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Children with Autism Fail to Orient to Naturally Occurring Social Stimuli

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Children with autism were compared to developmentally matched children with Down syndrome or typical development in terms of their ability to visually orient to two social stimuli (name called, hands clapping) and two nonsocial stimuli (rattle, musical jack-in-the-box), and in terms of their ability to share attention (following another's gaze or point). It was found that, compared to children with Down syndrome or typical development, children with autism more frequently failed to orient to all stimuli, and that this failure was much more extreme for social stimuli. Children with autism who oriented to social stimuli took longer to do so compared to the other two groups of children. Children with autism also exhibited impairments in shared attention. Moreover, for both children with autism and Down syndrome, correlational analyses revealed a relation between shared attention performance and the ability to orient to social stimuli, but no relation between shared attention performance and the ability to orient to nonsocial stimuli. Results suggest that social orienting impairments may contribute to difficulties in shared attention found in autism.

KEY WORDS: Social stimuli; autism; shared attention.

INTRODUCTION

Several authors have suggested that autism involves an impairment in attentional functioning (e.g., Courchesne *et al.*, 1994; Dawson & Lewy, 1989a, 1989b; Bryson, Wainwright-Sharp, & Smith, 1990). 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 may 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, which is impaired in autism, requires the young child to rapidly shift his/her attention between different stimuli. A somewhat different explanation, offered by Dawson (Dawson, 1991; Dawson & Lewy, 1989a, 1989b), focuses not on the ability to rapidly shift attention, but on the nature of the stimuli to be processed. Dawson has proposed that, although children with autism have general impairments in orienting and shifting of attention, these impairments are more evident for social stimuli. She hypothesized that, because social stimuli (e.g., facial expressions, speech, gestures) are complex, variable, and unpredictable, children with autism have difficulty processing and representing such stimuli and, therefore, their attention is not naturally drawn to such stimuli. The lack of attention to social stimuli limits the child's opportunity to engage in critical early social experiences which provide the foundation for social development (Dawson,

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Table I. Subjects Characteristics[a]

Group	n(M:F)	Ethnicity	CA (months)	Vineland MA[b] (months)	Vineland Scale IQ	PLS MA[c] (months)	PLS IQ	Nonverbal MA (months)
Autism	20 (19:1)	18 Caucasian	64.6	30.4	62.0	28.1	58.9	51.0
		2 Biracial	(15.1)	(13.4)	(16.4)	(14.9)	(14.3)	(26.2)
Down	19 (16:3)	17 Caucasian	65.3	27.3	57.2	29.9	56.7	34.1
		1 African Am	(16.5)	(10.2)	(8.2)	(12.3)	(9.4)	(11.8)
		1 Native Am						
Typical	20 (19:1)	17 Caucasian	30.9	32.4	103.4	31.8	105.9	33.2
		3 Biracial	(14.4)	(14.6)	(4.4)	(14.8)	(12.6)	(13.4)
F			0.00	0.78	0.70	0.35	0.31	5.89
p			ns[d]	ns	ns[d]	ns	ns[d]	.005

[a]Numbers represent means (standard deviations in parentheses).
[b]Vineland Scale refers to Communication Subscale.
[c]Preschool Language Scale.
[d]Comparison is between autism and Down syndrome groups only.

1991). To date, few studies have examined social attention in very young children with autism in naturalistic settings. One such study examined home videotapes of first birthday parties of toddlers later diagnosed with autism. In this study, Osterling and Dawson (1994) found that, in addition to impairments in shared attention, 1-year-olds later diagnosed with autism attended less to people and failed to orient when their names were called.

In the present study, we sought to examine autistic children's ability to orient to familiar social and nonsocial stimuli that were delivered in a naturalistic manner. One advantage of a naturalistic approach is this experimental paradigm could easily be used in clinical assessments. The primary hypothesis was that, compared to children with Down syndrome and typically developing children, children with autism would selectively fail to orient to social stimuli, as compared to nonsocial stimuli. In addition, shared attention skills were also assessed, which allowed us to examine whether degree of impairment in orienting to social stimuli is related to degree of impairment in shared attention. It can be argued that the ability to actively attend to social stimuli is a prerequisite for the development of shared attention skills, such as following another's gaze and declarative pointing.

METHOD

Participants

Three groups of children participated in the study: 20 children with autism or Pervasive Developmental Disorder Not Otherwise Specifi (PDDNOS), 19 children with Down syndrome, a 20 children with typical development. Descriptive i formation for the three groups of children regardi chronological age, ethnicity, sex, and language a cognitive ability is shown in Table I.

Diagnosis of autism or PDDNOS was based parent interview and a structured play session sp cifically designed to assess autistic symptoms list in the DSM-III-R (American Psychiatric Associatio 1987). Diagnosis of each child was made ind pendently by the first and third authors to insure r liability. Thirteen children received a diagnosis autistic disorder, and 7 children received a diagno of PDDNOS. In addition, each child was admin tered the Childhood Autism Rating Scale (CAR Schopler, Reichler, & Renner, 1986) and all childr in the autism group scored above 30 on the CAR

The three groups of children were matched terms of their receptive language mental age as a sessed by the Preschool Language Scale—3 (PL Zimmerman *et al.*, 1991) and the communicati subscale of the Vineland Adaptive Behavior Scal (Sparrow, Balla, & Cicchetti, 1984). In addition, ch dren with autism were matched to children wi Down syndrome in terms of chronological age a verbal IQ. Children with autism had significant higher nonverbal ability as compared to the childr with Down syndrome and typically developing ch dren. Nonverbal ability was assessed by administr tion of a battery of developmentally grade visual-spatial tasks derived from the Bayley Scales Infant Development, 2nd Edition.

Procedure

Each child was individually tested while seated at a table across from a familiar examiner. Children were praised for sitting in the chair and given breaks as needed. All sessions were videotaped through a one-way mirror. Videotapes consisted of a close-up of the child's upper body and a small picture-in-a-picture that recorded the entire experimental context so that exact time of stimulus delivery could be viewed on the videotape.

Orienting Task

While the child was seated across from the familiar examiner, a second examiner remained quietly in the room and delivered the four orienting stimuli.

The social stimuli each lasted approximately 6 seconds and consisted of (a) clapping hands three times, and (b) calling child's name three times. The two nonsocial stimuli consisted of (a) playing a musical jack-in-the-box for 6 seconds and, (b) shaking a rattle for 6 seconds. Each of the four stimuli was presented twice, once in the child's visual field and once behind the child (30 degrees to right or left). Auditory recordings were made of the stimuli to insure that all four stimuli were of similar decibel levels and were matched for duration (6 seconds). In addition, ratings of the degree of familiarity on a 5-point scale ranging from 1 (*never encountered*) to 5 (*highly familiar*) were made for each of the stimuli by parents of children with autism and those with typical development. There were no significant group differences in terms of the degree of familiarity for nonsocial stimuli nor for social stimuli.

Order and location (behind vs. front, left vs. right) of the stimuli were counterbalanced across subjects. The presentation of the orienting stimuli was interspersed between tasks designed to assess shared attention. This maximized stimulus novelty and minimized children's habituation to the orienting task.

Shared Attention Task

This assessment was based on an experimental method originally developed by Butterworth and Jarrett (1991) to assess shared attention skills in infants and toddlers. The child was seated at a table, on which there was a toy, with an experimenter sitting opposite the child. Four yellow crosses, approximately 8 inches high, were mounted on the wall at the child's eye level, 62 inches from the center of the room. The crosses were placed 30 degrees in front of the child on the right and left, and 30 degrees behind the child on the right and left.

There were two types of shared attention probes: (a) experimenter gazed at object, and (b) experimenter pointed to object. The experimenter waited until the child appeared to be losing interest in the toy which was chosen to be only mildly interesting. The experimenter then gained the child's attention by taking the child's toy and holding it near her face. Once the child was attending to the experimenter's face, the toy was removed from sight, and one of four shared attention probes was delivered. These consisted of (a) pointing to cross that was in front of child, (b) pointing to cross that was behind child, (c) looking at cross that was in front of child, and (d) looking at cross that was behind child.

Coding and Scoring of Orienting and Shared Attention Tasks

For both the orienting and shared attention tasks, whether or not the child looked toward the stimulus was coded live by two research assistants from behind a one-way mirror, as well as recoded from videotape. Coders were blind with respect to diagnosis (although it was obviously possible to tell if a child had Down syndrome), and with respect to the hypotheses of the study. An "error" was defined as a failure to turn eyes toward the stimulus within the 15-second response period. The live and videotape coding yielded identical statistical results, and thus, except for data involving latency measures, only the live coded data are presented.

For the orienting tasks, interrater percentage agreement for coding looking behavior was .96 ($\kappa >$ .75). In addition, for all subjects who looked toward the stimulus, assistants coded from the videotapes whether or not the child looked immediately at the stimulus or showed a delayed ($\geq$ 2 seconds) response to the stimulus. Twenty-eight percent of the tapes were coded by two independent raters. Interrater percentage agreement for latency data was .91.

For the shared attention task, 35 of the 59 subjects (close to 60%) were coded by two independent raters. Interrater percentage agreement for shared attention coding was .88 ($\kappa >$ .70).

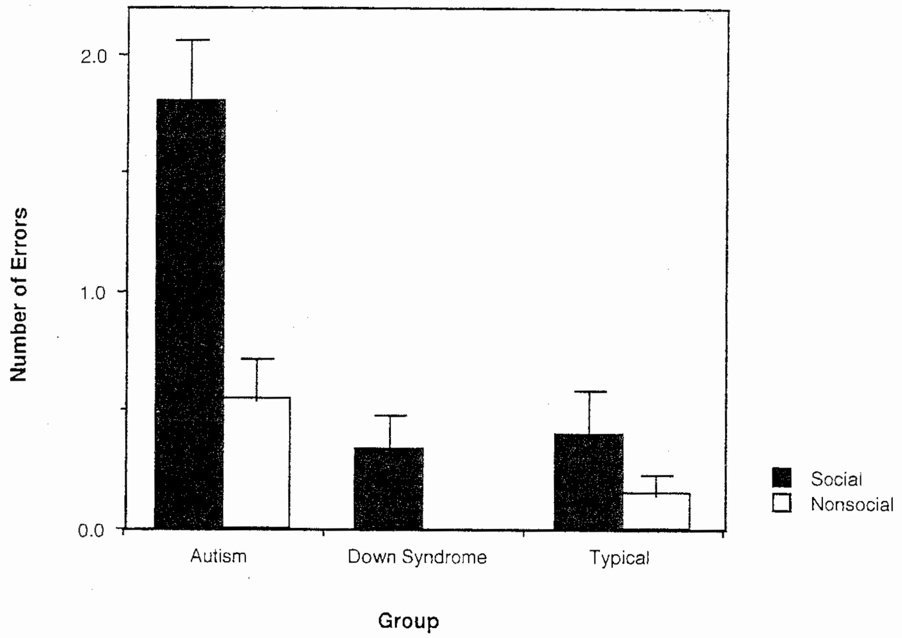

Fig. 1. Mean numbers of orienting errors to social vs. nonsocial stimuli made by children with autism, Down syndrome, or typical development (maximum number of errors = 4).

RESULTS

Orienting

Figure 1 displays the average numbers of orienting errors to social and nonsocial stimuli for children with autism, Down syndrome, and typical development. A 3 (diagnostic group) by 2 (social vs. nonsocial stimuli) repeated measures ANOVA with number of errors as the dependent variable yielded a main effect of group, $F(2, 55) = 16.56$, $p < .001$; a main effect of stimulus type, $F(1, 55) = 33.48$, $p < .001$; and a Group × Stimulus type interaction, $F(2, 55) = 9.42$, $p < .001$. When nonverbal ability was used as a covariate in this analysis, the results were virtually unchanged. These results indicate that autistic children more frequently failed to orient to all stimuli, but that this failure was more extreme for social stimuli. As can be seen in Fig. 1, for the children with Down syndrome and typical development, the mean number of orienting errors made to both the social and nonsocial stimuli was close to zero. Similarly, for children with autism, the mean number of orienting errors made to nonsocial stimuli was less than one (0.55). In contrast, on average, for approximately 50% of trials, children with autism failed to orient to the social stimuli ($M = 1.8$ with 4.0 errors possible on task). Although somewhat more orienting errors occurred in response to clapping than to name called, children with autism made more errors to both types of social stimuli, as compared to the children with Down syndrome or typical development.

For subjects who oriented to both social and nonsocial stimuli, an analysis of group differences in the percentage of subjects who showed an immediate vs. delayed orienting response was examined. These data are shown in Fig. 2. An ANOVA using nonverbal mental age (MA) as a covariate of the percentage of subjects showing an immediate response revealed a significant effect of group, $F(2, 49) = 3.85$, $p = .028$), and stimulus type, $F(1, 50) = 5.05$, $p = .029$. These results indicated that the autistic group showed more delayed responses in general, and that subjects were more likely to show delayed responses to social than nonsocial stimuli. Separate one-way ANOVAs were conducted for the social and nonsocial stimuli, with nonverbal MA as a covariate. For the social stimuli, the analysis revealed a significant main effect of group, $F(2, 50) = 4.29$, $p = .019$. In contrast, no effect of group was found when the same analysis was conducted for the nonsocial stimuli, $F(2, 52) = 0.40$, ns).

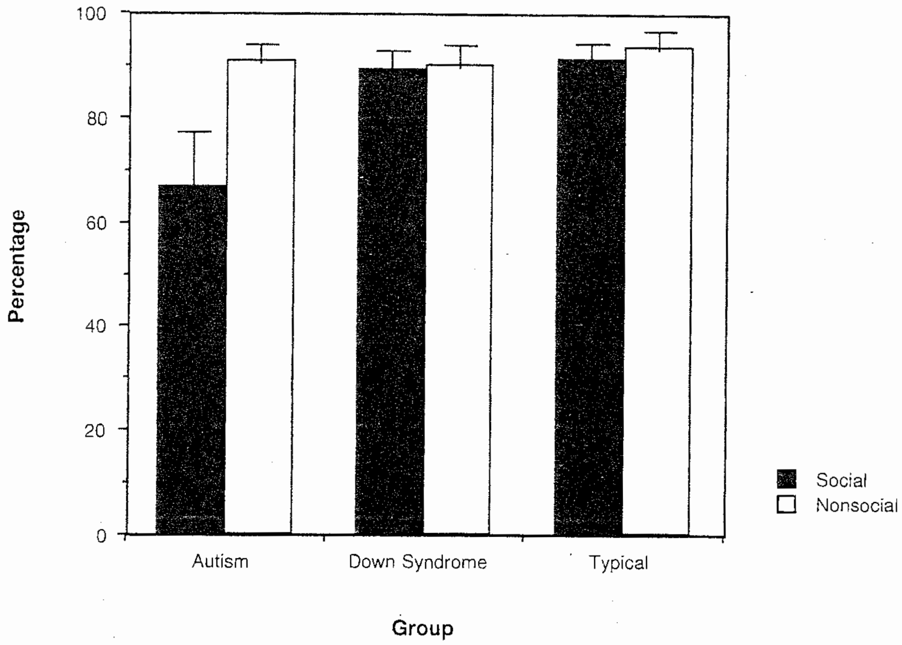

Fig. 2. For those subjects who oriented, the percentage of subjects showing immediate orienting responses to social and nonsocial stimuli.

Shared Attention

The average numbers of shared attention errors made by children with autism, Down syndrome, and typical development are shown in Fig. 3. An ANOVA with group as the independent variable, nonverbal ability as a covariate, and shared attention errors as the dependent variable yielded a significant effect of group, $F(2, 54) = 4.81, p = .01$. Children with autism made significantly more shared attention errors than children with Down syndrome ($t = 1.76, p < .05$) and those with typical development ($t = 3.10, p < .005$).

Relations Between Orienting Behavior and Other Domains

Table II displays the correlations between the children's performance on the social and nonsocial orienting tasks and their receptive language ability, nonverbal ability, and performance on the shared attention task. As can be seen in Table II, for children with autism and Down syndrome, social orienting ability was significantly related to shared attention ability. In contrast, no relation between nonsocial orienting ability and shared attention was found. Furthermore, orienting ability was not related to language or nonverbal ability for children with autism or Down syndrome. Children with typical development showed a different pattern: Social orienting ability was related to receptive language age but not to shared attention.

DISCUSSION

Results of the present study suggest that children with autism exhibit a general impairment in orienting ability, and that this impairment is more severe for social stimuli. Children with autism showed only a slightly greater number of orienting errors, compared to children with Down syndrome and typical development, when presented with the sound of a rattle or a musical toy. When they heard their names called or the sound of hands clapping, however, children with autism often failed to orient to these stimuli. In addition, children with autism who did orient to the social stimuli were more likely to show a delayed response, as compared to the other two groups of children. Such results suggest

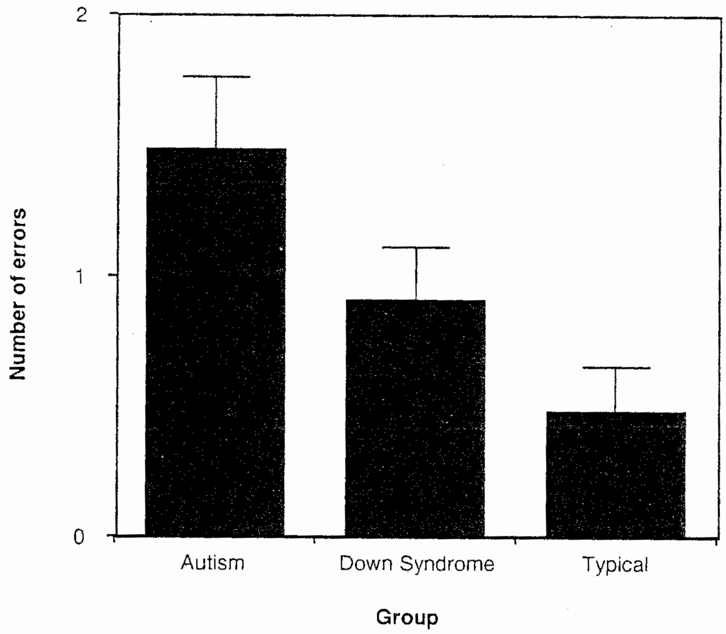

Fig. 3. Mean numbers of shared attention errors made by children with autism, Down syndrome or typical development, adjusted for nonverbal ability (maximum number of errors = 4).

that children with autism are particularly impaired in their ability to orient to social stimuli.

Consistent with findings from previous studies (e.g., Mundy, Sigman, Ungerer, & Sherman, 1986), children with autism were also impaired in their shared attention ability relative to children with Down syndrome and those with typical development, as reflected in their difficulty in following another's gaze or point. Moreover, as predicted for both children with autism and Down syndrome, correlational analyses revealed a relation between shared attention performance and the ability to orient to social stimuli, but no relation between shared attention performance and the ability to orient to nonsocial stimuli. This pattern of results supports the hypothesis that shared attention impairments in autism may be the result, in part, of a more basic failure to selectively attend to social stimuli, such as another person's eyes or facial expression. Shared attention skills, such as alternating gaze between a toy and another's face or visually referencing another's face while pointing to an object, presumably require that the child is interested in attending to another person. Social orienting emerges very early in development, evident even in the first few months of life. Dyadic gaze patterns then develop, patterns which themselves depend upon social attention. Participation in these early face-to-face social interactions then provide a basis for the later acquisition of shared attention skills.

Certain methodological limitations of the study should be noted. First, although the social and nonsocial stimuli were matched in terms of loudness and duration, they differed in other respects. Whereas the two social stimuli were discontinuous, one of the nonsocial stimuli was continuous. Furthermore, it is important to repeat this study with a wider range of social and nonsocial stimuli, carefully chosen to be as similar as possible in terms of their familiarity to the children, so that we may be able to conclude with more confidence that it is the social dimension of the stimuli to which the children with autism fail to attend.

One potential clinical implication of a social orienting impairment in autism is the need to target fairly basic social attention skills early in intervention. Unless children with autism are taught that social stimuli are interesting, rewarding, and meaningful, they may not be as likely to acquire more complex communicative or social skills that require paying attention to others. An impairment in social orienting may represent one of the earliest symptoms of autism,

Table II. Correlations Between Number of Orienting Errors for Social and Nonsocial Stimuli and Children's Language, Nonverbal, and Shared Attention Ability[a]

Group	Orienting stimulus	Vineland scale MA[b] (months)	PLS MA (months)	Nonverbal MA (months)	Shared attention (errors)
Autism	Social	-.21	-.24	-.32	.58
		ns	ns	ns	$p < .01$
	Nonsocial	.11	-.03	-.15	.07
		ns	ns	ns	ns
Down syndrome	Social	.13	-.02	-.08	.55
		ns	ns	ns	$p < .05$
	Nonsocial	—[c]	—[c]	—[c]	—[c]
Typical development	Social	.43	.52	.41	.02
		ns	$p < .05$	ns	ns
	Nonsocial	-.01	.07	.05	.03
		ns	ns	ns	ns

[a]All probability values are two-tailed.
[b]Vineland Scale refers to Communication Subscale.
[c]Because the Down syndrome group made no errors, correlational analyses were not possible.

manifesting at even an earlier age than shared attention skills. In a previous study of home videotapes of first birthday parties, a failure to orient to name was one of four behaviors that distinguished toddlers with autism from typically developing toddlers. If future research supports the notion of impaired social orienting in autism, it may be useful to design clinical assessments of orienting which could be used by practitioners interested in early diagnosis of autism.

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