. They also found that when the experimenter provided a 'minimal response' to a question (ie: only the information asked for), 47% of the children's 'next turns' were inappropriate; ie: they lacked the further pragmatic or discourse competence that would allow them to appropriately select topical material to maintain the dyadic interaction.

Hurtig et al interpreted these results as indicating that autistic children probably are motivated to initiate social contact - (why else would they ask questions?), and their persistence of inappropriate questions may represent the children's vain attempts to maintain the social contact. It is unfortunate that this study did not include any control groups. Nevertheless, their finding that autistic children lack the "conversational management skills" to maintain the dialogue, following the listener's answer to their question, confirms similar pragmatic difficulties found by other authors:

Baltaxe (1977), in her study of the pragmatics of 5 verbal, male autistic adolescents (IQ = 86-118), followed Bates (1974) in her definition of pragmatic competence as the ability to express oneself in a manner which is appropriate to a given social <u>context.</u> The speaker must be able to make certain assumptions about the hearer and about what the hearer brings to the linguistic interchange, in terms of knowledge, social background, and other variables. These assumptions affect the interchange itself. Baltaxe's study, though lacking in contextual detail (and thus difficult for the reader to evaluate) reported that the autistic children were impaired in their differentiation of speaker-hearer roles (eg: they adopted many different speech styles of different speakers as their own). They also reported an observed impairment in the differentiation of old and new information in a dialogue (eg: what the listener already knows and does not know - which Roth and Spekman (1984) call 'presuppositions').

This pragmatic deficit stands in sharp contrast to their often intact syntactic and semantic skills, as has been suggested in various reviews (Frith, 1982; Tager-Flusberg, 1981; Cromer, 1984). The typical pattern of social role-playing with an "imaginary interlocutor" found in the bedtime soliloquies of normal infants (Weir, 1962) has also been found to be missing from an autistic child's bedtime soliloquy (Baltaxe and Simmons, 1977). Fay and Schuler (1980) have also noted such autistic pragmatic-deficit characteristics as excessively rigid interactive routines, problems in initiating and terminating interaction, deficits in topic maintainance, topic-shifting, and perception of the listener's perspective.

Of course, pragmatic competence is not restricted to verbal language only: Some aspects of non-verbal communication have also been looked at experimentally in autism: Langdell (1981) looked at the production of emotional facial expressions by autistic, retarded, and normal children, matched on MA and CA. The children were simply asked to look happy or sad. Photographs of the children's attempts were taken, and subsequently rated for the adequacy of the expressions, from the point of view of recognizability. The independent raters did not know to which of the 3 groups any one particular child belonged. Langdell found that the autistic children's attempts to look happy or sad were far less successful than those of the other children. In fact, the raters frequently found it difficult to decide whether a particular attempt by an autistic child was meant to convey a face showing a happy or a sad expression. Such uncertainties never occurred when judging the faces of the control children.

Attwood (1984) observed Down's Syndrome children, 4 year old normal children, and autistic children (of varying degrees of mental retardation, namely severe, moderate and mild) in the naturalistic setting of a school playground. The Down's and normal children used 3 types of gesture, (1) pointing; (2) instrumental (ie: movements serving to regulate another person's behaviour, eg: command gestures, such as 'come here'); and (3) gestures expressing mental states. The autistic children used the former types of gestures in their (infrequent) interactions, but never the latter. This preponderance of 'instrumental' gestures and absence of 'communicative' ones has also been found by Wetherby and Prutting (1984) and Curcio (1978) and, taken together with the observed pragmatic deficit, suggests that their social impairment is not confined to verbal communication but to non-verbal as well.

It will be argued later (Chapter 3) that these observed impairments in verbal and non-verbal communication, so-called 'pragmatic deficits', are a product of an inability to attribute mental states to others, ie: a failure in conceptual role-taking. This will be expanded upon in the light of experimental evidence presented. In the next section (1.1.(v)), we briefly consider three different cognitive explanations that have been proposed for the autistic child's social impairment, as we have seen it manifested in terms of social behaviour, person-perception, and pragmatics.

1.1.(v): Cognitive accounts of the social impairment in autism.

This thesis attempts to give a cognitive account of the social impairment in autism. It will be assumed that 'ultimate explanations' in terms of either 'constitution' or 'environment' are independent of such cognitive accounts. It is also an acknowledged limitation of the thesis that only cognitive explanations are tested, and this is due to both historical reasons and availability of experimental paradigms. The affective dimension to the social impairment in autism is beginning to be discussed elsewhere (Hermelin and O'Connor, 1985).

Within the set of explanations that have been called Cognitive Deficit Theories, different aspects of cognition have been postulated as direct explanations for the social deficit. Three such theories are (1) the 'central language disorder' theory (Rutter, 1968; 1978b), (2) the 'central encoding deficit' theory (Hermelin and O'Connor, 1970; Frith, 1970a,b), and (3) the 'impaired symbolic capacity' theory (Ricks and Wing, 1975; Wing et al, 1977; Richer, 1978; Hammes and Langdell, 1981). Data from other clinical groups has contributed to the refutation of the first of these explanations; the remaining two, however, remain to be taken seriously and, indeed, in Chapter 8 it will be argued that the data reported in this thesis is consistent with the both of the latter two cognitive accounts.

The 'central language disorder' account has been refuted on the following grounds: 'Aphasic' and 'dysphasic' children have specific language impairments, and these children have been compared to autistic children (Bartak, Rutter and Cox, 1975; Cantwell, Baker and Rutter, 1978). However, Rutter (1983) concludes from these comparisons that the 2 groups were "much less alike in their social and behavioural characteristics than some of the earlier clinical descriptions had suggested... There were many developmentally 'dysphasic' children who showed a severe defect in their understanding of spoken language but yet who were not in the least autistic." (p.552). The evidently normal social development of aphasic children has also been documented by Caparulo and Cohen (1977). This suggests that 'language disorder' per se (and this is a very vague term) does not necessarily cause a social impairment of the type(s) found in autism.

Whilst a number of specific deficits in cognitive processing have been suggested in autism, many of these are theoretically inadequate to account for the autistic social impairment. One exception is the suggestion by DeMyer (1971) and Dawson and Adams (1984) that the social impairment might be due to an inability to imitate others, but the children in these samples had very low MA's, and there is evidence that the social impairment persists even among those autistic children of higher MA who show imitative abilities (Hammes and Langdell, 1981).

Certainly, general retardation cannot account for the social deficit, since Down's Syndrome children, despite often being language-impaired and of low IQ, may be delayed but nevertheless still progress through the normal social milestones in the first year of life such as the social smile (Emde, Katz and Thorpe, 1975), and "maternal referencing" ie: when infants check their caregiver's emotional facial expressions for information which they then use to guide their behaviour (Sorce, Emde and Frank, 1982). Later, Down's Syndrome children show normal social/communicative use of gesture and speech (Owens and MacDonald, 1982; Coggins, Carpenter and Owings, 1983) and laugh at different stimulus items in the same order as normal infants (Cicchetti and Sroufe, 1976). Cornwall and Birch (1969) have also shown that 'social maturity' continues to develop in Down's Syndrome even when IQ begins to decline with age. Down's Syndrome children, therefore, while delayed in their social development, provide a clear case of how general retardation may slow down but does not impair early social development.

What of the 'central encoding deficit' theory? This proposed that the deficits in autism are not specific to language but are found in other modalities as well. Thus, whilst autistic children were found to be more impaired in "decoding" auditory-vocal input, in tasks of "encoding" they were more impaired in the non-verbal channels as well (Hermelin and O'Connor, 1970, p.70-71). Using memory-recall paradigms, Hermelin and O'Connor (1967) found that whilst non-autistic retarded children's performance improved when word-strings were 'meaningful', autistic children's scores for sentences versus random word arrangements were not significantly different. This was also found by Frith (1969), using a paradigm in which meaning as contained in phonological stress as well as syntax was varied. In non-verbal channels, Frith (1970a,b; 1972) found that autistic children were less sensitive to structure in sequential stimuli in both perception and production, and instead tended to impose their own structure onto non-random data.

These authors proposed that such cognitive deficits could lead to an inability to acquire social skills (Hermelin and O'Connor, 1970, p.72). The model, though never explicitly stated, implied that a failure to perceive 'meaning' would inevitably lead to a social impairment. This model is in some respects consistent with data reported in this thesis: we argue later that an inability to impute mental states to others leads directly to the social impairment, and would also render autistic children unable to decode 'meaning', since this would involve being able to attribute to another person an <u>intention</u> to send a particular (meaningful) message. Moreover, just as the 'central encoding deficit' theory argued, this impaired 'theory of mind' should affect both verbal and non-verbal channels. We will return to discuss this cognitive account in Chapter 8.

The third major cognitive account of the social impairment in autism is the 'impaired symbolic capacity' theory. The main problem with this account is that the term "symbol" has been used quite loosely, without clear definition. Nevertheless, the support for such a theory continues to come from a growing number of studies which have observed deficits in autistic children's pretend [ie:symbolic] play (Ungerer and Sigman, 1981; Wing et al, 1977; Riguet et al, 1978; Gould, in press; Experiment 7, this thesis). A further problem with this theory is that there have been almost no attempts to relate such deficits in symbolic play to the social impairment, despite the notion of 'impaired symbolic capacity' being used as a general explanation for autism (Wing et al, 1977). These two shortcomings of the theory are addressed in Chapter 8. To anticipate an argument which is presented there, if a thorough definition of symbol is used (Langer, 1942; Cassirer, 1972; Werner and Kaplan, 1963), it is possible to see (a) an impaired 'theory of mind' (described in experiments in Chapter 4, and linked directly to the social deficit) and (b) symbolic deficits (as manifested in an absence of pretend play - described in an experiment in Chapter 7) as both due to an impairment in "second-order" or meta-representational capacity (Pylyshyn, 1978; Dennett, 1978a; Johnson-Laird, 1983; Leslie, to appear; Flavell, 1979).

This will be elaborated in Chapter 8. To summarize the various cognitive accounts of the social impairment in autism, two points should be stressed. First, that the impairment is not confined to or caused by a language impairment, but is more 'central' than that (Hermelin and O'Connor, 1970). Secondly, any cognitive account which seeks to explain the social impairments should make explicit how cognition and social behaviour are related. This thesis attempts to follow this prescription by examining various aspects of the autistic child's social cognition. The next section summarizes what is meant by 'social cognition', and presents an overview of various hypotheses examined in this thesis. These hypotheses attempt to specify in more detail which aspects of social cognition in autism are impaired or intact.

1.2. Overview of thesis:

What is meant by 'social cognition'? Briefly, a number of authors have argued that the physical and social environments are qualitatively different to each other, in that changes in the latter occur for quite different reasons than changes in the former (Glick, 1978; Gelman and Spelke, 1981; Damon, 1979 & 1981; Hamlyn, 1974). One illustration of this difference which is often cited is the social phenomenon that a person who is stared at will in all likelihood move away, whereas a rock, however long it is stared at, will never move at all. From the point of view of the developing child's cognitive system, understanding the social world requires not only attending to the physical attributes of a person, but also attending to their internal states, which are more indeterminate. It is argued, therefore, that in the social world much of the information to be processed by the cognitive system is nonveridical, and that to make sense of the social world one must make inferences about mental states which involve going beyond the immediately available data.

'Social cognition' therefore refers to the mental structures, processes, and knowledge that are employed in interpreting the social world. (It is easily confused with and to be distinguished from the Vygotsky tradition of 'social determinism', which studies the aspects of the social environment which influence cognitive development; 'social cognition' describes a part of the cognitive system, whereas 'social determinism' describes some effects of a part of the environment). The "social world" effectively comprises the knowledge one has about self and others. This conceptual distinction is a central focus throughout the thesis. To reiterate, because the social world is held to be qualitatively different to the 'non-social' world in many important respects, it is argued that specific cognitive structures and processes are likely to be necessary in order to understand it.

Chapter 2 will consider some so-called "lower level" aspects of social cognition in autism, namely, visual self-recognition (2.1-2.3) and visuospatial role-taking (2.4-2.6). This latter area looks at children's knowledge of what another person can see. These aspects are 'lower level' because much of the relevant information for these skills is perceptual, ie: is available to the senses. These cognitive processes are, in the jargon of the times, "bottom-up". In contrast, Chapters 3 and 4 will look at a "higher-level" aspect of social cognition in autism, namely, conceptual role-taking ie: children's knowledge of what another person thinks. As discussed earlier, this sort of skill requires going beyond perceptual information and inferring what another person knows on the basis of his or her particular experience. This skill involves "top-down" processes.

To anticipate some results, experiments are presented which indicate that the 'lower level' (ie: perceptual) aspects of the present sample of autistic children's social cognition are intact and normal, relative to their mental age, and this confirms experimental results from elsewhere. In contrast, severe deficits are found in their 'higher level', conceptual role-taking abilities, and this has not been experimentally tested before. These findings are fitted into a discussion of the autistic child's concept of 'self', which is seen to be unimpaired at the 'physical' level (the "self-as-object") but impaired at the level of 'mental states' (the "self-as-subject").

Chapter 5 presents data in support of the hypothesis that this deficit is specific to this part of autistic children's social cognition - autistic children's understanding of causal relations in the physical world is shown to be normal (5.1-5.2). Sections 5.3-5.4 attempt to establish the upper limits of all tested autistic subjects' social cognition. Chapter 5 ends with an attempt to fit the experimental results so far obtained into a theoretical framework which distinguishes "first-order and second-order representational capacities" (Leslie, to appear). Briefly, autistic children's normal cognition about the physical world is explained in terms of an intact first-order representational capacity. Their deficit in social cognition is taken as evidence of an impairment in their second-order representational capacity. Finally, no autistic children but some non-autistic control children show evidence of a "third-order" representational capacity. All of these terms are fully discussed in that chapter.

Chapters 6 and 7 then address the question of autistic children's pretend play, a known area of deficit, since this is also considered to require a second-order representational capacity. This final experiment confirms results from other studies that autistic children are impaired in their production of pretend play, and extends this literature in that new operational definitions of 'pretend' are used and various methodological shortcomings are refined. Chapter 8 draws some conclusions from all these experimental findings, and discusses the notion that the social impairment and the impairment in symbolic or pretend play are both primary (in that neither one is a byproduct of the other), and that both may be the result of a deficit in one cognitive mechanism. The relationship between this deficit and other 'symptoms' of autism is also discussed, as is the idea of a general 'symbolic deficit' in autism.

1.3. Methodological considerations and subject selection.

a. Control groups:

The question of who are the correct 'controls' for autistic children has been discussed by a number of authors (eg: Yule, 1978). However, selection of a control group depends on the hypothesis being tested; it depends on which factors need to be controlled or ruled out of later interpretation of results. Because of the 'nature' of autism, there is at least one control group which is essential in all experiments which aim to demonstrate autism-specific characteristics: Autism can be associated with all levels of intelligence, from severely mentally retarded to normal and even above normal IQ (Hermelin and O'Connor, 1970; Wing and Gould, 1979). Therefore, in experiments which search for autism-specific features, the effects of general mental retardation must be controlled, and this is achieved by comparison with a non-autistic mentally retarded group. This notion was pioneered in some seminal experimental research by Hermelin and O'Connor (1970). In the 7 experiments in this thesis, this control group is Down's Syndrome. This group was chosen because it represents a relatively homogeneous clinical diagnostic group, relative to other instances of mental retardation. Also, their frequently described 'sociability' makes it easy to rule out the presence of autism in these children.

Thus, any deficits found within the autistic group which are not found in the Down's Syndrome group can be more reliably attributed to autism-specific factors rather than mental retardation per se. This circumvents the familiar problem of having to define what is a 'pure' case of autism, uncontaminated by retardation or anything else.

The experiments in this thesis also include a control group of normal children. This controls for the effects of handicap in general, in that normal subjects can be matched at the same mental age as the handicapped groups, but differ from them in the crucial respect of being 'normal'. The normal children also function to highlight any differences that might be due to IQ, in that IQ represents the relationship between MA and CA; this relationship is different in normal and retarded children, MA and CA being discrepant in the latter, and in principle equivalent in the former.

To summarize, these two control groups are used in order to establish whether failures in the autistic group represent a specific deviance or just a developmental delay (Zigler and Balla, 1982). Deviance can only be identified when a failure occurs which would not be expected from the subject's MA.

b. Diagnosis:

The autistic subjects were drawn from 4 special schools in and around the London area. They were included if they had been given an unequivocal diagnosis of autism in their past. Since 2 of the schools were run by the National Autistic Society, the referrals to which are all by expert psychiatrists, the diagnosis of those children was not in any doubt. However, the other 2 schools admitted not only children diagnosed as autistic, but also those with some "autistic features", but not with the full autistic syndrome. Therefore, a symptoms checklist (based on Wing, 1978) was given to the child's teacher to fill in, and only those children who showed the full syndrome to a chronic degree were included in the sample. The checklist/questionaire is shown in Appendix I.

The Down's Syndrome subjects were all attending one of 2 ESN(M) or SSN schools in London, and had been unambiguously diagnosed. The normal children were drawn from 2 nursery/primary schools in London. The Down's Syndrome and normal children's schools were in lower middle class and working class neighbourhoods. Social class in the autistic group was heterogeneous, since children were drawn from all over London. This variable was not specifically checked and maybe this was an oversight, given the controversial findings that there is a bias towards upper middle class families in autism (Schopler, Andrew and Strupp, 1979; Rutter and Lockyer, 1967; Wing, 1980). However, there are no grounds for expecting that social class variables affect the results of the experiments to be reported.

c. Subject Selection and Randomness:

The schools were chosen on grounds of convenience, ie: in or near London. Autistic children in these schools tend to be overtested and over-researched relative to non-London autistic children, and this is regrettable, since subject selection cannot be said to be 'truly random'. However, there is so far no epidemiological evidence to suggest that geography might be an important variable to control, so this was ignored.

The sex ratio of the subjects was approximately 1:1 in the Down's and normal groups, and 4:1 (male to female) in the autistic group, in line with the ratio in the wider population (Wing and Gould, 1979).

d. Matching procedure:

Since autistic children are known to have a performance IQ higher than their verbal IQ on most tests (Shah and Holmes, 1985; DeMyer, 1976; Lockyer and Rutter, 1970), each of the clinical subjects was assessed for both verbal and non-verbal MA. For the latter, the Leiter International Performance Scale 1948 Revision (Leiter, 1980) was used, and the verbal MA was assessed using the British Picture Vocabulary Test. Details of the subjects used in the first 3 experiments are given in Table 1.1:

Table 1.1: Subject Variables (means, standard deviations and ranges) for the first 3 Experiments.

Group	n		CA	Nonverbal MA	Verbal MA
Autistic	20	x	11:11	9:3	5:5
		sd	3:0	2:2	1:6
		range	6:1-16:6	5:4-15:9	2:8-7:5
Down's	14	x	10:11	5:11	2:11
		sd	4:1	0:11	0:7
		range	6:3-17:0	4:9-8:6	1:8-4:8
Normal	27	x	4:5	-	-
		sd	0:7	-	-
		range	3:5-5:9	-	-

As is clear from Table 1.1, the autistic and Down's Syndrome subjects are of equivalent CA, and all 3 groups have an MA > 4 years. This was chosen on the grounds that Experiment 3 required it as a minimum level of intellectual development (Wimmer and Perner, 1983). With respect to the two clinical groups, it is also clear from Table 1.1 that the autistic children have an advantage over the Down's Syndrome subjects on both verbal and non-verbal MA. This ensures that any <u>superior</u> performance by the Down's Syndrome children cannot be due to their MA advantage. This will be discussed in the context of later experimental results. The next chapter considers one "primitive" level of autistic children's social cognition, their concept of self-as-object.

Chapter 2: Perceptual aspects of social cognition in autism.

2.1. The autistic child's concept of 'self-as-object'.

A number of authors have argued that autistic children have an undifferentiated sense of self: Ornitz and Ritvo (1968) described autistic children as having an "inability to maintain a distinction between self and non-self" (p.87), and Anthony (1958) also mentions the "confusion of self and non-self" in these children. Goldfarb (1963) also argued 'schizophrenic' children "lack an image of their bodies which is stable in time and clear in form" (p.49). His view was based on observations of 50 cases, of which the following are examples:

> "Betty was teased by another child who said she looked like a horse. For days she was compulsively preoccupied with the anatomical features of the horse, and was obviously bewildered and uncertain about whether she could be distinguished from the horse...Donna became fascinated by the motions of her hands and addressed her hand as a baby..." (p.49) etc.,

One problem is that these children were labelled 'schizophrenic' - they may or may not have been autistic. Another problem is the lack of experimental validation of Goldfarb's interpretation of the children's behaviour. However, the same idea appears in other papers: for example Creak (1961), in her summary of the 'British Working Party', included "apparent unawareness of personal identity" among the diagnostic criteria of autism. While this notion appears somewhat vague and non-empirical, it has nevertheless had a lot of mileage as an explanation of the social impairment in autism and has continued to appear in recent research (Cohen, 1980). Why the self-concept has been considered as an area of disorder in autism by so many authors may in part be due to Bleuler's (1913) original coining of the term "autistic", since this is derived from the Greek word 'autos', meaning self.

The psychoanalytic line of research in autism has specified this notion in far more detail: Bettelheim's (1967) classic book on autism even includes this notion in its title 'Infantile Autism and The Birth of The Self'. He credits Stern (1924) as responsible for the idea that, in the normal child, the concept of self is not present at birth, but develops slowly, culminating in the conceptual distinction between subject and object in the second year of life. Bettelheim's belief is that through the experience of successful autonomy in interaction with other people, the infant gradually develops a concept of being a separate person. This view is shared by other psychoanalysts (eg: Winnicott, 1951/82). In autism, Bettelheim contends, the infant's efforts at influencing the social world are repeatedly frustrated by maternal insensitivity during 'critical periods', and hence the development of self is arrested.

Mahler (1952, 1968) proposes a similar psychoanalytic view, and she specifies the different stages in the "separation-individuation" process which are not achieved in autism (Mahler and Furer, 1972). 'Separation' in her theory refers to the process of self-mother differentiation, while 'individuation' refers to the infant's gradual realization of its independent autonomous capacities. The hypothesized process is a shift from the "normal autistic phase" (no differentiation between self and other) through "normal symbiosis" to "differentiation", ie: formation of a stable mental representation of the mother in her absence. Mahler's theory, like Bettelheim's, focusses on the emotional aspects of separation, and in this they both have much in common with Bowlby's (1969) theory of attachment. Other psychoanalysts, too, have proposed that autism comprises a 'disorder of the self' (Fordham, 1976; Tustin, 1981).

It is interesting that although there is no scientific evidence for the aetiological view of autism proposed by these psychoanalysts, the notion of an undeveloped sense of self in autism has continued to be a focus of interest and hypothesis. For example, 'pronominal reversal' has been taken to support the idea of an undifferentiated concept of self (Bosch, 1962/70; Despert, 1946), although this interpretation has been questioned by a number of studies (Bartak and Rutter, 1974; Silberg, 1978). The obvious question that is begged by all this is the meaning of a 'concept of self'. In what follows, the notion of an unanalysable concept of self is discredited.

What is a concept of self?

In experimental psychology, the term 'self' was banished by the radical behaviourists, but previously had been discussed by William James (1890, Chap. 10). James (p.400) contrasted two fundamental aspects of the self, the 'self-as-subject' (the 'I') and the 'self-as-object' of one's knowledge (the 'Me'). James also characterized this distinction as the 'self-as-knower' (the 'I') in contrast to the 'self-as-known' (p.401). In post-behaviourist psychology, the self has once again become a focus of investigation. In Lewis and Brooks-Gunn's (1979) theory, for example, the earliest, most primitive aspect of the self concept is termed the 'existential' self, comprising knowledge of 'I' as distinct from 'other'. A later aspect is the 'categorical' self, which includes knowledge of the categories by which one is defined (eg: 'I am big', 'I am female' etc).

In this thesis, perceptual knowledge of the physical separateness of the self will be termed the 'self-as-object', whilst the term 'self-as-subject' will be confined to refer to the child's knowledge of the separateness of his/her own <u>mind</u> as distinct from other people's minds. A third distinction, the 'self-as-agent' (Harter, 1983) will be used to refer to the infant's earliest knowledge which is derived from the <u>contingency</u> between self-generated motor behaviour and outcome (eg: when one's eyelids close, the world becomes dark; or eg: the "double-sensation" phenomenon which occurs when touching one's own body, thus stimulating two skin-surfaces at once). Such contingent feedback is both immediate and consistent. To reiterate, the 3 different stages in the development of the self are hypothesized (and termed) as follows:

1. The self-as-agent (>8 months): comprises knowledge of
   'My actions' eg: I can do x.

2. The self-as-object (>15 months): comprises knowledge of
   'My body' eg: I am y.

3. The self-as-subject (> 30 months): comprises knowledge of
   'My mind' eg: I think z.

The 'self-as-agent' will not be studied at all in this thesis, in that we assume there is no debate over whether autistic children can conceive of themselves as agents. This assumption is made on the basis that autistic children have frequently been observed to be able to act on the environment in order to change it. The 'self-as-subject' (as defined above) will be explored in Chapter 3. In this chapter (2.1-2.4) the focus is only on the 'self-as-object' (as defined above).

Which technique would be useful to test the hypothesis that the autistic child's concept of 'self-as-object' is impaired? In the experimental literature, one widely used technique for determining if an infant has a concept of self even at the most primitive level is through 'mirror self-recognition'. This ability was noted long ago in a biography by Darwin (1877) of his baby son:

> "When four and a half months old, he repeatedly smiled at my image and his own in a mirror, and no doubt mistook them for real objects...like all infants, he much enjoyed thus looking at himself, and in less than 2 months perfectly understood it was an image; for if I made quite silently any odd grimace, he would suddenly turn around to look at me...When a few days under 9 months old, he associated his own name with his image in the looking glass, and when called by name would turn toward the glass even when at a distance from it." (pp.289-90).

This early study records the young infant's understanding of the reflective property of mirrors, but the presence of self-recognition ability is ambiguous. However, mirror self-recognition ability was also assessed in far more detail as part of early infant intelligence tests such as Cattell's (1940) and Gessell's (1928, quoted by Harter, 1983). The idea to use mirrors to test this ability may seem somewhat contrived; however, mirrors are not modern artefacts, but date back at least 3000 years to the Bronze Age. This fact has been used to argue that mirror representation is therefore ecologically valid. (Its validity is also based in its relation to more 'natural' reflective surfaces, such as water - Koehler [1925, p.318] describes chimpanzees' interest in their own reflections in water, for example).

Mirror self-recognition seemed to offer the possibility of a relatively simple way to establish whether autistic children do in fact have an impaired concept of self, at least at the level of visual self-recognition (ie: at the level of the 'existential' self, or 'self-as-object', as defined above). The literature surrounding this experimental paradigm is reviewed in the next section (2.2.). This emphasis on the visual modality is because normal infants' auditory and tactile self-recognition have not been studied empirically.

One terminological point needs to be clarified: Lewis and Brooks-Gunn (1979), as mentioned above, argue that mirror self-recognition tasks test whether the infant knows that self (as a physical entity) exists separately from other - they call this the "existential self". Equating this with William James' (1890) distinction of 'self-as-subject' versus 'self-as-object', Lewis and Brooks-Gunn write that the existential self is the self-as-subject. However, the subjective aspects of self are not tapped in mirror self-recognition experiments. (By subjective, we mean inner, non-observable mental states). Rather, knowledge of the identity of the self as an object of the infant's perception is being tested in the mirror tasks. Therefore, a more appropriate formulation might be that the existential self is the self-as-object.

2.2: The development of visual self-recognition in normal children: literature review.

As has been mentioned, the assumption has been that at birth infants do not conceptualize a self-other distinction (Piaget, 1926; Mahler, Bergman and Pine, 1975). Building on this assumption, Lewis and Brooks (1975) have argued that it is kinesthetic and sensory feedback (in the form of contingency information) which provides the basis for the development of a self-concept. A number of studies have documented the changes from birth to 24 months in the infant's reactions to its own mirror image and to that of others.

Boulanger-Balleyguier (1964) has noted that, as early as one month old, the infant already shows interest in a mirror, looks longer at/ prefers its own image to that of a female stranger's image, but prefers its mother's image more than its own image. By 6 weeks of age, the mirror elicits a smiling response in the infant (Boulanger-Ballayguier, 1964). Lewis and Brooks (1975) also review evidence that the 16 week old infant can discriminate between mother and strange female's mirror images. These visual preference studies cannot however be taken as evidence that the infant has a self-concept, but only demonstrate the infant's capacity to discriminate between people's mirror images, and the degree of interest engendered by different people.

Dixon (1957) observed 4 stages in infants' mirror reactions. Stage 1: the 'Mother' stage: the infant first 'enjoys' watching the mother's reflected movements. In stage 2 (5-6 months - the 'Playmate' stage) the infant responds to its own image as if it were a playmate. Then between 6-12 months, the infant shows an interest in the image of its own actions (- this third stage is amusingly termed the 'Who Do Dat When I Do Dat?' stage). Finally, stage 4 is characterized by coy, shy or fearful behaviour infront of the mirror (the 'Coy' stage). Again however, this study does not unambiguously demonstrate the presence of a <u>self</u> concept.

A technique which <u>does</u> provide evidence of an organism's concept of self is the <u>red-dot method,</u> first used by Gallup (1970) with non-human primates. He found that if a red odourless non-irritating dye was placed on an anaesthetized chimpanzee's eye-brow, when subsequently viewing a mirror it first treated the image as if it represented another chimpanzee, but with mirror experience, began to explore the red-marked part of its face. Using this technique, no monkeys lower than the great apes have demonstrated facial self-recognition, despite adequate mirror-experience (Gallup, 1977; 1979; Lethmate and Ducker, 1973; Maclean, 1964). Animals such as fish and birds display aggression or sexual arousal towards their mirror image instead (Thompson, 1963; 1964), which is a socially appropriate conspecific behaviour, and therefore not evidence of self-recognition. (In passing, one prediction from this work is that those (rare) human cultures in which there are no reflective surfaces, such as the Tasaday jungle people (Lewis and Brooks-Gunn, 1979), would nevertheless demonstrate the capacity for mirror self-recognition after some preliminary mirror-experience).

It is interesting to note that lower monkeys can use mirrors to look at objects indirectly:

> "If a human being thus viewed (in the mirror) makes a threatening movement, she (a Macacus monkey) will turn directly from the mirror to the person, as though verifying her indirect picture of the situation." (Tinklepaugh, 1928, p.218)

Nevertheless, lower monkeys still do not seem to understand the nature of a reflective surface as it pertains to themselves (Gallup, 1970). Mirror self-recognition is therefore more than merely understanding how mirrors work. It is now widely accepted that mirror self-recognition illustrates a striking discontinuity between great apes and lower primate species.

Amsterdam (1972) was the first to use Gallup's red-dot technique with human infants (although she devised her technique independently). In her study an infant or toddler has its nose marked with a small amount of rouge (under the pretext of needing its nose wiped) and is then faced towards a mirror. If the child reaches toward his or her nose rather than the mirror, the child is said to have demonstrated self-recognition. Thus, mirror self-recognition (self-directed behaviour) is operationally distinguished from what Gallup (1968) called mere 'mirror-image stimulation' (mirror-directed behaviour). Mirror-directed behaviour has been characterized as a sociable or an other-directed response that drops out as self-recognition emerges (Amsterdam and Greenberg, 1977; Gallup, 1977). It is seen as sociable in that human infants at first will search behind the mirror, presumably for the 'other person' (Amsterdam, 1972), as will lower primates (Gallup, 1979). The results of Amsterdam's study, and other similar ones with infants, can be summarized as follows:

Until about 10 months of age, normal infants are either indifferent toward the mirror image, or else treat it much like a "playmate" (Schulman and Kaplowitz, 1977; Amsterdam, 1972). Between 12-14 months, infants will turn towards other persons or objects that are reflected in a mirror, thus demonstrating they are beginning to acquire an understanding of the reflective nature of mirrors (Berenthal and Fischer, 1978). Around 1 year of age, a variety of new responses emerge, including curiosity, avoidant behaviour, and withdrawal (Amsterdam, 1972; Berenthal and Fischer, 1978). By 14 months, some infants act "embarrassed", "coy", or "self-conscious" (Amsterdam, 1972; Schulman and Kaplowitz, 1977; Lewis and Brooks-Gunn, 1979; Dixon, 1957). However, most strikingly, by 21-24 months, most children (>75%) show a definite recognition of their reflection by touching their rouge-altered nose (Berenthal and Fischer, 1978; Lewis and Brooks-Gunn, 1979; Amsterdam, 1972; Schulman and Kaplowitz, 1977). Lewis and Brooks-Gunn (1979) report the earliest mark directed behaviour, manifested by 25% of 15 month olds. By 24 months, more than 66% of toddlers also use personal pronouns to label their mirror-image (Lewis and Brooks, 1975; Schulman and Kaplowitz, 1977; Zazzo, 1982). The strong consistency between results from different studies suggests a stage model of visual self-recognition is appropriate.

Other techniques have also been employed to investigate self-recognition: it has been found that infants do not show any preference between normal and distorted mirror images of themselves until 18-20 months of age (Modaressi and Kenny, 1975; Schulman and Kaplowitz, 1977). Lewis and Brooks-Gunn (1979) have tested self-recognition in videotapes: babies were shown their own tapes as well as those of other infants, in which someone approached silently from behind. Infants as young as 15-18 months were more likely to turn around under conditions in which they were seeing another baby on the screen. Infants also tended to imitate their own images twice as much as a strange child's image. Since the videos of self and other baby were not 'live', these studies demonstrate that such self-other discrimination is independent of contingency cues and is entirely based on facial feature recognition. Results from other video studies (Papousek and Papousek, 1974; Amsterdam and Greenberg, 1977) are consistent with this. In a pictorial self-recognition task, 9-12 month old infants smile much more at their own photograph than at photos of their peers, while 15-18 month olds (for some unexplained reason) do just the opposite (Lewis and Brooks-Gunn, 1979). Of course, these video and pictorial studies do not demonstrate self-recognition ability as clearly as the red-dot method.

Lewis argues that since self is just a particular instance of object (in all of these tasks), self-recognition should be present as early as object permanence and 'person permanence'. This claim is debatable: self-recognition ability requires knowledge not only of self-'permanence', but also of self-'identity', and these 2 aspects of knowledge are not equivalent. Secondly, whether knowledge of permanence in these three domains of knowledge (self, person, and object) do all appear simultaneously is not only an empirical question, but also depends on which theory of object permanence is being used (Bower, 1975; Gratch, 1975). However, Berenthal and Fischer (1978) have found strong correlation between stages in mirror self-recognition and stages in object permanence as measured by the Uzgiris-Hunt scales ($r(46)=0.84$, $p<0.001$), although the relationship was not such that one skill was clearly a necessary precursor of the other.

The mirror and the video techniques are the best so far developed, given the constraints of pre-verbal infants. These 'red-dot' techniques are limited to use with infants with relatively developed motor ability (eg: hand-eye coordination). At the most, they can be said to test facial self-recognition visually, and all these studies acknowledge that this is only one aspect of the self-concept. It should be noted that although 24 month old infants do demonstrate mirror self-recognition unambiguously, there are reports that some adult schizophrenics have difficulty with mirror self-recognition (Faure, 1956; Traub and Orbach, 1964) and react to their mirror image as if in the presence of another person. The same has been found among profoundly retarded children (Boulanger-Balleyguier, 1964; Harris, 1977; Pechacek, Bell, Cleland, Baum and Boyle, 1973; Shentoub, Soulairac and Rustin, 1954). In the schizophrenic case, there may be some break-down of the ability as a result of the disease, but the results from the retarded population suggest a minimal level of cognitive development (MA>2yrs) may be necessary for self-recognition ability (as tested with these paradigms) to emerge at all.

Mirror self-recognition in autism:

Self-recognition in autism has also recently been studied. Neuman and Hill's (1978) experiment involved only 7 autistic children (all male, CA range = 5:5-11:4), and used a video technique rather than a mirror. The child's face was marked while blindfolded, supposedly for a 'Pin the tail on the donkey' type game, thus ensuring the child was not aware of the application of the red mark. 6 out of 7 of the autistic children showed a significant increase in mark-directed responses during the first session, and 5 out of 6 of these subjects deliberately rubbed and attempted to remove the marks from their faces. Although this study did not indicate if they gave any verbal responses indicating self-recognition, the autistic children's non-verbal responses are clear indications of their ability for self-recognition. A major criticism of this study however is that it did not clarify the relationship between MA and self-recognition ability in autism, since MA was not assessed. Another of its problems was the very small sample size.

These problems were overcome in a study by Ferrari and Matthews (1983), who used 15 autistic children of varying mental ages. The CA of their subjects ranged between 3:5-10:4 years. Self-recognition ability was assessed using a mirror, and some purple theatrical rouge was smeared on the tip of the child's nose while the experimenter pretended to wipe the child's nose. These authors found that 8 out of 15 of the autistic children (53.3%) showed clear evidence of self-recognition by touching their rouge-altered noses when in front of the mirror. Of the remaining 7 'non-recognizers', 3 touched the mirror, as if the rouge were on the surface of the mirror. The autistic children who showed self-recognition ability differed from those who did not in terms of their MA (recognizers' mean MA = 38.13 months, SD = 17.4; non-recognizers' mean MA = 22.14 months, SD = 8.7), but not in terms of their CA.

Spiker and Ricks (1984) obtained a similar result: 36 out of 52 autistic subjects (69%) showed mirror self-recognition and, as in the previous study, these subjects were only distinguished by MA (using Goldfarb's [1961] scale of overall functioning levels in psychotic children). Dawson and McKissick (1984) also found that 13 out of 15 autistic children (CA range = 4:1-6:8 yrs) showed mirror self-recognition, and the 2 who did not were the only children scoring below stage V or VI on the Object Permanence Scale.

These 4 studies present a consistent picture, ie: that mirror self-recognition in autism is dependent on a minimum level of MA. Hence, any apparent delay in this ability is not an autism-specific deficit. An explanation for the social impairment in non-retarded autistic children in terms of an impaired concept of self-as-object is thus ruled out by these studies. It was nevertheless decided to attempt to replicate these findings with the particular sample of non-retarded autistic children that are to take part in the later experiments, employing a simplified version of the technique, described below. This was felt necessary in order to establish that the autistic subjects in our sample, whatever else their problems with 'self' might be, at least could be shown to have this minimum level self-concept. This would later enable an impairment in concept of self-as-object to be ruled out with confidence as an explanation of their social impairment.

2.3: Experiment 1: Visual Self-Recognition in Autism.

Procedure:

Each subject was seen individually, in a small room that contained only a table and chairs, in the child's school. Thus, there were as few distracting objects as possible. The experimenter sat next to the subject and first allowed the child to get used to the room and explained that they were going to play a game. This initial period was found necessary in order to relax the subject and procure his or her attention. (This 'relaxation and familiarization' period was used at the start of all the other experiments reported in this thesis, and usually lasted no more than 3-5 minutes). The experimenter then merely asked the child "Who is that?", while holding up a round mirror (10 inches in diameter) in front of the child's face. The experimenter then noted down the verbal response by the child. The red-dot technique was <u>not</u> thought necessary in the testing of these children since they all had the minimal level of speech necessary (in contrast to normal pre-verbal infants, for whom the red-dot technique is necessary). Thus, if the child said his or her name, or responded with a first-person pronoun (eg "Me"), this was assumed to be an adequate indication of the ability to recognize self in the mirror.

Subjects:

There were 3 groups of subjects, 27 normal children, 14 Down's Syndrome children, and 20 autistic children. The 2 clinical groups both had a mean non-verbal MA > 5 yrs, using the Leiter International Performance Scale. The autistic group's mean verbal MA, using the British Picture Vocabulary Test, was 5.5 yrs, sd = 1.6 yrs, and the Down's Syndrome children's mean verbal MA was lower (x = 2:11 yrs, sd = 0:7 yrs). These subject data were shown earlier (see Table 1.1, p.48).

Results and Discussion:

This experiment resulted in all subjects performing at ceiling. There were no differences between groups, so no further analysis was necessary. Thus, the hypothesis that autistic children are impaired in their ability to recognize self-as-object is refuted by previous studies, and this refutation is confirmed for the present sample of high-functioning autistic children (mean MA = 9.3 yrs, sd = 2.2) in Experiment 1. This demonstrates very clearly that the widely held notion that autistic children cannot differentiate self from other is incorrect, at least at this level of visual self-recognition, ie: at the level of 'self-as-object'.

One doubt concerning the result from Experiment 1 may be over whether the test was adequate: Gallup (1979) argues that labelling of the mirror reflection need not imply self-recognition. This criticism is valid, and is an instance of the general problem of whether 'performance' always reflects 'competence'. However, this criticism is answered by the studies (discussed earlier, p.61-62), which did use the red-dot technique, and which also demonstrate that autistic children are not impaired in visual self-recognition (Dawson and McKissick, 1984; Ferrari and Matthews, 1983; Spiker and Ricks, 1984; Neuman and Hill, 1978; Flannery, 1976). Unlike the experiment reported here, these studies did not find ceiling performances for all their autistic subjects, but found that those who did not demonstrate mirror self-recognition tended to be of much lower developmental level, both in terms of language and general cognitive development.

We can assume that our sample of autistic and Down's children did so well on this task because of their relatively high MA. This explanation is supported by Mans, Cicchetti and Sroufe (1978) who found that MA is a good predictor for Down's Syndrome children's ability to demonstrate self-recognition in mirrors. They conclude that mental retardation may cause a developmental (ie: chronological) delay in visual self-recognition ability, but Down's syndrome subjects with MA > 3 years old do show this ability.

These results from autistic subjects may have implications for one particular psychoanalytic theory: Lacan (1949/77) proposed a model of child development in which it appears that mirror self-recognition causes the onset of social awareness. The words "it appears that" in the last sentence need qualifying: it is very difficult to specify exactly what Lacan's theory predicts, since the philosophical framework within which he writes is not directly translatable into the experimental psychological one. For example, he writes that "This moment in which the mirror-stage comes to an end inaugurates... the dialectic that will henceforth link the 'I' to socially elaborated situations." (p.5). It may be that Lacan did not intend a literal interpretation of his use of the term 'mirror' (Muller and Richardson, 1982, p.30), but if Lacan is proposing that mirror self-recognition ability is a necessary and sufficient condition for social relations to develop, the data from autism disconfirm this: in autism, mirror self-recognition ability is intact, but social relations are nevertheless chronically impaired.

In summary, the result of Experiment 1 did not reveal any autism-specific deficit, and this allows us to conclude at this stage that, at a perceptual level (ie: recognition of the physical attributes of the stimulus), the concept of self is not impaired in this sample of autistic children, and others of similar MA. Since this experimental result is in line with the other studies on this question, cited above, this is therefore now a strong result. In the terms used and defined earlier, autistic children can be said to have a concept of 'self-as-object' of their own perception.

However, the fact that this aspect of their self-concept is intact does not imply that other aspects of it are not impaired. In fact, two of the studies on mirror self-recognition in autism report a striking lack of shyness, embarrassment, or coyness in front of the mirror (Neuman and Hill, 1978, p.576; Spiker and Ricks, p.221), reactions which are usually found in young normal children (Dixon, 1957; Amsterdam and Greenberg, 1977) and are present in Down's syndrome children's reactions in front of the mirror (Mans, Cicchetti and Sroufe, 1978). There was also a conspicuous lack of such 'self-conscious' behaviour in this autistic sample in Experiment 1. Thus, there are certainly grounds for continuing to check other aspects of autistic children's concept of self, for any evidence of impairment. The next section considers another perceptual aspect of self-other differentiation, that of visuospatial perspective taking.

2.4: Visuo-spatial role-taking and autism.

An arguably more complex aspect of self-other differentiation is the development of knowledge about one's own visual perspectives in contrast to those of others. Piaget reported that this understanding does not develop until as late as 8 years of age (Piaget and Inhelder, 1956) in that, when younger children (aged 4-7 yrs) were presented with a model of 3 mountains and asked to select or construct a picture to correspond with the viewpoint of a doll that "observed" the scene from different positions, they tended to depict their own view of the landscape. The Piagetian argument is that such "egocentrism" (whether it is manifested in the visuospatial role-taking domain, or in some other, such as language) is primarily a result of undeveloped cognitive structures (such as knowledge of 'reversibility'); and that such egocentrism prevents social competence (Piaget, 1926).

A reasonable hypothesis therefore is the notion that the autistic child's social impairment is due to an inability to appreciate the "perceptual viewpoints" of others. This idea was originally proposed by Anthony (1958), and has been tested by Hobson (1984). Experiment 2 (p.75) will test this hypothesis using a different experimental technique to Hobson's, for reasons to be explained below. In this hypothesis, it is the perceptual aspect of role-taking that is considered, in contrast to the conceptual aspect. Perceptual role-taking can be called the child's "theory of sight" in so far as it is concerned with the child's knowledge about what other people can see, given their spatio-temporal relations to objects in the environment. It is important to emphasize that such perceptual role-taking is only one of many kinds of role-taking. In Chapter 3, for example, we will examine conceptual role-taking, or what has been termed the child's "theory of mind" (Premack and Woodruff, 1978). This refers to the child's knowledge of the mental states (beliefs, desires, etc.,) of another person. Yet a third aspect of role-taking might be characterized as emotional role-taking, or what is sometimes called "empathy" - ie: the identification of the emotions of another person. Kurdek and Rodgon (1975) made a similar distinction, using the terms 'perceptual, cognitive, and affective perspective-taking', respectively.

Whilst it is probably the case that most 'real' social situations are of a complexity that requires participants to make judgements about the perspectives of others on (at least) all three levels (perceptual, conceptual, and emotional) together, it is possible under experimental laboratory conditions to present simplified social situations in which the different types of role-taking can be disentangled and tested separately. Thus, Hobson's (1985) experiment (see p.30-32) could be said to have identified deficits in affective perspective taking in autism. Experiment 2 (p.75) tests the specifically perceptual aspects of role-taking (or the child's 'theory of sight') in autism. The justification for this Experiment requires a discussion of the literature surrounding it.

2.5: Perceptual role-taking: a literature review.

The most famous task that Piaget and Inhelder (1956) used in their study of visual perspective-taking has already been mentioned: the '3 mountains' task. Piaget and Inhelder elicited 3 different modes of response: first, the child was asked to reproduce the doll's view by arranging 3 pieces of cardboard shaped like the mountains. Second, the child was asked to select the doll's view from a set of

10 pictures. Finally, the child was asked to chooose one picture and then decide which position the doll must occupy to have that particular view of the mountains.

Piaget and Inhelder interpreted their data from 100 children (aged 4-12 years) as falling into a series of stages of perspective-taking ability:

Stage 1 (<4 yrs): The child does not comprehend the task.
Stage 2a (4-5:6 yrs): The child does not distinguish between his/her own and the doll's view of the objects.
Stage 2b (5:6-7 yrs): The child becomes aware of the possibility of imagining other viewpoints, but cannot identify them successfully.
Stage 3a (7-9 yrs): The child understands some relationships between viewpoints, but not all.
Stage 3b (>8:6 yrs): The child can imagine all relationships between viewpoints.

The Stage 2 child "appears to be rooted to his own viewpoint... so that he cannot imagine any perspective but his own" (Piaget and Inhelder, 1956, p.242). There is no suggestion, however, that the children consciously realize that they are responding with their own view. Nor is it suggested that the child does not know that appearances change as the observer moves, since Piaget reports the stage 2 child is not "surprised to find that in moving from position A to position C opposite, he has to make a new picture quite different from the previous one" (p.217). 3-5 year old children's knowledge of this is confirmed by Shantz and Watson (1970) who found evidence of "expectancy violation" in a trick condition in which the array did not appear as different when viewed from the opposite side. Piaget's emphasis is on the child's inability to imagine or anticipate the change.

Results from more recent experiments which use a different approach to the study of perceptual role-taking have thrown doubt on Piaget's interpretation of the young child's failure on the 3 mountains task. Masangkay et al (1974) presented 30-36 month old toddlers with a picture task and an eye-position task: in the picture task a piece of card with a different picture on each side was positioned vertically between the child and the experimenter so that each saw a different picture. Each child was asked what they could see and what the experimenter could see. In the eye-position task the child was asked to specify which of 4 toys the experimenter was looking at. Most children in this age-group were able to do both tasks correctly.

Lempers, Flavell and Flavell (1977) tested 12-36 month olds with 10 so-called 'percept production' tasks (eg: a photograph of a familiar object was glued to the inside bottom surface of a hollow cube and the child was asked to show the picture to the observer, thus demonstrating knowledge of how the environment-observer relationship must be arranged in order to 'produce a percept' in the other person). 4 'percept deprivation' tasks were also administered (eg: the child had to hide a toy car from the observer by moving it behind a screen). Finally, in 2 'percept diagnosis' tasks, the child was asked to state which object the experimenter was looking at. Astonishingly, 2-3 year olds were successful at this whole range of tasks.

Preschool children's success at percept production tasks has also been demonstrated by Fishbein et al (1972), Borke (1975) and Flavell et al (1968). Levine (1983) found that 2 year old boys' success at percept production tasks was not correlated with mirror self-recognition, but was related to pronoun comprehension and production. Flavell, Shipstead and Croft (1978) also found that 30-42 month olds could hide an object by placing it on the opposite side of a screen from another person even though it was visible to themselves. Similarly, Hughes and Donaldson (1979) found that 90% of three and a half year olds could hide a boy doll from 2 toy policemen positioned at separate points of 2 intersecting walls. Hobson (1980) obtained a similar result. Using 2 policemen (so there was only one possible hiding place) Hughes and Donaldson found the success rate remained high (79% correct on all 4 trials). With 3 policemen and a wall arrangement with 6 sections, 60% of 3 year olds and 90% of 4 year olds were still correct. Experimental results such as these have led some authors to challenge the very notion that young normal children are 'egocentric' at all (Donaldson, 1978).

How can the Piagetian finding of 8 year olds' inability to identify other perspectives on the 3 mountains task be reconciled with these more recent findings of children as young as 2 years old making correct inferences on the basis of someone else's perceptual viewpoint? One way is to argue that the recent studies have simplified the task demands sufficiently for younger subjects to attend to the relevant cues. Indeed, a number of studies have demonstrated that 2 important variables affecting role-taking ability in young children are salience of cues, and type of response requirements (Borke, 1975; Flavell et al, 1968; Huttenlocher and Presson, 1973; Fishbein et al, 1972; Hoy, 1974). Hughes and Donaldson (1979) explain their particular result in terms of the task demands testing the child's knowledge of intentions (to hide and to seek), which they claim even 3 year olds find very easy.

There is a third explanation, which is in terms of the cognitive processes used: this latter explanation of the conflicting results makes use of a distinction that is made in the literature (Cox, 1980) between 2 types of observer-object relations:

(1) In one, called perspectives problems, the subject is asked to predict what a stationary array would look like from a different position. The subject has to mentally rotate him/herself into another person's position and then use the 'facts of vision' to infer what would be visible to self in the new position. The 'facts of vision' are discussed by Lempers, Flavell and Flavell (1977) and include knowing that normally at least one open, unobstructed eye is necessary for vision, that eye-orientation indicates which objects are being viewed, that objects which are not occluded by any other and which stand along any imaginary straight line from a person's open eye(s) will be visible, and that what one person sees or does not see has absolutely no effect on what another person sees, etc. Such knowledge can be said to comprise one's "theory of sight".

(2) In the other, called rotation problems, the subject is asked to predict the view of an object if it were rotated while s/he remains stationary. This second type of problem involves the subject rotating the array only, and does not involve knowledge of the 'facts of vision', since the 'mental rotation' can be done without having to imagine either oneself or another person at all. These 2 problems are also called "viewer-rotation" and "array-rotation" problems respectively. Huttenlocher and Presson (1979) found that viewer-rotation problems were easier than array-rotation problems when children were asked questions about where specific items in the array would be from another perspective. Why one type of rotation

should be easier than another is not immediately evident. However, since a viewer-rotation problem usually involves imagining either another person or oneself in the future, this kind of activity may be more familiar than a rather laboratory-contrived mental-rotation type task.

This distinction between the 2 types of rotation strategies can be applied to explain the conflicting results concerning age at which perceptual role-taking is possible in the different tasks described earlier. It may well be that subjects treated the 3 mountains task as an array-rotation problem, and thus found it difficult; whilst the tasks used in the more recent experiments quoted above were treated as viewer-rotation problems, and were thus easier. This interpretation seems plausible, given that in the latter set of studies the experimenter explicitly emphasized that the child was to view the array from the position of the experimenter, ie: to rotate self into another person's position, whereas the 3 mountains task asked about the appearance of another side of the mountain (easily construed as an object-rotation problem). Certainly, the Hughes and Donaldson experiment was deliberately designed as a hide and seek game so as to emphasize that the dolls were 'perceivers' into whose position one could rotate oneself.

This brief review is sufficient to demonstrate that a wide variety of tasks and paradigms have been used to investigate children's visual/perceptual role-taking ability, but that many of them may have required a different ability altogether (eg: mental rotation of arrays) to solve them.

The one experiment that has investigated perceptual role-taking in autism is by Hobson (1984). In one of his tasks, 12 autistic children (mean CA=13.8 yrs, performance IQ range = 62-104) had to position a doll so that it could either see the experimenter or the child, who were seated on opposite sides of a table. All 12 autistic subjects were able to do this. In the second of his tasks, Hobson found that 11 out of 12 autistic children could hide model people so that the experimenter was unable to see them. In the third task which involved stating a doll's visual perspective of a cube, each face of which was a different colour, 8 out of 12 autistic children performed without error. Errors were more frequent among children of lower mental ages. In other words, performance was found to be influenced by <u>general</u> level of cognitive development rather than by <u>autism specific</u> factors.

Hobson's 3 tasks did not test autistic children's 'theory of sight' directly, ie: their knowledge of the 'facts of vision'. Certainly, his third task can clearly be performed as an 'array-rotation' problem, and thus the autistic children's success in this instance may not have been due to perceptual role-taking ability. In his other 2 tasks, it is likely that a 'viewer-rotation' strategy would have been required, and these can therefore be taken as evidence that perceptual role-taking ability is not impaired in higher MA autistic children. In order to establish that in the present sample of high functioning autistic children the social impairment was not due to impaired perceptual role-taking ability (ie: an impaired 'theory of sight'), a simple task was used (Experiment 2) which is designed to only test the subject's knowledge of the 'facts of vision'. This experiment is described in the next section.

2.6: Experiment 2: Does the autistic child have a 'theory of sight'?

This experiment was based on a study by Lempers, Flavell, and Flavell (1977), which investigated very young normal children's knowledge of visual perception in others. They found that the role of another person's eyes in seeing was well understood at least by 24-30 months of age. For example, a child of this age would take the other person's hands away from their eyes before trying to show them something, and could usually tell where the other person was looking from the person's eye-orientation alone. Scaife and Bruner (1975) and Butterworth and Cochran (1979) found that 100% of 11-14 month old infants showed this capacity for 'joint visual attention', too. Lempers et al called these abilities "percept diagnosis", since it involves the child identifying the percept(s) of another person.

One of their tasks was given to the same autistic, Down's Syndrome and normal subjects as participated in Experiment 1 (see Table 1.1, p.48). The prediction was that autistic children would not be impaired in this ability, relative to their MA. The task assessed the subject's ability to infer what the experimenter was attending to by the orientation of his eyes alone. The procedure is described below:

Procedure:

As in Experiment 1, subjects were tested individually, with only the experimenter present. Four small toys were placed around the seated subject: one above the child on a shelf approximately 4 feet behind him/her, near the ceiling level, one below (on the floor near the child's feet), and one to either side (placed on tables approximately 2 feet to either side). The child was first asked to name each toy, to check that these items were within their vocabulary, which in all cases they were. The experimenter, facing the subject, closed his eyes, moved them under closed lids to face one of the toys, and only then opened his eyes, continuing to face straight ahead. The subject was then asked: "Which toy am I looking at?". Thus, only the experimenter's eye-orientation and not head-orientation were available as useful cues. The child had to name the correct object to 'pass' the test. The child's verbal and non-verbal responses to the test questions were noted down. The order in which the toys were looked at was random.

Results:

Table 2.1: Number of children producing correct response to each question in Experiment 2.

TRIALS

	n	a	b	c	d
Autistic	20	19	19	20	19
Down's	14	13	13	13	12
Normal	27	27	27	27	26

[a,b,c,d = refer to 4 different toys]

Since there were no significant differences across questions within the task, the frequencies were averaged:

Table 2.2: Average number of children (and percentages of each group) producing correct response in Experiment 2.

	n	
Autistic	20	19 (95%)
Down's	14	12.8(99%)
Normal	27	26.8(99%)

Subjects in all 3 groups performed at or virtually at ceiling, so no further analysis was performed on these results.

Discussion:

Experiment 2 tested autistic children's 'theory of sight', ie: their understanding of the role of another person's eyes in seeing. The autistic children demonstrated they understood this as well as their matched MA controls. Thus, this level of perceptual role-taking is not impaired in these children. This result is in line with Hobson's (1984) study.

Autistic children therefore clearly demonstrated that they appreciate that other people (and even models of other people) can 'see', that is, that people have perceptions, and stand in a particular relationship to a perceived environment. In short, autistic children do appreciate that there exists a system of coordinated viewpoints, and that what a person (or a doll) 'sees' is determined by what is in front of its 'eyes'.

As Hobson points out, autistic children provide a 'natural' test and disconfirmation of the Piagetian view that non-egocentric visuospatial role-taking is sufficient for the development of social competence. (In fact, Piaget and Inhelder's (1956) argument was that non-egocentric visuospatial role-taking skill is <u>necessary</u> for the development of social competence, even though this might not be sufficient. This view is not challenged by the autistic data). If visuospatial role-taking ability and social competence [as discussed in Chapter 1] really are independent, it may not be surprising that autistic children whose (non-verbal) MA is in the region of 9 years old are able to succeed at visuospatial role-taking tasks, since this is in the repertoire of children with an MA of 2-3 years old (Lempers et al, 1977).

<u>Summary of results from the 'Mirror' Experiment and the 'Vision' Experiment:</u>

The first two Experiments demonstrate that the autistic subjects in the present sample have a concept of self-as-object (Experiment 1) and they have a "theory of sight" (Experiment 2). These 2 <u>perceptual</u> aspects of self-other differentiation are within their social cognition, and cannot therefore be used as explanations of their social impairment. These two experimental results thus serve as replications of other findings in autistic children's intact social cognition, and as a way of ruling out these 'lower level' aspects of their social cognition as being unimpaired. They can be called 'lower level' to the extent that they are both present in the normal 30 month old infant, and that they do not require any attribution of abstract, non-observable mental states. Such 'higher level' attribution is tested in the next chapter, which considers whether the aspect of self-other differentiation in autism which is impaired is <u>conceptual</u> role-taking, ie: their 'theory of mind'.

Chapter 3: Conceptual aspects of social cognition.

3.1: The autistic child's impairment in conceptual role-taking ability.

There is a curious history to the notion that conceptual role-taking ability in autism is impaired. It is curious in that this ability has frequently been assumed to be impaired in autism (Kanner, 1943; Wing and Gould, 1979; Newson, 1977; Rutter, 1983), but nevertheless the empirical truth or falsehood of this assumption has never been formally investigated, or even clearly articulated.

The notion has most frequently been couched in terms of a lack of "empathy", which includes conceptual role-taking, but which is certainly not synonymous with it. Thus, for example, Kanner (1943) observed that

> "the existence of feelings or wishes in other people that might not be in accord with the patient's own autistic thoughts and desires seemed beyond recognition." (p.95).

Similar statements have been made by other authors (Wing and Gould, 1979; Rutter, 1983). Newson (1977) even included "a failure in social empathy" as one of the diagnostic criteria for autism. She defines social empathy as "the ability to put oneself in another's shoes, and to know what a situation is like from another's point of view" (Newson, 1979, p.8). We have already seen that the autistic child's social impairment has nothing to do with a lack of appreciation of another person's "point of view" in the literal, perceptual sense (Experiment 2, this thesis; Hobson, 1984). As such, Newson's definition above does not help clarify the nature of the impairment. However, she also defines social empathy as that "which gives the normal child such easy access to other people's needs and wishes" (Newson, 1979, p.8, my emphasis). This takes us a small step further: it implies that autistic children's difficulty is in getting access not to what other people perceive but to what other people believe they need, and what they desire. Expressed more simply, autistic children are postulated to be impaired in their appreciation of other people's mental (but not perceptual) states. The example Newson gives to illustrate this is worth quoting:

> "A parent...called out one afternoon to her adolescent son, 'While you're out, buy me some cloves, I haven't got any. Take the money from my drawer'. When he had not returned after 3 hours, she looked in the drawer, to find he had taken $50. He finally returned well pleased with himself, laden down with smart boutique carrier bags, from which he produced the 'clothes' that he thought his mother had asked for, in teenage styles quite unlike those she normally wore, and including bra and pants" (Newson, 1979, p.9).

The autistic person in this account has clearly failed to ask himself the questions:

(1) Does my mother really intend me to buy her some clothes?

(2) Does my mother mistakenly believe she does not have any clothes?

(3) Which type of clothes would my mother desire for herself?

(4) Does the salesgirl in the boutique think it is a little strange that I am buying underwear for a female, even though I am male?

All of these 4 questions involve thinking about the mental states of another person. While Newson does not specifically identify the deficit in autism as in conceptual role-taking ability, this is clearly what she intends.

There are various arguments to establish that this ability is directly necessary for social skills, and these are outlined in section 3.2. below. Given these, it is perhaps surprising that this ability has never been experimentally investigated as a potential explanation for the social impairment in autism. Therefore, the hypothesis which will be tested (in Chapter 4) is that autistic children are specifically impaired in their 'theory of mind'. The term 'theory of mind' was originally coined by Premack and Woodruff (1978) to refer to conceptual role-taking ability. They defined it as the ability to

> "impute mental states to himself and others. A system of inferences of this kind is properly viewed as a theory because such states are not directly observable, and the system can be used to make predictions about the behaviour of others." (p.515)

In Chapter 4, two experiments which test conceptual role-taking ability in autism are reported, using different paradigms (Experiments 3 and 4). Before describing these, Chapter 3 will review the philosophical and psychological literature surrounding the development of this skill in normal children.

3.2: 'Theory of mind': literature review.

3.2.(i): Philosophical background:

The relationship between a person's knowledge of mental states (their 'theory of mind') and their social competence has perhaps been most closely studied within the realm of communication. In particular, this relationship has been powerfully analysed by the philosophical school of Speech Act Theory (Grice, 1957; Searle, 1965; Strawson, 1979). This theory of communication centres on the fundamental questions of what the meaning of an utterance is, and what is involved in understanding an utterance. A sketch of this theory is outlined below:

An act of communication is assumed to minimally consist of "an utterer's meaning something by an audience-directed utterance on a particular occasion" (Strawson, 1979, p.521). He continues:

> "An utterance is something produced or executed by an utterer; it need not be vocal; it could be a gesture or a drawing or the moving or disposing of objects in a certain way. What an utterer means by his utterance is... specified in specifying the complex intention with which he produces the utterance." (p.521).

According to the theory, then, it is impossible to give an adequate account of the concept of meaning and communication without reference to the possession by speakers of audience-directed "complex intentions" (Strawson, 1979, p.520). A 'complex intention' is an intention which involves other intentions within its scope. Thus, in the case of an assertion, John intends his audience to think he has a certain belief, and he intends that this intention of his should be recognized by the audience as the intention behind his utterance. Similarly, in the case of commands, requests, and the like, he intends his audience to think he desires them to perform some particular action, and he intends that this intention should be recognized by the audience as the intention behind his utterance.

Expressed in a more formalized way, Speech Act Theory proposes that every act of communication involves the embedding of at least two intentions:

1: I intend you to think I have belief (b) or desire (d); and

2: I intend that you recognize this intention (1) is the intention behind my utterance.

This embedding of intentions has certain cognitive implications, which will be discussed later (Section 4.4., p.144-6).

One of the earliest proponents of this sort of analysis was Grice (1957). Let us consider one of his examples:

> "I have a very avaricious man in my room, and I want him to go; so I throw a pound note out of the window. Is there here any utterance with a meaning? No, because in behaving as I did, I did not intend his recognition of my purpose

> to be in any way effective in getting him to go...If on the other hand I had pointed to the door... then my behaviour might well be held to constitute a meaningful utterance, just because the recognition of my intention would be intended by me to be effective in speeding his departure." (p.57).

Austin (1962), Strawson (1964) and Searle (1965) similarly proposed that meaningful communication always contains such embedded 'complex intentions'. Utterances or gestures that meet this definition of being communicative are known as "illocutionary acts", or "speech acts". Throwing the pound note out of the window would thus not be an illocutionary act, but a "perlocutionary" one, ie: one that causally affected someone else's behaviour without the participants having any necessary awareness of the other's mental states.

In 1967, Grice extended Speech Act Theory to the analysis of some specific 'complex intentions' which speakers hold implicitly as 'rules' which govern discourse. These rules are all part of what he called the "Cooperative Principle" (p.45) governing communication. He proposed 4 main categories of this principle:

1. Quantity (eg: be as informative as is required for the current purposes of the exchange);
2. Quality (eg: do not say what you believe to be false);
3. Relation (eg: be relevant); and
4. Manner (eg: be perspicuous, unambigous, orderly, polite, etc.,).

These he also called "maxims" (p.47). These ensure that discourse is an effective exchange of information which influences other people. Thus, Grice argues that in communicative discourse both participants hold the <u>implicit belief that the other speaker intends</u> to be cooperative in all of these 4 ways. (Of course, Grice mentions other 'maxims' which could be specified: eg: do not just walk off in the middle of a conversation unless there is a shared understanding that the conversation should terminate. However, these 4 categories cover the most important implicit beliefs governing discourse). Such an implicit belief is known as a "conversational implicature" (p.47). Communication is thus characterized as having a "quasi-contractual basis" which allows the contributions of the participants to be "dovetailed" (p.48).

Of course, another important 'conversational implicature' is that if any of these maxims are violated, this may communicate a speaker's non-cooperative intentions. (eg: If a speaker violates the maxim 'Be Relevant', this may indicate/be interpreted as meaning the speaker intends to mislead his or her audience). One of Grice's examples is worth quoting:

> "A is standing by an obviously immobilized car and is approached by B; the following exchange takes place:
> A: I am out of petrol.
> B: There is a garage round the corner." (p.51).

If A assumes that B intends to respect the maxim of relation ('Be Relevant'), then the implied meaning of B's utterance is that B thinks the garage is open and has petrol to sell; if A assumes B intends to violate this maxim, the implied meaning changes to one of deception.

Speech Act Theory thus asserts that in every communicative interaction both participants have beliefs about the other's intentions, and the meaning of the exchange is indissociable from these 'complex intentions'. Strawson's paper compares Speech Act Theory to an alternative theory of meaning, that proposed by Formal Semantic Theorists. This latter theory attempts to account for meaning only by reference to the truth conditions of semantic and syntactic rules, without any necessary reference to 'complex intentions' of the speaker. Strawson demonstrates how such a theory is inadequate, since the notion of 'truth-conditions' is inappropriate for many types of utterances (eg: imperatives, interrogatives, etc.,). Strawson concludes that while much of meaning obviously relies on and resides in the syntactic and semantic rules of a language, the meaning of speech cannot be separated from the speaker's "communicative-intentions" (p.539) within the particular communicative context.

The argument, then, is that both verbal and 'non-verbal' communication is impossible without mutual awareness of mental states, ie: without a 'theory of mind'. Logically, the question begged is 'What is a mental state?'. Here again, there is a philosophical literature which provides an analysis: Brentano (1874) is credited as being the first of the modern philosophers to identify the specific characteristics of mental states. 'Brentano's Thesis', as it is called, maintained that all phenomena are either physical or mental, and that mental phenomena have certain unique qualities. These qualities and their uses are summarized in the following 7 points:

1. Mental states are what are referred to by such natural language terms as believe, desire, expect, hope, want, remember, know, think, promise, assume, intend, pretend, imagine, etc.,. The first characteristic of such terms is that they are all directed to something (eg: one hopes for something, believes that something, intends to do something, etc.,). This quality of "directedness" philosophers have called "Intentionality" (Searle, 1979; Dennett, 1978a, 1979a, 1979b). The latin root for this term (intendere: to point towards something) clarifies the use of this term. Thus, there

are always two parts to mental states: the 'attitude' (eg: I believe that) and the 'proposition' (eg: it is raining). Knowing someone else's mental state thus involves knowing both of these two aspects simultaneously. We will return to the cognitive implications of this later (Section 4.4).

2. Propositions predicated by mental state terms do not have the same logical properties as any other type of propositions. Their unusual logical properties are:

(a) Non-entailment of existence or non-existence:

eg "John believes in ghosts" can be true without entailing that ghosts actually exist or do not exist.

(b) Non-entailment of truth or falsehood:

eg: "John believes that I am rich" can be true even if I am in fact poor. (nb: Compare the logical implications of a proposition <u>not</u> predicated by a mental state: "I am rich" is true only if I am in fact rich, and is false if I am in fact poor).

(c) Referential opacity:

eg: "I believe my next door neighbour would make someone a good husband" does <u>not</u> imply that "I believe the Mad Strangler would make someone a a good husband" even if my neighbour is the Mad Strangler. (For instance, I might not know that my neighbour is the same person as the Mad Strangler). The previous example comes from Dennett (1983). An example from Johnson-Laird (1983) is equally irrestible:

> " 'Mrs Thatcher thinks that the man who leaked Cabinet secrets is a traitor' may be true, but 'Mrs Thatcher thinks her husband is a traitor' may be false, even if the 2 noun phrases are co-referential" (p.430).

Thus, in these 3 logical properties (a,b and c above), there is a suspension of 'normal' reference, truth, and existence relations of propositions predicated by mental state terms. These logical properties are a unique feature of mental states.

3. Attributing mental states to other people allows one to explain and predict their actions (Dennett, 1971, 1978a). Consider Dennnett's (1978a) example: Why did the man stand under the tree? Because he <u>thought</u> it was raining and he wanted to stay dry, and he <u>believed</u> the tree would shelter him. Thus, only reference to the man's beliefs explain his actions, not the <u>fact</u> of whether it was raining or not, or whether the tree would in fact shelter him. Dennett emphasizes that the predictive power of this form of explanation is highly reliable. He calls such mental state attribution explanations "folk psychology". He writes:

> "We use folk psychology all the time, to explain and predict eachother's behaviour; we attribute beliefs and desires to eachother with confidence - and quite unselfconsciously - and spend a substantial portion of our waking lives formulating the world - not excluding ourselves - in these terms...Everytime we venture out on a highway, for example, we stake our lives on the reliability of our general expectations about the perceptual beliefs, normal desires and decision proclivities of the other motorists. We find...that it is a theory of great generative power and efficiency. For instance, watching a film with a highly original and unstereotyped plot, we see the hero smile at the villain and we all swiftly and effortlessly arrive at the same complex theoretical diagnosis: 'Aha!' we conclude (but perhaps not consciously), 'he wants her to think he doesn't know she intends to defraud his brother!' " (Dennett, 1979b, p.8-9).

4. Attributing mental states to complex <u>non-human</u> systems is also often an effective way of explaining and predicting the system's behaviour. Dennett (1971, 1978a) cites as an example of this a person trying to outwit a chess playing computer:

> "By <u>assuming</u> the computer has certain beliefs (or information) and desires (or preference functions) dealing with the chess game in progress, I can calculate...the computer's most likely next move..." (Dennett, 1978a, p.271).

5. A consequence of using such an 'intentional stance', Dennett (1979b) points out, is that we treat each other as if we were rational agents (ie: John believed x, therefore he acted in ways y and z). He continues: "This cheerful myth - for surely we are not all that rational - works very well because we are pretty rational" (p.12). Dennett (1978a) adds that the 'intentional stance' is pointless in cases where one has no reason to believe in the system's rationality, eg: "In weather predicting, one is not apt to make progress by wondering what clever move the wise old West Wind will make next" (p.238).

6. Mental states can have a causal relation to behaviour (Davidson, 1963), eg: "Her belief that John knew her secret caused her to blush" (Dennett, 1979b, p.21). This causal role (of 'mens rea') has for some time been a central assumption in legal and moral philosophy (eg: Bentham, 1789, p.84).

7. Dennett emphasizes that adopting an explanatory 'intentional stance' (that is, using a 'theory of mind') makes no factual claims about the nature of the system being explained; it merely describes the nature of our attitude towards that system. However, Dennett does identify certain properties about the nature of a system which can employ a 'theory of mind':

> "Let us define a second-order intentional system as one to which we ascribe not only simple beliefs, desires and other intentions, but beliefs, desires and other intentions about beliefs, desires, and other intentions. An intentional system would be a second-order intentional system if among the ascriptions we make to it are such as S believes that T desires that p, S hopes that T fears that q, and reflexive cases like S believes that S desires that p" (Dennett, 1978a, p.273).

So, a system that can hold beliefs about beliefs (etc.,) is a "second-order" system. An example of a "first-order" intentional system, Dennett argues, is any animal or machine to which a belief or desire can be attributed (eg: a mouse moves towards a piece of cheese because it believes it is edible and wants to eat). Thus, one attributes to a first-order system beliefs about the world, but not beliefs about beliefs. The question of whether or not the mouse really has beliefs is irrelevant to this explanation of its behaviour. As Dennett (1978a) says, the intentional stance is adopted for "pragmatic" reasons (p.238), and not because the object necessarily has beliefs or intentions.

So far, a plethora of terms have been used by the different authors reviewed to refer to the same ability: 'the intentional stance', 'conceptual role-taking', 'theory of mind', 'attribution of mental states', etc. Henceforth, only the term 'theory of mind' shall be used, but the assumption is that it embodies all of these.

The above discussion concerning the relationship between 'theory of mind' and communication largely centred on the human case, as this is obviously of most relevance for our consideration of the autistic child's theory of mind. However, it is worth noting that the philosophical issues raised are equally relevant for any analysis of animal communication. Mackay's (1972) classic paper links human and non-human communicative processes by focussing on the intentional aspect. He poses the question: "Is it good enough to say bluntly that...'all behaviour is communication'?" (p.4). He, like the Speech Act Theorists, proposes that information is not itself communicative if it is not both represented as intentional by the 'sender' and perceived as intentional by the 'receiver'. He cites some examples: a school boy's face would inform others that he had measles, but would not count as an instance of communication, but only of perception. Similarly, many (and perhaps all) signals which elicit responses between animals do not fall under this definition of communication since they are frequently neither intentionally sent nor perceived by the receiver(s) as such. We will return to the question of whether non-human animals are capable of employing a theory of mind in the review of experimental literature in section 3.2.(v) below.

To summarize the arguments from the philosophical literature reviewed, employing a theory of mind is necessary for both 'meaningful' communication and for explaining and predicting the behaviour of others. These two aspects of social behaviour (and maybe others) are thus seen to depend on the employment of a theory of mind. The next section reviews the literature surrounding the developing child's ability to attribute mental states to others. Although this review is quite lengthy, it is necessary because it will form the backdrop to the test of the autistic child's theory of mind in the next two Experiments. Its length is a result of the inherent difficulty in actually obtaining evidence of a theory of mind. It is not an entity which can be pinpointed as either clearly absent or present but, in the normal case, is inferred from a range of different experimental situations, as well as language and 'pragmatics' studies. All of these are reviewed in sections 3.2.(ii)-(iv), below.

3.2.(ii): Experimental studies:

There have been experimental studies into young children's understanding of mental states as varied as 'motive', 'intention', 'belief', 'know', etc. For the sake of convenience we will consider these separately, whilst bearing in mind that their 'semantic separateness' is unlikely to be so clearcut.

a) Attribution of 'motive' and 'intention':

It is often believed that Piaget's (1932) study of children's moral judgements centred on the question of whether young children possessed the concepts of motive and intention. In Piaget's classic study, 100 6-10 year olds were told stories about 2 actors, one who was ill-intentioned and accidently broke one cup, and the other who was well-intentioned and who accidently broke 15 cups. Piaget found that children under 7 years of age tended to only use the information about outcome (ie: high or low damage) in their moral evaluations of the actor, rather than considering the actors motives or intentions. Contrary to some interpretations of this result, Piaget in fact never suggested that this result implied that children under 7 lacked the concept of motive or intention; his result was instead concerned with the question of whether these concepts influenced the moral judgements the children made. This is an entirely separate question to that which is of current interest, namely, at what age can normal children attribute the mental-state concept of intention to others.

Piaget (1932) did consider the latter question elsewhere: from his observations of his own 3 children, he concluded that it is only before 30 months old that children cannot "distinguish between what is 'done on purpose'...and what is 'not done on purpose'" (p.176). In the recent literature (Berndt and Berndt, 1975; Keasey, 1978) the point has been made that the terms 'motive' and 'intention' are frequently confused. Certainly, Piaget often used them interchangeably. They can, however, be separated: a motive refers to the outcome an actor wants to produce (eg: to get a toy), whereas intention refers to whether an actor produced a given outcome accidently or 'voluntarily' (eg: injuring another child in the process of getting the toy). Berndt and Berndt (1975) showed films to 2 groups of children (mean CA = 4:11 and 8:2, respectively) in which the actor's motives and intentions were independently varied. They found that 5 year olds' answers to such questions as "Did he do it on purpose?" and "What did he want?" revealed that they did understand both the concept of a motive and the accidental-intentional distinction. However, like Piaget's results, the children's knowledge of these mental states was not always evident in their later moral evaluations of the actor.

Smith (1978) found that whilst 5-6 year olds could consistently distinguish 'voluntary'/intentional acts (eg: sitting down) from 'involuntary'/unintended acts (eg: sneezing), 4 year olds tended to say that all the film sequences (including ones of involuntary actions) were intended. Can we conclude from this study that 4 year old children lack the concept of intention? For each sequence, the children were asked questions such as "Was (the actor) trying to (do x)?"; the fact that they tended to reply 'yes' to all such questions may simply indicate that they did not understand the question. It certainly does not necessarily demonstrate an inability to distinguish intended and unintended actions. Despite this problem over how to interpret incorrect responses by the 4 year olds, Smith's study supports Berndt and Berndt's (1978) demonstration that children over 5 years old can attribute intentions to others. Other studies report similar results (Chandler, Greenspan and Barenboim, 1973).

Evidence that this ability is present in children as young as 3 years of age comes from more recent studies: Shultz, Wells and Sarda (1980) argued that moral judgement type paradigms are not useful to address this question because they do not test the child's understanding of intention directly; in their first task they therefore manipulated the subject's intention directly. Two pennies (one shiny and one dull) were placed next to each other on a table in front of the child. In the first condition the child had to close his/her eyes and pick up the shiny one, which all the children were able to do. In the second condition, the subject wore a set of prism glasses that laterally distorted his or her field of vision. When the glasses were removed, the child discovered that s/he had picked up the dull penny by mistake. After each condition, test questions were asked: "Did you mean to pick up that penny? Why did you pick up that penny?". In the second task, similar mistakes were induced, this time using verbal repetition: the child had to repeat a 'tongue-twister' ("She sells sea-shells by the sea-shore"). Again the child was asked "Did you mean to say it like that? Why did you say it like that?". Two further tasks involving finger and hand coordination were also used to induce 'mistaken behaviour'.

These 4 tasks were designed to elicit knowledge of intentions. A further manipulation concerned whose intentions were to be described. First, a child (A) was asked to explain his/her own behaviour; then another child (C) who had not been a subject was asked to explain child A's behaviour; finally, a child who had been a subject (B) was asked to explain child A's behaviour. Thus, the observers were either describing self or other's behaviour, and were either 'experienced' or not. The results showed that children as young as 3 years old accurately distinguished intentional from mistaken actions, both their own and someone else's, and that they could do this whether or not they themselves had previously performed those behaviours. The explanations offered by the children referred to internal, intention-like causes of behavior.

In their second experiment, Shultz, Wells and Sarda (1980) found that 5 year olds could distinguish intended actions from reflex actions (eg: 'knee-jerk' reflexes), although 3 year olds were not so good at this. This suggests that 3 year olds do have the concept of intention, but the distinction of intention-mistaken (experiment 1) may be easier (or occur developmentally earlier) than intention-reflex (experiment 2). Nevertheless, these 2 experiments show that 3 year olds regard intentions as <u>causes</u> of behaviour. This was also demonstrated by McGarrigle and Donaldson's (1974/5) well-known result in which 3 year olds were able to 'conserve' under conditions of "accidental change" as opposed to the experimenter's "intentional change".

In another experiment, Yuill (1984) used a 'judgement of satisfaction' paradigm, where the relation between an actor's motive and an outcome was varied so that the outcome was either intended or accidental. Thus, the child's understanding of motive and intention were separately tested. One of her stories, for example, was as follows: a boy wants to throw a ball at another boy to hit him on the head (bad motive), but the other boy catches the ball instead (unintended outcome). In the picture stories used, the character's motive was conveyed using a cartoon 'thinks' bubble, made from reduced versions of the outcome pictures. The experimenter asked the probe question 'What did the boy want to do?'. Then the outcome picture was laid down and the child was asked 'Is the boy pleased or sad about what happened, or just in between?'. The experimenter contrasted matching and mismatching the motive and outcome pictures (ie: intended outcome [match] or the accidental outcome [mismatch]). The results showed that all three age-groups (3, 5 and 7 yr olds) tended to judge an actor as more pleased with an intended than an unintended outcome, although the 3 year olds could only do this if there was no bad motive involved.

The studies reviewed above present evidence of normal 3 year olds' ability to understand the concepts of intention and motive, separately, at the simplest level. Individual differences in intention-cue detection skills among same-age 'normal' peers have been studied: Dodge, Murphy and Buchsbaum (1984) found that children identified by sociometric measures as having a peer status as 'socially rejected' or 'socially neglected' made significantly more errors than children identified as 'socially popular' or 'average'. The socially rejected and neglected children's errors tended to consist of erroneous labels of prosocial intentions as hostile. These differences lie in the detection of <u>type</u> of intention, but not in the ability to attribute intentions per se.

b) <u>Attribution of 'belief' and 'know':</u>

One paradigm which has been used extensively to investigate young children's understanding of the mental state concepts of 'belief' and 'know' is "conceptual role-taking". As we discussed in Chapter

2, this is distinguished from the traditional Piagetian perceptual role-taking tasks in that, as the name suggests, it requires inferences about another person's thoughts rather than their percepts. As such, conceptual role-taking could not be performed using a mental rotation strategy. The seminal set of experiments in this field is by Flavell et al (1968).

Flavell's first experiment (called the 'coin game', p.45) involved a game using 2 cups, one with a nickel in and one with a dime; the subject (S) had to remove the money from either one while another person (A) was absent, and then A would enter and choose a cup. The reward was that A could keep whatever was in the selected cup. The experiment focussed on where S thought A would search, and why. Flavell found that the younger subjects (aged 7-10 years) tended to predict that A would simply choose the 'dime' cup, on the grounds that A would want the larger amount of money. Older subjects (10-14 years) predicted that A would choose the 'nickel' cup, on the grounds that A would think that S would think that A would choose the 'dime' cup because s/he would want the larger amount of money.

In the 'coin game' experiment, then, the developmental shift is from younger subjects attributing to A a strategy based on a simple "monetary motive", to older subjects attributing to A a strategy based on complex, reflexive cognitions. Flavell calls the first, earlier attribution a "Level 1 operation" (p.49), (and this matches what Dennett (1978a) called a 'second-order intentional stance'). Flavell defines it as "S thinks that A believes that x". The more complex attribution Flavell calls a "Level 2 operation" (p.51), defined as "S thinks that A thinks that S or B (a third person) thinks that x". A conversational example of this would be "I'm sure you know what I think about Bill" (p.51). (This would be what Dennett called a "third-order intentional stance"). In section 5.4 these more complex levels of attribution will be discussed in detail.

To summarize, in the 'coin game' experiment, the youngest subjects were 7-8 years old, and they were capable of 'Level 1 operations'. From this Flavell argued that children at this age are therefore capable of role-taking, since "the fundamental definition of role taking is...the attribution of cognitions, in the broadest sense, to another individual" (p.52). Flavell believed that this ability, and the one at the next level up ("I think that he thinks that I think",etc, p.52) emerge for the first time in "middle childhood and adolescence". Other experiments are reviewed later (see p.99) which show this to be an underestimation of younger children's abilities.

In Flavell's second experiment (widely known as the "apple-dog" story), one experimenter (E1) displays a series of 7 pictures and asks the subject (S) to tell the story which they illustrate. 3 specific pictures are then removed, a second experimenter (E2) enters the room, and S is requested to predict the story which E2 would probably tell from the 4 remaining pictures. (E2 has supposedly never seen the whole series of 7). The pictures are so constructed that the entire series suggests a certain story while the series of 4 suggests another, quite different story.

Once again, in this experiment, the same developmental shift in responses was obtained: the probability of the subject predicting that E2 would tell the correct story (ie: one consistent with E2's lack of knowledge of the other 3 pictures) increased with age, although even many of the youngest subjects in Flavell's sample were able to do this. The ability required for this task, Flavell concludes, is definitely achieved by age 9-10 years (p.75). He maintains that role-taking demands not only "the ability to search and find the other's perspective. It is also likely to demand the ability to counteract the insistent intrusions of one's own (perspective) during the search" (p.81). In other words, it involves the <u>simultaneous representation</u> of two views (own and other's), and the appropriate selection of these. The cognitive implications of this are discussed in Section 4.4.

Flavell's two experiments without doubt require the attributions of the mental states of 'belief' and 'know' to another person. As such, they are definitely <u>conceptual</u> role-taking tasks. Borke (1971) set out to show that such studies enormously overestimated the age at which this abililty is present. She found that children as young as 3 years old could indicate in which situations another child would feel happy or sad, etc. However, this type of role-taking is not conceptual, but <u>affective,</u> and these two skills may be totally independent of eachother. This possibility seems to have been overlooked in much of the debate on this issue, as noted by Kurdek and Rodgon (1975). Thus, Chandler and Greenspan (1972) say that their results, in which 6-10 year olds were still very "egocentric", refute Borke's claims. This is an example of where different researchers are talking at cross-purposes, since Chandler and Greenspan's experiment, unlike Borke's, is very similar to Flavell's second experiment. The subject is required to tell a story from the limited perspective of a late-arriving and thus partially informed bystander, someone who thus does not have the "privileged information" that the subject has about the events in the story. This task does test conceptual role-taking in a way that Borke's does not. As such, their results are not comparable, and there need be no contradiction.

Chandler and Greenspan's (1972) experiment introduced a very important methodological consideration into tests of conceptual role-taking: that, to ensure non-egocentric responding, subjects must be required to adopt a point of view of someone who has a totally <u>different</u> belief about the situation than their own. Mossler, Marvin and Greenberg (1976) took this precaution in their experiment, in which they used children from 2-6 years of age. The children were shown a story on videotape, and then their mother was brought in to watch the same film but with the sound track turned off. Thus, the child had 'privileged information' (x) about the story, which the mother lacked. The children were then asked "Does your mommy know that (x)?" etc. The results revealed that 4 and 5 year olds were able to attribute 'lack of knowledge' to another person 'non-egocentrically'. In another experiment, Marvin, Greenberg and Mossler (1976) successfully replicated these findings using a "telling-a-secret" paradigm, in which the child again had to distinguish between those who knew x and those who did not know x. The authors' explanation for why subjects in their two experiments show this ability at a younger age (4 years old) to those in other studies was that they had sufficiently and legitimately <u>simplified</u> the test of conceptual role-taking.

This explanation is very valid. Studies are still being done (eg Chandler and Helm, 1984) which conclude on the basis of 4 year old children's failures that they are "egocentric", ie: unable to conceive of another person's mental states, whereas often their failure may be due to the inappropriate and unnecessary complexity of the task. In the next subsection, the 'best' experiments that have been done on the question of young children's theory of mind are reviewed. Their strengths lie in the fact that they ensure there is a clear conceptual difference between what the subject and the other person knows, (thus demanding 'true' conceptual role-taking), and they use tasks designed in such a way as to maximize the chances of eliciting a very young child's theory of mind, if it exists. The first of these features is most clearly found in the studies on attribution of false belief.

c) Attribution of false belief:

Many of the studies reviewed in the last section investigated children's ability to represent the absence of knowledge in another person. A number of commentators have argued that a more rigorous test of a child's theory of mind occurs when the child has to represent another person's definite belief which differs from that which the subject knows to be true (Bennett, 1978; Dennett, 1978b; Harman, 1978). In other words, the subject is required to attribute a false or wrong belief to another person, thus demanding that two people's different conceptual views of the world are simultaneously represented. The formal paradigm suggested by these authors as the 'acid test' of this ability is outlined as follows:

> The subject is aware that s/he and another person observe a certain state of affairs (x). Then, in the absence of the other person the subject witnesses an unexpected change in the state of affairs from x to y. The subject now knows that y is the case and also knows that the other person still believes that x is the case.

These authors suggested this paradigm in response to attempts to test whether chimpanzees had a theory of mind (Premack and Woodruff, 1978; Woodruff and Premack, 1979). Premack's interesting work will be discussed in Section 3.2.(v).

Wimmer and Perner (1983) used this paradigm to test children aged 4-9 years old. They told the subject a story in which a protagonist falsely believed a chocolate was in one location (x), when the subject knew it had been moved to another (y). The child was asked a 'Belief Question' which required the child to predict where the protagonist would look for the chocolate, on the basis of his wrong belief. Wimmer and Perner found that 57% of 4-6 year olds and 86% of 6-9 year olds pointed correctly to location x, thus demonstrating their ability to attribute a false (and therefore different) belief to another person, and their ability to use this attribution to predict another person's behaviour. Control questions checked their ability to represent the <u>actual</u> state of affairs as well. The authors argued on the basis of this result that children as young as 4 years old had the ability for "metarepresentation" (Pylyshyn, 1978), in that the child could represent not only a state of affairs (y) but also represent another person's relationship (believing) to these representations. This, again, is what Dennett (1978a) calls the child's ability to adopt a "second-order intentional stance".

As a test of the stability of the children's theory of mind the subject was then asked to predict what the protagonist would say if he wanted to either deceive an antagonist or truthfully inform a friend about the chocolate's location. Wimmer and Perner found that 85% of those who had correctly thought the protagonist would search in x also correctly thought that he would direct his antagonist to location y and his friend to location x. This correct attribution was found independent of age; however, 4-5 year olds were less successful at perceiving when an utterance was a lie than they were at producing a lie appropriate to someone else's belief state.

Wimmer and Perner's (1983) results support evidence from other studies that 4 year olds can attribute false beliefs to others: Shultz and Cloghesy (1981) found that at this age children start to understand the competitive nature of the 'Hide and Seek' game, which also depends on the correct simultaneous representation of two different "epistemic states" (Wimmer and Perner, 1983, p.126). Wimmer, Gruber and Perner (1984) also found that 4 year olds understood that a speaker in a story held a false belief, and they understood that the speaker held this false belief unintentionally, although most of them still called this a "lie". Despite this tendency to confuse 'being mistaken' with 'lying', 4 year olds are clearly shown to have a theory of mind. Similarly, the finding that 3 year olds have some ability to make correct "appearance-reality discriminations" of visual illusions (Flavell, Flavell and Green, 1983) suggests that they are aware of their own false beliefs as well as those of others.

Russell (in press) has explored young children's understanding of 'intensionality' (with an s), that is, their understanding of the limits of paraphrase or co-designation of mental state utterances in natural language. This refers back to the logical property of 'referential opacity' which was defined as a feature of mental states in 3.2.(i), p.86 (point c). In Russell's paper, entitled "Can we say...?", he tests children's understanding of what would be true to say of someone's beliefs, and what would be false. For example, one of the stories that the children were told was as follows: 'George's watch was stolen while he was in a deep sleep. The robber was a man with curly red hair. When George awoke and found his watch gone, he set out to find the thief.' The children were then asked some test questions about George's beliefs: (a) "Can we say that George was thinking 'I must find the man with the curly red hair who stole my watch'?" [answer: no, since George could not have known the thief had curly red hair if he was asleep]; and (b) "Can we say that George was thinking 'I must find the thief who stole my watch'?" [answer: yes]. Many 4-5 year olds made mistakes on these questions. In other words, they did not realize that 'the thief' and 'the man with the curly red hair' are not co-referential terms (they are 'intensional') when predicated by George's mental state term (eg: 'thinking'), even though they are co-referential ('extensional') in the actual story ('the thief' refers to the same person as 'the man with the curly red hair'). Thus, while children of this age are able to attribute false beliefs to others (Wimmer and Perner, 1983), their understanding of the logical properties of beliefs may not be achieved until later.

To summarize this review of the experimental studies into normal children's theory of mind, by at least 4 years of age children can understand and attribute the mental states of motive and intention, think and know, and false belief. This thus identifies the appropriate age control group for the planned experimental tests of autistic children's theory of mind (in Chaper 4).

Other studies have obtained evidence that young children use mental state terms in their <u>language</u> appropriately, and these are reviewed in the next subsection.

3.2.(iii): <u>Language studies:</u>

Another source of evidence for young children's theory of mind comes from studies into their use of linguistic terms which refer to mental states. Bretherton, McNew and Beeghly-Smith (1981) and Bretherton and Beeghly (1982) searched for any of 73 "internal state words" used by 30 10-28 month old children. These words referred either to cognition (eg: know, remember, dream, etc.), volition (eg: desire, need, etc.), and morality (eg: promise, allow, etc.). They also included words which referred to 'non-intentional' inner states, such as perception (eg: see, hear, etc.), sensation (eg: pain, touch, etc), physiology (eg: hunger, thirst, etc.) and affect (eg: anger, fear, sad, etc.). Mothers were asked to serve as observers. Of interest to this review are the 'intentional' words, of which 'know' was by far the most common - in fact, 66% of children produced it, and it was reported earliest in a child of 15 months. Terms such as 'remember', 'forget', 'think', and 'pretend' were also used by about 30% of the sample. The word 'think' was first used at 23 months, 'believe' at 26 months, and 'understand' and 'pretend' at 28 months. These ages are within the range reported by Limber (1973). Bretherton and her colleagues conclude from the linguistic data that the ability to analyse motives and beliefs in others is already well developed by the 3rd year of life, and is evidence of what they call an "explicit" theory of mind. (This is in contrast to an "implicit" one which Bates, Camaioni and Volterra [1975] have described in 9-13 month old children, which we shall discuss in section 3.2.(iv) below).

Shatz, Wellman and Silber (1983) carried out a similar investigation into "the ability to contemplate and communicate about the knowledge, beliefs, and goals of oneself and others (which) is a benchmark of human cognition" (p.301). They criticized Bretherton et al's study on the grounds that the occurence of lexical items noted does not necessarily provide evidence that young children have a theory of mind. Rather, the words might be being used for conversational functions without any reference to mental states. For example, 'you know' may be nothing more than a "conversational pause-filler" etc. (p.302). Shatz et al's more conservative study therefore decided to check whether any mental state terms used occurred in the context of contrasts between reality and non-reality, action and intention, fact and belief, etc. Such occurrences were called "contrastives". The importance of these was explained as follows:

> "We take (contrastives) to be especially informative cases because the recognition that mental events can be at variance with observable events seems to be a core element in understanding the internal world. Indeed, making the difference explicit seems to be a prime motivation for expressing mental states among adults. These sorts of contrastive utterances, then, constitute a paradigm case of mental state expression, and they would be good evidence that the young child's conception of the internal world is similar at least in one way to the adult's." (p.304).

These authors define 'contrastives' as:

> "Those sentences which mark an understanding of a difference or discrepancy between some mental state and present or observable reality. In the utterance, "Before I thought this was a crocodile; now I know it's an alligator", a prior belief is explicitly contrasted with the current state of affairs...(some) further examples (include): "I was teasing you; I was pretending 'cept you didn't know that". "The people thought Dracula was mean, but he was nice". "I thought there wasn't any socks, but when I looked I saw them". " (p.309).

The reason why contrastives are important to these authors is identical to the reason why false beliefs are important to Wimmer and Perner (1983). Both are considered to be paradigmatic cases in providing evidence of a child's theory of mind. Shatz et al derived their data from 2 sources: a single, longitudinal case study of a child from 2:4-4:0 yrs; and speech samples from 30 2 year olds. Using the more conservative criteria, their results nevertheless confirmed those of Bretherton et al (1981; 1982). They also found that their sample produced mental verbs in their third year. In addition, they found that contrastives were among the first mental state utterances.

Whilst these last two studies looked at production of mentalistic words, another set of studies has focussed on the child's comprehension of specific mental state terms: Miscione, Marvin, O'Brien and Greenberg (1978) looked at the words 'know' and 'guess', and Wellman and Johnson (1979) looked at 'remember' and 'forget'. Both studies report a period during the preschool years when children interpret these mental state terms only with reference to <u>external</u> states. Wellman and Johnson found that 4 year olds judged that if a story character correctly located an object they could be said to have 'remembered' its location, while one who was incorrect could be said to have 'forgotten', even when the character had no initial knowledge of the object's location. In Miscione et al's study, the same age pattern emerged: subjects claimed to 'know' when they were correct in locating an object and to 'guess' when they were incorrect, regardless of their <u>actual</u> knowledge. (Their actual state of knowing and guessing was systematically varied by having the subject either watch or not watch the experimenter hide the object). These authors report that by around 5 years of age the children's understanding becomes equivalent to the adult's.

However, Johnson and Wellman (1980) succeeded in demonstrating that

4 year olds could use the mental state terms 'remember', 'know', and 'guess' correctly, under conditions when the child is "tricked": the subject observed an object being hidden, but then the object was secretly moved elsewhere. Thus, the child's own immediate expectancy or belief was contradicted by the external events. Under these conditions, the children referred to their knowledge of where they had believed the object to be. These results caution against the view that young children base their early interpretation of mental terms solely on externally perceived states (Miscione et al, 1978).

Macnamara, Baker and Olsen (1976) found evidence that many 4 year olds understand the "unstated presuppositions and implicatives" (p.68) of the mental state terms 'pretend' and 'forget', and that in some cases they can employ such implicit propositions to make indirect inferences (eg: 'Robert is pretending to be sick' implies 'Robert is not really sick' and indirectly implies 'Robert should go to school', etc.).

Stern (cited by Piaget, 1926) was impressed by the anecdotal reports of preschoolers' use of the term 'think', since it implied the cognitive ability to differentiate opinion from fact. This ability was also anecdotally recorded by Susan Isaacs (1930):

> "Some questions of fact arose between James and his father, and James said, 'I know it is!' His father replied, 'But perhaps you might be wrong!' Denis (4 years 7 months) then joined in, saying, 'But if he knows, he can't be wrong! Thinking's sometimes wrong, but knowing's always right!' " (p.355)

This ability has been demonstrated experimentally more recently among 4 year olds by Johnson and Maratsos (1977). They used a paradigm which is very similar to that used by Wimmer and Perner (1983), in which a character is told a lie about an object's location, and thus holds a false belief. The subject is asked (a) where the character will therefore look for the object, and (b) whether the character 'thinks' or 'knows' the object is there. Some 4 year olds, but no 3 year olds, answered these questions correctly.

3.2.(iv): Evidence from studies of children's 'pragmatic' competence.

a. Preverbal infants:

Bruner (1975a; 1975b) argues that the preverbal infant shows the precursors to a 'theory of mind' in "joint reference" and "joint attention" (Bruner, 1975a, p.9). This includes such abilities as being able to follow another person's 'line of regard' and understand the 'pointing' gesture, both of which are within the abilities of a 9 month old infant (Scaife and Bruner, 1975; Churcher and Scaife, 1982; Butterworth and Cochran, 1979). Of course, to the extent that the former involves a 'theory of sight' (Experiment 2, this thesis), there may be no mentalistic component in being able to follow another person's line of regard. However, another such preverbal "intersubjective" activity or "format" (Bruner, 1983a & b) is turn-taking in parent-child interactive games. Bruner argues that all of these activities involve the child representing an "addresser's (and an) addressee's communicative intent" (Bruner, 1975b, p.262), much like any other Speech Act (Grice, 1975). He proposes that infant behaviour that has developed into this "reciprocal mode" (p.277) with others is a sign that an infant's theory of mind may be present in an embryonic form long before any explicit verbal indicators of it are present.

This view also characterizes the study by Bates, Camaioni and

Volterra (1975). Both their work and Bruner's leans heavily on Austin's (1962) distinction that Speech Acts (both verbal and non-verbal) are either "illocutions" or "perlocutions" (a distinction which was referred to before - see p.83). Perlocutions are acts that "create effects", intentionally or otherwise, on a listener. Thus, a hunger cry of a newborn infant can be regarded as a 'perlocution', as can a punch in the face. An illocution, in contrast, "requires the intentional use of a conventional signal to carry out some socially recognized function" (Bates et al, 1975, p.206). Bates et al regard acts such as pointing as illocutionary, again thus attributing to preverbal infants a theory of mind. They put the date of this ability at around 10 months of age:

> "It appears that, until 10-11 months of age, Carlotta is unaware of the potential role of adults as agents in fulfilling her desires. Hence, she is unaware of the effects of her signals as instruments for operating on adult intentions" (p.214).

The focus, for both Bruner and Bates et al, is on <u>use</u> of actions in communicative contexts, ie: on 'pragmatics'. Coggins and Carpenter (1981) have designed a "communicative intention inventory" as a checklist for the presence or absence of such 'preverbal speech acts', and their terminology suggests that they agree with the mentalist interpretations of pointing, etc. However, whilst there are now quite a number of authors (Dore, 1975; Schaffer, 1979; Trevarthen, 1980) who subscribe to the view that preverbal children as young as 12-18 months have a theory of mind, this view still rests heavily on a particular interpretation of behaviours such as pointing, etc. This view, while plausible, is scientifically 'fragile', in that it merely depends on whether one "likes it" or not. In contrast, the experimental evidence reviewed earlier (eg: Wimmer and Perner, 1983) makes certain predictions about what a child will do in a given situation if s/he has a theory of mind. These latter type of studies thus produce a stronger kind of 'evidence'.

b. Verbal children:

This scientific quality is also a feature of many of the studies into verbal children's pragmatic competence. Shatz (1978), in the tradition of Speech Act Theory, emphasizes that

> "understanding involves the listeners' representing the messages sent to them in just the way the senders intended them to be represented. Misunderstanding occurs when listeners represent messages in ways other than those intended" (p.272).

Thus, one source of evidence that young children have a theory of mind is if they can spontaneously repair misunderstood messages: this pragmatic skill implies both that they are aware that their listener has not understood the intention behind their message, and that modifying the form of the message is necessary in order to communicate the same meaning or intention.

Maratsos (1973) found that 3 year olds who had to communicate about some objects to someone blindfolded gave far more adequate messages than children communicating to someone with 'normal' vision. Thus, they showed evidence of "nonegocentric communication abilities" (p.697). This result is in line with studies by Shatz and Gelman (1973) and Sachs and Devin (1976) who independently found that 4 year olds modified their speech when talking to different aged listeners. Wellman and Lempers (1977) even found this ability among 2 year olds. Similarly, Menig-Peterson (1975) and Perner and Leekam (1985) found that 3-4 year olds modified their speech substantially depending on whether their listener was knowledgable about the experiences the child was describing (having participated in them), or whether the listener was 'naive'. Masur (1978) found that 3-4 year olds will also adapt their speech to their listener's linguistic level, and Mueller et al (1977) observed that 2 year olds will adjust their communications to their listener's attention. In all these studies, the children were thus "tailoring their behaviour in accordance with the listener's needs" (Menig-Peterson, p.1017), evidence of adopting an "intentional stance" (Dennett, 1978a).

Thus, it seems that young children's speech frequently takes the form of reciprocal dialogue, ie: it is social, 'intentional' and communicative (Garvey and Hogan, 1973; Mueller, 1972), although other egocentric features (eg: failure to resolve referential ambiguity) persist into later childhood (Sonnenschein and Whitehurst, 1984; Singer and Flavell, 1981). The conclusions from these studies on pragmatic competence tend to endorse the results from other language studies [reviewed in section 3.2.(iii)] and from experimental studies in conceptual role-taking [section 3.2.(ii)], ie: that strong evidence can be adduced to demonstrate that normal children have a theory of mind in their third year of life which is explicit in their language, and in the fifth year of life this is implicit in their experimental responses. Whether it exists any earlier than the third year is not out of the question but is simply hard to prove, eg: Wilcox and Webster (1980) found that if the experimenter deliberately created 'communication failures', children as young as 17-24 months would recode their messages. This could be evidence of their theory of mind (eg: my listener does not understand my intention), but this is not the only possible explanation of the toddlers' behaviour. The studies reviewed in the next section consider whether any non-human species have this ability.

3.2.(v): Do non-human animals have a theory of mind?

Dawkins and Krebs (1978) have described a number of examples of behaviour from different species of what on the surface appears to be 'deception' or 'lying'. For example, the sabre-toothed blenny (Aspidontus taeniatus - a fish) is evolutionarily equipped such that its appearance and locomotion are identical to the cleaner wrasse (Labroides dimidiatus): this allows it to approach larger fish closely, at which point instead of cleaning them it bites chunks out of them. For examples such as this to qualify as 'true' cases of deception, one would have to show that the deceiver intended to induce a false belief in the deceived (that x is true when really it is false). Such an intentional explanation is unparsimonious and unsupported, since it is evolutionary pre-wiring which allows 'lower' animals to behave with such "stimulus-contingent fixed action patterns" (Quiatt, 1984) like the sabre-toothed blenny above.

The most interesting examples of animal behaviour that are plausible candidates for being called 'deception' (and thus evidence of a theory of mind) come from monkeys and apes. Van Lawick-Goodall (1971) reports an incident of a monkey ignoring a banana until another monkey had left the area (p.107), but whether such an isolated incident qualifies as 'intentional deception' is hard to evaluate. A behaviour which occurs more frequently is "infant stealing and kidnapping" by rhesus monkeys (Quiatt, 1984, p.26). Descriptions of these activities are intriguing: a young female monkey approaches the mother to groom her, thus relaxing her and making the infant more accessible. Slowly she transfers her grooming activities to the infant, then suddenly scoops up the infant and runs off. Quiatt argues that if we are prepared to attribute the "complex intentions" (Strawson, 1979) necessary for deception to the kidnapper, then presumably the mother of the kidnapped infant should equally possess this ability for reflection on intentions. Since rhesus mothers do not appear to show any 'wariness' or 'suspicion' or 'overprotectiveness' when approached ostensibly for grooming activities, this kidnapping example may be no different to the kind of behaviour of the blenny fish, described above.

What of the reports involving practical jokes? Koehler (1925, p.85) describes a game called "chicken-teasing": the ape holds a stick in one hand and with the other hand holds out a piece of bread to the chickens who feed just outside the apes' large cage. When a chicken approaches and pecks at the bread, the ape whisks it away, leaving the chicken biting the air and getting a sharp poke in the feathers with the stick. Quiatt (1984) describes similar tricks chimpanzees play on (more intelligent, warier) human victims, such as sitting quietly in the cage until a human comes within 12 feet, and then dousing the person with a gushing jet of water from their mouth. This occurs successfully despite people being warned of the risks, perhaps because the chimpanzees often do not swell out their cheeks at all.

Quiatt's explanation for these two examples is in terms of captive non-human primates' need for sensory stimulation to dispel 'boredom'. He sees no grounds for calling these behaviours "intentionally deceptive", since they comprise provoking startle reactions for the sake of observing them. The fact that they are quite complex action sequences (especially the 'chicken-teasing') does not change the fact that they can be performed purely on the basis of a <u>causal</u> understanding, ie: knowing which actions will cause which effects. In the case of the chicken game, the routine is often performed 50 times in a row during a lunch-hour. There is thus plenty of opportunity for apes to learn the causal patterns.

Premack and Woodruff (1978) suggested that chimpanzees' theory of mind could be experimentally demonstrated to exist. They showed Sarah, an adult chimpanzee, videotaped scenes of a human actor struggling with a variety of problems such as food out of reach, being locked in a cage, trying to play an unplugged-in record player, etc. With each videotape she was given a pair of photographs, of which one was a 'correct' solution to the problem (eg: a stick for the inaccessible bananas, a key for the locked cage, etc). The fact that Sarah consistently chose the correct photograph was interpreted by Premack and Woodruff to indicate that Sarah had the ability to attribute <u>purpose</u> and intention to the actor, and to choose alternatives compatible with the actor's purpose (eg:'He <u>wants</u> to reach the bananas, and he <u>believes</u> that using the stick will achieve this', etc).

The difficulties inherent in ascertaining if a non-verbal being has a theory of mind are enormous, and this study has attempted to overcome these ingeniously. The question is whether these authors have succeeded in demonstrating a theory of mind in chimpanzees. As discussed earlier (see p.100), a number of commentators on this experiment (Dennett, 1978b; Bennett, 1978; Harman, 1978) raised the objection that the videotapes used could be described in 'behaviourist' terms just as easily (eg: 'Bananas are for eating, and with the stick the man reaches the bananas and eats them'). Thus, Sarah's correct responses on these tasks may have been achieved without recourse to attribution of mental states to the actor. An even more sceptical interpretation of her success is simply in terms of associationism: keys go with padlocks, sticks go with out-of-reach bananas, etc.

These commentators argued that a more stringent test of a chimpanzee's theory of mind is when the chimpanzee observes someone who sees an object put in one location (x), and who is absent when the object is moved (to y): if the chimpanzee predicts that the person will search for the object in x, then even the most radical behaviourist would be forced to conclude that the chimpanzee believed that the person falsely believed that the object was in x. Thus, the chimpanzee would be adopting a 'second-order intentional stance' (Dennett, 1978b). The acid test, then, of whether some person or animal has a theory of mind is in the attribution of false beliefs (ie: beliefs about different beliefs). This was the basis of Wimmer and Perner's (1983) experiment with 4 year old children, as was described earlier (p.101). It was also the basis of another experiment on chimpanzees:

Woodruff and Premack (1979) tested whether chimpanzees could convey and comprehend accurate and 'misleading' information concerning the location of hidden food. In one test, a chimpanzee was informed of the location of the food but denied access to it:

> "The animal could obtain food only by imparting information about its location to an uninformed human positioned outside the enclosure, in the vicinity of the goal. One human was friendly and cooperative; if he found the food he gave it to the chimpanzee, but if he failed the animal received nothing. Another human was hostile and competitive; if he found the food he kept it for himself, but if he failed the chimpanzee was allowed to leave the enclosure and obtain the food" (p.335).

4 chimpanzee subjects quickly learned to indicate to the cooperative

trainer the correct location of food, eventually using an outstretched arm or leg to "point" to the baited container. All 4 also learnt to "suppress information" when working with the competitive trainer, and 2 of them learned to convey misleading information, 'pointing' to the unbaited container.

Does this indicate that the chimpanzees intended the trainer to believe that the food was where they pointed? There are two obvious criticisms with this interpretation of the experiment: first, the results were achieved only after an extensive training of 5 months, and the learned responses (outstretched arm or inhibited arm movement) could be explained more simply in behaviourist terms of stimulus-contingent reinforcement. Secondly, the human stooges were expressly required not to 'see through' the chimpanzees' blatant 'lies' and modify their own behaviour accordingly. Since the competitive trainers did not respond to 'deception' as deception, the context can hardly be said to have any 'ecological validity' (for the humans or the chimpanzees). Dennett (1983) and Seyfarth (1984) further point out that it is surprising that the chimpanzees were not 'puzzled' when the competitive trainer, having gone to the incorrect box, failed to go to the correct box. This suggests that they did not understand the relation between their actions and the mental states of the trainer. Woodruff and Premack would disagree with this view, since they believe that "these instances of deceit (in their experiment) meet the most stringent behavioural criteria for intentional communication" (p.356). It is unfortunate that they did not really use the paradigm suggested by their commentators [Dennett, 1978b; Harman, 1978; Bennett, 1978] earlier (ie: attribution of false belief), an experiment which still needs to be done if chimpanzees, like humans, are to be shown to have a theory of mind.

Until then, it cannot yet be said that chimpanzees have a theory of mind, and, since a theory of mind is necessary for 'true' communication (Grice, 1957; Mackay, 1972), it is thus still a raging debate as to whether they can be said to 'communicate' (Seyfarth, Cheyney and Marler, 1980; Dennett, 1983; Sugarman, 1983; de Waal, 1982).

3.2.(vi): Summary of literature review on the theory of mind:

The evidence from the studies reviewed suggests the following picture:

1. If one accepts a Speech Act Theory of communication, then a theory of mind is a necessary prerequisite for the ability to communicate (Grice, 1957; Searle, 1965).
2. If one assumes people are rational, then a theory of mind allows one to explain and predict other people's (rational) behaviour (Dennett, 1978a).
3. If one has a theory of mind, this implies that cognitively one is a "second-order intentional system" (Dennett, 1978a), capable of "metarepresentation" (Pylyshyn, 1978 - this will be expanded in section 4.4).
4. Since children as young as 4 years old have been shown to understand and use the mental state concepts of 'intention' and 'motive' (Shultz, Wells and Sarda, 1980; Yuill, 1984), 'believe' and 'know' (Mossler, Marvin and Greenberg, 1976; Marvin, Greenberg and Mossler, 1976), and 'false belief' (Wimmer and Perner, 1983; Wimmer, Gruber and Perner, 1984), they can be said to have a theory of mind.
5. This conclusion is backed up by evidence from language studies reporting use of mental state terms by 2-3 year olds (Bretherton,

McNew and Beeghly-Smith, 1981; Bretherton and Beeghly, 1982), especially in 'contrastive' contexts such as false beliefs (Shatz, Wellman and Silber, 1983). Other studies have also demonstrated that 4 year olds' definitions of these mental state words are indeed 'mentalistic' (Johnson and Wellman, 1980; Macnamara, Baker and Olsen, 1976; Johnson and Maratsos, 1977).

6. Studies of 3-4 year olds' pragmatic skills have demonstrated use of their theory of mind in communicative contexts (Shatz and Gelman, 1973; Sachs and Devin, 1976; Menig-Peterson, 1977), and an increasing number of authors subscribe to the view that preverbal infants' gestures are evidence of their theory of mind being present as young as 12-18 months (Bates et al, 1975; Bruner, 1975a; b; 1983a & b).

7. Finally, it remains to be demonstrated convincingly that any animals other than humans have a theory of mind, although chimpanzees are a plausible candidate population for such an ability (Woodruff and Premack, 1979).

In the light of this evidence of young normal children's theory of mind, and in the context of its importance in social cognition, it was decided to experimentally investigate the hypothesis that autistic children are impaired in their theory of mind, since this might go some way towards explaining their lack of communicative and social skills.

Chapter 4: The autistic child's 'theory of mind': an empirical investigation.

4.1: Experiment 3: Attribution of false beliefs:

Introduction:

To test the hypothesis that the autistic child's theory of mind is impaired, a task derived from Wimmer and Perner (1983) was used. The experiment by Wimmer and Perner was described above (p.101), which conformed to the 'acid test' of demonstrating a theory of mind (Dennett, 1978b; Harman, 1978; Bennett, 1978). The strength of their paradigm can be summarized as follows: it requires the subject to represent both how the world actually is, and how an ignorant story character falsely believes it to be, thus clearly distinguishing between the beliefs of the subject and another person. Success thus requires 'beliefs about beliefs'. Secondly, it does not place too great a value on the child's verbal responses; certainly, the child has to be able to follow the narrative of the story (and this is checked by a number of control questions), but the child is given the opportunity to demonstrate his or her theory of mind through a non-verbal gesture (pointing). The paradigm thus avoids the possible pitfall of confusing mental state language with mental state understanding. For these reasons, and because the results of their experiment showed the ability to be present in normal children of 4 years old, it was decided to use Wimmer and Perner's paradigm in the evaluation of autistic children's theory of mind.

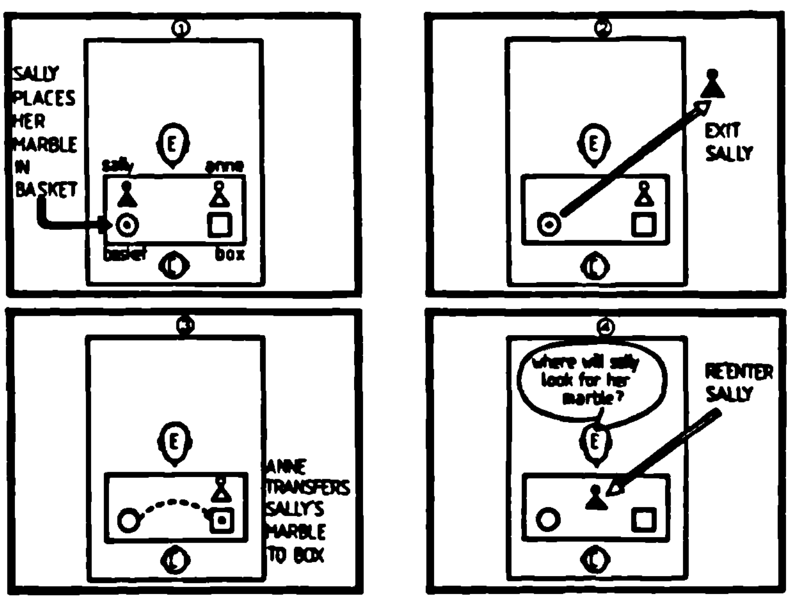
Subjects:

The subjects who participated in this experiment were the same as those who took part in the previous two experiments, and their details can be found in Table 1.1 on page 48. The main features of the sample were as follows: The autistic group (n = 20) had a higher mental age than the Down's Syndrome group (n = 14) on both the non-verbal scale (Leiter International Performance Scale) and on the more conservative measure of a verbal scale (British Picture Vocabulary Scale). It was assumed that the normal group (n = 27) had an MA which roughly corresponded with their CA. Therefore, their MA was, if anything, lower than that of both handicapped groups. A high functioning subgroup of autistic children was selected in order to enable a stringent test of the hypothesis to be made: that is, that the predicted deficit in their theory of mind would be autism-specific, and not a function of general retardation (such as characterizes the Down's Syndrome children).

Procedure:

The procedure is illustrated in Figure 4.1. [This Figure is reprinted from Baron-Cohen et al (1985), where this experiment is reported].

Figure 4.1: Procedure for Puppet Experiment (3).



There were 2 doll protagonists, Sally and Anne. The children were first tested to see if they knew which doll was which. This was called the 'Naming Question': the experimenter asked "Which one is Sally? Which one is Anne?". The subject only had to point to the correct doll. Passing the Naming Question was an inclusion criterion for the rest of the experiment, since this demonstrated a minimal level of language comprehension. All subjects were able to pass this first question. Then the subject was told the following story:

"Sally has a basket and Anne has a brown box". (These 2 containers are placed in front of the 2 dolls). "And Sally has also got a little red marble. She puts her marble into her basket." (Experimenter puts marble into basket). "Now Sally goes for a walk." (Sally walks off stage). "Anne gets up, goes over to Sally's basket, and takes her marble. She puts it inside her brown box, and turns the box upside down. (The marble is therefore out of sight). "Now, here comes Sally, back from her walk." (Sally enters, and walks to mid-stage, and stops, between the two containers)."Where will Sally look for her marble?" (This is called the 'Belief Question'. The subject points to one of the containers. If they point to the basket, the subject passes the Belief Question). "Where is the marble really?" (This is called the 'Reality Question': correct response is if the subject points to the box). "Where was the marble in the beginning?" (This is called the 'Memory Question': correct response is if the child points back to the basket).

The story was then repeated twice more: in the second version the marble is moved from the basket to the Experimenter's pocket. In the third version the ball is taken out of the basket, but then replaced in the basket. (This was called the 'replacement' condition). On the second trial there were therefore 3 different locations the child could point at (basket, box, and pocket). Correct responses to all 3 Questions for each of the 2 trials were therefore different.

Results:

The results are summarized in Table 4.1. The crucial column in this Table is marked 'B', indicating the Belief Question:

Table 4.1: Percentage of subjects passing in Experiment 3:

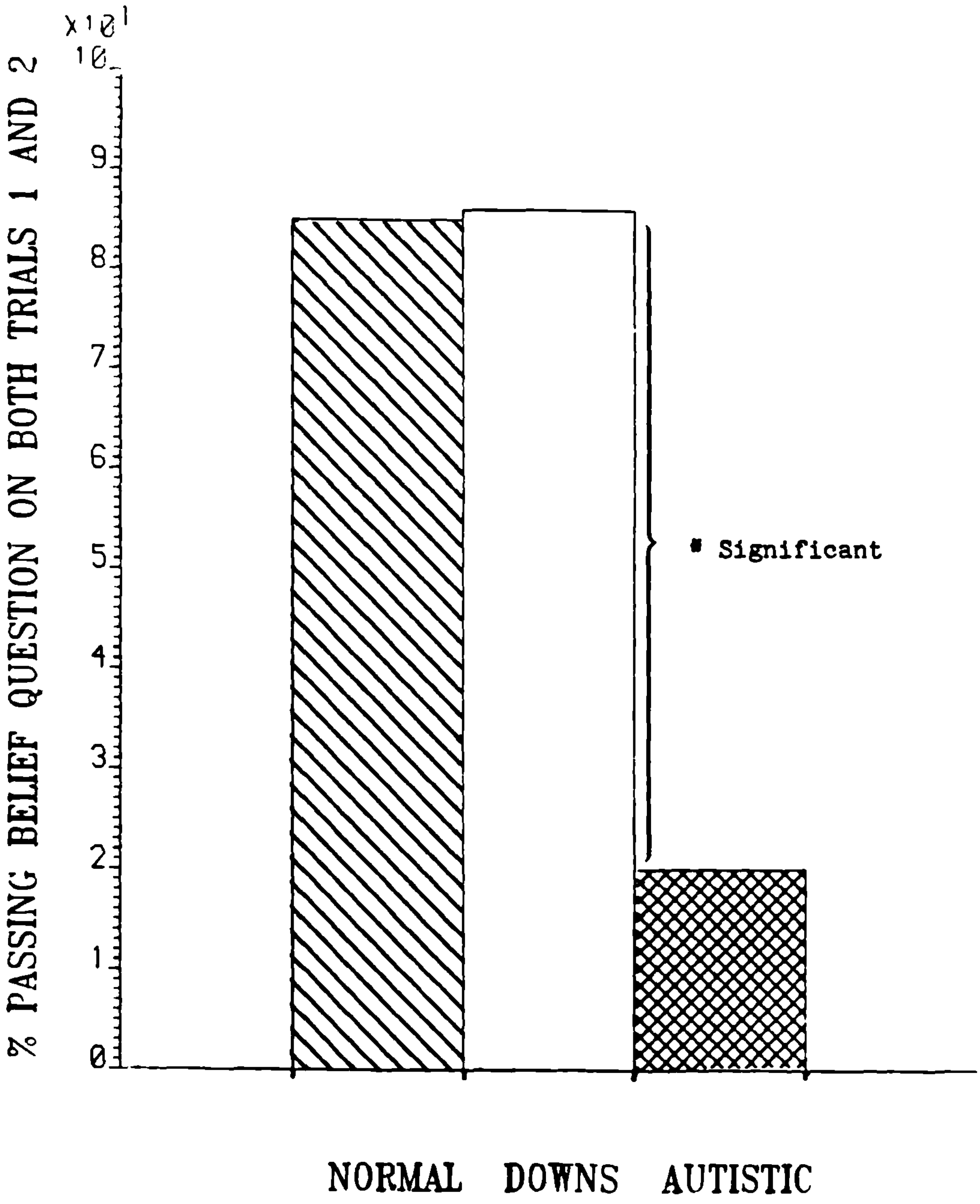
	TRIAL 1			TRIAL 2			TRIAL 3		
	B	R	M	B	R	M	B	R	M
Autistic	20	100	100	20	100	100	100	100	100
Down's	86	100	100	92	100	100	100	100	100
Normal	85	100	100	85	100	100	100	100	100

B = Belief Question; R = Reality Question; M = Memory Question.

All subjects passed the Naming Question. Furthermore, all subjects without a single exception performed without any errors for both the Reality and Memory Questions on all 3 trials, and in the replacement condition, all subjects passed the Belief Quesion as well. However, on this condition, there was no locational distinction between where the marble really was, and where Sally believed it to be. Thus, this condition was not a test of their theory of mind, but confirmed that all subjects followed the narrative of the story. The Belief Question for the first 2 trials was answered consistently by each child, with the sole exception of one Down's Syndrome child (Subject

Number 5, see Appendix 2) who failed trial 1 and passed trial 2. The results for the Down's Syndrome and normal subjects were strikingly similar: 23 out of 27 normal children (85%) and 12 out of 14 Down's Syndrome children (86%) passed the Belief Questions on both trials. By contrast, 16 out of the 20 autistic children (80%) failed the Belief Question on both trials. This difference between the groups is shown in Figure 4.2 (below) and was highly significant (Chi^2 = 25.9, df = 2, $p < 0.001$).

Figure 4.2: Group differences on Belief Question in Experiment 3.



All 16 autistic children who failed pointed to where the marble really was, rather than to any of the other possible locations, which suggests that their error was not due to random pointing ($p = 0.006$, Binomial Test, one-tailed). The four autistic children who passed succeeded on both trials. They were subject numbers 2,7,8,and 21, and their individual subject data can be found in Appendix 2. Their CA ranged from 10:11 to 15:10 years, their non-verbal MA's were between 8:10 and 10:8, and their verbal MA's between 2:9 and 7:0. Comparison with the data in Table 1.1 (p.48) shows that these children were fairly average on all the available variables. They were not significantly different from those who failed on either CA ($t = 1.33$, $df = 18$, $p = 0.2$, two-tailed) or MA [Leiter] ($t = 0.399$, $df = 18$, $p > 0.5$, two-tailed), or MA [BPVT] ($t = 0.59$, $df = 18$, $p > 0.8$, two-tailed). In other words, there were certainly other children of equal or greater MA and CA who gave incorrect responses. The 2 Down's Syndrome children who failed on the Belief Question on one or both trials are subjects 2 and 5 (see Appendix 2).

Discussion:

The fact that every single child taking part in the experiment correctly answered the control questions allows us to conclude that they all knew (ie: believed) that the marble was put somewhere else after Sally left. The critical question was: "Where will Sally look?" after she returns. Here a group difference appeared: autistic children answered this question in a distinctly different way from the others. The Down's Syndrome and the normal preschool children answered by pointing to where the marble was put in the first place. Thus, they must have appreciated that their own knowledge of where the marble actually was and the knowledge that could be attributed to the doll were different. That is, they predicted the doll's behaviour on the basis of the doll's belief. The autistic group, on the other hand, answered by pointing consistently to where the marble really was. They did not merely point to a 'wrong' location, but rather to the actual location of the marble.

This becomes especially clear on Trial 2 where the autistic children never pointed to the box (which had been the 'wrong' location on Trial 1), but instead pointed to the experimenter's pocket - ie: again to where the marble really was. This rules out both a position preference and a negativism explanation. The failure on the Belief Question was also not due to random pointing. Nor could it have been due to any failure to understand and remember the demands of the task or the narrative, since these children all answered the Naming, Memory and Reality Questions perfectly. The conclusion therefore is that the autistic children did not appreciate the difference between their own and the doll's belief.

The results thus strongly support the hypothesis that autistic children as a group fail to employ a theory of mind, ie: they showed no evidence of being able to attribute mental states such as different beliefs to another person. This was in contrast to an intact theory of mind in normal 4 year olds - a result which replicates that found by Wimmer and Perner (1983). A more dramatic contrast perhaps was with the Down's Syndrome subjects, who also demonstrated that they possessed and could employ a theory of mind. Thus, the failure shown by the autistic children cannot be attributed to the general effects of mental retardation, since even the more severey retarded Down's Syndrome children performed close to ceiling on this experiment.

There is however a suggestion that there may exist a small subgroup of autistic children who succeeded on the task and who thus may be able to employ a theory of mind. It is unclear in what way this 20% of the autistic sample were different from the rest of the group. They were not different from the other autistic children in terms of MA (either verbal or non-verbal) or CA. However, although not significantly so, they were among the older subjects in the autistic group. One hypothesis is that their social cognition is intact at least at this simple level (the level of a normal 3-4 year old), and thus they are less 'autistic' than the rest of the group, but their social cognitive deficits would become evident in a task of slightly greater complexity. This possibility is tested in an experiment to be reported later (Experiment 6, section 5.5).

As defined earlier, the Puppet Experiment (3) tested autistic subjects' <u>conceptual</u> role-taking skill, in contrast to Experiment 2 which tested <u>perceptual</u> role-taking skill. The results of these two experiments suggests that the two abilities are indeed distinct. The difference is postulated to lie in the fact that attribution of mental states is only required in conceptual and not perceptual role-taking tasks. These two experiments also show that only impaired conceptual role-taking skill is associated with the social impairment found in autism.

In the next experiment, the impairment in autistic children's theory of mind was retested, using a different paradigm, to test the stability of the finding from the Puppet Experiment, and to test whether the impairment was specific to understanding situations which required attribution of mental states, or whether it extended to all comprehension of all social situations.

4.2: <u>Experiment 4: Attribution of false beliefs and 'social scripts'.</u>

In Experiment 4, picture stories of social (ie: interpersonal) situations were presented to autistic children. Some of the stories required the subject to attribute false beliefs to a character, and some did not. Such an experimental design allowed the 'specific deficit hypothesis' to be tested: ie, that the social impairment in autism is associated with a failure to employ a theory of mind, rather than a difficulty in comprehending <u>all</u> social situations.

A picture-sequencing technique was chosen to test this hypothesis. The appropriateness of this paradigm lies in the fact that it "commands itself", that is, it requires no necessary verbal instructions from the experimenter. Furthermore, it requires <u>no</u> verbal response from the child, which is very convenient in the case of the autistic group. Lastly it allows a fairly uniform method of testing many different conceptual problems. An additional rationale behind the experiment was to test whether the deficit found in the first experiment using puppets was replicable using a different paradigm.

The child's ability to arrange the individual pictures into a coherent story was assumed to depend on the subject applying the appropriate explanatory schema which would connect the separate actions depicted in the pictures. There were 3 conditions:

<u>SCRIPTAL 1:</u> One person acting in very familiar situations;
<u>SCRIPTAL 2:</u> Two people acting in very familiar situations;
<u>MENTAL:</u> People acting with false beliefs;

The 'Mental' Condition was assumed to require the mental-state concept of false belief to link the pictures. The 'Scriptal' Conditions could be sequenced using 'social scripts' (Nelson, 1981; Wimmer, 1979), without any necessary knowledge of mental states. These latter stories comprised such everyday sorts of occurrences that a single routine or 'script' (Schank and Abelson, 1977) could specify their temporal order:

> "A script, as we use it, is a structure that describes an appropriate sequence of events in a particular context. A script is made up of slots and requirements about what can fill those slots. The structure is an interconnected whole, and what is in one slot affects what can be in another. Scripts handle stylized everyday situations. They are not subject to much change, nor do they provide the apparatus for handling novel situations...For our purposes, a script is a predetermined, stereotyped sequence of actions that define a well-known situation. A script is, in effect, a very boring little story...(For example) 'John went into the restaurant. He ordered a hamburger and a coke. He asked the waitress for the check and left'. " (Schank and Abelson, 1977, p.422).

Nelson (1981) adds:

> "Scripts are...concrete...general event representation(s) derived from and applied to social contexts" (p.101).

Since they are concrete, they can only describe behaviour, not mental states. All 3 conditions could be sequenced and understood using a mentalist strategy, since such a strategy is very powerful (Dennett, 1978a), but a complete understanding of the 'Mental' Condition was not possible using a scriptal strategy, although this might result in a correct sequence being produced. The child's understanding of the sequences s/he produced, whether 'correct' or not, was tested by eliciting protocols. This will be discussed in the Results section later.

Materials:

The pictures were drawn on white cards, 5 inches by 5 inches. The images had simple black outlines, and 4 colours were used throughout. A mixture of drawing styles was used, since some material was commercially available, and some were drawn either to specification by an artist, or by the Experimenter. These are shown in Appendix 5. Each picture contained approximately one action and three objects, in an attempt to match the stimuli for complexity across conditions. However, it is highly problematic to find appropriate objective criteria with which to assess complexity, and this question must remain open pending replication with a new range of materials. In the present design, each child was presented with the same set of stimuli. Thus, relative ease of performance can be compared. Figure 4.3 below shows the 9 stories used.

Figure 4.3: <u>Contents of Picture Stories in Experiment 4:</u>

Picture	1	2	3	4
SCRIPTAL 1:				
1.	Turns on tap	Stands under it	Soaps	Dries
2.	Puts on trousers	Then T-Shirt	Then shoes	Is dressed
3.	Man with spade	Digs hole	Pours in seeds	Fills hole
SCRIPTAL 2:				
1.	Girl walking	Open shop door	Buys sweets	Leaves shop
2.	Man rolls dough	Sprinkles veg	Cooks pie	Serves it
3.	Boy eats icecream	Girl sits down	Girl takes ice	Girl eats it
MENTAL:				
1.	Boy buys sweets	Leaves shop	Drops sweets	Boy shocked
2.	Girl puts down teddy	Picks flower	Boy takes teddy	Girl shocked
3.	Boy puts choc in box	Goes out	Mum eats choc	Boy shocked

These picture stories are shown in Appendix 5.

<u>Procedure:</u>

Each of the 3 conditions contained 3 stories, and each story comprised 4 pictures, so that the length was standardized. Autistic, normal, and Down's Syndrome subjects were each presented with every story, such that each child effectively had 3 trials in each condition. The order of presentation of the conditions was Scriptal 2, Mental, Scriptal 1 for all children. This order was designed so that the 'Mental' condition could benefit from any practice effects, and the Scriptal 1 condition could be used as a covariate in later analysis so as to assess any effects of fatigue. The stories within each condition were randomly presented.

With each story, the experimenter placed the first picture in its correct position (1) on a frame that had 4 empty squares in sequence, and the remaining 3 pictures in random order above it, so as to avoid any position cues which might lead to a systematic bias in sequencing. Each child was told, for each story:
"This is the first picture. Look at the other pictures, and see if you can make a story with them." If the child did not respond immediately, the experimenter first named all the objects in the picture, to ensure there was no ambiguity in the drawings, and then said: "Which is the next picture ?" The exact order of the placing of the 4 pictures in each story was noted down, as well as any self-corrections. Each child had only one attempt at each of the 9 stories. The narrations (protocols), spontaneous and elicited, of the stories they created were tape-recorded and transcribed (see Appendix 4).

The scoring system was as follows: Since the child was always told which was the first picture, there were 6 possible permutations in which the subject could sequence the other 3 pictures. These were 1234, 1243, 1324, 1342, 1423, and 1432. The correct sequence (1234) was given 2 points. 1 point was awarded if the child placed the last card in the correct position (1324), since the protocols showed that when this sequence occurred, the child at least understood that the story proceeded from a beginning to an end point. As a conservative measure, all other permutations were given a score of zero. The expected score by chance was therefore 0.5 for one story, or 1.5 for each condition (i.e. three stories).

Subjects:

The subjects were almost the same as in the first 3 experiments, with a few exceptions. The MA, CA, IQ, and Language Ages are given in Table 4.2, below. Once again, the autistic group can be seen to have the advantage of higher CA and MA over the control groups:

Table 4.2: Subject variables (means, standard deviations, and ranges) for Experiments 4 and 5.

	N	Chronological Age			Sex	
		x	sd	Range	Male	Female
Normal	27	4.5	0.7	3.5-5.9	14	13
Autistic	21	12.4	2.8	6.1-16.9	14	7
Down's	15	11.5	3.8	6.3-17.0	6	9

	Leiter M.A.			BPVT		
	x	sd	Range	x	sd	Range
Normal	-	-	-	-	-	-
Autistic	9.6	2.3	6.7-15.9	5.7	2.1	2.8-12.5
Down's	5.9	0.9	4.8- 8.5	2.9	0.6	1.8- 4.0

Results:

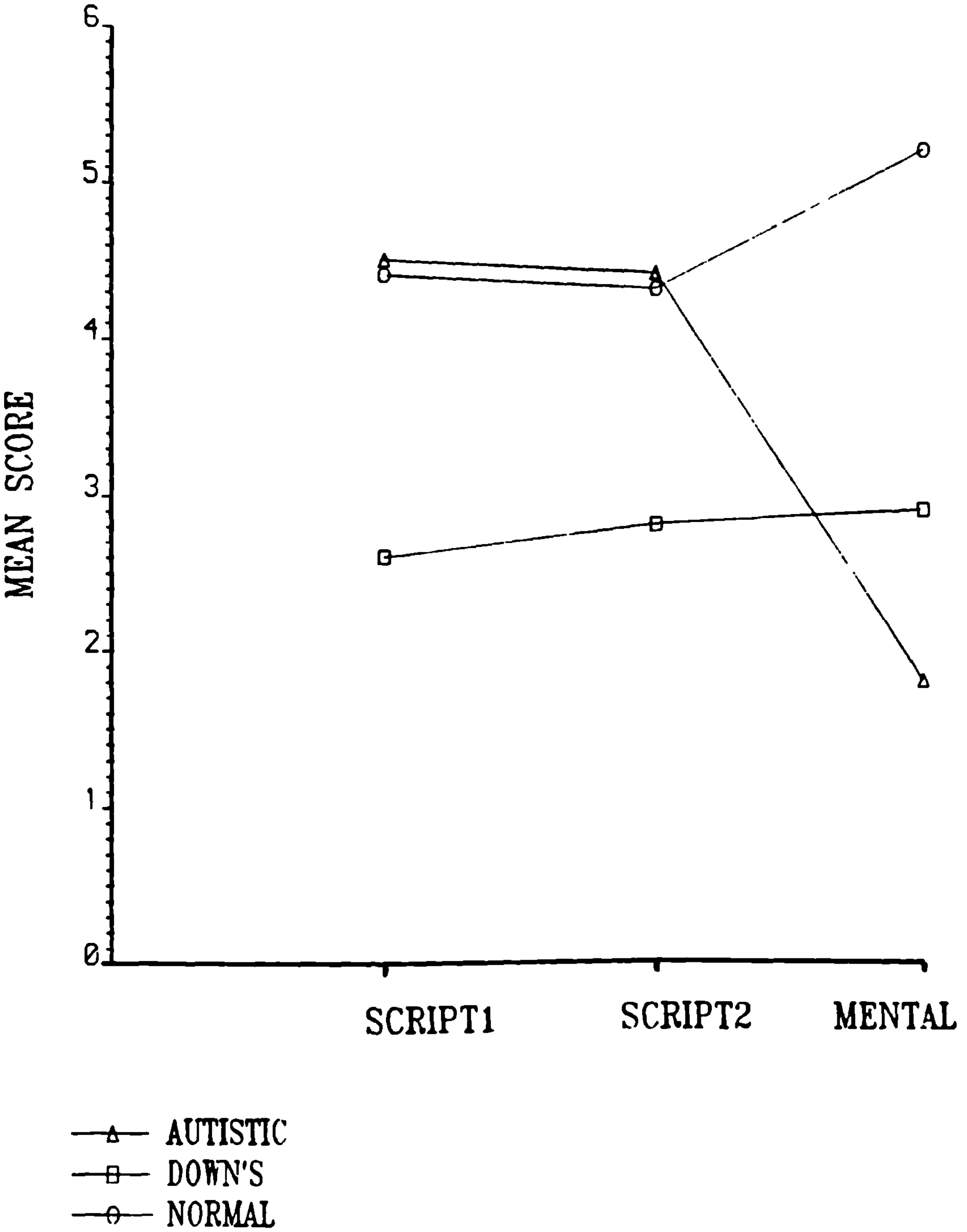
Table 4.3: Group Mean Scores for the three Conditions: Scriptal 1, Mental, and Scriptal 2.

	Conditions					
	SCRIPTAL 2		MENTAL		SCRIPTAL 1	
	x	sd	x	sd	x	sd
Normal	4.3	1.9	5.2	1.5	4.4	1.4
Down's	2.8	2.1	2.9	1.1	2.6	1.2
Autistic	4.4	1.6	1.8	2.5	4.5	1.3

Max = 6; Min = 0

The group mean scores for the 3 conditions is shown in Figure 4.4., overleaf.

Figure 4.4: Group mean scores for the 3 conditions in Experiment 4.



An ANOVA was performed to compare the 3 conditions (Scriptal 1, Scriptal 2, and Mental) and the 3 groups. There was a significant Group x Conditions interaction ($F_{4,120} = 14.68$, $p < 0.001$). Most importantly for the hypothesis, on the Mental condition the autistic group were significantly worse than even the Down's Syndrome group (Post-Hoc Scheffe Test, $p < 0.05$). There was no difference between the Scriptal conditions 1 and 2, and therefore there was no order effect. The autistic group were equal to the normal group on the Scriptal conditions, while the Down's Syndrome group were significantly worse (Scheffe Test, $p < 0.01$). For the Down's Syndrome group, performance was quite even throughout all conditions and quite poor overall.

When the last condition (Scriptal 1) was used as a covariate in order to control for the effects of fatigue on performance, there was still a significant Groups x Conditions interaction ($F_{2,60} = 19.93$, $p < 0.001$). This is effectively like matching the groups on the final condition. When CA was used as a covariate, the Groups x Conditions significant interaction remained ($F_{4,120} = 14.68$, $p < 0.001$) as when MA[Leiter] was used ($F_{2,68} = 11.1$, $p < 0.001$) and MA[BPVT] ($F_{2,68} = 11.1$, $p < 0.001$). In each case, the autistic group were significantly worse than the Down's group on the Mental condition (Scheffe Test, $p < 0.05$) as predicted.

An error analysis was performed on the sequences produced which scored zero. These combinations were 1423, 1432, 1342, and 1243. Their individual frequencies for each group were very similar, and so these were collapsed across the 3 groups. The observed frequencies were 21%, 21%, 30%, and 26% of the total number of errors, respectively. On the assumption that each had an equal probability of being produced (p = 0.25), these frequencies were not significantly different from chance (Binomial Test, $p > 0.15$). Furthermore, there were no significant differences within each condition (ie: between individual stories) but only between conditions, which suggests that within each condition the 3 stories were relatively homogeneous.

Protocol Analysis:

10 autistic and 6 Down's Syndrome children were sufficiently cooperative to provide verbal descriptions for either all or almost all 9 picture sequences. The minimum requirement was that the child should have given narrations in at least 5 out of 9 trials. In addition, protocols were gathered from a randomly selected one third of the normal children.

The narrations were rated according to strict criteria by 3 'non-independent' and 1 independent raters to fall into the categories of either 'mental state' or 'descriptive'. For each picture story a narration, regardless or length, was categorized into only 1 of the 2 classes. The score was determined on a "priority" basis, ie: for a Mental story, an utterance was scanned for a "mental state" expression (see below), and the default category was "descriptive". In Scriptal 1 and Scriptal 2 stories, utterances were scanned for mental state expressions and scored accordingly with "descriptive" again as the default category. Only if there was 100% agreement that an expression should be rated as 'mental state' from all 3 non-independent raters, and if this concurred with the independent rater, was an expression infact rated as 'mental state'. (This system, and the rating categories [shown overleaf], were devised by Alan Leslie).

The mental state category was applied only when the utterance contained:

a) A mental state expression (want, believe, know, pretend, wish, think, imagine, hope, expect, etc.) eg:

"He wanted to buy sweets". or eg:

"The boy didn't know she pinched his chocolate".

b) An implicit attribution of a mental state, eg:

"The boy was surprised 'cuz he couldn't find his chocolate".

c) An attribution of an utterance to the protagonist appropriate to his or her mental state, marked by special intonation, eg:

"He's shouting, 'Where's my sweet gone?'!"

Examples that were not considered to fall into the mental state category (because they are equivocal in terms of mentalistic language and are probably merely descriptive) were:

"He stole the teddy". or

"His mother claps her hands. He is frightened and goes outside".

Again, these utterances were placed by default into the descriptive category together with utterances such as:

"The girl puts her teddy down and the boy takes it, and the girl picks the flower". or eg:

"The boy buys some sweets and he drops them on the road. Then there are no more".

The protocols are shown in Appendix 4, together with their individual ratings. Between the independent and non-independent raters , 100% of Scriptal utterances and 95.6% of Mental utterances were scored identically. The remaining ones (3 out of 69) were, by default, scored as descriptive. For each child the ratings were turned into percentages relative to the total number of trials where verbal responses were made. The results of this classification are shown in Table 4.4:

Table 4.4: Percentage of utterances classified according to use of descriptive or mental state language.

CONDITION		SCRIPTAL 1 & 2		MENTAL
Utterances		"descriptive"		"mental state"
Groups				
Autistic	x	95		22
(n = 10)	sd	11	(n = 9)	33
Downs	x	98		78
(n = 5)	sd	7	(n = 6)	27
Normal	x	76		81
(n = 9)	sd	18	(n = 9)	24

The data were sufficiently normally distibuted to allow ANOVA with post-hoc Scheffe tests. In the Scriptal 1 and Scriptal 2 conditions all subjects used more "descriptive" utterances than any other kind but this was less evident in the normal groups who used a significantly greater proportion of "mental state" expressions ($F2,21 = 5.48$, $p < 0.01$). In the Mental condition a significant difference was obtained between the autistic group and the rest, since they used "mental state expressions" much more rarely than the Down's Syndrome and normal children ($F2,21 = 7.97$, $p < 0.002$). This is entirely consistent with the results of sequencing and suggests that success on this condition implies the ability to attribute mental states.

Discussion:

The results from the sequencing scores show that the autistic group were significantly worse on the 'Mental' Condition than either of the 2 control groups, though they were not worse on the other 2 conditions. What does the poor performance on the 'Mental' Condition imply? It would appear that, as the Puppet Experiment (3) showed, autistic children, independent of MA, are impaired in their ability to attribute a different belief to another person, since this is what the 'Mental' Condition is assumed to require.

The protocol evidence, although clinically gathered and therefore inconclusive, was highly consistent with this pattern. The autistic children showed a paucity of mental state language even in comparison with the Down's Syndrome children. In addition, the protocols for the autistic children showed that, with the exception of three subjects (Subjects Number 7, 8 and 10), they gave purely descriptive renderings of stories for which the other children readily gave mental state explanations. For example, a Down's Syndrome child (Subject Number 6) says for Mental Story 3 (see Figure 4.3, and pictorially illustrated in Appendix 5):

> "He says, 'Where's my chocolate?'!"

while a normal child (Subject Number 19) says:

> "The boy is putting the sweet in the box so nobody won't find it. Then he goes out. She eat it. And he's shouting, 'Where's my sweet gone?'!"

In both cases, the child attributes an utterance appropriate to the boy's expectation that the boy then discovers is false. A striking contrast is provided by the response to this story by an autistic child (Subject Number 5), who had managed to get the order of the pictures correct:

> "The boy put the chocolate in the box, and the woman ate it."

The experimenter prompts by asking,

"What does he say?"

The child replies,

"Why did you eat my chocolate?".

The subject's protocol reveals that he has not attributed a different belief to the character in the picture story. The first part of his description, however, suggests that the autistic child has understood the story full well in terms of the sequential displacements of the characters and the focal object, the chocolate. It is the final step of realizing that the boy believed the chocolate still to be in the box that is missing. Accordingly, such a protocol received a rating of 'descriptive' rather than 'mental state'.

The protocols also underline the point that the autistic children did not do so badly on the Mental stories because they could not make inferences or inventions "behind the scenes", as it were, to turn a group of pictures into a story. On the contrary, two autistic children (Subject Numbers 1 and 9) even made sense of the above story by <u>inventing</u> a second piece of chocolate:
"The boy puts his chocolate into the box. He eats his chocolate. He goes out to play. His grandmother eats a chocolate". Or, eg:
"The boy has a chocolate. He puts it in the box. Then his mother eats it and then he eats one too. He goes out of the door".
It appears that these autistic children, limited to purely behavioural descriptions, created a coherent story by assuming that there were 2 different chocolates in the story, overriding the visual information which suggested the <u>same</u> chocolate appeared in the different pictures. None of the normal or Down's Syndrome

children did this, presumably because their ability to attribute mental states made it possible to 'see' a different meaning in the pictures.

What of the autistic children's performance on the 'Scriptal' Conditions? Their good performance on these conditions suggests that the autistic group were able to use a 'social script' strategy, ie: they were able to sequence social events if they did not require recourse to the mental state of the characters. Their protocols (see Appendix 4) show that 9 out of 10 autistic children described the 'Scriptal' Condition stories they created in purely 'behavioural' language, as they had done in the 'Mental' Condition. The 1 autistic child who did not is one of those who used mental state expressions in the Mental condition (Subject Number 8).

44% of the normal and 100% Down's Syndrome children for whom protocols were available also did not use mental state terms in the 'Scriptal' Conditions. This suggests that these children too were able to sequence Scriptal stories correctly without any necessary recourse to mental states of the actors. In contrast, correct sequencing of the 'Mental' Condition stories was highly likely to require attribution of mental states to the actors. Thus, the 'Scriptal' Conditions could be correctly sequenced by referring only to external behaviour. The important conclusion to emerge from autistic children's good performance on the 'Scriptal' Conditions is that it is not all social or interpersonal information which autistic children find difficult to interpret, but only those where mental state attribution is involved.

It is also the case that 90% of the autistic children for whom protocols were available used temporal terms in their descriptions, (such as then, and, first, etc.), and this suggests that they are able to perceive their created story as a whole rather than purely frame by frame.

It should be noted that the picture sequencing task is not well suited to the Down's group in any of the conditions. They performed at a medium to low level throughout. The autistic group have been reported to also be particularly poor at the sequencing task of the WISC (Lockyer and Rutter, 1970; Rutter, 1978b), but this experiment suggests that it is not sequencing in general that they find difficult, so much as sequencing of social stories which require the attribution of mental states to the actors. Indeed, an analysis of the WISC-R picture-arrangement subtask shows that at least half of the stories used there (and arguably as many as three-quarters) are of a complexity that would require a 'theory of mind' in order to be able to sequence them, and this might in part account for autistic children's poor performance on this subtask.

4.3: Comparison of results from the Puppet and the Picture Experiments (3 and 4).

All autistic subjects in the Picture Experiment [4] (with the exception of one boy [Subject Number 10] and one autistic girl [Subject Number 20] who changed schools and were thus not available) also participated in the Puppet Experiment (3) involving attribution of a false belief. In addition, there was one autistic boy (Subject Number 22) who participated in the Puppet Experiment but who was excluded from the Picture Experiment because he was uncooperative. He did not succeed on the Belief Question of the Puppet Experiment. Thus, 19 autistic children participated in both Experiments (3 and 4).

Of critical interest was the comparison of performance on the Belief Question in the Puppet Experiment with the 'Mental' Condition (attribution of belief) in the Picture Experiment. If these are indeed measuring the same ability (ie: their theory of mind) then there should be consistent responding in these two tasks. Of the 19 children, 12 failed in both tasks, ie: failed to predict correctly where the doll would look for her marble on the basis of her false belief, and scored less than 4 on the picture sequencing task. 3 children (Subject Numbers 4,5 and 11) who failed on the Puppet task, passed the picture sequencing task (scoring 4 or more), while another 2 (Subject Numbers 2 and 21) who passed on Puppets, failed on Pictures. This leaves 2 children (Subject Numbers 7 and 8) who passed both tasks. Overall, this means that 14 out of 19 (74%) of the autistic children performed consistently on both tasks.

One question concerns how to account for the few autistic children who performed inconsistently: These comprised 3 subjects who 'passed' on the 'Mental' Condition of the Pictures but did not pass the Puppets, and 2 children who passed the Puppets but not the Pictures. These 5 children (Subject Numbers 2,4,5, 11, and 21) were retested on both tasks, and their results in terms of passing and failing stayed the same. (The actual sequences in their retest on Experiment 4 are in Appendix 3). Hence, the inconsistency is not unreliability. Analysis of the verbal protocols of these 5 children was performed in comparison to the protocols of the 2 children (Subject Numbers 7 and 8) who passed on both tasks. This showed that the protocols of those children who passed on the 'Mental' Condition of the pictures but failed the puppets did not contain any mentalistic terms. In contrast, the protocols of those 2 children who passed both the pictures and the puppets <u>did</u> contain mentalistic terms.

One conclusion that can be drawn from this is that the 2 children who passed both tasks can indeed attribute different beliefs, as indicated in their protocols, and they used this ability in both the Puppet and Picture Experiments. In contrast, the 3 children who passed the Pictures only may have done so by using pictorial cues for sequencing. Their protocols do not indicate that they could attribute different beliefs. This would account for why they failed the Puppets. Finally, the 2 children who passed the Puppets task only may have done so because they could use mentalistic concepts there, in the simpler conditions of that Experiment (3), but for some reason did not see how to use such concepts in the sequencing task. Certainly, judging from the Down's Syndrome group's performances, the Puppet Experiment was simpler than the Picture Experiment.

4.4: General Discussion.

The results from the Puppet and Picture Experiments suggest that the vast majority of autistic children are impaired in their theory of mind, as predicted. Expressed differently, the aspect of their self-other differentiation which is impaired is their conceptual role-taking ability. This is in contrast to their perceptual role-taking ability, or their 'theory of sight', which was shown to be intact in Experiment 2 and by others (Hobson, 1984). Since the deficit in theory of mind was not found in either of the two control groups, it can be assumed to be autism-specific. In addition, since Experiments 3 and 4 used widely differing experimental paradigms (namely, a puppet story versus picture-story sequencing), this finding can be considered as fairly robust. Furthermore, in both experiments, the autistic children showed they were able to cope with the 'structural' aspects of the tasks by performing at or close to ceiling on the control conditions (namely, the Control Questions in the Puppet Experiment, and the Scriptal Conditions in the Picture Experiment). Both of these high performances indicate that 'social information' per se is not confusing for them, but social information the comprehension of which requires attribution of mental states (such as false beliefs) appears to be beyond the competence of most autistic children in the present sample.

An analysis of the cognitive underpinnings of a theory of mind allows certain predictions to be made concerning other aspects of the environment which might be either confusing for autistic children, or within their competence. One such cognitive interpretation of a theory of mind is given below.

Dennett (1978a) has argued that the nature of a cognitive system which is capable of attributing mental states to others can be described minimally as a "second-order intentional system". That is, it is a system which can represent another system's representations (e.g. have beliefs about someone else's beliefs). Leslie (to appear) has called this a "second-order representational system". (Perner and Wimmer [1985] use a different notation, calling it "first-order belief attribution", since they do not include the subject's own mental state in their counting system. We will adhere to Dennett and Leslie's notation of 'second-order' to describe beliefs about beliefs. Thus, 'third-order' would be 'beliefs about beliefs about beliefs' etc.). Johnson-Laird (1983) points out that, since

> "the essential phenomenon about (other) people's beliefs is that they may be mistaken...(eg: They may believe that Euthanasia is a country somewhere in South-East

Asia)..,[thus] when you mentally represent someone else's beliefs, you can (and must) insulate them from your own" (p.433).

In order to do this, he argues, our cognitive machinery must be capable of a <u>"recursive embedding</u> of mental models" (p.433). Furthermore,

"One person can have an attitude about another person's propositional attitude, and so on indefinitely: eg 'Maggie knows that I hope Eddie believes that his wife thinks that...you are here', and such assertions are accomodated by the recursive embedding of mental models within mental models" (p.437).

In practice, Premack and Woodruff (1978) point out, human cognitive systems are limited to 4 or 5 levels of recursive embedding, before reaching the limits of comprehension - it is therefore not an indefinite process, except in principle.

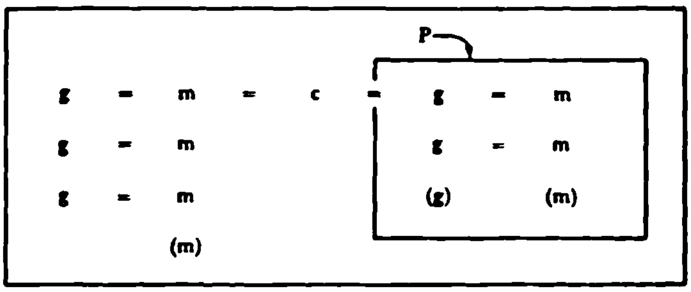
At the simplest level of a theory of mind, then, recursive, embedded <u>second</u> order representations are required. Johnson-Laird (1983, p.434) has drawn out a diagram of such a representation (Fig. 4.5):

Figure 4.5: <u>Diagram of a 'second-order' representation.</u>

Your beliefs:

1. All the members of the government (g) are monetarists (m).
2. Phil (p) believes (→) that at least some members of the government are monetarists.
3. We both believe that the chancellor of the exchequer (c) is a monetarist.

Your beliefs:



An example of a nested set of beliefs within a mental model.

Other authors have called this a 'metacognitive' system ie: a system that has cognitions about cognitions (Miller, Kessel and Flavell, 1970; Barenboim, 1978; Flavell, 1979; Eliot et al, 1979; Shultz and Cloghesy, 1981) and, like Johnson-Laird, all emphasize the recursive property of a representational system capable of this. According to Leslie (to appear) the ability to form second-order representations emerges at around 18 months in the normal child. Before this, the infant already possesses the ability to form "first-order representations". That is, the infant can represent real 'objects' and relations between objects in the outside world. Evidence of how robust the normal child's theory of mind is by the age of 4 years old is demonstrated in their understanding of the distinction between 'mind' and 'brain' (Johnson and Wellman, 1982).

One cognitive interpretation therefore of an impaired theory of mind in autism is a deficit in the ability to form second-order representations. From this hypothesis a prediction is that autistic children would also be impaired in areas other than the use of a theory of mind but which also require use of second-order representations. One such area is pretend play (Leslie, to appear). There is some evidence that pretend play is deficient in autistic children (Wing et al, 1977; Ungerer and Sigman, 1981; Riguet et al, 1981; Gould, in press), and Experiment 7 [described in Chapter 7] reports an attempt to explore this evidence further.

It is worth clarifying the nature of the postulated deficit: A person's theory of mind is the ability not only to have beliefs about beliefs, but also intentions about beliefs, beliefs about intentions, desires about intentions or beliefs, beliefs about desires, etc. In the Puppet and Picture Experiments (3 and 4), only one aspect of autistic children's theory of mind was investigated ie: their ability to have beliefs about beliefs, and this was found to be impaired. These experiments did not look at their understanding of intentions or desires, although these may be of equivalent cognitive complexity. (As discussed earlier [p.101], the reason why 'beliefs' were selected for investigation was because this was a mental state domain where one could guarantee a difference between one's own and another person's mental state [Wimmer and Perner, 1983; Dennett, 1978b]).

If it is indeed the case that autistic children are impaired in their ability to attribute mental states to other people, this would make much sense of their 'avoidance' of and incompetence in the social world: Since a great deal of people's behaviour is uninterpretable (ie: meaningless) without a theory of mind, people would appear unpredictable and confusing. The world of physical and inanimate objects, in contrast, which requires 'first-order' representations, should appear predictable and lawful to them, since the 'second-order' deficit should leave their understanding of physical causality unimpaired. This prediction is the basis of Experiment 5, reported in the next chapter.

Before proceeding, it is worth stopping to consider for a moment how the social world might appear to someone if they did indeed lack a theory of mind. The closest insight to such a 'world view' is perhaps to identify it as a form of 'Radical Behaviourism' (Watson, 1913; Skinner, 1971):

> "We do not need to try to discover what personalities, states of mind, feelings, traits of character, plans, purposes, intentions, or the other prerequisites of

> autonomous man really are in order to get on with a scientific analysis of behaviour". (Skinner, 1971, p.20).

Radical Behaviourists argued that all human behaviour could be understood in terms of operant conditioning and contingent reinforcement of the environment. However, such an approach becomes too cumbersome to explain many social events, in that it involves taking account of the history of every piece of behaviour, and it cannot account at all for totally novel behaviour. Furthermore, there are certain classes of behaviour which are unanalysable in Behaviourist terms. One such is deception, where attribution of false beliefs is essential if the behaviour is to have any 'meaning'.

To summarize, a theory of mind avoids the laboriousness of a Behaviourist analysis of people's actions, in that a single mental state can be attributed to a person to explain an action that might otherwise require dozens of S-R chain-links in a Behaviourist explanation; and a theory of mind can be used to explain both novel and highly sophisticated acts in a way that a Behaviourist account cannot. However, a Behaviourist world-view is essentially a causal one, in that certain aspects of the physical environment are seen as causally shaping an organism's responses. Thus, the (somewhat light-hearted) characterization of autistic children as analagous to Radical Behaviourists is consistent with the prediction that their concept of physical causality is unimpaired. This is tested in the next experiment.

Chapter 5: First, Second, and Third-Order Representation.

5.1: First-order representation in autistic and normal children.

As discussed in Chapter 4.4, a deficit in one's theory of mind implicates a deficit in the capacity for second-order representation. One prediction from such a hypothesis is that those domains which do not require more than a first-order representational capacity should not be impaired in autism. One question, then, is to determine which domains in our understanding of the world only require first-order representations.

In Piaget's theory (Piaget and Inhelder, 1969), the infant is said to show evidence of a representational capacity at the end of the 'sensorimotor' period (at about 8 months of age), when s/he "can evoke persons or objects in their absence" (p.3). Thus, acquisition of the 'object concept' is considered to require first-order representations. This can be considered as definitional of first-order representations: they represent the physical world, ie: objects, events, and relationships between objects. In contrast, as discussed in Chapter 4, second-order representations represent the mental world, ie: other representations.

Post-Piagetian developmental psychology has tended to argue that a (first-order) representational capacity is present long before 8 months of age, since infants of a few weeks old are able to discriminate between familiar and novel stimuli; indeed such an assumption is the basis of the 'habituation' paradigm. How much such young infants understand about the different aspects of objects (eg: object identity, object permanence, causality, etc.) is still a matter of debate, but since they have the capacity for representation very early on (and perhaps from birth), it is likely that such knowledge of objecthood is present at earlier ages than Piaget estimated (Bower, 1975; Gratch, 1975).

On the above definition, a child could be said to have a "fully-fledged" first-order representational capacity if s/he understood the basic attributes of the 'object world', ie: that objects exist independently of oneself over time and space, and that they interact causally with eachother. If the postulated second-order representational deficit in autism is a specific deficit, then one prediction is that knowledge of the object world should be unimpaired. Certainly, there are a number of studies which have found that autistic children do have an object concept which is not impaired relative to MA, and this runs counter to the once-held view that autistic children do not reach the end of the 'sensorimotor' stage (Anthony, 1958; Bettelheim, 1967; Thatcher, 1977).

Serafica (1971) studied 8 "deviant" children (CA = 4-8 yrs) who were variously diagnosed (infantile autism, symbiotic psychosis, and childhood schizophrenia). She found that, using the Uzgiris-Hunt (1975) Scales of Object Permanence, all the children were successful when a "preferred" object was used (ie: an object to which the child was emotionally attached), although only 2 subjects were successful when a "neutral" object was used. Serafica's subjects' performance, although inconsistent, does show that they could represent invisible displacements of objects. However, the inclusion criteria for her subjects are not adequate to be able to make generalizations about autism, and nor does her study show the relationship between object knowledge and MA.

The same criticism applies to the study by Curcio (1978), in that although his subjects (n = 12, CA = 4:9-12:0 yrs) all achieved at least Stage 5 on the Uzgiris-Hunt Object Permanence Scale, no MA data were included. Nevertheless, the results from these 2 studies are consistent with the hypothesis that autistic children's ability to represent the physical world of objects is not impaired. Curcio's study further found that autistic children performed very highly on the 'causality' scale (with 67% of subjects scoring at Stage 4 or above [max = 6]), and the 'means-ends' scale (83% of subjects scoring at Stage 5 or above [max = 6]). The 'causality' test included trying to activate a mechanical object, and the 'means-ends' test included using a rake to obtain an object, for example. This ceiling performance suggests that not only do young autistic children have a concept of 'object permanence' but they also understand the basic (causal) relationships that can exist between objects.

The question of the relation between such first-order representational capacity and MA in autism was addressed in a more recent study by Sigman and Ungerer (1981). Their sample of 16 autistic children (mean CA = 51.7 months, sd = 10.7) was assessed using Cattell's general IQ test (mean MA = 24.8 months, sd = 5.1) as well as the Merrill-Palmer performance MA test (mean MA = 33.4 months, sd = 7.8). The general IQ test was used as the matching criterion with the normal control group, so that the autistic group would not be matched with normal children who were far more advanced in their language skills. Using the Casati and Lezine (1968) Sensorimotor Scales, they found that their autistic subjects passed the majority of the subtests at Stage 6 (ie: ceiling); all the subjects showed Stage 6 level skills on the 'Search for Hidden

Objects' subtest. 5 children failed the highest level visible displacement problem, where the object is moved under each of 3 pads and left in the last location. However, these children went on to pass the invisible displacement problems, in which the object is moved invisibly. Thus, while their object knowledge seemed somewhat unstable, they showed clear evidence of representational capacity (of the 'first-order' type). These autistic subjects were however less good at the 'means-ends' subtests, although many of them were capable of using tools etc., without trial-and-error manipulations. Poor performance was found to correlate with MA and CA, but not with language level. The overall conclusion from Sigman and Ungerer's study is that autistic children's 'sensorimotor skills' are not delayed relative to their developmental level. These authors also confirmed Serafica's (1971) result that object permanence is demonstrated only when 'preferred' objects (such as sweets or food, in this study) are used, rather than 'neutral' objects such as small toys.

Sigman and Ungerer's (1981) result has been replicated by Wetherby and Gaines (1982) on a small sample of autistic children (n = 6; CA range = 4:8-15:2 yrs, mean = 8:5). Their MA was assessed using the Leiter Scale (mean = 5.0 yrs, sd = 3.2). All 6 subjects showed correct performance on the tests of Object Permanence, Causality, and Means-Ends, although their ability to show conservation of mass, liquid, and number was inconsistent. Thus, these autistic subjects also showed their 'sensorimotor knowledge' was intact, although their non-conservation suggests not all were at the level of 'concrete operations'. This was not out of line with their MA. In another experiment (Lancy and Goldstein, 1982), autistic children (n = 12, retarded IQ range, no MA data reported) passed both object permanence and conservation tasks. Hammes and Langdell (1981) found that their autistic sample (n = 8, mean MA = 4.6 years) showed "anticipatory gaze shifts" on a Bower, Broughton and Moore (1971) type test of object permanence. This implies that they possessed an internal repesentation of the object.

The consistent success at understanding object permanence and causality in the studies reviewed suggests that, with an MA of at least 2 years old, autistic children's first-order representational capacity is unimpaired. This is consistent with the hypothesis that their impairment is specific to second-order representational skills. Other evidence that autistic children understand causality is in their frequently noted interest in the mechanical world (Kanner, 1943; Bettelheim, 1967). Recent studies of autistic children's ability to use computer games (Jordan, 1984; Panyan, 1984), at least at the simpler levels, also confirms the presence of these skills.

What of the more sophisticated levels of causal understanding? Studies of normal preschool children have shown that many specific causal principles are understood. For example, Bullock and Gelman (1979) demonstrated that the principle 'cause always precedes effect' is part of 4-5 year old normal children's knowledge, and Bullock (1984) demonstrated that children at the same age can also infer mechanisms to explain how a cause brings about an effect. This is contrary to Piaget's (1950) belief that children under 7 years old are "phenomenistic" ie: lack the knowledge that a mechanism (inferred or visible) is necessary in causal events.

This discrepancy between Piaget's view and that from more recent studies derives mainly from how understanding of causality has been assessed. Piaget mainly asked 'why' questions and noted the absence of children's comments about how a cause brings about an effect. The more recent studies in contrast have used paradigms which are less dependent on verbal responses, so as to tap the child's implicit causal knowledge, even if this knowledge is unarticulable. For example, Shultz (1982) found that 3 year olds select as potential causes those events which offer a plausible causal mechanism (for actions such as wind generation, sound production, and light generation) over ones which do not. As such, their causal knowledge is not simply based on cues such as temporal contiguity, but is 'mechanistic'. That 4-5 year old normal children understand physical causality is now supported by many other studies in which children could predict which factor would cause an event to happen (Bullock, Gelman and Baillargeon, 1982; Kun, 1978; Brown and French, 1976). Nevertheless, the age at which children first demonstrate their causal knowledge remains a point of controversy (Sophian and Hubler, 1984; Leslie, 1984).

Whilst such studies have been done which demonstrate normal children's understanding of causal principles, autistic children's understanding of causality has not yet been experimentally tested beyond the sensorimotor level, described earlier. Since one prediction from the second-order deficit hypothesis is that autistic children's understanding should be unimpaired (being a 'first-order' representational skill), it is necessary to test that autistic children's causal understanding at the higher levels is at least as good as that which has been shown to be present in normal 4-5 year olds. This is tested in Experiment 5.

5.2: <u>Experiment 5: Attribution of physical causality in autism.</u>

A picture sequencing task was chosen to test autistic children's understanding of causality. This paradigm was chosen for several reasons: First, it demanded non-verbal as well as verbal responses from the child, and this was useful not only because many of the clinical subjects had very little language, but also because the research into normal children's understanding of causality had demonstrated that a lack of appropriately used causal terms in language does not necessarily imply a lack of causal understanding (Bullock, 1984). Secondly, it allowed comparison with the Picture Experiment (4), since the paradigm was the same, and only the story <u>content</u> differed. Thirdly, a number of studies with normal subjects have successfully used a picture sequencing paradigm to test causal understanding (Kun, 1978; Brown and French, 1976; Gelman, Bullock and Meck, 1980; Fein, 1973), so there were independent grounds for predicting that this task was within the repertoire of subjects whose MA was above 4 years old. This paradigm has even been used successfully with chimpanzees (Premack, 1976).

The picture sequencing task used in Experiment 5 differed from those used by others in certain ways: First, other studies had only used 3 pictures, and from pilot studies this was considered too easy for the present sample. In Experiment 5 therefore, as in the Picture Experiment (4) previously, 4 pictures are used. (It should be noted that in the WISC Sequencing Subtest, up to 5 pictures are used, so this increase in complexity to 4 pictures is still below that used in an IQ test). Secondly, the content of the pictures was different: for example, in the study by Gelman, Bullock and Meck (1980), one typical trial consisted of 3 cards: (1) an intact cup; (2) a hammer;

(3) a broken cup. These pictures however only depicted the 'before' and 'after' events, and the 'causal agent', but did not actually depict the change occuring. In the pictures used in the present 'Causality' Experiment (5), both factors were included. Thirdly, the demands on the subject were different: in the Gelman et al (1980) study, the subject was given 2 out of 3 of the pictures, and had to complete the sequence by choosing one from 3 other cards, only one of which was 'correct'. This meant that in their experiment the subject did not have to actively sequence the pictures; thus, a correct response could be obtained simply by using an 'associationist' strategy (eg: 'hammer "goes with" broken cup') without the subject necessarily understanding that the sequence of cause preceding effect is important.

For these reasons, the task in the Causality Experiment (5) was designed to test causal knowledge about both temporal sequence and mechanism. This is described below.

Design:

The child's ability to arrange the individual pictures into a coherent story was assumed to depend on the subject applying a causal explanatory schema which would connect the separate actions depicted in the pictures. In order to assess whether knowledge of physical causality was equal in competence when applied to both the physical and social worlds, 2 conditions were used:

CAUSAL 1: Objects interacting causally on each other.

CAUSAL 2: People and Objects acting causally on each other.

This thus allowed a test of the hypothesis that the inclusion of people was not per se confusing to autistic children. This design is similar to that used in the Picture Experiment (4), in which autistic children's good performance on the Scriptal Conditions showed that not all social events are equally difficult for them.

Procedure:

The procedure and the scoring system for the Picture and Causality Experiments (4 and 5) were the same, and these were described on p.128-131. In addition, both of these experiments were carried out at the same time, and are reported together elsewhere (Baron-Cohen et al, to appear).

The exact order of the placing of the 4 pictures in each story was noted down, as well as any self-corrections. Each child had only one attempt at each of the 6 stories. As in the Picture Experiment (4), the narrations (protocols), spontaneous and elicited, of the stories they created were tape-recorded and transcribed. These are shown in Appendix 7, and their analysis will be discussed in the Results section.

Materials:

The pictures were drawn on white cards, 5 inches X 5 inches. The images had simple black outlines, and 4 colours were used throughout. They were similar to those used in the Picture Experiment (4). They are shown pictorially in Appendix 8, and described in Figure 5.1, below.

Fig. 5.1: Picture Stories used in Experiment 5.

	1	2	3	4
CAUSAL 1:				
1.	Rock on hill	Rock topples	Rolls down	Knocks tree over
2.	Egg on table	Egg rolls	Egg falls	Egg smashes
3.	Balloon	Balloon flies	Hits tree	Bursts
CAUSAL 2:				
1.	Man walking	Trips over	Falls down	Leg bleeds
2.	Rock on hill	Rock topples	Rolls down	Knocks man over
3.	Man with rock	Pushes rock	Rolls down	Falls in water

Subjects:

The subjects were the same as in the Picture Experiment (4). The MA, CA, and Language Ages can be found in Table 4.2, p.131.

Results:

Table 5.1: Group Mean Scores for each Condition in Experiment 5.

	Conditions			
	CAUSAL 1		CAUSAL 2	
	x	sd	x	sd
Normal	3.3	1.7	3.7	2.0
Down's	2.8	1.9	2.7	1.2
Autistic	5.7	0.7	5.8	0.6

Max = 6; Min = 0

An ANOVA was performed on the scores from this experiment. There was no effect of Conditions ($F_{1,60} = 0$, $p > 0.98$), which suggests that the presence of people in the stories did not affect performance for any of the groups. There was also no Groups x Conditions interaction ($F_{2,60} = 0.12$, $p > 0.88$). However, there was a significant effect between groups ($F_{2,60} = 28.23$, $p < 0.001$), with the autistic group performing significantly better than the other 2 groups on both conditions (Post-hoc Scheffe test, $p < 0.05$). The Down's and the Normal groups were not significantly different to eachother (Scheffe Test, $p > 0.05$). The Between Groups difference remained significant even when Leiter MA was used as a covariate ($F_{1,35} = 33.25$, $p < 0.001$) or BPVT ($F_{1,35} = 45.76$, $p < 0.001$), or CA ($F_{2,59} = 19.23$, $p < 0.001$).

Protocol Analysis:

As in the Picture Experiment (4), 10 autistic and 7 Down's Syndrome children produced verbal descriptions for all or almost all 6 pictured sequences. The minimum requirement was that the child should have given narrations in at least 4 out of the 6 trials. In addition, protocols were gathered from a randomly selected one third of the normal children.

The narrations were rated by the same raters as had judged the protocols from the Picture Experiment (4). Using strict criteria narrations were judged to fall into the following categories: causal or descriptive. For each picture story a narration, regardless of length, was categorized into only 1 of the 2 classes. The score was determined on a 'priority' basis: ie, an utterance was scanned for a "causal" expression (see below) and the default category was "descriptive". Interestingly, there was no disagreement between the raters at all. The protocols are shown in Appendix 7.

The causal category was applied only when the utterance contained at least one of the following:

a) because clauses: eg. "the egg broke because it fell off the table"; or

b) explicit mention of agent - causal verb - object, or passive construction with by-phrase, eg: "The boulder broke the tree"; or "The man was hit by the rock"; or

c) causal verb phrase, ie: made...happen, eg: "The rock made the man fall down".

Some examples were considered to be too equivocal to qualify for the causal category, eg: "He tripped over and his foot bleeded"; or "It popped on tree"; or "The ball hits the man and he falls down". All these utterances were placed by default into the descriptive category together with the utterances such as "It broke on the floor"; or "It smashed"; or "He tripped over the brick".

For each child the ratings were turned into percentages relative to the total number of trials where verbal responses were made. The results of this classification are shown in Table 5.2:

Table 5.2: Percentage of utterances classified as causal in Experiment 5.

GROUPS		CAUSAL UTTERANCES
AUTISTIC	x	78
(n = 10)	sd	20
DOWNS	x	17
(n = 7)	sd	14
NORMAL	x	39
(n = 9)	sd	16

The protocol ratings data were sufficiently normally distributed to allow ANOVA with post-hoc Scheffe tests. The autistic children used more causal terms than the other two groups who did not differ from eachother ($F_{2,21} = 10.33$, $p < 0.001$). This is consistent with performance on sequencing and suggests that success on this implies an understanding of physical causality.

Discussion.

The autistic children in the present sample performed significantly better than both of the control groups on both conditions and performance did not differ between conditions for any of the groups. This demonstrates that the inclusion of people per se does not impede autistic children's ability to sequence physical-causal stories.

Can the autistic children's high performance be interpreted to imply that they have a concept of physical causality, at least at the developmental level expected in this task? Their sequencing performance alone does not allow this interpretation unambiguously, since it is possible that the children used purely perceptual cues (e.g. closeness of similarity) as a sequencing strategy. However, the results of the protocol analysis rules out this explanation: 9 out of 10 of the protocols from the autistic children used causal terms in their verbal descriptions of the stories in both Conditions. For example (Subject number 2):

> "The balloon is gassy. The gas came out because the tree made it pop."

and (Subject number 3):

> "The egg broke because it fell off the table."

It is therefore possible to ascribe an understanding of physical causality to autistic children with confidence. Since the autistic children produced correct sequences as well as causal language, this is evidence that they understand both the two principle of temporal sequence and mechanism in causality. The autistic children's competence in this area is consistent with results from other investigators (Sigman and Ungerer, 1981; Wetherby and Gaines, 1982; Curcio, 1978; Hammes and Langdell, 1981). Furthermore, the Causality Experiment (5) extends the results from other studies in demonstrating autistic children's causal understanding at levels beyond the sensorimotor stage.

A separate question surrounds the interpretation of the performance differences between the three groups. Although the autistic group were significantly better than the normal group when CA was used as a covariate, and better than the Down's Syndrome group when MA was used, it is nevertheless possible that their superiority is due to their higher MA averaged over the group. A high MA matched normal group would be necessary in order to settle this question, since the Down's Syndrome subjects may have had specific problems with sequencing per se.

The implications from the autistic children's high performance are important, in that it suggests that their understanding of the physical world, as tested here, is perfect - ie: at ceiling performance. Exactly how it relates to MA, however, remains to be seen. In any case, the result highlights the specificity of the deficit found in the Puppet and Picture Experiments (3 and 4). Furthermore, given that the Picture and Causality Experiments (4 and 5) used an identical paradigm (picture-sequencing), the autistic children's poor performance in the Picture Experiment (4) and good performance in the Causality Experiment (5) can only be attributed to the story-content differences, ie: 'mental' versus 'causal'. In representational terms, this distinction suggests that, as hypothesized, autistic children's first-order representational capacity is unimpaired.

5.3: Discussion of the Puppet, Picture and Causality Experiments (3, 4 and 5).

It is worth drawing together the results from Experiments 3,4,and 5. The first 2 of these identified a deficit in 16 out of 20 autistic children's theory of mind, and this was argued to implicate a deficit in 'second-order' representational capacity. The Causality Experiment (5) confirmed that their 'first-order' representational capacity was unimpaired in all the present autistic sample, as demonstrated in their understanding of physical causality. The specific second-order deficit thus seems to apply to a large majority of the present autistic sample (80%), but not all of them.

What of the remaining 20% who passed on the Puppet Experiment (3) and who, if their correct performance was not due to chance, may well have a theory of mind? Is this the top 20% that have been identified in other studies as being a high-functioning sub-group (Bartak and Rutter, 1976; Lockyer and Rutter, 1970; DeMyer, et al, 1974)? These children were among the brightest and oldest of the sample, yet there were other autistic children of an equivalent CA and MA who failed to demonstrate a theory of mind. Thus, they are not distinguished by either CA or MA.

One explanation could be formulated as follows: in about 20% of cases, a high CA and MA may allow an autistic child to develop a theory of mind at the simplest level (ie: a theory of mind that would at least be expected of a normal 4 year old). This could be seen as a sort of 'cognitive compensation' explanation, and posits that with their general cognitive advantage, a theory of mind may develop in some bright autistic teenagers, although it is not present at the normal time (ie: at preschool age). This type of explanation has been used by Hermelin and O'Connor (1985) and implicates a deviant and delayed course of development, whereby normal competence is achieved via an 'alternative' cognitive route.

Let us assume, then, that there is a subgroup who may have a theory of mind at the simplest level (ie: one that requires second-order representations such as "I believe you think I'm rich"). Is this subgroup capable of using a more advanced theory of mind (ie: one that requires 'third-order' representations such as "I believe you think I think you're rich")? Such a third-order representational capacity has been shown to be within the repertoire of normal 6-7 year old children (Perner and Wimmer, 1985). This question is explored in Experiment 6, and the literature surrounding this more advanced theory of mind is reviewed below:

5.4: Third Order Representation in normal children: literature review.

As described in Chapter 3.2.(ii), p.96-7, Flavell et al (1968) observed that 11 or 12 year old subjects are capable of third-order belief attribution (or what he called 'Level 2 operations'), as demonstrated in the 'coin game' in which subjects reasoned as follows: "I think he thinks I want the dime, so I'll choose the nickel". Miller et al (1970) also found that 12 year olds could describe embedded "think-bubble" cartoons such as "Johnny is thinking of Daddy thinking of Mummy", etc. Both of these studies have failed to elicit such third-order belief attributions from younger subjects, which suggests that the paradigms used were rather difficult for the younger subjects to follow. In addition, the think-bubble paradigm has the flaw that correct responses do not demonstrate "understanding" of beliefs beyond a syntactic exercise of matching embedded sentences with embedded think-bubbles. Perner and Wimmer (1985) point out that adults might be able to give a correct description of even a ten-fold embedded think-bubble, but would find it impossible to understand the 'meaning' of such a belief or why it might be used.

Shultz and Cloghesy (1981) used a card-game paradigm in which normal children aged 3:0-9:9 years had at times to actually deceive their opponent, and at other times pretend to deceive their opponent. In other words, they had to reason either 'I want him to think I'm deceiving him', or 'I want him to think I'm not deceiving him'. They found that 5 year olds could win at this game, and thus suggested that "recursive awareness of intention" (p.469) begins to appear at that age. However, it is difficult to prove that this game did actually involve third-order belief attribution and not just second-order beliefs, since the verbal descriptions that some 9 year olds gave of their strategies were usually of the type 'I <u>know</u> which one you <u>think</u> I'm going to point to' etc. This might be third-order (eg: 'I <u>know</u> which one you <u>think</u> I am <u>thinking</u> of..'), but a better-designed experimental paradigm would guarantee that success in the task unambiguously required third-order belief attribution, and would make this clearly distinguishable from second-order belief attribution.

Perner and Wimmer (1985) took just these precautions. The essence of their experimental design is that second and third-order belief attributions result in different responses respectively, and thus make it relatively straight forward to 'diagnose' the level of complexity of the subject's theory of mind.

Their test story is based around the following episodes: 2 characters (eg: John and Mary) are interested in the location of a critical object (eg: the icecream van, which is either in the park or the church). In the first episode, both characters are informed that the van will stay in the park all afternoon. In the second episode, only Mary is informed about a sudden change in plans, that the van will move to the church and stay there for the rest of the day. In the third episode, John unexpectedly finds out about the van's new location, but Mary does not know that he was told. In the fourth episode, Mary goes over to John's house where she is told that he just went out to buy an icecream. The subject has to employ a third-order representation to answer the Test Question 'Where does Mary think John has gone to buy an icecream?' [answer: to the park, since Mary thinks John thinks the van is still in the park]. The subject need only use a second-order representation to answer the control question 'Where has John gone to get an icecream?' [answer: to the church, since John knows the van is at the church].

Thus, in their experiment, a second-order belief attribution results in the subject pointing to the church, whereas a third-order belief attribution results in the subject pointing to the park. (Use of a first-order representation would also result in the subject pointing to the church, since that is where the van really is). Thus, only if a child uses a third-order reasoning strategy does this result in a correct response. This is because the subject has to represent two false beliefs, ie: 'Mary thinks that John thinks that the van is in the park, when in fact both John and Mary (independently) know that the van is at the church'. (Here, the term 'think' is used to denote a false belief, and 'know' to denote true knowledge).

Perner and Wimmer found that many 6 year olds and almost all 7-9 year olds were able to give correct answers, although the younger subjects were only able to do this under optimal conditions when inferences of third-order beliefs were prompted: for example, by such questions as 'Does Mary know the icecream man talked to John?' [answer: no, since she was still in the park]. Furthermore, in answer to a Justification Question, many subjects explicitly articulated their third-order representation (eg: "She thinks that he thinks that the icecream man is still in the park"). Such justifications rule out any explanation of responses in terms of guessing. In addition, subjects who gave wrong answers to the Test Question tended in their Justifications to reveal their inappropriate second-order strategy (eg: "Because John had talked to the icecream man") or first-order strategy (eg: "Because the van is at the church").

Perner and Wimmer's (1985) experiment thus comes closer to being a reliable test of third-order representational capacity than the other studies. Landry and Lyons-Ruth (1980) argue that their experiment tested the same ability, in that the subject had to represent 'My brother thinks that I am afraid of dogs'. However, as Perner and Wimmer point out, there is no evidence that this is more than a second-order belief attribution, in that the subject merely represents another person's representation of a true state of affairs in the world ('being afraid of dogs') rather than a propositional attitude. 'Being afraid' is a mental state in one sense, but need not be represented as such (since it can have a behavioural description), whereas 'thinking' must be represented as a mental state.

Since Perner and Wimmer's task is the best paradigm available to test third-order representational capacity, it was decided to use it with the 4 autistic subjects who had previously passed the second-order belief attribution test (Experiment 3). This Experiment is reported below:

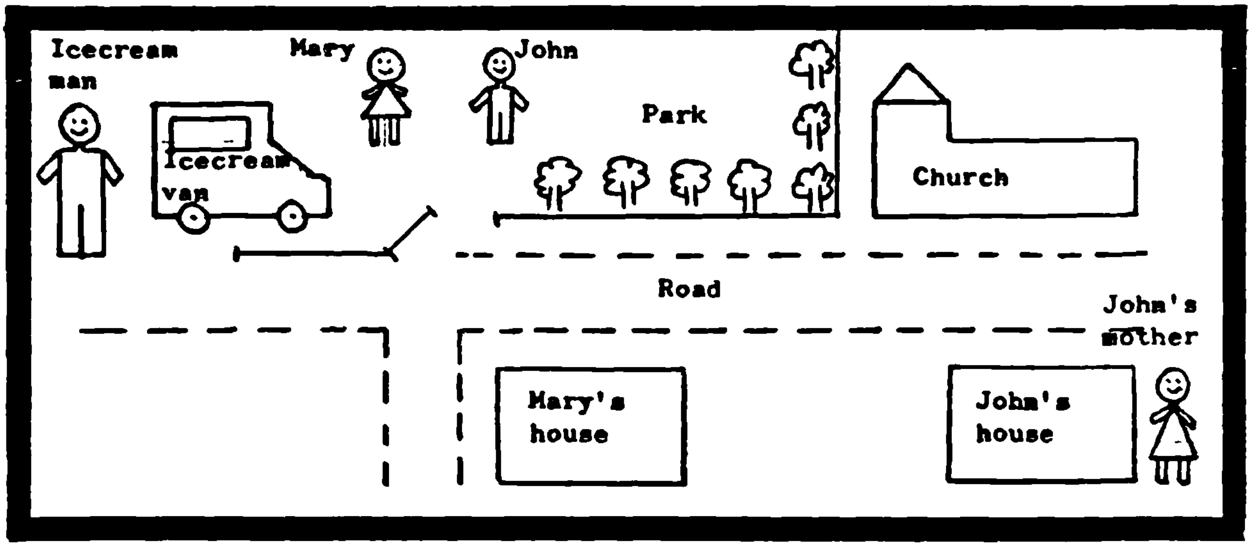
5.5: Experiment 6: Third-Order representation in autism and Down's Syndrome.

The assumption behind this experiment is that in this autistic subgroup there has been a delayed and possibly deviant onset of a second-order theory of mind (as manifested in the Puppet Experiment [3]), and the question is posed whether they have also progressed to a third-order theory of mind. The contrast group were the most able Down's Syndrome controls who had previously passed the Puppet Experiment (3). If the Down's Syndrome subjects should show a third-order capacity, despite having lower MA, and if the autistic subjects did not, then the specificity of the theory of mind deficit could be strongly confirmed.

Procedure:

Each child was tested individually in a small room. The experimenter laid out a toy village on the table in front of the child. The materials are described overleaf. This scene is illustrated in Fig. 5.2 (overleaf):

Figure 5.2: The layout of the toy village used in Experiment 6.



First, the child was asked to name all the toys, which all the subjects could do easily. The experimenter then told the following story, moving the characters and the icecream van accordingly.

Story:

This is John and this is Mary. They live in this village. (Naming Question).
Here they are together in the park. Along comes the icecream man. John would like to buy an icecream but he has left his money at home. He is very sad. 'Don't worry,' says the icecream man, 'You can go home and get your money and buy some icecream later. I'll be here in the park all afternoon..'
'Oh good,' says John, 'I'll be back in the afternoon to buy an icecream'.
Prompt Question (1): 'Where did the icecream man say to John he would be all afternoon?'
So John goes home...he lives in this house. Now, the icecream man says 'I'm going to drive my van to the church to see if I can sell my icecreams outside there.'
Prompt Question (2): 'Where did the icecream man say he was going?'
Prompt Question (3): 'Did John hear that?'
The icecream man drives over to the church. On his way he passes John's house. John sees him and says 'Where are you going?' The icecream man says 'I'm going to sell some icecream outside the church.' So off he drives to the

church.
Prompt Question (4): 'Where did the icecream man tell John he was going?'
Prompt Question (5): 'Does Mary know that the icecream man has talked to John?'
Now Mary goes home. She lives in this house. Then she goes to John's house - she knocks on the door and says 'Is John in?' 'No,' says John's mother, 'He's gone out to buy an icecream.'
Test Question: 'Where does Mary think John has gone to get an icecream?'
Justification Question: "Why?"
Reality Question: 'Where did John really go to buy his icecream?'

At the end of the story, the child's responses to the 5 Prompt Questions, the Test Question, and the Justification Question were noted down. Then the whole experiment was repeated (= Trial 2), this time reversing the locations (ie: the children and the icecream man start off playing behind the church, then the van moves to the park, etc). Again, the child's answers were noted down. The responses to the Justification Question are shown in Appendix 9.

Materials:

The toy village comprised 2 houses, a church, a fence to separate the park and the road, 4 'playpeople', and an icecream van. In addition, there was a row of trees, so that it was not possible for a story character to 'see' the church or John's house from the park (or vice-versa). The buildings were about 5 inches high. The whole village fitted onto a table-top 2 feet square.

Subjects:

The 4 autistic subjects who passed the earlier Puppet Experiment took part in this experiment. In addition, 4 Down's Syndrome children who had also passed in the Puppet Experiment and who were of similar CA were used as a control group. The autistic group had the advantage of a higher MA (both verbal and non-verbal). Details of these 8 subjects are given in Table 5.3 (below). Normal subjects were not included since data existed elsewhere which indicates that this task is within the competence of 6-7 year olds (Perner and Wimmer, 1985), and the non-autistic retarded control group was adequate to test the hypothesis.

Table 5.3: Subjects' Variables in Experiment 6.

		MA(Leiter)	CA	MA(BPVT)
Autistic (n = 4)	x	9.0	14.7	5.5
	sd	1.5	2.1	1.7
Down's (n = 4)	x	6.7	13.6	3.2
	sd	1.2	4.1	0.6

[The Mental ages are all from the time of initial testing, one year earlier, and not from the time of running this Experiment. It can be assumed however that change in MA's, if any, will be uniform for all subjects over this period].

Results:

All subjects, except 1, passed the naming question, the prompt questions (1-5), and the reality question. Differences emerged on the critical Test Question, and this is shown in Table 5.4 (overleaf). The results from Trials 1 and 2 were identical, and so are collapsed in Table 5.4.

Table 5.4: Subjects' performance on the Test Question in Experiment 6.

	PASS	FAIL
Autistic	0	4
Down's	3	1

A Fisher Exact Probability Test showed that the autistic and Down's groups differed significantly from eachother ($p < 0.025$).

The other data collected in this Experiment were responses to the Justification Question. (This is transcribed in Appendix 9). All subjects who passed the Test Question correctly demonstrated their third-order reasoning by answering the Justification Question with such explanations as "Cuz she don't know the icecream man talked to him", (ie: they saw the usefulness of Prompt Question [5]), or more explicitly with "Cuz she thinks he doesn't know it's at the church". In contrast, those subjects who failed the Test Question demonstrated that they inappropriately used a second-order reasoning strategy by answering the Justification Question with "Because he knows the icecream man is at the church". (The response of one autistic boy could have been a first-order type, since he simply said "The van is at the church").

Discussion:

The results show very clearly that the autistic group, as predicted, failed to demonstrate a third-order representational capacity, whilst 75% of the Down's subjects did. In the case of the Down's subjects, this was amply supported by their answers to the Justification Question, which were either implicitly or explicitly of a third-order type. Of the 4 autistic subjects, 3 failed because they employed lower level reasoning (first or second-order), and one subject failed because he had too little language comprehension to follow the task. In this respect, he cannot be said to have been adequately tested.

It is important to emphasize that the sample size in the Village Experiment (6) comprised only 4 subjects in each group. It is therefore not statistically a very robust result, but unfortunately the initial autistic sample (n = 20) only yielded 4 subjects who were eligible to be included in the Village Experiment (ie: those who had passed the Puppet Experiment). The lack of a third-order theory of mind in these 4 subjects is a strong reminder of their social impairment, in that normal children of CA > 6-7 years can manage mentalistic reasoning of this complexity, and it is precisely this ability which allows them to participate in sophisticated social interactions. The fact that the Down's Syndrome subjects showed a third-order theory of mind confirms that their social cognitive skills are in line with their non-verbal MA. (It incidentally shows that these skills are relatively independent of their <u>verbal</u> MA, since in the Down's case the mean was only 3.2 years).

Combining the results from the Puppet and the Village Experiments (3 and 6) creates the proper focus to view these results. The picture that emerges is that most autistic children (80%) show no evidence of being able to employ a theory of mind at the simplest level (ie: that which requires second-order representation), whilst the remaining 20% of autistic children who do have a theory of mind at that level fail to show evidence of one at the next level up (ie:

one which requires third-order representation).

To summarize this chapter, the Causality and Village Experiments (5 and 6) have supported two predictions which emerged from the Puppet and Picture Experiments (3 and 4). The first prediction was that if most autistic children were impaired in their second-order representational skills, this should leave their first-order representational capacity unimpaired. This was demonstrated in their ability to sequence causal stories correctly, both in the 'personal' and the 'non-personal' world [Experiment 5]. The second prediction was that if the few autistic children who passed the Puppet Experiment (3) had somehow compensated for their deficit and here showed delayed development in their theory of mind, then they should be impaired in the more advanced levels of this (requiring third-order representation). This too was confirmed (Experiment 6). The strong effect beginning to emerge from the last 4 experiments (3-6) is that the difficulty in autism hinges specifically at the second-order level of representation. In the next two chapters another skill which requires second-order representation, namely pretend play, is investigated in autism.

Chapter 6: Pretend play in normal and abnormal development.

Since most autistic children are impaired in their ability to employ a theory of mind, then (as was discussed earlier [Section 4.4]) the possibility exists of a deeper underlying deficit, namely, their capacity for second-order representation is impaired (Leslie, to appear; Dennett, 1978a; Johnson-Laird, 1983; Wimmer and Perner, 1983).

Leslie's account of the development of second-order representation in normal 12-18 month old infants is based on two important findings infant studies - both relatively uncontroversial:
First, that from birth infants have a capacity for "primary representation", and this is gradually developed and refined during the first year of life. This capacity allows the infant to faithfully represent objects, events, states of affairs and situations in the world. This capacity is equivalent to what was referred to earlier as "first-order representation" [Section 5.1].

Secondly, only from the second year of life, infants have the capacity to "pretend". (This capacity is described in Section 6.1., p.177). Leslie argues that this presupposes a special cognitive mechanism. A primary representational capacity is sufficient for representing the world as it actually is, but the 12-18 month old infant's ability to pretend that one thing is another could not by definition occur if the infant's representational capacity only allowed representation of the world as it actually is. The question, then, is to account for how the infant's cognitive system is simultaneously able to represent the actual world and the pretend world. Leslie proposes that the capacity for second-order representation makes this possible.

His claim is that a second-order representational capacity first gives rise to the ability to pretend play, and later to the ability to form a theory of mind. Both abilities not only involve the same representational structures, but 'pretend' is itself a mental state term. Thus, in pretend play, Leslie argues, the infant represents "I (or you) pretend that...", and this is equivalent to what is represented when employing a theory of mind, eg:"I (or you) believe that...". In this respect, 'pretend' has the same logical properties as 'believe' (see 3.2.(i), p.86; this will be expanded in 6.3, later). The essential difference is that in pretend play an infant's theory of mind is expressed before s/he can speak. Thus, whereas the earliest evidence of a theory of mind that is expressed in language is found around 24 months of age (Bretherton, McNew and Beeghly-Smith, 1981; Bretherton and Beeghly, 1982; Shatz, Wellman and Silber, 1983), evidence of pretend play is found almost a year earlier.

Leslie's model therefore allows a very specific prediction: namely, that if autistic children's impaired ability to attribute the mental state of belief (Experiments 3 and 4) is an indication of an impaired second-order representational capacity, then a deficit should also be observed in autistic children's ability to engage in pretend play. There is already some evidence from several studies on autistic children's pretend play that this is the case (Sigman and Ungerer, 1981; Wing, Gould, Yeates, and Brierley, 1977; Gould, in press; Riguet et al, 1981), although there are methodological shortcomings in all these experiments. (These will be discussed in 6.2). For this reason, it was decided to collect fresh evidence, and this is reported in Experiment 7 (see 6.4). In the next section, the development of pretend play in normal children is reviewed.

6.1: <u>The normal development of pretend play: literature review.</u>

The question of defining 'play' (as opposed to 'not play') is notoriously difficult. Since this review is only concerned with 'pretend' play, the definition of play will not be discussed here. Nor will the various theories about the function of play be discussed. Interesting as these issues might be, they are not relevant here (and a good review of this subject already exists: see Rubin, Fein and Vandenberg, 1983). Instead, the focus is exclusively on 'pretend play'. In what follows, the term 'pretend play' will be used to refer to what has also been called 'imaginative play', 'make-believe play', 'fantasy play', 'dramatic play', and 'symbolic play' (Fein, 1981). A definition of this will be presented in 6.3.

Piaget (1962) proposed that pretend play reflects the development of the 'semiotic function', that is, the understanding that one thing (a signifier) can stand for something else (that which is signified). For Piaget, the key to pretend play is "the <u>separation</u> of 'signifier' from 'signified' which ...constitutes symbolism" (p.123). He argued that pretend play is just one aspect of the semiotic function, others being language, drawing, etc. Piaget suggested that pretend play develops out of imitation: imitation allows the infant to represent things externally, and "interiorized imitation" allows the infant to create mental images or 'signifiers'. This relationship between imitation and pretend play remains as yet, however, purely speculative. In structural terms, Piaget proposed that pretend play was the 'opposite' of imitation:

> "If every act of intelligence is an equilibrium between assimilation and accomodation, while imitation is a continuation of accomodation for its own sake, it may be said conversely that play is essentially assimilation, or the primacy of assimilation over accomodation" (p.87).

This stresses how in pretend play the infant ignores (rather than accomodates to) the stimulus' real properties, instead assimilating them to his or her own internal schema. Thus, in pretend play an object can become almost anything else. According to Piaget, by Stage 6 of the sensorimotor period, the infant produces pretend play:

> "In the case of J...'make-believe' first appeared at 1:3(12)...At 1:3(30) it was the tail of her rubber donkey which represented the pillow!...Similarly, at 1:6(28) she said "avon" (savon = soap), rubbing her hands together and pretending to wash them (without any water)...At 1:7 she pretended to drink out of a box and then held it to the mouths of all who were present" (pp.96-97).

Most studies agree that pretend play first appears at 12 or 13 months of age (Fein and Apfel, 1978; Rosenblatt, 1977; Kagan, 1978; Lowe, 1975). Before this, play is either 'sensorimotor' (ie: banging, waving, and mouthing an object), observed during the first 7 months, or 'functional' (ie: appropriate actions in keeping with the specific functions and social usages for an object), which is present between 9-15 months (Rosenblatt, 1977; Fein and Apfel, 1979; Zelazo and Kearsley, 1980). These patterns appear to be universal: they have been observed in French children (Inhelder et al, 1972), Guatemalan children (Kagan, 1978), Japanese children (Shimada, Kai and Sano, 1981; Shimada, Sano and Peng, 1979), as well as American and English children from all social classes (Fein and Apfel, 1979; Fenson et al, 1976; Rosenblatt, 1977).

When pretend play does appear, it appears quite abruptly: Bates et al (1977) reported this development over a 3 month period: that 8% of children produced at least one pretend gesture at 9.5 months, 44% did so at 10.5 months, 72% at 11.5 months, and 96% at 12.5 months. The earliest form of pretend behaviour appears when the child produces a familiar behaviour (such as drinking) "in the void" (Rubin et al, 1983). It is identifiable as pretend

(1) because of its "as if" quality (eg: head tilted, cup tipped, synchronized in timing as if liquid was diminishing in volume); and

(2) because it is detached from its ordinary situational context (eg: mealtime); and

(3) because it is detached from the outcome with which it is normally associated (eg: quenching thirst).

Thus, 2 frequent key words used in the definition of pretend play are 'simulative' and 'non-literal' (Fein, 1981; Reynolds, 1976).

Whereas much of pretense in 12 month olds is self-referenced, at 18 months most pretend play incorporates self-other relationships (eg: the child feeds a doll with an empty bottle [Fein and Apfel, 1979; Lowe, 1975; Watson and Fischer, 1977; Nicolich, 1981]). Fenson and Ramsay (1980), following Piaget (1962), call this developmental trend 'decentration'. At this level, the child is the active agent and the 'other' (eg: the doll) is a passive recipient or object of the child's action. At a more advanced level (30 months), the child manipulates the 'other' as if it were an active agent (Lowe, 1975; Watson and Fischer, 1977).

Which objects can substitute for others in pretend play? In 12-19 month olds, pretend play occurs with miniature replica objects (eg: toy cups) as well as adult-sized objects (Fein and Apfel, 1979; Lowe, 1975; Fenson et al, 1976; Kagan, 1978), provided that the objects resemble their real counterparts. From 19-24 months the use of a substitute object (eg: a wooden block for a doll) is frequent (Fein, 1975; Ungerer, Zelazo, Kearsley and O'Leary, 1981; Watson and Fischer, 1977). For example, at 24 months, 75% of the children in the Watson and Fischer study demonstrated substitution behaviour. Fein (1975) found that at 24 months old, 93% of the children pretended to make a realistic toy horse drink from a cup, 79% pretended using a 'single' substitution (eg: make a toy horse drink from an egg-shell), but only 33% could manage a 'double' substitution (eg: make a piece of metal drink from a shell). Jackowitz and Watson (1980) further found, as one would predict, that an object with ambiguous function (eg: a block) is easier to substitute than one with a clearly conflicting function (eg: a car). The latter type of object is easier, in turn, to substitute than a condition in which no object is present.

In general, the infant is described as being capable of increasing <u>decontextualization.</u> S/he can use increasingly less realistic (ie: prototypical) objects as symbols. Fein (1975) described this as "the child's growing capacity to create analogies (or symbols) which are increasingly independent of external stimulation" (p.292). In other words, the symbols show increasing "distancing" (Werner and Kaplan, 1963) or "emancipation" (Vygotsky, 1933/1976). This developmental trend is supported by a number of other studies (Ungerer et al, 1981; Jackowitz and Watson, 1980; Bretherton et al, 1981). To illustrate, Bretherton et al (1981) give the example of a child who initially pretends to telephone using a particular toy telephone, then later does so with other toy telephones, and finally with other objects, such as pretending a spoon is a telephone.

Fein (1975) suggested that pretend could be thought of as involving <u>'transformations'</u> of real situations or objects. Such transformations can involve role-shifts (eg: the infant pretends to be someone else), animating inanimates, attributing absent characteristics to objects (eg: pretending a toy cooker is hot) and, as mentioned earlier, object substitutions. This is clearly an important quality of pretend. Another is that it is generative: pretend play is not limited to one or two topics but, like language, it is highly productive. These issues will be discussed later, when formulating an operational definition of pretend (in Section 6.3).

Both Piaget (1962) and Nicolich (1977) observed that length of pretend acts follows an invariant sequence, from single pretend gestures to combined pretend gestures, and finally to 'announced' pretend gestures, in which the child indicates that a pretend sequence is planned before being executed (Field, deStefano and Koewler, 1982). Another developmental trend was identified by Overton and Jackson (1973): they asked children (CA = 3-8 years) to pretend that they were using common objects in action sequences (eg: given a real comb "Pretend you are combing your hair"). Subsequently, the children were asked to demonstrate the same action sequences but without physical props. At 3 and 4 years old, the predominant strategy was to use a body part to designate the referent object (eg: finger used as comb). At 8 years old, the predominant strategy was to use imaginary objects. They conclude from this that pretend play becomes more 'ideational' with age, and this also supports Werner and Kaplan's (1963) hypothesis.

In Piaget's (1962) theory, "Level 1" symbolic play (1-2 years) is exclusively solitary, whilst "Level 2" (2-3 years) is social or interactive. This sequence has been confirmed by Nicolich (1977) and Smith (1977). Another stage ("parallel pretend play") has been identified between these 2 levels, in which pretend play occurs when children are in close proximity to [but are not interacting with] others (Hetherington et al, 1979). Dale (1983) questions the validity of the category of 'solitary' pretend play, arguing that pretend play has a social function right from the outset. Social pretend play will not be reviewed here as most of the studies of it tend to include older children, and the focus of this chapter is on the earliest manifestations of pretend play. However, it is worth noting that in social pretend play children not only pretend but also communicate to others that "this is play" (Bateson, 1955), using such markers as smiles and laughter, attenuation and exaggeration (Garvey, 1974; McCune-Nicolich and Fenson, 1984). Garvey and Berndt (1977) noted explicit verbal 'metacommunications' in all diads of their 3-5 year old sample, of the form 'You be the bride', and 'Pretend you hate fish', etc. Macnamara, Baker and Olsen (1976) have confirmed that 4 year olds clearly understand the indirect logical implications of the word "pretend".

Individual differences in styles of pretend play have been studied longitudinally as part of Harvard's Project Zero (Wolf and Gardner, 1978). Two types of pretend players have been identified: those whose play is focussed primarily on objects ("patterners") and those whose play is focussed primarily on people ("dramatists"). These stylistic differences are reported to emerge at about 12 months of age and become more pronounced over the next year. However, this study has only used a very small sample size, so generalized conclusions can only be made with caution. This object-person difference in play styles has however also been found in an independent study (Jennings, 1975).

It is important to look closely at the diverse methodological approaches these various studies of pretend play have used. Fenson et al (1976) observed each child individually, and allowed 10 minutes for 7-9 month olds, and 20 minutes for the 13-20 month olds. The mother was present but non-participating. They used a wide range of toys, including a metal tea-set, dolls, wooden blocks, a cowboy hat, and a wooden rabbit. Two observers coded play episodes into 3 classes of responses: 'relational acts' (ie: combining or relating 2 objects), 'symbolic acts' (in this study this included drinking, pouring, stirring and spooning imaginary substances from one container to another), and 'sequential acts'.

This contrasts with the methodology used in Fein's (1975) study: Again the child's mother was present, but not actively involved. Toys were different to the last study, and included a range from highly prototypical (eg: a detailed, plush toy horse, and a plastic egg-cup) to highly 'unprototypical' (eg: a metal horse shape and a clam-shell). The procedure was different, too: Each child observed a 'display trial', a 'modeling trial' (ie: the experimenter pretended to feed the horse), and a 'suggestion' trial (ie: the experimenter said "Let's pretend he's still hungry. You give him something to eat"). The child was given 10 seconds to respond after each presentation. Fein's definition of pretend centred on whether the child would pretend using the 'substitution' objects (ie: the 'unprototypical' objects). The fact that Fein's study used only 10 second episodes, and used modeling, whereas Fenson et al's study used 10-20 minute episodes and only involved spontaneous (ie: non-modelled) play shows the huge task differences at work. On the question of play duration, Lowe's (1975) study also allowed the child up to 30 minutes.

Jackowitz and Watson (1980) used children of 2 age groups (mean CA's

= 15:9 and 23:3 months). Toys included a real telephone, a play telephone, a plastic banana, a plastic walkie-talkie, a wooden block, and a toy car. The children were videotaped, unlike the previous studies, and the camera was hidden behind a one-way mirror. This study, like Fein's, also used modeling, in which the adult demonstrated pretend behaviours, following which the child was allowed 3 minutes to pretend. As in the other studies, the child's mother was present but uninvolved, but the experimenter left the room during the 3 minute play episode. Pretend play in this study was defined only if it involved object substitutions (eg: using the car as a telephone was scored as pretend, but pretending to drive a car was not). Two observers scored the videotapes. The inclusion of modeling in both this study, the previous one, as well as others (Watson and Fischer, 1977; Overton and Jackson, 1973) sheds doubt on what the children were actually doing: were they pretending or merely imitating?

Shimada, Sano and Peng (1979) longitudinally observed a small sample (n = 4) using miniature toys, a doll, and "junk material" (such as twigs and crumpled paper, which the other studies did not use). The subjects were tested in the presence of their mother once a month from aged 12-24 months. The toys were presented for 5 minutes and the spontaneous behaviour of the child was scored for any symbolic play. This was defined in terms of object substitution (eg: eating with a twig as a spoon) and gesture (eg: taking an imaginary candy out of a paper and eating it). Other behaviour was simply categorized as non-symbolic 'manipulative play', either 'relational' or 'non-relational'.

As a final illustration of the lack of consistency between methodologies in studies of pretend play with normal children, it is worth citing an experiment by Takhvar, Gore and Smith (1984). They found that by giving the children the opportunity to comment or interpret their own actions, many behaviours which were initially scored as 'functional' or 'constructive' were rescored as 'dramatic' (ie: pretend). For example, "Some children are sitting on a barrel, kicking their feet on the sides, without vocalizing; when asked, they say it is a galloping horse" (p.12). These authors argue that the conventional procedure of non-interactive observers rating the child's play significantly underestimates how much of it is pretend.

McCune-Nicolich and Fenson (1984) have discussed the problems which stem from the diversity of procedures adopted by different studies. The main points to be noted are the following: (1) Studying play at home (Fein and Apfel, 1979; Dunn and Wooding, 1977) or in laboratory settings results in similar descriptions; (2) An observation period of 5 minutes is a minimum for meaningful data collection; (3) The mother's presence can have a critical effect on results, depending on whether she is allowed to respond actively to the child (Dunn and Wooding, 1977); and (4) Eliciting procedures such as modeling are not mandatory for studying pretend play, although they do enhance it.

Given the range of variables that have been noted, careful design was required for the design of Experiment 7, testing pretend play in autistic children. This is discussed later. In the next section, the various studies that have already been done on autistic children's pretend play are reviewed.

6.2: Experimental studies of pretend play in autism: literature review.

Eisenberg and Kanner (1956) described autistic children's preoccupation with repetitive activities and fascination with objects, but their early records do not comment on whether this repetitive, ritualistic activity had a pretend quality or not. Tilton and Ottinger (1964) found that in their sample of 13 autistic subjects (CA range = 3:7-6:7 years, all of whom are reported to be "untestable on standard psychological tests" [p.969]), only 5 demonstrated any combining of toys, and instead most spent a higher proportion of their play in "repetitive manipulations" (such as patting, sucking, shaking, twirling, and spinning toys) than either normal or non-autistic retarded children. This replicates Kanner's earlier observation (Eisenberg and Kanner, 1956), and this has also been found by DeMyer et al (1967), using maternal questionaires, by Black, Freeman and Montgomery (1975), and by Strain and Cooke (1976). Again, however, 'pretend play' was not included among the behaviour categories in any of these studies.

Wing, Gould, Yeates and Brierley (1977), using a structured interview schedule with parents of retarded autistic and non-autistic children in the Camberwell area of South London, obtained information about symbolic play in the home. The children were also observed at school. The definition of symbolic play in this study included, for example, making appropriate noises while pushing a toy car along, or pretending to drive it; holding dolls as if they were real babies, and brushing their hair, or tucking them up in bed. However, these behaviours do not show any unambiguous object substitution, and thus cannot really be called 'pretend'. In a more rigorous scheme they would instead be considered as 'functional play', since they are appropriate to the toys. Nevertheless, the results of this study were as follows: no retarded children below MA = 20 months showed any symbolic play, the autistic children showed 'stereotyped play' (ie: a preoccupation with one activity), and none of the autistic children showed any symbolic play, even given the lenient scoring scheme. This result confirms an earlier prediction made by Ricks and Wing (1975), on the basis of a theory of symbolic deficit in autism. (This is discussed further in Chapter 8.3).

In Curcio and Piserchia's (1978) autistic sample (n = 24, CA range = 5:10-15:7 years, mean Verbal MA = 5:6 years), it was found that pretend gestures could be elicited under verbal instructions or following modeling; however, most responses consisted of "low-level" substitutions of a body-part in place of the absent object. This has also been found by Attwood (1984). This <u>may</u> be evidence that autistic children are capable of some "primitive" object substitution - primitive, in the sense that normal children of the same MA are capable of more abstract pantomimic representation (Overton and Jackson, 1973). Curcio and Piserchia's result is difficult to interpret, since this was not spontaneous behaviour and thus may have been either the result of instruction or imitation, and also because there was no non-autistic control group in this study. However, Attwood's inclusion of a non-autistic control group demonstrates this failure to produce more abstract gestures is autism-specific.

A study which did investigate both the spontaneous and the modeling-elicited play of autistic children (n = 10) in comparison to Down's Syndrome (n = 10) and normal preschool children (n = 10) was by Riguet, Taylor, Benaroya and Klein (1981). All 3 groups of children had a Peabody Picture Vocabulary Test median MA of 2.5 years, and the Down's Syndrome group had the same CA range as the autistic group. The autistic group also showed a mean non-verbal MA of 5.3 years on the Leiter Scale. Each child had a 4 minute free play period, followed by various modeling sessions, followed by a final 4 minute free-play period. The children's play was then scored for whether it was symbolic or not. Symbolic play was defined in terms of object substitution. Their results showed that none of the autistic children showed any symbolic play during the free play sessions, and during the modeling period some symbolic play was elicited, but this was confined to a literal imitation of the demonstration. In contrast, the control children showed symbolic play in the free play period, and higher level symbolic play in the modeling condition. This study thus clearly shows the effects of modeling, and the deficit in autistic children's spontaneous pretend play. It should be noted, however, that this study used a somewhat limited definition of pretend play, this being object substitution exclusively. In other words, while this is certainly an important criterion, no other indexes of pretend were considered. This limitation is discussed later.

Ungerer and Sigman's (1981) study also looked at both spontaneous and modeled play. 16 autistic children (mean CA = 4.4 years, mean MA [Cattell Scale] = 2.1 years; mean MA [Merrill Palmer] = 2.9 yrs) were compared to a normal control group of comparable MA. Unfortunately, no retarded non-autistic control group was included in this experiment. They categorized the autistic children's play into either "simple manipulation", "relational play", "functional play" or "symbolic play". The first two are essentially sensorimotor activities. Functional play was defined as appropriate use of an object, or the conventional association of 2 or more objects such as placing a teacup on a saucer. Ungerer and Sigman see functional play as the earliest manifestation of symbolic play, but such a view blurrs the conceptual boundaries and, as is evident from their definitions (below), these two types of play are mutually exclusive. Another problem with this study is that each play session began with the experimenter modeling 4 different symbolic acts with the toys. The child was then permitted to play alone for 16 minutes. This condition was called the "unstructured setting", although the initial modeling made it far from completely spontaneous. The other condition ("structured setting") was experimenter-directed throughout, using verbal instructions such as "feed the baby with the bottle" etc, plus modeling if necessary.

Apart from the criticisms concerning the distinction between functional and symbolic, and concerning the use of a modeling procedure, Ungerer and Sigman's definition of pretend play is very thorough and worth quoting:

> "Three categories of symbolic acts were recorded: substitution play, defined as the use of one object as if it were a different object (eg: using a tea-cup as a telephone receiver), agent play, defined as the use of a doll as an independent agent of action (eg: propping a bottle in a doll's arms as if it could feed itself), and imaginary play, defined as the creation of objects or people having no physical representation in the immediate environment (eg: making pouring sounds as imaginary tea is poured from a teapot into a cup)" (p.324).

Their results showed that, in the 'unstructured condition', the autistic children's play fell into the categories of manipulation, relational, and functional, but symbolic play occurred extremely rarely. The form of simple manipulation which occurred most frequently was that of exploring an object with the fingers. The existence of a high frequency of 'relational play' (ie: combining toys) contradicts the earlier finding by Tilton and Ottinger (1964) that most autistic children do not combine objects in play. However, relational play was found to correlate with higher language levels, and this may explain the discrepancy between this study and the earlier one by Tilton and Ottinger. The presence of some object-directed functional play also refutes the claim by Despert and Sherwin (1958) that this is absent in autism. In the functional play category, Ungerer and Sigman report that the most frequent acts were directed towards objects (eg: putting a spoon into a cup), and in the 'structured condition', functional play was positively correlated with overall MA.

Only 4 of the autistic children demonstrated any symbolic play. Of this group, 2 performed completely novel acts and 2 performed their own variations of the symbolic acts modeled by the experimenter. Thus, only 12.5% of the autistic sample can be said to have produced spontaneous pretend play. These children were in the higher level receptive language group (n = 7), using a test of picture vocabulary, but clearly not all autistic children in this group produced pretend play. 3 other children produced direct imitations of the modeled symbolic acts. In the 'structured condition', the verbal cueing and modeling procedures increased the number of different acts observed in all 4 play categories, but this does not necessarily reflect anything more than the effects of imitation.

One final result from Ungerer and Sigman's study was that autistic children's doll play was impoverished, compared to object play, in the functional category. They explain this as being due to autistic children's impaired ability to differentiate objects and actions, but there is no evidence to support this explanation. A better explanation for this result might be in terms of autistic children's impaired theory of mind, found in the Puppet and Picture Experiments (3 and 4), reported earlier. The argument would be that such an impairment would not impair functional object play, but might impede functional doll play of the sort "Mary <u>wants</u> to make some tea and <u>thinks</u> the other dolls want some too", etc.

Hammes and Langdell (1981) tested whether their sample of autistic children (mean MA = 4:6 years, mean CA = 9:10 years) could imitate pretend actions which varied in terms of their 'abstractness'. They found that when the task did not require any imaginary objects (eg: copying the modeled action of giving a doll a drink) all the autistic children could do this. When the task required having to imitate the use of objects (eg: hammering a nail), again all the children could do this, although the autistic children performed the act in a "real" manner, with <u>no</u> pretend quality at all. In the third task, 6 out of 8 of the autistic children did not copy modeled pretend use of an imaginary object (such as pouring tea from an empty pot into an imaginary cup), whereas all the retarded non-autistic children (matched on MA and CA) did. This difference was highly significant ($p < 0.0003$, Fisher Exact Test). Finally, in the fourth type of action, children had to copy purely pantomimic behaviours (eg: the model pretended to pour tea but neither teapot nor cup was present). Again, the 2 groups of subjects differed. The difference lay in their ability to show "empty gestures" on at least 3 of the 5 possible occasions: whereas 7 out of 8 of the retarded children did, 6 out of 8 of the autistic children did not.

In a test of object substitution (in which the children had to copy the model's activity but were given the "wrong" object with which to do so) Hammes and Langdell found that the retarded children virtually always gave some symbolic response, but 5 of the autistic children failed to respond on at least half of the occasions, and those who did respond did so with "proper" (ie: non-symbolic), functional uses of the objects. This interesting set of experiments demonstrate clearly that autistic children of this MA (4:6 years) can only imitate 'concrete' actions but fail to imitate modeled pretend actions which require any symbolic (ie: substitute) elements. The results after careful matching with a non-autistic retarded control group shows that this deficit is not due to retardation but is autism-specific. A similar pattern of results was obtained by Attwood, (1984) in a test of mime production and comprehension.

Gould (in press) tested "socially impaired" children using the Lowe and Costello (1976) standardized test of symbolic play development. In this test, sets of miniature objects arranged in predetermined patterns are presented. No expressive speech is required, and the subject's uses of the toys are scored as age-equivalents based on norms established with normal children up to 3 years old. The socially-impaired group (n = 31) was compared to a group of "sociable" children (n = 29) who were retarded in language comprehension and use, and of similar age (CA range = 5-12) and IQ to the socially-impaired group. "Sociable" was defined in terms of the children showing social interaction appropriate for their MA (although no standardized instrument is mentioned as having been used to test this). 18 out of 31 of the socially impaired group (and none of the sociable group) had a history of classic Kanner's syndrome (ie: autism).

The 2 groups did not differ on visuo-spatial scores, but the social group had a significantly higher play test age. Even so, 9 of the 31 socially-impaired children were rated as showing symbolic play, since they scored 3 or more on the Lowe and Costello scale. These subjects, however, failed to show any elaboration or creativity in their use of the materials. In contrast, the pretend play of the sociable children was in line with their MA, and their use of the materials was varied and flexible. The socially impaired group also showed less observed spontaneous play than the sociable group. Play test ages and language comprehension were positively correlated to a moderate degree in all the children who scored on the test at all.

Gould's study concludes that the retarded socially impaired group, 58% of whom had been diagnosed autistic, showed less pretend play than would be expected from their MA, but nevertheless some autistic children did show some pretend play, albeit unelaborated and 'unimaginative'. This co-occurence of social and symbolic skills is in line with the other studies reviewed above, showing an autism-specific deficit in pretend play. It is of interest that this pattern also applied to those socially-impaired children who had not been diagnosed autistic. This supports the idea that deficits in these two skills, social and pretend, depend on the same underlying mechanism, whether it is found within the classically autistic population or not. (This same correlation between poor social interaction and impoverished pretend play in autism has been found in two other, more recent studies, [Mundy et al, 1984; Wetherby and Prutting, 1984], although these unfortunately included no non-autistic retarded control group data, and the second of these scored 'functional' play as pretend).

The main criticism of Gould's study is that it accepts the Lowe and Costello definition of pretend: This includes such behaviours as combing or brushing one's own or another person's hair, placing toy tea-cups onto saucers, placing a toy knife and fork next to a plate, wiping cutlery with a cloth, wiping one's face with a cloth, putting a cloth on a toy table, putting a miniature chair next to it, or attaching a toy trailer to a toy tractor. Unfortunately, all of these actions are appropriate for the objects, and as such constitute 'functional play'. There is nothing necessarily pretend about them. The problem in the Lowe and Costello Test is that it assumes that play with miniature objects (toys) is necessarily pretend, since miniature objects are symbols of real-size objects. However, this assumption is not reliable, since for the child the miniature object may be perceived simply as a small but real object. Thus, this study may well overestimate the incidence of pretend play, through the use of inadequate criteria.

The studies on pretend play in autism can be summarized as follows: All studies to date suggest that there is a deficit in pretend play in autism, either in terms of its absence in most cases or its limited form in those who do show it. However, all of the above studies have methodological short-comings which prevent any conclusions about autistic children's pretend play from being made without qualification. These methodological problems are of two types: (1) either that spontaneous play was not studied (Curcio and Piserchia, 1978; Ungerer and Sigman, 1981; Hammes and Langdell, 1981), and/or (2) that the definition of pretend was inadequate (Wing et al, 1977; Gould, to appear; Riguet et al, 1981). The first of these problems may overestimate the amount of pretend play in autism (ie: by counting imitation as pretend), while the second of these problems could either overestimate it (ie: by counting functional play as pretend) or underestimate it (ie: by overlooking behaviour which should be included as pretend). An attempt is made to avoid these methodological problems in Experiment 7.

The other major finding of these studies is that pretend play is not deviant in non-autistic retarded children, but is 'normal' relative to their MA (Hulme and Lunzer, 1966; Wing et al, 1977; Riguet et al, 1981; Hammes and Langdell, 1981; Gould, to appear). This is also confirmed in specific studies of Down's Syndrome children's pretend play (Hill and McCune-Nicolich, 1981; Cunningham et al, 1985). Mogford (1977) and Quinn and Rubin (1984) have reviewed the literature on play in a variety of handicapped populations (retarded, speech impaired, blind, deaf, autistic) and concludes that play abnormalities are most pronounced in the autistic group.

The relationship between deficits in language and pretend play remains a subject of controversy: Piaget (1962) argued that they are two aspects of the 'semiotic function' and therefore necessarily interlinked. However, Rutter, Bartak and Newman (1971) found that only 3 out of 14 autistic children showed any pretend play, in contrast to 9 out of 11 aphasic children who did pretend, which suggested that language and pretend play are independent. (No details of how pretend play was evaluated are given in this study). Sigman and Ungerer (1984b) also found that language and pretend play deficits were independent of each other, in that the autistic children with more advanced receptive language showed less pretend play than the <u>non-autistic</u> mentally retarded children with less advanced language skills. They argue that the pretend deficit in autism is thus not simply a result of delayed language development.

Before describing Experiment 7, it is important to present a thorough definition of 'pretend', and this will be derived from a consideration of its cognitive properties, in the next section.

6.3: Cognitive aspects of pretend play:

Certain qualifications are perhaps required before presenting a cognitive analysis of pretend play, since it is likely that pretend play serves 'non-cognitive' functions as well. Indeed, Vygotsky (1933/76) is in no doubt over this:

> "If play is to be understood as symbolic, there is the danger that it might turn into a kind of activity akin to algebra in action;...I feel that this...stresses the importance of the cognitive process while neglecting not only the affective situation but also the circumstances of the child's activity" (p.540).

The affective and social aspects of pretend play are very important, and initial investigations into this exist (Dunn and Wooding, 1977; Dale, 1983; Connolly and Doyle, 1984). However, these will not be discussed in this thesis, since it is only the cognitive aspects of pretend play which are predicted to be related to autistic children's deficit in their theory of mind (Chapters 3 and 4).

What are these cognitive features of pretend? The first distinction to make is between pretend play versus 'reality play'. Reality play can be defined as responding to the actual properties of objects and persons, and exercising a variety of appropriate action schemes (Leslie, to appear). At an early level, this would include sensorimotor play, (ie: manipulation of objects and exploration of their physical properties) and, at a higher level, functional play (ie: acting out the conventional use of objects, such as setting out a tea set properly). A working definition of reality play is when the infant treats the object as being what it actually is. Thus, a plastic cup is treated as being plastic, or a cup, or hard, etc. In contrast, pretend play can be defined as when the infant treats the object as being what it is not. Thus, the plastic cup is treated as if it contained fluid, or as if it were a space-ship, etc.

This working definition has certain cognitive implications: namely, that for a person to be pretending s/he must simultaneously know both what the object actually is, and what the object is now represented as being (Golomb and Cornelius, 1977). This ensures that the person is pretending rather than simply being mistaken or confused (Austin, 1961; Leslie, to appear). Some authors have termed these simultaneous representations "double knowledge" (McCune-Nicolich, 1981; Rosenblatt, 1977). Leslie adds the qualification that the pretender must be able to tell the difference between the pretence and reality at the time the pretence takes place. Thus, to borrow an example from Piaget (1962), the child might pretend by using a donkey's tail (x) to represent a pillow (y), and for this to count as pretend, the child must be able to discriminate x's from y's. Stern (1924) proposed the "ignorance" hypothesis, which viewed pretend play as due to mistakes by the child, but clearly this does not meet the definition adequately, since ignorance and pretence are conceptually distinct.

How pretend play is cognitively achieved has received relatively little attention since Piaget (1962), with the exception of a recent analysis by Leslie (to appear). As mentioned briefly earlier (p.149), in Leslie's model, the real world is represented by "primary representations" and, whilst in 'pretend mode', primary representations are "decoupled" from their normal input-output relationships. He postulates that this is performed by a cognitive mechanism called the "decoupler". This is necessary so that, as Austin (1961) expresses it, "Pretence is always insulated...from reality" (p.253), and, in Leslie's terms, the system has some way of "quarantining" pretence from reality. This ensures that during pretend play, one's knowledge about the real world does not get interfered with or "abused". This idea is also expressed in an earlier paper by Reynolds (1976):

> "The essential feature of the simulative mode is that the system, while functioning normally, is uncoupled from its normal consequences vis-a-vis the other systems. However, the feedback consequences within the acting systems are unimpaired" (p.621).

Thus decoupled from their normal use, primary representations become "second-order" representations, or "metarepresentations" (Pylyshyn, 1978).

Leslie identifies 3 logical properties of pretending:

(1) Deviant reference, in which objects are substituted for one another (eg: "this banana is a telephone");

(2) Deviant truth, in which 'false' properties are attributed to objects (eg: "this doll's (clean) face is dirty");

(3) Deviant existence, in which absent objects are present (eg: "this (empty) cup is full of tea").

Leslie points out that these 3 logical properties of pretending are identical to the 3 logical properties of mental states, noted by Brentano (1874), discussed earlier (see p.86). These are: "referential opacity"; "non-entailment of truth"; and "non-entailment of existence", respectively. These 3 features can be handled by the cognitive system precisely because primary representations have been 'decoupled' from reality. This again parallels the cognitive requirements for representing mental states (see p.144-6).

The cognitive significance of this, therefore, is that in reality play (such as 'functional play') only a primary or 'first-order' representational capacity is required, whereas pretend play employs second-order representations.

Having discussed some of the important logical and cognitive properties of pretend play, it is possible to formulate a definition of pretend play which (with the exception of Sigman and Ungerer's [1981]) goes further than that used in the previous studies with autistic children. This is the definition which will be used in Experiment 7.

Definition:

Pretend play can be said to occur if there is evidence that:

(1) The subject is using an object as if it were another object, and/or

(2) The subject is attributing properties to an object which it does not have, and/or

(3) The subject is referring to absent objects as if they are present.

Even with this definition, it is the case that some pretence will be missed, since this definition is expressed in purely behavioural terms and, as discussed earlier, pretence in principle can be totally "in one's head", with no outward, visible indeces (Austin, 1961). This is therefore a definition of visible pretend play, and is used so that it can be independently identified. Along with this definition also runs the possibility that some pretence will be attributed when there is none, eg: a child might look at a wooden brick and say the word "car", and this would meet the third part of the definition above of pretend play, even though the child may have no intention to refer to the brick as a car. Such errors, however, will be a feature of all definitions of pretend play. The strength of the one above is that it includes more forms of substitution than just object substitution, and it allows pretend play to be distinguished from other types of play, and these are described in Experiment 7, in the next Chapter.

Chapter 7: An empirical investigation of Pretend Play in autism.

To summarize the arguments so far, the Puppet and Picture Experiments (3 and 4) have suggested that autistic children's ability to understand other people's mental states, an ability which involves second-order representations, (Dennett, 1978a; Leslie, to appear; Johnson-Laird, 1983; Wimmer and Perner, 1983) is impaired, whilst the Causality Experiment (5) suggested that their ability to understand physical causality, which requires first-order representations (ie: representations receiving input from and referring to external stimuli), is intact.

According to Leslie, pretend play may be the earliest manifestation of a second-order representational capacity in human development. Therefore, a theory of autism which posits a 'second-order representational deficit' should also predict that pretend play is impaired in autism, but not in other mentally handicapped groups who can attribute mental states to others. Thus, the predicted contrast should again be between Down's Syndrome versus autistic children. Experiment 7 tests the hypothesis that autistic children do not show any spontaneous pretend play, and this experiment is designed to overcome the methodological and definitional shortcomings of earlier studies (Ungerer and Sigman, 1981; Wing et al, 1977; Riguet et al, 1981; Gould, in press), as discussed in Chapter 6.2.

7.1: Method:

Subjects:

The subjects once again were drawn from special schools in the London area, in the case of the clinical groups, and from a nursery school in the case of the normal group. It was decided to use a different sample of subjects from the previous experiments, on the grounds that it was expected that pretend play was more likely to be elicited in as young a sample as possible. This sample selection thus increased the chances of finding some pretend play, since it might not be expected in an older age-group. The background data for individual subjects is shown in Appendix 11.

Table 7.1 shows that the Down's Syndrome and the autistic children are matched as groups on mean chronological age, mental age (non-verbal) as well as on IQ and language age (BPVT).

Table 7.1: Subject Variables in Experiment 7.

Group	N	Chronological Age			Sex	
		x	sd	Range	Male	Female
Normal	10	4.1	0.7	3.0 - 5.1	7	3
Down's	10	7.5	2.9	2.5 -12.2	5	5
Autistic	10	8.1	2.6	4.3 -12.4	7	3

Group	MA (LEITER)			IQ		
	x	sd	Range	x	sd	Range
Normal	-	-	-	-	-	-
Down's	3.8	1.7	1.9- 5.8	59	20.6	30- 89
Autistic	4.9	2.9	2.3-10.2	58	25.6	35-106

BPVT			
	x	sd	Range
Normal	-	-	-
Down's	2.5	0.6	1.7-3.7
Autistic	2.5	0.9	1.7-3.4

Non-verbal MA was measured using the Leiter International Performance Scale. Verbal MA was assessed using the BPVT, which resulted in 6 subjects (3 Down's and 3 autistic) being classed as 'non-verbal' in that they produced no score at all on this scale. They were nevertheless included in this experiment on the grounds that no a priori assumptions were being set up regarding the relationship between pretend play and language; as stated above, the hypothesis being tested focussed on the relationship between diagnostic group and pretend play. The individual subject data is shown in Appendix 11.

Procedure:

Each child was filmed for 15 minutes individually, using 3 different sets of toys (5 minutes each). The choice of materials used was decided on the basis that as wide a variety of toys as possible would increase the likelihood of eliciting pretend play. Having 3 sets of different toys also meant that novelty would be introduced at regular intervals, if one set of toys was less attractive to a particular child. Limiting it to 3 sets of toys was thought necessary because pilot studies had shown that more than this was beyond the child's concentration span, and this was limited enough to be easily standardizable. The 3 toy sets were:

a. 5 different stuffed animals, (namely, a crocodile, a snake, a cow, a frog and a mouse, each between 2-6 inches long), and wooden building bricks (of different shapes and sizes, of the sort frequently found in nursery schools). The inclusion of toy animals was because pretend play with these would be very easily identifiable (eg: animating them, making animal noises, etc). The wooden bricks were available to be incorporated either into any 'animal play', and/or because they lend themselves very easily for use as object substitutes (eg: house, train, etc);

b. A toy kitchen stove (made of plastic), with miniature pots, pans, spoon, 2 dolls, small pieces of green sponge, and a toy telephone. The pieces of sponge were included so as to provide the child with material which was clearly non-functional but which could be incorporated as substitute objects in pretend cooking. The pieces of sponge were <u>the</u> essential part of this second set of toys, since other studies which have used cooking or domestic-type toys usually only elicit functionally appropriate use of them, whereas if the child incorporated the sponge as food, this would clearly be an example of pretend. Similarly, it was hoped the telephone might encourage construction of a pretend conversation with an imaginary listener;

c. A set of 'play people' (commercially available) - ie: small plastic people (approximately 3 inches high), in a playground setting (swings, climbing frame, bench). This third set of toys was included because it was more conventionally something to 'play with' (eg: pushing a swing, assembling a climbing frame, etc). It did not contain any materials of ambiguous function, as the other 2 sets of toys had deliberately done. As such, it was not expected to lend itself particularly to pretend play, but it was included in order to be used for other types of play, discussed below.

The child was seated at a small table, away from other children, and the experimenter presented one set of toys at a time. Another experimenter videotaped the child in each of the 3 conditions for 5 minutes continuously. The order of presentation of these 3 sets of toys was randomized, but each child played with all 3 sets. The experimenter simply said to each child: "Here are some toys. Would you like to play with them? Good. You can do anything you like with them." Following these instructions, the experimenter only spoke to the child if the child initiated any interaction (eg: asked questions, etc.,). For long periods, and for most of the time, the focus was on the child's solitary spontaneous play. There was no modeling at all.

Subjects who did not interact with the materials at all , ie: who could not be described even minimally as "object-directed", were excluded from the experiment. This resulted in 1 Down's Syndrome and 1 autistic child being excluded. After 30 children who had met the inclusion criteria had been tested, their video-films were examined.

Video Film Coding Scheme.

The children's toy-directed behaviour was coded into any one of 4 mutually exclusive categories:

1. Sensorimotor:

Definition: banging, waving, sucking, throwing, rolling, 'twiddling', or sniffing objects, with no attention paid to their 'function'.
Example: child sucks brick.

2. Ordering:

Definition: a more 'intelligent' behaviour involving the child imposing some pattern onto the objects, such as lining them up, piling them up, puting one inside another, arranging them in systematic ways, but still with no regard for their 'function'.
Example: child piles up bricks.

3. Functional Play:

Definition: Using the objects 'appropriately', that is, according to their intended function.
Example: child dials telephone, picks up receiver, and says "Hello".

4. Pretend Play:

Definition: Child uses an object as if it was another object, (eg: using bits of sponge as food), or attributes properties to an object which it does not have (eg: acting as if the toy stove was hot), or refers to absent objects as if they are present (eg: pouring water when there is none).

These 4 categories were found to encompass all toy-directed behaviours of interest produced. The object-directed behaviours above are numbered 1 to 4 because they also represent a developmental sequence, from simple to complex, concrete to abstract, in the first few years of child development (Fein, 1975; Sigman and Ungerer, 1984b).

All the films were analysed and the behaviour categorized accordingly, and strict criteria were used throughout. This was achieved by having 3 measures of certainty for each category:

1. Very sure;

2. Quite sure;

3. Ambiguous;

If the behaviour was very ambiguous, it was 'relegated' to the simpler, developmentally earlier behaviour category. For example, a child sucking a brick could be taken as a very ambiguous example of pretending the brick was food. In our strict coding scheme however, this would be scored as sensorimotor. Similarly, piling up bricks could be taken as pretending the bricks were a tower etc., but in the absence of any other supporting evidence for a pretend interpretation, this would be coded as 'ordering'.

Given the limited range of play materials presented, there was a limited range of behaviours elicited. In order to clarify the nature of the coding scheme, the entire list of behaviours generated by these toys is shown below, for the 4 object-related categories.

Table 7.2: Toy-type x behaviour category interaction, in Experiment 7.

(Overleaf)

BEHAVIOUR CATEGORY

Toy-Type	1 Sensorimot	2 Ordering	3 Functional	4 Pretend
Animals	Sucking, throwing, banging, waving, rolling, 'twiddling' or sniffing the animal.	Lining up animals.	-	Animating animals eg: making animal walk, eat, bite, fight, etc.; Making animal noises
Bricks	Same actions as above on bricks.	Lining up bricks; Piling up bricks; Arranging them by colour, size, shape, etc.	-	Name pile of bricks as house, etc.; Using a brick as another object, eg: a knife, or a train, etc.
Telephone	Same actions as above on telephone; making it ring.	-	Naming telephone; dialing; picking up receiver, replacing it, holding it to ear, saying 'Hello'.	Adapting telephone conversation as if someone else was at other end.
Cooker Set	Same actions as above on pans, spoon, sponge, dishes.	Putting pans inside one another.	Turning dials on cooker; opening cooker doors; assembling parts of cooker; placing empty pan in/on to cooker.	Putting sponge into pan; putting pan with sponge inside in/on to cooker; stirring sponge in pan with spoon; stirring empty pan with spoon; serving sponge from pan to dishes; feeding dolls with sponge from spoon;animates dolls eg: making doll cook.
Play People	Same actions as above on play people; Pushing swing without people in it.	Lining up play people.	Sitting people on bench; putting people in swing and pushing it; making people climb up ladder.	Giving people roles other than those related to actions appropriate on a climbing frame or swing. (ie: not functional).

As Table 7.2 above shows, there were 5 separate toys within the 3 conditions, and 4 object-related behaviour categories. This generated 4 x 5 = 20 Toy x Category combinations. However, as the chart shows, 3 toy x behaviour combinations were excluded so as to preserve their mutually exclusive nature:

1. In the animals condition, 'functional play' was in principle impossible, since this would have been indistinguishable (and therefore not mutually exclusive) from pretend play.

2. Similarly, the bricks could not be used 'functionally' without also being 'ordering behaviour'.

3. Finally, the telephone, by its very design, could not be acted on such that the behaviour could be classified as 'ordering'.

Apart from these 3 exceptions, the remaining 17 other toy x behaviour category interactions were in principle possible (ie: distinguishable) and indeed did arise.

7.2: Video Analysis.

(i) All the video films were analysed first by the experimenter, noting down and transcribing all different (ie novel) examples which fell into each behaviour category for each type of toy. Each was also scored for whether the category judgement was very sure, quite sure or ambiguous. Repetitions of the same behaviour on the same toy were not scored. The transcriptions of these films are shown in Appendix 10. There is no objective definition of what counts as a distinct behaviour, but the way in which the stream of action has been 'chunked' is clear from the transcriptions in Appendix 10. The subjective guideline used was that one act on one object or one act relating 2 objects together constituted a unit of behaviour (eg: 'puts dish in oven'), unless the next action was not separated by any 'noticeable' pause in time (eg: 'puts dish in oven and takes it out again'). Because of the unreliability of counting behaviours, all of the analyses which were done were qualitative (ie: does the subject show this type of behaviour or not) rather that quantitative (ie: how much of this type of play does the subject show).

(ii) The experimenter then watched all the video films for a second time and recoded whether each child produced behaviours of each type, as a test of reliability of his judgement about each child's behaviour.

(iii) An independent judge then analysed all the films, as a test of reliability both of the first judge, and of the scoring method for each diagnostic group. This was done by using Table 7.2 as operational definitions of each play category, and the films were randomized so that all 3 groups of children were mixed up together. Whilst this does not entirely prevent knowledge of diagnosis from influencing ratings, it makes it more difficult to guess the diagnosis of each child. This second judge simply scored each child for whether they produced any of the 4 play behaviours, and whether these judgements were ambiguous, quite sure, or very sure.

(iv) Finally, 14 independent judges (drawn from psychology postgraduate students) were asked to rate films of 3 subjects' play (1 normal, 1 Down's Syndrome, and 1 autistic child) for unambiguous instances of pretend play only, in the animal condition. The Down's Syndrome and the autistic child were selected at random from those who could be matched for non-verbal MA, verbal MA, and CA.

<u>Results:</u>

It was decided to analyze the experimenter's first rating in terms of the number of children in each group showing each behaviour at different levels of certainty. These 3 levels (very sure, quite sure, and ambiguous) are not mutually exclusive for any one subject (although they are for any one action), as at different times the same child might produce behaviours at more than one level of clarity. The reason the analysis was in terms of the number of subjects producing each type of behaviour was because this is a far more reliable measure than the number of behaviours produced of each type, since, as discussed earlier, it is not possible to say where a behaviour begins and ends with any reliability. These results are shown in Table 7.3. A subject was rated as showing the behaviour if it occurred at all with any of the 3 toy sets.

Table 7.3: First judge's (experimenter's) ratings, expressed as percentage of each group showing each play behaviour.

Pretend

	Very Sure	Quite Sure	Ambiguous
Autistic	20*	20	40
Down's	80	50	40
Normal	90	50	50

(* = significant)

Functional

	Very Sure	Quite Sure	Ambiguous
Autistic	80	0	20
Down's	90	10	30
Normal	100	0	10

Sensorimotor

	Very Sure	Quite Sure	Ambiguous
Autistic	100	30	10
Down's	80	10	20
Normal	40	10	0

Ordering

	Very Sure	Quite Sure	Ambiguous
Autistic	40	10	0
Down's	20	0	0
Normal	40	0	0

These results are from all 3 conditions combined. A Fisher-Yates Test of Significance for 2x2 matrices was performed on these data, resulting in a significant difference being found only between the Autistic and the 2 control groups in the pretend category ($p = 0.025$). All other group differences were non-significant ($p > 0.05$). Furthermore, the difference in the pretend category was unaffected when only non-verbal pretend acts were considered. There was an effect of condition, in that the play people condition elicited functional and sensorimotor play from all 3 groups, but no unambiguous pretend play. In contrast, the other 2 conditions did elicit pretend play to an equal extent. There was no effect of sex on pretend play (12/19 males pretended, and 7/11 females pretended [$Chi^2 = 0.599$, $df=1$, $p > 0.3$]).

The experimenter further analysed the pretend play category by considering the number of unambiguous pretend actions made, and the number of children making them, for each diagnostic group. Table 7.4 overleaf shows this comparison: This particular analysis was done despite the problems in deciding how to count behaviours. This was because it was important to determine how much pretend play is produced by each group, at an approximate level. The measures (none, few, and many) are sufficient to show the group differences:

Table 7.4: <u>Number of subjects in each group producing different quantities of unambiguous pretend play.</u>

	None	Few	Many
Autistic	8	2	0
Down's	2	5	3
Normal	1	3	6

(FEW = Less than 10 instances; MANY = More than 10 instances).

Analysis of Table 7.4 showed that there were significantly more autistic children who produced <u>no</u> pretend play at all (Fisher Exact Probability Test, $p = 0.025$). The 3 groups were not significantly different in terms of the number of children producing a 'few' pretend actions (Fisher Exact Probability Test, $p > 0.05$). There were significantly more normal than autistic children who produced 'many' pretend actions, (Fisher Exact Probability Test, $p = 0.01$), but there were not significantly more normal than Down's, or more Down's than autistic children in the 'many' category (Fisher Exact Probability Test, $p > 0.05$, in both).

<u>Measures of reliability:</u>

The experimenter's test-retest reliability for rating each child as either showing each behaviour or not was calculated by using Cohen's Kappa (Cohen, 1960), and is shown in the following table:

Table 7.5: Test-Retest Reliability Measures for each unambiguous play category by the first judge:

	Pretend	Function	Sensory	Order
Coefficient of Agreement:				
(Cohen's K, n=30)	1.0	0.71	0.81	1.0

The inter-rater reliability for the 2 judges for each group x play category is given in the following table:

Table 7.6: Inter-rater reliability measures for each unambiguous play category.

	Pretend	Function	Sensory	Order
Coefficient of Agreement: (Cohen's K, n=30)	0.86	0.71	0.92	0.92

Since both the test-retest reliability measures and the inter-rater reliability measures were all above 0.70, this is considered to be within the range of acceptability.

The third test of reliability was from the 14 judges rating 1 of each type of child for pretend play: 14 out of 14 rated the normal child as having unambiguous pretend play (100%), 12 out of 14 rated the Down's syndrome child as showing this as well (85.7%), but none of the 14 judges scored the autistic child as showing any unambiguous pretend play at all (0%). This difference was highly significant (Fisher Exact Probability Test, $p < 0.005$).

Analysis of Background Variables:

Further analysis of subject variables was performed to ascertain if those childen who did show pretend play were different along any dimension from those who did not show any pretend play, other than in terms of clinical diagnosis. Table 7.7 shows the background variables of those children who, on the basis of both judges' ratings, did (P) or did not (P') show unambiguous pretend play. Table 7.7 was analysed with a Mann Whitney (Small Sample) Test, since the distribution of scores in the autistic group who showed pretend play (henceforth referred to as the 'pretenders') and the Down's Syndrome group who did not show pretend play (henceforth referred to as the 'non-pretenders') was obviously non-normal (n = 2 in both).

Table 7.7: Background Variables in 'Pretenders' (P) and 'Non-Pretenders' (P'), in Experiment 7.

CA

	n	x	sd
Aut (P)	2	8.6	1.0
Aut (P')	8	8.0	2.8
Down (P)	8	7.9	2.6
Down (P')	2	5.8	3.3

MA (non-verbal)

	n	x	sd
Aut (P)	2	7.4	0.3
Aut (P')	8	3.4	1.8
Down (P)	8	4.3	1.5
Down (P')	2	1.8	0.1

BPVT

	n	x	sd
Aut (P)	2	3.5	0.95
Aut (P′)	8	1.1	1.2
Down (P)	8	2.2	1.5
Down (P′)	2	0	-

IQ

	n	x	sd
Aut (P)	2	100	6
Aut (P′)	8	44	9
Down (P)	8	62	20
Down (P′)	2	43	13

The autistic pretenders differed significantly from the autistic non-pretenders in terms of their non-verbal MA ($U = 1$, $p = 0.044$), their verbal MA ($U = 1$, $p = 0.044$), and their IQ ($U = 0$, $p = 0.022$). The autistic pretenders were not different in CA to the autistic non-pretenders ($U = 6$, $p = 0.356$).

The Down's pretenders had significantly higher non-verbal MA ($U = 0.5$, $p = 0.044$) compared to the Down's non-pretenders, but did not differ in CA ($U' = 6$, $p = 0.356$), IQ ($U' = 3.5$, $p = 0.2$), or verbal MA ($U = 3$, $p = 0.133$). Finally, the autistic non-pretenders did <u>not</u> differ significantly from the Down's pretenders in terms of non-verbal MA ($U = 12$, $p = 0.164$), verbal MA ($U = 19.5$, $p = 0.117$), CA ($U = 33$, $p = 0.48$), or IQ ($U = 17.5$, $p = 0.08$). This is clarified by the use of the graph overleaf.

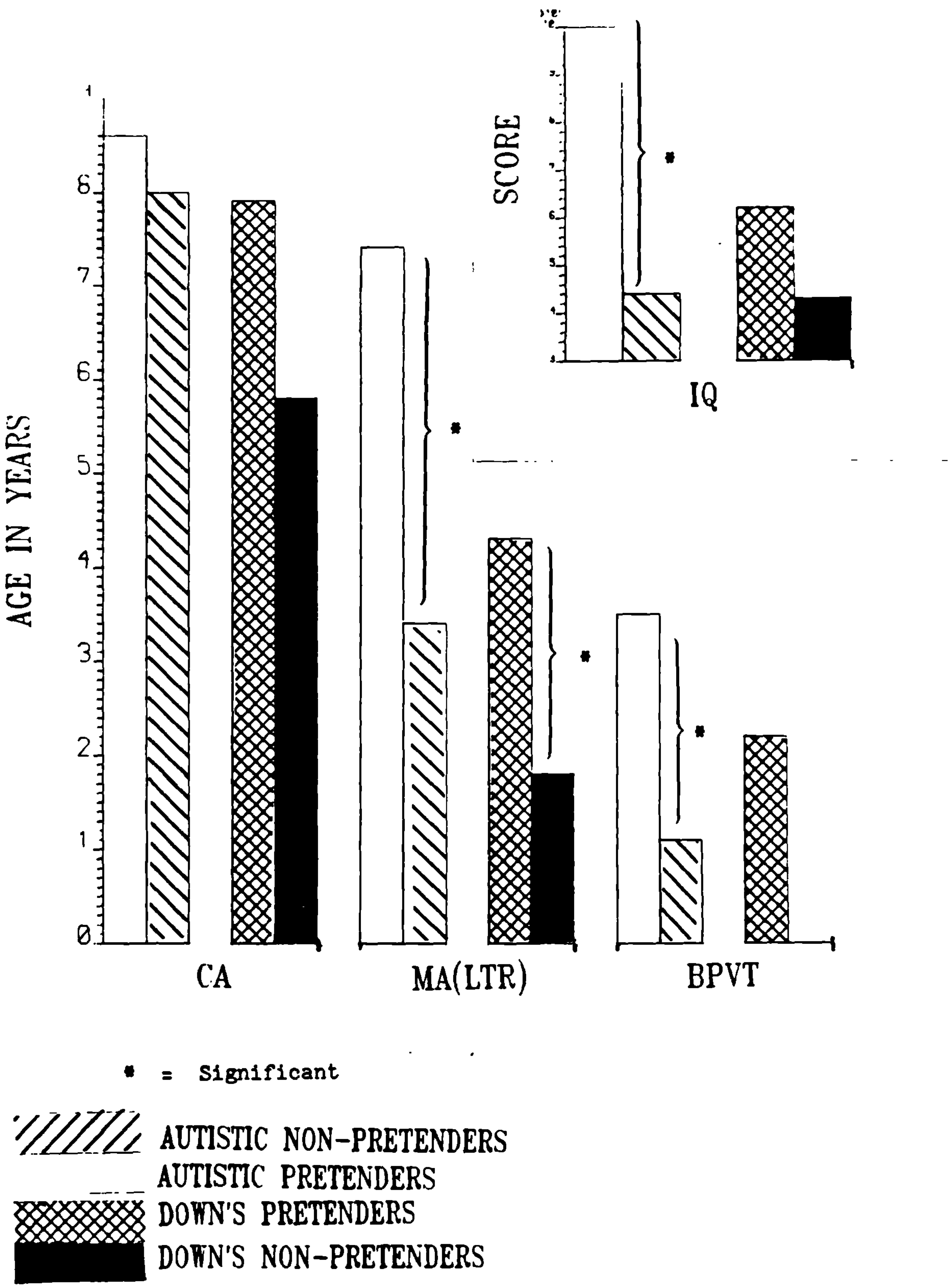


FIG 7.1: BACKGROUND VARIABLES IN 'PRETENDERS' AND 'NON-PRETENDERS' (1ST JUDGE'S RATINGS) IN EXPERIMENT 7

7.3: Discussion:

Experiment 7 shows that significantly fewer autistic children produced any spontaneous pretend play, and that the few 'autistic pretenders' produced significantly less pretend play than both normal and Down's 'pretenders'.

Furthermore, the autistic pretenders, identified by the first judge only (n = 2), are distinguished from the autistic non-pretenders (n = 8) in that the pretenders had a higher non-verbal and verbal MA and a higher IQ. However, the 8 Down's pretenders were not distinguished from the 8 autistic non-pretenders in any of the background subject variables. Therefore, while these variables do explain in what way the 20% of the autistic group who did pretend were different from the autistic non-pretenders, neither age, general cognitive, or language level can account for why 80% of the autistic group did not pretend, since matched Down's Syndrome subjects did pretend. This strongly suggests the conclusion that it must be an autism-specific deficit. This confirms previous work (Ungerer and Sigman, 1981; Gould, in press; Riguet et al, 1981).

Within the Down's Syndrome group, the pretenders (n = 8) were distinguished from the non-pretenders (n = 2) only in terms of non-verbal MA. This result is not unexpected in that the mean MA of the Down's Syndrome non-pretenders was 1:8 yrs (see Table 7.7), and the onset of pretend play in normal children is between 12-24 months. Clearly, the Down's Syndrome group of non-pretenders are at the slow end of the normal range, but not outside of it. As regards the one normal child who did not show pretend play, no other background variables apart from CA were available, which makes explanation of her result difficult.

Of interest is the discrepancy of the 2 raters for unambiguous pretend play. The coefficient (K) of 0.86 was the result of 2 autistic children being classed as pretenders by the first judge but not-pretenders by the second judge. These 2 cases are of course of paramount importance. The second judge added the report that her decision not to score these 2 cases as pretenders was based on two reasons: First, the behaviours in question involved one autistic child saying "Don't touch it. It's hot", referring to the toy cooker, and while the first judge scored this as pretend attribution of absent qualities, the second took this to be possibly "word association" or echolalia, ie: producing words that he had been used to hearing in the context of cookers. Similarly, the autistic child who was scored as a pretender by the first judge because he said "Are these potatoes? I don't know. They might be peas" was scored as a non-pretender by the second judge for the same reasons, ie: just "free-association" with green bits of sponge, without the subject appearing to <u>decide</u> that x would stand for y. Secondly, the nonverbal instances which were classed by the first judge as pretend (ie: putting sponge in dish in oven) were seen as possibly fortuitous positioning by the second judge, because the child did not extend this action into any pretend cooking.

To summarize the second judge's reasons for why she scored these 2 autistic subjects as at best <u>ambiguous</u> pretend, it is best to quote her impressions in her own words:

> "These children lacked any sign of having planned or decided to let one thing stand for another in a deliberately created pretend situation. In contrast, all of the other children classed as pretenders, however visibly retarded and non-verbal, produced actions which were unambiguously pretend because it was immediately obvious how, for example, putting the sponge into the dish and the dish into the oven was not a random or fortuitous

> act, because it was then brought out of the oven, served into another dish, stirred, repeated and extended into a whole planned cooking story.
> Furthermore, all the other (non-autistic) pretenders showed adequate evidence of their ability to pretend by producing it in the 'animals' condition as well as in the 'cooker' condition - ie: by producing it with more than one object. In contrast, the 2 ambiguous pretending autistic children did not produce any pretend play in the animal condition, but only an isolated instance in the cooker condition".

This last point is important, since part of the definition of pretend play is that it is highly productive and generative. Thus, in the second judge's opinion, no autistic children produced any unambiguous pretend play, and the first judge's scoring of 2 autistic subjects as pretenders was only possible through more lenient criteria.

This result is in line with that found by previous studies in this area, and it strengthens these findings by examining spontaneous pretend play only (where others have examined modeled play [Curcio and Piserchia, 1978; Ungerer and Sigman, 1981; Hammes and Langdell, 1981;]) and by using a definition of pretend play which is more rigorous than in some previous studies (Wing et al, 1977; Gould, to appear; Riguet et al, 1981). Experiment 7 also found that pretend play is 'normal' in non-autistic retarded children, relative to their MA, and this replicates the results of other studies (Hulme and Lunzer, 1966; Wing et al, 1977; Hill and McCune-Nicolich, 1981).

Whether the autistic subjects in the Pretend Play Experiment (7) also have a deficit in their theory of mind, as tested in the Puppet and Picture Experiments (3 and 4) is another question, since different subjects took part in Experiment 7 as against Experiments 3 and 4. In this respect, whilst both a theory of mind and pretend play are second-order representational skills, and whilst a deficit in each of these skills has been observed in 80% of each autistic sample separately, this is insufficient evidence to conclude that a deficit in one necessarily implies a deficit in the other; they may be a different 80% in each case.

Two case studies:

Whilst none of the autistic children in the theory of mind Experiments (3 and 4) took part in the Pretend Play Experiment (7), it was decided to test for a theory of mind in the 2 autistic children from Experiment 7 who alone showed some pretend play, at least according to the first judge. It was predicted on the basis of the second-order representation theory that they would possess the cognitive prerequisites for a theory of mind. Accordingly, these 2 children, [subject numbers 5 and 6 - see Appendix 11] were tested on the Puppet and Picture procedures (Experiments 3 and 4). Both subjects succeeded in sequencing the Scriptal stories correctly, but whereas the younger child (CA = 7:4 yrs) with a lower verbal MA (2:8 yrs) and non-verbal MA (7:2 yrs) failed either to attribute a false belief by pointing to the correct location (despite passing control questions) [Experiment 3], or to sequence the 'Mental' Condition stories correctly [Experiment 4], the older, more able child (CA = 9:8 yrs, Verbal MA = 4:3 yrs, non-verbal MA = 10:2 yrs) passed on all tests. In addition, the older of these 2 children alone used appropriate mental state terms in his narrations.

The result of this 'mini-study' is not intended to be the basis of any conclusions, since without testing all other subjects on both Pretend play and theory of mind, it is not possible to discuss the empirical relationship between these two skills. Unfortunately, the other subjects from the Pretend Play Experiment (7) had too low a verbal MA to test for the presence of a theory of mind, whilst the subjects from the Puppet and Picture Experiments (3 and 4) were too old to be tested for pretend play. However, the results from these 2 subjects can be interpreted as tentative evidence that the ability to pretend play in combination with a verbal MA higher than 4 years will result in the development of a theory of mind in an autistic child. This fits in with Leslie's (to appear) formulation, discussed earlier, that pretend play occurs developmentally earlier than a theory of mind. It would be expected that if the younger of these 2 subjects has a higher verbal MA when he is older, then he too should develop a theory of mind. It would be of value to follow up this prediction in the future.

In conclusion, the results of the Pretend Play Experiment (7) support the notion of the separation of first and second-order representation, in that autistic children showed a deficit in pretend play deficit but not in other 'functional' play. This notion of a cognitive dissociation or independence between pretend play, on the one hand, and knowledge about the real world, on the other, echoes what was found in the Picture and Causality Experiments (4 and 5), ie: that autistic children understood the physical but not the mental world, and has also been proposed by Sigman and Ungerer (1984b): In their studies, they have demonstrated autistic children's intact object concept in the face of impaired pretend play, and they take this as an indication that "representational thought may be manifested in two systems, only one of which is impaired in the autistic child" (p.293). They consider this second system to be the ability to form and manipulate symbols, a view also proposed earier by, among others, Ricks and Wing (1975). They do not, however, link this to the autistic child's social deficit, as has been done in this thesis, via the 'theory of mind'.

The final chapter will discuss the notion that a general 'symbolic deficit' exists in autism, and will relate this both to the experimental results from this thesis, and to the formulations found elsewhere.

Chapter 8: Conclusions and Implications:

8.1: Summary of experimental results:

A core concept in social cognition is, as discussed in Chapter 1, the distinction between self and other. As the experiments in this thesis have shown, this conceptual distinction has many levels, ranging from concrete to abstract, and postulated to require different levels of representation in the cognitive system.

At the most concrete level, that of visual self-recognition, autistic children whose MA was in the normal range were shown to be unimpaired (the Mirror Experiment [1]). In the terminology used earlier, they can be said to have a concept of "self-as-object".

At a more abstract level, that of attributing different perceptions to another person, the same autistic children were shown to be unimpaired (the Vision Experiment [2]). In the terminology used earlier, they can be said to have a "theory of sight".

At a yet more abstract level, that of attributing mental states such as different beliefs to another person, the autistic children were shown to be severely impaired (the Puppet and Picture Experiments [3 and 4]). In the terminology used earlier, they can be said to be impaired in their "theory of mind".

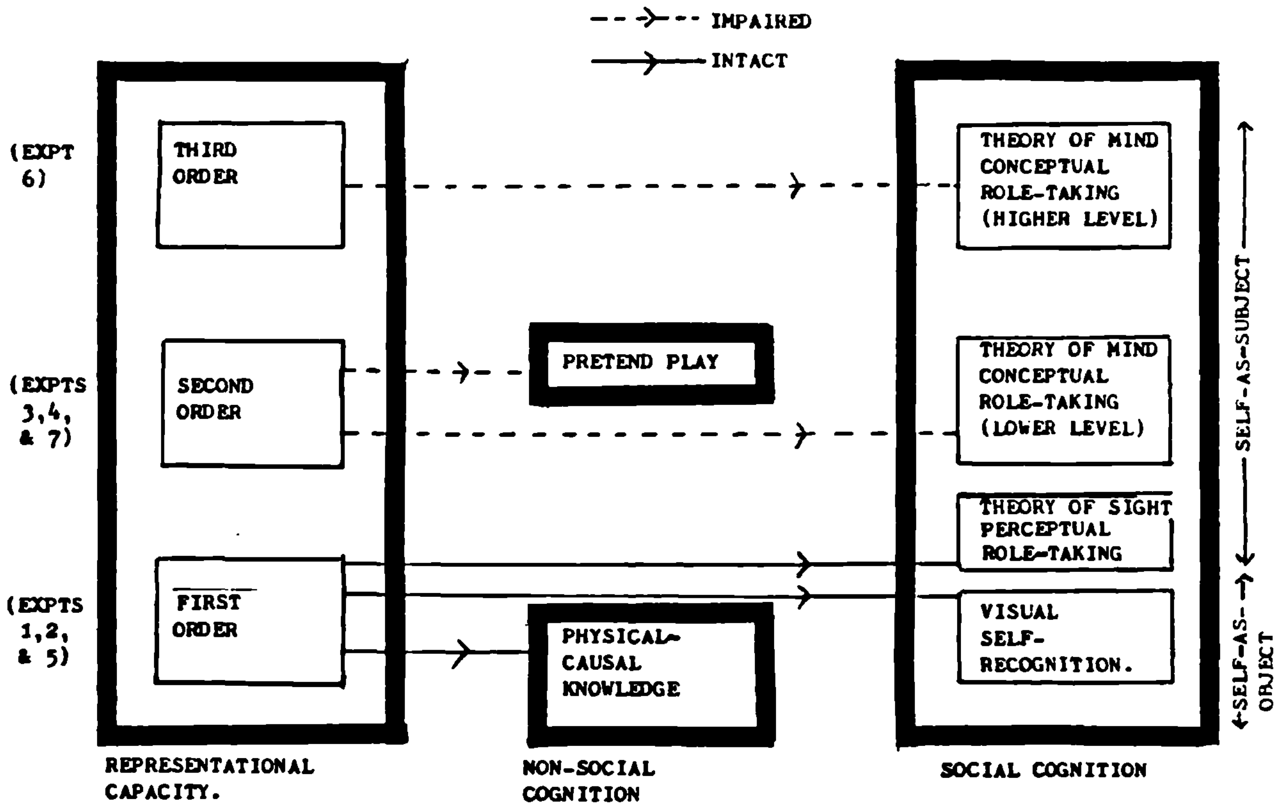
Thus, the level of their self-other differentiation which is undeveloped is the level of conceptual role-taking. This deficit was found in contrast to Down's Syndrome children of a lower verbal and non-verbal MA, and clinically normal children of a lower CA. It thus appears to be autism-specific. This deficit was found in 80% of autistic children tested. The 20% who did have a theory of mind at the level tested in the Puppet and Picture Experiments [3 and 4] (ie: at the level appropriate for a normal 4 year old) were found to lack a theory of mind at the level appropriate for a normal 6-7 year old (the Village Experiment [6]). Again, Down's Syndrome children of equivalent MA did not. It was argued that such deficits (at both levels of their theory of mind) could account for autistic children's impoverished communication skills and social relationships. This will be expanded upon in some detail in Section 8.2.(i).

The Causality Experiment (5) resulted in a dramatic demonstration of the same autistic children's unimpaired non-social cognition, in their ability to attribute physical causality to mechanical type events. A similar contrast was shown in their ability to understand certain social situations, namely those for which a descriptive, behavioural understanding was sufficient (the Picture Experiment [4], Scriptal Conditions). These two results serve to highlight that (a) the impairment is specific to the domain of social cognition and (b) within this domain, it is not understanding people per se which is of difficulty, but understanding people's mental states.

The final Experiment (7) found just as pervasive a deficit among a younger sample of autistic children in another domain, that of pretend play. This was consistent with the hypothesis that perhaps their cognitive deficit was not confined purely to their theory of mind, but was a type of damage which would affect both their theory of mind and pretend play, whilst leaving their knowledge of physical causality intact. This was predicted on the basis of a proposed cognitive explanation, namely, an impairment in the capacity for 'second-order' representations. As was expected, the autistic children in the Pretend Play Experiment (7) did produce other, so-called 'functional' play, indicating the deficit was specifically in pretence.

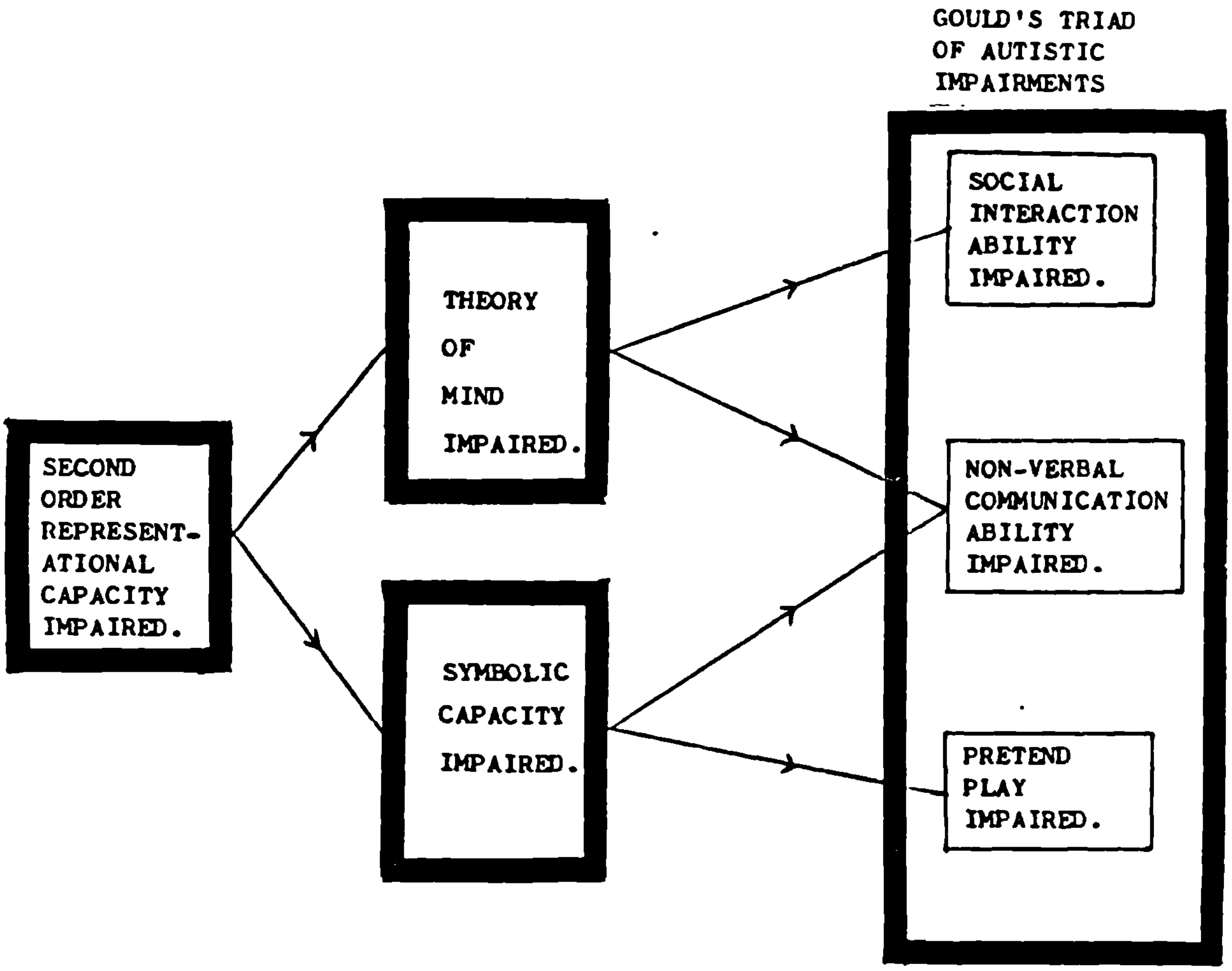
The various levels of autistic children's self-concept which were investigated are represented in Figure 8.1, in order to clarify the location of the deficit.

Figure 8.1: Evidence from Experiments 1-7 implicating intact and impaired cognition in autism.



As schematized in Figure 8.1, the 'second-order' representational deficit theory is proposed to explain the impairments found in both autistic children's theory of mind and pretend play. This formulation has parallels with one proposed by Gould (1982), in that social and pretend deficits are assumed to be caused by one underlying mechanism. Gould's "Triad theory of autism" is shown in Figure 8.2. The second-order representational deficit theory allows Gould's model to be modified to take into account the experimental evidence from the Puppet and Picture Experiments (3 and 4). This modification is also shown in Figure 8.2.

Figure 8.2: Modification of Gould's Triad Theory.



To summarize Figure 8.2, Gould's Triad theory is supported by the results of the Puppet, Picture and Pretend Experiments (3, 4, and 7), to the extent that the social, communicative and pretend deficits are found to co-occur. However, it required modification in that her theory leaves unspecified <u>which</u> impaired cognitive mechanism might give rise to these observed deficits.

8.2: Implications from the second-order representational deficit theory.

8.2.(i): How does the theory relate to Kanner's description of the social impairment?

It is worthwhile to consider the explanatory power of the second-order representational deficit theory. It has already been used quite 'economically' in order to link two observed deficits (ie: theory of mind and pretend play) in terms of one underlying cognitive mechanism. Both of these can be argued to require second-order representation in that (1) attributing mental states to another person involves representing another person's representations; and (2) pretence involves simultaneously representing an object as it is and as if it is something else. In the first part of this Section an attempt will be made to show how the second-order representational deficit theory relates to the 15 aspects of the autistic child's social impairment, as extracted from Kanner's (1943) description and outlined in Chapter 1 (p.11-13).

In order to save turning back to Chapter 1, the 15 aspects of the social impairment are relisted here, and discussed in turn:

(1) Lack of positive emotional expression:

It is worth noting that not all positive emotional expression is absent in autism: laughter, smiles, etc, are often observed (Ricks and Wing, 1975), so the idea of a permanently 'blank expression' is probably a fiction. However, such laughter and smiles are probably rarely observed as a social response. The second-order representational deficit theory would account for this absence of communication of emotional state as follows: For one person (A) to smile with another person (B) assumes that A thinks that B thinks the same event/thing is amusing. This particular type of emotional expression, then, may require a second-order theory of mind.

However, this first aspect of the social impairment is only partially accounted for by the second-order representational deficit theory in that, whilst some emotional expression (such as humour) may require a theory of mind, others (eg: some types of empathy) may not. This 'symptom' may turn out to be better accounted for by Hermelin and O'Connor's (1985) notion of a disturbance in the "affective system", although this construct still needs to be 'unpacked' much further.

(2) Withdrawal from people:

The second-order representational deficit theory would account for the withdrawal from the social world not in terms of avoidance of a hostile parent (Bettelheim, 1967), but rather as due to a lack of comprehension of other people's behaviour. This is based on the premise that a theory of mind is a second-order representational ability which allows one to explain and predict the behaviour of others (Dennett, 1978a), and lacking a theory of mind would render one unable to make sense of all social behaviour, with the exception of highly routine, 'scriptal' events (of the type used in the Picture Experiment [4]). This might, additionally, go some way towards explaining the 'insistence on sameness' symptom in autism, in that such a strategy which resulted in other people's behaviour becoming highly 'routinized' would compensate for lack of a theory of mind.

(3) <u>Disinterest in people:</u>

Autistic children are not disinterested in the <u>physical</u> aspects of other people, and indeed speaking autistic children frequently comment on details of other people's appearance. They are specifically 'disinterested' in the mental aspects of other people (ie: what they think, know, feel, etc), and this can also be simply explained as being due to lack of a theory of mind.

(4) <u>Non-social use of language:</u>

A 'social use of language' can be defined as the pragmatic aspects of language. Very little needs to be said about this here since, in the literature reviews earlier, 'pragmatics' was discussed in connection with both autistic children (Section 1.1.iv) and normal children (Section 3.2.iv). That literature indicated that autistic children's pragmatic competence was impaired, although much more detailed analyses are still needed to constitute a proper investigation of this area. In contrast, normal children's pragmatic competence was reviewed and found to be present from as early as 3 years old, as shown in their ability, for example, to repair misunderstood messages to make them more appropriate to suit the age or state of their listener.

This pragmatic deficit, or non-social use of language, in autism is consistent with the second-order representational deficit theory, in that a Speech Act view (see Chapter 3) argues that much pragmatic competence requires both participants to be able to attribute intentions to each other for a communicative exchange to be effective and appropriate to the context (Grice, 1957; Searle, 1965;

Bates, 1974). To the extent that a second-order theory of mind is minimally required in order to attribute intentions, this 'symptom' is entirely consistent with the theory. It may also turn out to be an important focus from a treatment intervention consideration, since communication improvement can only be expected if this pragmatic deficit is tackled directly.

(5) Abnormal non-verbal communication:

Attwood (1984) found that autistic children rarely, if ever, used 'expressive' gestures which refer to mental states, although they did use gestures of other types (eg: 'instrumental'). As mentioned above, a Speech Act theory of communication argues that in every communicative exchange both participants must have a second-order representational capacity in order to represent each other's communicative intentions. This would apply whether the channel of communication is natural language, sign-language, gestures, or anything else. This would explain Attwood's findings, and is consistent with the observation that not only production but comprehension of another person's gestures are impaired. A second-order theory of mind is thus viewed as an essential piece of cognitive development for this ability.

(6) Non-social response to other people's language:

Whereas the 4th symptom referred to the pragmatics of speech production, this symptom refers to the pragmatics of dialogue management and speech comprehension. However, a global pragmatics deficit is expected if one's theory of mind is impaired, as explained under the 4th symptom, so no additional explanatory assumptions are required here.

(7) Responding to parts of people and not wholes:

This symptom is not well explained by the second-order representational deficit theory, except (as with the 3rd symptom) in terms of selective responding to particular physical details of a person rather than their mental states. However, this may turn out to be related to an entirely different cognitive explanation, perhaps linked to autistic children's superiority at Embedded Figures Tasks (Shah and Frith, 1983).

(8) Lack of differential response to people and objects:

The second-order representational deficit theory can account for this symptom in that lack of a theory of mind would result in a failure to distinguish people from objects by their most human characteristic: their mental states. Hence people frequently report that they feel autistic children 'treat them like objects'. This is not inconsistent with the next symptom.

(9) Preferential response to objects over people:

Again, the second-order representational deficit theory can explain this as being due to the fact that most behaviour of objects can be understood without a theory of mind, whereas most of people's behaviour cannot. Hence, autistic children are often reported to be more interested in machines than in people.

(10) Inappropriate use of personal pronouns:

Lack of a theory of mind would mean that autistic children could not appreciate speech as 'intentional communication' (Grice, 1957; Searle, 1965). This also means that they may fail to distinguish who of two speakers was intentionally 'sending' the message, and who was 'receiving' it (Mackay, 1972). This in itself might result in inappropriate use of personal pronouns. Bartak and Rutter (1974) saw this symptom as echolalia which occurred due to lack of comprehension, and this is also consistent with the theory of mind explanation.

(11) Lack of eye-contact:

Mirenda et al (1983) have reported that autistic children do not use eye-contact to intentionally signal turn-taking in a dialogue. Normally, eye-contact during speech allows a speaker to indicate to a listener "I want you to recognize my intention to pause to let you speak at this particular point", whilst absence of eye-contact allows a speaker to indicate "I want you to recognize my intention to continue speaking uninterrupted" (Argyle, 1972). A theory of mind is therefore necessary to be able to attribute such intentions to a speaker, and lack of a theory of mind would interfere with such non-verbal communication as appropriate eye-contact. This symptom thus also fits into the second-order representational deficit theory.

(12) Lack of behaviour appropriate to cultural norms:

Insofar as behaviour appropriate to cultural norms depends on detecting what implicit, shared beliefs members of the same culture hold, a theory of mind is a requirement. Thus, autistic children may be able to learn the explicitly sanctioned cultural norms (eg: punishment ensues if you drive on the right-hand side of the road in Britain) but would be unable to appreciate the more subtle, implicit cultural norms, eg: In Britain, strangers do not stare at each other or invade each other's 'personal space'. Normally, unspoken shared beliefs about what such behaviour represents prevents this. This symptom is therefore also consistent with the second-order representational deficit theory.

(13) Selective attention to non-social features of people:

This symptom is interpreted by the second-order representational deficit theory in the same way as symptom 3.

(14) Lack of empathy:

One prediction from the present theory is that attribution of all mental states, (not only beliefs but also desires, hopes, fears, etc), which require second-order representation should be impaired in autism. Hoffman (1983) separates empathy into cognitive and affective types, and argues that these are different categories. Hence, it is wise to limit the application of the theory to only the cognitive aspects of empathy. Autistic children should be able to learn that certain observable facial and bodily features indicate that someone is happy, sad, angry, and frightened, in that because they have outward manifestations these need not be represented as mental states. However, such states as desire, believe, expect, being surprised, pretend, know, think, etc, must be represented as mental states because they all 'point' to a mental content, eg: fear that, / expect that, / pretend that, / desire that, / believe that, / be surprised that, / know that, etc.

Certainly, there are numerous reports that autistic children lack the ability to empathize (Newson, Dawson and Everard, 1984; Newson, 1979; Dewey and Everard, 1974; Kanner, 1943), but this term may be too vague to be useful at this stage. More detailed investigation of attribution of mental states other than belief need to be done to assess if comprehension of all mental states are of equal (second-order) complexity.

(15) Lack of 'savoir-faire':

This symptom is interpreted by the second-order representational capacity deficit theory in the same way as symptom 12.

Thus, of the 15 aspects of the social impairment in Kanner's (1943) original description of autism, only 2 of these (numbers 1 and 7, above) are not well explained by the second-order representational deficit theory. All the others can be seen as a consequence of an inability to employ a theory of mind, itself a second-order representational skill. The theory therefore has wide explanatory power when it comes to linking disparate apsects of the social impairment.

8.2.(ii): Other implications from the second-order representational deficit theory.

What other skills, apart from those included in Kanner's description, require second-order representation? And is there any evidence to suggest that these too are impaired in autism, as the theory predicts they should be?

It is possible to argue that second-order representations are also required in the ability to (1) produce and comprehend figurative language; (2) introspect; and (3) show embarrassment. These 3 skills shall be considered in turn, both in order to analyse if second-order representations are completely necessary for their competence, and so as to briefly review any evidence from the autism literature relevant to these predictions.

(1) Figurative Language:

Figurative language is characterized by a discrepancy between what is said and what is meant, and a discrepancy between what is said to exist and how things really are. Demorest et al (1983) have shown that in different types of figurative language (eg: euphemism, metonymy, synecdoche, sarcasm, metaphor, understatement, hyperbole, irony, etc), the degree of this discrepancy varies, but nevertheless the discrepancy always exists. In contrast, in non-figurative (or 'literal') language, there is no discrepancy between what is said and what is meant, and there is no discrepancy between what is said to exist and how the world really is (ie: its truth value). Therefore, in order both to produce figurative language and comprehend its use by others, it is necessary to be able to represent simultaneously the utterance and the discrepant intention behind it, and be able to represent simultaneously the described state of affairs and the actual state of affairs. This suggests that second-order representations are necessarily involved in understanding and producing figurative language. One example from the domain of metaphor will suffice to clarify this analysis:

"The surgeon is a butcher".

Since the surgeon is not really a butcher, comprehension of this metaphor requires the listener to represent simultaneously both the surgeon as a surgeon and the surgeon as a butcher [Step 1]. In addition, the listener needs to represent the utterer's intention (eg: "The surgeon is clumsy and unprecise when he cuts, like a butcher is...") [Step 2]. Demorest et al (1983) argue that the first step is a logical task, ie: recognizing that the truth value of the statement is discrepant from the facts of the situation. It may be that a simple match-mismatch decision is all that is involved in this first step, and no second-order representation is required. However, the second step involves recognizing the discrepancy as intentional, thus distinguishing the figurative utterance from a mistake or from a lie. Demorest et al (1983) found that from the age of 11 years old children recognize a speaker's intention in using figurative language, although this seems quite late. A number of other authors (Winner et al, 1984; Billow, 1975; Vosniadou and Ortony, 1983) argue that children as young as 4-5 years old frequently produce genuine metaphors (ie: not overextensions) in language. Vosniadou et al (1984) showed that task complexity influenced the age at which metaphor was understood, and that under the right conditions even preschoolers show evidence of metaphor comprehension.

Thus, figurative language is arguably a second-order representational skill and is within the competence of young normal children. If it is a second-order skill, it should be conspicuously absent in speaking autistic children's utterances, and in their comprehension of other people's language. Is there any evidence of this? There have been no experimental investigations of this area in autism to date, but numerous anecdotal and clinical descriptions exist which are consistent with this prediction. For example, Kanner (1943) wrote in his first case history:

> "Words to him had a specifically literal, inflexible meaning. He seemed unable to generalize, to transfer an expression to another similar object or situation." (p.4).

In his summary of the eleven cases, Kanner (1943) raised this to the status of a symptom of speaking autistic children: "Apparently the meaning of a word becomes inflexible and cannot be used with any but the originally aquired connotation" (p.35). This is not inconsistent with his later description of autistic children's language as "metaphorical" (Kanner, 1946), since the examples of metaphorical language he cites are all instances of either delayed echolalia or 'word-association', but not evidence of an intention to create a metaphor. This rigid, literal quality in autistic language has also been reported by others (Dewey and Everard, 1974; Taylor, 1976; Ricks and Wing, 1975). The flavour of this abnormality is captured in the following quote, and is very typical:

> "Some literalness is based on a phrase or sentence rather than a word of several possible meanings. This was the case when a young autistic man (of normal IQ)... would answer such questions as 'Do you have a hobby?' with a simple 'Yes'. No more, unless another question followed. A different question might bring out a longer answer than was wanted. For example, somebody asked an autistic teenager how he learned to type. Instead of just indicating the source of his instruction, he said 'For the first lesson I practiced the letters f and j'. No doubt, he would have covered the entire keyboard if he had not been stopped after he had described several lessons in detail." (Dewey and Everard, 1974, p.348).

This literal interpretation of an utterance suggests an inability to comprehend the figurative aspects of language, and as argued earlier, this may stem from an inability to impute intentions to a speaker to use language in a non-literal way for a particular purpose. In other words, the failure to understand figurative language may itself be due to lack of a theory of mind. This prediction from the second-order representational deficit theory seems to have some clinical reality and thus deserves further research.

(2) Introspection:

The ability to introspect is synonymous with the ability to be self-reflective or self-conscious, and involves thinking about oneself thinking. In this respect, it involves a theory of mind, ie: one's own. Evidence has already been presented which suggests autistic children cannot attribute beliefs to others (the Puppet and Picture Experiments [3 and 4]), and on the assumption that attribution of mental states to oneself involves the same process(es) as attribution of mental states to others, the prediction is that they should be unable to introspect. Normal children show evidence of being able to talk about notions of their own mind and brain from as young as 4 years old (Johnson and Wellman, 1982), and this is the same age as they are shown to be able to talk about other people's inner states (Wimmer and Perner, 1983).

If this prediction is correct, autistic children could certainly be said to have a severe impairment in their concept of self, at the level of self-consciousness. Using the framework discussed in Chapter 2, this would be at the level of their self-as-subject; their concept of self-as-object has already been demonstrated to be unimpaired (the Mirror Experiment [1]). There are no studies of introspection in autism at present with which to assess this prediction, but this area should be relatively straightforward to test in speaking autistic children. If it should turn out in fact to be the case that autistic children lack the ability to introspect, would this mean that they lack "consciousness"? Such a term is not particularly useful, in that it is too general: Autistic children are 'conscious' of the physical world, but are not conscious of the mental world.

(3) Embarrassment:

This phenomenon is closely related to possession of a theory of mind and the ability for introspection. Embarrassment requires being able to imagine how another person thinks of oneself and, although this is not all that is involved (Edelman, 1981), it is an essential part.

Buss, Iscoe and Buss (1979) used a questionnaire study and found that the onset of blushing was at approximately 5 years of age, although other authors (Kagan, 1982) put it as early as 2-3 years old. Again, this is an unresearched area in autism, but plenty of anecdotal evidence suggests that autistic children are not inhibited from performing actions which would be experienced as socially-embarassing by 'normal' people (Kanner, 1943; Dewey and Everard, 1974). This is clear in the example cited on p.80, earlier. In some mirror self-recognition studies in autism (Spiker and Ricks, 1984; Neuman and Hill, 1978; Experiment 1, this thesis), there are reports that autistic children do not show the 'coyness' reaction when confronted by their mirror-image, which control children typically showed, and which is reported from studies of normal 20 month old children (Amsterdam and Greenberg, 1977). Both of these sources of evidence suggest that it would be of value to investigate more thoroughly whether autistic children really do differ in this respect.

Apart from the above predictions being possible, it is also worth discussing a particular ambiguity surrounding the interpretation of some of the results in this thesis. One common confusion stems from a person's theory of mind also being referred to as "Intentionality". In these terms, the Puppet and Picture Experiments (3 and 4) suggest that autistic children are not capable of "Intentionality", but this does not mean that they themselves do not have intentions. To have intentions does not require a theory of mind, and only requires a first-order representational capacity. Piaget (1953) proposed that intentions first appear around 8 months of age, after the stage of "secondary circular reactions", when infants begin to understand means-ends relations. This view is also held by Frye (1981) and is evident in the distinction made between 'intentional behaviour' and 'intentional communication' (Bretherton and Bates, 1979). For behaviour to be intentional it simply needs to be non-automatic and goal-oriented (Wellman, 1977). However, only when children can coordinate their <u>own actions with someone else's</u> can they be said to have a theory of mind, or to have "Intentionality". Frye (1981) calls this "the criterion of <u>mutual</u> intentionality" (p.328).

8.3: <u>Relationship between this and other cognitive theories of autism.</u>

8.3.(i): <u>Different cognitive theories:</u>

Whilst the dichotomy of 'first' and 'second order' representation may seem novel, the notion of "first and second signal systems" has a 50 year old history in Soviet psychology (Vygotsky, 1960/79; Leont'ev, 1975/79; Van der Veer and Van IJzendoorn, 1985). Whether it is appropriate to equate this notion with first and second order representation is too big a question to explore here, and furthermore, it will be argued below that the ideas behind the second-order representational deficit theory of autism are similar to the major cognitive theories of autism.

As was discussed earlier [Chapter 1.1.(v), p.38-41], there are 3 other major cognitive theories of autism. The 'central language deficit' theory (Rutter, 1968; 1978b) was found to be refutable using data from other language-handicapped groups who are not autistic. The 'central encoding deficit' theory (Hermelin and O'Connor, 1970; Frith, 1970a & b) constituted an advance over the previous theory in recognizing the deficit as 'non-modality-specific' and in steering research in autism towards the domain of 'meaning'. Finally, it was argued earlier that the 'impaired symbolic capacity' theory (Ricks and Wing, 1975; Wing et al, 1977; Richer, 1978; Hammes and Langdell, 1981) deserves more attention, since it has received experimental support from a number of studies into autistic children's pretend play. However, two main criticisms were raised in connection with this theory: (1) that the definition of 'symbol' had been somewhat loose and unclear, and (2) that the theory had not specified how pretend play and social impairments were related to each other. These points shall be taken up in more detail here:

Ricks and Wing (1975) use the following as a definition of 'symbol':

> "something that stands for, represents, or denotes something else, not by exact resemblance, but by vague suggestion or by some accidental or conventional relation." (p.192)

Their definition was wide enough to include all non-echolalic words, as well as all concepts, gestures, representations, etc. Hermelin (1978) highlighted the need to restrict the term 'symbol', since, for example, concept and "image" formation was found to be within autistic children's competence. However, no alternative definition was proposed. Hammes and Langdell (1981) argued the case for a symbolic deficit in autistic children on the basis of their inability to perform abstract pantomimic actions, but still did not offer any general definition of 'symbol'. Nor did Richer (1978) or McHale et al (1980), both of whom also argued in support of the 'impaired symbolic capacity' theory.

Regarding the second criticism of the theory, all of its proponents suggest that a symbolic capacity must be necessary for communication (both verbal and non-verbal) in that all language systems involve the manipulation of symbols such as words, gestures, braille dots, etc. This is left as an explanation of how the pretend play and social deficits are related. Again, the inadequacy of this formulation becomes apparent, for example, when trying to account for speaking autistic children.

This absence of definition or theoretical connections is evident even in the most recent of articles using this theory (Wulff, 1985). However, the question remains whether, if these problems were tackled, the 'impaired symbolic capacity' theory is useful, how it relates to the 'second-order representational deficit' theory (discussed earlier), and whether the results of the experiments reported in this thesis support it or not.

8.3.(ii): <u>Is there a general "symbolic deficit" in autism?</u>

As argued above, any attempt to answer this question must begin with a definition of what constitutes a 'symbol'. If a symbol is simply taken to mean a <u>representation</u> of something else, then autistic children can create symbols: The possession of an object concept and all that this entails (object identity, object permanence) and their understanding of physical causality are adequate indications that autistic children can represent the physical world (Serafica, 1971; Curcio, 1978; Sigman and Ungerer, 1981; Hammes and Langdell, 1981). Furthermore, there is evidence that autistic children can produce albeit 'concrete' mime-gestures to represent other actions (Attwood, 1984; Hammes and Langdell, 1981). So, if these are symbolic, then autistic children can produce symbols.

And yet, the results from studies into autistic children's pretend play indicate a lack of symbolic elements (Ungerer and Sigman, 1981; Wing et al, 1977; Riguet et al, 1981; Gould, in press; Experiment 7, this thesis), and there are reports that autistic children cannot produce the more 'abstract' mime of representing absent objects using "open-hand gestures" (Attwood, 1984; Hammes and Langdell, 1981). What do these impairments mean? It will be argued that, using a different definition of 'symbol', these impairments do implicate a deficit in the autistic child's "symbolic capacity".

Susan Langer (1942), in her now classic analysis of symbolism, distinguishes 'signs' from 'symbols', and this distinction is found elsewhere (Werner and Kaplan, 1963; Cassirer, 1972). Langer writes:

> "A sign indicates the existence - past, present or future - of a thing, event, or condition. Wet streets are a sign that it has rained... (A sign) is a symptom of a state of affairs." (p.57).

This is an example of a "natural sign". An "artificial sign" can be produced out of purely arbitrary events, eg: a whistle is a sign that the train is about to start. She continues:

> "The logical relation between a sign and its object is a very simple one: they are associated, somehow, to form a pair; that is to say, they stand in a one-to-one correlation. To each sign there corresponds one definite item which is its object, the thing (or event, or

> condition) signified. All the rest of that important function, signification, involves the third term, the subject, which uses the pair of items." (p.57).

Dogs as much as humans are capable of being the essential third term, the "interpretant", in finding meaning in a sign. Pavlovian Classical Conditioning is evidence that both human and non-human species have this capacity. In contrast,

> "Symbols are not proxy for their objects, but are vehicles for the conception of objects ...it is the conception, not the things, that symbols directly 'mean'." (p.60-61).

Langer uses the example of a word to illustrate the distinction between signs and symbols: The word "James" represents a certain person in the physical world, and in this capacity it functions as a sign. However, the word "James" can also represent my concept of a certain person, and in this capacity it represents something in the mental world and functions as a symbol. Thus,

> "If you say "James" to a dog whose master bears that name, the dog will interpret the sound as a sign, and look for James. Say it to a person who knows someone called thus, and he will ask "What about James?" That simple question is forever beyond the dog; signification is the only meaning a name can have for him - a meaning which the master's name shares with the master's smell, with his football, and his characteristic ring of the doorbell. In a human being, however, the name evokes the conception of a certain man so-called, and prepares the mind for further conceptions in which the notion of that man figures; therefore the human being naturally asks: 'What about James?' ". (p.62).

This distinction is formalized as follows:

> "In an ordinary sign-function, there are three essential terms: subject, sign and object. In a.. symbol-function, there have to be four: subject, symbol, conception, and object." (p.64).

A symbol, then, is not just a representation of an object, as the initial definition proposed. That is a sign. A symbol, under Langer's definition, is a representation of a concept (which itself refers to an object). In other words, a symbol is a representation of a representation or, in the terminology used in earlier parts of this thesis, it is a second-order representation.

Langer distinguishes these two types of meaning (of signs and symbols) still further, by using their traditional names: The relationship between a sign and its object is called denotation, whereas the relationship between a symbol and its concept is called connotation.

To return to the case of autism: Autistic children can represent objects in the physical world. In this respect they show evidence that they have the capacity to produce signs. In Chapter 5.1, these were called "first-order representations". But autistic children cannot represent other representations in the mental world. In this respect the evidence suggests that they do not have the capacity to produce symbols, at least not if Langer's definition is accepted. They are capable of denotation but they are not capable of connotation.

This is consistent with the Experimental results from this thesis: they have a first-order representational capacity (they can represent physical causality [the Causality Experiment (5)] and people's behaviour [the Picture Experiment (4), Scriptal Conditions]) but they do not have a second-order representational capacity (they cannot represent mental states [the Puppet and Picture Experiments (3 and 4)] or pretend one object is another [the Pretend Play Experiment (7)]).

A sceptic might object to this view as follows: If autistic children lack a "symbolic capacity", how are they able to produce drawings of objects (Selfe, 1977) Surely such an ability is evidence of the capacity to create symbols? The symbolic deficit theorist could answer this objection in terms of Langer's definition: The drawings autistic children produce would be expected to be first-order representations, or signs, ie: representations of the actual object, whereas the drawing a normal child produces would be expected to be a symbol, or a second-order representation, ie: a representation of the child's concept of the object. This prediction fits in with at least one person's view of an autistic child's drawings:

> "Gombrich's considerations (were) that (normal) children draw what they know not what they see. Nadia (an autistic girl)...drew what she perceived. Like the camera, she recorded a footballer with a massive foot because this was extended towards the viewer - no allowance (and reduction) was made for what she knew about the size of the human foot in relation to the human body. This adjustment is automatic in the...(normal) mind". (Selfe, 1977, p.126).

One line of argument, then, is that autistic children's drawings may not be 'symbolic', but may instead be 'signal', to use Langer's (1942) terms. This would be consistent with the characterization of autistic children as possessing first-order representational powers only.

The attraction of the symbolic deficit theory is that, if a symbol is defined as above, ie: as a second-order representation, it accounts for both the impairment in theory of mind and in pretend play. This is because (as discussed in Chapter 4.4), to have beliefs about beliefs requires a second-order representational capacity, as does the ability to pretend a thing is what it is not (see Chapter 6.3). It furthermore provides a bridge to earlier cognitive theories, as discussed in Section 8.3.(i).

Is the theory really valid for all autistic children? What of the autistic children of high IQ who are competent mathematicians, etc.? The symbolic deficit theorist might find this objection more difficult to counter, because whilst a certain level of mathematics might be possible if the subject used the notations only as signs (ie: as representations of specific physical objects) and not as symbols, the limits of such a mathematical strategy would soon be reached (how could 'infinity' be represented as an object and not as a concept, for example?). It would have to be conceded that not all autistic children could lack a symbolic capacity, and this superior group would be expected to possess a theory of mind. In fact, 20% of autistic subjects tested in the Puppet and Picture Experiments (3 and 4) responded in such a way as to suggest they did indeed have a theory of mind at the level of second-order representation (although no further than this, as the Village Experiment [6] demonstrated). Thus, the symbolic deficit argument, if it is valid at all, may apply only to the 80% of autistic children who failed to show a theory of mind or any pretend play, but not to all autistic children. This suggests the idea of two subgroups within autism, and this hypothesis warrants further research.

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APPENDICES

APPENDIX 1: Assessment Sheet (Circled scores = Autism).

CHILD'S NAME: ____

AGE : _________ years, and _________________ months.

Please consider the following questions. When answering them, you may find it helpful to think of the child as you have seen him/her in a variety of different situations, both in and out of the classroom.

The scoring system is as follows:

0 = NEVER 1 = SOMETIMES 2 = FREQUENTLY 3 = ALWAYS

Please circle the appropriate number next to every question. If you are unable to answer because you don't know about that aspect of the child, simply leave that particular question unscored.

1. SOCIAL IMPAIRMENT:

Question				
a) Does the child seem to look past rather than at you ?	0	1	2	(3)
b) Does the child seem aloof and indifferent to other people, especially other children ?	0	1	2	(3)
c) Does the child have inappropriate emotional reactions ? (eg: lack of fear of real dangers, but excessive fear of some harmless objects or situations)	0	1	2	(3)
d) Is the child unable to play imaginatively with objects or other people ?	0	1	2	(3)
e) Does the child select minor or trivial aspects of a person (eg: an earing) instead of the whole person ?	0	1	2	(3)
f) Does he make naive and embarassing remarks ?	0	1	2	(3)
g) Does the child point things out to other people and want them to look ?	(0)	1	2	3
h) Does the child show any response to people's feelings?	(0)	1	2	3

Extra comments (if any):

2. LANGUAGE IMPAIRMENT:

a) Is the child mute ? Yes_______ No________. (If yes, go straight to the next section).

Question				
b) Does the child have problems in comprehension of speech ?	0	1	2	3
c) Does the child produce immediate echolalia (ie: a parrot-like repetition of words the child has just heard) ?	0	1	2	(3)
c) Does the child produce delayed echolalia (ie: repetition of words or phrases heard in the past) ?	0	1	2	(3)
d) Does the child use words and phrases in an inflexible, repetitive stereotyped way ?	0	1	2	(3)
e) Does the child seem confused in the use of pronouns ?	0	1	2	(3)
f) Does the child have poor use and comprehension of communicative gestures ?	0	1	2	(3)
g) Are the child's questions repetitive and stereotyped?	0	1	2	(3)

3. RESISTANCE TO CHANGE, AND ATTACHMENT TO OBJECTS AND ROUTINES:

a) Does the child carry out rituals ?	0	1	2	(3)
b) Does the child insist upon exact repetition of some or all of the daily programme ?	0	1	2	(3)
c) Does the child arrange objects in special ways (eg: in certain patterns or in long lines) ?	0	1	2	(3)
d) Does the child replace things in the exact position from which they came, down to the smallest detail ?	0	1	2	(3)
e) Is the child attached to particular objects which must accompany him/her everywhere ?	0	1	2	(3)
f) Does the child collect particular objects obsessively?	0	1	2	(3)
g) Does the child have an obsessive, repetitive interest in certain subjects ?	0	1	2	(3)
h) Is the child's play repetitive and stereotyped (eg: does the child continually manipulate the same objects in the same way; or play the same record again and again; or perform the same series of actions over and over again) ?	0	1	2	(3)

Extra comments (if any):

4. SPECIAL SKILLS:

a) Is the child good at music ? Yes:________ No:________ (Please tick).

b) Is the child good at arithmetic ? Yes:________ No:________

c) Is the child good at dismantling and assembling mechanical objects? Yes:________ No:________

d) Is the child good at fitting together jigsaws or constructional toys ? Yes:________ No:________

e) Does the child have any other special skill(s) ? Yes:________ No:________

If yes, please specify:

f) Does the child have an unusual form of memory ? Yes:________ No:________

Extra comments (if any):

5. ESTIMATED AGE OF ONSET OF PROBLEMS (If known):

Thank you for providing this information. Please complete the last section (below), and return the sheets to Simon Baron-Cohen.

Your name:________________ Relationship to child:________________
Date:________________ (Teacher, Parent, etc.,

Appendix 2: Individual Background Data of Subjects in Experiments 1-6.

All subjects were tested in Experiments 1-5, except where indicated as follows:

+ = Not in Experiments 1-3.
* = Not in Experiments 4&5.
$ = Tested in Experiment 6 as well.

MA and CA are shown in months.

AUTISTIC SUBJECTS:

Number	Initials	Sex	CA	MA(Leiter)	MA(BPVT)	EXPT
1	JM	M	137	118	89	
2	M	M	131	106	69	$
3	A	M	127	90	36	
4	C	F	198	189	77	
5	PM	M	173	104	77	
6	AH	M	148	128	36	
7	D	F	159	116	84	$
8	JM	M	176	122	80	$
9	PW	M	176	127	65	
10	JH	M	203	180	149	+
11	PT	M	171	119	88	
12	SH	M	179	92	62	
13	V	F	73	79	61	
14	N	F	82	79	79	
15	NF	M	120	124	81	
16	A	M	132	120	51	
17	N	M	135	93	66	
18	J	F	135	102	53	
19	NR	F	139	109	66	
20	S	F	149	94	28	+
21	MA	M	190	125	33	$
22	G	M	78	64	39	*

DOWN'S SYNDROME SUBJECTS:

Number	Initial	Sex	CA	MA(Leiter)	MA(BPVT)	EXPT
1	H	F	157	67	30	+
2	E	F	94	61	20	
3	C	F	178	80	32	
4	N	F	90	79	30	
5	G	M	79	57	34	
6	G	M	122	63	42	
7	D	F	138	66	34	$
8	R	M	174	102	48	$
9	J	F	204	83	41	$
10	R	M	89	69	30	$
11	T	F	89	64	44	
12	B	F	75	67	25	
13	D	F	89	72	40	
14	JG	M	102	65	32	
15	G	M	201	65	34	

<u>**NORMAL SUBJECTS:**</u>

Number	Initial	Sex	CA	EXPT
1	J	M	54	
2	N	F	49	
3	L	F	55	
4	N	M	54	
5	D	F	57	
6	J	M	45	
7	N	F	55	
8	A	F	60	
9	N	F	68	
10	J	F	64	
11	A	F	69	
12	O	M	64	
13	J	M	53	
14	R	M	47	
15	M	M	46	
16	O	M	54	
17	S	F	46	
18	M	M	55	
19	C	F	55	
20	V	F	50	
21	R	M	45	
22	D	F	46	
23	D	M	60	+
24	S	M	63	+
25	S	M	61	+
26	M	M	46	
27	A	F	48	
28	T	F	48	*
29	V	M	41	*
30	C	F	43	*

APPENDIX 3: Individual Raw Scores in Experiment 4.

Key:
Scriptal 2 Story (1) = Icecream; (2) = Cooking; (3) = Shop.
Mental Story (1) = Sweets; (2) Chocolate; (3) = Teddy.
Scriptal 1 Story (1) = Shower; (2) = Digging; (3) = Dressing.

Autistic Subjects:

Ss Number	Story	Scriptal 2	Mental	Scriptal 1
1	1	1234	1234	1234
	2	1234	1423	1234
	3	1234	1342	1234
2	1	1243	1342	1234
	2	1234	1423	1324
	3	1234	1342	1234
3	1	1234	1243	1234
	2	1234	1423	1234
	3	1324	1432	1234
4	1	1234	1234	1234
	2	1234	1234	1342
	3	1234	1234	1234
5	1	1234	1234	1234
	2	1234	1234	1234
	3	1234	1234	1234
6	1	1234	1234	1234
	2	1234	1342	1234
	3	1234	1342	1234
7	1	1234	1234	1234
	2	1243	1234	1342
	3	1234	1234	1243
8	1	1234	1234	1234
	2	1234	1234	1432
	3	1234	1342	1234
9	1	1342	1342	1234
	2	1234	1342	1243
	3	1234	1243	1234
10	1	1234	1234	1234
	2	1234	1324	1234
	3	1234	1234	1234
11	1	1234	1234	1234
	2	1234	1234	1234
	3	1234	1234	1234

12	1	1243	1423	1234
	2	1234	1342	1243
	3	1342	1432	1234
13	1	1234	1432	1234
	2	1243	1342	1234
	3	1324	1423	1243
14	1	1324	1432	1234
	2	1234	1423	1324
	3	1432	1342	1234
15	1	1342	1243	1234
	2	1324	1342	1342
	3	1234	1423	1234
16	1	1234	1342	1234
	2	1234	1432	1324
	3	1234	1243	1234
17	1	1234	1243	1243
	2	1243	1423	1432
	3	1234	1342	1234
18	1	1234	1423	1234
	2	1234	1432	1234
	3	1423	1423	1243
19	1	1324	1342	1234
	2	1243	1423	1324
	3	1432	1243	1243
20	1	1432	1432	1324
	2	1423	1342	1234
	3	1432	1423	1432
21	1	1324	1432	1234
	2	1234	1342	1234
	3	1234	1423	1234

<u>Down's Syndrome Subjects:</u>

1	1	1342	1234	1432
	2	1234	1342	1324
	3	1234	1234	1234
2	1	1234	1342	1324
	2	1234	1234	1234
	3	1234	1324	1342
3	1	1234	1234	1324
	2	1234	1423	1423
	3	1234	1342	1234

4	1	1234	1324	1342
	2	1243	1234	1234
	3	1234	1234	1342
5	1	1432	1234	1234
	2	1234	1243	1432
	3	1234	1234	1234
6	1	1243	1342	1243
	2	1234	1234	1243
	3	1234	1234	1234
7	1	1234	1234	1234
	2	1432	1432	1234
	3	1342	1342	1342
8	1	1243	1432	1234
	2	1243	1423	1342
	3	1243	1234	1234
9	1	1342	1324	1324
	2	1342	1423	1324
	3	1423	1234	1234
10	1	1342	1342	1234
	2	1432	1432	1432
	3	1423	1324	1342
11	1	1234	1243	1432
	2	1432	1234	1324
	3	1234	1342	1342
12	1	1234	1423	1234
	2	1423	1234	1324
	3	1234	1324	1432
13	1	1342	1324	1432
	2	1342	1234	1432
	3	1432	1243	1342
14	1	1234	1234	1324
	2	1423	1243	1243
	3	1423	1342	1243
15	1	1342	1342	1324
	2	1423	1324	1234
	3	1234	1234	1423

Normal Subjects:

1	1	1234	1234	1234
	2	1324	1234	1234
	3	1342	1234	1423

2	1	1234	1234	1324
	2	1342	1432	1234
	3	1243	1243	1423
3	1	1234	1234	1243
	2	1423	1234	1324
	3	1243	1234	1234
4	1	1243	1324	1423
	2	1423	1423	1324
	3	1243	1342	1342
5	1	1432	1234	1234
	2	1324	1342	1342
	3	1243	1234	1234
6	1	1234	1234	1342
	2	1342	1234	1234
	3	1234	1324	1324
7	1	1234	1234	1234
	2	1234	1234	1234
	3	1234	1234	1243
8	1	1234	1234	1234
	2	1234	1234	1234
	3	1234	1234	1234
9	1	1234	1234	1234
	2	1234	1423	1234
	3	1234	1432	1234
10	1	1234	1234	1234
	2	1234	1234	1234
	3	1234	1234	1324
11	1	1234	1234	1234
	2	1234	1234	1234
	3	1234	1234	1234
12	1	1234	1234	1432
	2	1423	1234	1234
	3	1234	1234	1234
13	1	1342	1234	1234
	2	1234	1432	1243
	3	1234	1234	1234
14	1	1234	1234	1243
	2	1234	1243	1243
	3	1324	1234	1234
15	1	1234	1234	1234
	2	1234	1234	1234
	3	1243	1234	1243

16	1	1234	1234	1234
	2	1234	1234	1234
	3	1234	1234	1234
17	1	1234	1234	1234
	2	1234	1234	1234
	3	1234	1234	1234
18	1	1423	1234	1234
	2	1324	1342	1234
	3	1243	1234	1324
19	1	1234	1234	1234
	2	1234	1234	1234
	3	1234	1234	1234
20	1	1234	1234	1234
	2	1234	1234	1324
	3	1234	1234	1234
21	1	1324	1234	1234
	2	1324	1234	1243
	3	1234	1234	1234
22	1	1432	1234	1342
	2	1234	1234	1324
	3	1324	1234	1234
23	1	1234	1234	1234
	2	1234	1234	1234
	3	1234	1234	1234
24	1	1234	1234	1234
	2	1234	1234	1243
	3	1234	1234	1234
25	1	1234	1234	1234
	2	1234	1234	1234
	3	1234	1234	1234
26	1	1243	1234	1324
	2	1243	1234	1234
	3	1234	1234	1423
27	1	1234	1234	1234
	2	1432	1234	1234
	3	1234	1234	1423

<u>Retested sequences of those autistic subjects who were inconsistent in Experiments 3 and 4.</u>

2	1	1423	1423	1234
	2	1234	1342	1324
	3	1234	1243	1234

4	1	1234	1234	1234
	2	1234	1234	1234
	3	1234	1234	1234
5	1	1234	1234	1234
	2	1234	1234	1234
	3	1234	1234	1234
11	1	1234	1234	1234
	2	1234	1234	1234
	3	1234	1234	1234
21	1	1423	1234	1234
	2	1234	1234	1234
	3	1234	1234	1234

Appendix 4: Protocols from Experiment 4.

Key:
(P) = Passed puppet experiment;
(F) = Failed puppet experiment;
(C) = Correctly sequenced pictures.
[M] = Mental Rating.
[D] = Descriptive Rating.
(....) = Experimenter.

Protocols of 10 autistic subjects:

Subject Number (1): (F)

SCRIPTAL 2:
(C) (i) She goes to the sweetshop. She opens the door. She buys the sweets. She goes out. [D]
(C) (ii) The boy is eating icecream. The girl sat on the bench and eats an icecream. [D]
(How did she get an icecream?)
She stole it off the boy.
(C) (iii) Baking a cake. Cutting it. A birthday cake. [D]

MENTAL:
(C) (i) The boy bought some sweets. He dropped them out of the hole. [D]
(What is he doing at the end?)
He is eating his sweets.
(Is the bag empty or full?)
Empty or full.
(1423) (ii) The boy puts his chocolate in the box. He eats his chocolate. He goes out to play. His grandmother eats a chocolate.
(What is the boy saying in this picture?)
I like chocolates, chips, gravy and roastbeef. [D]
(1342) (iii) The girl has a teddy. She picks a flower. It is raining on Sunday. The boy has a teddy. [D]

SCRIPTAL 1:
(C) (i) Getting dressed. [D]
(C) (ii) Washing the feet. Jamie, wash your dirty face. [D]
(C) (iii) He has a shovel and a bag. He puts the seeds in. He covers it up. [D]

Subject Number (2): (P)

SCRIPTAL 2:
(1243) (i) He has an icecream and she wants some. She eats his icecream and then gives it back to him. [M]
(C) (ii) She goes into the sweetshop. She buys some sweets. She goes out again. [D]
(C) (iii) Cooking a pie. [D]
(What's this?)
Vegetables.
(And this?)

A knife.

MENTAL:
(1342) (i) The boy buys some sweets. He walks home. He eats his sweets. He goes to another shop. [D]
(1342) (ii) The girl has a teddy and she picks a flower, and the teddy is gone. The boy stole it. [D]
(1423) (iii) The boy has chocolate and he eats it. Then he goes out to play and his mother claps her hands. He is frightened and went outside. [D]
(What is he saying here?)
A mars a day.

SCRIPTAL 1:
(C) (i) Having a bath. He is drying himself. [D]
(C) (ii) Going getting his clothes on. First his shoes, then his shirt, then he is dressed. [D]
(1324) (iii) The man has a spade and a bag. He puts the seeds into the hole. He digs a hole and he pushes the soil in. [D]

<u>Subject Number (3):</u> (F)

SCRIPTAL 2:
(C) (iii) Cooking. We do the cooking on Mondays. [D]
(1324) (ii) The girl is walking and she is going into the sweetshop. She buys winegums and goes out. [D]
(C) (iii) The girl takes the icecream from the boy. [D]
(Is he happy or sad?)
Happy or sad. Good boy.

MENTAL:
(1243) (i)
(1423) (ii) (Nothing)
(1432) (iii)

SCRIPTAL 1:
(C) (i) Getting dressed. [D]
(C) (ii) Washing his arms. Drying his arms. [D]
(C) (i) Man holding spade and a bag. Good boy, good boy. [D]

<u>Subject Number (4):</u> (F)

SCRIPTAL 2:
(C) (i) She stole the icecream. [D]
(Good. Is he happy or sad?)
Sad.
(C) (ii) Baking a pie. Put it in the oven for half an hour. Then eat it. [D]
(C) (iii) The girl walks along. She buys some sweets, then she comes out of the shop. [D]
(What is she doing here?)
Closing the door.

MENTAL:
(C) (i) The girl puts her teddy down, and the boy takes it, and the girl picks the flower. [D]
(What does she say?)
The boy took the teddy.
(C) (ii) The boy's sweets dropped out of the bag.
(What does he say?)
The sweets are on the road. [D]
(C) (iii) The boy puts the chocolate in the box, then his mother eats it, then he comes back, and the box...
(Yes?)
Yes.
(What does he say?)
Nothing.
(Why does this picture go last?)
Because here the chocolate is here, then the mother eats it, then the chocolate is gone. [D]

SCRIPTAL 1:
(C) (i) Boy's got no clothes on. He's having a shower and now he's drying himself. [D]
(1342) (ii) Digs a hole. Then he pours the seeds in. Then he fills it up again. [D]
(C) (iii) The boy is getting dressed. [D]

Subject Number (8): (P)

SCRIPTAL 2:
(C) (i) The man cooks a pie for his school. [D]
(C) (ii) She goes in the door, buys sweets, and then goes out again. [D]
(C) (iii) The boy is sitting on the bench, eating an icecream. The girl sits on the bench. The girl takes the icecream and she eats the icecream. [D]
(Is he happy or sad here?)
Sad, cuz the girl took his icecream.

MENTAL:
(C) (i) (What did the boy say?)
Oh, my sweets are gone! [M]
(C) (ii) (What did the boy say in this picture?)
Oh, it's gone! [M]
(1342) (iii) (What happened here?)
The girl put her teddy down, and then she lost it.
(Why?)
Because she did.
(How did she lose it?)
I don't know. [D]

SCRIPTAL 1:
(C) (i) The boy has a shower. [D]
(C) (ii) The boy gets dressed. [D]
(1432) (iii) He digs a hole. He puts the treasure in there and then he covers it with soil. Then he digs. [D]

Subject Number (5): (F)

SCRIPTAL 2:
(C) (i) The girl walks into the shop and she buys some sweets and now she's bought some. [D]
(C) (ii) The man cooks a cake. [D]
(C) (iii) The boy is eating an icecream. The girl sits down. The girl snatched the icecream. [D]
(Is he sad?)
Yes.

MENTAL:
(C) (i) The girl puts her teddy on the grass, and the boy takes it.
(What does she say?)
The boy took the teddy. [D]
(C) (ii) The boy put the chocolate in the box and the woman ate it.
(What did he say?)
Why did you eat my chocolate? [D]
(C) (iii) The boy buys some sweets and he drops them on the road. Then there are no more.
(What does he say?)
Nothing. [D]

SCRIPTAL 1:
(C) (i) The boy has a shower. [D]
(C) (ii) The boy gets dressed. [D]
(C) (iii) Digging. Putting the seeds in. Filling the hole in. [D]

Subject Number (7): (P)

SCRIPTAL 2:
(C) (i) The girl's got a long ribbon. She's walking to the sweetshop. I've got this one wrong. I could pretend that's me and that I'm wearing a yellow teeshirt. [M]
(What happens when you pretend?)
It's acting.
(C) (ii) She's taking the boy's icecream and the girl's got it and the boy's very upset because the girl took the icecream. Imagine if the girl was me and Rodney took my icecream then I'd be the same. [M]
(1243) (iii) Making a pie. [D]
(What happens?)
Here he puts the vegetables on. Then he puts it in the oven. Then he gives it to the children. And then she cuts it.

MENTAL:
(C) (i) The boy was surprised cuz he couldn't find his chocolate. [M]
(C) (ii) 'Where's my teddy gone?' [M]
(C) (iii) He dropped all his sweets.
(What did he say?)
My sweets are gone. [D]

SCRIPTAL 1:
(C) (i) Washing himself. [D]
(1243) (ii) Dressing by himself. [D]

(1342) (iii) The man is digging and he pours in seeds and pushes all the soil back and digs it again. [D]

Subject Number (9): (F)

SCRIPTAL 2:
(C) (i) She goes into the sweetshop. She buys sweets. She comes out. [D]
(C) (ii) Cooking a Pizza in the Pizza Express in West Acton. [D]
(1342) (iii) She took his icecream. [D]

MENTAL:
(1243) (i) The girl is standing and she has a teddy. Then she picks a flower and her teddy is there, the boy has got it. [D]
(What does she say, here?)
Hello.
(1342) (ii) The boy buys sweets with money and then he comes out and goes home. He eats his sweets. They fall out of the bag. [D]
(Is he happy?)
Yes.
(1342) (2ST) (iii) The boy has a chocolate. He puts it in the box. Then his mother eats it and then he eats one too. He goes out of the door.
(What is he doing here?)
Eating his chocolate. He's got his mouth open. [D]

SCRIPTAL 1:
(C) (i) Getting dressed. [D]
(C) (ii) Having a wash on Tuesdays and Thursdays. [D]
(Is that your bath night?)
Yes.
(1243) (iii) He has a shovel. He puts the seeds in and he puts soil in to make the seeds grow, then he digs the garden. Where do you live? [D]
(Islington)
You can get the number 73, 30, 19, or B1 to Kings Cross and then change to the buses along Marylebone Road no standing on the top and change buses in Hammmersmith for Acton Town.

Subject Number (10): (Not in puppet expt).

SCRIPTAL 2:
(C) (i) She walks to the shop. Goes in. Buys sweets. Goes out. [D]
(C) (ii) The man makes a pie. Then they eat it. [D]
(C) (iii) She stole his icecream. That's naughty. [D]

MENTAL:
(1324) (i) The boy didn't know she pinched his chocolate. [M]
(C) (ii) Oh! My sweets are gone! [M]
(C) (iii) (What does she say?)
He stole my teddy. [D]

SCRIPTAL 1:
(C) (i) He is having a shower. [D]

(C) (ii) The boy is dressing. Now he's dressed. [D]
(C) (iii) He has a spade and a bucket. He digs a big, big hole. He pours in the water. Then he fills in the hole again. [D]

Subject Number (15): (F)

SCRIPTAL 2:
(1342) (i) The man eats his icecream and the lady snatches it, and thd girl eats it. Then he eats another one. [D]
(1324) (ii) Cooking a pie. They eat it. [D]
(C) (iii) That lady's walking into the shop and she's getting some sweets and she's coming out of the shop. [D]
Is it chips today? They only have eggs at school. Is she a girl?
(No, it's a boy).

MENTAL:
(1342) (i) The sweet is in the box, and the boy goes out, and the sweet's missing, and Mummy eats the sweet.
(What is the boy doing here?)
He is shouting?
(What is he shouting?)
Shut the box. [D]
(1423) (ii) She has a teddy. Then it's raining. The boy plays with the teddy. [D]
(What is she saying here?)
Nothing.
(1243) (iii) The boy buys some more sweets. The sweets fall out on the road. [D]
(What is he saying here?)
My sweets are in my tummy.
(But here they are on the road!)
Yes.

SCRIPTAL 1:
(C) (i) Getting dressed in the morning. [D]
(1342) (ii) He digs a hole and pours the soil in there. [D]
(C) (iii) The boy washes in the shower. He puts soap on his tummy. He dries himself. [D]

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Subject Number (10):

SCRIPTAL 2:
(1423) (i) Buying sweets. [D]
(1432) (iii) Lunchtime. [D]
(1342) (iii) She wants his icecream. [M]

MENTAL:
(1342) (i) -
(1432) (ii) -
(1324) (iii) -

SCRIPTAL 1:
(C) (i) Washing. [D]
(1342) (ii) Dressing. [D]
(1432) (iii) -

Subject Number (13):

SCRIPTAL 2:
(1342) (i) -
(1342) (ii) -
(1432) (iii) -

MENTAL:
(C) (i) "It's missing!" [M]
(1324) (ii) They fell down and there's none in there. [D]
(1243) (iii) She's crying and sad.
(Why?)
Cuz she's lost her teddy. [D]

SCRIPTAL 1:
(1432) (i) -
(1432) (ii) -
(1342) (iii) -

Subject Number (8):

SCRIPTAL 2:
(1243) (i) Buying sweets. [D]
(1243) (ii) Having lunch at home. [D]
(1243) (iii) She's eating his icecream. Naughty girl! [D]

MENTAL:
(1432) (i) -
(C) (ii) "My teddy's gone!" He took it. [M]
(1423) (iii) "My chocolate's gone!" [M]

SCRIPTAL 1:
(C) (i) Washing. [D]
(C) (ii) Dressing. [D]
(1342) (iii) -

Subject Number (9):

SCRIPTAL 2:
(1342) (i) -
(1342) (iii) -
(1423) (iii) -

MENTAL:
(1324) (i) "My sweet's is gone!" [M]
(C) (ii) Gone! The boy took it. [M]
(1423) (iii) -

SCRIPTAL 1:
(1324) (i) -
(C) (ii) -
(1324) (iii) He's digging. [D]

Subject Number (5):

SCRIPTAL 2:
(C) (i) She gets sweets. [D]
(C) (ii) -
(1432) (iii) She took the boy's icecream. [D]
(What happened here?)
He got it back.

MENTAL:
(C) (i) "They've gone!" [M]
(C) (ii) The boy took the teddy.
(What did she say?)
"It's gone!" [M]
(1243) (iii) -

SCRIPTAL 1:
(C) (i) -
(1432) (ii) -
(C) (iii) -

Subject Number (6):

SCRIPTAL 2:
(C) (i) She buys sweets. [D]
(C) (ii) -
(1243) (iii) Icecream. [D]

MENTAL:
(1342) (i) The sweets dropped on the floor. [D]
(C) (ii) "Where's my teddy!" [M]
(C) (iii) "Where's my chocolate!" [M]

SCRIPTAL 1:
(1243) (i) Washing himself. [D]
(C) (ii) Getting dressed. [D]
(1243) (iii) -

Subject Number (1):

SCRIPTAL 2:
(C) (i) Buying sweets. [D]
(C) (ii) -
(1342) (iii) Naughty girl. She took his icecream and ate it. [D]

MENTAL:
(C) (i) "Where's my sweets gone!" [M]

(C) (ii) "My teddy's gone!" [M]
(1342) (iii) -

SCRIPTAL 1:
(1432) (i) Washing. [D]
(C) (ii) The boy's getting dressed. [D]
(1324) (iii) -

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Subject Number (5):

SCRIPTAL 2:
(1243) (i) She's getting some sweets for her friends. [D]
(1324) (ii) The daddy is cooking. [D]
(1432) (iii) He's eating an icecream, and then she gives it to him and he eats it. [D]

MENTAL:
(C) (i) "Oh! My teddy ain't there!" [M]
(1342) (ii) She took the chocolate, then he came back and looked and there weren't nothing in there and he said "Oh my chocolate ain't in the box!" He was sad! [M]
(C) (iii) He lost all his sweets.
(What did he say?)
"Oh! They're gone!" [M]

SCRIPTAL 1:
(C) (i) He's takin' a shower. [D]
(C) (ii) He's gettin' dressed in his clothes. [D]
(1342) (iii) He's digging, but I don't know what he's doing here. [D]

Subject Number (3):

SCRIPTAL 2:
(1243) (i) She bought some sweets. [D]
(1423) (ii) Cooking a flan, I think. [D]
(C) (iii) She nicked his icecream, naughty girl. [D]

MENTAL:
(C) (i) "Where are my sweets!" (Cries). [M]
(C) (ii) "Oh! Where's my teddy!" [M]
(C) (iii) "My chocolate's gone!" [M]

SCRIPTAL 1:
(1243) (i) He's having a shower. [D]
(C) (ii) He's dressing hi'self to go to school. [M]
(1324) (iii) He's digging a hole to hide something. [M]

Subject Number (4):

SCRIPTAL 2:
(1243) (i) She's buying some sweets. [D]
(1423) (ii) -
(1243) (iii) The girl wanted it. [M]

MENTAL:
(1423) (i) The chocolate hurt her mouth.
(What does he say?)
I want my chocolate.
(Where is it?)
Gone.
(Who took it?)
She did! [D]
(1342) (ii) The boy nicked her teddy and she were angry. [D]
(1324) (iii) He lost all his sweets. He'd better pick 'em up. [D]

SCRIPTAL 1:
(1423) (i) -
(1324) (ii) He's doin' the gardenin'. [D]
(1342) (iii) -

Subject Number (6):

SCRIPTAL 2:
(C) (i) She's bought some sweets. [D]
(1342) (ii) They want some pizza. [M]
(C) (iii) She snatched it! [D]

MENTAL:
(C) (i) "I don't know where my sweets is!" [M]
(1324) (ii) She put her teddy down. Then he nicks it. Then he puts it back. [D]
(C) (iii) "Where's my chocolate?" [M]

SCRIPTAL 1:
(1342) (i) He has a shower. Then he gets out. [D]
(1324) (ii) Here's a boy. Here's a girl dressing. [D]
(C) (iii) He's burying his dad's money! [D]

Subject Number (19):

SCRIPTAL 2:
(C) (i) She snatched his icecream. He nearly punched her. "Gimme back my icecream!" [D]
(C) (ii) This girl wants to eat some. [M]
(C) (iii) She goes into the sweetshop and she buys jellybabies and comes out. [D]

MENTAL:
(C) (i) The boy is putting the sweet in the box so nobody won't find it. Then he goes out. She eat it. And he's shouting "Where's my sweet gone?" [M]

(C) (ii) She puts her teddy down and the boy snatched it cuz she weren't looking. And he took it to his house and she said "Where's my teddy gone!" [M]
(C) (iii) The sweets fallin' out. He said "Where's my sweets gone?" [M]

SCRIPTAL 1:
(C) (i) He's digging and he puts his money in the hole so nobody won't find it. [M]
(C) (ii) He's getting dressed. [D]
(C) (iii) He's having his wash. [D]

Subject Number (12):

SCRIPTAL 2:
(C) (i) She's buying sweets in the shop. [D]
(1423) (ii) That man is cooking a pie. [D]
(C) (iii) She nicked his icecream. [D]

MENTAL:
(C) (i) There was a hole in the bag and they dropped out.
(What did he say?)
"My sweets have gone!" [M]
(C) (ii) The old lady ate the chocolate, so he got mad.
(Did he know she ate it?)
No.
(Why not?)
Cuz he were out of the room. [M]
(C) (iii) She put her teddy down, then, while she were looking here, that boy nicked it.
(What did she say?)
"My teddy's gone!" [M]

SCRIPTAL 1:
(1432) (i) He washed his hair. [D]
(C) (ii) He's getting dressed. [D]
(C) (iii) He's digging to make a hole. [D]

Subject Number (10):

SCRIPTAL 2:
(C) (i) She's bought some sweets. [D]
(C) (ii) The dad is making a cake for the whole family. [D]
(C) (iii) She's naughty. She stole his icecream and now he's gonna get angry. [D]

MENTAL:
(C) (i) The little boy come and nicked it.
(What did she say?)
"My teddy's gone!" [M]
(C) (ii) When he came back the chocolate was gone. [D]
(C) (iii) His sweets dropped out of the bag.- "Oh! My sweets have gone!" [M]

SCRIPTAL 1:
(C) (i) He's washin' hi'self. [D]
(1324) (ii) He's dressing to go to school. [D]
(C) (iii) He digging up the garden. [D]

Subject Number (9):

SCRIPTAL 2:
(C) (i) She's running away cuz she didn't pay enough. [D]
(C) (ii) -
(C) (iii) She nicked his icecream. [D]

MENTAL:
(C) (i) "I'll have to go buy some more sweets." [M]
(1432) (ii) He's putting the teddy back cuz she were angry with him cuz he nicked it before. [D]
(1423) (iii) He put his chocolate in his box then he shouted cuz his chocolate was gone, then he went out and his mum ate it. [D]

SCRIPTAL 1:
(C) (i) -
(C) (ii) He's digging in his garden. [D]
(C) (iii) -

Subject Number (8):

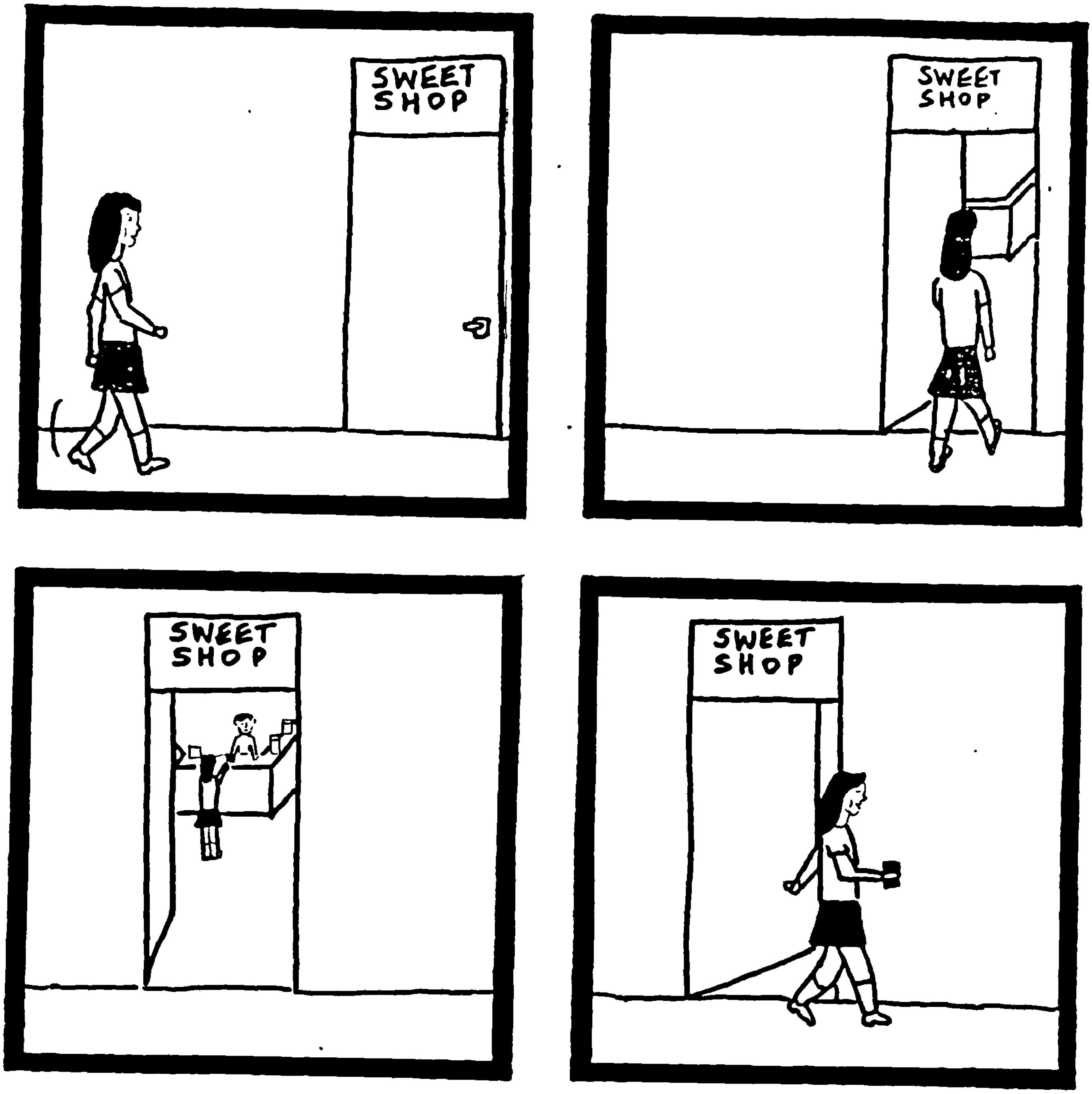
SCRIPTAL 2:
(C) (i) They look like nice sweets! Bubblegums! [D]
(C) (ii) This man is making a pizza for all his friends. [D]
(C) (iii) She takes it away. [D]

MENTAL:
(C) (i) They've all dropped out.
(What does he say?)
"Where's my sweets!" [M]
(C) (ii) The boy take's it while she's picking a flower. She said "Where's my teddy!" [M]
(C) (iii) "Where's my chocolate gone!" [M]

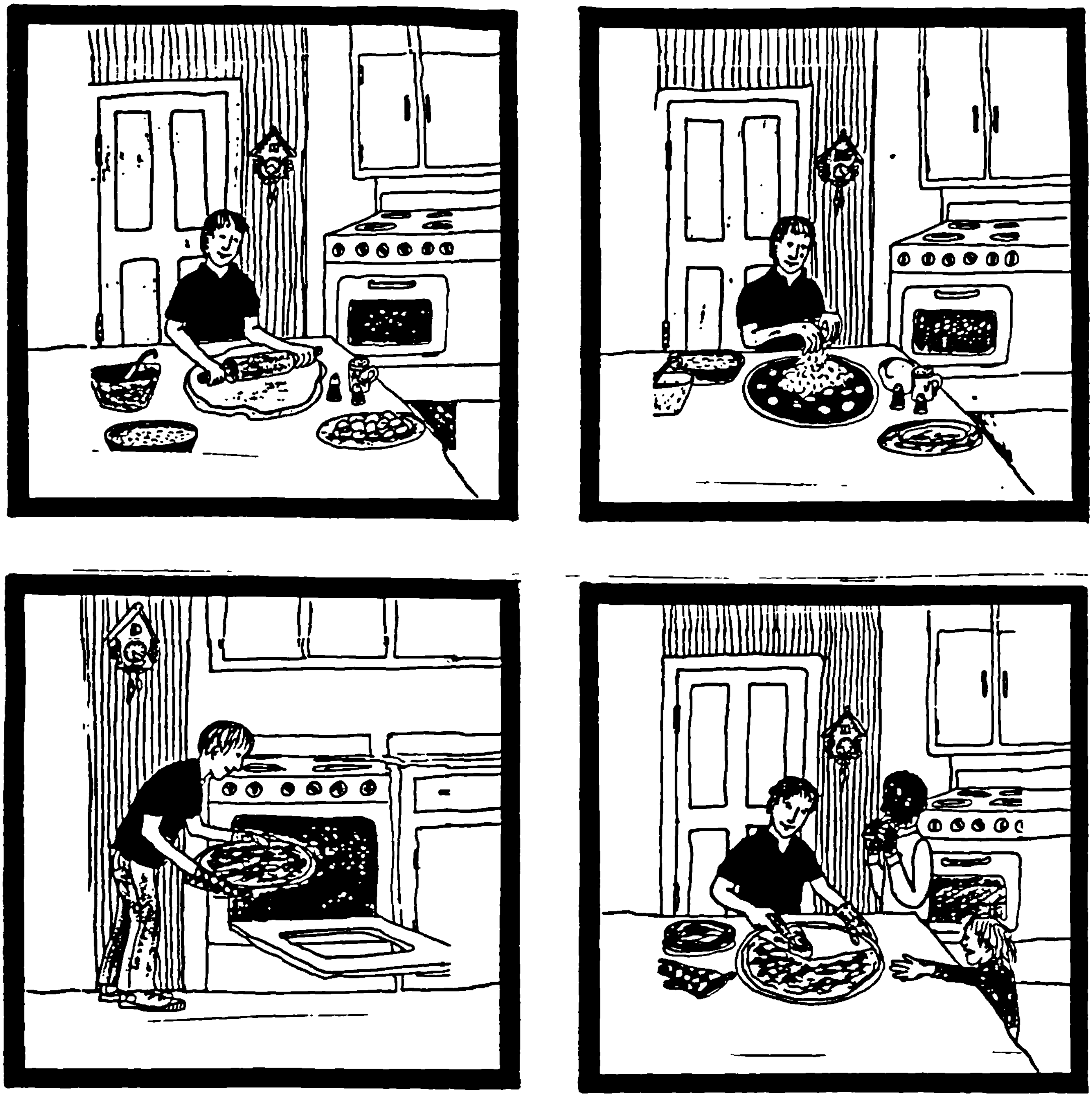
SCRIPTAL 1:
(C) (i) The boy is having a shower and washing hi'self. [D]
(C) (ii) Another boy is getting dressed and looking in the mirror. [D]
(C) (iii) He's digging to hide his toys. [M]

Appendix 5: Pictures used in Experiment 4.

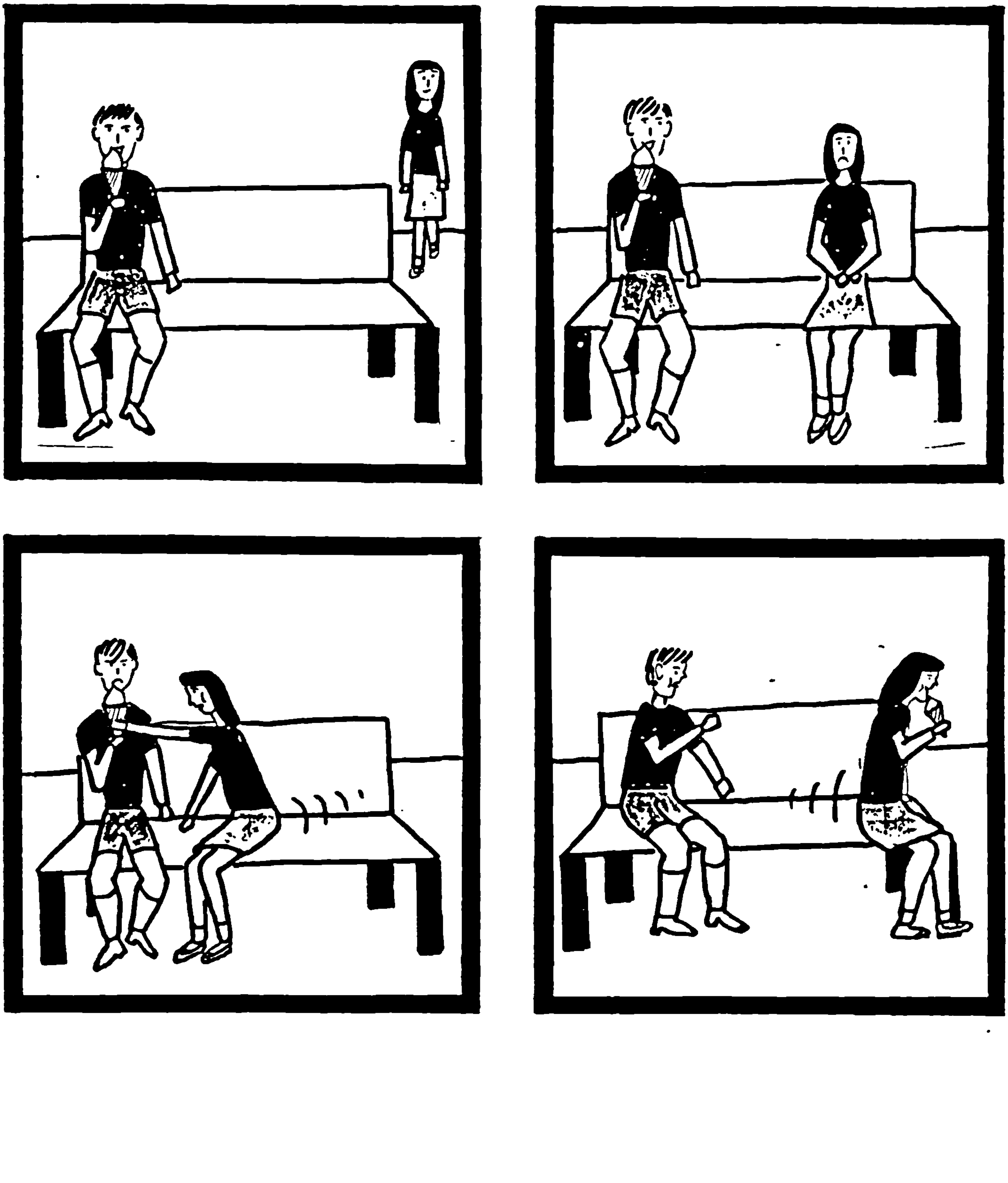
SCRIPTAL 2, STORY 1:



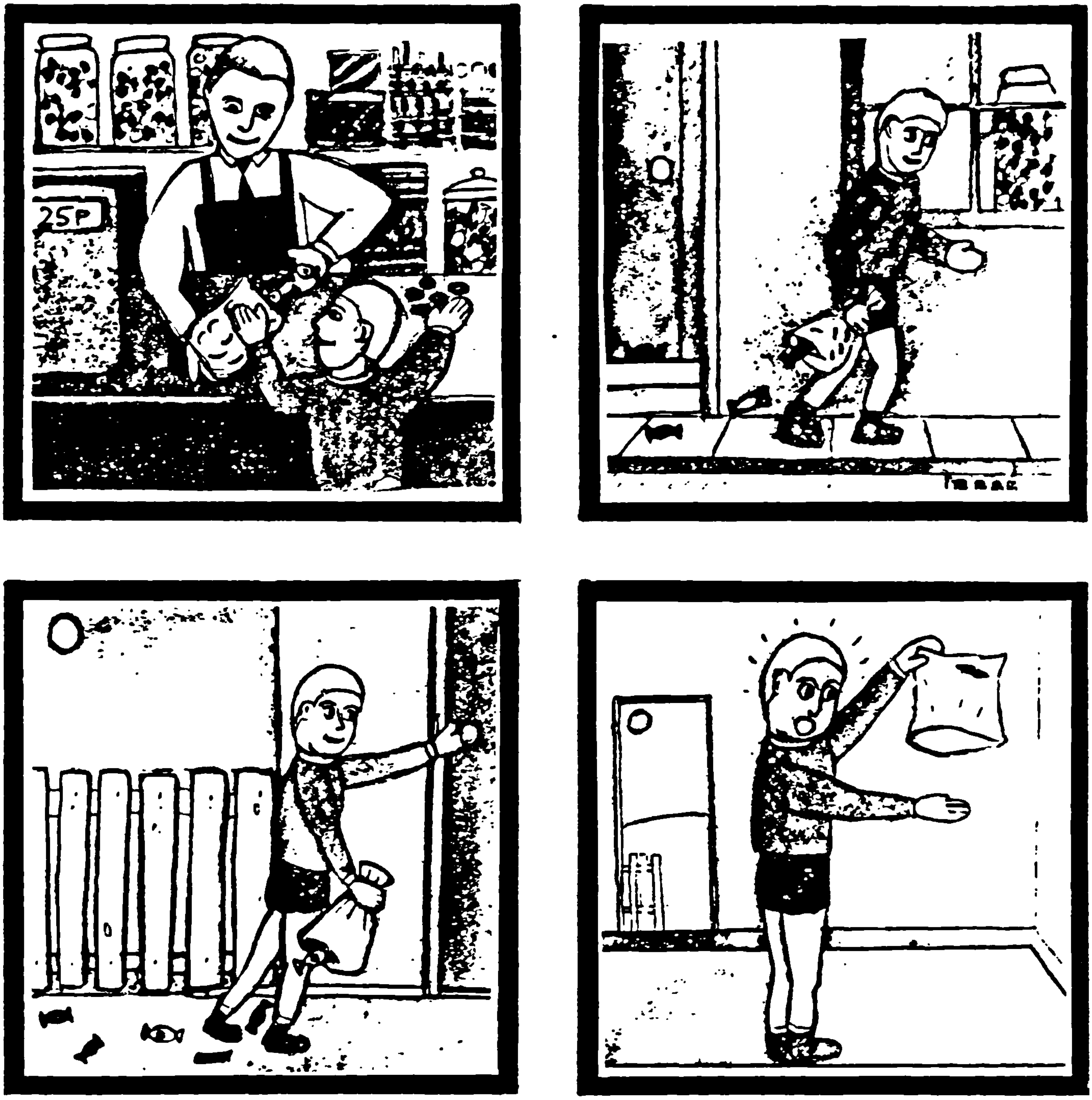
STORY 2:



STORY 3:

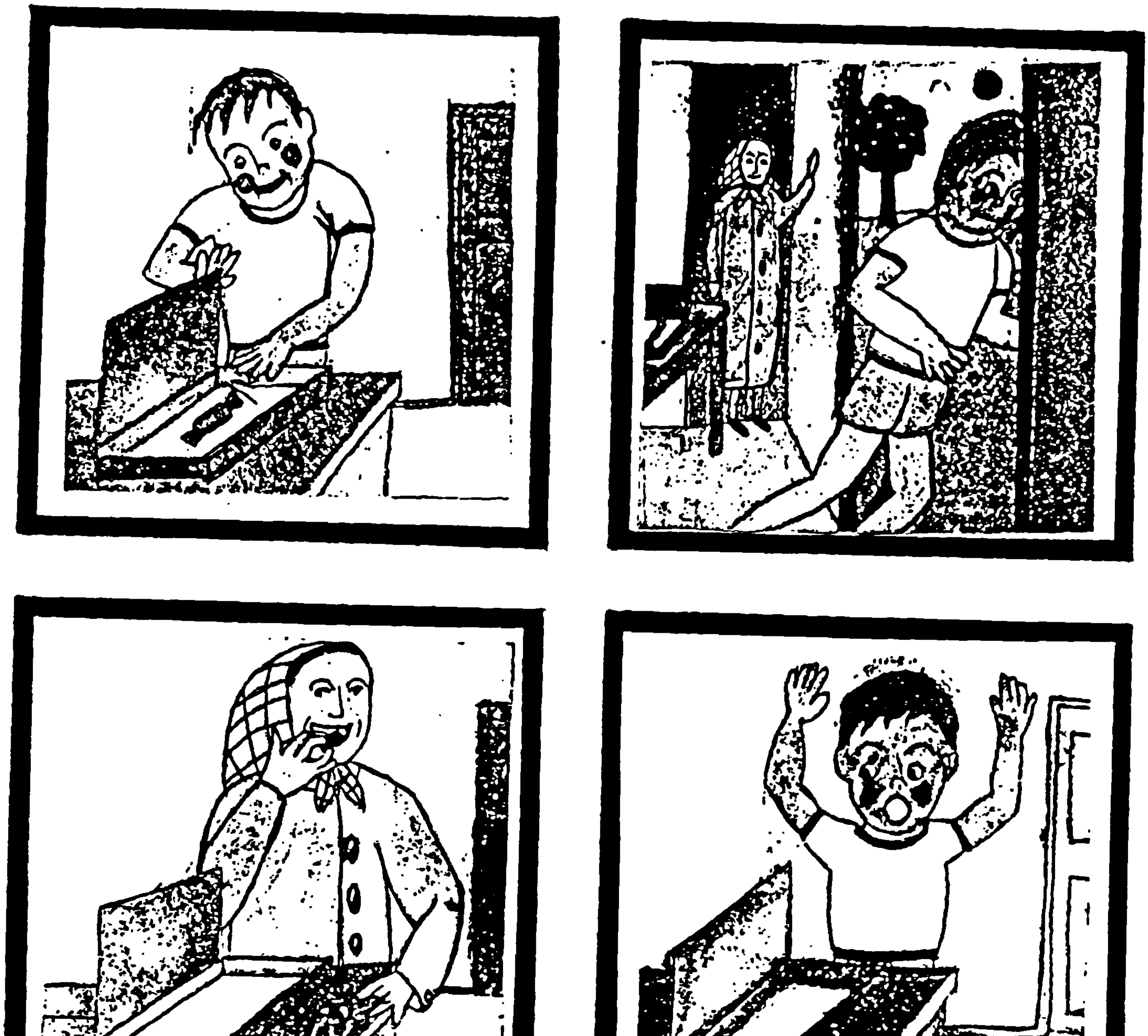


MENTAL, STORY 1:

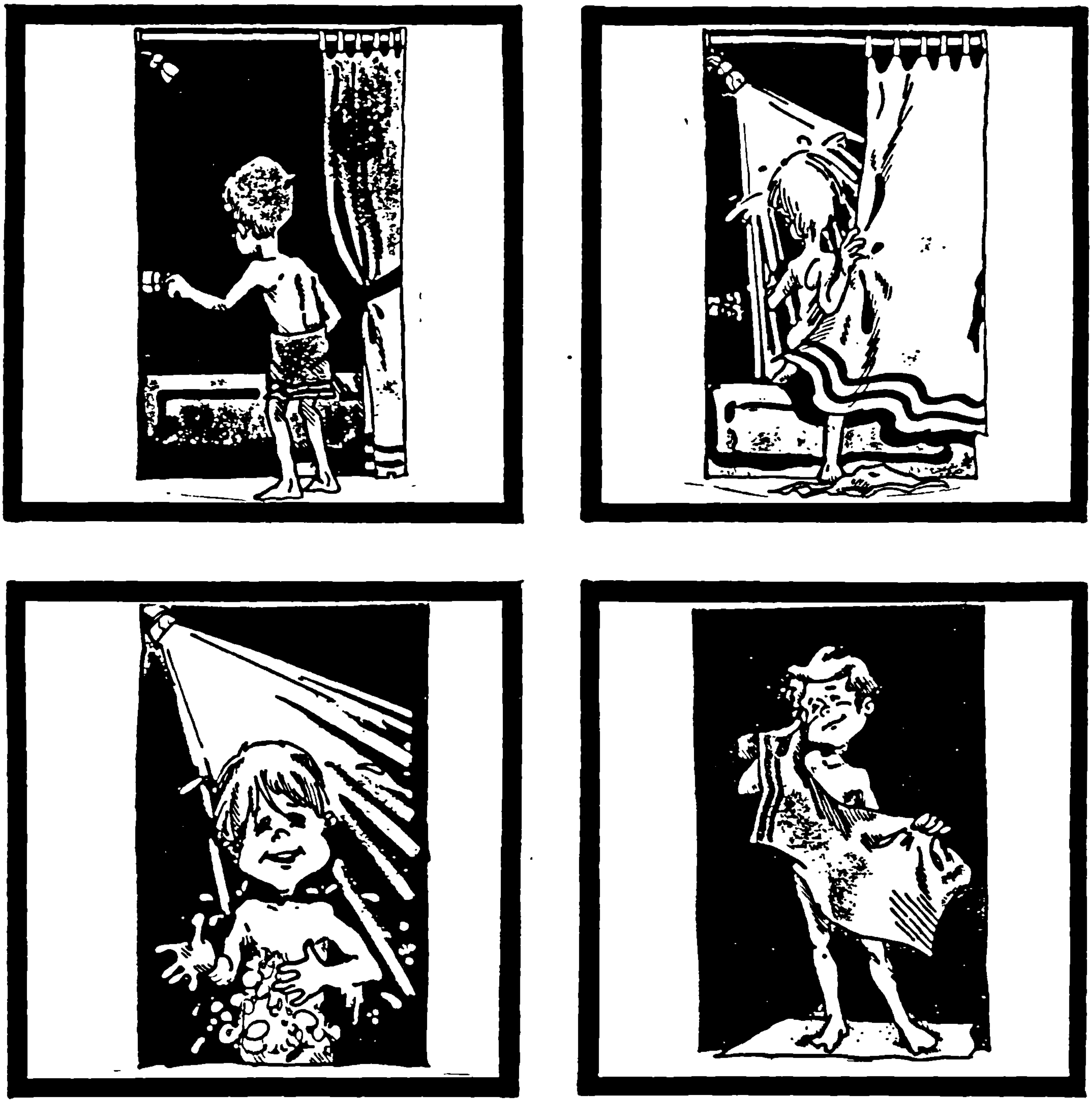


STORY 2:

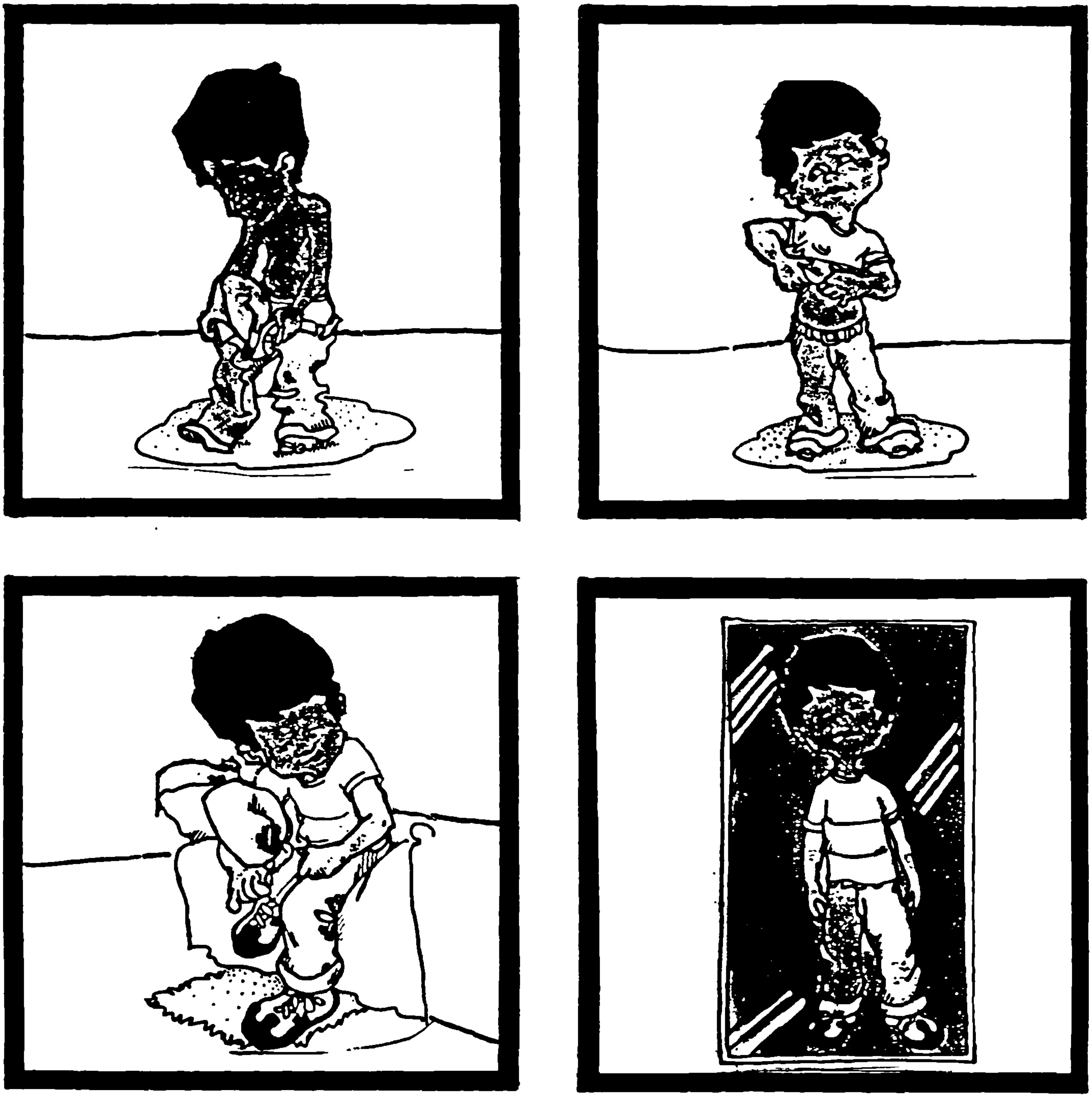
STORY 3:



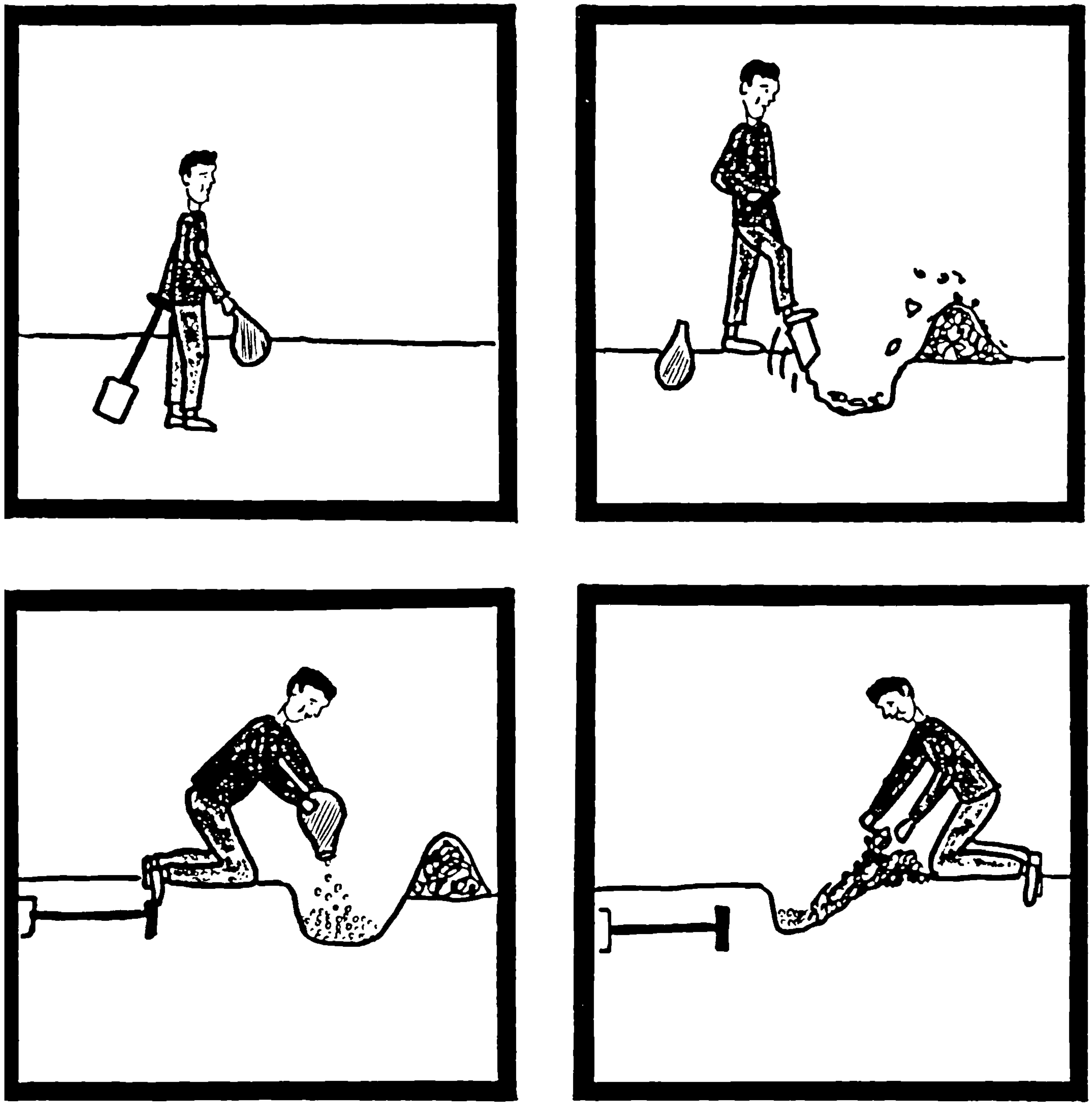
SCRIPTAL 1 STORY 1:



STORY 2:



STORY 3:



APPENDIX 6: Individual Raw Scores in Experiment 5.

Key:
Causal 1 Story (1) = Balloon; (2) = Egg; (3) = Tree.
Causal 2 Story (1) = Water; (2) Rock; (3) = Tripping.

Autistic Subjects:

Ss Number	Story	Causal 1	Causal 2
1	1	1234	1234
	2	1234	1234
	3	1234	1234
2	1	1234	1234
	2	1234	1234
	3	1234	1234
3	1	1234	1234
	2	1234	1234
	3	1234	1234
4	1	1234	1234
	2	1234	1234
	3	1234	1234
5	1	1234	1234
	2	1234	1234
	3	1234	1234
6	1	1234	1234
	2	1234	1234
	3	1234	1234
7	1	1234	1234
	2	1234	1234
	3	1234	1234
8	1	1234	1234
	2	1234	1234
	3	1234	1234
9	1	1234	1234
	2	1234	1234
	3	1234	1234
10	1	1234	1234
	2	1234	1234
	3	1234	1234
11	1	1234	1234
	2	1234	1234
	3	1234	1234

12	1	1234	1234
	2	1234	1234
	3	1234	1234
13	1	1234	1234
	2	1234	1234
	3	1234	1234
14	1	1234	1423
	2	1234	1234
	3	1234	1234
15	1	1234	1234
	2	1234	1234
	3	1234	1234
16	1	1234	1234
	2	1234	1234
	3	1234	1234
17	1	1234	1234
	2	1243	1234
	3	1234	1324
18	1	1234	1234
	2	1234	1234
	3	1234	1234
19	1	1234	1234
	2	1234	1234
	3	1432	1234
20	1	1243	1324
	2	1234	1324
	3	1234	1234
21	1	1234	1234
	2	1234	1234
	3	1234	1234

Down's Syndrome Subjects:

1	1	1234	1234
	2	1342	1324
	3	1234	1234
2	1	1234	1243
	2	1234	1234
	3	1234	1243
3	1	1234	1234
	2	1234	1234
	3	1243	1324
4	1	1234	1342
	2	1234	1234

	3	1234	1234
5	1	1234	1324
	2	1243	1342
	3	1432	1234
6	1	1234	1324
	2	1243	1234
	3	1234	1243
7	1	1242	1324
	2	1432	1432
	3	1423	1342
8	1	1324	1234
	2	1423	1423
	3	1243	1243
9	1	1432	1324
	2	1234	1342
	3	1243	1423
10	1	1234	1234
	2	1432	1423
	3	1342	1432
11	1	1243	1243
	2	1432	1234
	3	1234	1342
12	1	1234	1432
	2	1432	1234
	3	1324	1324
13	1	1243	1234
	2	1243	1432
	3	1342	1243
14	1	1234	1234
	2	1342	1423
	3	1342	1342
15	1	1423	1432
	2	1234	1324
	3	1234	1234

Normal Subjects:

1	1	1342	1423
	2	1432	1342
	3	1432	1324
2	1	1234	1234
	2	1432	1324
	3	1234	1234

3	1	1243	1423
	2	1432	1324
	3	1234	1234
4	1	1234	1423
	2	1432	1423
	3	1423	1432
5	1	1324	1234
	2	1342	1342
	3	1432	1234
6	1	1234	1324
	2	1324	1342
	3	1342	1234
7	1	1324	1234
	2	1324	1234
	3	1234	1423
8	1	1234	1234
	2	1234	1234
	3	1234	1234
9	1	1324	1234
	2	1324	1234
	3	1234	1234
10	1	1243	1342
	2	1324	1432
	3	1324	1234
11	1	1234	1234
	2	1234	1324
	3	1324	1234
12	1	1234	1324
	2	1432	1243
	3	1342	1234
13	1	1432	1423
	2	1324	1432
	3	1423	1234
14	1	1234	1432
	2	1234	1342
	3	1432	1324
15	1	1234	1234
	2	1234	1234
	3	1243	1324
16	1	1234	1432
	2	1342	1243
	3	1324	1324
17	1	1234	1234
	2	1423	1234

	3	1324	1243
18	1	1423	1243
	2	1324	1324
	3	1324	1324
19	1	1234	1432
	2	1324	1423
	3	1324	1423
20	1	1234	1432
	2	1432	1342
	3	1324	1243
21	1	1234	1234
	2	1234	1234
	3	1234	1234
22	1	1243	1234
	2	1234	1234
	3	1234	1234
23	1	1234	1234
	2	1234	1234
	3	1234	1234
24	1	1234	1234
	2	1234	1234
	3	1234	1234
25	1	1342	1243
	2	1234	1234
	3	1234	1234
26	1	1432	1234
	2	1243	1324
	3	1234	1243
27	1	1234	1234
	2	1432	1324
	3	1342	1243

Appendix 7: Protocols from Experiment 5.

Protocols of 10 autistic subjects:

Key:
(C) = Correctly sequenced pictures.
[C] = Causal Rating.
[D] = Descriptive Rating.
(....) = Experimenter.

Subject Number (1):

CAUSAL 1:
(C) (i) The balloon is gassy. The gas came out because the tree made it pop. [C]
(C) (ii) The floor made the egg crack. [C]
(C) (iii) The ball is rolling down the hill and it broke the tree. [C]

CAUSAL 2:
(C) (i) The boy pushed the ball into the water. [C]
(C) (ii) The ball is rolling and it is rolling and it hurt the man. [C]
(C) (iii) The man is walking. He tripped over a (pause) Uta is coming tomorrow. He tripped over a brick. He hurt his foot.
(Why did he hurt his foot?)
Because of the brick. [C]
(Does he have a happy or a sad face?)
A sad face.

Subject Number (2):

CAUSAL 1:
(C) (i) It got caught on the branches and went pop.
(What made it pop?)
The branches. Very sharp. [C]
(C) (ii) The boulder broke the tree. [C]
(C) (iii) The egg cracked open.
(What made it crack?)
Cuz it fell off the table. [C]

CAUSAL 2:
(C) (i) He tripped over and his foot bleeded. [D]
(C) (ii) The splash. The rock made a splash. [C]
(C) (iii) The cannon ball knocked the man over. [C]

Subject Number (3):

CAUSAL 1:
(C) (i) It popped on tree. [D]
(C) (ii) The egg broke because it fell down off the table. [C]
(C) (iii) The tree broke.
(Why?)
The rock hit it. [C]

CAUSAL 2:
(C) (i) The ball rolling and the ball falls in the water. [D]
(C) (ii) The man is walking. He tripped. Red blood. [D]
(Why is there blood?)
Hurt his foot.
(C) (iii) The rock made the man fall down. [C]

Subject Number (4):

CAUSAL 1:
(C) (i) It popped.
(What made it pop?)
The tree. [C]
(C) (ii) It smashed.
(Why?)
It fell off the table. [C]
(C) (iii) The tree has broken.
(What broke the tree?)
The big black rock. [C]

CAUSAL 2:
(C) (i) His knee bleeds. Blood.
(Why is it bleeding?)
Because he fell over. [C]
(C) (ii) Got knocked down.
(Why?)
Don't know.
(Yes you do. Why did he fall down?)
Because the ball knocked him. [C]
(C) (iii) It made a splash. [C]
(What did?)
The rock.

Subject Number (8):

CAUSAL 1:
(C) (i) It hit the tree and it 'bang!'
(Why did it bang?)
Cuz it hit the tree. [C]
(C) (ii) There's an egg and it rolls there, and then it smashes.
(Why?)
Cuz it fell down. [C]
(C) (iii) The ball rolls down and it cracks the tree. [C]

CAUSAL 2:
(C) (i) A ball hits the man and he falls down.
(Why does he fall down?
Because he's dead.
(What happens when you die?)
You fall down. [D]
(C) (ii) The man is walking along. He trips over a brick. He falls, and there's blood.
(What made the blood come out?)
The brick made....
(Is he happy or sad?)
Sad.
(Why?)
Cuz he hurt his foot. [C]

(C) (iii) The ball goes into the water and it makes a splash. [C]

Subject Number (5):

CAUSAL 1:
(C) (i) The ball is rolling down, bit more, bit more, it knocked down the tree. [C]
(C) (ii) The egg rolled along the table, it fell off the table and it cracked.
(Why did it crack?)
Because it fell down. [C]
(C) (iii) It blew up a bit more. Burst.
(What made it burst?)
The tree branch. [C]

CAUSAL 2:
(C) (i) The boy rolls his ball down. Splash.
(What makes it splash?)
It fell in the water. [C]
(C) (ii) The boy is walking. He trips. [D]
(C) (iii) Man fell over.
(What made the man fall over?)
The big ball. [C]

Subject Number (7):

CAUSAL 1:
(C) (i) The balloon popped because it had very sharp things on. [C]
(C) (ii) The egg rolled off here and went on here and it smashed. [D]
(C) (iii) (Nothing)

CAUSAL 2:
(C) (i) This was the story of a boy with a big boulder. Threw it up to here, then here, then it landed in the water. [D]
(C) (ii) The man is knocked over and hurt his foot.
(Is he happy or sad?)
Sad.
(Why is he sad?)
'Cause he's knocked over. He has to go to the hospital and have his foot in bandages. There's blood. [C]
(C) (iii) He was knocked over by the boulder. [C]

Subject Number (9):

CAUSAL 1 and 2:
(C) - No description - impatient.

Subject Number (10):

CAUSAL 1:
(C) (i) The tree falls over.
(Why?)
Because it got knocked over. [C]
(C) (ii) The balloon has popped.
(Why?)
It hit the sharp twigs. [C]
(C) (iii) The egg is broken on the floor. [D]

CAUSAL 2:
(C) (i) He tripped over and hurt his foot on the brick and he is crying. [C]
(C) (ii) The man got knocked over by the - what is this?
(A big rock)
A big rock. [C]
(C) (iii) Splash.
(What made the splash?)
The rock. [C]

Subject Number (15):

CAUSAL 1:
(C) (i) The egg's broken because it fell on the floor. [C]
(C) (ii) The rock knocked the tree over. [C]
(C) (iii) The balloon pops.
(Why?)
Because it hit the tree. No more balloon. [C]

CAUSAL 2:
(C) (i) The man was walking along. He tripped over the brick, and he cut his foot.
(Why did he cut his foot?)
Because of the brick. [C]
(C) (ii) The man is knocked over by the rock. [C]
(C) (iii) Here is a splash.
(Why?)
The rock fell in the water. [C]

Protocols of 7 Down's Syndrome Children:

Subject Number (10):

CAUSAL 1:
(1342) (i) It fell over. [D]
(1432) (ii) (Looks on floor for broken egg).
(C) (iii) It burst. [D]

CAUSAL 2:
(C) (i) -
(1423) (ii) Man fell over! [D]
(1432) (iii) Splashing in the water. [D]

Subject Number (13):

CAUSAL:
(1342) (i) The ball fall down the tree. [C]
(1243) (ii) The egg fell down.
(Why?)
Fell off the table. [C]
(1243) (iii) -

CAUSAL 2:
(1243) (i) He fall down.
(Why?)
Fell over that. [C]
(1432) (ii) -
(C) (iii) Splash in the water. [D]

Subject Number (8):

CAUSAL 1:
(1243) (i) It broke. [D]
(1423) (ii) It smashed. [D]
(1324) (iii) It burst. [D]

CAUSAL 2:
(1243) (i) He fell over. [D]
(1423) (ii) It knocked him over. [C]
(C) (iii) Splash. [D]

Subject Number (9):

CAUSAL 1:
(1243) (i) Tree fell down. [D]
(C) (ii) Crashed.
(Why?)
It fell on the floor. [D]
(1432) (iii) It burst! A bird made it burst! [C]

CAUSAL 2:
(1423) (i) Bleeding! He fell over on the brick and hurt his knee! [D]
(1342) (ii) He got knocked over. [D]
(1324) (iii) Splash. [D]

Subject Number (5):

CAUSAL 1:
(1432) (i) It fallen down. [D]
(1243) (ii) It spilled. [D]
(C) (iii) It popped.
(Why?)
Cuz it hit there. [C]

CAUSAL 2:
(1342) (i) -
(C) (ii) Fell over. [D]
(1324) (iii) Splash! [D]

Subject Number (6):

CAUSAL 1:
(C) (i) The ball made the tree fall down. [C]
(1243) (ii) It broke on the floor. [D]
(C) (iii) It popped.
(Why?)
Cuz it hit the tree. [C]

CAUSAL 2:
(C) (i) -
(1243) (ii) The ball fell down and the man fell down. [D]
(1324) (iii) It fell in the water. [D]

Subject Number (1):

CAUSAL 1:
(C) (i) -
(1342) (ii) Egg on floor. [D]
(Why?)
Fall down.
(C) (iii) Pop! [D]

CAUSAL 2:
(C) (i) He fell over the brick. [D]
(1324) (ii) -
(C) (iii) Splash in water. [D]

Protocols of 9 Normal children:

Subject Number (5):

CAUSAL 1:
(1342) (i) It smashed. [D]
(1432) (ii) It cracked.
(Why?)
Cuz it fell off the table. [C]
(What happened here?)
It fallin' off again.
(1324) (iii) It busted. [D]

CAUSAL 2:
(C) (i) He fell on his face. [D]
(1342) (ii) He got knocked down. [D]
(C) (iii) Splash! [D]

Subject Number (3):

CAUSAL 1:
(C) (i) It knocked over. [D]
(1432) (ii) The yoke came out. [D]
(1243) (iii) The balloon's bust.
(Why?)
Cuz it popped itself on the tree. [C]

CAUSAL 2:
(C) (i) Oh! Poor thing! Look! He's tripped over! [D]
(1324) (ii) He got knocked down cuz the ball went on his leg. [C]
(1423) (iii) It splashed! [D]

Subject Number (4):

CAUSAL 1:
(1423) (i) It breaked.
(Why?)
Cuz the rock knocked it. [C]
(1432) (ii) It smashed.
(What happened here?)
It got up on the table again! [D]
(C) (iii) It burst.
(Why?)
Cuz it hit the tree. [C]

CAUSAL 2:
(1423) (i) He fell down.
(Why?)
He got hit, didn't he. [C]
(1432) (ii) He tripped over the brick. [D]
(1423) (iii) Splash!
(What made the splash?)
Dunno. Here's another one coming. Splash! [D]

Subject Number (6):

CAUSAL 1:
(1342) (i) It knocked it over. [C]
(1324) (ii) It fell off the table. [D]
(C) (iii) It bust.
(What made it bust?)
The branch. [C]

CAUSAL 2:
(C) (i) He fell down.
(Why?)
Cuz he tripped over that thing. [C]
(1342) (ii) The ball rolled down there, and there, and knocked 'im down, and it's rolling down again. [C]
(1324) (iii) It splashed.
(Why?)
Cuz of the water. [D]

Subject Number (19):

CAUSAL 1:
(1324) (i) It smashed the tree. [C]
(1324) (ii) The egg smashed.
(Why?)
Cuz it fell off from here onto the floor. [C]
(C) (iii) Balloon bursted. [D]

CAUSAL 2:
(1423) (i) He falls over. He looks sad. [D]
(1423) (ii) The man fell over cuz the ball rolled him. [C]
(1432) (iii) It splashes in the water. [D]

Subject Number (12):

CAUSAL 1:
(1342) (i) -
(1432) (ii) -
(C) (iii) -

CAUSAL 2:
(1243) (i) He fell over, and he was dead. [D]
(1324) (ii) He got knocked down by that rock. [C]
(C) (iii) It splashed. [D]

Subject Number (10):

CAUSAL 1:
(1324) (i) It knocked down the tree. [C]

(1324) (ii) The egg broke.
(Why?)
It fell off the table. Someone must've pushed it. [C]
(1243) (iii) Here it popped, and now another one's coming along. [D]

CAUSAL 2:
(C) (i) He tripped over. [D]
(1432) (ii) He got knocked down by that black thing. [C]
(1342) (iii) It splashed in the water. [D]

(What's it doing there?)
Rolling down again.

Subject Number (9):

CAUSAL 1:
(C) (i) The tree got knocked over. [C]
(1324) (ii) The egg broke on the floor.
(Why?)
Because it fell off the table. [C]
(1324) (iii) The balloon popped when it flew up on the tree. [D]

CAUSAL 2:
(C) (i) He cut hi'self really hard. There's blood. [D]
(C) (ii) That man got knocked over. [C]
(C) (iii) It splashes. [D]

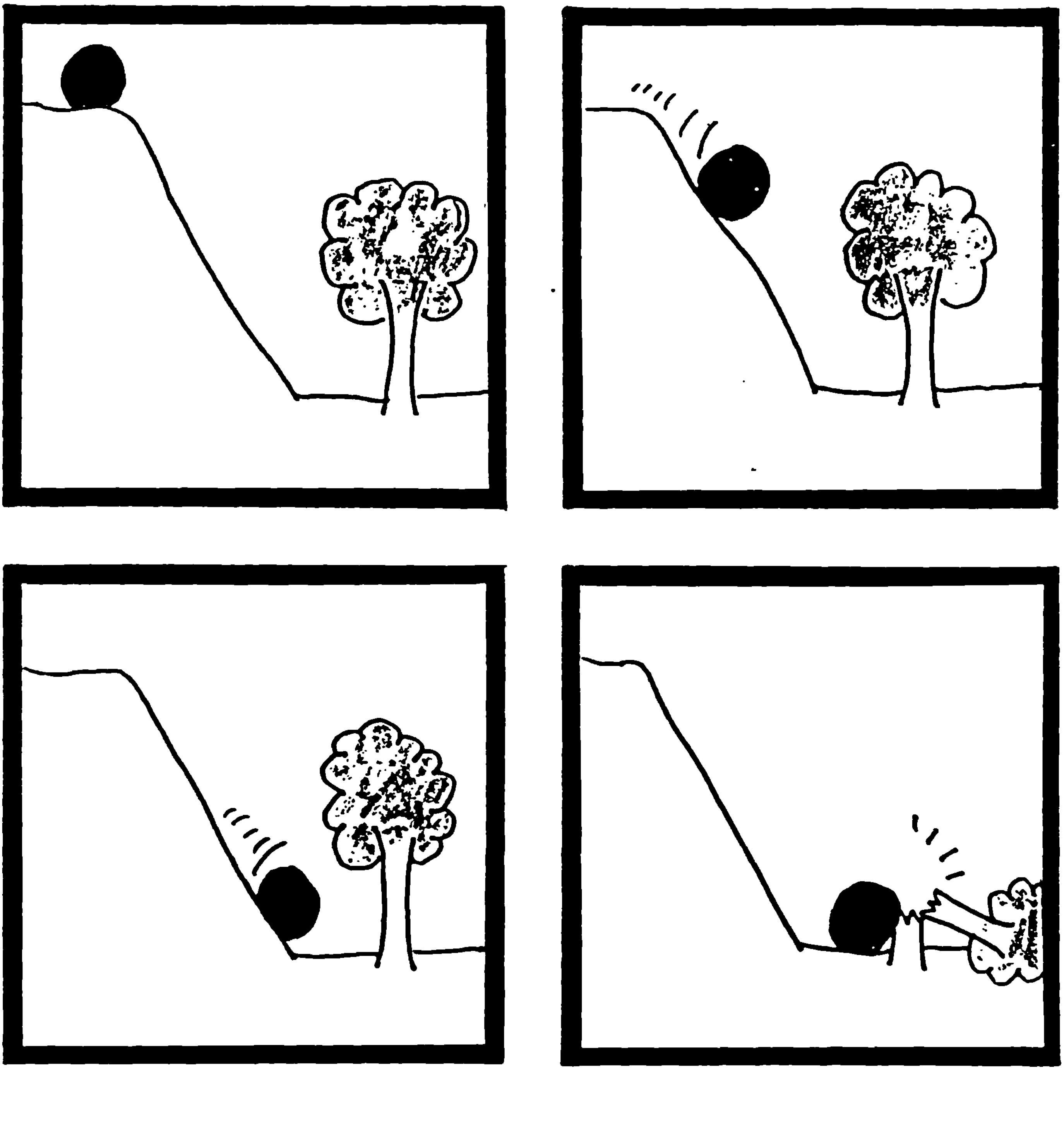
Subject Number (8):

CAUSAL 1:
(C) (i) It breaks the tree. [C]
(C) (ii) It smashed on the floor. [C]
(C) (iii) It burst on the branch. [C]

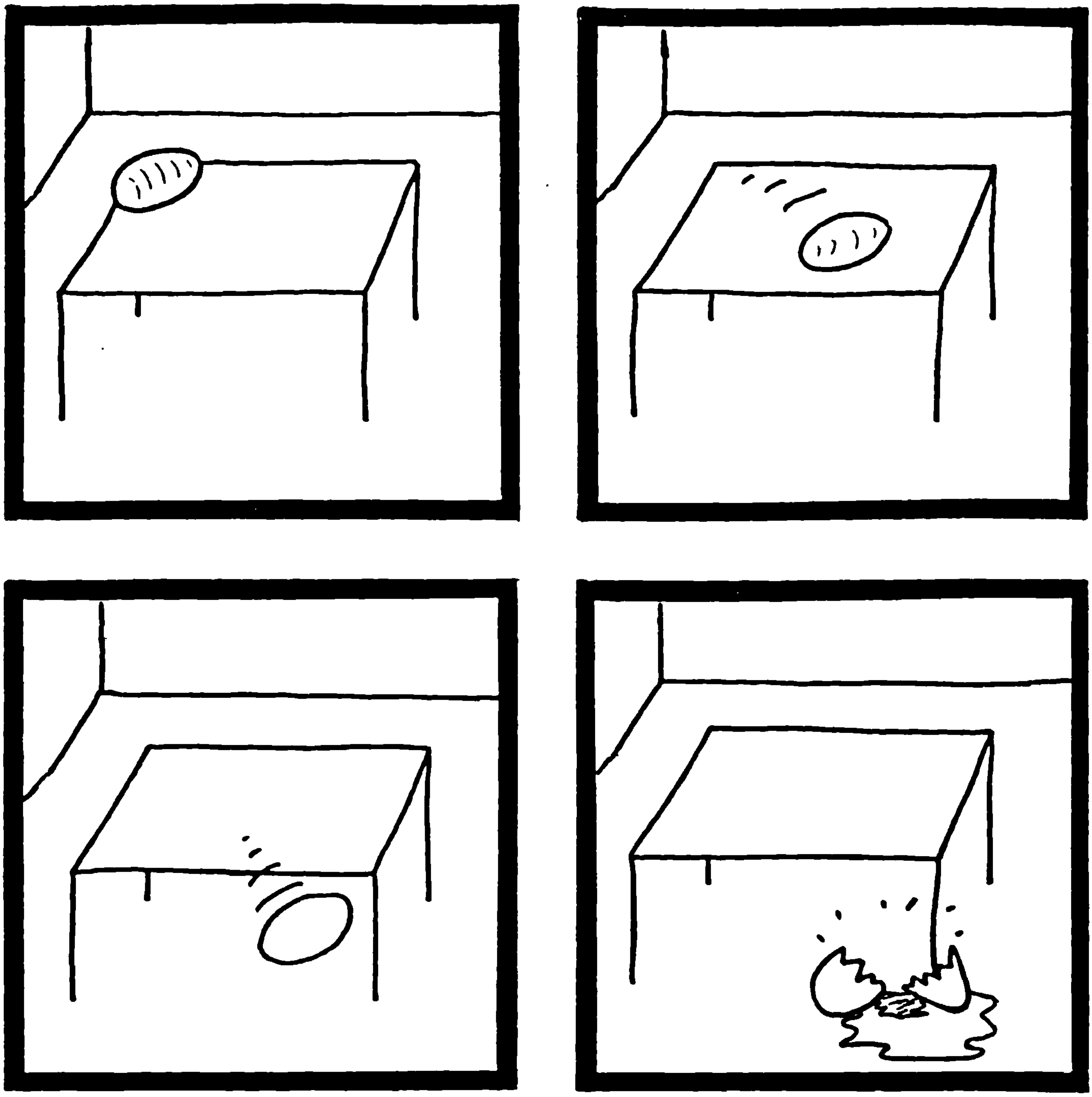
CAUSAL 2:
(C) (i) He's got blood. Someone left a brick. It's not nice. [D]
(C) (ii) He got knocked over. [D]
(C) (iii) It made a splash. [C]

Appendix 8: Pictures used in Experiment 5:

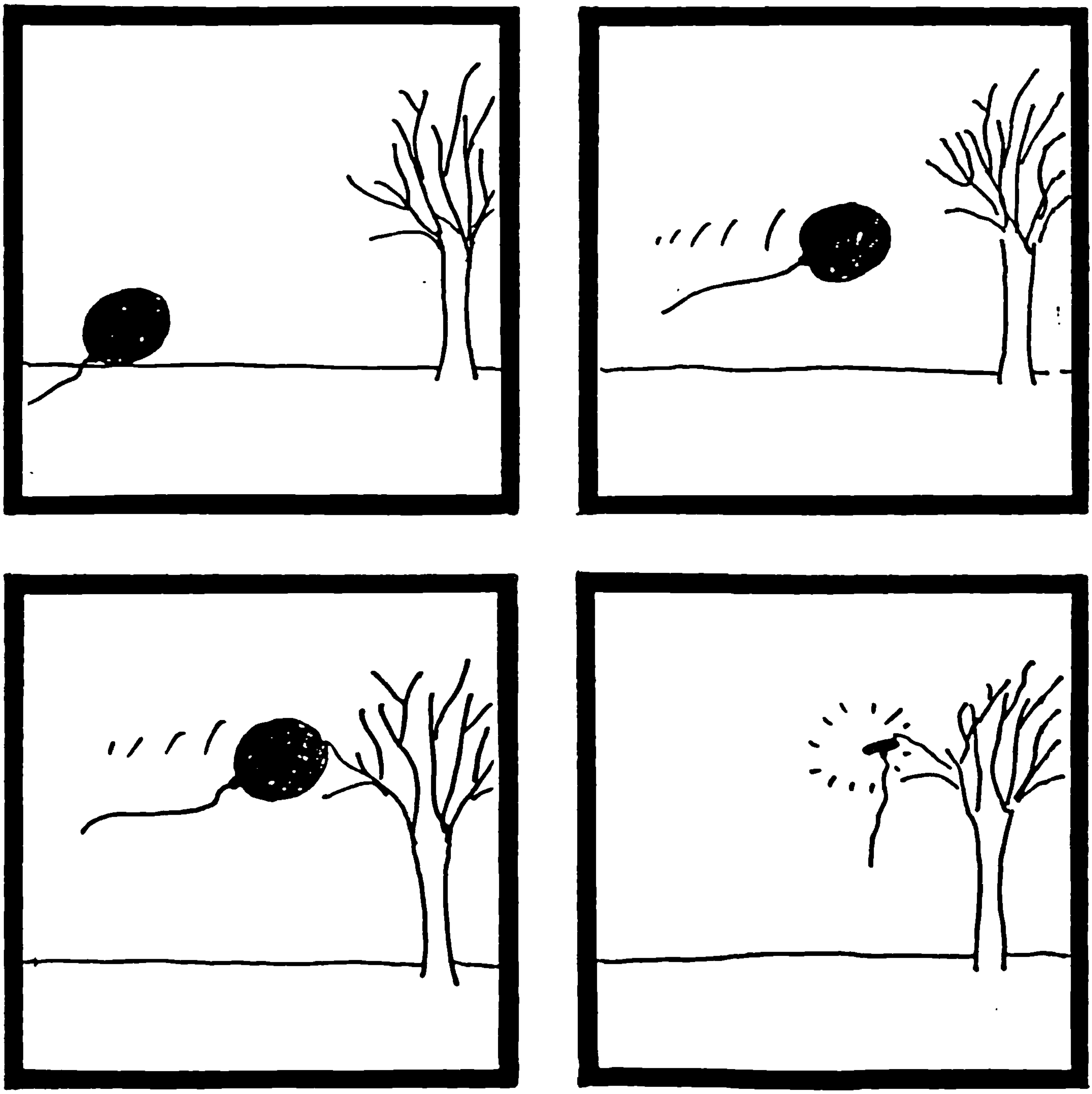
CAUSAL 1, STORY 1:



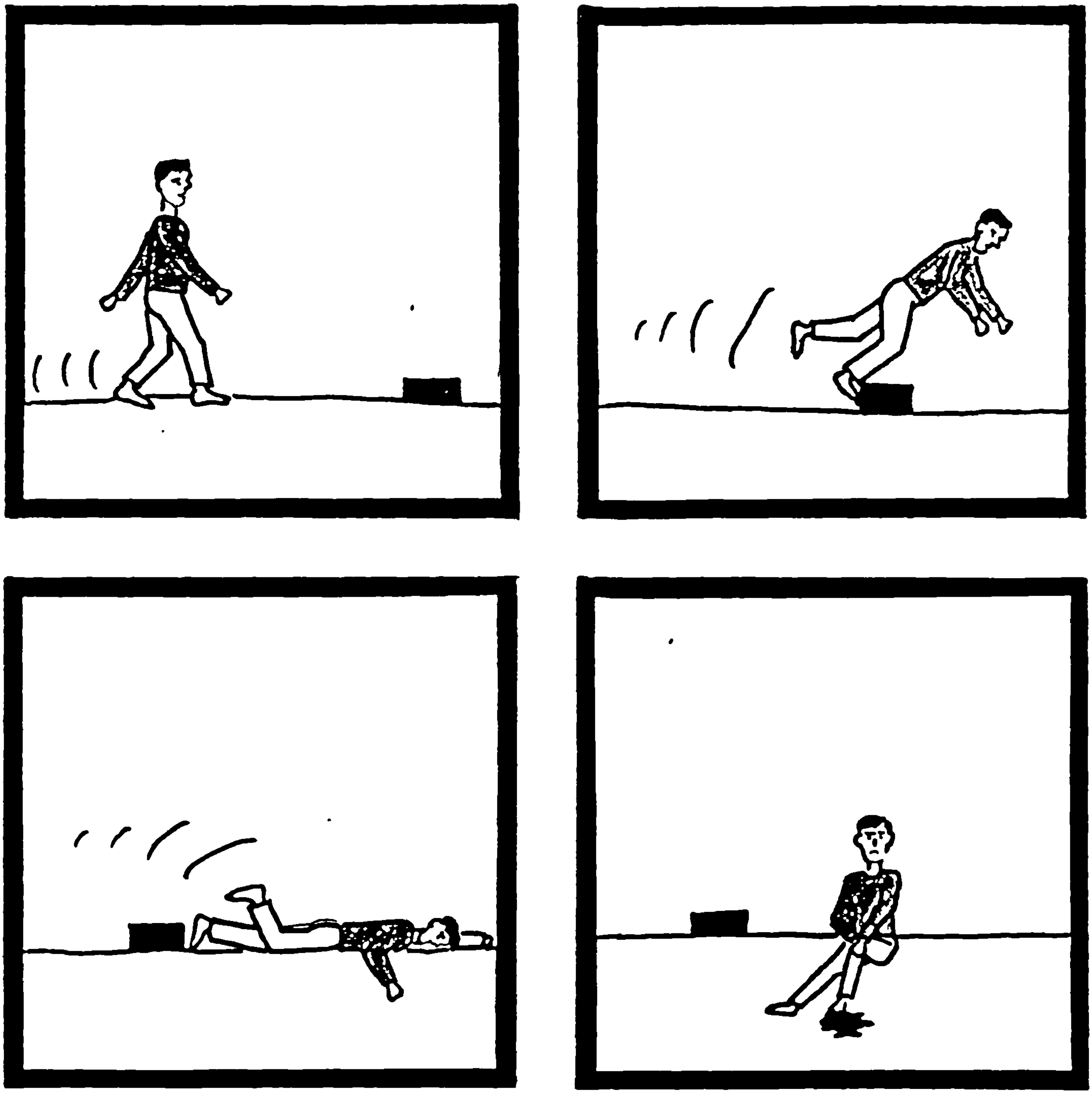
STORY 2:



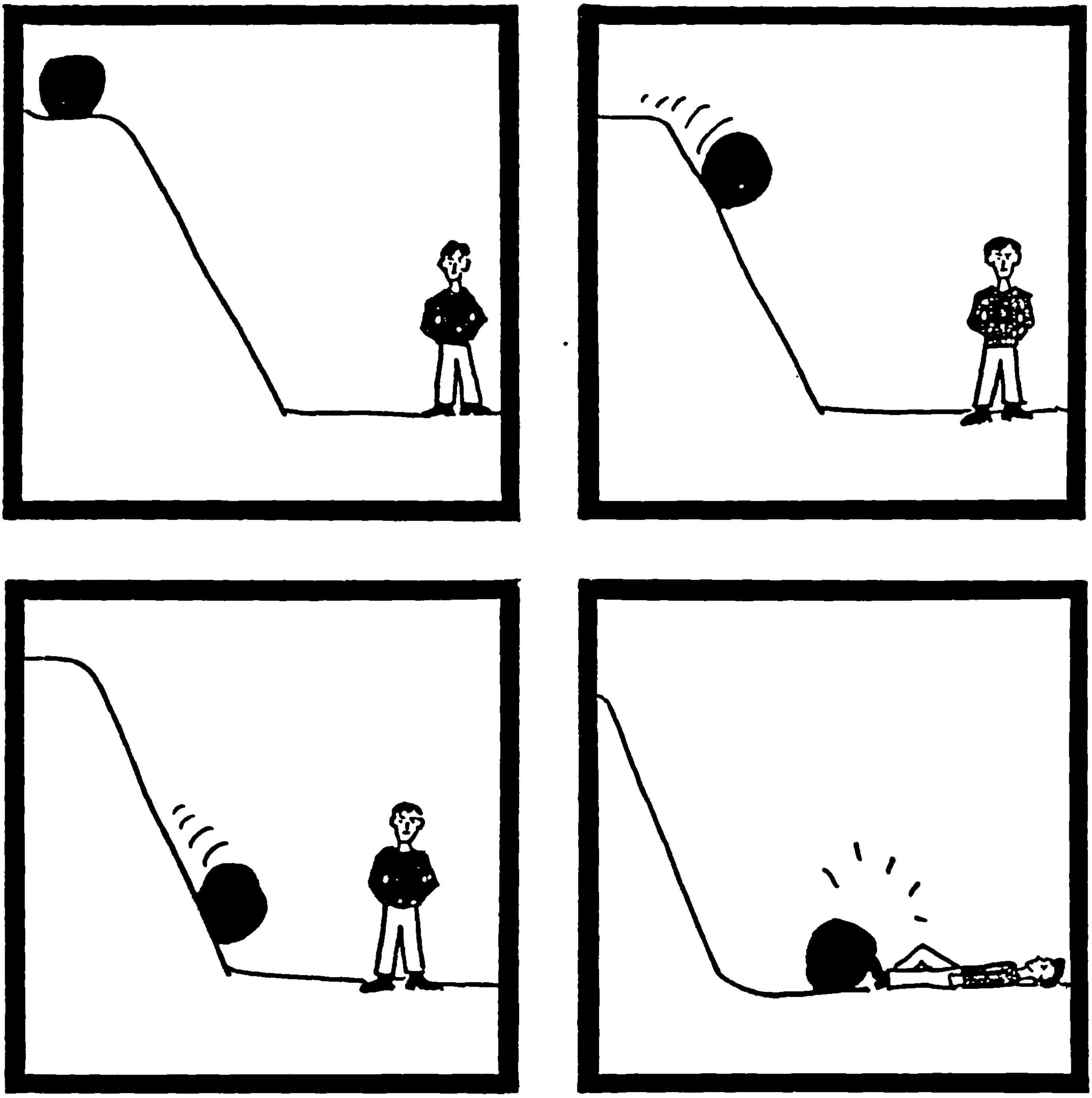
STORY 3:



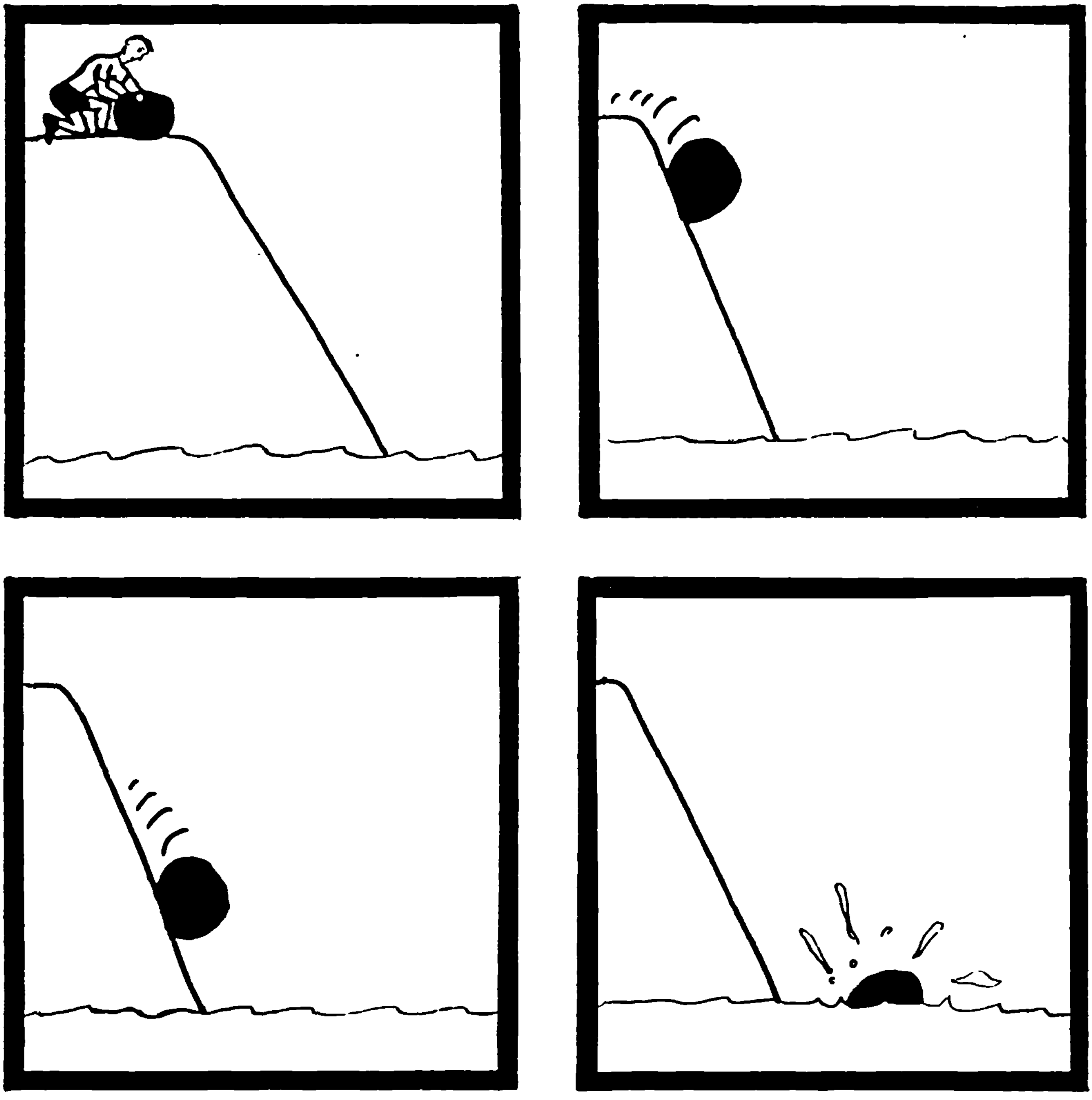
CAUSAL 2, STORY 1:



STORY 2:



STORY 3:



Appendix 9: Responses to Justification Question in the Village Experiment (6), [Trial 1 only].

Autistic Subjects:

Subject Number 2: "He knows the icecream-man is at the church".
7: "Cuz the van is at the church".
8: "He knows the icecream-van went to the church".
21: Nothing.

Down's Subjects:

7: "Cuz she don't know the icecream-man talked to him".
8: "She thinks he doesn't know it's at the church".
9: "Cuz she thinks he thinks it's still in the park!".
10: "Because she thinks he doesn't know the icecream-man is at the church".

APPENDIX 10: INSTANCES OF DIFFERENT BEHAVIOURS CLASSED INTO 4 CATEGORIES OF PLAY BY FIRST JUDGE.

Instances of different behaviours classed as pretend play by first judge.

Normal Subjects.

V = Very Sure.
Q = Quite Sure.
A = Ambiguous.

Subject 1:

[V] Puts sponge into saucepan, and saucepan into stove. Then takes it out.
[V] Transfers sponge into frying pan and dish.
[Q] Makes elephant walk/ slides elephant along.
[V] Makes mouse walk/ bounces mouse along.
[Q] Opens and closes crocodile's mouth.
[A] Makes frog jump/ lifts frog into air, glides it along, then places it down again.
[V] Lifts elephant over brick. Says "Elephant's jumping over there".
[V] Says "Bear is cuddling the cow". Puts cow into big bear's arms.

Subject 2:

[V] Makes animals hold hands. Says "They're playing".
[V] Points to sponge which she has placed in basket. Says "All the shopping".
[V] Puts saucepan with sponge into cooker. Then takes it out.
[V] Stirs sponge in dish. Says "I'm making dinner".
[V] Puts sponge in dish on stove. Says "If it's burned I'll have to run away!"
[V] Says "Quick! Take the food off before it burns!"
[A] Stands the dolls by the stove and says "2 children".
[V] Bounces frog up and down. Says "Frogs don't walk, they always bounce".
[V] Puts snake inside crocodile's mouth. Says "He's eating the snake!"
[V] Makes hissing/ snake sound.
[V] Says "It's gobbled 'im up. It's bit his head off. It's gonna go all down his throat. Oh look! He ate himself! (Makes eating noises). Look! The snake went round my arm! Silly sausage!"
[V] Piles bricks up. Says "It's a train hole. That's where the train comes through and that's the long thing where the train trackles".
[V] Makes crocodile knock bricks over.
[V] Says "He's knocked it over. I'm gonna squeeze him on the bum-bum!" (Hits crocodile on the back). Says "I'm gonna smack him cuz he destroyed my new thingy. I'll gobble him up!" (Bites crocodile).
[V] Laughs. Says "I'm only pretending! I'll bite his tail off!"
[V] Says "I'll chop his tail off and his mouth off!" (Uses brick to cut crocodile/ as a knife). Says "All that's left is his tail and his legs". Uses brick as a knife. Says "Cut".

Subject 3:

[Q] Holds 2 dolls face to face and touches their faces to eachother. Says "Kissing".
[A] Stirs spoon in empty basket.

Subject 4:

[V] Holds doll and dish with sponge, and places dish onto stove.
[V] Makes doll walk over to stove.
[V] Says "This is Lucy". Walks doll over to telephone.
[V] Holds telephone to doll's ear.
[V] Doll opens oven door, then removes dishes from top of cooker.
[V] Doll lays out 3 dishes on table.
[V] Doll puts new dish into oven.
[V] Makes frog jump up, glide in air, and land, then walk along table.
[V] Makes crocodile walk.
[V] Then makes frog walk.
[V] Then makes mouse walks along.
[V] Piles up bricks. Says "Castle".
[V] Points. Says "Horses live inside there".

Subject 5:

[V] Puts sponge in dish in cooker.
[V] Says "I'm cooking".
[A] Stands the 2 dolls in front of the stove.
[V] Then holds telephone receiver to doll's ear. Rings phone and dials it.
[V] Says "It's my mummy! Now I'm gonna talk to my dad". (Does so).
[V] Opens door of cooker. Takes out dish. Shows experimenter contents.
[V] Says "It hasn't finished yet".
[V] Makes elephant walk.
[V] Makes crocodile eat elephant.
[V] Says "It's cutting its trunk".
[V] Then makes crocodile eat a brick.
[V] Says "He's eating his dinner".
[V] Then says "He gonna eat him next".
[V] Makes crocodile eat snake. Says "You're gonna die".
[V] Makes eating noises.
[V] Bounces frog along.
[V] Bounces bear over to frog.

Subject 6:

[V] Puts sponge in saucepan and saucepan on stove.
[V] Says "It's food".

Subject 7:

[V] Puts sponge in saucepan on stove.
[V] Turns dial on stove. Stirs 'food' with spoon.
[V] Puts lid on saucepan. Puts another dish of "food" in the oven.
[V] Says "I'm making sausages and bakebeans".
[V] Transfers sponge between 2 dishes on stove.
[V] Says "Simon. This is a pancake. It's for you".
[V] Transfers 'food' into 2 dishes, one infront of each doll.
[V] Puts sponge in dish on stove again and says "These ones aren't cooked alright". Puts lid on saucepan.
[Q] Takes 'food' off stove.
[V] Rings phone. Picks it up. Says "Who is it? Oh, alright. When will you come?" Then hangs up. Says "That was Elsie on the phone.

When I said 'Who is it?' she didn't answer. Then I asked her again and she said she'll come when she's dressed James".
[V] Says "There's one zoo and one hill. And the bear is the biggest of all of them and he lives in Hertford and it's a really big zoo cuz it's in China, in Oxford, everywhere, in India, in Hongkong, and the bear's over here and the zoo's right over there".
[V] Says "He lives there and all the houses only come up to here (uses brick as house) - so he's the biggest of all the animals and all the giants. The giants are only about up to here".
[V] Traces an imaginary line half way up the bear. Says "And god's only about up to here (traces another line with hand).
[V] Says "And I'm making a whole big zoo. How can I make such a big one? There's not enough bricks to make it so big. And you know what? It's gonna be a really big house. This is <u>his</u> big house".
[V] Says "The house is up to there and there (uses bricks, piles them up).
[V] Says "This is the bear's chair and you have to be really careful with it cuz it's really precious".
[V] Says "So he's sitting on his little chair".
[V] Makes frog jump on elephant, then on phone.
[V] Announces "Now I'm gonna make the zoo".

Subject 8:

[V] Puts individual bits of sponge in stove. Turns dials.
[V] Puts dishes with sponge into stove.
[A] Has dolls standing up, watching(?).
[V] Pours sponge from dish to basket to box.

Subject 9:

[Q] Moves crocodile along.
[V] Makes crocodile bite elephant's trunk.
[V] Makes frog bite elephant's trunk.
[V] Makes frog bite mouse's leg.
[V] Makes crocodile bite frog's head.
[V] Makes crocodile bite elephant's head. Says "He's eating them all up!"
[V] Animates frog. Repeats.
[V] Crocodile eats frog's leg, then head again, then snake.
[V] Puts sponge into saucepan and saucepan into stove.
[V] Takes it out and transfers 'food' to dish.
[V] Puts 'food' on stove.
[V] Transfers it into another saucepan and into the oven.
[V] Says "I'm making a cake".
[V] Puts 'food' into basket and then into another saucepan.

Subject 10:

[V] Makes crocodile eat snake.
[V] Pretend eating noises.
[Q] Says "He's got a big long tail".
[V] Walks snake. Makes hissing noises and then eating noises.
[V] Builds with bricks. Says "This is the thing where the snakes lives".
[V] Makes cow noises, snake noises.
[V] Makes a tower of bricks. Says "Look at this chimney. The snake knocked down the chimney".

[V] Makes crocodile eat snake. Says "He bited his tongue, look!"
[V] Pretend eating noises.
[V] Makes snake eat bear.
[V] Makes bear eat snake.
[V] Puts sponge in pan on stove, and in stove.
[V] Says "I'm gonna cook her" - puts doll in oven.
[V] Puts food in oven. Says "Ouch! It burned me!"
[V] Says "I'm making everything". Turns dials.
[V] Takes food out and says "Mmm!"

Down's Syndrome Subjects:

Subject 1:

[V] Makes doll put sponge in dish.
[V] Makes doll put dish in oven.
[Q] Tells doll off - smacks doll's hand.
[V] Stirs sponge with spoon in dish.
[V] Transfers sponge from one dish to another.
[A] Hits doll on head with dish, aggressively.
[Q] Makes snake and mouse fight.
[Q] Has extended talk into telephone receiver, modulated intonation, says "Mummy" and "Goodbye mummy".

Subject 2:

[Q] Makes doll put dish in oven.
[V] Opens the door. Says "No ready".
[V] Says "A pie in the oven. Mummy's cooking in the oven".
[V] Says "Take the pie out of the oven". Points to food.
[A] Rings phone. Listens in receiver. Replaces receiver and makes gesture (hands inverted, ie: "Noone's there").
[Q] Says "Snake" - then pushes snake along.
[V] Makes hissing noise.

Subject 3:

[V] Puts saucepan with sponge on stove.
[V] Puts sponge from brown container in basket. Puts basket on doll's arm.
[V] Transfers basket sponge to saucepan and puts the saucepan into oven and closes door. Sets dials and says "4 hours".
[V] Stirs sponge with spoon, repeatedly.
[V] Then puts it back on stove and then serves it into a dish.
[V] Animates snake and crocodile and elephant.
[V] Makes hissing sound with snake. Prolonged hissing.
[V] Makes mouse noises.
[V] Opens crocodile's jaws and makes eating noises.
[V] Says "I'm gonna eat you!" Says "Elephant says 'Oooh!'"
[V] Wraps snake around elephant's throat.
[V] Makes elephant scream and run away. Snake hisses.
[V] Makes snake attack crocodile.
[A] Makes snake move along a row of bricks.
[V] Piles up bricks. Says "It's a house!"
[V] Makes crocodile bite snake. Says "Oh! Help!" then says "Ouch! Ouch! You won't bash me never again".

Subject 4:

[V] Stirs empty dish, transfers imaginary food on spoon from one dish to another.
[V] Puts dish with sponge in it in oven.
[V] Takes it out again.
[V] Makes mouse walk along.
[V] Animates bear.
[V] Makes snake slide along floor. Wriggles it. Says "Look at the snake".
[Q] Says to the crocodile "Come on, don't be stupid. Good girl". (Could be self-referenced).
[V] Makes frog and crocodile bite the mouse.
[Q] Puts finger inside crocodile's mouth, then looks hurt.

Subject 5:

[V] Puts sponge into dish.
[V] Puts dish with sponge inside into oven.
[V] Transfers invisible 'food' from brown dish to pan with spoon.
[V] Stirs sponges.
[V] Says "I'm making dinner: sausages".
[V] Takes 'food' out of oven. Stirs it with spoon.
[V] Says "Sausages. It's hot. It's hot".
[V] Puts them in another saucepan, and then back into oven.
[V] Says "Right. Turn it on". (Turns dials). Says "That's it. (Opens door). Hot dinner". Takes it out.
[V] Says "Don't eat it", while making the crocodile eat the brick.
[V] Lines up bricks. Says "Building". Knocks it down. Laughs.
[V] Holds the snake at arms length. Says "It's frightening me!" (Doesn't look frightened).

Subject 6:

[A] Puts sponge on doll's mouth.
[V] Puts doll in large container. Then feeds doll with spoon, from dish. Repeats this.
[A] Puts brick in crocodile's mouth.
[A] Makes frog walk/jump.

Subject 7:

[Q] Makes elephant walk.
[V] Makes crocodile walk.
[Q] Makes animal noise.
[V] Wriggles snake.
[V] Makes crocodile bite snake.
[V] Makes snake wrap around crocodile.
[V] Makes frog jump.
[V] Stirs sponge with spoon in dish.
[V] Transfers it to dish and puts it in oven. Closes door. Turns dials. Puts 2 other pans on top of cooker.
[Q] Opens door and puts another inside. (Can't see sponge).
[V] Takes food out and says "Dinner".
[V] Sits 2 dolls down and serves it with spoon into each one's plate.
[V] Then serves doll (spoon to doll's mouth).
[V] Transfers sponge to box. Stirs it.

Subject 8:

[V] Puts dish with sponge into stove. Says "I've done it. Bye-Bye". Closes door.
[V] Takes 'food' out and says "Tastes good!". Puts 'food' on spoon and then 'food' back in oven.
[V] Pretends to eat from empty dish with spoon.
[V] Transfers 'food' into another dish with spoon and puts it into stove.
[Q] Makes frog jump.
[V] Makes elephant walk.
[V] Makes crocodile noises.
[V] Makes cow noises.

<u>Autistic Subjects.</u>

Subject 1:

[A] Puts toy spoon in mouth.
[A] Bangs toy spoon against inside of empty dish (stirring?).
[A] Puts toy saucepan to her mouth.

Subject 2:

[A] Touches sponge. Sniffs it. Does not use it for cooking or feeding.
[A] Names toy frog. Then bounces it up and down on table. (However, this could be to make it 'squeak').

Subject 3:

[Q] Says "Don't touch it . It's hot" (pointing to stove - could be echolalia?).
[A] Smells sponge.
[V] Puts sponge on saucepan, and puts this into the oven.
[V] Says "Cooking pancakes".
[Q] Repeats "Don't touch it. It's hot". Opens door. Turns dials on stove. Says "1,2,3,4,5".
[V] Takes 'food' out of oven.
[Q] Smells it. Says "Ready frying pan".
[V] Puts more sponge into another pan.
[V] Puts this ontop of cooker.

Subject 4:

[V] Says "The 2 (rings) are red. They're on".
[A] Says "You can put sponge in the oven".
[Q] Says "Are these potatoes? I don't know. They might be peas".
[V] Puts pans with sponges on stove.
[V] <u>Mimes</u> rolling out pancakes, then puts them in the oven.

<u>Instances of different behaviours classed as functional play by first judge.</u>

<u>Normal Subjects:</u>

Subject 1:

[V] Puts hat on playperson's head.
[V] Puts man into swing.
[V] Sits playpeople on bench.
[V] Swings playperson back and forth.
[V] Puts hat on another playperson's head.
[V] Says "That's a mouse", touching the mouse.

Subject 2:

[V] Puts people in swing.
[V] Puts people sitting on bench.
[V] Makes person climb ladder.
[V] Puts hat on playperson.
[V] Swings people in swing.
[V] Names spoon.
[V] Makes phone ring. Picks up receiver and says "Hello".

Subject 3:

[V] Puts playpeople into swing and pushes it back and forth.
[V] Puts hat on playperson.
[V] Sits playperson on bench.
[V] Stands dolls up, facing eachother.

Subject 4:

[V] Turns dials on stove.
[V] Puts playpeople into swing.
[V] Attaches another person to trapeze.
[V] Sits one person on bench.
[V] Makes another climb ontop of climbing frame and jump down.
[V] Swings the trapeze back and forth.

Subject 5:

[V] Swings playpeople.
[V] Places 3 playpeople on bench. Sits 2 others on table and floor. Says "I've finished".
[V] Sits people around the swing.
[V] Dials telephone.

Subject 6:

[V] Rings phone and holds to ear.
[V] Stands mouse up on table.
[V] Puts people in swing and pushes it.
[V] Stands people up on table.
[V] Puts another person in swing and pushes it.
[V] Sits the largest person on the bench.

Subject 7:

[V] Stands up 2 dolls on table.
[V] Sits 2 dolls down on table.
[V] Puts people on climbing frame.
[V] Attaches man to climbing frame.
[V] Swings him back and forth.
[V] Puts people in swing and swings it.

Subject 8:

[V] Holds telephone receiver to ear.
[V] Turns dials on stove.
[V] Puts people into swing.
[V] Names animals. Says "Snakes go in water. That goes in a farm. That goes in the water".
[A] Asks "Why does it need that?" (Pointing to frog's mouth).

Subject 9:

[V] Swings playpeople.
[V] Puts hat on playperson.
[V] Sits person on bench.
[V] Swings it again.

Subject 10:

[V] Swings playperson.
[V] Makes a playperson climb up the ladder and jump off.
[V] Sits playpeople on bench.
[V] Puts hat on playperson.
[V] Makes another playperson climb up ladder.
[V] Dials phone.
[V] Rings phone.

Down's Subjects:

Subject 1:

[V] Picks up and replaces telephone receiver.
[V] Puts empty dish on stove.
[V] Puts playpeople on swing and rocks them back and forth.
[V] Stands playperson on bench.

Subject 2:

[A] Feeds himself bits of sponge (not pretend because he appears to think it is really is edible).
[V] Speaks into telephone receiver.

Subject 3:

[V] Opens door of oven.
[V] Makes phone ring.
[V] Puts 2 playpeople in swing. Pushes it back and forth.
[V] Puts playpeople on bench.

Subject 4:

[V] Swings playpeople.
[V] Sits playpeople on bench.
[V] Makes playperson climb up ladder. Says "Climbing up".
[V] Tries to attach playperson to trapeze (unsuccessfully).
[V] Puts hat on playperson's head.
[V] Rings telephone and dials it. Holds receiver to ear.
[V] Says "2 arms and 2 legs" (describing crocodile).

Subject 5:

[V] Rings telephone and smiles repeatedly.
[V] Puts empty saucepan in oven.
[V] Puts doll in oven. Takes her out again.
[V] Puts empty dish in oven.
[V] Puts playperson in swing and swings it.
[V] Stands person on bench and says "Standing on the chair".
[V] Repeats this with a second play person.
[V] Stands person next to swing and says "Push the swing. Push". Repeats.

Subject 6:

[V] Rings phone. Holds receiver to her ear.
[V] Dials phone. Hangs up.
[V] Rings phone again. Picks it up. Says "Hello". Rings it again. Says "Look, it's ringing".
[V] Names bear.
[V] Puts people in swing and swings it. Says "Different toys. Swings".
[V] Puts people on bench, sitting.
[V] Stands people up on table.
[V] Puts toy hat on her head.

Subject 7:

[V] Puts heater rings on stove.
[V] Picks up phone, mumbles into receiver, and hangs up.
[Q] Tries to undress doll.
[V] Turns dials on stove.
[V] 'Talks' into phone again.
[A] Opens stove door and closes it again.
[V] Swings people.
[V] Makes a person walk on top of climbing frame.

Subject 8:

[V] Swings playperson.
[V] Sits playperson on bench.
[V] Attaches playperson to trapeze.
[V] Stands playpeople up on table and bench.
[V] Rings phone.
[V] Dials phone.
[V] Says "Hello. See you later. Bye-Bye".

Subject 9:

[V] Names spoon.
[V] Puts phone receiver to ear and says "Listen".
[V] Dials phone and talks into it.
[V] Rings phone.
[V] Names cow.
[V] Sits people on bench.
[V] Attaches man to trapeze and swings him.
[A] Puts bench on climbing frame.
[V] Swings people in swing.
[V] Sits man on bench. Pats man on head.

Autistic Subjects:

Subject 1:

[V] Turns dials on stove.
[V] Opens and closes door of stove.
[V] Inserts tray into oven.
[V] Holds telephone to ear. Dials telephone.
[V] Opens draw of cooker.
[V] Makes telephone ring repeatedly.

Subject 2:

[V] Puts heater rings in position on stove.
[V] Dials phone. Rings it. Holds receiver to ear.
[V] Opens door of oven.
[V] 'Mouths' silently into receiver of phone.
[V] Fits lids to saucepans, trying out different sized lids and bases.
[V] Names frog, crocodile.
[V] Puts 3 playpeople sitting on bench.
[V] Attaches playperson to trapeze. Swing it back and forth.
[V] Puts playperson into swing. Swings it.

Subject 3:

[V] Swings playpeople on swing.

Subject 4:

[A] Picks up both dolls, stands them up.
[A] Moves their limbs as if exploring their properties.
[V] Puts playpeople on swing. Swings it.
[V] Makes a playperson climb up on climbing frame. Says "Climb up. Swing".
[A] Examines little man. Moves its legs, arms, bends it/ explores it.
[V] Swings man again. Vocalizing throughout, not clearly.
[V] Repeats "Up, swing".

Subject 5:

[V] Dials phone.
[V] Replaces receiver.

Subject 6:

[V] Puts heater rings into stove, correctly.

Subject 7:

[A] Tries to eat sponge. (Not pretend).

Subject 8:

[V] Puts person in swing. Says "Sit down on swing".
[V] Swings it back and forth. Says "Oh! Falling down."
[V] Sings "All sitting on a swing".
[V] Names crocodile, snake, elephant, and frog.
[V] Puts saucepan into stove.
[V] Names cooker.
[V] Names oven.
[V] Rings phone.

Subject 9:

[V] Names animals.
[V] Says "Hello bear".
[V] Says "He's a nice bear".
[V] Makes man walk over climbing frame. Says "You'll hurt yourself if you do that".
[V] Swings playpeople.
[V] Asks "Where's the seat for here?"
[V] Makes the man walk up the ladder.

<u>Instances of different behaviours classed as sensorimotor play by first judge.</u>

<u>Normal subjects:</u>

Subject 1:

[V] Squeaks frog.

Subject 2:

[V] Tries to squeak mouse.

Subject 3:

[V] Touches snake's and crocodile's tails.
[Q] Picks up cow and puts it down again.

Subject 4:

[V] Plays with string.
[V] Handles all the materials, but talking about TV throughout.

<u>Down's Syndrome:</u>

Subject 1:

[V] Bangs saucepan on table repeatedly.

[V] Throws brick on floor.
[V] Flicks crocodile's tail back and forth.
[V] Flicks snake's tail back and forth.

Subject 2:

[V] Throws bricks on floor.
[V] Bangs animals on table.
[V] Empties rest of bricks on floor.
[V] Throws sponge on floor.
[V] Throws telephone on floor.

Subject 3:

[V] Squeezes frog to make it squeak.
[V] Pushes empty swing back and forth.

Subject 4:

[V] Squeaks the frog.

Subject 5:

[V] Bangs bricks on table, repeatedly.
[V] Squeaks frog.

Subject 6:

[V] Bangs climbing frame on table.
[V] Pushes swing without people in it.
[V] Turns frame upside down and bangs it repeatedly.
[V] Vocalizes/ grunts.
[V] Feels texture of soft bear.
[V] Picks up mouse and puts it down again.
[V] Empties bricks onto table.
[V] Fingers elephant.
[V] Bangs elephant on table.
[V] Picks up telephone and puts it down again.
[Q] Opens and closes cooker door.
[V] Rattles saucepan on table.
[V] Holds up oven tray to light.
[V] Hits oven tray on stove, repeatedly.
[V] Taps oven tray with fingertips.

Subject 7:

[V] Bangs saucepan on table a few times.
[A] Bangs animal on table.
[V] Stands bricks up.
[V] Makes frog squeak.

Subject 8:

[V] Throws bricks on floor.
[V] Empties rest of bricks onto table.
[A] Kisses mouse.

<u>Autistic subjects:</u>

Subject 1:

[V] Sucks saucepan, and heater ring.
[V] Rotates saucepan against metal dish between index finger and thumb, to make clattering sounds. Repeatedly.
[V] Rotates saucepan against back of stove for auditory effect. Repeatedly.
[V] Sucks crocodile's tail.
[V] Rotates mouse's tail in the same manner. Sings at same time.
[V] Sucks snake.
[V] Drops climbing frame on floor.

Subject 2:

[V] Pushes swing back and forth, without playperson, not necessarily as a swing but as a pendulum.

Subject 3:

[V] Feels doll's hair, then puts it down again.

Subject 4:

[V] Rotates top of saucepan round and round.
[V] Bangs bricks on table.
[V] Sucks bricks.

Subject 5:

[V] Puts saucepan in mouth.
[V] Bangs it on table, then against fingertips.
[V] Bounces saucepan against wall.
[V] Juggles with saucepan and basket.
[V] Sucks everything.
[V] Bites doll's foot.
[V] Taps tray from stove.
[V] Taps door of stove.
[V] Bites crocodile, spins it.
[V] Juggles with mouse and frog.
[V] Spins mouse in circles, and same with snake.
[V] Juggles with bricks.
[V] Squeaks frog.
[V] Bites frog.
[V] Bites elephant.
[V] Juggles with playpeople.
[V] Taps climbing frame repeatedly.
[V] Sucks playpeople.

Subject 6:

[Q] Licks dish.
[V] Bites phone cord.
[V] Bites basket. Bangs it on phone. Repeatedly.
[V] Dangles phone by wire off table.
[V] Stretches cord and bangs phone on table.
[V] Dismantles stove and bangs it on table.

[V] Puts mouse's tail into his mouth.
[V] Bites frog's head.
[V] Licks cow.
[V] Licks brick.
[V] Bites elephant's trunk.
[V] Feels texture of bear's fur against face.
[V] Bites elephant's foot.
[V] Licks crocodile's tail.
[V] Swings seat back and forth as pendulum.
[V] Sucks playperson.
[V] Throws playperson.
[V] Bangs climbing frame on table.
[V] Twists head of playperson round and round.

Subject 7:

[V] Puts bricks into bag and then empties them onto table again.
[V] Shakes crocodile.
[Q] Puts all the bricks back into the bag again. Makes strange noises.
[V] Pulls crocodile's tail.
[V] Bites crocodile's tail.
[V] Dangles phone by cord, off table.

Subject 8:

[V] Bangs doll on floor, repeatedly.
[Q] Bangs spoon inside dish.
[V] Buries face in bear's soft fur.
[V] Flicks crocodile's tail.
[V] Bites crocodile's tail.
[V] Bangs crocodile's tail on table.
[V] Bangs snake on floor.
[V] Stretches snake.
[V] Pushes swing back and forth without people in it.
[V] Bites swing.

Subject 9:

[V] Touches snake with lips.

Subject 10:

[V] Looks inside phone to see what makes it ring.
[V] Squeaks frog.
[A] Names colours on frog.

<u>Instances of behaviour classed as ordering by first judge.</u>

<u>Normal Subjects:</u>

Subject 1:

[V] Puts all the saucepans in the basket.

Subject 2:

[V] Piles up 6 bricks into a wall-like structure (2x3 bricks).

Doesn't say what it is. Then makes it even bigger.

Subject 3:

[V] Piles up bricks.

Subject 4:

[V] Compares his own size to bear's size.

Down's Syndrome Subjects:

Subject 1:

[V] Makes a 'tower' of bricks.

Subject 2:

[V] Makes a 'wall' of bricks.

Autistic Subjects:

Subject 1:

[V] Puts the 2 saucepans into the brown box.

Subject 2:

[Q] Lifts up every object on table and sets them down again.
[Q] Makes a series of structures in a 'stone-henge' shape, all identical, with the bricks.

Subject 3:

[V] Puts all the saucepans in the brown dish. Drops bits of sponge into the dish, but does not treat it as food.
[V] Piles up bricks into a 4 brick structure, then knocks it down.
[V] Lays out all the bricks onto the table, in a pattern, unconnected.

Subject 4:

[V] Stands all the people in a straight line. Knocks them over. Repeats.

Subject 5:

[V] Lines up all the animals.
[V] Puts bricks next to each animal.
[V] Names the colours of the bricks, then counts them.

Appendix 11: Individual subject data for Experiment 7:

Number	Initial	CA	IQ	MA	BPVT	Sex
Autistic Subjects:						
1	A	6:8	35	2:4	2:0	M
2	N	6:9	42	2:10	2:0	F
3	P	5:3	48	2:6	-	M
4	B	6:8	40	2:0	1:8	M
5	M	9:8	106	10:2	4:3	M
6	A	7:4	94	7:2	2:8	M
7	J	10:5	35	2:6	-	M
8	C	4:3	50	3:0	2:0	F
9	L	12:5	63	7:10	3:5	F
10	C	11:7	37	4:4	-	M
Down's Subjects:						
1	J	3:9	78	2:11	1:8	M
2	D	12:2	48	5:6	2:10	F
3	S	11:9	30	2:0	1:8	M
4	K	9:2	30	2:0	-	M
5	N	7:10	66	5:3	3:1	F
6	B	6:3	89	5:7	2:4	F
7	R	7:5	78	5:9	2:6	M
8	D	2:6	65	1:9	-	M
9	T	7:5	72	5:4	3:8	F
10	S	6:7	35	2:4	-	F
Normal Subjects:						
1	R	3:0				M
2	T	4:8				M
3	J	5:1				M
4	L	3:3				F
5	T	4:8				F
6	T	3:10				F
7	N	4:5				M
8	J	4:4				M
9	A	4:7				M
10	P	3:8				M