

Infants With Autism: An Investigation of Empathy, Pretend Play, Joint Attention, and Imitation

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Systematic studies of infants with autism have not been previously carried out. Taking advantage of a new prospective screening instrument for autism in infancy (S. Baron-Cohen et al., 1996), the present study found that, compared with developmentally delayed and normally developing children, 20-month-old children with autism were specifically impaired on some aspects of empathy, joint attention, and imitation. Infants with autism failed to use social gaze in the empathy and joint attention tasks. Both the infants with autism and the infants with developmental delay demonstrated functional play, but very few participants in either group produced spontaneous pretend play. In the developmental delay group, but not the autism group, pretend play was shown following prompting. The implications of these findings for developmental accounts of autism and for the early diagnosis of the disorder are discussed.

Research into impaired social communication of children with autism has mostly been conducted with school-age children, adolescents, or young adults (for a review, see Baron-Cohen, Tager-Flusberg, & Cohen, 1993). However, theoretical accounts of the development of autism emphasize the role of various social, cognitive, and affective factors in infancy (e.g., Baron-Cohen, 1995; Hobson, 1993; Leslie, 1994; Mundy, Sigman, & Kasari, 1993; Rogers & Pennington, 1991). To date, no experimental work has been conducted with infants with autism because the disorder is rarely diagnosed before the age of 3 years (Gillberg et al., 1990). The present research takes advantage of a recent prospective method of identification of autism (Baron-Cohen et al., 1996) to investigate the development of social communication in infants with autism.

Previous research with school-age children and adolescents has demonstrated autism-specific impairments in empathy, pre-

tend play, joint attention, and imitation; these impairments have been linked to the later problems in social understanding and reciprocal social communication that is characteristic of autism (Baron-Cohen, 1993, 1995; Leslie, 1987, 1994; Meltzoff & Gopnik, 1993; Mundy, 1995; Mundy et al., 1993; Rogers & Pennington, 1991). These theoretical accounts also claim a crucial role for these abilities in normal social and communicative development. Studying infants with autism may inform our understanding of abnormal development in autism. In the following, we summarize these four abilities:

1. *Interest in and empathic response to others:* Children with autism show poor coordination of affective response. They are less likely than are children in the control group to combine smiles with eye contact, less likely to smile in response to smiles from their mother (Dawson, Hill, Spencer, Galpert, & Watson, 1990; Kasari, Sigman, Mundy, & Yirmiya, 1990), and are impaired in their empathic responses (Sigman, Kasari, Kwon, & Yirmiya, 1992). Although we would expect very young children with autism to show the same impairments, studying the responses of infants with autism to displays of feigned distress may also demonstrate whether at an early age they notice the distress at all and, hence, whether the lack of empathic response found in autism is secondary to a primary deficit in perception of the emotional displays of others (Hobson, 1993).

2. *Pretend play:* In unstructured or free-play conditions, children with autism produce significantly less pretend play, but intact functional play, compared with chronological or mental age-matched comparison groups (see Jarrold, Boucher, & Smith, 1993, for a review). Under structured, or prompted, conditions, some studies have found that children with autism produced fewer functional and symbolic acts than did developmentally delayed controls (e.g., Mundy, Sigman, Ungerer, & Sherman, 1986; Wetherby & Prutting, 1984), whereas in at least one study, children with autism produced as many functional

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and symbolic acts as did controls (Lewis & Boucher, 1988). Studying the spontaneous and prompted play of infants with autism may show us whether aspects of play that develop earlier—such as functional play—are also impaired in younger children with autism.

3. *Joint attention:* There is substantial experimental evidence for impairments in both the production and the comprehension of joint attention behaviors in children with autism. Many studies have shown, for example, that although children with autism are able to use gestures to request objects (protoimperative gestures) or to engage in social action routines, they nevertheless do not use gestures to share interest in objects or their properties (protodeclarative gestures; e.g., Baron-Cohen, 1989; Mundy et al., 1986; see Mundy et al., 1993, for a review). Studying the response of infants with autism to ambiguous objects and ambiguous actions may show under what conditions such a joint attention deficit is evident in younger children.

4. *Imitation:* Although some studies have demonstrated impaired imitation—in particular of complex and novel sequences of actions—in children with autism (see Smith & Bryson, 1994, for a review), other studies have found that school-age children with autism are able to produce basic-level imitation of gestures, actions on objects, and facial expressions (Charman & Baron-Cohen, 1994; Loveland et al., 1994; Morgan, Cutrer, Coplin, & Rodrigue, 1989). Studying the imitation skills of infants with autism may show us whether basic-level imitation is impaired in younger children with autism.

Finally, studying the pattern of intact abilities and impairments shown by infants with autism in these early emerging social-communicative abilities should tell us which behaviors are functionally related to the later emerging skills, which previous research has demonstrated are impaired in school-age children with autism. This type of study will have implications for our understanding of the abnormal development of social communication in autism and will further our understanding of the developmental trajectories of empathy, play, joint attention, and imitation in the normal case. Indeed, it is apparent that in many of these areas—such as the relationship between functional and pretend play or the relationship between basic-level imitation and more complex imitation—there are significant gaps in our understanding of normal development.

Baron-Cohen, Allen, and Gillberg (1992) used a new instrument, the Checklist for Autism in Toddlers (CHAT), as a screening instrument for childhood autism. The CHAT checks for the presence of pretend play and joint attention behaviors as well as unrelated developmental accomplishments such as rough-and-tumble play. Baron-Cohen et al. found that although some of a group of 50 randomly selected toddlers at 18 months of age still lacked protodeclarative pointing, and some lacked pretend play, none lacked both. Forty-one siblings of children already diagnosed with autism were also screened with the CHAT at 18 months. For genetic reasons (Bailey et al., 1995), 2 to 3% of these children would be expected to have autism themselves. As such, this second group constituted a “high risk” group for autism. Four of these children lacked both pretend play and joint attention at 18 months. From both groups, only these 4 children went on to receive a diagnosis of autism at the age of 30 months.

A similar screening method has been used on a large population of 18-month-olds (see Baron-Cohen et al., 1996, for de-

tails). This enabled prospective identification of 10 infants with autism as well as comparison groups of children with developmental delay and normally developing children. In the present study, infants aged 20 months were tested on the following experimental measures: interest in and empathic response to a display of distress, spontaneous and elicited play, joint attention, and imitation. Because work with school-age children with autism has demonstrated autism-specific impairments in some aspects of these abilities, we would expect the same aspects to be impaired in infants with autism. However, two questions arise about the developmental course of these social-communicative impairments in autism: First, will infants with autism show specific impairments in comparison to language and mental-age-matched children with developmental delay but without autism? Second, will related behaviors such as functional play, the non-social use of gaze, and basic-level imitation (which have been shown to be relatively intact in school-age children with autism) also be intact in infants with autism?

Method

Participants

The present research was part of the first epidemiological study to attempt early screening for autism. In it, we used the CHAT on a population of 16,000 children who were 18 months old (Baron-Cohen et al., 1996). The epidemiological aspects of the larger study are addressed in Baron-Cohen et al. and will not be considered here. Following the administration of the CHAT to the whole population, three groups of children were identified according to their scores on the key items of the CHAT.¹ The autism risk group comprised the children ($n = 12$) who failed protodeclarative pointing, gaze monitoring, and pretend play items on the CHAT. The developmental delay risk group comprised the children ($n = 44$) who failed protodeclarative pointing, or who failed protodeclarative pointing and pretend play, but passed gaze monitoring. The no risk group comprised the children ($n = 15,944$) who passed all three key items; these children were expected to be developmentally normal. Note that the CHAT is designed as a screening instrument, and there is no suggestion that the identified risk groups constitute diagnostic groups. Following this screening process, 48 children were followed up at age 20 months for the present study. All parents who were approached agreed to take part in the study. All 12 children in the autism risk group were seen, as were 18 of the 44 children in the developmental delay risk group (randomly selected) and 18 of the no risk group (randomly selected). Children seen at this stage were allocated into one of three experimental groups by the application of standardized diagnostic and psychometric instruments.

Autism group. Because autism is not commonly diagnosed until the age of 3 years, rigorous criteria for the diagnosis of autism at 20 months were applied. Three independent measures of autism were employed, and a child was included in the autism group only if he or she met criterion for diagnosis on two out of three independent measures: First, the Autism Diagnostic Interview—Revised (ADI-R) was used. This instrument has been shown to have a high sensitivity and specificity in

¹ The most severely delayed children were necessarily excluded from the sample by the health visitors conducting the screening, as it was felt unethical to pose inappropriate developmental questions about children who had already been identified as severely retarded. For details, see Baron-Cohen et al. (1996).

diagnosing childhood autism (Lord, Rutter, & Le Couteur, 1994).² Second, a pair of experienced clinicians (Gillian Baird, Antony Cox) carried out a systematic assessment of communication skills and behavior and diagnosed childhood autism according to established criteria from the *International Classification of Diseases—10th Edition*, (ICD-10; World Health Organization, 1993). Third, another member of the research team (Simon Baron-Cohen), also an experienced clinician, rated videotapes of the experimental sessions and similarly applied ICD-10 criteria. This resulted in 10 children meeting criteria for autism. Agreement between these diagnostic ratings was high, with 8 of the 10 children meeting criteria on all three measures; the remaining 2 children met criteria on two of the three independent measures ($\kappa = 0.76$). All diagnoses of autism were confirmed on follow-up at age 42 months with both the ADI-R (Lord et al., 1994) and ICD-10 criteria (World Health Organization, 1993).³

Developmental delay group. A child was included in the developmental delay group if their nonverbal mental age (NVMA) score from the A (Motor Development), D (Eye-Hand Coordination) and E (Performance) scales of the Griffiths Scale of Infant Development (Griffiths, 1986) was 3 or more months below their chronological age (CA), or if, according to parental report, their vocabulary had equal to or less than 5 words. This is on the basis that less than 5% of children at 20 months old have equal to or less than 5 words (Fenson et al., 1993). They also had to have no autism, as assessed above.

Normal group. Finally, if a child met neither the criteria for autism nor the criteria for developmental delay and were free of any other clinical problem, they were allocated to the normal control group.

Ten (all boys) of the 12 children in the autism risk group met the criteria for autism; the remaining 2 (both girls) met the criteria for developmental delay. A further 14 children (9 boys, 5 girls) from the developmental delay risk group met the criteria for developmental delay but not for autism. The remaining 22 children (19 boys, 3 girls) met neither criteria and were developmentally normal. Because all 10 children with autism were boys, for the present study only data from boys in the other two groups were analyzed to control for any sex differences. Thus, the final groups for the present experimental study were 10 boys with autism, 9 boys with developmental delay, and 19 normally developing boys. The descriptive data (CA, NVMA, and language age measured by raw scores on the Verbal Comprehension (VC) and Expressive Language (EL) subscales of the Reynell Language Scale; Reynell, 1985; raw scores were used because some children scored below the floor for assigning a language age equivalent) for the three experimental participant groups are shown in Table 1. The normal group of participants had a higher NVMA, VC, and EL than the those with autism and those with developmental delay (all analyses of variance, ANOVAs, $p < .01$). However, there were no differences between the autism and developmental delay groups on CA, NVMA, VC, or EL. The groups did not differ for social class of main caregiver (Economic Activity of Great Britain, 1981).

Testing Session

The experiments were conducted in a single session, and there was no fixed order of administering the tasks except that the beginning of the testing sessions was invariant: The spontaneous play session was conducted first to avoid its being unduly influenced by the other tasks. Because of noncompliance, not all children took part in all the trials. However, the dropout was very low and is reported below for each individual task. The total testing time varied from child to child but was usually between 1.25 hr and 1.5 hr. The sessions were videotaped and analyzed subsequently. The raters were blind to the diagnoses of the children. A subset of all tapes was rated by a second rater, and inter rater reliability was calculated.⁴ Agreement was moderate to high. Kappa values (Cohen, 1960) were between 0.75 and 1 for over three quarters

Table 1
Chronological Age (CA), Nonverbal Mental Age (NVMA), and Language Age for the Experimental Groups

Subscale	Autism (n = 10)		Developmental delay (n = 9)		Normal control (n = 19)	
	M	SD	M	SD	M	SD
CA	20.7	1.5	21.1	1.0	20.3	1.0
NVMA ^a	17.1	1.9	17.1	2.51	20.2	1.9 ^b
VC ^c	4.80	4.10	6.67	4.42	13.8	6.95 ^d
EL ^e	6.80	3.46	6.67	4.06	14.4	4.27 ^f

Note. VC = verbal comprehension; EL = expressive language; A = autism group; DD = developmental delay group; N = normal control group.

^a Griffiths scores expressed as mental age in months. ^b Reynell Verbal Comprehension Scale raw score. ^c Reynell Expressive Language Scale raw score. ^d Analysis of variance (ANOVA), $F(2, 45) = 11.2, p < .001$. Post hoc Scheffé test, $A < N, p < .01$; $DD < N, p < .01$. ^e ANOVA, $F(2, 45) = 12.8, p < .001$. Post hoc Scheffé test, $A < N, p < .01$; $DD < N, p < .01$. ^f ANOVA, $F(2, 45) = 17.3, p < .001$. Post hoc Scheffé test, $A < N, p < .01$; $DD < N, p < .01$.

of the variables coded, and for only one variable did kappa fall below 0.50—pointing, during the joint attention tasks (0.47). This variable was therefore excluded from the analysis.

Measures

Empathic response. A measure of affective and attentional response to a display of distress by an adult, based on earlier work by Sigman et al. (1992) and Zahn-Waxler, Robinson, and Emde (1992), was used. The experimenter played jointly with the child, with a plastic pounding toy, and a hammer. During this time, at a point when the child was actually touching the toy, the experimenter pretended to hurt himself by hitting his thumb with the hammer. For 10 s the experimenter displayed facial and vocal expressions of distress (i.e., cries of pain), without using words, and stopped touching the toy. After a further 10-s period of neutral affect, the experimenter showed the child that his finger did not hurt anymore and resumed playing with the toy. Following the protocol used by Sigman et al. (1992), it was recorded whether during the first 10 s of the trial, the child (a) looked to the experimenter's face,

² A slight modification was made in the present study to the application of the ADI-R threshold criteria that are based on four axes. This was because the children in the present sample were younger than those studied previously with the ADI-R and would have had less opportunity to display some of the more developmentally mature behaviors that are scored on the third axis, repetitive and stereotyped behavior (e.g., circumscribed interests, verbal rituals), compared with the older ADI-R standardization sample. Therefore, a threshold criterion score of 2 was used in place of the criterion of 3 used by Lord et al. (1994). The threshold criteria for the other three domains—social interaction and verbal and nonverbal communication—were unchanged.

³ Two of the 10 participants did not meet full criteria for autism but met criteria for pervasive developmental disorder. With these participants excluded, the pattern of significant results does not change, and data are presented for all 10 participants in this group.

⁴ For the empathy, play, and goal detection tasks, 17 children (5 children from the autism, 5 from the developmental delay, and 7 from the normal groups) and 12 children for the joint attention and imitation tasks (4 from each group).

(b) looked to the experimenter's hand, and (c) stopped playing with, or touching, the toy. In addition, the child's own facial affect was coded as either (a) concerned/upset, (b) indifferent/neutral, or (c) positive.

Spontaneous play task. When the child entered the room, the following sets of toys were available (all at once), spread out on the floor: a toy teaset; a toy kitchen stove with miniature pots and pans, spoon, and pieces of green sponge; and junk accessories (e.g., brick, straw, rawplug, cottonwool, cube, box) and conventional toy accessories (toy animals, cars, etc.). This combination of objects was based on the earlier studies by Baron-Cohen (1987) and Lewis and Boucher (1988). The child's parents and the experimenters remained seated and offered only minimal and nonspecific responses to child-initiated approaches. Each child was filmed for 5 min. Each different play act produced by the child during the 5-min session was coded into the following four mutually exclusive categories, according to the definitions employed by Baron-Cohen (1987): sensorimotor, ordering, functional play, and pretend play. If there was uncertainty over which rating to make, the action was scored conservatively (i.e., the lower developmental categorization was scored: sensorimotor less than functional less than pretend; ordering play was not considered part of this hierarchy).

Structured play task. A series of structured play tasks designed to evaluate the effects of scaffolding were conducted, on the basis of the earlier work of Fein (1975) and Charman and Baron-Cohen (in press). Each child was given the functional (FN) and object substitution (OS) tasks in the order described below:

1. OS Trial 1—child presented with a toy telephone with a banana in place of a receiver;
2. FN Trial 1—child presented with a doll and a toy spoon;
3. OS Trial 2—child presented with a doll and a metal rod;
4. FN Trial 2—child presented with a doll and a toy cup; and
5. OS Trial 3—child presented with a doll and a wooden brick.

In turn, each set of objects was placed in front of the child. The following series of scaffolding prompts was given until a response was made: First, an *open prompt* was given ("What can you do with these?"), and for 20 s the child was given an opportunity to respond. Next, a *specific prompt* was given ("Let's pretend. Give the doll a drink of juice."), and for 20 s the child was given an opportunity to respond. Finally, the functional or pretend play action was modeled, and a specific prompt was given ("Let's pretend. Give the doll a drink of juice."), and for 20 s the child was given an opportunity to respond. On each trial, the first response made was scored according to the following criteria:

1. On the FN trials, functional play was scored if the spoon or cup was placed onto the doll's mouth in a feeding or drinking motion.
2. On the OS trials, object substitution was scored if the rod or brick was placed onto the doll's mouth in a feeding or drinking motion, or if the child picked up the banana and put it to his or her ear in the manner of a telephone receiver.

Joint attention tasks. A series of the three active toy tasks based on those described by Butterworth and Adamson-Macedo (1987) were conducted. Although these tasks are similar to social referencing paradigms (e.g., Klinnert, Emde, Butterfield, & Campos, 1986), social referencing behavior was not coded, as the target variable was joint attention. The child stood or sat between his or her mother and the experimenter. A series of mechanical toys, designed to provoke an ambiguous response—that is, to provoke a mixture of attraction and uncertainty in the child—were placed one at a time onto the floor of the room 1 to 2 m from the child. The toys were a robot, which flashed and beeped and moved around in circular sweeps, a car that followed a circular path around the room, and a pig that made "oinking" noises and shunted backwards and forwards. The toys were controlled by the experimenter through a control box and an electrical lead that ran from the box to the toy. They were active for a period of 1 min, during which time they stopped and restarted twice. The following actions were scored as either

present or absent for each trial: (a) Infant switched gaze between toy and adult (experimenter or parent) and back to toy, and (b) infant looked to control box.

Second, a series of goal detection tasks, as described by Phillips, Baron-Cohen, and Rutter (1992), were conducted at different times throughout the testing session. The first, the *blocking task* involved the following: When the child was manually and visually engaged with a toy, the experimenter covered the child's hands with his own, preventing the child from further activity, and holds the block for 5 s. This was repeated 4 times during the session. The second was the *teasing task*: The experimenter offered the child a toy. When the child looked at the toy and began to reach out for it, the experimenter withdrew the toy and held it out of reach for 5 s. The experimenter then gave the toy to the child. This was repeated four times during the session. The key behavior recorded on each trial was whether the child looked up toward the experimenter's eyes during the 5-s period immediately after the block or the tease.

Imitation. The materials and method for the procedural imitation task followed those used with normally developing infants by Meltzoff (1988) and those used with older children with autism by Charman and Baron-Cohen (1994). The child sat opposite the experimenter. Four actions were modeled, all on objects designed to be unfamiliar to the child:

1. *Dumbbell.* The first object was a wooden dumbbell-shaped toy that could be pulled apart and put back together again. The action demonstrated was to pick up the object by the wooden cubes and to pull outward so the toy came apart, and then to put the two pieces back together.

2. *Hinge.* The second was an L-shaped hinge made of a flat rectangular base and a wooden flap that could be folded flat or to an angle of 135 deg. The action demonstrated was to unfold the flap to its maximum angle and to return it to the flat position.

3. *Beeper.* The third object was a small black box, with a recessed button on the top surface. The box was tilted by a support so that the top surface was facing the child. The action demonstrated was to push in the recessed button, which produced a mechanical beeping sound.

4. *Light box.* The fourth object was another small black box, with a translucent panel on its top surface. The novel action demonstrated was for the experimenter to lean forward and touch the top panel of the box with his forehead, which illuminated the top panel of the box.

Each act was modeled three times. At the end of the modeling period (about 2 min in all), the objects were placed, in turn, in front of the child. One nonspecific prompt ("What can you do with this?") was given if the child failed to pick up or manipulate the object at once. The response period was 20 s for each object. Rigorous scoring criteria for imitation of each action, as set out by Meltzoff (1988), were adopted.

Analysis

For some tasks, such as the empathic response task and the play tasks, single behaviors were recorded by their presence or absence, and the data were analyzed nonparametrically. For other tasks in which multiple trials were conducted, such as the joint attention and imitation tasks, group differences were analyzed by an analysis of covariance (ANCOVA), with CA, NVMA, VC, and EL entered as covariates.

Results

Empathic Response Task

All participants took part in this task. The results are summarized in Table 2. Proportionally more children in the developmental delay and in the normal groups looked to the experimenter's face ($\chi^2(2, N = 38) = 19.9, p < .001$; Fisher's exact: A

Table 2
Percentages of Children Who Produced the Key Behaviors on the Empathy Task

Group	n	Look face (%)	Look hand (%)	Continue to touch toy (%)	Show facial concern (%)
Autism	10	40.0	20.0	80.0	0
Developmental delay	9	100.0	55.5	44.4	44.0
Normal control	19	100.0 ^a	47.4	47.4	68.4 ^b

Note. A = autism group; DD = developmental delay group; N = normal control group.
^a $\chi^2(2, N = 38) = 19.9, p < .001$. Fisher's exact: A \times DD, $p < .009$; A \times N $p < .001$; DD \times N, *ns*. ^b $\chi^2(2, N = 38) = 12.1, p < .003$. Fisher's exact: A \times DD, $p < .04$; A \times N $p < .001$; DD \times N, *ns*.

\times DD, $p < .009$; A \times N, $p < .001$; DD \times N, *ns*; A = autism group; DD = developmental delay group; N = normal group), and more children in the normal group and in the developmental delay group were rated as showing facial concern, compared with children in the autism group—none of whom expressed facial concern, $\chi^2(2, N = 38) = 12.1, p < .003$; Fisher's exact: A \times DD, $p < .04$; A \times N, $p < .001$; DD \times N, *ns*. There was no difference in the proportion of children in each group who looked to the experimenter's "injured" hand or continued to touch the toy.

Spontaneous Play Task

All children took part in this task. The percentage of children in each group producing at least one example of play in each of the four categories—sensorimotor, ordering, functional, and pretend—is shown in Table 3. There were no group differences for the production of sensorimotor, ordering, or functional play. Importantly, over half the children in all three groups produced some functional play acts. However, only 1 child in the autism group and 2 in the developmental delay group produced any examples of pretend play, significantly less than in the normal group, $\chi^2(2, N = 38) = 9.2, p < .01$; post hoc Fisher's exact: A \times DD = *ns*; A \times N, $p < .008$; DD \times N, $p = .05$.

Structured Play Task

The numbers of children in each group who produced at least one functional or object substitution act across all trials are

Table 3
Production of Categories of Play in Spontaneous Play Task

Group	n	Sensorimotor (%)	Ordering (%)	Functional (%)	Pretend (%)
Autism	10	100.0	10.0	60.0	10.0
Developmental delay	9	88.8	11.1	77.7	22.2
Normal control	19	94.7	15.8	86.5	63.2 ^a

Note. A = autism group; DD = developmental delay group; N = normal control group.
^a $\chi^2(2, N = 38) = 9.22, p < .01$. Fisher's exact: A \times DD, *ns*; A \times N, $p < .008$; DD \times N, $p = .05$.

shown in Table 4. Noncompletion rates were high—especially for the functional trials—because children were excluded if they did not pick up the relevant materials following prompting, and this was particularly difficult with the children with autism. To provide meaningful comparisons between the groups on the structured play tasks, the production of any one example of the target functional or object substitution act was scored across the two functional and the three object substitution trials. On the functional trials, only 1 of the 5 children with autism who completed at least one functional trial produced the required functional act, even after the prompts and model had been given. This was significantly lower than the proportion of children in the normal group, although not significantly lower than the proportion of children in the developmental delay group, $\chi^2(2, N = 24) = 9.8, p < .008$; Fisher's exact: A \times DD, *ns*; A \times N, $p < .005$; DD \times N, *ns*. On the object substitution trials, none of the children with autism produced an example of object substitution, even after prompting and modeling. This proportion was significantly lower than that for the developmental delayed children, all of whom produced at least one example of object substitution, and than that for the normal children, of whom two thirds produced at least one example of object substitution, $\chi^2(2, N = 31) = 16.9, p < .001$; Fisher's exact: A \times DD, $p < .001$; A \times N, $p < .002$; DD \times N, *ns*.

Joint Attention Tasks

There was no significant difference between the mean number of trials completed by each group, ANOVA, $F(2, 35) = 0.26, ns$ (see Table 5). There was a significant main effect for group on gaze switch between toy and adult, ANCOVA, $F(2, 31) = 38.2, p < .001$, and no covariate effects. Post hoc group-by-group ANCOVA comparisons revealed that children with autism gaze switched less than the children from both the developmental delay and normal groups, ANCOVA, $F(1, 13) = 71.2, p < .001$, and ANCOVA, $F(1, 23) = 39.7, p < .001$, respectively. There was no group difference in the proportion of trials in which children looked to the box that controlled the mechanical toys.

There was no significant difference between the mean number of blocking and teasing trials completed by each group, ANOVA, $F(2, 35) = 0.14, ns$, and ANOVA, $F(2, 35) = 1.83, ns$, respec-

Table 4
Production of Functional Play and Pretend Play in Structured Play Task

Group	Functional trials (%)	n	Object substitution trials (%)	n
Autism	20.0	5	0	8
Developmental delay	60.0	5	100.0	7
Normal control	92.9 ^a	14	68.8 ^b	16

Note. A = autism group; DD = developmental delay group; N = normal control group.
^a $\chi^2(2, N = 38) = 9.8, p < .008$. Fisher's exact: A \times DD, *ns*; A \times N, $p < .005$; DD \times N, *ns*. ^b $\chi^2(2, N = 38) = 16.9, p < .001$. Fisher's exact: A \times DD, $p < .001$; A \times N, $p < .002$; DD \times N, *ns*.

Table 5
Proportion of Joint Attention Trials on Which Key Behaviors Observed by Diagnostic Group

Group	n	Gaze switch		Look to box		Number of completed trials	
		M	SD	M	SD	M	SD
Autism	10	0.08	0.18	0.37	0.29	2.70	0.48
Developmental delay	9	0.83	0.26	0.61	0.42	2.62	0.53
Normal control	19	0.91	0.18 ^a	0.46	0.38	2.68	0.48

^a Analysis of covariance, main effect of group, $F(2, 31) = 38.3, p < .001$. Covariate effect: Chronological age, nonverbal mental age, verbal comprehension, expressive language, $F(4, 31), ns$.

tively (see Table 6). There was a significant main effect for group for blocking and teasing, with no covariate effects, ANCOVA, $F(2, 31) = 3.77, p < .04$, and ANCOVA, $F(2, 31) = 3.52, p < .05$, respectively. Post hoc group-by-group ANCOVA comparisons revealed that children with autism looked less to the experimenter than did children from the normal group in both the blocking and teasing tasks, ANCOVA, $F(1, 23) = 8.37, p < .009$, and ANCOVA, $F(1, 23) = 5.46, p < .03$, but there were no differences between the proportion of trials on which the autism and developmental delay groups looked to the experimenter on either task.

Imitation Task

There was no significant difference between the mean number of imitation trials completed by each group, ANOVA, $F(2, 34) = 0.51, ns$ (see Table 7). The proportion of completed imitation trials on which participants successfully imitated the modeled action are shown in Table 7. There was a significant group effect, ANCOVA, $F(2, 30) = 11.1, p < .001$, and a significant covariate effect for NVMA, with children with a higher NVMA showing more imitation than children with lower NVMA, ANCOVA, $F(1, 30) = 9.1, p < .006$. Post hoc group-by-group ANCOVA comparisons revealed that children with autism produced less imitation than children from both the developmental

delay and the normal groups, ANCOVA, $F(1, 13) = 5.24, p < .04$, and ANCOVA, $F(1, 22) = 15.1, p < .001$, respectively.

Discussion

On some variables, 20-month-old infants with autism showed clear and specific impairments relative to a control group of developmentally delayed children; on others, the autism group did not differ from the developmental delay controls, whereas on a third set, floor effects make interpretation of the present findings difficult.

On the empathy task, fewer children with autism looked to the experimenter's face, and none expressed facial concern in response to feigned distress. This finding is consistent with previous studies that have found impairments in the coordination of affect and attention in autism (Dawson et al., 1990; Kasari et al., 1990; Sigman et al., 1992) in contrast to normally developing infants (Zahn-Waxler et al., 1992) and infants with a developmental delay. Although some children with autism clearly noticed the experimenter's "distress" (4 looked to the experimenter's face, 2 of whom also looked to his "injured" hand), we cannot be sure that the other 6 noticed the display of distress. Future work should aim to further delineate the lack of responsiveness to displays of distress shown by infants with autism to determine whether they do not notice the emotional reactions of others, as has been suggested by recent work by Dawson, Meltzoff, and Osterling (1995), or whether they notice but simply respond less to the emotional reactions of others.

On the joint attention tasks, infants with autism produced fewer gaze switches of visual attention in response to ambiguous toys than did controls, consistent with the findings of studies with school-age children with autism (see Baron-Cohen, 1993; Mundy et al., 1993, for reviews). In contrast, they produced as many "nonsocial" looks at the box that controlled the toys. Thus, it seems clear that children with autism were interested in the mechanical toys (indeed, all children looked intently at the ambiguous toys), and were able to use gaze to investigate physical aspects of the paradigm (by looking to the control box through which the experimenter stopped and started the toy), but did not use gaze to share aspects of the situation with an adult, in contrast to children in both the developmental delay and normal control groups, who produced gaze switches on

Table 6
Proportion of Blocking and Teasing Trials on Which Children Made Eye Contact With Experimenter

Group	n	Blocking		Trials completed		Teasing		Trials completed	
		M	SD	M	SD	M	SD	M	SD
Autism	10	0.29	0.40	3.60	0.70	0.15	0.32	2.90	1.10
Developmental delay	9	0.36	0.40	3.67	0.71	0.48	0.45	3.11	1.36
Normal control	19	0.80	0.31 ^a	3.74	0.65	0.71	0.40 ^b	3.63	0.83

^a Analysis of covariance, main effect of group, $F(2, 31) = 3.77, p < .04$. Covariate effect: Chronological age, nonverbal mental age, language age, $F(4, 31), ns$. ^b Analysis of covariance, main effect of group, $F(2, 31) = 3.52, p < .05$. Covariate effect: Chronological age, nonverbal mental age, language age, $F(4, 31), ns$.

Table 7
*Proportion of Trials on Which Imitation Occurred
 by Diagnostic Group*

Group	n	Imitation		Number of trials	
		M	SD	M	SD
Autism	10	0.22	0.25	4.00	—
Developmental delay	9	0.53	0.29	4.00	—
Normal control	18	0.82	0.17 ^a	3.89	0.47

^a Analysis of covariance, main effect of group, $F(2, 30) = 11.1, p < .001$. Covariate effect: Nonverbal mental age, $F(1, 30) = 9.0, p < .005$.

most trials. However, in contrast to previous work with school-age children with autism (Phillips et al., 1992), the infants with autism did not produce fewer eye contacts with an adult than did the infants in the developmental delay control group following an ambiguous action because the controls produced relatively few looks. Future work should investigate the relationship between the development of gaze switching between a toy and an adult and the more direct infant-to-adult social look that occurs in the goal detection tasks.

The infants with autism also produced less imitation than did the infants in the developmental delay control group, contrasting with a recent study with school-age children with autism using the same tasks that found no autism-specific deficit (Charman & Baron-Cohen, 1994); this suggests that although basic-level imitation abilities are present by school age in children with autism, these abilities are not present by age 20 months. This underscores the developmental importance of the present study. Future research should aim to track the developmental relationship between basic-level imitation and more complex sequential imitation (Heimann, 1989; Rogers & McEvoy, 1993; Smith & Bryson, 1994).

On the play tasks, few infants in either the autism or the developmental delay group produced spontaneous pretend play. Thus, group differences in the production of spontaneous pretend play, which are apparent in school-age children with autism (see Jarrold et al., 1993, for a review), may have been masked by floor effects. This may be because object substitution only emerges at around 18 months of age and remains somewhat infrequent and fragile until later in the second year (Fein, 1981). However, many infants with autism and developmental delay produced some examples of functional play. Whatever deficit in autism underlies their poor pretend play it does not affect the production of functional play—at least not by 20 months of age (but see Mundy et al., 1993). In contrast, on the structured play task, the developmentally delayed infants, but not the infants with autism, produced object substitution. However, the structured play task should be interpreted with caution because the “refusal rate”—especially in the autism group—was high and because a “correct” response may reflect cooperation with the instruction given by the experimenter, or imitation of the modeled action, rather than a truly generative pretend action (see Charman & Baron-Cohen, in press).

The picture that emerges from this series of experiments is

that some differences between children with autism and other developmentally delayed children are clear by the end of infancy. Children with autism do not gaze switch between interesting objects and an adult’s face, nor do they coordinate emotional responses and gaze in response to an emotional display by an adult, and they are also impaired in imitation. Thus, impairments in social communication are evident in abilities that emerge soon after the end of the first year of life in normal development. In contrast, autism-specific impairments were not apparent at age 20 months in spontaneous pretend play because most developmentally delayed children without autism did not produce this either.

A developmental picture emerges of the course of the specific impairments that children with autism show in comparison to children with general developmental delay but without autism. This is consistent with the picture from studies with older school-age children with autism. Although there is some evidence for intact pretend play, under structured, or prompted, conditions, and basic-level imitation in autism, these are present only in older and more able children with autism and only at a very much later age than for children with developmental delay without autism (e.g., Lewis & Boucher, 1988; Charman & Baron-Cohen, 1994, in press; Morgan et al., 1989).

Finally, there is a third set of variables that emerge early in the second year of life on which infants with autism show intact performance relative to those in the developmental delay control group—namely, nonsocial use of gaze to obtain information about the physical world and production of functional play. These abilities may be intact because they are not part of the central social communicative deficit in autism, suggesting that there may be critical differences between the development of social and nonsocial use of gaze, and functional and pretend play, which also apply to normal development.

There are several important limitations to the present study. First, the sample of children with autism studied is not wholly representative of the total autistic population because it excluded cases with severe developmental delay (see Footnote 1, and Baron-Cohen et al., 1996). Their mean NVMA delay was just over 3 months, placing them in the lowest functioning 16% of the population, and their expressive language skills placed them in the lowest 5% of the population (Fenson et al., 1993). Over three quarters of the total population with autism have IQs in the developmental delay range (placing them in the lowest 2.5% of the population; De Myer, 1976). Thus, the present sample constitutes a moderately high-functioning sample of children with autism, whose performance may not be generalizable to the more disabled total autistic population. Nevertheless, it is informative to study relatively able infants with autism because they may reveal what is specific to the condition.

Second, on some measures—most notably spontaneous pretend play—floor effects may mask differences between the autism and developmental delay groups. Adding to the difficulty in interpreting these floor effects is the fact that although the autism and developmental delay groups were matched on measures of CA, NVMA, VC, and EL, the normally developing children were necessarily matched on CA only. Thus, no normative data on normal infants with an equivalent mental age are available to the clinical groups. This was an inevitable result of the screening study through which the present sample was

recruited (Baron-Cohen et al., 1996). Furthermore, only boys were included in the present sample because of the all male composition of the autism group identified. This led to a lack of data on any male-female differences. We could therefore not test the evidence from normally developing children that gender differences exist in the emergence of play and empathy skills (Fein, 1981; Zahn-Waxler et al., 1992). These sample limitations are a consequence of the design of the larger epidemiological study through which the present sample was identified, and although these factors limit the generalizability of the present study, such disadvantages are, in our opinion, easily outweighed by the opportunity to study a younger sample of children with autism than has previously been possible. The present sample will be followed up at age 42 months, and clearer evidence of the developmental importance of the pattern of intact and impaired abilities found in this young sample of children with autism may emerge then.

Detailing the specificity of the impairments in infants with autism, in comparison to those that are present in other children with general developmental and language delays but without autism, also has implications for aiding early clinical diagnosis (Baron-Cohen et al., 1996; Lord et al., 1994). Although children with developmental delay may be delayed in the development of empathy, joint attention, play, and imitation, the present results show that at least some aspects of these impairments are more severe in 20-month-olds with autism than in children with general developmental delay but without autism. Consistent with the present findings, retrospective parental accounts (Gillberg et al., 1990; Ohta, Nagai, Hara, & Sasaki, 1987) and home videos taken of children who go on to receive a diagnosis of autism, before such a diagnosis was made (Adrien et al. 1992; Osterling & Dawson, 1994), indicate that the factors that best discriminate between autism and other developmental disorders include deficits in joint attention, play, communication, and emotional expression as well as perceptual and motor abnormalities. The present study adds to this picture by detailing the presence of autism-specific deficits in a sample of 20-month-olds with autism, identified prospectively for the first time.

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