Developmental Psychology
2004, Vol. 40, No. 2, 271–283

0012-1649/04/$12.00 DOI: 10.1037/0012-1649.40.2.271

Early Social Attention Impairments in Autism: Social Orienting, Joint Attention, and Attention to Distress

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This study investigated social attention impairments in autism (social orienting, joint attention, and attention to another's distress) and their relations to language ability. Three- to four-year-old children with autism spectrum disorder (ASD; $n = 72$), 3- to 4-year-old developmentally delayed children ($n = 34$), and 12- to 46-month-old typically developing children ($n = 39$), matched on mental age, were compared on measures of social orienting, joint attention, and attention to another's distress. Children with autism performed significantly worse than the comparison groups in all of these domains. Combined impairments in joint attention and social orienting were found to best distinguish young children with ASD from those without ASD. Structural equation modeling indicated that joint attention was the best predictor of concurrent language ability. Social orienting and attention to distress were indirectly related to language through their relations with joint attention. These results help to clarify the nature of social attention impairments in autism, offer clues to developmental mechanisms, and suggest targets for early intervention.

Identifying impairments that distinguish young children with autism from typically developing children and those with other developmental disorders can allow for early identification and shed light on the nature of this disorder. The present article focuses on impairments in social attention. Three types of impairments were examined: social orienting (Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998), joint attention (Dawson, Meltzoff, Osterling, & Rinaldi, 1998; Mundy, Sigman, Ungerer, & Sherman, 1986), and attention to the distress of others (Sigman, Kasari, Kwon, & Yirmiya, 1992). A developmental model of autistic pathology posits that early impairments in social attention deprive the child with autism of social information input during infancy and preschool development and that this deprivation further disrupts normal brain and behavioral development (Mundy & Neal, 2001). This cycle acts like a negative feedback loop, affecting subsequent social development. The implication of such a model is that if social attention impairments could be identified early in life and changes made to the manner in which the child attends to his or her social environment, children with autism might be directed back closer toward the path of typical development. Moreover, research has shown that social attention—specifically, joint attention—is important for the acquisition of communicative competence (Carpenter, Nagell, & Tomasello, 1998). As such, insight into the social attention impairments that are found in very young children with autism might aid in designing more effective early interventions that facilitate social and communicative development and provide clues to the nature of this disorder.

In the present study, social orienting, joint attention, and attention to the distress of others were examined in young children with autism spectrum disorder (ASD) and mental-age-matched children with developmental delay (DD) and typical development. The purpose of this study was threefold: First, as there currently exist very few experimental studies that have systematically examined social orienting impairments in autism, one aim was to replicate the results of a previous study conducted with slightly older children with autism who demonstrated this type of impairment (Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998). Second, as these impairments might eventually be useful in identifying very young children with autism, we sought to examine which of these impairments, alone or in combination, best discriminated children with autism from children with DD and typical development. Third, as impairments in social attention might be important prerequisites for communicative development (Carpenter et al., 1998), we sought to examine whether and how these impairments were related to concurrent verbal language ability. To begin, we briefly review the literature pertinent to each of the social attention impairments we studied.

Social Orienting

Dawson and colleagues coined the term *social orienting impairment* to refer to the failure of young children with autism to

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This research was funded by National Institute of Child Health and Human Development (NICHD) and National Institute on Deafness and Communication Disability (NIDCD) Program Project Grant U19HD35465, which is part of the NICHD/NIDCD Collaborative Program of Excellence in Autism, and by National Institute of Mental Health Center Program Grant U54MH066399, which is part of the National Institutes of Health Studies to Advance Autism Research and Treatment (STAART) Centers Program.

We gratefully acknowledge the parents and children who participated in this study and several other people who made significant contributions to this research: Cathy Brock, Emily Werner, and several undergraduate research assistants.

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spontaneously orient to naturally occurring social stimuli in their environment (Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998). The notion that impairments in social orienting can alter the developmental pathway of young children with autism by depriving them of appropriate social stimulation was articulated by Mundy and Neal (2001). In typical development, at birth and during the first 6 weeks of postnatal life, infants exhibit a remarkable sensitivity to social stimuli (Rochat & Striano, 1999). Neonates display a particular attraction toward people, in particular to the sounds, movements, and features of the human face (Maurer & Salapatek, 1976; Morton & Johnson, 1991). At 5 months of age, infants have been shown to demonstrate sensitivity to even very small deviations in eye gaze during social interactions with adults, smiling and attending less when eyes are averted (Symons, Hains, & Muir, 1998). In these earliest stages, the infant's orientation is involuntary rather than intentional. Later emerging aspects of social cognition likely depend on this very early propensity to devote particular attention to faces (Rochat & Striano, 1999). Active volitional orienting to a social stimulus, such as head turning when one's name is called, typically emerges by 5–7 months of age. At the same time, early joint attention skills may be emerging. As early as 6 months of age, typically developing infants have been shown to match the direction of the mother's head turn to a visible target (Morales, Mundy, & Rojas, 1998).

It has been argued that a failure to orient to social stimuli represents one of the earliest and most basic social impairments in autism and may contribute to the later-emerging social and communicative impairments (Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998; Mundy & Neal, 2001). Retrospective studies of 1st-birthday home videotapes have shown that 1-year-old infants later diagnosed with autism attended less to people, failed to orient to their names, and showed impairments in joint attention compared with typically developing and mentally retarded 1-year-olds (Osterling & Dawson, 1994; Osterling, Dawson, & Munson, 2002). Another home videotape study demonstrated that 8- to 10-month-old infants later diagnosed with autism were much less likely to orient when their names were called than were typically developing 8- to 10-month-old infants (Werner, Dawson, Osterling, & Dinno, 2000). Swettenham and colleagues (1998) found that 20-month-old toddlers with autism spent less time overall looking at people and looked more briefly at people and for longer durations at objects than did toddlers with DD and typically developing toddlers. Dawson and colleagues examined social orienting ability in an experimental study of children with autism, Down's syndrome, and typical development (Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998). In that study, children's tendency to orient to two social stimuli (name calling and hand clapping) and two nonsocial stimuli (a rattle and a musical toy) was observed. It was found that, compared with children with Down's syndrome and children showing typical development, children with autism more frequently failed to orient to both social and nonsocial stimuli, but this failure was much more extreme for social stimuli. Children with autism were also more impaired in their joint attention ability, and the severity of their joint attention ability was strongly correlated with social orienting ability but not with nonsocial orienting ability.

The question of what accounts for a failure to orient to social stimuli in autism is unresolved. Several authors have suggested that autism involves a basic and general impairment in attentional functioning (e.g., Bryson, Wainwright-Sharp, & Smith, 1990; Courchesne et al., 1994; Dawson & Lewy, 1989a, 1989b). Even very able persons with autism have been found to exhibit impairments in selective attention and orienting (Casey, Gordon, Mannheim, & Rumsey, 1993; Courchesne et al., 1994; Wainwright-Sharp & Bryson, 1993). Various explanations have been offered for how such attentional impairments might contribute to the profound social disabilities that characterize autism. One explanation, proposed by Courchesne, Chisum, and Townsend (1995), is that early social exchanges require rapid shifting of attention between different stimuli. In particular, the ability to share attention with others requires the young child to rapidly shift his or her attention between different stimuli. A somewhat different explanation (Dawson, 1991; Dawson & Lewy, 1989a, 1989b; Gergely & Watson, 1999) focuses not on the ability to rapidly shift attention, but on the nature of the stimuli to be processed. Because social stimuli (e.g., facial expressions, speech, gestures) are complex, variable, and unpredictable, children with autism may have difficulty processing and representing such stimuli, and therefore their attention is not naturally drawn to such stimuli. A third explanation is that autism might involve a failure to assign reward value to social stimuli (Dawson, Carver, & McPartland, 2000a, 2000b; Dawson, Osterling, Rinaldi, Carver, & McPartland, 2001; Mundy & Neal, 2001). According to this view, the failure to orient to social stimuli reflects a disturbance in the motivational mechanisms that normally draw an infant's attention to social stimuli such as faces and voices (Rochat & Striano, 1999). Sahley and Panksepp (1987) proposed that abnormalities in brain opioids might affect underlying "emotional desire" and "social communicative intent" in young children with autism (p. 203). Mundy (1995) hypothesized that "a disturbance of neurological systems that involves inherent reward feedback for initiating social behaviors" might explain the joint attention disturbance in young children with autism (p. 73). Dawson, Carver, Meltzoff, Panagiotides, and McPartland (2002) have discussed the role of reward value in the emotional tagging of social information as relevant, which could affect how information is represented and later recalled. Although there continues to be interest in the social reward hypothesis, little systematic investigation of this hypothesis has taken place to date.

As there currently exist few experimental studies on social orienting impairment in autism, in the present study, we aimed to replicate and extend the results of the Dawson, Meltzoff, Osterling, Rinaldi, and Brown (1998) study. The 1998 study of orienting in children with autism was limited in terms of the small number of stimuli used (name calling and hand clapping vs. a rattle and a musical toy). Also, it was discovered that the social stimuli were more familiar to the children than the nonsocial stimuli (this was found to be true for all groups tested: autism, DD, and typical development). Thus, it is possible that the finding of a social orienting impairment in the autism group reflected a difference in the way children with autism responded to familiar versus unfamiliar stimuli rather than to the social–nonsocial dimension. Determining whether a particular impairment in social orienting is present in autism is important for several reasons. First, if such an impairment does exist, it is not only likely to be present early in life but may also be relatively easy to assess in clinical settings. Second, the presence of an impairment in social orienting would suggest that the attentional deficits in autism are more basic than previously proposed and perhaps are even the ontogenetic precursor to triadic joint attention deficits in autism. Third, whereas

general orienting ability ("disengage and shift") has been linked to the cerebellum (Courchesne et al., 1994), orienting to social stimuli, particularly emotional stimuli, has been more closely linked to the amygdala (LeDoux, 1987; Ohman, 2002). Thus, the nature of the orienting impairment in children with autism would shed light on the neuroanatomical basis of this disorder. To further explore the question of the presence and specificity of social orienting impairments in autism, we examined children's attention to a wider range of social and nonsocial stimuli and better controlled for familiarity with the stimuli.

Joint Attention

Joint attention refers to the ability to "coordinate attention between interactive social partners with respect to objects or events in order to share an awareness of the objects or events" (Mundy et al., 1986, p. 657). Joint attention behaviors include sharing attention (e.g., through the use of alternating eye gaze), following the attention of another (e.g., following eye gaze or a point), and directing the attention of another. Many infants display all of these skills by 12 months of age (Carpenter et al., 1998), and some infants display some aspects of joint attention (e.g., matching the direction of the mother's head turn to a visible target) as early as 6 months of age (Morales et al., 1998). In children with autism, previous research has established joint attention ability as an early-emerging and fundamental social-communication impairment, present by 1 year of age and incorporated into the diagnostic criteria for autism (American Psychiatric Association, 1994; Mundy et al., 1986). Some studies have shown that children with autism are better able to use gestures to request objects or events than they are able to use similar gestures to initiate joint attention (Mundy et al., 1986). These findings indicate an apparent dissociation in the early social skill development of children with autism (Mundy, 1995).

Joint attention ability has been found to distinguish preschool-age children with autism from those with DD and typical development (Bacon, Fein, Morris, Waterhouse, & Allen, 1998; Charman et al., 1998; Dawson, Meltzoff, Osterling, & Rinaldi, 1998; Mundy et al., 1986; Sigman et al., 1992). In young infants, however, some evidence suggests that social orienting impairment might be a better discriminator of autism. In a home videotape study of 1st birthday parties of infants later diagnosed with autism, mental retardation, or typical development (Osterling et al., 2002), 1-year-olds with autism looked at people and oriented to their own names less frequently than did infants later diagnosed with mental retardation and infants with typical development. Both infants with autism and infants with mental retardation, however, displayed fewer joint attention and other gestural behaviors compared with typically developing infants. The question addressed in the present study is whether social orienting impairment improves our ability to discriminate preschool-age children with autism from those with DD and typical development.

Joint attention has been found to be a good predictor of both concurrent and future language skills in children with autism. In a longitudinal study of social competence and language skills in children with autism and Down's syndrome, Sigman and Ruskin (1999) found that joint attention skills were concurrently associated with language ability for both groups and predicted long-term gains in expressive language ability for the children with autism. In the present study, we examined the concurrent associations between each of the three social attention skills—joint attention, social orienting, and attention to distress—and verbal language ability in young children with ASD. On the basis of Sigman and Ruskin's study, we hypothesized that joint attention would be the strongest concurrent predictor of language ability. In addition, we hypothesized that social orienting ability would be *indirectly* related to language ability through its contribution to joint attention skills. This hypothesis is based on the notion that a child's voluntary attention to social information makes a critical contribution to the acquisition of joint attention skills because such skills require the child to actively attend to social cues, particularly those expressed on the face, such as direction of eye gaze (Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998). If the child fails to pay attention to such cues, he or she will be missing important opportunities for acquiring and practicing joint attention skills. This hypothesis contrasts with other views that posit that the lack of a "shared attention mechanism" is fundamentally responsible for the joint attention impairments seen in autism (Baron-Cohen, 1995).

Attention to Distress

By 4–6 months of age and perhaps earlier, infants attend to the affective displays of others (Trevarthen, 1979) and respond differentially to faces showing different emotions (e.g., neutral, happy, sad) by exhibiting more smiling and visual attention toward happy faces than toward neutral or sad faces (Rochat & Striano, 1999; Tronick, Als, Adamson, Wise, & Brazelton, 1978). By 9–12 months of age, social referencing, whereby children seek emotional information from an adult's face when presented with a stimulus of uncertain valence, is established (Feinman, 1982; Moore & Corkum, 1994). Furthermore, as early as the 2nd year of life, children begin to respond affectively and prosocially to another person's distress by helping, comforting, and sharing (Rheingold, Hay, & West, 1976; Zahn-Waxler & Radke-Yarrow, 1990). Studies have shown that when adults displayed facial expressions of distress, children with autism looked less at the adult and showed less concern than did children with mental retardation and typically developing children (Bacon et al., 1998; Charman et al., 1998; Dawson, Meltzoff, Osterling, & Rinaldi, 1998; Sigman et al., 1992). When a neutral affect condition was included, children with autism were able to distinguish between negative affect displays and neutral displays, as evidenced by their tendency to look more at the examiner's face and show more concern when the examiner showed distress than when he or she showed a neutral expression, but they looked for shorter durations and showed less interest and concern in both conditions than did children with mental retardation (Corona, Dissanayake, Arbelle, Wellington, & Sigman, 1998). In the present study, we sought to examine how well attention to distress discriminates young children with autism from those with DD and typical development, and we examined its relation with concurrent language ability in young children with autism. As we did for social orienting, we predicted that a child's tendency to attend to another's distress would be indirectly related to language ability through its contribution to joint attention skills. The rationale here is that acquisition of joint attention skills might be facilitated by sensitivity to affective cues, because joint attention episodes are frequently punctuated and motivated by affective engagement with another (Paparella, D'Angiola, & Kasari, 2001; Paparella & Kasari, 2002). Thus, sensitivity and attention to an-

other's emotional cues might increase motivation and opportunities for engaging in joint attention episodes, thereby facilitating the acquisition of joint attention skills.

Method

Participants

Three groups of children participated in the study: (a) 72 children with ASD comprising 50 children with autistic disorder and 22 children with pervasive developmental disorder not otherwise specified (PDD-NOS); (b) 34 children with DD without autism; and (c) 39 children with typical development. The DD group included 31 children with idiopathic developmental delay and 3 children with Down's syndrome. Groups were matched on mental age on the basis of their composite scores on the Mullen Scales of Early Learning (Mullen, 1984). Participants were recruited from local parent advocacy groups, public schools, the Washington State Department of Developmental Disabilities, clinics, hospitals, and the University of Washington Infant and Child Subject Pool. Exclusionary criteria included the presence of a neurological disorder of known etiology (for the ASD group only), significant sensory or motor impairment, major physical abnormalities, and a history of serious head injury and/or neurological disease. Children with typical development were excluded if they exhibited unusually high or low cognitive ability as assessed by their composite scores on the Mullen Scales of Early Learning (Mullen, 1984). Table 1 presents demographic and descriptive information, including gender, socioeconomic status (SES), chronological age, and composite mental age and IQ, for the three groups of children. Ethnicity for each of the three groups was as follows: ASD—50 European American, 3 African American, 13 biracial, 2 Hispanic/Latino, 4 Asian/Pacific Islander; DD—23 European American, 1 African American, 1 American Indian, 8 biracial, 1 Hispanic/Latino; Typical—28 European American, 1 African American, 9 biracial, 1 Asian/Pacific Islander. There were no significant differences among the three groups in SES, ethnicity, or composite mental age. Fourteen children with ASD (19%) and 6 children with DD (18%) displayed an expressive language age equivalence of 36 months or higher on the Mullen Scales of Early Learning. Because the children with typical development were matched to the clinical groups on mental age, this group had a significantly lower chronological age than the ASD group, $t(109) = 13.16$, $p < .01$, and the DD group, $t(71) = 10.14$, $p = .001$. On the basis of their scores on the Autism Diagnostic Interview—Revised (ADI–R), 16 children with ASD and 1 child with DD were reported to have lost some level of spontaneous, meaningful communicative speech. Parents reported 6 children with ASD and 10 with DD as having experienced seizures.

Diagnoses of autism were based on the ADI–R (Lord, Rutter, & LeCouteur, 1994) and the Autism Diagnostic Observation Schedule—Generic (ADOS–G; Lord, Rutter, Goode, & Heemsbergen, 1989). Both instruments assess the symptoms of autistic disorder listed in the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM–IV*; American Psychiatric Association, 1994). In addition, clinicians made a clinical judgment of diagnosis based on the presence or absence of autism symptoms as defined in the *DSM–IV*. Diagnosis of autism was defined as meeting criteria for autistic disorder on the ADOS–G and the ADI–R and meeting *DSM–IV* criteria for autistic disorder on the basis of clinical judgment. In addition, if a child received a diagnosis of autistic disorder based on the ADOS–G and on *DSM–IV* criteria and came within 2 points of meeting criteria on the ADI–R, the child was also considered to have autistic disorder. Diagnosis of PDD-NOS was defined as meeting criteria for PDD-NOS on the ADOS–G, meeting criteria for autistic disorder on the ADI–R or missing criteria on the ADI–R by 2 or fewer points, and meeting *DSM–IV* criteria for PDD-NOS on the basis of clinical judgment. Children with DD and typically developing children also were administered the ADOS–G. These children did not meet criteria for autistic disorder or PDD-NOS on the ADOS–G or on the basis of clinical judgment based on *DSM–IV* criteria, nor did they show elevated symptoms on these measures.

Procedure

The following measures were gathered over the course of three sessions. Each child was individually tested while seated at a table. The child's parent remained in the room, seated behind the child or at the table with the

Table 1
Demographic Characteristics of the Sample

Measure	Group: ASD (n = 72; 60 M, 12 F)	Group: DD (n = 34; 18 M, 16 F)	Group: Typical (n = 39; 30 M, 9 F)	F	p
Socioeconomic status					
M	47.4	48.1	49.5		
SD	11.5	13.4	12.1		
Chronological age (months)				1.93	*ns*
M	43.5	44.8	27.1		
SD	4.3	5.3	8.9		
Mullen composite mental age (months)				1.98	*ns*
M	25.2	27.6	28.4		
SD	8.8	8.3	9.1		
Mullen composite IQ				0.62	*ns*
M	57.6	60.7	105.3		
SD	20.0	15.8	7.7		
Mullen verbal AE (months)				4.36	.02
M	22.5	26.2	27.9		
SD	10.5	8.1	9.5		

Note. ASD = autism spectrum disorder; DD = developmental delay; Typical = typically developing; M = male; F = female; Mullen = Mullen Scales of Early Learning; AE = age equivalence.

child on his or her lap. Children were given food snacks and praise as a reward for sitting at the table when necessary and were provided breaks as needed. The ADOS–G and the Mullen scales were administered during the child's first laboratory visit, the Early Social Communication Scales (ESCS) and attention to distress tasks were administered during the second visit, and the experimental assessment of social orienting was administered during the third visit.

Social Orienting Measures

Orienting was defined as turning the head and/or eyes toward an auditory stimulus. If a child turned his or her eyes and/or head toward the stimulus, the response was coded as a correct response whether or not the response included shared attention with the examiner.

Social orienting: Experimental assessment. The paradigm used was similar to that administered by Dawson, Meltzoff, Osterling, Rinaldi, and Brown (1998) with the exception that a larger number of social and nonsocial auditory stimuli were delivered. The child was seated across from a familiar examiner and allowed to play with a toy chosen to be only mildly interesting. Once the child was engaged in play, a second examiner delivered the stimuli.

The four social stimuli consisted of live sounds that used the human voice and body: (a) humming a neutral tone, (b) calling the child's name, (c) snapping fingers, and (d) patting hands on thighs. The four nonsocial stimuli consisted of mechanical sounds of inanimate objects, although they were activated by a human being: (a) a timer beeping, (b) a phone ringing, (c) a whistle blowing, and (d) a tape recording of a car horn delivered while the examiner held a toy car. Each stimulus was delivered three times with a 1-s interstimulus interval, for a total presentation time of approximately 6 s. A decibel meter placed on the table next to the child for a subset of the participants confirmed that social and nonsocial stimuli were matched in terms of loudness. To control for acoustics, we used the same testing room for all children participating in this task. Stimulus order and location (behind vs. in front of the child, 30° to the right or the left) were counterbalanced across participants. Delivery of the stimuli occurred only when the child was not looking at the second examiner, and the examiner remained in each location for 15 s following stimulus delivery to allow for a delayed orienting response. The examiner assumed a neutral facial expression when delivering the social stimuli and looked down at the floor when delivering the nonsocial stimuli to ensure that the child's response was not unduly influenced by personal or social characteristics specific to the examiner.

Parent ratings of the degree of familiarity were obtained for each of the stimuli on a 5-point scale ranging from 1 (*very unfamiliar*) to 5 (*very familiar*). There were no significant between-groups, $F(2, 120) = 2.17$, $p = .12$, or within-group, $F(1, 120) = 0.17$, $p = .68$, differences in degree of familiarity for social versus nonsocial stimuli. Parents also indicated whether or not the child had received behavioral training in responding to his or her name being called, and this variable was included as a covariate in the analyses.

Children's behavior was videotaped from behind a one-way mirror. The two examiners coded live whether the child oriented to the stimulus. An error was defined as a failure to turn head and/or eyes toward the stimulus within 15 s of delivery of the stimulus. Coding discrepancies, though rare, were resolved immediately following the task by viewing the videotape. An additional coding from videotape by coders unaware of the hypotheses was obtained for a random subset of participants (19% of the total sample). The intraclass correlation coefficient for the live versus videotape coding was .87.

Social orienting: ADOS–G. The second measure assessing children's orienting response was taken from the scoring criteria of the ADOS–G. This item represented "the child's response to hearing his name called during a specific press" (Lord et al., 1989). The item was coded on the basis of the participant's response to probes included in the play interview. While the child was playing quietly, the experimenter called the child's name once or twice from a distance of 3–5 feet (0.9–1.5 m). If the child failed to orient with eyes or head, the experimenter repeated the procedure. If the child failed to orient after four probes, the parent was asked to call the child's name without touching the child. A score of 0 indicated that the child looked toward the experimenter and made eye contact immediately on at least one of the first two clear presses made by the experimenter (i.e., name only is called). A score of 1 indicated that the child either responded to the third or fourth press of name only by the experimenter or looked toward the parent and made eye contact immediately for the first or second press. A score of 2 indicated that the child did not make eye contact with an adult after four attempts of name only.

Joint Attention Measures

In the present study, joint attention ability was defined as triadic (i.e., child–adult–object) social interactions involving sharing, following, and/or directing attention through the use of eye gaze and/or gesture.

Joint attention: ESCS. This measure of joint attention was based on an abridged version of the ESCS (Seibert & Hogan, 1982). In this procedure, the child was seated at a table across from a familiar examiner. A set of toys, including a hat, a comb, a pair of glasses, a book, a ball, a car, wind-up and hand-operated toys, and a plastic jar, was in view but out of reach of the child. Three posters were hung on the walls of the room, 90° to the child's right and left and 180° behind the child. The examiner presented a sequence of wind-up and hand-operated toys, activating each three times per trial (6 trials). Intermittently, the examiner attracted the child's attention, then turned to point and gaze at each poster while stating the child's name three times (2 trials), made simple gestural and verbal requests of the child ("Give it to me"), and presented the child with turn-taking opportunities, consisting of a tickle game (2 trials), taking turns with an object (2 trials), and taking turns wearing a hat, a comb, and glasses (3 trials). The examiner also gave the child the opportunity to look at pictures in a book and to follow the examiner's point (1 trial). The 20-min structured assessment was videotaped from behind a one-way mirror to include a full view of the child and a profile view of the examiner. Behavioral ratings were made from the videotapes by trained observers unaware of the child's diagnosis and the hypotheses.

Behavioral observations yielded frequency scores in two categories: initiating joint attention (IJA) and responding to joint attention (RJA). IJA behaviors consisted of the number of episodes of gaze, alternating gaze, showing, and pointing to share attention with the examiner with respect to an active toy. RJA was measured as the percentage of six trials on which the child accurately oriented with the eyes and/or a head turn beyond the examiner's finger and in the direction of the examiner's point and gaze. A more complete discussion of the ESCS procedures is available elsewhere (Mundy, Hogan, & Doehring, 1996).

Initial interrater reliability was first assessed by independent paired ratings made from 15 practice tapes provided by Peter Mundy, who developed a behavioral coding system for this measure. Intraclass correlation coefficients were above .84. Reliability was maintained with Karen Toth and assessed by independent paired ratings made from videotapes of a randomly selected group of participants (10% of the total sample). Intraclass correlation coefficients across observers were .80 for IJA and .76 for RJA.

Joint attention: ADOS–G. The second measure assessing children's joint attention was taken from the ADOS–G. The child's "response to joint attention" referred to his or her responding to the examiner's use of gaze, pointing, or both in directing the child's attention to a distal object (Lord et al., 1989). This item was coded on the basis of the participant's response to joint attention probes included in the play interview. While the child was playing quietly, the experimenter placed himself or herself directly in front of the child and established eye contact by calling the child's name or, if necessary, providing a physical prompt. Upon making eye contact, the experimenter said "Look, [child's name]" and looked toward a toy that had been placed in front and 65° to one side of the child. If the child did not respond to this joint attention probe by following the examiner's gaze to the toy, the probe was repeated with the phrase "Look at that" appended to

the verbal prompt. If the child failed to respond to this bid, the examiner stated "[Child's name], look at that" and pointed to the toy. A score of 0 indicated that the child had successfully used the orientation of the examiner's face and eyes as a cue to attend to the toy. A score of 1 indicated that the child had required a point to attend to the toy. A score of 2 indicated that the child had not responded to any of the joint attention probes or that the experimenter had been unable to obtain the child's attention to administer the joint attention probe after five attempts.

Also from the ADOS–G, the child's ability to "initiate joint attention" referred to his or her attempts to direct an adult's attention to objects that neither the child nor the adult was touching solely for the purpose of sharing attention rather than for requesting the objects (Lord et al., 1989). This item was scored on the basis of the examiner's judgment of the child's attempts at protodeclarative attention bids throughout the course of the entire play interview. A score of 0 indicated that on at least one occasion the child directed an adult's attention to a distal object by gazing at the object, establishing eye contact, and redirecting gaze to the object. Using a point or a vocalization was acceptable but not necessary to receive a score of 0. To obtain a score of 0, a child must have successfully integrated attention to the adult and attention to the distal object. A score of 1 indicated that on at least one occasion a child partially referenced a distal object by either looking at the object and pointing or vocalizing or by looking or pointing at an adult without redirection. To obtain a score of 1, the child may have demonstrated attention to the adult or attention to the object, but he or she failed to integrate the two in a bid for joint attention. A score of 2 indicated that the child did not initiate a bid for joint attention to reference a distal object.

Attention to Distress

The method used to measure attention to distress was based on that used by Sigman and colleagues (1992). In this procedure, a familiar examiner allowed the child to play with either a wooden or plastic hammer-and-peg toy. The examiner then requested a turn and pretended to hurt her finger by striking it with the hammer. For 30 s, the examiner displayed facial and vocal expressions of distress ("crying") without using words, followed by a 10-s period of neutral affect with the examiner looking down. The examiner then showed the child her finger, stating, "It is all better now." In a second trial, the examiner again requested a turn with the toy and hit her finger, but this time she displayed neutral affect while humming a neutral tone for 30 s, followed by 10 s of silence. The type of toy (wooden or plastic) and the order of the conditions were counterbalanced across participants. Parents were asked to remain silent during the short session and to display neutral affect. Children's behavior was videotaped from behind a one-way mirror and coded from videotapes by coders unaware of the hypotheses of the study.

Multiple measures of attention to distress were derived from the videotapes, reflecting children's attention to the examiner, play behavior, and degree of concern. Children's attention was coded on a frame-by-frame basis in terms of four mutually exclusive categories: (a) looked at toy, (b) looked at examiner, (c) looked away, or (d) unscorable (child's eyes not visible). Total time in half seconds was calculated for each of these categories, as well as latency to first look at the examiner. Play behavior was coded as (a) active play (hammering), (b) passive play (holding, brief touching), (c) no play, or (d) unscorable (child's play not visible). Finally, degree of concern was rated on a 4-point scale as follows: (1) *shows no interest* (did not look once at examiner), (2) *shows some interest, but no concern* (brief looking, neutral or positive facial expression), (3) *shows concern* (facial expression shows concern, worry, or discomfort; looked at examiner more than briefly), and (4) *shows intense affective involvement and/or comforting behaviors.* Coders were unaware of the hypotheses. Interrater reliability was assessed by independent paired ratings made from videotapes for a randomly selected group of participants in the study (17% of the total sample). Intraclass correlation coefficients ranged from .79 to .99 for all variables.

Results

All children with complete data were included in each of the following analyses. Sample sizes varied across analyses because of occasional noncompliance. Although hypothesis testing regarding mean differences included verbal mental age as a covariate, all results were the same when no covariate was used. Verbal age did not interact with group for the dependent variables of interest. Thus, for simplicity of interpretation, the means reported are raw unadjusted means.

Social Orienting Ability: Group Comparisons

Social orienting: Experimental assessment. Figure 1 displays the mean percentages of correct head or eye turns exhibited by children with ASD, DD, and typical development in response to social versus nonsocial stimuli. Replicating Dawson, Meltzoff, Osterling, Rinaldi, and Brown (1998), a 3 (group) x 2 (stimulus type: social vs. nonsocial) repeated measures analysis of variance (ANOVA) with verbal mental age entered as a covariate yielded a significant main effect of group, $F(2, 133) = 13.86$, $p < .01$, and a marginally significant Group $\times$ Stimulus interaction, $F(1, 133) = 2.47$, $p = .09$. Prior to testing, some children had received behavioral therapy that had as a goal responding when called by name; when such behavioral therapy was entered as an additional covariate in this analysis, the results were virtually unchanged. As can be seen in Figure 1, children with ASD more frequently failed to orient to all stimuli than did children with delayed and typical development, but this impairment was more severe for social stimuli. To explicitly test whether children with ASD showed a greater discrepancy between their ability to orient to social stimuli and their ability to orient to nonsocial stimuli than did the other children, we conducted a planned contrast comparing the social versus nonsocial difference. Results indicated that children with ASD showed a more severe impairment for social stimuli than did children without ASD (DD and typical development combined), $F(1, 133) = 4.88$, $p < .05$. Finally, when individual items were

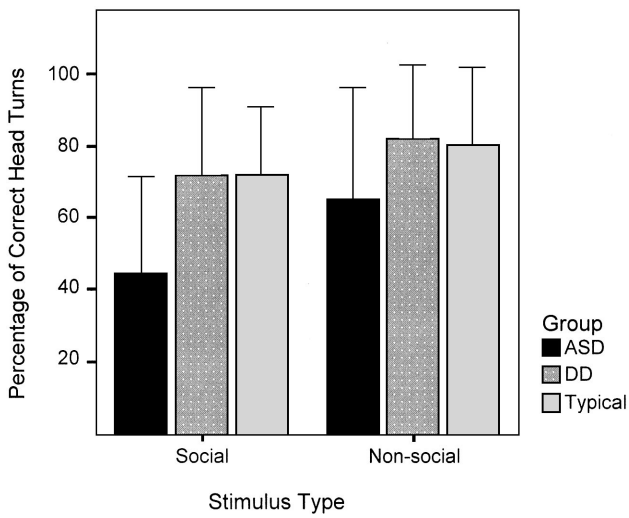

Figure 1. Mean number of head or eye turns to social and nonsocial stimuli exhibited by children with autism spectrum disorder (ASD), developmental delay (DD), and typical development.

examined to determine whether one or two of the stimuli of each type (social and nonsocial) accounted for the ASD versus DD differences, we found that the children with ASD oriented significantly less often than the DD group to each of the four social stimuli; *t*s(99) ranged from 2.32 to 3.40 (*p*s $< .05$). These results provide further evidence of a general deficit in social orienting in young children with autism.

Social orienting: ADOS–G. Results of an ANOVA for the ADOS–G social orienting variable (which is not included in the diagnostic algorithm) revealed a significant group difference in orienting to name, $F(2, 138) = 9.18$, $p < .01$, even when verbal mental age was entered as a covariate. Pairwise comparisons of the estimated marginal means using the Bonferroni adjustment showed that children with ASD oriented less when called by name ($M = 1.07$, $SD = 1.03$) than did children with delayed ($M = 0.35$, $SD = 0.65$; $p < .01$) and typical ($M = 0.24$, $SD = 0.55$; $p < .01$) development (higher scores indicate more severe impairment). No difference in orienting to name being called was found between DD and typically developing children.

Joint Attention Ability: Group Comparisons

Descriptive statistics for each group and results of ANOVAs and post hoc tests for the four joint attention measures derived from the ESCS and the ADOS–G are presented in Table 2. With verbal mental age entered as a covariate, significant group differences were found for all four measures of joint attention. Overall, children with ASD made fewer attempts to initiate joint attention, and were less likely to respond to the examiner's attempts to engage them in joint attention, than DD and typical children. Children with DD, on the other hand, were just as likely as typical children to initiate and respond to attempts to share attention with the examiner. Although the two ADOS–G items are included in the ADOS–G diagnostic algorithm, they reflect just 12.5% of the total score used for diagnostic classification. Furthermore, the ADOS–G was just one of three measures used to determine diagnostic group.

Attention to Distress: Group Comparisons

Figures 2, 3, and 4 show the mean durations of attention to the experimenter, latencies to first look at the experimenter, and degrees of concern shown for the experimenter, respectively, for the three groups of children. ANOVAs with verbal mental age entered as a covariate were conducted to assess group differences in these variables for the distress and neutral conditions. Results revealed a significant group difference in mean duration of attention in both conditions: $F(2, 124) = 13.00$, $p < .01$ for the distressed examiner condition, and $F(2, 122) = 8.55$, $p < .01$ for the neutral (hum) condition. Pairwise comparisons of adjusted means, with Bonferroni correction, indicated that children with ASD looked at the examiner less than did children with DD in both conditions ($p < .01$), and less than did children with typical development in the distress ($p < .01$) but not the neutral condition ($p = .13$). A significant main effect of group was also found for latency to first look at the examiner in the distress condition, $F(2, 104) = 9.96$, $p < .01$, but not in the neutral condition, $F(2, 85) = 2.06$, $p = .13$. One limitation of this test of latency is the fact that many more children with ASD than with delayed or typical development never looked at the examiner and thus received no score for this measure.

Table 2
Joint Attention (JA) Ability in Young Children With Autism Spectrum Disorder (ASD), Developmental Delay (DD), and Typical Development (Typ)

Variable	ASD		DD		Typical		ANOVAs			Pairwise comparisons[a]		
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*df*	*p*	ASD:DD	ASD:Typ	DD:Typ
ESCS initiate JA[b]	7.85	8.60	18.03	12.21	15.80	8.14	12.09	2, 128	<.01	<.01	<.05	0.576
ESCS respond to JA[c]	0.53	0.35	0.81	0.27	0.86	0.18	14.28	2, 125	<.01	<.01	<.01	1.00
ADOS-G initiate JA[d]	1.10	0.75	0.12	0.33	0.05	0.23	48.55	2, 139	<.01	<.01	<.01	1.00
ADOS-G respond to JA[d]	0.92	0.88	0.24	0.55	0.05	0.23	14.40	2, 136	<.01	<.01	<.01	1.00

Note. Verbal age equivalent was entered as a covariate. ESCS = Early Social Communication Scales; ADOS–G = Autism Diagnostic Observation Schedule—Generic; ANOVAs = analyses of variance.
[a] Bonferroni adjustment. [b] Frequency score. [c] Percentage correct. [d] Scale is 0–2. On this scale, 0 = *typical ability*, 1 = *some impairment*, and 2 = *more severe impairment.*

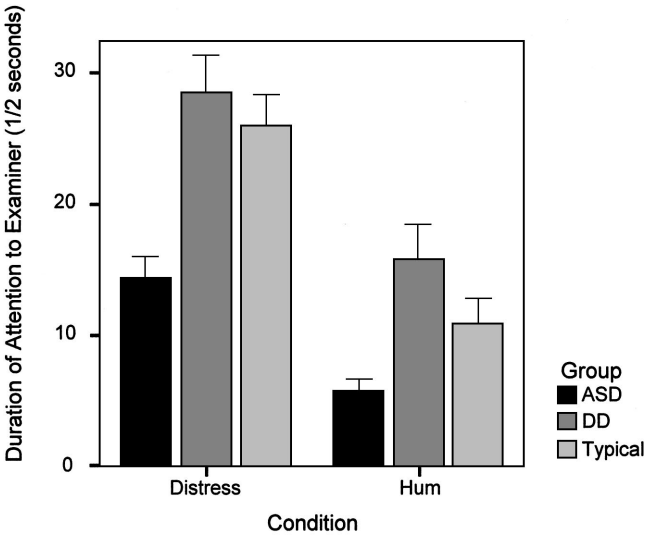

Figure 2. Mean duration of attention to the examiner (in half seconds) exhibited by children with autism spectrum disorder (ASD), developmental delay (DD), and typical development.

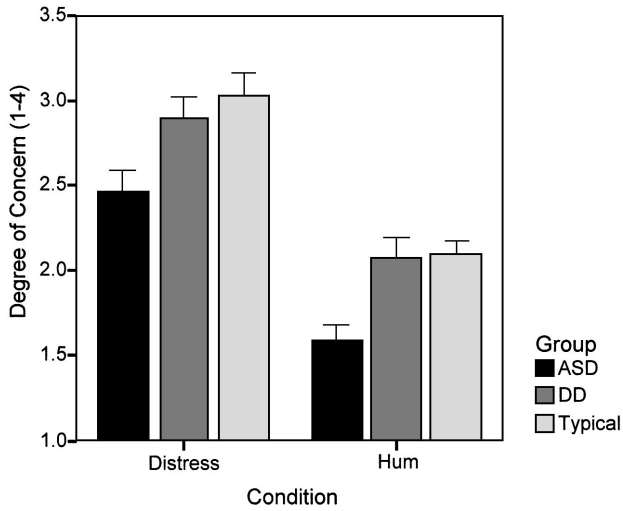

Figure 4. Mean degree of concern shown toward the examiner by children with autism spectrum disorder (ASD), developmental delay (DD), and typical development.

In the distress condition, 21.5% of children with ASD did not look at the examiner, compared with only 6.5% of the children with DD and 0% of the typically developing children, $\chi^2(2, N = 128) = 10.46$, $p < .01$. In the neutral condition, a similar pattern emerged as children with ASD failed to look at the examiner much more often than did the other children (44.4%, 12.9%, and 3.1%, respectively), $\chi^2(2, N = 126) = 22.50$, $p < .01$.

Finally, significant group differences in degree of concern were found in both conditions: $F(2, 114) = 3.98$, $p = .02$ for the distressed examiner condition, and $F(2, 110) = 7.81$, $p < .01$ for the neutral condition. Pairwise comparisons of the estimated marginal means using the Bonferroni adjustment revealed that children with ASD showed less concern for the examiner than did typically developing children in the distress condition ($p = .03$) and less concern than both control groups in the neutral condition (DD, $p = .006$; typical, $p = .003$). No group differences were found for amount of time spent in active play in the distress condition (ASD, $M = 37.16$, $SD = 21.33$; DD, $M = 39.84$, $SD = 18.13$; typical, $M = 38.28$, $SD = 20.58$) or in the neutral condition (ASD, $M = 42.19$, $SD = 19.60$; DD, $M = 44.23$, $SD = 21.36$; typical, $M = 49.06$, $SD = 12.16$).

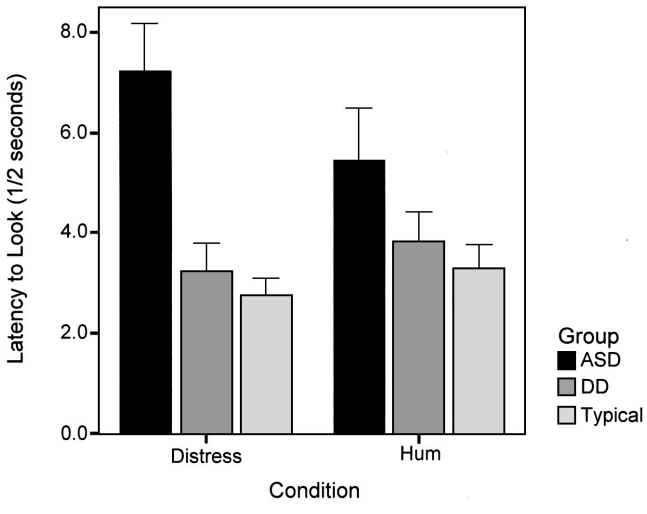

Figure 3. Mean latency to first look toward the examiner (in half seconds) for children with autism spectrum disorder (ASD), developmental delay (DD), and typical development.

Discrimination Between Autism and Comparison Groups

The next analysis examined which of the social impairment domains—uniquely or in combination—best discriminated 3- to 4-year-old children with autism from the mental-age-matched comparison groups of DD and typically developing children. One indicator from each of the three social impairment domains was included in this analysis. No items from the ADOS–G were used in this analysis as the ADOS–G was part of the algorithm used to determine diagnosis and thus group membership. The indicators—(1) social orient–experimental, (2) ESCS "initiates joint attention", and (3) attention to distress—were entered into a discriminant function analysis to examine their ability to discriminate children with ASD from those with DD and typical development.

Because there were no differences between the DD and typically developing groups on any of the social attention measures, these groups were combined into a single non-ASD group. The multivariate test was highly significant, Wilks's lambda = .66, $F(3, 103) = 18.0$, $p < .01$, indicating large differences between these two groups on these variables. The Roy–Bargman stepdown F test revealed that joint attention yielded the greatest separation between the groups, stepdown $F(1, 105) = 28.20$, $p < .01$, followed by social orienting, stepdown $F(1, 104) = 19.39$, $p < .01$. The attention to distress variable did not significantly add to the separation of these groups beyond that shown on these first two variables, stepdown $F(1, 103) = 1.40$, $p > .10$.

To assess the relative utility of these variables for discriminating children with ASD from children without ASD, we conducted

three sets of discriminant function analyses, the results of which paralleled the results from the stepdown test presented above. The first analysis entered joint attention alone, whereas the second and third analyses added social orienting and attention to distress, respectively. The classification data for these analyses are presented in Table 3. With joint attention as the only variable in the model, 83% of children with ASD were correctly classified, compared with only 63% of children without ASD. Thus, this variable by itself shows a fair degree of sensitivity but less specificity. By adding the second variable (social orienting) to the model, we improved the specificity to 81.5%, but the sensitivity dropped to 75.5%. Adding the third variable to the model did not improve the classification rates, as was expected given the nonsignificant stepdown value for this variable presented above.

Next, we repeated these analyses after subdividing the children with ASD into children with a diagnosis of autistic disorder and those with a diagnosis of PDD-NOS. These results are also presented in Table 3 and show that, in comparison to children without autism, more children with autistic disorder were correctly classified than were children with PDD-NOS. The overall classification rates for the model that included joint attention and social orienting were 88.8% for children with autistic disorder and 66.7% for children with PDD-NOS. These rates are largely due to the fact that, on average, children with PDD-NOS showed better joint attention skills than children with autistic disorder. The discriminant function analyses were also run including the Mullen Scales of Early Learning composite age equivalence score to examine how the inclusion of overall cognitive functioning affected classification rates. The results remained essentially unchanged.

Relations With Language Ability

The next set of analyses examined the relations between social attention impairments and language ability in young children with ASD. On the basis of the hypothesis that social orienting facilitates acquisition of joint attention ability, and on previous findings by Sigman and Ruskin (1999) of a predictive relation between joint attention and language ability, we predicted (a) that joint attention would be predictive of language ability and (b) that social orienting ability would be indirectly related to language ability through its association with joint attention ability. We also tested the similar hypothesis that attention to distress would be indirectly related to language ability through its relationship with joint attention.

The correlations among the indicators and their standard deviations are presented in Table 4. Note that ADOS–G scores were kept in their original metric, where higher scores indicate greater impairment. For all other variables, higher scores indicate greater adaptive behavior. Table 5 shows the results of the total effects of the social attention factors with language; all factors are correlated with one another. In addition to a good overall fit of the data to the model, $\chi^2(48) = 69.69$, comparative fit index (CFI) = .946, root mean square error of approximation (RMSEA) = .080, the measurement of each of the four factors was found to be strong, with each indicator having a statistically significant loading with its hypothesized factor. Although the Joint Attention and Social Orienting factors both contain indicators from the ADOS–G, the magnitude of their loadings was comparable to that of the loadings of the other indicators for the factor collected during different tasks and on different days. This model shows that each of the social attention factors was significantly correlated with the others and with language ability. Next, we wished to test the specific hypothesis that social orienting ability is indirectly related to language ability through its association with joint attention ability. This model is presented in Figure 5. Overall, this model fit the data well, $\chi^2(32) = 58.11$, CFI = .927, RMSEA = .107, and the data supported the hypothesis of no direct relationship between social orienting and language ($Z = 0.23$, *ns*) but rather an indirect relationship through joint attention (Social Orienting → Joint Attention path, $Z = -2.41$, $p < .01$; Joint Attention → Language path, $Z = 2.30$, $p < .05$).

Similarly, we tested for the presence of direct versus indirect relationships between attention to distress and language (see Figure 6). Again, the model fit the data well, $\chi^2(32) = 43.92$, CFI = .967, RMSEA = .072, and attention to distress showed no direct relationship to language ($Z = -.02$, *ns*) but an indirect relationship through joint attention (Attention to Distress → Joint Attention path, $Z = 3.17$, $p < .01$; Joint Attention → Language path, $Z = 3.52$, $p < .01$).

Discussion

The present study was designed to provide a better understanding of the social attention impairments found in autism, their ability to discriminate young children with autism from children with DD and typical development, and their relations with language ability. Replicating previous studies, the present study showed that preschool-age children with ASD were significantly impaired in the domains of social orienting, joint attention, and attention to distress relative to mental-age-matched children with DD and typical development. In the domain of social orienting, the present study replicated and extended an experimental study con-

Table 3
Percentages of Children Correctly Classified According to Discriminant Function Analyses Based on Joint Attention, Social Orienting, and Attention to Distress (Degree of Concern) Variables

Variables in model	ASD ($n = 53$)	Non-ASD ($n = 54$)	Total ($n = 107$)	Autistic disorder ($n = 35$)	Non-ASD ($n = 54$)	Total ($n = 89$)	PDD-NOS ($n = 18$)	Non-ASD ($n = 54$)	Total ($n = 72$)
Joint attention	83.0	63.0	72.9	97.1	66.7	78.7	61.1	53.7	55.6
Joint attention and social orienting	75.5	81.5	78.5	88.6	88.9	88.8	61.1	68.5	66.7
Joint attention, social orienting, and attention to distress	75.5	83.3	79.4	88.6	90.7	89.9	61.1	68.5	66.7

Note. ASD = autism spectrum disorder; PPD-NOS = pervasive developmental disorder not otherwise specified.

Table 4
Correlations (and Standard Deviations on the Diagonal) of Indicators Used in Structural Equation Analysis

Indicator	1	2	3	4	5	6	7	8	9	10	11	12
1. Initiate joint attention, ADOS–G	(0.75)											
2. Initiate joint attention, ESCS	−.44	(8.60)										
3. Respond to joint attention, ADOS–G	.37	−.29	(0.90)									
4. Respond to joint attention, ESCS	−.41	.33	−.44	(0.35)								
5. Social orienting, ADOS–G	−.17	.34	−.30	.09	(1.03)							
6. Social orienting, experimental	−.34	.44	−.30	.30	.31	(0.28)						
7. Attention to distress–attention	−.28	.14	−.22	.26	.21	.32	(12.86)					
8. Attention to distress–concern	−.35	.21	−.32	.34	.35	.41	.59	(0.96)				
9. Vineland receptive language	−.44	.32	−.38	.41	−.32	.42	.14	.33	(13.21)			
10. Mullen receptive language	−.52	.44	−.50	.52	−.36	.38	.32	.38	.51	(11.09)		
11. Vineland expressive language	−.53	.47	−.46	.62	−.27	.46	.34	.36	.67	.69	(9.90)	
12. Mullen expressive language	−.54	.42	−.51	.53	−.27	.42	.38	.38	.58	.90	.81	(10.50)

Note. ADOS scores were kept in their original metric, where higher scores indicate greater impairment. ADOS–G = Autism Diagnostic Observation Schedule—Generic; ESCS = Early Social Communication Scales; Vineland = Vineland Adaptive Behavior Scale; Mullen = Mullen Scales of Early Learning.

ducted by Dawson, Meltzoff, Osterling, Rinaldi, and Brown (1998) by demonstrating that young children with ASD were less likely to orient to both social and nonsocial auditory stimuli and that this orienting impairment was more severe for social stimuli. In the present study, larger numbers of more carefully matched stimuli were used, and a younger and larger sample of children with ASD was studied. For each of the four social stimuli tested (humming, calling the child's name, snapping fingers, and patting hands on thighs), children with autism were more likely to fail to orient than were the children with DD and typical development, suggesting a general social orienting impairment in autism.

Of the three domains of social attention impairment examined, joint attention was found to be the most sensitive discriminator of autism from DD or typical development. On the basis of measures of joint attention ability alone, it was possible to classify correctly 83% of children with ASD and 63% of children without ASD. Although joint attention currently is part of the ADOS–G diagnostic algorithm, it is only one symptom among many that are assessed, and a child can receive a diagnosis of autism without having joint attention impairment. The fact that this symptom alone discriminated fairly well between children with and without ASD underscores its diagnostic value. Knowledge of a child's social orienting ability increased specificity (i.e., there were fewer false positives). That is, it was seldom the case that the children without ASD showed an impairment in social orienting. At the same time, the addition of social orienting decreased sensitivity somewhat, reflecting the fact that some children with autism oriented to social stimuli at a level comparable to that shown by children without ASD. When both joint attention and social orienting abilities were considered, 75.5% of the children with ASD and 81.5% of children without ASD were correctly classified. Thus, the combination of joint attention and social orienting improved classification overall. Knowledge of children's attention to distress did not improve classification in terms of either sensitivity or specificity. Social orienting might be especially useful in detecting autism in infants and toddlers. In a home videotape study of 8- to 10-month-olds later diagnosed with autism and 8- to 10-month-olds with typical development, Werner et al. (2000) found that a child's ability to orient to his or her name being called was the best discriminator of the two groups. Joint attention ability did not discriminate between the two groups, as would be expected because such skills are just developing at 8–10 months of age. Similarly, in another home videotape study, Osterling et al. (2002) found that 1-year-old infants later diagnosed with autism could be distinguished from 1-year-old infants later diagnosed with mental retardation (without autism) on the basis of two behaviors: looking at people and orienting to their names being called. Joint attention behaviors did not distinguish the two groups at this early age. In summary, these results suggest that assessments of both social orienting and joint attention might be more useful in identifying young children with autism than is an assessment of joint attention alone.

We also examined the relations between social attention and language ability in young children with ASD. On the basis of the hypothesis (Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998) that social orienting ability facilitates the acquisition of joint attention skills, and Sigman and Ruskin's (1999) finding that joint attention ability was predictive of both concurrent and future language ability in children with autism, we hypothesized that social orienting would be directly related to joint attention ability and indirectly related to language ability. Structural equation modeling analyses supported this hypothesis. Attention to distress also

Table 5
Results From Structural Equation Model Relating Social Orienting, Joint Attention, and Attention to Distress to Language Ability

Measurement model paths	Path[a]	*Z*
JA → Initiate joint attention, ADOS–G	−.66	−4.6*
JA → Initiate joint attention, ESCS	.56	4.0*
JA → Respond to joint attention, ADOS–G	−.61	−4.3*
JA → Respond to joint attention, ESCS	.64[b]	—
SO → Social orienting, ADOS–G	.47[b]	—
SO → Social orienting, experimental	.65	3.2*
AD → Response to distress—attention	.68[b]	—
AD → Response to distress—concern	.87	4.1*
LANG → Receptive language, Mullen	.92[b]	—
LANG → Expressive language, Mullen	.97	5.4*
LANG → Receptive language, Vineland	.60	5.8*
LANG → Expressive language, Vineland	.82	6.0*
Correlations among factors		
JA–SO	.81	2.6*
JA–AD	.57	2.6*
SO–AD	.75	2.5*
JA–LANG	.86	3.4*
SO–LANG	.67	2.5*
AD–LANG	.48	2.5*
χ^2 = 69.69, CFI = .946, RMSEA = .080		

Note. In the structural equation models, JA is the Joint Attention factor, SO is the Social Orienting factor, AD is the Attention to Distress factor, and LANG is the Language Ability factor. ADOS–G = Autism Diagnostic Observation Schedule—Generic; ESCS = Early Social Communication Scales; Mullen = Mullen Scales of Early Learning; Vineland = Vineland Adaptive Behavior Scale; CFI = comparative fit index; RMSEA = root mean square error of approximation.
[a] Standardized path coefficient. [b] The unstandardized path for this indicator was set equal to 1 because this indicator functions as the reference indicator for this endogenous factor. No significance tests are performed for reference indicators.
* $p < .01$.

was found to be directly related to joint attention ability and indirectly related to language ability. Social orienting and attention to distress both index a child's tendency to notice and attend to social and affective cues. Such attention to social information might facilitate the acquisition of joint attention by increasing opportunities for engaging in joint attention episodes. Given that preferential attention to social stimuli, such as faces, emotional expressions, and voices, is typically apparent very early in life, it is likely that a failure to orient to social stimuli represents one of the first symptoms, if not the first, to emerge in autism. This impairment would be expected to have profound and far-reaching consequences for social development because the acquisition of more complex communicative abilities, such as joint attention and

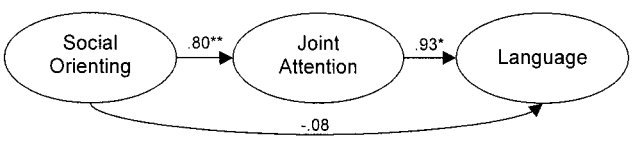

Figure 5. Structural equation model testing the mediating role of joint attention between social orienting and language ability in 3- to 4-year-old children with autism spectrum disorder.

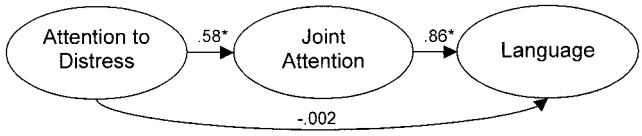

Figure 6. Structural equation model testing the mediating role of joint attention between attention to distress and language ability in 3- to 4-year-old children with autism spectrum disorder.

communicative speech, requires the child to actively attend to and make meaning of social stimuli, including facial features, direction of eye gaze, facial expressions, and so on.

Although not directly tested in the present study, one possible explanation for this social orienting impairment is a child's failure to find social stimuli inherently rewarding (Dawson et al., 2000a, 2000b, 2001, 2002; Mundy & Neal, 2001). More specifically, it is likely that the shared affective experience that typically accompanies joint attention and other communicative acts serves to motivate the typically developing toddler to attend to and engage in such acts. When a child initiates joint attention episodes, especially ones that are protodeclarative in nature (e.g., showing a parent an object of interest), such episodes are often accompanied by affective sharing between the child and the adult (e.g., mutual delight), and affective sharing typically is inherently rewarding to the child. In autism, a failure to find such affective exchanges inherently rewarding arguably might affect the child's motivation to participate in early protodeclarative exchanges, which themselves provide the basis for practicing and acquiring communicative skills.

It is possible to facilitate the development of joint attention in children with autism (Dawson & Zanolli, 2003; Klinger & Dawson, 1992; Siller & Sigman, 2002; Whalen & Schreibman, 2003). In early intervention with autism, this is often accomplished by requiring the child with autism to look at an adult and point to a highly preferred object in order to have access to that object. In other words, the child is required to produce protoimperative joint attention acts in order to have access to nonsocial rewards. In this case, the development of joint attention proceeds in a way very different from that in typical development. As mentioned above, in typical development, infants' motivation to engage in joint attention acts often centers around mutual affective exchanges that both the child and the adult find rewarding (Adamson & Russell, 1999; Kasari, Sigman, Mundy, & Yirmiya, 1990; Mundy, Kasari, & Sigman, 1992). In children with autism, however, joint attention acts are rarely accompanied by shared exchanges of positive affect (Kasari et al., 1990; Paparella et al., 2001; Paparella & Kasari, 2002). If joint attention acts carried out by children with autism rarely are motivated by an inherent interest in the shared affective experience, the nature of joint attention and thus of communication in general will be different in autism. Children with autism will be less likely to engage in joint attention and other communicative acts purely for the sake of shared experience (e.g., showing, commenting). Furthermore, they will be less likely to attend to and make meaning out of others' emotional expressions during communicative exchanges, and this might further impede the development of the pragmatic aspects of language.

In summary, the results of the present study suggest that combined impairments in joint attention and social orienting ability distinguish young children with autism from children of similar mental age without autism better than does joint attention impair-

ment alone. Furthermore, whereas joint attention is the best predictor of concurrent language ability, both social orienting and attention to distress appear to indirectly contribute to language ability via their relations with joint attention. These results help to clarify the nature of impairment in social attention in autism, offer clues to possible developmental mechanisms, and suggest specific targets for early intervention. It is possible to facilitate the development of joint attention ability in young children with autism by increasing their motivation to attend to social stimuli and triadic communicative exchanges. Such interventions are important for setting the stage for the later development of communicative skills.

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Received May 21, 2001
Revision received October 21, 2003
Accepted October 27, 2003 ■