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Early intentional communication as a predictor of language development in young toddlers*

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ABSTRACT

Interrelations between various types of early intentional communication measures, and their relations to children's concurrent and subsequent language skills and maternal interactional sensitivity were studied in a sample of 111 mother-infant pairs. Intentional communication was assessed at 14 months of age using a composite of early actions and gestures derived from parental reports (MacArthur Communicative Development Inventories, MCDI), and measures of early joint attentional behaviours obtained via observations of parent-child play interaction. The sum of actions and gestures and the measures of joint attentional behaviours correlated significantly with each other suggesting that the measures obtained using different techniques and data sources partly tap the same social-cognitive skills. However, the interrelations between various types of joint attentional behaviours did not indicate a single coherent structure. Whereas the parental ratings of intentional communication significantly predicted both later language comprehension and production, the relations between observed joint attentional behaviours and language skills varied depending on the specific aspects of these behaviours that were measured. Both sets of measures of intentional communication were related to concurrent maternal interactional sensitivity, which in turn predicted children's language comprehension at

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18 months of age. Overall, the present study suggested that early communicational behaviours form the basis for the development of language skills, and that the development of intentional communication is supported by a sensitive parental interactive style.

INTRODUCTION

Children's entry into verbal communication vastly expands their interaction with other people and their experiences with objects and the world around them. Studies on infants' early communication development have revealed that there is much continuity between early prelinguistic parent-infant interaction and later emerging verbal communication (Bates, Benigni, Bretherton, Camaioni & Volterra 1979, Mundy, Kasari, Sigman & Ruskin 1995, Olson, Bates & Bayles 1984, Tomasello 1995). During the first months of life, infants and their caretakers engage in interpersonal exchanges in which partners take turns as 'speakers' and listeners, much as they do later in verbal communicative episodes (Bruner 1977, Tronick, Als & Adamson 1979). Infants and their partners appear to use and elaborate prior structures in order to allow new conventional forms to develop. Gestures and words settle into the established arrangement of joint interactional episodes between the infant and the parent (Adamson 1996, Bates *et al.* 1979). In the early stage the new emerging symbolic structures serve the old communicative functions, but rapidly they expand and create new possibilities to convey messages and share information and feelings between people.

The empirical evidence on infants' early social-cognitive behaviours has convinced researchers (Adamson 1996, Tomasello 1995) that around their first birthday infants undergo a revolution in their understanding of other people and how they work. This new understanding has been called 'secondary intersubjectivity' referring to the infant's ability to recognize the mutuality inherent in joint attention on objects external to the interactional participants (Baldwin 1995, Trevarthen 1977). Tomasello, Kruger & Ratner (1993) have presented evidence that infants' early joint attentional skills have to do with their emerging understanding of other persons as intentional agents. In parent-infant communications involving external objects, the infant's growing understanding of the world of objects and the uses of things become apparent. The appropriate use of objects also signals relevant advances in representational competence (Fenson, Dale, Reznick, Bates, Thal & Pethick 1994). Infants no longer just act on objects, but

instead they develop gestures about them (Adamson 1996). Around the first birthday infants start to use conventional gestures and ritualized vocalizations which are no longer attached to specific objects or context (Bates 1979, McCathren, Warren & Yoder 1996). These social behaviours are salient indicators of intentional communication prior to the onset of expressive language.

Numerous factors are predictive of overall language development (e.g., neurological, social-environmental). A small group of predictors comes from the development of prelinguistic communication (McCathren *et al.* 1996). Early communication skills are considered to reflect the infant's level of social cognition, i.e., abilities for representational thought, understanding of means-ends relations (Bates *et al.* 1979), and integration of cognitive processes with interpersonal aspects (Bruner 1977, Mundy, Kasari & Sigman 1992, Tomasello 1995). The study of prerequisities to language and relations between language and cognition has originated from the theoretical works of Piaget (1962) and Werner & Kaplan (1963) over three decades ago. In the 1970s, after many years of silence, empirical studies (Bates, Camaioni & Volterra 1975, Bloom 1973, Bruner 1975, Schaffer 1977) began to emerge, which all shared the same key element: the view of the child as an active creator of his/her language. In this new theorizing the roots of language were, however, considered to derive from the social interaction of the first two years of life. These studies strengthened the view that social-cognitive processes inherent in prelinguistic communication provide a foundation that supports or facilitates subsequent language development (Bates *et al.* 1979).

Among the most influential investigations of prelinguistic communication are the studies conducted by Bates and her colleagues (Bates *et al.* 1975, Bates *et al.* 1979, Bates, Bretherton & Snyder 1988). Their interest was in the development and interrelations of gestural communication (e.g., showing, giving, requesting, pointing), language (e.g., comprehension, babbling, nonreferential and referential words) and play (symbolic and combinatorial). These studies laid the basis for a parent checklist format: the MacArthur Communicative Development Inventories, MCDI (Fenson *et al.* 1994), which is nowadays a widely used research instrument and covers early vocabulary and grammar as well as the communicational and representational skills independent of verbal expression. In other studies these prelinguistic skills have been referred to in various terms (e.g., pretend acts, symbolic acts, functional play, conventional actions with objects, etc.). Despite these terminological differences the current theory on early intentional communication has emphasized that the development of various nonverbal

communicational behaviours may reflect a single common cognitive process (Bates 1979, Fenson *et al.* 1994, Tomasello 1995). Recently, however, it has been claimed that various aspects of early communicational behaviours may reflect the development of different psychological processes, and consequently also have different linguistic correlates (Mundy & Gomes 1998).

Mundy and his colleagues (e.g., Mundy, Kasari, Sigman & Ruskin 1995, Mundy & Gomes 1998) have studied infants' nonverbal communication using the Early Social-Communication Scales (ESCS; Selbert, Hogan & Mundy 1982). This scale yields six mutually exclusive categories: initiating and responding to social interaction, initiating and responding to joint attention, and initiating and responding to behaviour regulation. The recent findings (Mundy & Gomes 1998) indicated that after considering initial covariance in language and cognitive status, different aspects of early joint attentional behaviours related to different aspects of early language: responding to joint attention had strong predictive associations with receptive language whereas joint attentional initiations predicted expressive language. Although the sample size in this study was quite small (N = 24), these data provide support for the hypothesis that aspects of nonverbal communication contribute uniquely to subsequent language development.

Studies which contain joint attentional abilities in their conceptual framework provide strong evidence on the importance of these skills in early language learning (Adamson & Bakeman 1991, Bruner 1983, Dunham & Dunham 1992, Smith, Adamson & Bakeman 1988). Most commonly, joint attentional states are defined in a way which includes the infant's spontaneous gaze alternation between the interactional partner and the shared object (Mundy *et al.* 1995, Tomasello 1995, Tomasello & Farrar 1986). Not all instances of eye-contact during joint object play are regarded as signs of intersubjective understanding. Of crucial importance are the quality and timing of the eye-contacts and other social behaviours, the affect they express, and their co-ordination into ongoing interaction. The infants' co-operative behaviours, their social initiatives relating to objects, and imitations of object actions are also regarded as reflecting new understanding of other persons and communication (Baldwin 1995, Tomasello 1995).

Adults play an important role in the development of infants' early communicational skills (e.g., Adamson 1996, Bruner 1975, 1983, Dunham & Dunham 1990, Schaffer 1984, Tomasello & Farrar 1986). Parents commonly take the responsibility for creating the state of joint engagement at the age when infants are not yet capable of doing it on

their own (Adamson 1996, Schaffer 1984). Parental structuring of these early object-engagements has been shown to raise the infant's concurrent level of object manipulation (Bornstein 1995, Fiese 1990), and communication (e.g., Stevens, Blake, Vitale & MacDonald 1998). Sensitive parental activity includes, for example, maintaining the infant's attention and motivation, simplifying the task, demonstrating and marking the critical features (e.g., Stevens *et al.* 1998), and matching the intensity and temporal patterning of the parent's behaviours according to the infant's emotional states (Dunham & Dunham 1995). Maternal sensitivity in joint object interactions has been shown to explain variance in early language development (Dunham & Dunham 1992, Smith *et al.* 1988, Tomasello & Farrar 1986, Tomasello & Todd 1983). Stevens and her colleagues (Stevens *et al.* 1998), for instance, showed that mothers who to a higher extent scaffolded their child's object interactions by maintaining attention and motivation had infants with a greater number of early words. These kind of parental behaviours are believed to make a long-term contribution to children's language development (Saxon 1997, Smith *et al.* 1988)

Although infants' joint attentional abilities and prelinguistic communication have been eagerly investigated, surprisingly few studies exist focusing on their interrelations and their associations to subsequent language development in normally developing infants. Our research questions were centred along the lines of the following three main assumptions. First, based on the current conceptualization suggesting a common underlying process in nonverbal communication, we expected a positive relationship among different measures of infants' early intentional communication at 14 months of age (gestures and actions measured by the MCDI parental report forms, and joint attentional skills observed in mother-child play interaction). Second, we expected that these measures of early intentional communication predict children's subsequent language development at 18 and at 24 months of age. And third, we assumed that maternal interactional sensitivity at 14 months of age has positive links both with children's prelinguistic communication and early language.

METHOD

Participants

The participants were 111 mother-child pairs. Children (66 boys, 45 girls) were all full-term and none of them had mental, physical or sensory handicaps. The mean age of mothers was 31 years (SD = 4.3,

range 19–41). Mother-child play interactions were studied when the child was 14 months old (+/– one week). Measures of the child's early gestures and actions were obtained using parental reporting at the same age. Information on the child's language development was gathered at the ages of 14, 18 and 24 months. The children and their families came from the city of Jyväskylä and its surrounding communities in the Province of Central Finland, and all parents spoke Finnish as their native language. The parents' educational distribution was representative of the Finnish population. Education was classified into five categories which were based on both basic level education and advanced educational training. Of the parents, 6.3 % had less than vocational school level professional training, 28.7% had 2 years' vocational school level training, 31.5% had completed training in at least three-year vocational institutes or colleges, and 33.4% had a higher degree from a college or university. This sample is part of a larger study on early language development and precursors to reading skills (see Lyytinen 1997, Lyytinen, Leinonen, Nikula, Aro & Leiwo 1995). Altogether 214 families with varying parental reading skills participated in the follow-up, and the present subsample consisted of those children who had turned 2 years at the onset of analyses and whose mothers represented different levels of reading skills from average to poor readers. Levels of maternal reading skills or parental education did not have an effect on any of the measures used in the present analyses.

Procedure

Intentional communication: actions and gestures An index of early communicative actions and gestures was derived from the MacArthur Communicative Development Inventory, MCDI, which covers the ages from 8 to 16 months. The Finnish adaptation (Lyytinen, Poikkeus & Laakso 1997) of this parental report scale includes the comprehension and production of first words. The Actions and Gestures section includes altogether six subscales, but one of them, Pretend Objects, was excluded from the analyses based on findings from previous studies indicating that this subscale shows little variation and does not, therefore, function adequately psychometrically (Fenson *et al.* 1994).

A. First communicative gestures (e.g., shakes head 'no', waves bye-bye)
B. Games and routines (e.g., plays peekaboo, plays chasing games)
C. Actions with objects (e.g., combs or brushes own hair, drinks from a cup)
D. Pretending to be a parent (e.g., puts to bed, feeds with spoon)

E. Imitating adult actions (e.g., pounds with hammer, 'reads', waters plants).

The skills measured by these five subscales are theoretically closely related to each other (Fenson *et al.* 1994), and the items represent behaviours that appear to predict early language development (Bates *et al.* 1979). The Cronbach alpha reliability of the Actions and Gestures scale was 0.78.

Intentional communication: joint attentional behaviours Free play between the mother and the child was videotaped in the laboratory for 10 minutes. Videotaping took place through a one-way mirror using a standard VHS-camera that was monitored by the experimenter in the adjoining room. A high quality external microphone was placed centrally in the testing room, and the child and the parent could move about freely in the room while playing with the toys. An amiga system was used to include running time (at 0.1 sec) in the video recordings.

Mothers were asked to participate in their children's play behaviours in the way they do typically at home. The play material consisted of toys familiar to children of this age (e.g., ball, telephone, doll, truck, blocks and a nesting tower of cups). Frequencies of the child's joint attentional behaviours were coded from videotapes using a 15-second time-sampling procedure. The child's behaviour was observed over four time samples per minute (giving 40 time samples per subject for the 10-minute period). For every 15-second period in which the child exhibited the criterion behaviour at least once, he or she received one tally mark. Thus, the score for each of the five coded behaviour categories could range from 0 to 40.

The following categories were used to code the child's behaviours:

1. Using co-ordinative actions (e.g., accepting objects from the mother, complying with the mother's object-related requests, prolonged and active looking at the mother's object-related actions).

2. Alternating gaze between the mother and an external object (while playing with a toy him- or herself or while the mother manipulates the toy, the child looks into the mother's eyes, and again looks back at the toy).

3. Following or directing the mother's gaze (following the mother's gaze: the mother looks at a toy and the child looks first at the mother and then directs his or her gaze towards the same toy as the mother; directing or attempting to direct the mother's

gaze: the child looks at a toy and vocalizes or points towards the toy and then looks at the mother with the result that mother directs her gaze towards the same toy or the child demonstrates this type of clear communicational intent, although the mother does not respond by switching her gaze towards the object of the child's focus).

4. Imitating the mother's object-related actions or verbalizations (e.g., the mother demonstrates a new activity such as putting a spoon in a cup and stirring with the spoon, and shortly after observing this the child stirs with the spoon in a similar fashion; the mother moves a toy truck back and forth and at the same time vocalizes 'broom, broom' while the child is paying attention, and shortly after this the child vocalizes in a similar fashion).
5. Making social initiatives (e.g., giving objects to the mother; pointing to objects while vocalizing communicatively at the same time).

Two coders participated in the coding of joint attentional behaviours. One of the coders was the first author and the other one was a female graduate student of psychology. A training period took place prior to the coding of this sample to ensure agreement and mutual understanding of the categories and specific criteria. Interobserver reliability was assessed by having these two coders independently code the same randomly selected cases which represented 20% of the sample of 111 mother-child dyads. The mean correlation between the ratings of the coders was 0.85. Correlations ranged from 0.74 (imitating mother's behaviour) to 0.95 (co-ordination in interaction).

Maternal interactional sensitivity A total of 11 variables was used to assess different aspects of maternal interactional sensitivity (e.g., attention directing and maintenance, versatility of motivational strategies, emotional availability, cognitive guidance). Based on watching the whole 10-minute session, the coder rated separately the mother's behaviour on each of these variables using either a 5- or 3-point Likert-scale. A composite score reflecting the overall maternal sensitivity was computed from these variables. In order to give equal weight to the ratings they were standardized before computing the sum score. The Cronbach alpha reliability for this composite was 0.90. The sum score was based on the following variables (for detailed descriptions see Appendix): (1) initiatives to motivate the child's play; (2) providing reinforcement; (3) drawing into joint activity; (4) versatility of

motivational strategies; (5) emotional availability; (6) emotional attunement; (7) affective encouragement; (8) enjoyment of joint interaction; (9) allowing the child's independent activity; (10) sensitivity in guidance of the child's activity; (11) extending of the child's activity.

The same two coders who coded the child's behaviours also rated these maternal data. The mean interobserver correlation was 0.81 ranging from 0.79 (drawing into joint activity) to 0.87 (enjoyment of joint interaction).

Child language The child's language development was assessed at 14, 18 and 24 months of age.

1. *Comprehension and production at 14 months* The scores derived from the vocabulary section of the younger children's form of the MacArthur Communicative Development Inventory (MCDI; Dale 1996, Fenson *et al.* 1994) were used as the measure of the child's vocabulary comprehension and production at 14 months. The comprehension and production scores are based on parents' observations of their child's behaviours on a day-to-day basis in the child's natural contexts.

2. *Comprehension at 18 months* The Reynell Developmental Language Scales (RDLS; Reynell & Huntley, 1987) were administered in the laboratory setting by a familiar experimenter when children were 18 months old. This test provides separate measures of verbal comprehension and expressive language, but only the index of verbal comprehension was used in this study. The index of verbal comprehension is based on the child's performance on 67 items. The 18-month-old children in our sample typically passed 15 items. The first item sets that most children mastered include recognition of familiar words and phrases, relating words to familiar household objects or miniature toys, and relating objects with each other according to instructions. The MCDI parental report form for older children (16–30 months) does not include a scale for vocabulary compre-hension, and the choice of the RDLS was, thus, well founded and provided a reliable and a widely used measure of comprehension at this age.

3. *Expressive language at 24 months* The sum score of expressive language was based on three sources of data: vocabulary production and maximum sentence length reported by the parent, and Bayley expressive score obtained in the administration of the Bayley Scales of Infant Development (Bayley 1993). Vocabulary production

score and maximum sentence length (MSL) were both obtained from the MCDI parental report forms (Fenson *et al.* 1994). Scoring of the MSL follows the procedure used in scoring the MLU (mean length of utterance) adapted from Miller (1981). MSL, however, differs from MLU in being based on the three longest sentences that the parent can recall. Bayley expressive score was based on the sum of correctly named targets on two expressive language items (Naming Pictures and Naming Objects). This expressive language index was used by Siegel, Cooper, Fitzhardinge & Ash (1995). The range of the MCDI vocabulary production was considerably wider than that of the Bayley expressive score, and the mean sentence length (see Table 2). In order to give equal weight to each of the three scores, they were standardized before computing the sum score of expressive language. The Cronbach alpha reliability for this sum score was 0.87. The sum score was slightly skewed on the right, and therefore, natural logarithmic transformation was applied prior to the analyses.

RESULTS

Descriptive statistics

Actions and Gestures In the categories of games and routines, and actions with objects the means approached the maximum score in their representative scales. For games and routines and communicative gestures a third of the infants received the maximum score. For actions with objects half of the infants received the score 13 or higher (maximum was 16). However, symbolic gestures were rarely reported by parents at this age; a third of the 14-month-olds had only one or no symbolic gestures in their behavioural repertory. Means and standard deviations for early actions and gestures are presented in Table 1.

Joint Attentional Behaviours At 14 months of age, using co-ordinative actions was the most frequently observed category of joint attentional behaviours (see Table 1). Alternating gaze between the mother and the external object and object-related initiatives towards the mother were also common. Imitating mothers' object-related behaviours and following or directing mothers' gaze were still quite rare.

Maternal interactional sensitivity The total score in maternal interactional sensitivity ranged from 17 to 47 (mean = 35, SD = 7.43). This score did not correlate with the mothers' age, or with maternal

TABLE 1. *Means and standard deviations for the intentional communication measures at 14 months old*

Measure	Mean	(SD)	Range
Actions and Gestures			
Communicative gestures	13.39	3.36	3–20
Games and routines	3.79	1.08	1–5
Actions with objects	11.97	2.61	3–16
Symbolic gestures	3.79	3.50	0–13
Imitating adult actions	6.64	2.41	1–11
Joint Attentional Behaviours			
Co-ordinative actions	21.44	6.33	5–35
Alternating gaze	14.77	6.61	3–33
Following gaze	1.95	2.10	0–8
Imitating	2.20	1.49	0–5
Making initiatives	11.16	6.37	1–30

education. Maternal interactional sensitivity towards boys or girls did not differ, although the mean score was somewhat higher for the girls than for the boys (girls 36.78, boys 34.47).

Child's language skills Children's vocabulary comprehension at 14 months clearly exceeded vocabulary production. Between 14 and 24 months a substantial increase was observed in children's productive vocabularies (from 15 to 265 words). Language comprehension across age correlated significantly ($r = 0.38$; $p < 0.001$), but the comparison of absolute values is difficult because the data were derived from different sources (parental reports at 14 months vs. standardized test situation at 18 months). The means and standard deviations for all these language measures are shown in Table 2.

Associations between different aspects of children's intentional communication, maternal interactional sensitivity, and child's language at 14 months

Pearson correlations (except for following mother's gaze and vocabulary production which were not normally distributed and required the use of Spearman correlations) showed that five out of ten possible correlations between the various joint attentional behaviours were significant (see Table 3). The association was strongest between alternating gaze and interactional initiatives ($r\ (111) = 0.68, p < 0.001$),

TABLE 2 *Means and standard deviations for the language measures*

Measure	Mean	(SD)	Range
14 months			
MCDI: vocabulary comprehension	156.79	83.89	13–369
MCDI: vocabulary production	14.64	20.33	0–135
18 months			
RDLS: verbal comprehension	15.18	5.67	4–33
24 months			
MCDI: vocabulary production	265.11	160.52	0–595
MCDI: mean sentence length	5.14	2.72	0–15
BSID: expressive language	8.86	4.94	0–15

while, for example, alternating gaze and imitating mother's behaviours did not correlate with each other. The relations between the actions and gestures sum and the different aspects of joint attentional behaviours were, however, mostly significant. Only interactional initiatives did not correlate with early actions and gestures. The infant's ability to follow or direct mother's gaze was the category of joint attentional abilities which was most strongly related to the actions and gestures sum.

The correlation between the actions and gestures sum and infant's concurrent language comprehension was strong, and although the correlation coefficient was considerably lower with language production, this relation was also statistically significant. Of joint attentional measures only co-ordinative actions had significant correlations to language comprehension at 14 months ($p < 0.05$). However, three joint attentional measures produced significant correlations with concurrent language production: gaze alternation ($p < 0.01$), imitating the mother's behaviour ($p < 0.01$), and interactional initiatives ($p < 0.01$).

Maternal interactional sensitivity correlated very significantly ($p < 0.001$) with concurrent language comprehension, but not with language production. The correlation of maternal interactional sensitivity was also significant with the actions and gestures sum and two aspects of joint attentional behaviours (e.g., co-ordination in interaction and imitating maternal behaviour).

Intentional communication, maternal interactional sensitivity and children's subsequent language comprehension

In order to investigate the extent to which the infants' various intentional

TABLE 3. *Within-age correlations*[a] *between child measures and maternal measures at 14 months old*

Measures	2	3	4	5	6	7	8	9
Language skills								
1. MCDI: vocabulary comprehension	0.36***	0.72***	0.20*	0.06	0.05	0.17	0.08	0.32***
2. MCDI: vocabulary production		0.41***	0.14	0.29**	0.18	0.34***	0.27**	0.18
Parent reported and observed intentional communication measures								
3. MCDI: Actions and Gestures sum			0.21*	0.21*	0.26**	0.21*	0.18	0.23*
4. Co-ordinative actions				0.12	0.21	0.22*	0.15	0.26**
5. Gaze alternation					0.40***	–0.06	0.68***	0.01
6. Following or directing mother's gaze						–0.10	0.42***	0.04
7. Imitating mother's behaviour							0.09	0.29**
8. Interactional initiatives								0.09
Maternal interaction								
9. Interactional sensitivity								

[a] Pearson correlations, except for associations involving variables 2 and 6 which were examined using Spearman correlations.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

TABLE 4. *Results of the hierarchical regression analyses predicting language comprehension at 18 months old*

Step predictor at 14 months	Increase in R^2	Beta[a]	r
1. Actions and Gestures	0.12***	0.34***	0.34***
2. Maternal interactional sensitivity	0.07**	0.26**	0.32***
3. Joint Attentional Behaviours	0.03		
Co-ordinative actions		0.16	0.30**
Gaze alternation		–0.11	–0.04
Following or directing gaze		–0.02	0.04
Imitating mother's behaviour		–0.04	0.13
Interactional initiatives		–0.00	0.00
Total R^2	0.22** [$F(7,102) = 3.69, p < 0.01$]		

[a] Standardized beta at each step.
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

communication skills and maternal interactional sensitivity were associated with children's subsequent language, hierarchical regression analyses were carried out. First, hierarchical regression analyses were performed with children's verbal comprehension at 18 months of age as dependent variable. The independent variables were entered into the equations in three steps: (1) Actions and Gestures sum; (2) Maternal interactional sensitivity; and (3) Joint Attentional Behaviours: co-ordinative actions, gaze alternation, following or directing mother's gaze, imitation and initiatives. These independent variables were selected on the basis of the concurrent associations detected between these measures of intentional communication and interactional variables and child's language skills.

The results of the first regression analysis (see Table 4) showed that the early communicational gestures contributed significantly to the prediction of verbal comprehension at 18 months: the more the parents reported their infants used actions and gestures at 14 months, the higher was the level of their child's verbal comprehension four months later. Maternal interactional sensitivity entered at Step 2, added to the prediction of verbal comprehension. The more sensitive and guiding the mother was during joint play interaction at 14 months of age, the more developed her child's verbal comprehension was at 18 months. None of the joint attentional variables added to this prediction. However, Pearson-correlation analyses carried out separately showed

TABLE 5. *Results of the hierarchical regression analyses predicting language production at 24 months*

Step predictor at 14 months	Increase in R^2	Beta[a]	r
1. Actions and Gestures	0.10***	0.32***	0.32***
2. Joint Attentional Behaviours	0.10**		
Co-ordinative actions		0.03	0.20*
Gaze alternation		−0.10	0.15
Following or directing gaze		0.22	0.23*
Imitating mother's behaviour		0.25	0.27**
Interactional initiatives		0.10	0.17
3. Maternal interactional sensitivity		0.06	0.16
Total R^2	0.20** $F(7,102) = 3.61, p < 0.01$		

[a] Standardized beta at each step.
*** $p < 0.001$; ** $p < 0.01$; ** $p < 0.05$

that co-ordinative actions were associated with verbal comprehension at 18 months ($r = 0.26, p < 0.01$).

Intentional communication, maternal interactional sensitivity and children's subsequent language production at 24 months

Next, hierarchical regression analyses were performed with children's expressive language skills at 24 months as a dependent variable. The same independent variables were entered in the equation as was the case with language comprehension. However, we moved the maternal interactional sensitivity from Step 2 to Step 3 when analysing relations to language production instead of comprehension, because based on previous studies we expected that maternal interactional sensitivity would play a less important role in language production. The independent variables were: (1) Actions and Gestures; (2) Joint Attentional Behaviours: co-ordinative actions, gaze alternation, following or directing the mother's gaze, imitation and initiatives; and (3) maternal interactional sensitivity. The results of this regression analyses (see Table 5) revealed that the sum of actions and gestures contributed significantly to the prediction of expressive language at 24 months: the more the child was reported to use communicational actions and gestures at 14 months, the higher was his/her expressive language at 24 months. The joint attentional variables, entered at Step 2, added significantly to the prediction of expressive language. Two of the joint attentional variables made a unique contribution and showed a significant

correlation with the child's expressive language: imitating maternal behaviour and following the mother's gaze. The more the child imitated maternal object related behaviours and followed or directed the mother's gaze at 14 months, the more advanced was the child's expressive language 10 months later. Maternal interactional sensitivity did not add a unique contribution to the prediction of the child's expressive language.

DISCUSSION

The age around infants' first birthday represents a critical period in the development of communicative intentions and conventional signals. Intentional communication is viewed as a process which precedes, correlates with, and possibly also contributes to the emergence of verbal communication (Bates 1979). Within normal populations there is a great deal of variation in children's nonverbal communication skills (Mundy & Gomes 1998) and verbal skills, for example, in vocabulary size (Bates, Dale & Thal 1995, Huttenlocher, Haight, Bryk, Seltzer & Lyons 1991). There is also some indication, especially for special populations (Mundy *et al.* 1995, Mundy, Sigman, Kasari & Yirmiya 1988, Mundy, Sigman & Kasari 1990, Ulvund & Smith 1996), that early communicational competence is consistently related to later language development. This study both addressed the questions of inter-relations between various aspects of early communicational competencies at 14 months of age, and analysed the continuities between early intentional communication and later language development in a large sample of children whose development is proceeding normally.

Children's early intentional communication can be investigated and categorized using various approaches and methods of assessment. Mundy & Gomes (1998) have argued that multiple measures would be useful in the study of early communicational development in order to understand better the psychological processes behind these skills. In their recent study (Mundy & Gomes 1998), they found that the measures of initiating joint attention and responding to joint attention did not correlate with each other, whereas initiating behavioural regulation correlated positively with both of these measures. Based on these results, they concluded that their data were not completely consistent with models emphasizing the commonality of cognitive processes behind the measures of nonverbal communication. The present study found some support for this view as the correlational analyses indicated strong associations between some joint attentional behaviours (e.g., gaze alternation and interactional initiatives), while

some other aspects had no significant interrelations (e.g., following or directing the mother's gaze and imitating the mother's behaviour). On the other hand, we found that the parental report of the child's actions and gestures correlated significantly with most aspects of joint attentional behaviours, except for interactional initiatives. These associations indicate that different measurement techniques partly tap the same social-cognitive skills present in early intentional communication.

Our next task was to investigate how the different measures of early intentional communication relate to children's concurrent and subsequent language development. Our results showed that the sum of actions and gestures correlated significantly with both concurrent language comprehension and production, and was a strong predictor of language comprehension at 18 months and expressive language at 24 months. A very high concurrent association with language comprehension indicates that the parental reports, which measure the child's use and understanding of nonverbal communicative gestures and appropriate actions with objects, probably reflect the same underlying skills as the index of early vocabulary comprehension. It could be speculated that the associations between the actions and gestures sum and the language measures that were based on parental reports are influenced by the fact that parents were the only source of data in these measures. The finding that the sum of actions and gestures was a strong predictor of the tester-administered Reynell 18-month verbal comprehension, however, points to the reliability of parents as reporters of early preverbal communication. This is consistent with our earlier studies showing parents' ability also to observe reliably their children's vocabulary skills (Lyytinen, Poikkeus, Leiwo, Ahonen & Lyytinen 1996).

In line with Mundy and his colleagues (Mundy & Gomes 1998, Mundy *et al.* 1995), we found that the associations between children's joint attentional behaviours and language skills depended on the specific aspects of the skills that were measured. The studies on specific relations between various aspects of joint attentional behaviours and language skills have been rare. The recent study of Mundy & Gomes (1998) found support for their hypothesis that responding to joint attention (in contrast to initiating these episodes) is an especially strong predictor of receptive language. In the present study, joint attentional behaviours were not categorized according to this dimension (initiating vs. responding). However, our result that the category of co-ordinative actions (in which infants followed or responded to various maternal object-related actions) was a significant predictor of later receptive language, was in accordance with the findings of Mundy and his

colleagues. In the earliest phase, development of comprehension skills may need mostly passive joint engagement on the child's part with the caregiver providing the necessary supportive structure, which makes the language used in the situation immediately meaningful for the child (Bakeman & Adamson 1984, Bruner 1982).

The results of the present study concerning the joint attentional predictors of later expressive language are somewhat difficult to interpret in the framework provided by Mundy & Gomes (1998), who used different and broader categories of joint attention. As a whole their results appear to suggest that more active joint attentional behaviours on the child's part predict later language production than comprehension. This view gained support also in our study. We found that following or directing the mother's gaze and imitating the mother's object actions contributed significantly to the prediction of expressive language at 24 months. This finding is in line with the beliefs that the child's ability to follow or direct another person's gaze is an important precursor to later language development (Baldwin 1995, Tomasello 1995), and, for instance, with the finding by Desrochers, Morisette & Ricard (1995) that the child's gaze-following at 15 months related significantly with his or her expressive language at 24 months. Infants' use of imitation in mother-child interactional contexts, on the other hand, has been suggested to be closely linked with children's skills in participating in dialogue and understanding of some linguistic structures (Martinsen & von Tetzchner 1989). Accordingly, the present study showed that early imitation predicted subsequent expressive language containing a measure of syntax construction (MSL).

The role of caregivers in creating and structuring early joint object engagements has been emphasized in previous research (Adamson 1996, Bruner 1975, 1983, Dunham, Dunham & Curwin 1993, Schaffer 1989, Tomasello & Farrar 1986, Tomasello & Todd 1983). In the present study, maternal interactional sensitivity rated during infant-mother play had a significant association with the sum of actions and gestures and two measures of child's observed joint attentional behaviours. The mothers who were more skilful in maintaining the infant's attention and motivation and more sensitive in matching their behaviours according to the infant's emotional states had infants who were more advanced in their early intentional communication. This result supports the earlier findings that sensitive parental guidance raises the level of infant's object actions and early communicational behaviours (e.g., Bornstein 1995, Fiese 1990, Stevens *et al.* 1998). Gaze following and gaze alternation, however, were not associated with maternal interactional sensitivity. Their weaker links with parental

interactional strategies may be attributed to the assumed greater dependence of the development of gaze-following behaviours on maturational and adaptive mechanisms (Baron-Cohen 1995, Butterworth 1995).

Interactional and home environmental factors have been shown to have an important role in the development of language comprehension (Miller & Siegel 1989). We found that maternal interactional sensitivity correlated concurrently with language comprehension and also contributed significantly to subsequent language comprehension at 18 months. Corresponding relations were not observed in relation to expressive language skills. The quality of maternal behaviours plays an important role in the early interactional routines in which mothers and infants develop mutual sensitivities. In harmonious interactions the mother's nonlinguistic cues aid the child in interpreting the mothers' signals and understanding her utterances (Bruner 1983, Schaffer 1989), and thus this kind of interaction may be especially relevant for the development of the child's later comprehension skills.

Our finding that maternal sensitivity had no significant concurrent or predictive relation to the child's expressive language skills was partly inconsistent with some previous research. Stevens and her colleagues (Stevens *et al.* 1998) found that maternal scaffolding at 9 months did not have predictive associations with infants' productive vocabularies at 15 months, although it had concurrent positive association with expressive skills. Smith and her co-workers (Smith *et al.* 1988) showed that mothers' attention-directing strategies at 15 months made a unique contribution in explaining the infants' productive vocabularies 3 months later. Language comprehension was not assessed in these studies. It might be speculated that differences between the studies in these predictive relationships could be attributed to the characterization of maternal sensitivity. Different aspects of social environmental factors are known to influence the child's development at various age phases (Rutter 1985). The measure of maternal sensitivity used in the present study – which emphasizes somewhat more strongly affective aspects of sensitive parental guidance than cognitive attention-directing – may thus contribute significantly to the early phases of children's language development, but it may be less strongly linked to the more complex aspects of language of later ages.

The current study provided relevant information on several methodological issues in the domain of early intentional communication and mother-child interaction. Parental reports using the MCDI were found to provide a valid evaluation of the child's early gestures and actions, correlating significantly with joint attentional behaviours and also with concurrent and subsequent language skills. The MCDI has been widely

used as a research instrument in the evaluation of early lexicon and grammar (Bates *et al.* 1995, Bates, Marchman, Thal, Fenson, Dale, Reznick, Reilly & Hartung 1994, Fenson *et al.* 1994), whereas very few reports exist on the utility of the sum of actions and gestures as a measure of early prelinguistic skills. This sum promises to have considerable value in clinical practice as it provides a valid and cost-saving diagnostic and predictive measure on the communicative and symbolic skills of infants who have little expressive language.

Our observations of joint attentional behaviours specified various aspects of preverbal communication that are worth paying attention to in observational contexts when evaluating children's communicative skills and predictors to later language development. To our knowledge the time-sampling procedure has not been used previously in the assessment of joint attentional behaviours. However, some validation for its use is suggested by significant correlations between these measures and parental reports of preverbal communication. We have also used a more traditional frequency-based coding procedure without time-sampling, which is based on three-minute interactional episodes, and preliminary analyses show high correlations between the measures obtained using these two procedures (unpublished manuscript). The advantage of the time-sampling procedure is that, although it uses the same criteria, it is more economic. In summary, the present study with its large sample size and a broad set of measures increased our knowledge on the links between different aspects of intentional communication and language and their interactional correlates. As we follow the same group of children into school age, it is of interest to us: (a) whether nonverbal communication assessed in early toddlerhood continues to contribute to linguistic and cognitive development, and (b) what kinds of cognitive and affective aspects of parental attention-directing and guidance support the children's development at the later ages.

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APPENDIX

Maternal interactional sensitivity

1. *Initiatives to motivate the child's play* (1–5: 1 = The mother's initiatives do not sensitively contribute to the child's play, the mother does not make initiatives of her own or her initiatives are poorly timed or she provides an excessive number of initiatives minimizing the child's room for activity; 5 = The mother's initiatives fit in the flow of the child's activities so that the child's

interest and affective state remain at an optimal level throughout the session.)

2. *Providing reinforcement* (1–5: 1 = The mother typically provides no support or encouraging feedback to the child; 5 = The mother consistently supports the child's play by providing sensitively timed reinforcement and encouragement when the child needs it.)

3. *Drawing into joint activity* (1–5: 1 = The mother does not display an interest in the child's play, and she does not make initiatives to draw the child back into activity when he or she loses interest in the toys; 5 = The mother displays high interest in the joint play and by her actions and communication she maintains the child's interest and skillfully encourages him or her to continue going on when he or she begins to lose interest.)

4. *Versatility of motivational strategies* (1–3: 1 = The mother uses only one or two different strategies for maintaining and motivating the child's play, e.g., smiles, acknowledges; 3 = The mother has a large repertoire for maintaining and motivating the child's play, e.g., re-orienting, suggesting, modelling, joining in play, extending.)

5. *Emotional availability* (1–5: 1 = The mother does not actively observe the child's behaviours or provide emotional support to the child; 5 = The mother's focus is consistently on the child's activity and she expresses warmth and availability of support to the child, e.g., by smiling, using affectionate bodily gestures and tone of voice, and making linguistic remarks.)

6. *Emotional attunement* (1–5: 1 = The mother does not express sharing of the child's feelings; 5 = The mother consistently expresses sharing of the child's feelings, e.g., by providing comfort when the child is upset or hurt, expressing enthusiasm when the child is excited, smiling or laughing when the child is cheerful.)

7. *Affective encouragement* (1–5: 1 = The mother's affective behaviour is not in synchrony with that of the child, e.g., the mother does not express any enthusiasm or the mother's affective stimulation is too excessive in comparison with the child's mood and behaviour; 5 = The enthusiasm and excitement exhibited by the mother is consistently in harmony with the mood and behaviour of the child.)

8. *Enjoyment of joint interaction* (1–5: 1 = The mother does not show any signs of enjoying the play with the child, e.g., expresses

tiredness, boredom, lack of interest, reluctance, or nervousness; 5 = The mother expresses high enjoyment of the joint activity, e.g., appears to be relaxed, 'at home', is smiling, joking, participating eagerly.)

9. *Allowing the child's independent activity* (1–3: 1 = The mother does not leave room for the child's independent activity; 3 = The mother allows the child's independent activity and supports and encourages it with her actions and communicative feedback.)

10. *Sensitivity in guidance of the child's activity* (1–3: 1 = The mother does not direct or guide the child's activity in any way; 3 = The mother consistently guides the child's activity in a sensitive and delicate manner.)

11. *Extending of the child's activity* (1–3: 1 = The mother makes no attempts to extend the child's activities or vocalizations or her extensions are insensitive and intrusive, e.g., interrupting the child's play by removing a toy from a child to demonstrate a new action with it; 3 = The mother typically extends the child's play by providing new versatile models in a way that is constructive and takes into account the child's developmental level.)