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Links Between Social Understanding and Social Behavior in Verbally Able Children with Autism

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This study investigated the relations between various measures of social understanding and social interaction competence in verbally able children with autism. Measures of social understanding included measures of verbalizable knowledge (false belief understanding, affective perspective taking), as well as measures of more intuitive forms of social responsiveness (empathy, concern to distress, and initiating joint attention). Two measures of social interaction competence were employed: level of engagement with peers on the playground, and prosocial behavior in a structured laboratory task. For children with autism, initiating joint attention and empathy were strongly related to both measures of social interaction competence. No understanding–behavior links were identified for a language-age matched comparison sample of developmentally delayed children. Several accounts of these understanding–behavior links are considered, including the possibility that for children with autism, more impaired forms of understanding are more closely linked to behavior because they serve as limits on competence.

KEY WORDS: Social understanding; social behavior; autism.

INTRODUCTION

Autism is characterized by deficits in social understanding and social behavior. The exact nature of these deficits is increasingly well understood as the result of careful studies comparing autistic samples to appropriate control groups. However, less research has examined these deficits from an individual differences perspective. That is, although autistic individuals are known to suffer from impairments in both social understanding and social behavior, little is known about how these deficits are related within the autistic group. Do the extent and type of understanding deficits predict the extent and type of social interaction difficulties an autistic individual is likely to manifest? Do children with autism as a group differ from other groups in the patterns of relations between understanding and behavior? The present paper explores these two questions using a variety of measures of social understanding and two measures of social interaction. Our measures of social interaction include naturalistic observations of peer interaction on the school playground, and a measure of prosocial behavior toward an adult in a laboratory situation. The kinds of social understanding we chose to explore have all been demonstrated in previous research to be impaired in autism. Some of our measures, such as false belief understanding and affective perspective-taking, tapped explicit verbalizable knowledge, whereas others, such as joint attention and responsiveness to distress, assessed more intuitive forms of understanding as manifested by social responsiveness. We also included a self-report measure of empathy, which depended both on intuitive responsiveness and verbalizable knowledge. Because we were interested in both verbal and nonverbal measures of understanding, our focus was on a high-functioning sample. Our sample consists of those autistic and (non-Down syndrome) developmentally delayed children from Sigman and Ruskin's (1999) study who achieved a mental age (MA) of 48 months or higher by middle childhood. Thus our sample includes the more able half

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of their autistic group and the more able two thirds of their developmentally delayed group.

Previous research has already found links between some of our measures of social understanding and social interaction in autistic children. For example, affective perspective taking ability (Hauck, Fein, Waterhouse, & Feinstein, 1995) as well as responsiveness to distress and joint attention (Sigman & Ruskin, 1999) have been found to correlate with peer interaction. In this paper we focus on replicating these results with a high-functioning sample. In addition we hypothesize that false belief understanding and self-report of empathy might predict skill in interacting with peers. Theory of mind ability relates to at least some types of social interaction, including conversational ability (Capps, Kehres, & Sigman, 1998; Eisenmajer & Prior, 1991; Happé, 1994), and specific social behaviors (Frith, Happé, & Siddons, 1994). We reasoned that autistic children with greater theory of mind ability should be better able to predict and understand the behavior of their peers, which in turn should facilitate peer interaction. Less research has explored prosocial behavior in autistic children, so we were less confident in predicting its correlates. However, we considered all of our measures of social understanding to be plausible as correlates of prosocial behavior.

We were also interested in comparing understanding–behavior links in our autistic and our nonautistic samples. One hypothesis regarding group differences in these links is that they will be stronger in the autistic than in comparison groups due to understanding deficits in autism. Autistic individuals should be functioning at lower levels on understanding measures, and thus for them, understanding may be more of a limiting factor on social interaction competence than it is for other children. For other groups, who are functioning overall at higher levels of understanding, factors other than understanding may account for more of the variance in social behavior. According to this hypothesis, there is nothing specific to autism per se that is responsible for tighter understanding–behavior links other than low levels of social understanding. When level of understanding is controlled for, the autistic group and other groups should show similar behavior–understanding relations.

An alternative is that autism causes understanding and behavior to be organized and integrated in an unusual or deviant manner. One reason for this different organization might be that social understanding in autism is never quite equivalent to that of nonautistic children. Even though some children may appear to have a certain form of competence, such as an understanding of false belief, closer examination reveals that this competence is likely to rest on different foundations (e.g., Leslie & Roth, 1993), and is likely to have been arrived at via a different developmental route than in other children. One popular idea is that autistic children's social understanding is acquired through a painstaking reasoning process, whereas the same understanding is achieved relatively effortlessly and intuitively by typically developing children. It has been argued that such nonintuitive social knowledge may fail to support effective social interaction, because it is slow and cumbersome compared to more intuitive knowledge (Bowler, 1992). According to this different organization hypothesis, children with autism are likely to look different from other children in the pattern of relations between understanding and behavior, though it is difficult to arrive at specific hypotheses about how they will differ.

A third possibility is that because the foundations of social and affective functioning are compromised in autism, children with autism will show more fragmented, disorganized development in the social domain. Thus they may be less likely to show relationships between understanding and behavior. Some support for this view has been obtained looking at the relations among different measures of understanding. Buitelaar and van der Wees (1997) found theory of mind ability and emotion recognition abilities were correlated in a combined sample of normal and psychiatric patients, but that the same relation did not hold for a sample of high-functioning children with autism and children with pervasive developmental disorder.

To summarize, this study has two main goals. The first is to examine, for a verbally able autistic sample, the relation of a variety of measures of social understanding to two measures of social interaction competence: peer interaction and prosocial behavior. The second is to compare the relations between understanding and interaction measures in the autistic group to those found for a control group of developmentally delayed children.

Our ability to address these issues is subject to some statistical limitations. First, our small sample and limited power puts us at risk for Type II error (failing to detect true relations), and our use of multiple comparisons involving the same samples puts us at risk for Type I error (incorrectly identifying relations as reliable by chance). Nevertheless we chose to use our data to address these questions in an exploratory manner because, though limited, a comprehensive set of data such as ours on a relatively rare group (verbally able children with autism) constitutes an unusual resource. With regard to Type II errors, it is important to bear in mind that with our sample size, we only have acceptable power for the detection of large effects (e.g., *r*s ≥ .50). Detection of small to moderate effects must await future studies with larger samples. With regard to Type I errors, we adopt the following approach. We employ correction for multiple comparisons, but report our results both with and without correction. Thus more conservative readers can consider only those results that are significant with correction, while less conservative readers can consider the full pattern of results.

METHOD

Participants

Twenty children with autism (1 girl) and 20 children with developmental delay (DD) (3 girls) participated in this study. These children were selected from a group consisting of 43 children with autism and 33 children with DD, participating in a larger longitudinal study (Sigman & Ruskin, 1999). To be included in this study, children were required to have MAs of at least 48 months (as determined by the revised Stanford-Binet (Thorndike, Hagen & Sattler, 1986).

All children were administered the following subtests of the revised Stanford-Binet: Vocabulary, Bead Memory, Pattern Analysis and Quantitative Analysis. The mean score of the four subscales was used to determine mean MA and overall IQ scores. In addition, the Reynell Scales of Language Abilities (Reynell, 1977) were administered to all children. These scales provide separate age-equivalent scores for expressive and receptive abilities. The scores reported in this study represent the mean of these two scores. The characteristics of our sample are presented in Table I. The autistic and DD samples were matched for language age, with mean language ages of 5 years 11 months and 6 years 0 months, respectively. The two groups were also closely matched on IQ, with mean IQs of 76.8 and 77.1, respectively. The mean MA of the autistic group was somewhat higher than that for the DD group (8 years 4 months vs. 6 years 11 months), but this difference was not statistically reliable. The autistic cohort was chronologically older than the DD cohort, $t(38) = 2.79$, $p < .01$.

Table I. Sample Characteristics[a]

	Autistic			Developmentally delayed		
	M	*SD*	Range	*M*	*SD*	Range
CA	12,8	3,2	8,6–18,6	9,10	3,2	7,0–18,5
MA	8,4	3,1	4,0–15,2	6,11	2,0	4,1–11,10
LA	5,11	2,5	2,1–9,7	6,0	1,4	3,5–9,0
IQ Score	76.8	21.9	38–116	77.1	23	41.5–108

[a] *n* = 20 for each group. Chronological, mental, and language age given in years, months.

Children with autism were recruited from a group seeking diagnosis and treatment at UCLA's Neuropsychiatric Institute. All of the children were initially diagnosed in early childhood, and then had diagnosis reconfirmed using the Autistic Diagnostic Interview (ADI; Le Couteur *et al.*, 1989) at the time the measures for this study were collected. Because these children were recruited over a long period, during which time diagnostic standards changed, methods of initial diagnosis varied. Five of the children with autism received clinical diagnoses from an interdisciplinary team of clinicians, using DSM-III or DSM-III-R. The rest of the children received the same clinical diagnosis applied by a single clinician, supplemented by the Childhood Autism Rating Scale (CARS; Schopler, Reichler, & Renner, 1986) and the Autistic Behavior Checklist (ABC; Krug, Arick, & Almond, 1980), administered as an interview to the parent. Of this latter group, only children satisfying criteria for autism by at least two of the three methods were included in the study. At the time the data described in this study were collected, the ADI was administered to confirm the original diagnosis. Only one child failed to have diagnosis confirmed by the ADI, and this child only missed criteria by 1 point on the repetitive behavior subscale.

Most of the children with DD had mental retardation with no known cause. These children were recruited from various sources including the Los Angeles School District, local preschools and parent groups, and from an inpatient unit. Children were excluded if they satisfied criteria for autism on more than one of the three diagnostic measures (CARS, ABC, clinician's diagnosis) administered in early childhood, or if they met criteria for autism according to the ADI at the time the follow-up measures were administered (see Table I).

Procedure

Joint Attention

Initiating and responding to joint attention were measured using a modified version of the Early Social Communication Scales (ESCS; Mundy, Hogan, & Doehring, 1996). The ESCS is a standardized procedure designed to assess nonverbal communication skills in young children (toddlers to preschoolers with limited or no verbal ability). To make the procedure more appropriate for our older, more able sample, several modifications to the original procedure were made. In the original and in the modified procedure, child and experimenter sit facing each other at a table, with attractive toys in view but out of the child's reach. Toys are presented one at a time. Initiating joint attention is coded each time the child attempts to draw the experimenter's attention to a toy for purposes other than requesting, using behaviors such as pointing, showing, gaze alternation, or verbal comments. In the modified procedure, toys more appropriate for the older age group were substituted. To elicit initiation of joint attention, in addition to the use of wind-up toys as in the original ESCS procedure, the experimenter surreptitiously activated a mechanical seal placed several inches in front of the child. Response to joint attention was tested as in the original procedure by recording the child's responses to the experimenter's calling the child's name and pointing to the left/right and behind the child. Based on a large sample of children from this lab, the generalizability coefficient for this measure is .80.[3]

False Belief Understanding

Three different false belief tasks were administered on two different testing days.

In the *puppet* task, the experimenter presented a brief scenario involving two puppets, Madeleine and Babar. Madeleine hides her ball in one location and then leaves the room. While she is gone, Babar moves her ball to a new location. Then Madeleine returns, and the child is asked the key question: "Where will Madeleine look for her ball?" The child is also asked a reality control question, "Where is the ball really?" and a memory control question "Where was the ball before?". Children were also asked to provide justifications for their answers.

The *real person* task paralleled the puppet task exactly, except that real people played the roles of the puppets.

In the *Smarties* task, the experimenter showed the child a candy box. The child was asked "What is in the box?". The box was then opened and the child was shown that instead of the expected candy, the box contained pencils. The box was closed again, and another person walked into the room. The child was asked the key question: "Cindy has never seen this box before. What will she think is in it?" Children were also asked to answer "What is really in the box?" (reality question), and "What did you think was in the box when you first saw it?" (memory for own false belief question) and were asked to give justifications for their answer to the key question.

Children who did not demonstrate satisfactory understanding of the task by their performance on the memory and reality control questions were excluded from further analyses. Five control questions including the three reality questions and the two memory questions from the puppet and real person tasks were considered. (The memory for own false belief question was not considered as a control question because it involves both memory and false belief understanding.) If all five control questions were not correctly answered, the child was excluded from further analyses. Five children with autism and one child with developmental delay were excluded on this basis. For the remaining children, a total false belief score was created by adding the total number of key questions answered correctly across the three tasks.

Responsiveness to Distress

Experimenter and child sat across from each other at a table during a refreshment break. The experimenter pretended to bump her knee, and then exclaimed loudly in pain. She continued to display distress, facially and vocally, and also continued to rub her knee for 30 seconds. She then reassured the child and showed neutral affect for the following 10 seconds. The child's behavior during the 45-second period immediately following the bump was rated on degree of concern on a three-point scale. Interrater reliability was excellent ($k = 1.0$). The experimenter's display of distress was also rated for quality on a three-point scale. All displays received the highest rating.

Affective Perspective Taking

Children were administered an affective knowledge task, adapted from Denham (1986). This task makes use of a puppet that has four detachable felt faces depicting four different emotions (happiness, sadness, fear, and anger). The experimenter enacted two vignettes depicting the protagonist experiencing each emotion (eight total), accompanied by standardized visual and vocal cues. For each vignette, the child was asked to select a face from among four alternatives to match the puppet's emotion, and to provide a label for that emotion. For both selection and labeling, 2 points

[3] All the reliability statistics reported here are based on the entire sample from Sigman and Ruskin (1999), from which our sample was drawn.

were assigned for an exact match for the emotion depicted, 1 point for matching the depicted emotion in valence (positive or negative), and 0 points for other responses. Total score for labeling and selecting were added across the eight vignettes to provide a score that ranged from 0 to 32.

Empathy

Following each vignette, the child was "How does this make you feel?". As in the understanding task, the child was asked both to select a face and to provide a label to describe the emotion he was feeling. Scores were based on the correspondence between the child's responses for himself and his responses for the puppet, regardless of whether the answers to the perspective taking task were correct. The child received a score of 2 if his choices matched the expression he had selected for the puppet exactly, a score of 1 if it matched his choice for the puppet in valence, and a score of 0 for non-matching responses. Two autistic and three developmentally delayed children were excluded from analyses of this task, because their patterns of performance indicated that they were obtaining high scores due to perseverative responding.

Peer Interaction

Children were observed during the least structured part of their school day, usually on the playground during recess time. Observations lasted for a minimum of 30 minutes, but ranged from 31 to 64 minutes ($M = 41$, $SD = 10.72$). To account for differences in observation times, all peer interaction data were transformed to proportion of total observation intervals during which particular behaviors were observed. Our analyses focused on high-level social play, as defined by the Peer Play Scale (Howes, 1980). High-level social play includes simple social play and organized games. Level of play was coded in continuous 15-second intervals. Interrater reliability for high-level social play as measured by intraclass correlations was 1.0.

Prosocial Behavior

Sharing and helping behaviors were assessed in a structured laboratory situation. Two opportunities for helping and two opportunities for sharing were presented during the course of a refreshment break during testing. In all situations, the child was given the opportunity to act without prompting, and if the expected behavior did not occur, was given a hint, followed by a specific verbal prompt. The two situations designed to elicit helping involved (a) the experimenter holding a full tray, and standing near a table that was almost completely covered with objects and (b) the experimenter spilling some juice. The two situations designed to elicit sharing involved (a) the child's sharing of food and (b) the child's willingness to show photos to an experimenter who sat across from the child and demonstrated interest in them. Response to each situation was coded from a 4-point scale ranging from 1 (*no helping/sharing after both hinting and asking*) to 4 (*unsolicited helping/sharing behaviors*). Interrater reliability for helping and sharing behavior, as measured by kappas, ranged from .79 to .91.

RESULTS

Due to time limitations and failures of cooperation in some cases, not all measures were obtained for all subjects. In addition, as described in the Method section, several children's performance on particular tasks indicated failure to understand the task, so their data were excluded from analyses of those tasks. Finally, performance on the responding to pointing task was uniformly high for both groups, so we excluded it from further analyses. With this exception, the range and variance for each measure indicated that there were no floor or ceiling effects (Table II), although for some measures a few children obtained the highest possible scores. Note also that measures of false belief understanding, concern to distress, and prosocial behavior had fairly restricted ranges (see Table II), which may have affected our ability to detect correlations involving these measures. All correlations were run pairwise, in order to include the largest possible number of subjects.

Table II compares the two groups' levels of performance on all variables. Because all measures were chosen based on previous literature indicating specific impairments in autism for these abilities, one-tailed t tests were employed. Effect sizes are also reported, in order to identify cases where moderate-sized group differences might fail to reach statistical reliability because of limited power. First, based on comparison by t tests, the only reliable differences between the groups were in peer interaction and prosocial behavior. As predicted, in both cases, the group with autism showed less competence than the group with developmental delay. The groups also showed marginally reliable differences, and moderate effect sizes in the predicted direction on initiating joint attention, concern to distress, and empathy (all ps = .06). There were also differences in false belief understanding of moderate effect size that failed

Table II. Comparison of Autistic and Developmentally Delayed Groups on Understanding and Behavior Measures

Variable[a]	Group: Autism	Group: Developmental delay	t	df	p	Effect size[c]
Initiates joint attention (0–24)						
M	8.2	13.6				
SD	6.1	11.0	1.69	20.9[b]	.053	—[d]
n	18	15				
False belief understanding (0–3)						
M	2.1	1.7	1.01	30	.161	.36
SD	1.0	1.1				
n	13	19				
Concern to distress (0–3)						
M	1.8	2.2	1.58	36	.062	.44
SD	0.9	0.7				
n	20	18				
Affective perspective taking (0–32)						
M	26.4	26.5	.07	32	.474	.01
SD	6.9	4.1				
n	15	19				
Empathy (0–32)						
M	21.8	27.6	1.68	20.9[b]	.054	—[d]
SD	10.6	7.5				
n	13	16				
Prosocial behavior (1–4)						
M	2.5	2.8	1.99	37	.027	.42
SD	0.7	0.4				
n	20	19				
Peer interaction (0–1.0)						
M	.34	.66	3.18	30.3	.002	.86
SD	.37	.23				
n	19	18				

[a] Numbers in parentheses indicate possible range.
[b] For these tests, equal variances were not assumed.
[c] For all effect sizes, the larger of the two *SD*s was used as an estimate of the population *SD*.
[d] Effect sizes could not be calculated because of unequal *n* and unequal variance.

to reach statistical reliability. However, these differences were in the opposite direction to that predicted, with the autistic group outperforming the DD group.

As a preliminary step before examining relations between understanding and social interaction, we examined the relations between all measures and our basic measures of linguistic and intellectual functioning. Table III presents the correlations between language age, mental age, and IQ and our other variables. False belief understanding was strongly and in most cases reliably correlated with all measures of intellectual and linguistic ability for both groups. In addition, for the autistic group, IQ was reliably correlated with affective perspective taking. For the developmentally delayed group, MA was reliably correlated with peer interaction. No other correlations were statistically reliable or of large effect size.

Because of the relations between intellectual/language ability and some of our variables of interest, we present correlations between social understanding and social interaction measures both with and without partialing out language age (Table IV). Language age (LA) was highly correlated with both MA and IQ for both the autistic (rs = .82 and .63, respectively, ps < .05) and for the developmentally delayed group (rs = .76 and .68, respectively, ps < .001), thus LA served as a good index of overall level of intellectual functioning.

First, examination of Table IV reveals that in all cases, analyses in which LA was partialed out were essentially the same as those involving bivariate correlations. Therefore, the present description focuses on the bivariate correlations only. For the autistic group, initiating joint attention and empathy were strongly correlated with both measures of social interaction (all rs ≥ .50). Individually, all four correlations were statistically reliable, $p < .05$. However, with Bonferonni correction, only the correlations between understanding measures and peer interaction were reliable, $p < .05$. In contrast, no correlations between understanding and social behavior were statistically reliable for the developmentally delayed group.

We compared the four correlations that were reliable for the autistic group with their counterparts for the developmentally delayed group. Correlations between initiating joint attention and peer interaction differed between the two groups, $z = 3.08$, $p < .005$. The other three pairs of correlations came close to being reliably different, all ps < .07.

Because correlations on small samples such as ours may be substantially distorted by the presence of outliers, scatterplots were examined for all correlations. Figure 1 presents the scatterplots for the four highest correlations for the autistic group. In no case did the correlation appear to be solely attributable to the influence of outliers. However, one individual who received an unusually high score on initiating joint attention may have inflated correlations involving this variable. To minimize the contribution of this one data point, Spearman's rho was also calculated for correlations involving initiating joint attention. Spearman's rho for initiating joint attention and prosocial behavior was .56, $p < .05$, and rho for initiating joint attention and peer interaction was .63, $p < .01$.

In the case of false belief understanding, we performed an additional analysis to test for a relation between false belief understanding and social interaction. We compared those children who met the strict crite-

Table III. Correlations Between Understanding and Behavior Measures and Mental Age, Language Age, and IQ

	Autism group			Developmentally delayed group		
Measure	Language age	Mental age	IQ	Language age	Mental age	IQ
Understanding						
Initiates Joint Attention	.13	−.01	.08	.07	.24	−.03
False belief understanding	.66[a]	.55	.51	.45	.64[a]	.58[a]
Affective perspective taking	.33	.42	.60[a]	.43	.36	.27
Empathy	.29	−.01	.34	.07	.24	.34
Concern to distress	.19	.22	.16	−.07	.16	−.07
Behavior						
Prosocial behavior	.33	.28	.32	.16	.10	−.01
Peer interaction	.25	.08	.38	.35	.49[a]	.35

[a] $p < .05$.

Table IV. Correlations Between Social Understanding and Social Behavior Variables

	Autism				Developmental delay			
Social understanding variables	*n*	Full *r*	Partial *r* (−LA)	95% *CI* on ρ	*n*	*r*	Partial *r* (−LA)	95% *CI* on ρ
Prosocial behavior								
Initiates joint attention	18	.50[a]	.49[a]	.05–.79	15	−.16	−.08	−.38–.62
False belief understanding	13	−.20	.07	−.68–.39	19	.40	.37	−.07–.72
Affective perspective taking	15	.44	.50	−.09–.78	19	.18	.13	−.30–.59
Empathy	13	.67[a]	.70[a]	.19–.89	16	.03	.03	−.47–.52
Concern to distress	20	.16	.10	−.30–.57	18	.32	.37	−.20–.67
Peer interaction								
Initiates joint attention	17	.73[b]	.73[b]	.39–.90	14	−.27	−.17	−.30–.70
False belief understanding	12	.05	.07	−.54–.61	18	.31	.23	−.18–.68
Affective perspective taking	14	.28	.23	−.29–.71	18	−.07	−.20	−.52–.40
Empathy	12	.82[b]	.81[b]	.47–.95	15	.30	.30	−.25–.71
Concern to distress	19	.01	−.04	−.45–.46	17	.10	.18	−.38–.54

[a] $p < .05$.
[b] $p < .01$.

rion of passing all three false belief questions (passers) with those who failed one or more tasks (failers) on our two measures of social interaction. For neither autistic nor developmentally delayed children did this comparison yield any reliable differences (Table V).

For the autistic group, prosocial behavior and peer interaction were significantly correlated, $r = .49$, $p < .05$. For the developmentally delayed group, prosocial behavior and peer interaction were not correlated, $r = -.026$, $p > .90$.

DISCUSSION

Our results raise two issues. First, what accounts for the observed pattern of relations within the autistic group? Second, what accounts for the differences between the autistic and developmentally delayed groups in understanding–behavior relations (i.e., lack of relations in the DD sample)?

Regarding the first issue, it is easier to account for our positive findings than our negative ones. There are a number of plausible explanations for the relations between initiating joint attention, empathy, and social interaction competence in the autistic sample. First, our findings are quite consistent with Mundy's (1995) proposal that children with autism suffer from specific impairments in "social emotional approach behavior." Mundy argued that social-emotional approach behaviors may be a distinct class of behaviors functioning within a system subserving affiliative, affectively positive social interactions. Such behaviors are viewed as

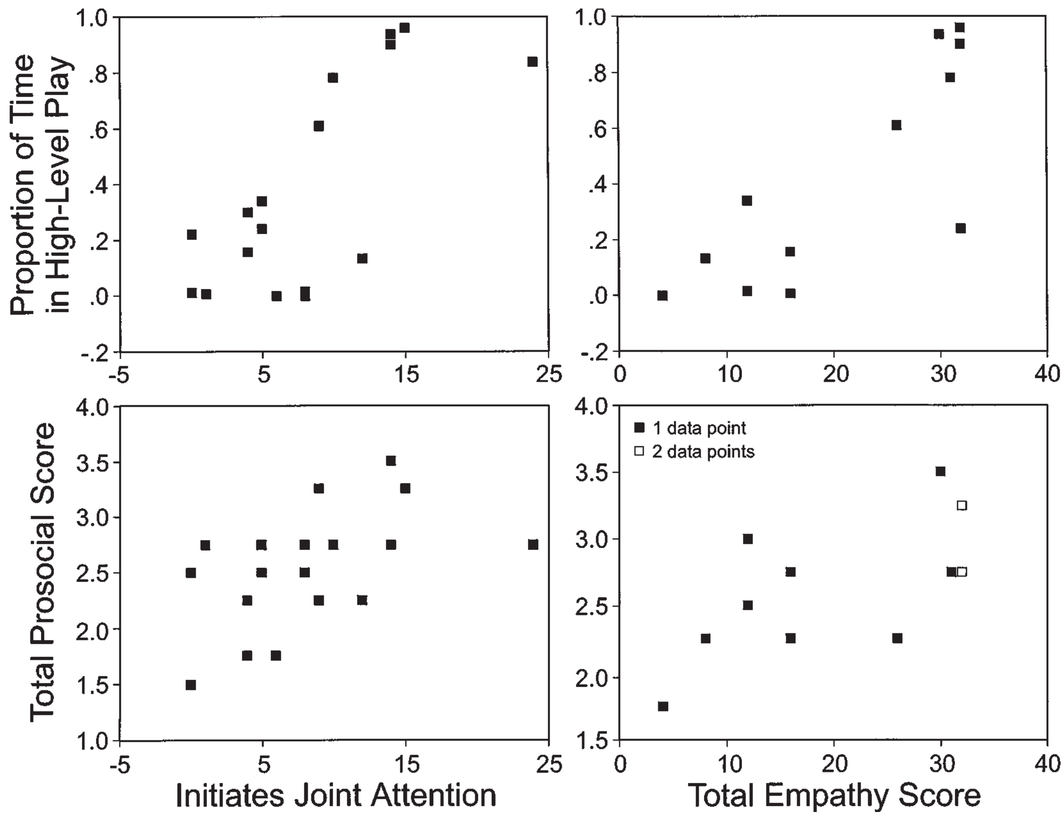

Fig. 1. Scatterplots for four highest correlations for the autistic group.

Table V. Comparison of Theory of Mind "Passers" and "Failers" on Social Interaction

	Theory of mind performance					
	Autism			Developmental delay		
	Pass (*n* = 6)	Fail (*n* = 7)	*t*	Pass (*n* = 6)	Fail (*n* = 13)	*t*
Prosocial behavior						
M	2.54	2.82	*t*(11) = 1.08, ns	2.88	2.79	*t*(17) = 0.47, ns
SD	0.58	0.35		0.41	0.35	
Pear interaction						
M	0.45	0.38	*t*(10) = 0.28, ns	0.81	0.60	*t*(16) = 1.78, ns
SD	0.40	0.44		0.15	0.23	

distinct from other social behaviors such as attachment behaviors and instrumental and information-seeking behaviors in terms of their function and possibly in terms of their neural substrate. Mundy argued that autism may reflect impairment in exactly this social system, and that initiating joint attention is a prototypical example of social emotional approach behavior.

Our results are consistent with Mundy's proposal. First, our autistic group showed less initiating joint attention, less empathy, less concern to distress, and substantially impaired social interaction in comparison to the developmentally delayed group. In addition, the degree of impairment in initiating joint attention and empathy were related to the degree of impairment in social interaction. If initiating joint attention and empathy are at least partially mediated by a neural system subserving affiliative, affectively positive interactions, it is not surprising to find that they are correlated with the tendency to engage in prosocial behaviors and play with peers. Such a correlation would reflect shared neural underpinnings of understanding and social interaction. In the case of empathy, there are also plausible functional mechanisms that may mediate the relation. For example, the capacity to share positive affect with another may reinforce a child's tendency to make social approaches, and thus increase their frequency. Capacity for empathy would thus be related to peer interactions because individuals more prone to affective sharing would find such interactions more rewarding.

An alternative interpretation of the relations between initiating joint attention and social interaction is that initiating joint attention indexes the degree of executive function (EF) impairment in an individual. Because individuals with autism are known to suffer from EF impairments involving perseveration and initiation difficulties (Ozonoff & McEvoy, 1994; Ozonoff, Pennington, & Rogers, 1991), it is possible that the initiation component of joint attention, peer interaction, and prosocial behavior mediates the correlations among them.

There are also alternative accounts of the relation between empathy and social interaction skills. One possibility is that individuals who report more empathy do not actually experience more empathic feelings but have greater self-awareness, and thus are able to report their feelings more accurately. Previous research by Capps, Sigman, and Yirmiya (1995) has shown that more socially competent high-functioning individuals are more aware of their social deficits. Increasing self-awareness may also lead to better awareness of one's own emotions, as well as to better ability to adapt one's behavior to the demands of social interaction. A second interpretation, and one that we consider the most plausible, is that the story vignette task is too artificial to elicit true feelings of empathy, but rather elicits what subjects perceive to be socially desirable responses (Eisenberg & Miller, 1987). Such awareness of implicit social rules and expectations would undoubtedly play a role in ability to enter into simple social games, which was central to our measure of peer interaction. On this interpretation, although our empathy measure did not successfully tap the capacity to experience empathy, it did tap into an important component of social competence.

We must also account for our failure to find relations between our other measures of understanding and behavior. For example, on the social-emotional approach account, it is somewhat surprising that we did not find any relations between responsiveness to distress and social interaction. It is possible that our responsiveness to distress measure was not appropriate for our relatively high-functioning sample. We suspect that awareness that the experimenter's displays might be faked decreased responsiveness for some children. Although responsiveness did not show a negative relation to mental or language age, it may be that this measure is subject to conflicting influences for a high-functioning population, making it a poor measure of social competence.

Failure to find relations between false belief understanding and social interaction is counterintuitive and also inconsistent with some previous research. Two studies have shown that theory of mind ability relates to everyday social competence in verbally able individuals with autism (Fombonne, Siddons, Achard, & Frith, 1994; Frith *et al.*, 1994). Both studies employed items from the Vineland Adaptive Behavior Scales (Sparrow, Balla, & Cicchetti, 1984), which were a priori categorized as likely to depend on theory of mind or not. For example, choosing appropriate presents and engaging in deception were considered to be theory-of-mind-dependent, whereas initiating social contacts and sharing toys were not. Both studies found that individuals who passed false belief tasks also showed more competence in theory-of-mind-dependent everyday behaviors. However, in Fombonne *et al.*'s study, the individuals who passed theory of mind tasks also had more linguistic competence than those who did not, and when this was statistically controlled, differences in social behavior were no longer reliable.

There are several differences between these previous studies and the present study that may account for differences in findings. One difference is that Frith *et al.* and Fombonne *et al.* employed caregiver-report measures of social behavior, whereas we used observational measures. It is possible that caregiver reports, which reflect global assessments based on much larger samples of behavior, may be more sensitive to infrequent but highly salient events indicative of subtle social impairments. An additional difference between these previous studies and ours is that we did not specifically target abilities that a priori appear to *require* theory of mind. Rather, we hypothesized that theory of mind might *facilitate* peer interaction and prosocial behavior. Our failure to find relations between theory of mind and these more general social behaviors may in fact be consistent with Frith *et al.*'s and Fombonne *et al.*'s view that theory of mind abilities may have an impact on a relatively narrow and well-defined range of social behaviors. A few other studies that have assessed relations between theory of mind and social behavior generally in children with autism support this interpretation. For example, training studies have shown that although specific aspects of theory of mind can be taught to children with autism, such training does not generalize to other social skills such as understanding of emotions (Hadwin, Baron-Cohen, Howlin, & Hill, 1996) or overall social interaction competence (Ozonoff & Miller, 1995).

Our failure to find relations between affective perspective-taking skill and social interaction measures is inconsistent with one previous study which did find a relation between this ability and peer interaction (Hauck *et al.*, 1995). Because our samples were similar, and our affective perspective-taking tasks were also quite comparable, it seems most likely that this difference stems from our social interaction measures. Whereas we measured duration of sustained high-level play, Hauck *et al.* focused on social initiations. It is possible that these two aspects of peer interaction covary differently with understanding. It is also possible that our negative finding simply reflects lack of power.

Finally, we need to consider why we found understanding–behavior links in our autistic sample that were not present in our developmentally delayed sample. In considering this issue, it is important to bear in mind the nature of group differences on the variables of interest and in basic intellectual abilities.

Although our groups were closely matched on language age and on IQ, the group with autism was older and had a higher mental age than the group with DD. Differences in MA and in chronological age (CA) are essentially the result of language matching, since language delays are characteristic of autism. Although CA by itself appears implausible as a mediator of group differences, MA differences are more of an issue. However, in our data it appears unlikely that MA differences account for different patterns of relations in the two groups. When variance attributable to LA was covaried out of the relations, the patterns remained the same, and for both groups, LA and MA were highly correlated.

We expected to find group differences in favor of the DD group on all of our understanding and behavior variables, but failed to find differences for two understanding measures, namely, affective perspective taking, and false belief understanding. In fact, a few other studies comparing similar samples have also failed to find group differences on these measures (e.g., Hauck *et al.*, 1995; Yirmiya & Shulman, 1996; Yirmiya, Solomonica-Levi, Shulman, & Pilowksy, 1996). Our groups showed a particularly striking difference in terms of peer interaction, but again this pattern is consistent with previous research. The few studies that have reported naturalistic observational data comparing the peer interactions of children with autism to control groups show differences with especially large effect sizes (Hauck *et al.*, 1995; Lord & Magill-Evans, 1995). In our case, because the children were observed in different schools, it is possible that systematic differences in school environments between the groups may have served to exaggerate this difference. Although we cannot rule out this possibility, we do know that the groups did not differ in terms of their access to typically developing peers during the observation time. Fifteen of 19 children with autism, and 15 of 18 children with DD had access to typically developing peers.

In summary, our groups were well matched in terms of language abilities, and group differences in mental age do not appear likely to account for the different patterns of interest. Our groups showed the most striking differences in social interaction (peer interaction and prosocial behavior), moderate-sized differences in more intuitive forms of social understanding and responsiveness (initiating joint attention, concern to distress, and self-report of empathy), and did not differ in the most purely cognitive social-cognitive tasks (false belief understanding and affective perspective-taking).

Earlier, we considered three possible types of differences in understanding–behavior links: (a) *Limiting factor pattern*. Understanding might be more closely linked to behavior in the autistic group simply by virtue of its being more impaired in that group and therefore more of a limiting factor on behavior. (b) *Different organization pattern*. There might be different, but not necessarily more or stronger relations for the autistic group due to developmental and processing differences. (c) *Disorganization pattern*. The group with autism would show fewer relations because of disorganization as a result of disruption to a system that is normally well integrated. Although our findings are clearly inconsistent with the disorganization pattern, they are somewhat ambiguous with respect to the other two patterns.

Consistent with the limiting factor pattern, the two measures of social understanding on which the autistic group performed most poorly were also those that were related to social interaction. Thus it is possible that more severe impairment on these measures accounts for their tighter links to behavior within the autistic group. However, one measure, concern to distress, showed impairments of a similar magnitude for the group with autism, yet this measure showed no hint of being related to social interaction competence. As mentioned previously, this may reflect the fact that the concern to distress measure may not have been appropriate for our high-functioning group. On the other hand, this may be a finding that challenges the limiting factor interpretation in favor of the different organization hypothesis.

In summary, this study investigated the relations of social understanding to social behavior in verbally able children with autism, and compared understanding–behavior relations in an autistic sample to those found in a developmentally delayed control group. The results suggest that more intuitive, nonverbal forms of social understanding (initiating joint attention and either empathy or awareness of social expectations) are closely related to peer interaction and prosocial behavior in a high-functioning autistic sample. In contrast, measures of consciously accessible, verbalizable social knowledge such as false belief understanding and affective perspective-taking ability are not related to social interaction skill, or at least not to the general measures employed in this study. This may reflect the fact that social cognitive abilities have influence only on a limited range of social behaviors, and not on social interaction competence broadly conceived. In a developmentally delayed comparison sample, none of these measures of understanding related to social interaction competence. Group differences may either reflect different patterns of organization between understanding and behavior for children with autism, or they may simply reflect greater levels of impairment in some forms of understanding for autistic individuals. Our findings must be interpreted with some caution, because of our small sample and other statistical issues, such as the limited range for some of our measures. Nevertheless, they provide an intriguing starting point for further investigations of the links between understanding and behavior in individuals with autism.

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