Journal of Speech and Hearing Research, Volume 38, 157–167, February 1995

Nonverbal Communication and Early Language Acquisition in Children With Down Syndrome and in Normally Developing Children

Peter Mundy
University of Miami
Coral Gables, FL

Connie Kasari
Marian Sigman
Ellen Ruskin
University of California at Los Angeles

Many children with Down syndrome display asynchrony in development with the acquisition of language preceding at a slower pace than the acquisition of other cognitive skills. Recent research suggests that the expressive language delays that are displayed by these children may be associated with an earlier disturbance in the development of nonverbal requesting skills (Mundy, Sigman, Kasari, & Yirmiya, 1988; Smith & von Tetzchner, 1986). To test this hypothesis, a longitudinal study of 37 children with Down syndrome and 25 children with normal development was conducted. The results of the study indicated that this sample of children with Down syndrome exhibited a disturbance in nonverbal requesting. Furthermore, individual differences in nonverbal requesting were associated with the subsequent development of expressive language in these children. This association was observed even after taking into account initial variance in developmental level and language status. These data suggested that some of the processes involved in the expressive language delay of children with Down syndrome were not unique to linguistic development. Instead, some aspects of this delay appeared to be associated with problems in an earlier nonverbal phase of communication development. Additionally, the results suggested that measures of nonverbal communication skills also made a unique contribution to the prediction of language development among children with normal development. These data supported the hypothesis that the acquisition of nonverbal communication skills provides an important foundation for the emergence of language in atypical as well as typical development.

KEY WORDS: nonverbal communication, Down syndrome, language development

The first half of the second year of life is a significant transition period in cognitive and communication abilities. One important development in this period is the acquisition and consolidation of nonverbal communication skills, such as the capacity to direct the attention of others by pointing. The development of nonverbal communication skills is thought to be important for several reasons. First, these skills may reflect fundamental cognitive processes such as the capacity for representational thought (Bates, Benigni, Bretherton, Camaioni, & Volterra, 1979; Butterworth & Grover, 1988) and executive functions such as the capacity to inhibit responses selectively and engage in flexible, planned action sequences (McEvoy, Rogers, & Pennington, 1993). Second, nonverbal communication skills may also involve the integration of cognitive processes with affective and interpersonal aspects of early development (Adamson & Bakeman, 1985; Bruner, 1975; Jones, Collins, & Hong, 1991; Kasari, Sigman, Mundy, & Yirmiya, 1990; Mundy, Kasari, & Sigman, 1992; Trevarthen, 1977). Indeed, it may be that the development of nonverbal communication skills involves the growth and development of varied cognitive capacities as they are applied to the specific context of problem solving in social interactions. That

0022-4685/95/3801-0157

is, measures of nonverbal communication may provide a window through which the early development of social cognition may be observed (Bretherton, 1991; Bruner, 1975, 1977; Mundy & Hogan, 1994). Moreover, it has been suggested that the social-cognitive processes inherent in nonverbal communication may provide a foundation that supports or facilitates subsequent language development (Bates et al., 1979; Bruner, 1977; Sigman & Mundy, 1993; Tomasello, 1988; Werner & Kaplan, 1963).

The foregoing literature leads to several testable hypotheses. First, and perhaps most obvious, is the hypothesis that individual differences in the development of nonverbal communication skills should be associated with individual differences in the subsequent development of language skills. Although there is some empirical support for this possibility (Bates et al., 1979; Masur, 1981; Olson, Bates, & Bayles, 1984; Tomasello, 1988), surprisingly little work has been directed to this issue in the literature on normal development.

A second related hypothesis is that if the relation between nonverbal communication skills and language development is robust, then language disturbance in some children with developmental disorders may be associated with an earlier manifest disturbance in the development of nonverbal communication skills. A corollary here is that the observation of such a nonverbal communication disturbance may provide information about the nature of a particular developmental disorder. Evidence in support of these assumptions has emerged in research with children with autism (Curcio, 1978; Loveland & Landry, 1986; Mundy, Sigman, & Kasari, 1990; Mundy, Sigman, Ungerer, & Sherman, 1986; Wetherby & Prutting, 1984). Furthermore, recent research has begun to suggest that there may also be an association between nonverbal communication disturbance and early difficulties with expressive language acquisition in children with Down syndrome (Mundy et al., 1988; Smith & von Tetzchner, 1986).

In this regard, Smith and von Tetzchner (1986) investigated the development of two types of nonverbal communication skills, nonverbal imperatives and declaratives, in thirteen 24-month-old Norwegian children with Down syndrome. Nonverbal imperatives or requests involve the child's use of gestures and eye contact to elicit assistance from an adult in achieving a goal (Bates et al., 1979). For example, a child might extend his or her arm to a toy that is out of reach and look to an adult to elicit assistance in obtaining the toy. Nonverbal declarative or joint attention skills also involve the use of gestures and eye contact to direct attention to objects or events. However, the instrumental goal of these behaviors is less apparent (Bates et al., 1979), such as when a child points to an interesting toy that is within reach while looking at an adult.

Smith and Tetzchner reported that, compared to mental-age-matched nondelayed children, children with Down syndrome displayed a deficit in nonverbal joint attention skills but not in imperative skills. Previous research had reported related results (Greenwald & Leonard, 1979; Lobato, Barrera, & Feldman, 1981). However, the declarative deficits of the children with Down syndrome observed in the Smith and von Tetzchner study, unlike those reported in the earlier efforts, could not be explained in terms of differences in the children's tendency to use words for declarative or imperative purposes. Thus, the Smith and von Tetzchner study was one of the first to clearly suggest that children with Down syndrome displayed an early-emerging nonverbal communication deficit. Smith and Tetzchner also examined the relation between nonverbal communication development and subsequent language development. They found, in contrast to the group differences described in their study, that it was nonverbal requesting, rather than joint attention, that was significantly related to expressive language development in their sample with Down syndrome after a 1-year follow-up period.

In a related study, Mundy et al. (1988) also reported that a measure of nonverbal requesting, rather than nonverbal joint attention, was associated with expressive language in a sample of young children with Down syndrome. However, in contrast to the group differences described by Smith and Tetzchner, Mundy et al. (1988) reported that their sample of young children with Down syndrome displayed deficits on a measure of nonverbal requesting, rather than on a measure of joint attention skills relative to other children. Hence, although this study also suggests that children with Down syndrome may display a preverbal communication disturbance, these data suggested that nonverbal requesting rather than joint attention deficit may be characteristic of young children with Down syndrome. Similarly, Wetherby, Yonclas, and Bryan (1989) have reported that a small sample of children with Down syndrome tended to score at the very low end of the normal distribution on a standardized measure of nonverbal requesting, but scored in the average to high range on a measure of joint attention skill.

Thus, both the data of Smith and von Tetzchner (1986) and Mundy et al. (1988) suggest that the early development of nonverbal requesting is associated with the development of expressive language in children with Down syndrome. However, although Smith and von Tetzchner observed deficits in nonverbal joint attention skills, the data from Mundy et al. (1988) and Wetherby et al. (1989) suggest that a disturbance in the development of nonverbal requesting, rather than nonverbal joint attention skills, may be more characteristic of the early development of children with Down syndrome.

Resolving this inconsistency and replicating the association between nonverbal requesting and language development may be important. A clear picture of the pattern of nonverbal communication skill development may contribute to an understanding of the nature of Down syndrome. Furthermore, describing the links between nonverbal communication and language development may assist in understanding the nature of the developmental delays in language acquisition that are associated with Down syndrome. To this end a longitudinal study of nonverbal and verbal communication development in a sample of young children with Down syndrome was conducted. There were three primary goals in this study. The first goal was to determine if it was possible to replicate the finding that children with Down syndrome display fewer nonverbal requesting bids than mental-age-matched controls (Mundy et al., 1988; Wetherby et al., 1989). The second goal of the study was to test the hypothesis that individual differences in nonverbal requesting would be associated with individual differences in the subsequent expressive language development in children with Down syn-

TABLE 1. Initial (1st) and follow-up (2nd) means for descriptive data from Down syndrome and normal subjects (standard deviations in parentheses).

Variables	Down syndrome	Normal
1st Chronological Age[a]	22.5 (7.0)	14.6 (4.4)*
2nd Chronological Age	35.1 (7.6)	26.3 (7.1)*
1st Mental Age	16.6 (5.0)	17.3 (4.1)
2nd Mental Age	24.4 (5.2)	30.7 (11.5)*
1st IQ	74.3 (14.9)	120.6 (13.4)*
2nd IQ	65.9 (13.3)	112.8 (17.8)*
1st Expressive Language Age	14.5 (3.2)	15.5 (3.4)
2nd Expressive Language Age	18.4 (4.9)	32.4 (11.9)*
1st Receptive Language Age	15.4 (4.6)	16.0 (4.2)
2nd Receptive Language Age	20.6 (7.2)	35.7 (10.2)*
Caucasian/other	57% vs. 43%	52% vs. 48%
Mother's Education[b]	5.9 (1.5)	6.5 (1.7)

[a]All ages in months.
[b]Quantified with an 8-point scale: 1 = less than 7th grade, to 8 = graduate or professional training.
*Significant group difference, $p < .005$.

drome. Finally, based on the extant literature (Olson et al., 1984; Tomasello, 1988), we also expected that measures of nonverbal communication would make a contribution to the prediction of language development in children with normal development.

Method

Subjects

Thirty-seven children with Down syndrome were recruited for this study. Eighteen were boys and 19 were girls. Four screening criteria were employed in recruiting children for this study: (a) chronological age between 12 and 36 months, (b) expressive speech of less than 20 words by caregiver report, (c) no known gross visual or auditory handicaps, and (d) the functional use of both hands. Parental report of medical records indicated that all of these children were affected by autosomal trisomy of the 21st chromosome. No cases of Down syndrome involving translocation or mosaic presentation were reported. Thirteen children were from English/Spanish bilingual homes.

A comparison sample of 25 children without developmental disorder between the ages of 8 and 28 months chronological age was recruited from birth records at university hospitals and local early child care and education centers. Seven children were from English/Spanish bilingual homes, and there were 13 boys and 12 girls in the sample. This group was selected to yield a sample with comparable distributions on estimates of mental age, language age, sex, ethnicity, family language, and mother's education.

The samples were assessed during an initial assessment phase and a follow-up assessment phase. The follow-up assessment was conducted 13 months (± 21 days) after the initial assessment. Descriptive statistical data for these samples at the time of the initial and follow-up assessments are presented in Table 1. Thirty-three children with Down syndrome (89%) and 22 control children (88%) returned for the follow-up assessments. There were no differences noted with regard to the initial CAs, MAs, IQs, or language age estimates between the children who returned and those who did not return at follow-up. Ten of the children who returned for follow-up were from bilingual backgrounds, while four of the follow-up children in the sample with normal development were from bilingual backgrounds.

Procedure

Assessments were conducted in a laboratory playroom in either English or Spanish depending upon the caregiver's report of which language was most prominent in the home. Two assessments were conducted in Spanish with children in each group. To estimate IQ and mental age each child was administered the Cattell Infant Intelligence Scale (Cattell, 1940). Language development was assessed with the Reynell Scales of Language Development (Reynell, 1977). The Reynell Scales provided standardized measures of expressive and receptive language development between the ages of 1 and 7 years; these scales have demonstrated validity in the language assessment of young children with developmental delays (Cantwell, Howlin, & Rutter, 1977).

The children were also administered the Bayley Scales of Motor Development (Bayley, 1969) and the Movement Assessment Inventory (MAI; Chandler, Andrews, & Swanson, 1980). These measures were presented to examine the possibility that an association between nonverbal requesting and expressive language development in children with Down syndrome may not reflect psychological processes so much as it reflects a disturbance in motor activation processes that may be common to nonverbal requesting and the physical generation of speech (Mundy et al., 1988).

The Bayley Motor Scale was scored to yield a norm-referenced motor age estimate in months. The MAI was administered according to established procedures and scored by one of the authors who had been trained on this measure (C.K.). This measure is sensitive to muscle tone and motor reactivity in young children with Down syndrome (Lydic, Short, & Nelson, 1983) and has adequate interrater and test-retest reliability (Harris, Haley, Tada, & Swanson, 1984). Typically this measure yields a six-point rating of motor tone from hypotonic to hypertonic based on ratings of 10 items that assess posture and range of motion of extremities. However, in this study none of the children evinced hypertonic tone. Therefore, this measure was scored to yield a three point rating of the muscle tone of the child's extremities and trunk: 1 = severely hypotonic, 2 = moderately hypotonic, 3 = normal.

Nonverbal Communication Assessment

Nonverbal communication behaviors were assessed with an abridged version of the Early Social-Communication Scales (ESCS; Mundy et al., 1986, 1988; Seibert, Hogan, & Mundy, 1982). In this procedure the child and a tester sat facing each other at a small table. A set of toys including a hat, a comb, a picture book, a ball, a car, three small wind-up mechanical toys, and three hand-operated mechanical toys were in view but out of reach of the child. Colorful posters adorned the walls of the room, and the child's caregiver sat approximately 3 feet directly behind the child.

The tester presented the six mechanical toys by activating each one on the table at least three times. Between toy trials the tester also presented other situations. Two trials of clapping, singing a brief song, and then gently tickling the child were presented. In each of these trials the tester tickled the child three times with pauses between each tickle episode. The tester also presented two sets of pointing trials in which the tester pointed to the left, right, and behind the child while emphatically stating the child's name. In these trials the tester did not fully extend his or her arm when pointing to avoid eliciting a head turn response simply with arm movement.

In addition, the tester also presented the child with object turn-taking opportunities. These included presenting the child with the opportunity to roll a car back and forth with the tester. Opportunities to take turns using a comb, hat, or glasses in a functionally appropriate fashion with the tester were also presented.

This procedure was videotaped to record the front-upper body profile of the tester and a full-face and upper body view of the child. The interaction period with each child lasted approximately 20 minutes. Frequencies of nonverbal behaviors were recorded from the videotapes by trained observers who were blind to the hypotheses of this study. Behavior observations were grouped into three mutually exclusive, functionally defined categories of communication skills: social interaction, joint attention, and requesting. A total frequency score was computed per category for each child because previous research suggests these ESCS measures may be most useful in studies of individual differences (McEvoy et al., 1993; Mundy, Sigman, & Kasari, 1990).

Social interaction behaviors involved eliciting attention or physical contact from the tester and engaging in turn-taking with objects. These behaviors included (a) responding to a pause in being tickled with eye contact and a gesture (e.g., reach or bang table); (b) initiating a turn-taking sequence by rolling the ball or the car back and forth with the tester three or more times; (c) placing the hat, comb, and/or glasses on the tester's head after the tester leaned toward the child and said "Can I play"; (d) engaging in a prohibited activity (e.g., child holds toy as if to drop it behind the table), smiling and making eye contact with the tester (teasing).

The requesting category included behaviors that were used to direct attention to objects or events in order to request aid in obtaining the object or a repetition of an event (i.e., reactivation of a mechanical toy). Behaviors rated here included (a) reaching to toys out of reach; (b) making eye contact and reaching to toys out of reach; (c) giving a toy to the tester, defined as extending a toy toward the experimenter's hand; and (d) pointing (extending index finger) to toys that were out of reach.

The joint attention category also involved the coordination of the child's and tester's attention to objects or events, but the instrumental function of these behaviors was less apparent because the object was within reach, or the event was ongoing. These behaviors included (a) eye contact while holding a toy, (b) alternating eye gaze between the tester's face and an active toy, (c) pointing to toys within reach, and (d) showing toys or extending toys toward the tester's face.

According to Butterworth and Grover (1988), the capacity of the child to respond appropriately to pointing may constitute an important and somewhat distinct joint attention skill. Consistent with this notion, a separate "responding to joint attention" is also scored on the ESCS. This measure was scored according to whether a child turned his or her head (at least 45 degrees) and eyes in the correct direction when the tester pointed to the left, right, and behind the child while emphatically stating the child's name.

Previous data on paired ratings of 19 children with typical or delayed development indicated adequate rater reliability for the ESCS variables examined in this study (Mundy et al., 1988). To replicate this finding, 7 children in this study (4 children with Down syndrome and 3 controls) were randomly selected and rated by three independent observers to assess multiple rater reliability with generalizability analyses. Generalizability coefficients above .50 indicate adequate reliability (Mitchell, 1979). The generalizability coefficients for the total frequency scores for each category of ESCS behaviors were as follows: Social Interaction, .93; Joint Attention, .80; Responds to Joint Attention, 1.0; and Requesting, .89. Similar high levels of reliability for the frequency scores generated by the ESCS have been reported elsewhere (McEvoy et al., 1993).

Results

Preliminary Analyses

Although the samples were comparable on several demographic variables the possible influence of sex, language in the home, mother's level of education, and ethnicity were examined in preliminary analyses. Group (Down syndrome vs. controls) × mother's level of education (college graduate vs. not college graduate) ANOVAs of the initial ESCS variables, initial Reynell language variables, mental age, and the Reynell follow-up language variables yielded no significant effects involving mother's level of education. Similarly, no significant effects were associated with differences in lan-

TABLE 2. Comparison of children with Down syndrome and control children on the means for the ESCS measures (standard deviations in parentheses).

	Down syndrome		Control	
ESCS Variables	**Lower MA**	**Higher MA**	**Lower MA**	**Higher MA**
Requesting	8.3 (6.6)	13.8 (7.2)	11.6 (7.2)	17.9 (7.1)[b]
Social Interaction	5.5 (3.5)	5.9 (2.4)	4.1 (3.8)	7.8 (3.8)
Joint Attention	11.9 (5.4)	16.5 (6.8)	15.2 (5.2)	16.9 (6.1)
R-Joint Attention[a]	46% (36%)	61% (36%)	54% (31%)	90% (10%)[b]

[a]"R" indicates the Responding to Joint Attention variable.
[b]Significant group differences.

guage exposure in the home in this study. The most important findings here may have been that the English-only versus English/Spanish bilingual subgroups did not display differences on initial or follow-up language scores, nor did home language experience interact with group membership to affect Reynell performance. The *F* values associated with these analyses ranged from 0.01 to 2.69. These data are important because the validity of the Reynell for the assessment of children from bilingual backgrounds has not been well established. Although these data were not definitive, they suggested that, in this study, the performance on the Reynell language measures was not systematically affected by home language environment for either the children with Down syndrome or children with normal development.

Analyses of ethnicity (Caucasian vs. Other) yielded a significant main effect of ethnicity on follow-up receptive language ($F = 4.04$, $df = 1{,}54$, $p < .05$), with caucasian children displaying higher age estimate scores across the groups (28.3 months vs. 23.2 months). However, ethnicity was not associated with significant effects on any of the other variables.

Analyses of sex effects yielded a significant group × sex interaction on the initial Reynell expressive language scores, $F = 5.21$, $df = 1{,}61$, $p < .05$. Girls with normal development obtained a higher mean expressive language age estimate (17.2 months) than did boys (14.0 months). However, this was not the case for children with Down syndrome (14.2 vs. 14.7 months, respectively). These results are consistent with data which suggest that girls with normal development exhibit an advantage in early expressive language development (Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991). These results also suggest that the factors operative in this early sex bias have less of an effect in the early development of children with Down syndrome. This was the only significant effect associated with sex. There were no significant effects of sex on the ESCS scores or the follow-up Reynell language scores in either group.

These results suggested that sex, language in the home, ethnicity, and mother's level of education were associated with few significant effects involving the ESCS variables and the outcome language variables. Moreover, where significant effects were obtained they did not appear to be of a kind that would confound the interpretation of data in this study.

Nonverbal Communication Comparisons

In previous research Smith and von Tetzchner (1986) examined a sample of children with Down syndrome with a mean CA of 24 months and a mean MA of 13.7 months. As can be seen in Table 1 the MA estimate for the children with Down syndrome in this study was somewhat higher (16.6 months). In order to yield data that were as comparable as possible to the data provided by Smith and von Tetzchner (1986), each of the summary scores for the nonverbal communication measures was analyzed with a 2 (group) × 2 (mental age) ANOVA in this study. The mental age subgroups were dicotomized at 18 months (higher, MA > 18 months; and lower, MA < 18 months) because this yielded a developmentally younger subsample of children with Down syndrome with MA estimates more comparable to the estimates reported for children in the Smith and von Tetzchner study. There were 22 children with Down syndrome in the lower MA subgroup (Mean MA = 13.2, *SD* = 2.5) and 15 in the higher subgroup (Mean MA = 21.7, *SD* = 2.7). Among the children with normal development there were 15 children in the lower subgroup (Mean MA = 14.3, *SD* = 2.3) and 10 children in the higher subgroup (Mean MA = 21.3, *SD* = 3.1).

The means corresponding to the nonverbal communication variables in these analyses appear in Table 2. Analyses revealed that the children with Down syndrome displayed fewer nonverbal requests than did the control children, $F = 4.05$, $df = 1{,}61$, $p < .05$. There was also an MA effect with both higher MA groups displaying more nonverbal requests, $F = 10.28$, $df = 1{,}61$, $p < .001$. However, the Group × MA interaction was not significant, $F = 0.04$ (see Table 2). Thus, even the younger MA group most comparable to the children in the study of Smith and von Tetzchner displayed fewer nonverbal requests than did control children in this study.

Analyses revealed that there were no group differences on the Joint Attention measure, $F = 1.41$, but a mental age effect was evident with both higher MA groups displaying more joint attention bids, $F = 4.23$, $df = 1{,}61$, $p < .05$. The interaction of Group with MA was not significant, $F = 0.34$.

In our previous study, children with Down syndrome exhibited higher frequencies of social interaction behaviors than did controls regardless of developmental level (Mundy et al., 1988). In this sample, there was a main effect for mental age on the social interaction variable, $F = 5.12$, $p < .05$, but there was no main effect for group on this variable, $F = .12$, $p < .8$. However, the group × mental age interaction approached significance, $F = 3.26$, $p < .08$ because the lower MA children with Down syndrome had higher scores than lower MA controls on this variable, whereas the higher MA children with normal development displayed a relative strength on this variable (see Table 2). Thus, consistent strength on this variable was not observed for the children with Down syndrome in this study.

Significant group, $F = 4.77$, $df = 1{,}61$, ($p < .05$), and MA effects, $F = 9.04$, $df = 1{,}61$, ($p < .001$), were obtained on the Responding to Joint Attention variable. The data in Table 2 indicated that the Higher MA groups responded with correct head turns to tester's pointing more frequently than did the Lower MA groups. However, regardless of MA, the children with Down syndrome performed more poorly on this measure than did the controls.

Thus, the group comparisons of the nonverbal communication variables indicated that the children with Down syndrome in this study evinced consistent deficits in nonverbal requesting and responding to joint attention regardless of developmental level.

Nonverbal Requesting and Neuromotor Status

It has been suggested that a nonverbal requesting deficit among children with Down syndrome may reflect a passive interactive style that arises because of neuromotor hypotonia (Mundy et al., 1988). To address this concern the Bayley Motor age scores and MAI scores were examined. These two variables were significantly correlated in the sample with Down syndrome ($r = .45$, $p < .01$). Therefore, they were considered to be convergent measures of neuromotor development. MANOVA of these measures yielded a significant effect of group, (Wilk's L), $F = 52.4$, $df = 2{,}57$, $p < .001$; and MA (Wilk's L), $F = 31.3$, $df = 2{,}57$ $p < .001$. The children with Down syndrome displayed lower Bayley Motor age estimates (13.6 mos., $SD = 13.7$) and more hypotonic scores on the MAI (1.6, $SD = 0.6$) than did the control sample (Bayley motor age = 17.1 mos, $SD = 5.4$; MAI = 2.9, $SD = 0.2$, respectively). Higher MA children had higher Bayley Motor Age estimates (18.73 mos. vs. 11.82 mos.), but MA difference on the MAI were negligible (2.3 vs. 2.0).

The covariance among the neuromotor and ESCS variables was also examined to determine if less optimal neuromotor indices (lower Bayley Motor and higher MAI scores) were associated with less optimal or lower nonverbal requesting scores within the sample of children with Down syndrome. The results indicated that there was a positive, significant correlation between nonverbal requesting and the Bayley motor age estimates ($r = .44$, $p < .01$). However, this correlation was not specific to nonverbal requesting, as the Bayley Motor age estimates were correlated with the Joint Attention ($r = .39$, $p < .01$) and the Responding to Joint Attention ($r = .39$, $p < .01$) variables as well. None of the correlations with the MAI scores attained significance.

Language Outcome

Initially the groups did not differ on estimates of expressive or receptive language abilities (see Table 1). However, by follow-up the children with Down syndrome displayed significant delays on the Reynell expressive language age estimates ($F = 34.68$, $df = 1{,}54$, $p < .001$) and the receptive language age estimates ($F = 40.12$, $df = 1{,}54$, $p < .001$). Post hoc analyses indicated that, although the children with Down syndrome lagged well behind the controls, they did display significant gains on both the expressive and receptive language measures ($ps < .05$). Nevertheless, because the groups differed in language development at follow-up, it is important to keep in mind that the prediction of language acquisition was to different developmental points in the two groups in this study. Therefore, the profiles of correlations between initial assessment and language outcome may not be directly comparable in this study.

TABLE 3. Concurrent and predictive correlations with language estimates among children with Down syndrome (follow-up, $N = 33$).

	Language estimate			
	Initial		Follow-up	
Variables	EXP[a]	REC[b]	EXP	REC
Language				
Initial Expressive age	—	.61**	.77**	.51**
Initial Receptive age	.61**	—	.73**	.69**
Nonverbal Communication				
Social Interaction	.19	.23*	.42*	.33
Joint Attention	.43*	.53**	.39*	.39*
Respond to Joint Attention	.03	.30	.15	.23
Requests	.32	.53**	.49**	.31
Neuromotor				
Motor Age	.62**	.72**	.65**	.50**
Developmental				
Mental Age	.72**	.80**	.73**	.63**
Chronological Age	.63**	.75**	.62**	.50**
IQ	.10	.03	.11	.13

[a]EXP = Expressive Language Age Estimate.
[b]REC = Receptive Language Age Estimate.
*$p < .05$. **$p < .01$.

Analyses were conducted to determine if any of the nonverbal communication, neuromotor, and general developmental variables were predictors of variance in follow-up expressive and receptive language estimates. Those variables with significant zero-order correlations with language outcome among the children with Down syndrome are presented in Table 3. The correlations for the children with normal development are presented in Table 4.

As expected, nonverbal requesting was a moderately strong predictor of expressive language in the sample with Down syndrome. The Joint Attention and Social Interaction variables were also significant predictors of expressive language development in this sample. In addition, Joint Attention was significantly related to receptive language development in this sample (see Table 3). However, performance on the Responding to Joint Attention variable was not related to either the expressive or receptive language measures in this sample.

Since children from both English-only and bilingual Spanish/English language backgrounds were included in this sample, it is important to note that none of the variables with significant predictive correlations with language in Table 3 yielded significantly different correlations for the 23 children with English only and 10 children with bilingual language exposure. Indeed, these correlations tended to be similar across the groups, although the degree to which correlations achieved significance varied across the groups. For exam-

TABLE 4. Predictive and concurrent correlations with follow-up language estimates among children with normal development (follow-up, *N* = 22).

Variables	Language estimate: Initial EXP[a]	REC[b]	Follow-up EXP	REC
Language				
Initial Expressive age	1.0	.83**	.52*	.48*
Initial Receptive age	.83**	1.0	.48*	.46*
Nonverbal Communication				
Social Interaction	.52*	.43*	.55**	.56*
Joint Attention	.46*	.35	.04	.02
Respond to Joint Attention	.42*	.50*	.59**	.70**
Requests	.43*	.49*	.42*	.50*
Neuromotor				
Motor Age	.83**	.85**	.60**	.44*
Developmental				
Mental Age	.85**	.91**	.64**	.57**
Chronological Age	.83**	.86**	.61**	.45*
IQ	−.25	−.21	−.09	.10

[a]EXP = Expressive Language Age Estimate.
[b]REC = Receptive Language Age Estimate.
$^*p < .05$. $^{**}p < .01$.

ple, the important correlation between requesting and expressive language outcome in the former subgroup was .52 ($p < .05$), and in the latter subgroup it was .43 ($p > .10$). The difference in significance between these correlations may be attributable to differences in sample size (23 vs. 10) rather than to population characteristics.

Among the normal children, social interaction, requesting, and responding to joint attention were significant predictors of both expressive and receptive language at follow-up. However, the Joint Attention variable did not correlate with follow-up language scores in this sample (see Table 4).

These data indicated that nonverbal communication measures were correlated with language outcome in both samples. However, there was also a significant degree of covariance among the initial language measures, the measures of general developmental status (CA and MA), and nonverbal communication scores (see Tables 3 and 4). Moreover, as can be seen in Tables 3 and 4 the initial language status, CA, and neuromotor status were also associated with language outcome in both groups. Therefore, it was possible that the associations between language outcome and nonverbal communication observed in each group was not due to a unique source of shared variance, but rather to an epiphenomenon of the latter variables associated with initial language acquisition and/or general developmental status.

One approach to evaluating this issue was to compute the squared-semipartial correlation coefficients to estimate the proportion of variance in language outcome that was uniquely associated with initial nonverbal communication performance in both groups (Cohen & Cohen, 1983). Since this was a study of language development it was especially important to determine if the nonverbal communication variables predicted language outcome above and beyond effects associated with initial language estimates. Moreover, because the children in these samples differed considerably on initial CA, and initial CA was a strong predictor of language

TABLE 5. Squared semipartial correlation coefficients between follow-up expressive language and the nonverbal communication variables in both Down syndrome and normal subjects.[a]

Variables	Down syndrome	Normal development
Mental Age	.03	.04
Motor Age	.01	.00
Requesting	.05*	.00
Joint Attention	.00	.03
Respond to Joint Attention	.01	.10
Social Interaction	.07*	.18*

[a]Partialling variance shared between the initial and follow-up expressive language estimates.
$^*p < .05$. $^{**}p < .01$.

outcome in both samples (see Tables 3 and 4), it also appeared to be important to attempt to statistically control for this most basic index of individual differences in initial developmental status.

These analyses first estimated and removed the variance shared between the initial expressive language and follow-up expressive language, or between the initial receptive language and follow-up receptive language in both groups. The variance associated with initial CA was also partialled in the first step of these analyses. Then the proportion of the residual language variance associated with the nonverbal communication variables was estimated with the squared value of the semipartial correlation coefficient. The proportion of residual variance associated with a general index of cognitive development (MA) and an index of neuromotor status (Bayley Motor Age) was also computed for comparative purposes. The results of these analyses for follow-up expressive language in both groups are presented in Table 5, and the results for follow-up receptive language are presented in Table 6.

The data in Table 5 indicated that in this sample of children with Down syndrome both nonverbal requesting and social interaction skills appear to be associated with 5% and 7% of the variance in expressive language outcome respectively after considering initial variance in CA and expressive language status.

After considering initial age and expressive language status, nonverbal requesting did not appear to make a significant contribution to the prediction of expressive language in the children with normal development. In this group, the nonverbal social interaction measure appeared to reflect a significant unique portion of the variance (18%) associated with expressive language development. Furthermore, we should note that the portion of expressive language variance associated with the Responding to Joint Attention variable (10%) approached significance ($p < .08$; see Table 5).

It was noteworthy that, once initial age and expressive language was considered, neither MA nor Motor Age appeared to share a significant unique source of variance with expressive language outcome in either group (see Table 5). Thus, the initial measures of expressive language, general cognitive development, and neuromotor status appeared to index a largely overlapping source of variance that was associated with expressive language outcome. However, the measures of nonverbal communication reflected an addi-

TABLE 6. Squared semipartial correlation coefficients between follow-up receptive language and the nonverbal communication variables in both Down syndrome and normal subjects.[a]

Variables	Down syndrome	Normal development
Mental Age	.03	.19*
Motor Age	.00	.00
Requesting	.01	.09
Joint Attention	.00	.02
Respond to Joint Attention	.00	.28**
Social Interaction	.01	.18*

[a]Partialling variance shared between the initial and follow-up receptive language estimates.
*$p < .05$. **$p < .01$.

tional and significant source of variance that was related to the early phase of expressive language acquisition in both groups. Furthermore, the observation that nonverbal requesting, but not neuromotor status (Bayley Motor MA), contributed to expressive language variance in the Down syndrome group after considering initial CA and language status was inconsistent with the hypothesis that hypotonia alone could explain the link between nonverbal requesting and expressive language development in these children.

The pattern of results for receptive language for both groups is presented in Table 6. After considering initial age and receptive language variance neither the nonverbal communication variables, MA, nor neuromotor status were significantly associated with receptive language outcome in the sample of children with Down syndrome. In the sample of children with normal development, the Responding to Joint Attention, Social Interaction, and MA variables all yielded significant squared semipartial coefficients with receptive language outcome. Because MA yielded a significant effect in these analyses it was important to determine if the nonverbal communication variables would yield a significant association with receptive language outcome in this sample if the variance in initial MA was controlled. Analyses relevant to this issue indicated that, after extracting variance associated with MA, the squared semipartial correlation coefficients between receptive language outcome and Responding to Joint Attention and Social Interaction were .18, $F = 6.99$, $p < .025$; and .09, $F = 3.15$, $p < .10$, respectively. Thus, after considering initial variance in MA, the Responding to Joint Attention variable appeared to share a significant source of variance with receptive language development, but the association between Social Interaction and receptive language only approached significance.

Discussion

Consistent with previous data (Mundy et al., 1988; Wetherby et al., 1989), the children with Down syndrome in this study demonstrated an attenuated tendency to display nonverbal requests, and this disturbance was apparent regardless of developmental level. In one earlier study a similar nonverbal requesting deficit was observed in young children with Down syndrome, but not in a MA-matched sample of children with mental retardation of unknown etiologies (Mundy et al., 1988). Therefore, this may be a unique characteristic of Down syndrome. Moreover, Beeghly, Weiss-Perry, and Cicchetti (1990) have reported a similar pragmatic deficit in verbal requesting among children with Down syndrome. Thus, a requesting deficit may be a characteristic of the early verbal, as well as nonverbal, development of young children with Down syndrome.

The group differences in this study differed from those reported by Smith and von Tetzchner (1986). This apparent inconsistency across studies may be best interpreted in terms of the methodological differences between the studies. Unlike the studies of Mundy et al. (1988) or Wetherby et al. (1989), Smith and von Tetzchner compared children on qualitative, ordinal scaled measures, rather than quantitative indices of nonverbal communication. Moreover, they presented children with only three opportunities to display joint attention and requesting behaviors, and the opportunities to display joint attention behaviors were always presented first. In the ESCS, and the related methods used by Wetherby et al. (1989), numerous opportunities for both types of behavior are provided, and the presentation sequence ensures that joint attention opportunities are presented both before and after requesting opportunities. Furthermore, the children with Down syndrome in the Smith & von Tetzchner study did display a variety of high-level joint attention behaviors (i.e., showing and pointing to direct attention), but differed only on the tendency to display "Step 5" behaviors or "child uses a sound and gaze shift to get the adult to attend to the object" (Smith & von Tetzchner, 1986, pp. 59, 61). The latter combination of vocal and gestural behavior was not directly assessed on the ESCS. Thus, differences in the order of presentation of tasks, number of tasks presented, scoring of tasks, and behaviors observed under the rubric of joint attention may have contributed to the singular findings of Smith and von Tetzchner.

The importance of understanding the nature and degree of the nonverbal requesting deficit in children with Down syndrome is emphasized by the finding that the longitudinal data in this study were quite consistent with those of Smith and von Tetzchner (1986). Initial variance in nonverbal requesting was a significant predictor of individual differences in the expressive language development of children with Down syndrome in this study. Moreover, the predictor status of nonverbal requesting held even after variance in their initial linguistic developmental status of the children with Down syndrome was considered. The amount of unique variance in expressive language outcome associated with nonverbal requesting was significant, but did not appear to be especially large in this study (5%). However, the degree to which any variable could exhibit a significant unique association with follow-up expressive language was constrained by the very strong correlation between initial and follow-up expressive language observed in this sample of children with Down syndrome (see Table 3). Moreover, the size of the unique variance estimate associated with nonverbal requesting yielded in this study must be interpreted very cautiously as it is likely to vary considerably across samples of this size (Cohen & Cohen, 1983). Additional studies will be needed to better estimate the extent of the association between nonverbal requesting and expressive language development in children with Down syndrome.

A methodological caveat should be noted at this point. The combination of children from English-only and English/Spanish bilingual backgrounds raises the issue of whether language background could have affected the results of this study. This important question could not be addressed definitively in this study. However, two findings suggest that language background did not affect the results of this study. Language background did not appear to affect Reynell or ESCS performance in this study, and language background was not associated with significant differences in the correlations among predictor and outcome variables in this study. These findings, however, need to be interpreted with caution since samples sizes limited the power of these comparisons. Additional research will be needed to clearly address this issue. Nevertheless, it may be important to remember that Smith and von Tetzchner made their original observation on a Norwegian sample. Thus, the currently available data suggests that the relation between nonverbal requesting and expressive language development may be observed in samples of children with Down syndrome from varied cultures and language backgrounds.

Of course the meaning of "language development" in this study should be made clear. The mean Reynell expressive language age of 18 months in the sample with Down syndrome at follow-up (see Table 1) suggests that the variance in expressive language predicted in this study related only to the initial acquisition of holophrastic speech (i.e., early lexicon size) in this sample. It is not clear whether variance in nonverbal requesting, or other nonverbal communication measures, predict variance in subsequent, more complex aspects of language development in these children. Nevertheless, the group differences and longitudinal correlations observed in this study have at least one implication regarding the nature of Down syndrome. They suggest that some aspect of the processes involved in the expressive language disturbance of these children may be associated with an earlier disturbance in a specific form of nonverbal communication behavior. Thus, explanations of the expressive language delay in these children, only in terms of speech motor deficits or cognitive processes that are specific to language development, may be incomplete (Cardoso-Martins, Mervis, & Mervis, 1985; Miller, 1990). Instead, additional important information on the nature of Down syndrome, and the language delays of children with this handicapping condition, may be provided through a better understanding of their atypical development of nonverbal requesting skills.

In this regard current data fail to support several hypotheses. One possibility is that hypotonia or delays in neuromotor development could contribute to both the attenuation of nonverbal requesting and delays in speech skills and, thereby, to the link between these domains in children with Down syndrome. However, there was little evidence in this study to suggest that neuromotor delays played a specific role in the nonverbal requesting deficit or the link between nonverbal requesting and expressive language development. Current data also suggest that the nature of the nonverbal requesting deficit in children with Down syndrome may not be secondary to problems associated with attention or affective processes in these children (Kasari, Mundy, Yirmiya, & Sigman, 1990) or with caregiver responsiveness and directiveness (Mundy et al., 1988). Thus, it may well be that the disturbance in nonverbal requesting reflects a relatively unique aspect of Down syndrome. However, these negative findings must be interpreted with caution, and more research in these and other areas is needed before firm conclusions can be drawn. Other possibilities include the hypotheses that nonverbal requesting disturbance in these children may be related to an arousal disturbance or, perhaps, attenuated object mastery motivation (Mundy et al., 1988).

In addition to a nonverbal requesting disturbance, a disturbance in the capacity of children with Down syndrome to follow tester line of regard and pointing was also evident in this study. This was not observed in our previous study. However, in that study the tester said "look" while pointing and the children were developmentally more advanced than in this study. Thus, it was not clear whether the inconsistency in this finding was due to methodological or sampling effects. Confirmation of the presence of this type of deficit would be of value, as it may be related to the joint attention process deficits attributed to younger children with Down syndrome (Landry & Chapieski, 1989; Smith & von Tetzchner, 1986).

Apart from the focus on Down syndrome, another goal of this study was to contribute to an understanding of the nature of the relations between nonverbal and verbal communication development in young children with normal development. Here the relevant results indicated that measures of nonverbal communication were significantly related to both expressive and receptive language outcome in children with normal development. Moreover, nonverbal communication measures predicted language development over and above variance in initial linguistic developmental status in the children with normal development.

Given the size of the normal sample in this study, these data need to be regarded as preliminary and interpreted with caution. Nevertheless, the observation that significant relations between nonverbal communication and language outcome is manifest in children with normal development, as well as children with Down syndrome, suggests that this is a robust developmental phenomenon. Together, these data provide considerable support for the hypothesis that nonverbal communication reflects unique aspects of early development that are related to language. Furthermore, some suggestions concerning the nature of the path(s) of association between nonverbal communication and language acquisition in normal development may be offered by the data in this study.

Semipartial correlation data from the normal sample, as well as the Down syndrome sample, suggested that nonverbal social interaction was a correlate of expressive language development. This variable involves maintaining interaction with others via participating in turn-taking with toys or physical interaction. Thus, these data were consistent with Bruner's (1977) suggestion that the child's ability to structure social interactions and engage in turn-taking may be an important ability in the development of verbal communication skills language. Alternatively, the capacity to follow the pointing of the tester appeared to be the most robust correlate of receptive language development in the normal sample. Theoretically, the capacity to follow the referential gestures of others may be an especially good index of behavioral and cognitive processes that facilitate language development, especially those involved in the initial comprehension of object labels (e.g., Butterworth & Grover, 1988; Hogan, Seibert, & Mundy, 1980).

In considering these conjectures, it is important to remember the aforementioned caveats associated with sample size. Studies of larger samples will be needed to more clearly establish the links between the development of different types of nonverbal communication skills and different types of language skills. Nonetheless, these data do support the hypothesis that specific and important links may exist between nonverbal and verbal communication in the course of normal and atypical development (Bates et al., 1979; Bruner, 1975; Tomasello, 1988). Verification of these links, let alone establishing a substantial understanding of the nature of association between these domains, awaits additional empirical inquiry.

Acknowledgments

This research was conducted at UCLA and supported by grants HD17662 from NICHD to Peter Mundy and Marian Sigman, and NS25243 from NINCDS to Marian Sigman. Preparation of the manuscript was supported by a James W. McLamore award through the University of Miami. We would like to acknowledge the indispensable assistance of the Los Angeles Chapter of the Parents of Children with Down Syndrome, as well as Alison Anson, Mike Espinosa, Stephanie Freeman, Margie Greenwald, Alisa Hoffman, Nicholas Lofthous, Alma Lopez, and Susan Toth in the execution of this study.

References

Adamson, L., & Bakeman, R. (1985). Affect and attention: Infants observed with mothers and peers. *Child Development, 56*, 582–593.

Bates, E., Benigni, L., Bretherton, I., Camaioni, L., & Volterra, V. (1979). *The emergence of symbols: Cognition and communication in infancy.* New York: Academic Press.

Bayley, N. (1969). *Manual for the Bayley Scales of Infant Development.* New York: Psychological Corp.

Beeghly, M., Weiss-Perry, B., & Cicchetti, D. (1990). Beyond sensorimotor functioning: Early communicative and play development of children with Down Syndrome. In D. Cicchetti & M. Beeghly (Eds.), *Children with Down Syndrome: A developmental perspective* (pp. 329–368). New York: Cambridge University Press.

Bretherton, I. (1991). Intentional communication and the development of an understanding of mind. In D. Frye & C. Moore (Eds.), *Children's theories of mind: Mental states and social understanding* (pp. 49–73). Hillsdale, NJ: Lawrence Erlbaum Associates.

Bruner, J. (1975). From cognition to language: A psychological perspective. *Cognition, 3*, 255–287.

Bruner, J. (1977). Early social interactions and language acquisition. In H. Schaffer (Ed.), *Studies in mother infant interaction* (pp. 271–289). New York: Academic Press.

Butterworth, G., & Grover, L. (1988). The origins of referential communication in infancy. In L. Weiskranz (Ed.), *Thought without language* (pp. 5–25). Oxford: Oxford University Press.

Cantwell, D., Howlin, P., & Rutter, M. (1977). The analysis of language level and language function: A methodological study. *British Journal of Disorders of Communication, 12*, 119–135.

Cardoso-Martins, C., Mervis, B., & Mervis, C. (1985). Early vocabulary acquisition by children with Down Syndrome. *American Journal of Mental Deficiency, 90*, 177–184.

Cattell, P. (1940). *The intelligence of infants.* New York: Psychological Corp.

Chandler, L., Andrews, M., & Swanson, M. (1980). Movement assessment of infants. In A. Larson (Ed.), *Movement assessment of infants.* Rolling Bay, Washington.

Cohen, J., & Cohen, P. (1983). *Applied multiple regression/correlation analysis for the behavioral sciences.* Hillsdale, NJ: Erlbaum.

Curcio, F. (1978). Sensorimotor functioning and communication in mute autistic children. *Journal of Autism and Childhood Schizophrenia, 8*, 282–292.

Greenwald, C., & Leonard, L. (1979). Communicative and sensorimotor development of Down's syndrome children. *American Journal of Mental Deficiency, 84*, 296–303.

Harris, S., Haley, S., Tada, W., & Swanson, M. (1984). Reliability of observational measures of the Movement Assessment of Infants. *Physical Therapy, 4*, 471–477.

Hogan, A., Seibert, J., & Mundy, P. (1980, October). *The emergence of object labels in developmentally delayed toddlers: Implications for intervention and for a theory of early reference.* Paper presented at the 5th Annual Boston University Conference on Language Development.

Huttenlocher, J., Haight, W., Bryk, A., Seltzer, M., & Lyons, T. (1991). Early vocabulary growth: Relation to language input and gender. *Developmental Psychology, 27*, 238–246.

Jones, S., Collins, K., & Hong, H. (1991). An audience effect on smile production in 10-month-old infants. *Psychological Science, 2*, 45–49.

Kasari, C., Mundy, P., Yirmiya, N., & Sigman, M. (1990). Affect and attention in children with Down syndrome. *American Journal of Mental Retardation, 95*, 55–67.

Kasari, C., Sigman, M., Mundy, P., & Yirmiya, N. (1990). Affective sharing in the context of joint attention interactions of normal, autistic, and mentally retarded children. *Journal of Autism and Developmental Disorders, 20*, 87–100.

Landry, S., & Chapieski, M. L. (1989). Joint attention and infant toy exploration: Effects of Down Syndrome and prematurity. *Child Development, 60*, 103–118.

Lobato, D., Barrera, R., & Feldman, R. (1981). Sensorimotor functioning and prelinguistic communication of severely and profoundly retarded individuals. *American Journal of Mental Deficiency, 85*, 486–496.

Loveland, K., & Landry, S. (1986). Joint attention and language in autism and developmental language delay. *Journal of Autism and Developmental Disorders, 16*, 335–349.

Lydic, J., Short, M., & Nelson, D. (1983). Comparison of two scales for assessing motor development in infants with Down Syndrome. *Occupational Therapy Journal of Research, 3*, 213–221.

Masur, E. (1981). Mothers' responses to infants object related gestures: Influences on lexical development. *Journal of Child Language, 9*, 23–30.

McEvoy, R., Rogers, S., & Pennington, B. (1993). Executive function and social communication deficits in young autistic children. *Journal of Child Psychology and Psychiatry, 34*, 563–578.

Miller, J. (1990). The developmental synchrony of language development in children with Down Syndrome. In L. Nadel (Ed.), *The psychobiology of Down syndrome.* Cambridge, MA: MIT Press.

Mitchell, F. (1979). Interobserver agreement, reliability, and generalizability of data collected in observational studies. *Psychological Bulletin, 86*, 376–390.

Mundy, P., & Hogan, A. (1994). Intersubjectivity, joint attention and autistic developmental pathology. In D. Cicchetti & S. Toth (Eds.), *Rochester Symposium on Developmental Psychopathology, Vol. 5: The Self and its disorders* (p. 1–30). Rochester, NY: University of Rochester Press.

Mundy, P., Kasari, C., & Sigman, M. (1992). Nonverbal communication, affective sharing and intersubjectivity. *Infant Behavior and Development, 15*, 377–381.

Mundy, P., Sigman, M., & Kasari, C. (1990). A longitudinal study of joint attention and language development in autistic children. *Journal of Autism and Developmental Disorders, 20*, 115–128.

Mundy, P., Sigman, M., Kasari, C., & Yirmiya, N. (1988). Nonverbal communication skills in Down Syndrome children. *Child Development, 59*, 235–249.

Mundy, P., Sigman, M., Ungerer, J., & Sherman, T. (1986). Defining the social deficits of autism: The contribution of nonverbal communication measures. *Journal of Child Psychology and Psychiatry, 27*, 657–669.

Olson, S., Bates, J., & Bayles, K. (1984). Mother-infant interaction and the development of individual differences in children's cognitive capacities. *Developmental Psychology, 20*, 166–179.

Reynell, J. (1977). *Reynell Developmental Language Scales (Revised).* Los Angeles: Western Psychological Corp.

Seibert, J., Hogan, A., & Mundy, P. (1982). Assessing social interactional competencies: The Early Social-Communication Scales. *Infant Mental Health Journal, 3*, 244–258.

Sigman, M., & Mundy, P. (1993). Infant precursors of childhood intellectual and verbal abilities. In D. F. Hay & A. Angold (Eds.), *Precursors, causes, and psychopathology* (pp. 123–143). Sussex, England: John Wiley.

Smith, L., & von Tetzchner, S. (1986). Communicative, sensorimotor and language skills of young children with Down syndrome. *American Journal of Mental Deficiency, 91*, 57–66.

Tomasello, M. (1988). The role of joint attention processes in early language development. *Language Sciences, 10*, 69–88.

Trevarthen, C. (1977). Descriptive analyses of infant communicative behavior. In H. Schaffer (Ed.), *Studies in mother child interaction* (pp. 227–270). London: Academic Press.

Werner, H., & Kaplan, B. (1963). *Symbol formation.* New York: Wiley.

Wetherby, A., & Prutting, B. (1984). Profiles of communicative and cognitive-social abilities in autistic children. *Journal of Speech and Hearing Research, 27*, 367–377.

Wetherby, A., Yonclas, D., & Bryan, A. (1989). Communication profiles of preschool children with handicaps: Implications for early identification. *Journal of Speech and Hearing Disorders, 31*, 148–158.

Received September 30, 1993
Accepted July 14, 1994

Contact author: Peter Mundy, Psychological Services Center, Department of Psychology, University of Miami, Coral Gables, FL.