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The Behaviors of Parents of Children with Autism Predict the Subsequent Development of Their Children's Communication

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The present study focused on behaviors that caregivers of children with autism show during play interactions, particularly the extent to which the caregiver's behavior is synchronized with the child's focus of attention and ongoing activity. The study had two major findings. First, caregivers of children with autism synchronized their behaviors to their children's attention and activities as much as did caregivers of children with developmental delay and caregivers of typically developing children, matched on language capacities. Second, caregivers of children with autism who showed higher levels of synchronization during initial play interactions had children who developed superior joint attention and language over a period of 1, 10, and 16 years than did children of caregivers who showed lower levels of synchronization initially. These findings suggest a developmental link between parental sensitivity and the child's subsequent development of communication skills in children with autism. Implications for parent training interventions are discussed.

KEY WORDS: Autism; attention; communication; parent; language.

INTRODUCTION

Communication is a major area of concern in children with autism. Their nonverbal communication is characterized by a lack of *joint attention*, defined as behaviors used to follow or direct the attention of another person to an event or object to share an interest in that event or object. Previous research has demonstrated that children with autism respond to joint attention (i.e., follow an adult's gaze or pointing gesture to an object) less than do typically developing or developmentally delayed children. Similarly, they initiate joint attention less than do children in these other groups in that they attempt less to direct the attention of another person to an object or event by either pointing, showing, or alternating their gaze between an object and another person's eyes (Loveland & Landry, 1986; Mundy, Sigman, Ungerer, & Sherman, 1986; Sigman, Mundy, Sherman, & Ungerer, 1986; Mundy, Sigman, & Kasari, 1990; Sigman & Ruskin, 1999).

Deficits in verbal communication are even more obvious in children with autism. Compared with typically developing children, most children with autism develop language late and at significantly slower rates (Le Couteur, Rutter, Lord, Rios, Robertson, Holdgrafer, & McLennan, 1989; Lord & Rhea, 1997). What is striking about the language development of children with autism is that some children acquire good language skills and others remain largely nonverbal. Two longitudinal studies tracked the language development of 4-year-old children with autism who were considered preverbal as defined by receptive language skills that were equivalent to those of typical children younger than 24 months. In one study, about 50% developed at

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least some language (receptive language age of 24 months or above) by 10 years of age (Lord & Schopler, 1989). In the second study, about 72% of the children with autism showed at least some language skills when they were tested at about 13 years of age (Sigman & Ruskin, 1999).

Attempts to explain the variability of the language outcome in children with autism have generally investigated the relations between the children's initial abilities and their consequent level of language acquisition. One relation that is widely established is that the child's language skills during early childhood are predictive of his or her consecutive language development (Sigman & Ruskin, 1999). With respect to children with autism who are still nonverbal at age 4, both longitudinal studies reported above showed that initial IQ did not differentiate the children who later acquired language from those who did not. In contrast, early nonverbal communication and functional play skills have been linked to subsequent gains in language skills. Young children with autism who responded more frequently to bids for joint attention by others made larger gains in language skills over a period of both 1 year (Mundy *et al.,* 1990) and 9 years (Sigman & Ruskin, 1999) than did children with autism who initially responded less to others' bids for joint attention.

In typically developing infants, both joint attention behaviors and language emerge within a relatively brief developmental period between 9 and 15 months (Sugarman, 1984; Bakeman & Adamson, 1984; Murphy & Messer, 1977; Leung & Rheingold, 1981; Franco & Butterworth, 1996; Carpenter, Nagell, & Tomasello, 1998). Research concerning typically developing children has shown that the social experiences that the infant engages in during interactions with the caregiver play an important role in fostering these newly emerging social behaviors. Bakeman and Adamson (1984) found that before infants are able to actively coordinate their attention between an object and the caregiver, mothers act to ensure a joint focus of attention by homing in on the spontaneous object engagement of the child. It has been suggested that situations in which infant and caregiver display similar intentional states toward an external object provide the necessary information to enable the infant to acquire an understanding of the "similarity between self and other." From this understanding comes the awareness that other people attend to and have intentions toward outside entities (Moore, 1996; Carpenter *et al.,* 1998). The emergence of this concept is reflected in the infant's gaze alternation between the caregiver's face and an object of interest and is the basis for further attempts of the child to read the attentional focus of another person (i.e., respond to joint attention) or actively direct the attention of another person either nonverbally (i.e., initiate joint attention) or with linguistic means.

Although infants who develop joint attention seem to be equipped with the cognitive and social skills required for language, it has been argued that their attentional capabilities are not up to the challenges they face. Their language acquisition rather depends on particular social environments and routines (language learning formats) in which the adults' communicative intentions are made especially salient for the children (Bruner, 1981, 1983; Ratner & Bruner, 1978; Ninio & Bruner, 1978). Social encounters that have been shown to be important for language learning are episodes where mother and child attend to the same object and the child coordinates attention between mother and object (joint engagement). The ability of the mother-child dyad to initiate and maintain episodes of joint engagement has been shown to be predictive for the child's language growth in both typically developing and children with developmental delay. For typically developing children, superior consecutive language development has been linked to the amount of time that they spent as infants in joint engagement with their mothers (Tomasello & Todd, 1983; Tomasello, Mannle, & Kruger, 1986), maternal use of language to label objects within the shared focus of attention (Tomasello & Farrar, 1986; Carpenter *et al.,* 1998), and low frequencies of maternal utterances with a leading prescriptive pragmatic function (Akhtar, Dunham, & Dunham, 1991). Similarly for children with Down syndrome, the extent to which caregivers maintained the child's attention to child-selected toys predicted the child's subsequent language development (Harris, Kasari, & Sigman, 1996).

The role of parents in the fostering of nonverbal and verbal communication in children with autism has not been investigated. The possible contributions of parents to their children's development have been neglected, probably because of a sensitivity of investigators, clinicians, and parents to previous, fallacious, psychogenic theories of autism. However, given that there are predictive relations between parental styles of interaction and their children's communication skills for both typically developing children and children with Down syndrome, it seems likely that such relations should exist for children with autism.

Findings from the literature on typically developing children contrast to some extent with how parents of children with autism seem to behave and with how they are often advised to behave. The few studies that have compared the behaviors of parents of children

with autism with the behaviors of parents of typically developing children have documented that parents of children with autism are more directive and controlling (Kasari, Sigman, Mundy, & Yirmiya, 1988; Watson, 1989). The same finding is also often reported when the behaviors of parents of developmentally delayed children are compared with the behaviors of parents of typically developing children (Cunningham, Reuler, Blackwell, & Deck, 1981; Eheart, 1982; Jones, 1977). Moreover, parent training interventions in autism often explicitly instruct caregivers to structure their interactions so that the adult follows through on his or her clear expectations about what the child should do and how the child should do it (Schopler & Reichler, 1971; Mesibov, Schopler, & Hearsey, 1994; Lovaas, 1978; Buch, 1995; Hemsley, Howlin, Berger, Hersov, Holbrook, Rutter, & Yule, 1978; Howlin *et al.*, 1987). Although children with autism have been shown to demonstrate more on-task behavior, relevant use of material, and educational progress in a setting that involves high levels of task-directed structure (Bartak & Rutter, 1973; Rutter & Bartak, 1973; Clark & Rutter, 1981), an association with the child's social responsiveness and language development has not been shown. The demonstration that parental sensitivity to the attention of their autistic children is linked to gains in communicative abilities would be relevant to the design of parent training interventions.

In conceptualizing the communicative deficits in autism from a developmental point of view, it would be expected that caregivers who try to maintain their child's spontaneous toy engagement by pointing to, showing, or talking about objects the child is already attending to will have children who later develop superior communication skills. At an early stage of development, caregiver behaviors of this type facilitate the social understanding of the child and thereby the developmental origin of joint attention behaviors. Later, the same caregiver behaviors scaffold the constrained attentional capabilities of the child and therefore facilitate the acquisition of language. The study reported here addressed one question and one hypothesis. The question was whether caregivers of children with autism attempt to adopt the child's focus of attention and toy engagement in an equal manner as parents of typically developing children and parents of children with developmental delays who are at a similar stage of language development. The hypothesis was that caregivers of children with autism who spend a higher proportion of the play engagement targeting objects that are already the focus of the child's attention, trying to maintain the child's ongoing activity, will have children with superior communication skills at later ages.

METHODS

Participants

Twenty-five children with autism (20 males and 5 females), 18 children with developmental delay (11 males and 7 females), and 18 children with typical development (14 males and 4 females) were recruited as participants. The children with autism were recruited from local special education programs, private pediatricians, and psychiatrists and psychologists at the UCLA Neuropsychiatric Institute between 1980 and 1985. The diagnosis of each child was made independently of the research by a group of clinicians who form the diagnostic core of the Clinical Research Center in Childhood Psychopathology. This core group was experienced in the evaluation of developmental disorders and used American Psychiatric Association (*DSM-III*, 1980) criteria. For all the subjects who were seen for follow-up testing during the 1990s, the diagnosis was confirmed using the Autism Diagnostic Interview-Revised (ADI-R; Lord, Rutter, & Le Couteur, 1994; Le Couteur, Rutter, Lord, Rios, Robertson, Holdrafer, & McLennan, 1989). The children with developmental delay included 9 children with Down syndrome and 9 children with unspecified etiologies. Group comparisons reported in this study were based on a subsample of 18 children with autism (14 males and 4 females) who were selected to match the typically developing children and the children with developmental delay on mental and language age. Data on chronological age, mental age, language age, and IQ of the children and the educational background of the mother obtained during the initial assessment are presented in Table I. For the children with autism, descriptive statistics are provided for both the complete sample and the subsample that was the basis for group comparisons.

To determine whether the three comparison groups differed in chronological age, mental age, language age, IQ, and maternal education, a series of analyses of variance (ANOVAs) were calculated. The results showed no significant group differences for language age, mental age, or years of maternal education. Therefore, we considered the groups as matched on these measures. However, significant group differences were found for chronological age [$F(2, 51) = 30.52$, $p = .000$] and IQ [$F(2, 51) = 129.02$, $p = .000$]. For both chronological age and IQ, follow-up *t*-tests showed that the children with autism and the children

Table I. Descriptive Information About the Sample at Intake

		Autistic sample		Developmentally delayed sample	Typically developing sample
		Complete	Comparison		
n		25	18	18	18
Chronological age	mean	50.3	54.2[a]	46.1[a]	21.8
(in months)	*SD*	11.7	11.1	18.3	6.8
Mental age	mean	24.2	26.8	24.9	25.2
(in months)	*SD*	8.4	8.5	6.8	8.9
IQ	mean	46.0	46.8[a]	54.3[a]	110.4
	SD	9.4	10.3	16.0	12.5
Language age	mean	16.7	18.4	20.3	22.5
(in months)	*SD*	6.9	7.5	5.5	9.3
Maternal education	mean	13.3	13.5	13.7	15.0
(in years)	*SD*	1.6	1.5	2.4	2.1

[a] Significantly different from the typically developing group, $p < .001$.

with developmental delay did not differ from each other but that both differed significantly from the typically developing children ($p < .001$).

Procedures

The initial assessments for each child occurred during two individual sessions scheduled at the UCLA Medical Center. These assessment sessions occurred within a 3-week period and included the administration of the Early Social Communication Scale (ESCS; Mundy *et al.*, 1986), a test of developmental abilities and a language assessment, and the videotaping of an episode of caregiver-child interaction. The children in the autistic sample were seen for follow-up testing at three time points. Because not all of the initial 25 children returned for each follow-up assessment, the sample size varies for each time point. At the first follow-up, approximately 1 year after the initial assessment (mean interval, 13.8 months; *SD*, 1.0 months), 18 children were administered the ESCS. Of these children, 17 were also administered a language scale. The second follow-up was about 10 years after the initial assessment (mean interval, 10 years 1.5 months; *SD*, 20.9 months), and the third follow-up was approximately 16 years after the initial assessment (mean interval, 16 years 1.2 months; *SD*, 16.9 months). At the second and third follow-ups, a language scale was administered to 17 and 19 children, respectively.

To determine how representative the follow-up samples are of the children who were originally recruited, a series of ANOVAs was calculated that compared the subjects who did not return with those who did return on chronological age, mental age, IQ, language age, and maternal education. The results showed that the group of children who returned for testing 1 year later had a lower mean chronological age [$F(1, 23) = 7.81$, $p = .01$] when recruited as well as a lower mean mental age [$F(1, 23) = 6.64$, $p = .02$] and a lower mean language age [$F(1, 23) = 13.31$, $p = .001$] than the group of children who did not return. The 10-year follow-up sample had more highly educated mothers than the group who did not return [$F(1, 23) = 12.77$, $p = .002$]. There were no differences between the two groups in the 16-year follow-up.

Assessment of Nonverbal Communication Skills

The ESCS is designed to assess nonverbal communication behaviors of young children. In this procedure, the child and experimenter sat facing each other at a small table. A set of toys was in view but out of reach by the child. The experimenter presented and/or activated the toys on the table one at a time. When presented, these toys were not within the grasp of the child. Verbal interactions were kept to a minimum during the ESCS. The child-experimenter interaction was videotaped to record the front upper body view of the child and the upper body profile of the experimenter using a split-screen video system. The period of interaction with each child was approximately 25 minutes. Behavior ratings were collected from the ESCS videotapes by trained observers. This measure has been used in a variety of studies before, and reliability has been shown. The mean generalizability coefficient of this measure is .90, with a range between .73 and .98 (Mundy *et al.*, 1990). The ESCS gives behavior ratings for two groups of joint attention behaviors: child initi-

ations for joint attention and child responses to bids for joint attention. Child initiations for joint attention include behaviors used to direct the attention of the experimenter to an event or object as an act of indicating (alternates gaze between an active mechanical toy or a toy in his hand and the tester's face, points toward a toy within reach or a poster, or shows a toy to the tester). The child response to bids for joint attention is evaluated by the tester pointing to the left, right, and behind the child and is measured as the percentage of instances in which the child followed the point by turning his head and eyes in the designated direction.

Assessments of Developmental and Language Skills

The test of developmental abilities used at the initial recruitment was the Cattell Infant Intelligence Scale (Cattell, 1940) or, if the child passed the highest items on that scale, the Stanford-Binet Intelligence Scale (Thorndike, 1972). The Cattell Scale, which is composed of most of the subscales of the Gesell Developmental Examination, was designed to be a downward extension of the Stanford-Binet Scale. The Cattell Scale was selected because it was initially used clinically in our setting and because we wished to keep the developmental measure the same over successive samples.

The language measure used at the initial and first follow-up assessment were the Reynell Developmental Language Scales (Reynell, 1977), which was selected because it was the only standardized language measure that could be used with our entire sample when we started our studies in autism. At the second and third follow-ups, the Reynell Scales were administered to subjects who could not obtain basal scores on the Childhood Evaluation of Language Fundamentals-Revised (CELF-R; Semel, Wiig, & Secord, 1987). For one child in the 16-year follow-up, language assessment was done with the Mullen Scales of Early Learning (Mullen, 1995), and for another child, the Childhood Evaluation of Language Fundamentals-Preschool (CELF-Preschool; Wiig, Secord, & Semel, 1992) was used. All these measures provide age-equivalent scores for the child's language skills.

Caregiver-Child Interactions

Interactions were carried out in a carpeted playroom of a university laboratory that included a sectional couch placed in a semicircle and a set of standard toys placed on the carpet in the center of the room. These toys included a wooden form board, a plastic shape-sorting puzzle, a doll, a doll bed and bottle, a car, blocks, a cup, a rattle, and a toy basket. The caregivers were asked to play with their children using any toy they would like to use. The interactions were videotaped with a hand-held camera for 4 minutes. Because the participants were free to move around and only one camera was used, the faces of both members of the dyad were not always visible simultaneously and, occasionally, either the child or the caregiver was out of view. For this reason, four sequences of 30 seconds were selected for analysis for each dyad. These sequences were selected to provide optimal views of the caregiver and child.

All sequences were coded with respect to three behavioral dimensions, each one in a separate pass through the videotape. The coding was done using an observational computer system (The Observer; NOLDUS) that is able to read the time code of videotapes. For the coding, the tape was watched at full speed until a change in behavior occurred. Then the tape was rewound and replayed at slow speed to determine the exact onset/offset time of the behavior. The observers who coded the caregiver-child interaction were different individuals than those who administered or coded the ESCS, the cognitive or language assessment. Most of the coding was done by the first author, who was kept blind to the dependent measures (language age and joint attention), as well as to the individual diagnosis of each child. The videotapes were coded in random order.

The coding system was designed to provide an online protocol of both the child's toy-directed attention as well as the caregiver's toy-directed behaviors. With respect to the child's toy-directed attention, each time the child started or stopped gazing at one of the target toys, both the time code and a code for the target toy were added into the coding protocol. Caregiver behaviors that were coded consisted of indicating behaviors and verbalizations. Indicating behaviors were coded each time the caregiver pointed to, showed, or offered one of the toys to the child and included both onset time and target toy. For the caregiver's verbal behavior, only those verbalizations that referred to at least one of the target toys were coded. In the first step, the caregiver's verbal behavior was transcribed and then divided into distinct utterances. In the second step, the onset/offset time was determined for each utterance. The identity of the target toy that the utterance referred to was also noted. Finally, each utterance was categorized as either demanding (demands a change in the child's ongoing activity) or undemanding (caregiver maintains the child's ongoing activity by offering reinforcement or a comment), and this was recorded. For an utterance to be coded as un-

demanding, it was not sufficient that the caregiver only referred to the same toy to which the child was attending. It was necessary that the caregiver also maintained the child's ongoing activity without demanding that the child modified the way he played with the toy of his interest. For example, if the child was engaged with making the dump truck drive on the floor and the caregiver said, "Can you dump the truck," the caregiver utterance would be considered as demanding a change in the child's ongoing activity. On the other hand, if the caregiver said, "Oh boy, this truck is driving fast," it would be considered as an undemanding caregiver utterance.

Interrater reliability was established with two undergraduate students based on the interactions of 10 caregiver-child dyads (four children with autism, three with developmental delay, and three with typical development). Reliability was calculated both for onset/offset time within the different behavioral categories and for the target toy to which the behaviors were directed. For onset/offset reliability, a tolerance of 2 seconds was used, and percentage agreement indices were calculated. This seemed appropriate, because the interobserver differences in timing were very small (in 88% of the cases, the differences were less than 0.4 second), and therefore the possibility of chance agreement seemed negligible. Percentage agreement indices for the onset/offset within the different behavioral categories had a mean of 77% and ranged between 74% and 81%. *Kappa* coefficients for the agreement on the target toy had a mean of .93 and ranged between .90 and .98. For the distinction between demanding and undemanding caregiver utterances, a *kappa* coefficient showed an agreement of .78.

For data analysis, the principal operation was to determine the degree to which the caregivers showed/pointed to or talked about objects to which the child was already attending (caregiver synchronization). Using the coding protocol, the synchronization or lack of synchronization was determined for the onset of each caregiver behavior. Based on the frequency of synchronized caregiver behaviors, two separate composite scores were calculated for the caregiver's indicating and verbal behaviors, using formula I. This formula was designed to control for differences in the base rate of caregiver behaviors as well as the total duration of child toy-directed attention. A third composite score was calculated by applying the same formula to caregiver verbalizations that were not only synchronized with the child's attention but also categorized as undemanding. For nine children (three with autism, two with developmental delay, and four with normal development), the composite score for the caregiver indicating behavior could not be calculated because the total frequency of the behavior was zero.

Formula I. Computation formula used for the three measures of caregiver synchronization

$$\text{Caregiver Synchronization} = \frac{\text{Percentage of synchronized and/or undemanding caregiver behaviors}}{\text{Percentage of child toy-directed attention}}$$

RESULTS

Group Comparisons of Maternal Synchronized Behaviors

Before we investigated group differences in maternal synchronized behaviors, preliminary analyses were conducted to determine whether the groups of children differed in the extent of their attention to toys, because this would have influenced the caregiver's opportunity to act synchronously. Preliminary analyses were also conducted for the total frequencies of caregiver behaviors in the two domains: indicating behaviors and verbalizations. Based on a series of one-way ANOVAs, no reliable group differences were found in any of those variables (Table II). Children with autism spent the same duration attending to toys as did children in the other two groups. In addition, the three groups did not differ in the mean frequency of caregiver indicating behaviors and verbalizations.

Finally, a series of ANOVAs was calculated comparing caregiver synchronized indicating behaviors, verbalizations, and undemanding verbalization across the three groups (see Table II). The results showed only one marginally significant group difference for the synchronization of the caregiver's undemanding verbalizations [$F(2, 51) = 3.00$, $p < .06$]. No significant group differences were found for the other two measures of caregiver synchronization. In summary, caregivers were similar across groups in their overall frequency of behaviors as well as the synchronization of their behaviors with ongoing child attention.

Prediction of the Children's Gain in Skills From Caregiver Synchronized Behavior

The second issue to be addressed was the hypothesis that the degree of caregiver synchronization would

Table II. Group Comparison of Caregiver and Child Measures

		Autistic sample	Developmentally delayed sample	Typically developing sample
Child measure				
Duration of toy-directed attention (sec)	mean	92.8	95.2	95.6
	SD	19.1	18.3	14.8
Frequency of caregiver behaviors				
Indicating behaviors	mean	3.7	4.3	3.7
	SD	3.6	2.9	2.7
Verbalizations	mean	28.4	28.6	26.1
	SD	14.2	10.4	11.2
Synchronization of caregiver behaviors				
Indicating behaviors	mean	.93	.96	.87
	SD	.60	.33	.52
Verbalizations	mean	.91	.95	.98
	SD	.15	.12	.21
Undemanding verbalizations	mean	.54	.49	.69
	SD	.26	.22	.28

be predictive of the children's gain in nonverbal communication and language skills. Difference scores between initial and follow-up testing were used as measures of the child's gain in skills. Five measures of gain were calculated: 1-year gain in the percentage of responding to joint attention, in the frequency of initiating joint attention, and in language skills; 10-year gain in language skills; and 16-year gain in language skills. The mean language gain over the course of 1, 10, and 16 years was 4.7 months (*SD*, 6 months), 29.2 months (*SD*, 29.2 months), and 36.0 months (*SD*, 47.7 months), respectively. Gains in nonverbal communication over 10 and 16 years were not calculated because the ESCS was modified for the older children so that the scores were no longer comparable to those acquired by the children at the first two testing sessions. For two children whose initial percentage of response to joint attention was 100%, a measure of 1-year gain in response to joint attention was not calculated.

As a preliminary step, Pearson product moment correlations were calculated between the five gain scores and total frequencies of caregiver indicating and verbal behaviors as well as the total duration of child toy-directed attention. None of these correlations was significant. Therefore, the degree of attentiveness of the children to toys did not predict their increasing nonverbal and verbal competence. In addition, the children's communicative gains were not predicted by the total frequency of the caregiver's indicating or verbal behaviors.

To determine whether caregiver synchrony was associated with the child's future development of communication skills, Pearson product moment correlations were calculated between the three measures of caregiver synchronization and five measures of gain in child skills; these correlations are reported in Table III.

One-Year Gains in Nonverbal Communication

The children's 1-year gain in response to joint attention was significantly correlated with both the total measure of caregiver synchronized verbalizations and the measure of undemanding synchronized verbalizations. The child's 1-year gain in frequency of initiating joint attention was significantly correlated with the score for the caregiver's synchronized indicating behavior and the score for the caregiver's undemanding synchronized verbalizations. Because of a concern that the results might be partly attributable to outliers, these results were confirmed using Spearman's nonparametric test. The association between the gain in responding to joint attention and the score for total synchronized verbalizations, Spearman's $Rho = .68$, $p < .004$, remained significant. This was also true for the association between the gain in initiating joint attention and the score for synchronized indicating behaviors, Spearman's $Rho = .66$, $p < .006$. The relations between the scores for undemanding synchronized verbalizations and the improvement in both responding to and initiating joint attention were not significant when the nonparametric test was used and may have been due to outliers.

The predictive relation between caregiver synchronized verbalizations and the children's increase in the percentage of responding to joint attention might be attributable to initial skills in the children if any of these skills predicted both the increase in the percentage of responding to joint attention and the total score

Table III. Prediction of Child Gain Based on Caregiver Synchronization

Synchronization of caregiver behaviors		Gain in joint attention		Gain in language		
		Response (1 year)	Initiates (1 year)	1 year	10 years	16 years
Indicating behavior	*r*	.11	.67	.15	.23	.40
	p	.71	.01	.61	.43	.11
	n	14	16	15	14	17
Verbalizations	*r*	.63	.46	.46	.43	.44
	p	.01	.05	.07	.08	.06
	n	16	18	17	17	19
Undemanding verbalizations	*r*	.57	.50	.33	.67	.79
	p	.02	.03	.20	<.005	<.001
	n	16	18	17	17	19

for synchronized caregiver verbalizations. To determine whether this explanation was plausible, correlations between the four initial child skill measures (percentage of responding to joint attention, frequency of initiating joint attention, IQ, and language score) and the gain in the percentage of responding to joint attention were calculated. There were no predictive relations between any of these initial child skills and the gain in the percentage of responding to joint attention. Thus, the predictive association between the caregivers' use of synchronized verbalizations and the children's gain in responding to joint attention cannot be attributed to initial characteristics of the children.

It is possible that the association between the caregivers' use of indicating behaviors and the children's gain in the frequency of initiating joint attention stems from an initial association between the caregivers' use of indicating behaviors and the child's initial skills. If this were true, the association might be attributable to a continuity in communicative skills in the children rather than to any influence of the caregivers' behaviors. To test this hypothesis, correlations were calculated between the four initial measures of child skills and the score of caregiver synchronous indicating behaviors. The results showed that none of the initial child skills was significantly correlated with the caregiver synchronized indicating behaviors.

Finally, both predictive relations (caregiver synchronized verbalizations and gain in responding to joint attention; caregiver synchronized indicating behaviors and gain in initiating joint attention) remained significant even when initial IQ, joint attention, or language skills was statistically controlled for.

Language Gains

The Pearson product moment results show a significant correlation between the score for the caregiver undemanding verbalizations and the 10- and 16-year gain in language skills of the children. These associations were also significant using the nonparametric test, Spearman's *Rho* = .59, $p < .013$ and Spearman's *Rho* = .67, $p < .002$, respectively. Although the association between the score for total synchronized verbalizations and gain in 10-year language did not reach significance when assessed with Pearson's *r*, there was a significant association when this was assessed with the Spearman's nonparametric test (*Rho* = .49, $p < .04$). Overall, then, the frequency of synchronized verbalizations, particularly those with an undemanding quality, significantly predicted the child's future gain in language skills.

One explanation for the relation between synchronized caregiver vocalizations and child's future gain in language might be that caregivers vocalize synchronously more with children who concurrently have higher communicative and developmental capabilities and that these initial capabilities account for the predictive relation between caregiver behaviors and child improvement. To test this explanation, correlations were computed between the four initial measures of child skills and the two measures of caregiver verbal synchronization, as well as the three measures of language gain. The results showed that none of the measures of caregiver synchronization were significantly correlated with any of the initial measures of child skills. However, we did find an association between the initial child measures and the measures of language gain. The results showed that initial skills in response to joint attention were significantly correlated with the 1-year ($r = .54$, $p < .05$) and 10-year ($r = .47$, $p < .05$) gains in language. Also, initial IQ was significantly correlated with the child's 10-year ($r = .56$, $p < .05$) and 16-year ($r = .53$, $p < .05$) gains in language. The fact that neither of the two measures of caregiver synchronization was significantly correlated with any of the

initial child measures suggests that the relation between the synchronization of undemanding caregiver utterances and the child's gain in language cannot be explained as continuity in the child's communication skills. In addition, both predictive relations between caregiver undemanding synchronized verbalizations and the 10- and 16-year language gains remained significant even when initial IQ, joint attention, or language skills were statistically controlled for.

DISCUSSION

In summary, the study reported here focused on behaviors that caregivers of children with autism show during play interactions with their children. We were particularly interested in the extent to which the caregiver's verbal and nonverbal behaviors were synchronized with the child's focus of attention as well as his or her ongoing activity. The study had two major findings. First, caregivers of children with autism synchronized their behaviors to their children's attention and activities as much as did caregivers of children with developmental delay and caregivers of typically developing children, matched on language capacities. Second, caregivers of children with autism who showed higher levels of synchronization during initial play interactions had children who developed superior communication skills over a period of 1, 10, and 16 years compared with children of caregivers who showed lower levels of synchronization initially.

The fact that parents of children with autism achieve an equivalent level of synchronization is remarkable given how difficult it often is to determine what the child with autism is attending to and intending to do. It is also remarkable because the developmental profile of children with autism, the distribution of weaknesses and strengths in different areas of development, is qualitatively different from that of typically developing children or children with developmental delay. One would expect that the complexities involved would challenge the caregiver's ability to recognize and adapt to the developmental level of the child with autism. Our findings suggest that caregivers of children with autism successfully adapt their interactive behavior to the language level of their child. However, it is important to mention that children with autism, when matched with control groups on language abilities, show characteristic deficits in preverbal communication skills, especially joint attention. Whether caregivers of children with autism also recognize and adapt to these more subtle characteristics of their children cannot be answered based on our study. Given their difficulties in sharing attention with others, optimal development of language skills in children with autism might require higher levels of synchronization from the caregiver than is true for typically developing and even developmentally delayed children, who do not show deficits in joint attention.

The predictive relation between the extent of caregiver synchronization and the children's future gain in communication skills is striking. Generally, this association was found with both parametric and nonparametric tests and was therefore not due to a few extreme cases. With regard to the child's nonverbal communication skills, it is interesting that the strongest predictor of the gain in initiating joint attention is the caregiver's own tendency to initiate joint attention herself, albeit in a synchronized way. Total caregiver indicating behavior does not predict gain in the frequency with which children initiate joint attention unless the caregiver chooses to show, point, or offer an object that is already the focus of the child's attention. This evidence suggests that children with autism are able to learn by modeling if the activity selected is part of their attentional focus.

The child's gain in language skills, however, is associated with the quality of the caregiver's verbal but not his nonverbal behavior. Although overall the quality of the caregiver's verbal behavior turned out to be a strong predictor of the child's long-term gain in language skills (over a period of 10 and 16 years), short-term gain in language skills (over a period of 1 year) was not predicted in the same way. The lack of prediction over 1 year may have been due to the fact that there was very little change over the course of a year in language skills. The language measures used in this study may not have been sensitive enough to capture the small short-term gains, whereas the substantial long-term gains were measured more reliably.

The strongest predictor of the child's future gain in language skills in our study was caregiver utterances that are not only synchronized with the child's focus of attention but also undemanding in quality. This is somewhat surprising given that even authors who favor the idea of giving the choice over the stimulus material to the child expect the caregiver to demand activities from the child that go beyond his or her spontaneous toy engagement (Kern, Vorndran, Hilt, Ringdahl, Adelman, & Dunlap, 1998). There are two distinct features of undemanding caregiver utterances that might explain this finding. First, undemanding utterances by definition not only match the toy to which the child is attending but also the toy-directed activity in which the child is engaged. Demanding utterances, however, describe, suggest, or demand an activity that is different from the child's ongoing activity. If we think of the child's focus

of attention as a "focus on a certain activity with an object" rather than just a "visual focus on a certain object," the match between caregiver utterance and the child's focus of attention is better for undemanding synchronized utterances than it is for demanding synchronized utterances. Also, it has been reported in the literature that children with autism are less compliant and demonstrate atypical gaze and affect patterns when confronted with interpersonal demands (Arbelle, Sigman, & Kasari, 1994; Lemanek, Stone, & Fishel, 1993). It might be easier for a child with autism to process utterances that do not involve interpersonal demands.

Another issue that needs to be addressed is the optimal level of synchronized caregiver behaviors. Our findings showed a positive correlation between the caregiver's level of synchronization and the child's outcome. However, we must be very cautious not to extrapolate our findings beyond the range of synchronization scores that were observed in our sample of 25 caregiver-child dyads. Our study does not picture perfect synchronization and a complete ban of verbal demands as a behavioral goal for caregivers. The only conclusion that our study allows is that caregivers of children with autism may have the tendency to show too little synchronization and too many demanding verbalizations rather than the other way around.

Although it is tempting to conclude from our findings that caregiver behavior facilitates the child's development of communication skills, it is important to take at least two alternative explanations into consideration. First, one could argue that the level of caregiver synchronization reflects an adaptation of the caregiver to a certain child characteristic and that it is this child characteristic that in itself determines the child's future development. The second alternative explanation is based on Sandra Scarr's concept of evoked gene-environment effects (Scarr & McCartney, 1983). Following her interpretation, early child characteristics have an indirect effect on the child's outcome, mediated by the child's social environment. Early child characteristics elicit certain adaptations from his caregiver. These adaptations in the social environment, rather than the child characteristics itself, are considered to play an important role in determining the developmental outcome of the child. In fact, with respect to typically developing children, there is some empirical evidence that early child characteristics (joint attention, language skills) do affect the subsequent development in the quality of caregiver-child interaction (Markus, Mundy, Morales, Delgado, & Yale, 2000). The concept of evoked gene-environment effects is interesting in that the relation between child characteristics and behavioral adaptations of the caregiver is viewed as an empirical phenomenon rather than as a theoretical necessity. Decoupling this empirical link might be a powerful tool for parent training interventions.

The design of this study does not allow us to finally decide in favor of either one of the three causal interpretations given above. However, four arguments speak against the alternative explanations that attribute a crucial causal role to initial child characteristics. First, the measures of caregiver synchronization were specifically designed to minimize the impact of child behaviors by selectively focusing on the onset of caregiver behaviors. In addition, the formula used to calculate the measures of caregiver synchronization controlled for the caregiver's opportunity to act synchronous (defined by the duration of the child's toy-directed attention). Second, the profound differences in child characteristics across the diagnostic groups were not associated with variations in the extent of caregiver synchronization. Third, our statistical analysis showed that none of the initial child characteristics—language age, joint attention skills, IQ, or duration of child-directed attention to toys—was able to explain the predictive relation between the measures of caregiver synchronization and the child's future gain in communication skills. It is true that one could argue for a variety of other initial child variables of this type that were not identified as part of our study. However, it is important to mention that initial language and joint attention skills are the most powerful predictors of later language outcome that have been identified in the autism-related literature.

Finally, the causal interpretation of our findings is consistent with research on typically developing children as well as with recent approaches of both research and intervention in autism. Research on typically developing children showed that maternal synchronization is predictive for the child's later language development and that this relation can be observed from very early ages (9 months) (Carpenter *et al.,* 1998). This finding suggests that the link between caregiver synchronization and the child's language development is foundational rather than the product of some later derived strategy.

Genetic research provides compelling evidence for the importance of biological factors in autism (Bailey, Phillips, and Rutter, 1996; Rutter *et al.,* 1999), but it also highlights that the relation between the "autistic genotype" and its manifestation in behavioral deficits is far from being deterministic (Le Couteur, Bailey, Goode, Pickles, Gottesman, Robertson, & Rutter, 1996). Therefore, findings that the environment does play a

significant role in the development of communication skills in children with autism is consistent with a line of research that has a complex view on the processes that are involved in the initiation, persistence, and desistance of behavioral deficits in childhood psychopathology and a focus on the interaction between biological and environmental factors (Rutter, 1996; Rutter & Plomin, 1997, Plomin, 1994).

In addition, the interactive style that was identified in our study as being beneficial for the development of communication skills in children with autism (being sensitive to the focus of attention of the child and trying to maintain his or her ongoing activity) is closely related to the concept of "child choice" (for a review, see Kern *et al.,* 1998), which is central to a variety of current interventional techniques. Child choice was shown to promote the language development in children with language delay (Yoder, Kaiser, Alpert, & Fischer, 1993; Camarata & Nelson, 1992; Koegel, O'Dell, & Koegel, 1987). In addition, a variety of recent interventions that specifically target communication skills in children with autism consider the child's motivation and the sharing of control over material and tasks as basic parameters of intervention: Pivotal Response Intervention (Koegel, Koegel, Harrower, & Carter, 1999; Koegel, Koegel, Shoshan, & McNerney, 1999), Natural Language Learning Paradigm (Koegel, O'Dell, & Koegel, 1987), Incidental Teaching Approach (McGee, Morrier, & Daly, 1999; Laski, Charlop, & Schreibman, 1988; Schreibmann, Kaneko, & Koegel, 1991), and Functional Development Approach (Greenspan & Wieder, 1999).

Given the assumption that there is a causal link between sensitive care giving and the child's future development of communication skills, the questions arises as to why it might be so important for caregivers of children with autism to be sensitive to their children's focus of attention. Why is it so important that the caregiver's behavior matches the child's focus of attention and ongoing activity? Three interrelated answers are suggested. First, recent research highlights the attentional deficits, especially in disengaging from an ongoing stimulus and shifting attention to a new stimulus, in children with autism (Wainwright & Bryson, 1996). Therefore, an interactive partner who is engaged with or talks about an object that the child is already attending to, one who comments on the child's ongoing activity, might provide the child with social and language experiences while compensating for the child's attentional deficits. From a social-cognitive point of view, the shared intentional state toward an external object between caregiver and child might help the child to acquire the understanding that other persons attend to and have intentions about external objects or events, an understanding thought to be the basis for the development of joint attention and language. The third reason why a caregiver who follows the child's lead might promote the child's communication is related to the functional nature of communication. Naturally occurring communication always has a goal and is therefore closely related to the motivation of the person who wants to communicate. Children with autism who have specific difficulties in interacting with other people might often experience these interactions as frustrating and unsuccessful. Therefore, an interactive partner who is sensitive to the child's interests might provide the child with the experience that interacting and sharing an interest with another person are fun and motivating in and of themselves.

The difficulty in identifying a causal network from this correlational study suggests future directions for research. An experimental design in which caregivers are encouraged to increase the extent of their synchronous indicating behaviors and verbalizations would be useful from several points of view. Such a study would investigate whether it is possible to modify the synchronous behaviors of parents during interactions with their children with autism. If such modification was possible, the causal links between synchronized parental behavior and improvements in communication styles of children with autism would be more fully drawn.

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