Developmental problems and interactions between mothers and prematurely born infants

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Abstract:

This study explored how the developmental status of 49 3-year-old prematurely born children related to the interactions between these children and their mothers. Two 2-hour observations of mother-child interactions, the Home Observation for Measurement of the Environment (HOME) inventory, a developmental assessment, and Nursing Child Assessment Teaching Scale (NCATS) were scored when the child was 3 years corrected age. The effects of specific developmental problems (cognitive, language, and attention) were examined by comparing subgroups with and without these problems. Children with normal IQs spent less time not playing and scored higher on the NCATS than children with low IQs. Mothers of children with normal IQs scored higher on provision of play materials on the HOME. The mothers of children with language concerns interacted less, talked less, were more negative, and scored lower on the HOME and NCATS than mothers of the children with normal language abilities. Children with attention problems were more active than children with normal attention spans. These findings suggest that mother-child interactions might be useful for identifying children at risk for developmental delay and that interventions with preschool children with developmental delays will probably be more effective if their mothers are helped to provide a more appropriate social environment.

Keywords: premature birth | human development | developmental delays | mother-child interaction

Article:

About 50% of prematurely born children weighing less than 1,500 g or needing mechanical ventilation exhibit developmental problems by preschool age, and this rate of problems is much higher than that of children born at term (Hack, Friedman, & Fanaroff, 1996; Halsey, Collin, & Anderson, 1996; Middle, Johnson, Alderdice, Petty, & Macfarlane, 1996; Singer et al., 1999; Thompson et al., 1997). Premature infants are at particular risk for cognitive (Hack et al., 1996; Halsey et al., 1996; Singer et al., 1999), language (Jennische & Sedin, 1998; Magill-Evans & Harrison, 1999), and attention problems (Klebanov, Brooks-Gunn, & McCormick, 1994; Levy-Shiff, Einat, Mogliner, Lerman, & Krikler, 1994). This high incidence of developmental problems creates long-term challenges for parents and for nurses working with these families.

Researchers have shown that the quality of the social environments of prematurely born children has a significant effect on their developmental outcomes (Berlin, Brooks-Gunn, Spiker, & Zaslow, 1995; Lee & Barratt, 1993; Smith, Ulvund, & Lindemann, 1994; Thompson et al., 1994). In particular, the social environment is related to a child's cognitive status. The quality of the social environment, as measured by the Home Observation for Measurement of the Environment (HOME), is related to IQ in prematurely born and full-term children (Berlin et al., 1995; Censullo, 1994; Molfese, DiLalla, & Bunce, 1997). The quality of the parent-child interactions in the first 2 years was predictive of premature children's cognitive abilities (Greenberg & Crnic, 1998; Magill-Evans & Harrison, 1999; Olson, Bates, & Kaskie, 1992). Bornstein (1985) found that cognitive development of full-term infants was caused by both mother and infant, such that infants with more cognitive abilities were more proficient at visual processing of information and had mothers who encouraged them to pay attention to their environments. Cognitive abilities of preschool children were also related to concurrent maternal provision of cognitive and verbal experiences (Heincke & Lampl, 1988).

Language development is also related to the social environment. Low levels of maternal and child joint attention to toys predict poorer language skills in full-term and premature children (Lemerise & Malatesta, 1989), and other maternal play behaviors are related to full-term infants' language development (Goodwyn, Acredolo, & Fulmer, 1992; Vibbert & Bornstein, 1989). HOME scores and maternal interactive behaviors in the first year predicted language abilities in prematurely born children (Berlin et al., 1995; Greenberg & Crnic, 1988; Rocissano & Yatchmink, 1983). Maternal verbal sensitivity leads to better language comprehension in full-term children who were initially low in this area (Baumwell, Tamis-LeMonda, & Bornstein, 1997).

Less is known about the effect of the social environment on attention problems, such as impulsiveness, distractibility, and hyperactivity. Prematurely born children raised in better social environments have fewer behavioral problems, including attention disorders (Spiker, Kraemer, Constantine, & Bryant, 1992). Attention problems in children born at term are associated with limited maternal provision of cognitive and verbal experiences (Heincke & Lampl, 1988). Mothers of children with behavior problems are less supportive of their children than mothers of children without problems (Crowell, Feldman, & Ginsberg, 1988).

Although these findings appear to blame developmental problems in prematurely born children on parenting problems, this conclusion is unwarranted. According to the developmental systems approach to understanding maternal-child interaction (Cairns, Elder, & Costello, 1996; Thoman, Acebo, & Becker, 1983; Zeanah, Boris, & Larrieu, 1997), children develop in a continuous, ongoing, reciprocal process of interaction with their social environments (Gottlieb, 1996; Magnusson, 1995). The child is an active participant in the social environment, constantly changing this environment at the same time that he or she is being influenced by the mother-child relationship and the rest of the social environment. The child is constantly changing and, if possible, self-correcting. A poor-quality social environment interferes with self-correction, and a more positive environment enhances it.

The child's developmental status, therefore, is caused by the reciprocal relationship of the child and the social-environment system (Pfeiffer & Aylward, 1990). Mothers who are not responsive to their children will not provide adequate stimulation for optimal cognitive maturation, and children with developmental delays are less likely to be satisfactory social partners. Thus, in a study of 2-year-old to 4-year-old full-term children, Crowell and Feldman (1988) found that "[t]he behavior of mothers and children not only corresponded to situational factors such as partner's behavior and task difficulty but also to long-standing characteristics of mothers, children, and their interactional history" (p. 1284). Language development is related to the amount of maternal speech, but mothers talk in response to their children. Only one third of the speech of a child 2 to 3 years old is in response to maternal speech (Bloom, Margulis, Tinker, & Fujita, 1996).

The purpose of this study was to explore how 3-year-old prematurely born children's developmental status is related to maternal and child interactive behaviors. The amounts of specific behaviors were compared between groups of children with and without the three most common problems of prematurely born children: low IQ, language delays, and attention problems. We hypothesized that mothers of children with low IQs would provide these children with less cognitive stimulation and, thus, would interact less, teach less, and have lower scores on assessments of the quality of the social environment (HOME and Nursing Child Assessment Teaching Scale [NCATS]) than mothers with children with normal IQs. The children with low IQs were expected to spend less time involved in play, an activity that reflects the cognitive status of the child. We hypothesized that children with language delays would talk less than children with normal language skills and that their mothers would provide less stimulation for language development by interacting less, talking less, teaching less, being more negative and less positive, and having lower social-environment scores. We also expected that children with attention concerns would be more active than children with normal attention spans and that their mothers would be more often negative and less often positive because of the children's negative behaviors.

Methods

Participants

Participants for this study were 49 3-year-old, prematurely born children and their primary caretakers—41 mothers and three grandmothers (two paternal grandmothers and one maternal step grandmother). Two grandmothers had legal custody; the third was the primary caretaker for a child who was in the father's custody after a divorce. There were five sets of twins in this sample. These children were born between October 1985 and March 1990, cared for in a neonatal intensive care unit (NICU) in the southeast, and primarily from rural areas. They were all participants in a larger study of the relation between behavioral development of preterm infants during the neonatal period and their development at age 3 years (Holditch-Davis & Edwards, 1998; Tesh & Holditch-Davis, 1997). They were at high risk for developmental problems because they had a birthweight less than 1,500 g or required mechanical ventilation. Thirty-eight (78%) had both problems. All children from the larger study, except those with cerebral palsy, who had an observation and a developmental assessment were included in the sample for this analysis. Children with cerebral palsy were excluded because their motor

problems might have altered the mother-child interaction. The demographic characteristics are summarized in Table 1.

Table 1. Demographic Characteristics of the 49 Prematurely Born Children and Their 44 Caregivers

	Mean	**(SD)**
Caregiver age	29.7 years	(6.1)
Caregiver marital status: % married	67.3%	—
Caregiver education	12.8 years	(2.1)
Gestational age	28.2 weeks	(2.1)
Birthweight	1,131 g	(321)
Size: % average for gestational age	86.7%	—
Sex: % male	51.1%	—
Race: % white	42.9%	—
Birth order: % first born	59.2%	—
Number: % multiple birth*	32.7%	—
Length of mechanical ventilation	8.6 days	(11.9)
% Of infants with specific neonatal complications:		
Intraventricular hemorrhage	42.9%	—
Chronic lung disease	28.6%	—
Birth asphyxia	4.0%	—
Theophylline treatment	81.6%	—

*Five sets of twins were in the study, and six additional twins were in the study without their siblings.
Abbreviation: SD, standard deviation.

Instruments

Observations

Two 2-hour naturalistic observations of mother-child interactions were conducted 1 to 2 weeks apart in the home. When both children from a twin pair were in the study, they were observed at different times. The observer brought a suitcase of age-appropriate toys (puppets, dolls, wooden cars, puzzles, books, modeling clay, etc.) with her. The mother was instructed to play with the child with the toys from the suitcase until the child felt comfortable with the observation and then to do what she would normally do when she was home alone with the child. The child was free to do whatever he or she wanted and could play with the toys from the suitcase or other toys. The toys brought by the observer served both as an icebreaker and to provide all children with something to do because several families did not have any toys at all.

During the observations, the observer recorded the occurrences of mother and child behaviors every 10 seconds by using a behavioral scoring system (Holditch-Davis & Thoman, 1988; Tesh & Holditch-Davis, 1997; Thoman, Acebo, Dreyer, Becker, & Freese, 1979). The end of each 10-second epoch was signaled audibly to the observer through an earphone from a small electronic timer. At this signal, the observer recorded onto paper the behaviors that occurred during the epoch. Multiple occurrences of the same behavior in the same epoch were not recorded.

Three observers, who were all masters-prepared nurses, conducted these observations. The investigator who was experienced in behavioral observation of children did the training. Before beginning observations, each observer achieved interrater reliability of at least 85% exact

agreement on occurrences by coding live observations on children along with the trainer. It usually took 3 to 6 months of practice before initial reliability was achieved. Ongoing interrater reliability, assessed throughout the study by having two observers score about 45 minutes of an observation together every couple months, was 87.9% exact agreements for the 13 variables in this report: Mother interact—The mother talks to, touches, gestures toward, or plays with the child; Passive observation—The mother is looking at the child but not interacting; Mother uninvolved—The mother is not interacting with or looking at the child; Mother talk—The mother is talking to the child; Mother positive—The mother directs positive affect to the child, as by smiling or praising; Mother negative—The mother directs negative affect to the child, as by frowning or scolding; Mother teach—The mother instructs the child, as by naming an object or demonstrating an activity; Sedentary activity—The child is still or takes no more than two steps; Moderate activity—The child is moderately active (takes more than two steps, struggles or moves when physically restrained, or is involved in an activity, such as swinging, requiring physical exertion despite remaining in one spot); Very active—The child spends the majority of the 10-second period in a high physical activity such as running, jumping, or climbing quickly; Activities competing with play—The child engages in activities that compete with play (eating, toileting, or watching television); Uninvolved with play—The child is not playing or engaged in a competing activity; Child talk—The child says words.

Each behavior was measured as a percentage of the total observation. Because the values for all variables were correlated between weeks and no variable differed significantly between weeks, the mean of the two observations was used in data analyses. Three children had only one observation. In two cases, family problems prevented obtaining a second observation, and one subject was only observed once because his family was located out of state. For these three children, the percentages from the single observation were used. Two groups of variables by definition summed to 100% of the observation—maternal interaction (interact, passive observation, mother uninvolved) and activity level (sedentary activity, moderate activity, very active).

HOME

The Home Observation for Measurement of the Environment (HOME) (0-3 Year Version) is a standardized instrument designed to identify children from birth to 3 years of age who are at risk for developmental delays because of home environments that fail to provide adequate stimulation for development (Caldwell & Bradley, 1980). The HOME has six subscales: Emotional and Verbal Responsivity of the Mother, Avoidance of Restriction and Punishment, Organization of the Environment, Provision of Appropriate Play Material, Maternal Involvement with the Child, and Opportunities for Variety in Daily Stimulation. Internal consistency for the HOME using all participants in the larger study was .89 (Tesh & Holditch-Davis, 1997).

NCATS

The Nursing Child Assessment Teaching Scale (NCATS) is designed to detect asynchronous interaction skills of mother-child pairs (Barnard, 1983). The parent is asked to teach the child a novel task, and an observer records the presence or absence of responses on four mother subscales (Sensitivity to Cues, Response to Distress, Social Emotional Growth Fostering,

Cognitive Growth Fostering) and two child subscales (Clarity of Cues and Responsiveness to Parent). The scale has 73 binary items (Barnard et al., 1989). Internal consistency for the NCATS using all participants in the larger study was .75 (Tesh & Holditch-Davis, 1997). In our sample, Response to Distress had no variance considering no child showed distress, so this scale was not used in analyses.

IQ

The Stanford-Binet Intelligence Scale (4th edition) is a continuous scale for measuring the cognitive status of individuals from ages 2 to adult (Thorndike, Hagan, & Sattler, 1986). It has a mean of 100 and a standard deviation (SD) of 16. IQs below 84 indicate low cognitive abilities; IQs of 84 and above are within the normal range. In our sample, the IQs of four children were estimated because these children could not be tested on all items. These estimates were judged to be correct as to being normal or low, but no exact score could be obtained.

PEET

The Pediatric Extended Examination at Three (PEET) measures learning, attention, and behavior problems in 3-year-old to 4-year-old children (Blackman, Levine, Markowitz, & Aufseeser, 1983). Developmental observation and aspects of the physical examination are used to assess gross-motor, language, visual-fine-motor, memory, and intersensory-integration status. The child's attention is scored on a 19-item Reactions During Assessment scale. Only the language domain and attention scores are used in this report. PEET scores are significantly related to areas of the McCarthy Scales of Children's Abilities (McCarthy, 1971), and the PEET scores of normal children differ from those of children with developmental problems (Blackman et al., 1983).

Each of the 9 items on the language domain was scored as falling below levels or at levels 1, 2, or 3. Level 2 is considered normal behavior for children 3 ½ years of age. A definite concern in the language domain occurred when the child scored 2 or more items as below levels or 4 or more items as below levels, level 1, or refusals (Huber, Holditch-Davis, & Brandon, 1993). A probable concern occurred if 1 item was below level or if 2 to 3 items were level 1 or refusals. For all the children in the larger sample, the language-domain score correlated .70 ($p < .001$) with the verbal reasoning-subscale score on the Stanford-Binet.

The Reactions to Assessment Scale scores range from 19 to 57, with higher scores indicating better attention. Scores of 36 or below indicate attention concerns. Internal consistency for the Reactions to Assessment scale using all children in the larger study was .88.

CBCL

The Child Behavior Checklist for Ages 2-3 (CBCL) is a parent-completed instrument designed to detect behavior problems in 2-year-old and 3-year-old children (Achenbach & Howell, 1983). The checklist results in a total-behavior-problem score and subscale scores. Scores falling above the 98th percentile are considered to be of clinical significance. For this study, the CBCL was considered to indicate possible concern if the child scored in the clinical range on any subscale or above the 85th percentile on two or more subscales.

Attention questionnaire

The Aggregate Neurobehavioral Student Health and Educational Review (ANSER) is a group of parental questionnaires for preschool- through school-aged children (Levine, 1981). The portion of the ANSER used in this study was a set of 20 questions about attention problems and hyperactivity. One question that refers to underactive behavior was eliminated because it did not relate to the rest of the scale, even when reverse-scored. Each question is scored on a three-point scale: 0—does not apply, 1—applies somewhat, 2—definitely applies. Overall score ranges from 0 to 40. Internal consistency using all children in the larger study was .90.

Procedures

At 3 years postterm, the child and mother were visited in the home. Two 2-hour naturalistic observations of maternal-child interactions during free play were made. At the conclusion of one of the observations, the observer interviewed the mother and scored the HOME inventory. Although both the HOME and the observation were scored by the same person based on the same situation, the information obtained on each was different. Only 8 of the 45 items on the HOME inventory could be directly scored from the naturalistic observation.

One month later, the family visited a developmental evaluation center for developmental and physical assessments of the child. (Two families were tested in their homes. One had moved out of state, and the other had repeatedly broken appointments at the center.) The Stanford-Binet Intelligence Test, the PEET, and the NCATS were administered during the developmental assessment visit. These assessments were conducted by two experienced examiners, neither of whom had previous contact with the family or was aware of the child's history. In addition, the mother completed the Child Behavior Checklist and the ANSER attention questionnaire.

Data analysis

The effects of cognitive, language, and attention concerns on interactive behaviors were determined by comparing the behaviors of children with normal development and those with developmental concerns in each area. Student *t* tests compared single behaviors, the HOME, and the NCATS. Two-factor (Pattern by Group) repeated measures analyses of variance (ANOVAs) were used for the groups of behaviors that summed to 100% (mother interaction and activity level). The repeated measures ANOVAs had one nonrepeated factor—Group (normal versus suspect children)—and one repeated factor—Pattern. The Pattern factor was made up of variables that summed to 100%. The Pattern factor in the ANOVAs is made up of three variables: for maternal interaction, the percentages of the observation spent in interact, passive observation, and mother uninvolved; and for activity level, sedentary activity, moderate activity, and very active. Because the variables in the Pattern factor sum to 100%, the *F* value for Pattern was expected to equal 0. It was the Pattern by Group interaction that indicated whether there was a significant difference between the two groups.

To determine whether the relationships between interactive behavior and developmental status were caused by the overall quality of the social environment, the analyses comparing interactive

behaviors between children with and without developmental problems were repeated by using the NCATS and HOME scores as covariates. For these covariate analyses only, the one child who was missing the NCATS had her score estimated by using the mean of the total sample.

Results

Developmental status

The children were divided into groups based on the results of their developmental assessment. The 49 children had an average IQ of 89.0 (SD, 14.3). Eighteen had IQs below 84 and were considered low IQ. The other 31 children had IQs between 84 and 117.

Language status was determined based on the PEET language domain and the clinical judgements of the developmental testers. Twenty-three children were considered to have a language concern because they had either had a definite concern on the PEET language domain or had a probable concern and the examiners judged that a language delay existed. The other 26 children were classified as having normal language abilities. The child who was tested out of state did not have a PEET score but was placed in the normal-language group based on a verbal reasoning score on the Stanford-Binet of 101 and the lack of any examiner concerns.

An attention concern was based on the Child Behavioral Checklist, the ANSER attention questionnaire, the attention score on the PEET, and qualitative judgements of the developmental testers (inability to be tested, unusual problems separating from parents, impulsiveness, or unusually short attention span). A child was considered to have an attention concern if he or she was identified as abnormal on at least two measures, one of which was scored by the testers. One child who scored abnormal on these measures was eliminated from this analysis because he was known to have a specific behavioral problem related to eating, rather than an attention problem. Twenty-four children were found to exhibit attention concerns, and the other 24 had normal attention.

These problems overlapped. Only 16 children had no developmental concerns. Ten children had problems in all areas. Seven had cognitive and language concerns. One had cognitive and attention concerns, and four had attention and language concerns. No child had a low IQ alone. However, two children only had language concerns, and nine only had attention concerns.

Relation between developmental concerns and interactive behaviors

Table 2 presents the means and standard deviations of the 13 interactive variables for children with and without developmental concerns. The amounts of maternal teaching, the mother-interaction variables, and child uninvolved with play were higher for mothers and their children with normal IQs, as was hypothesized. However, the only significant difference was that children with low IQs were uninvolved with play more than the children with normal IQs. The one difference from hypotheses was that children with normal IQs spent more time in activities that competed with play.

The mean amounts of mother-talk, mother-teach, mother-positive, mother-negative, child-talk, and the mother-interaction variables for mothers and their children with normal and suspect language development differed in the expected direction, and three variables differed significantly between the groups. The mothers of children with language concerns interacted less, talked less, and were more negative than the mothers of the children with normal language abilities.

Table 2. Mean Percentages (and Standard Deviations) of Interactive Variables Hypothesized to Differ Between Children With and Without Specific Developmental Concerns

	IQ		**Language**		**Attention**	
	Normal n = 31	**Low n = 18**	**Normal n = 26**	**Concern n = 23**	**Normal n = 24**	**Concern n = 24**
Mother interact	52.7 (21.3)	46.4 (18.9)	56.9 (18.1)	43.1 (20.9)*	—	—
Passive observation	15.7 (11.7)	11.9 (7.3)	14.8 (10.7)	13.7 (10.4)*	—	—
Mother uninvolved	31.6 (21.4)	41.7 (23.4)	28.3 (19.6)	43.2 (23.3)*	—	—
Mother talk	—	—	48.2 (17.7)	34.5 (18.3)*	—	—
Mother teach	2.7 (2.5)	2.7 (2.4)	2.9 (2.6)	2.5 (2.2)	—	—
Mother positive	—	—	6.0 (3.8)	4.0 (3.5)	5.8 (4.1)	4.2 (3.2)
Mother negative	—	—	0.7 (0.9)	1.9 (2.0)*	1.1 (1.4)	1.5 (1.8)
Sedentary activity	—	—	—	—	74.1 (11.9)	66.1 (15.9)*
Moderate activity	—	—	—	—	24.7 (11.5)	32.1 (15.2)*
Very active	—	—	—	—	1.2 (1.4)	1.8 (2.2)*
Activities competing with play	9.1 (9.3)	6.3 (4.6)	—	—	—	—
Child uninvolved with play	11.5 (5.2)	16.1 (8.8)*	—	—	—	—
Child talk	—	—	56.1 (11.7)	51.0 (13.6)	—	—

*$p < .05$. For variables summing to 100% and tested in a single ANOVA, apostrophes are placed on all variables.
NOTE. Values for only the variables hypothesized to be affected by a specific developmental concern are given.

The mean amounts of mother positive and mother negative for the mothers of children with attention concerns differed in the expected direction from those of mothers of children without attention concerns but did not differ significantly. The children with attention concerns were significantly more active than were children with normal attention spans.

Developmental concerns and the quality of the social environment

Next, the groups were compared on the two measures of the overall quality of the social environment, the HOME and the NCATS (Table 3). One child, having only a language concern, was missing the NCATS, so she was not included in the NCATS analyses. One HOME subscale differed significantly between the groups—children with low IQs had lower scores on Provision of Appropriate Play Materials. Children with normal IQs had significantly higher NCATS scores and higher scores on four subscales: Sensitivity to Cues, Social and Emotional Growth Fostering, Cognitive Growth Fostering, and Responsiveness to Parents.

Both the NCATS and HOME differed significantly between children with and without normal language development. The children with normal language abilities had higher scores on the HOME and on two subscales: Avoidance of Restriction and Punishment, and Provision of Appropriate Play Materials. Children with normal language abilities also had higher NCATS scores and higher scores on the Sensitivity to Cues, Social Emotional Growth Fostering, and Cognitive Growth Fostering subscales.

Table 3. Mean Scores (and Standard Deviations) on HOME, NCATS, and their Subscales for Children With and Without Specific Developmental Concerns

	IQ		Language		Attention	
	Normal n = 31	**Low n = 18**	**Normal n = 26**	**Concern n = 23**	**Normal n = 24**	**Concern n = 24**
HOME	37.7 (6.2)	34.2 (7.3)†	39.2 (4.7)	33.2 (7.5)§	37.8 (6.0)	34.8 (7.3)
Emotional and verbal responsivity of the mother	10.2 (1.4)	9.9 (1.3)	10.3 (1.5)	9.9 (1.2)	10.3 (1.1)	9.8 (1.5)
Avoidance of restriction and punishment	5.8 (1.9)	4.9 (2.2)	6.4 (1.6)	4.5 (2.1)‖	5.8 (1.9)	5.2 (2.2)
Organization of the environment	5.3 (0.9)	5.2 (0.8)	5.4 (0.7)	5.1 (1.0)	5.4 (0.7)	5.1 (1.0)
Provision of appropriate play material	8.0 (1.9)	6.7 (2.0)‡	8.3 (1.1)	6.6 (2.4)§	7.7 (1.5)	7.2 (2.4)
Maternal involvement with the child	4.8 (1.5)	4.0 (1.9)	5.1 (1.2)	3.8 (1.9)†	4.7 (1.7)	4.7 (1.7)
Opportunities for variety in daily stimulation	3.7 (1.2)	3.5 (1.0)	3.9 (1.0)	3.3 (1.2)	3.9 (1.0)	3.3 (1.2)†
NCATS*	60.8 (4.6)	55.3 (5.7)‖	61.1 (4.7)	56.1 (5.5)§	60.1 (5.0)	57.3 (6.1)
Sensitivity to cues	9.9 (1.1)	9.2 (1.3)‡	10.0 (0.9)	9.2 (1.4)‡	9.9 (1.2)	9.4 (1.3)
Social-emotional growth fostering	9.2 (1.4)	8.1 (1.5)§	9.4 (1.4)	8.2 (1.4)§	9.4 (1.4)	8.2 (1.4)§
Cognitive growth fostering	13.4 (2.5)	11.8 (2.5)‡	13.5 (2.4)	11.9 (2.5)‡	13.2 (2.3)	12.2 (2.7)
Clarity of cues	8.2 (0.9)	8.1 (1.1)	8.3 (0.9)	8.1 (1.0)	8.3 (0.9)	8.1 (1.0)
Responsiveness to parent	9.0 (2.5)	7.2 (2.4)‡	8.9 (2.5)	7.7 (2.7)	8.3 (2.4)	8.5 (2.8)

*The n values for NCATS and its subscales are one less than those listed because one subject was missing this assessment.
†$p < .08$. ‡$p < .05$. §$p < .01$. ‖$p < .001$.

Children with and without attention concerns did not differ significantly on total HOME or NCATS scores. Children with normal attention spans had significantly higher scores on the Social Emotional Growth Fostering subscale on the NCATS.

Interactive behaviors and the quality of the social environment

The analyses comparing interactive behaviors between children with and without developmental problems were repeated by using the NCATS and HOME scores as covariates. The HOME score was significantly related to the amount of mother interaction and teaching for children with low and normal IQs, but the NCATS scores and IQ status had no effect. The overall statistical tests and the tests of all factors were not significant for activities competing for play or child uninvolved with play. For children with and without language concerns, the HOME was significantly related to the amounts of all variables. The NCATS score and the language status had no significant effects on any variable. For the children with and without attention concerns, the HOME scores were significantly related to all variables. In addition, child activity and the NCATS score were significantly related, such that more active children had lower NCATS scores.

Relation between maternal and child interactive behaviors

Finally, we explored the relation between the amounts of maternal and child interactive behaviors by correlating maternal and child behaviors (Table 4). We did not include passive observation, moderate activity, or very active in this analysis because variables that sum to 100% are invariably correlated, so we selected only some variables from each group. As Table 4 shows, all maternal behaviors correlated with at least some child behaviors, and all behaviors of the children, except activities competing with play, correlated with at least some maternal behaviors.

Table 4. Correlations Between Maternal and Child Behaviors During the Naturalistic Observations

	Child Behaviors			
Mother Behaviors	**Sedentary Activity**	**Activities Competing With Play**	**Child Uninvolved With Play**	**Child Talk**
Mother interact	.22	−.13	−.26*	.56§
Mother uninvolved	−.33†	.17	.30†	−.53§
Mother teach	.35†	−.17	−.53§	.42‡
Mother talk	.25*	−.13	−.26*	.60§
Mother positive	.22	−.16	−.18	.38‡
Mother negative	−.42‡	−.09	.26*	−.04

*$p < .08$. †$p < .05$. ‡$p < .01$. §$p < .001$.

Discussion

Clearly, when prematurely born 3-year-old children have developmental problems, their interactive behaviors and those of their mothers are affected. When children had low IQs, they spent less time playing and were less responsive to their mothers on the NCATS than children with normal IQs. Their mothers provided fewer play materials and had lower NCATS scores. The mothers of children with language concerns interacted less, talked less, were more negative, and scored lower on the HOME and NCATS than mothers of the children with normal language skills, but the behaviors of their children did not differ from those of children with normal language skills. Children with attention concerns were more active than children with normal attention spans, and their mothers provided less stimulation to foster social and emotional growth on the NCATS. Although a number of the hypothesized relationships between developmental status and interactive behaviors were not significant, differences between children with and without developmental concerns were almost always in the hypothesized direction, suggesting that the overall interactional patterns between children with and without developmental concerns were consistent with our hypotheses.

In particular, mothers of language-delayed, prematurely born children provided less interactive stimulation than mothers of children with normal language skills. Because learning to talk depends on exposure to speech (Baumwell et al., 1997; Berlin et al., 1995; Bloom et al., 1996), children whose mothers are less involved, talk to them less, and provide a less stimulating environment (as measured by the HOME and NCATS) probably have less opportunities to learn to talk. However, our findings might also be explained by an effect of the language-delayed child on the mother. If the child has poor language comprehension, the child's mother would be forced to rely on nonverbal techniques for communication. Because the primary elicitor of maternal talking is the child's talking to the mother (Bloom et al., 1996), language-delayed children are less likely to be exposed to maternal speech. In fact, in this study, child talk was correlated with all maternal behaviors except mother negative. The lower level of maternal involvement when the child has language delays might be caused by the frustration the mothers feel in dealing with a child who does not understand her speech. Thus, a positive-feedback loop may develop in which mothers who are less involved with their children have children who have poorer language comprehension, and this lower comprehension further discourages maternal involvement.

By contrast, for both cognition and attention, differences in both child and maternal behaviors occurred. Children with low IQs spent less time playing than children with normal IQs, and their

mothers provided fewer play materials, providing further evidence that play and cognitive abilities are closely related (Bornstein, 1989; McDonald, Sigman, & Ungerer, 1989). The mothers of children with cognitive concerns had lower scores on all three maternal NCATS subscales, even though maternal behaviors did not differ during the observations. A teaching situation may be more likely to identify interactive patterns associated with cognitive problems because of the importance of didactic interactions for cognitive growth (Bornstein, 1989). Other studies have also found that the quality of parent-child interactions was related to the cognitive abilities of the child (Berlin et al., 1995; Censullo, 1994; Greenberg & Crnic, 1998; Molfese et al., 1997; Olsen et al., 1992). There has been less study, however, of the effect of the child's cognitive abilities on maternal stimulation. It is likely that children with better cognitive abilities are more responsive to maternal stimulation and teaching, and as a result, mothers are encouraged to provide more of this stimulation.

For attention problems, there were fewer interactive differences. As would be expected, children with attention problems were more motorically active. Their mothers also provided less social and emotional growth-fostering stimulation during the NCATS, providing further evidence that the social environments of children with attention problems are less positive than those of children with normal attention (Carlson et al., 1995; Heincke & Lampl, 1988; Spiker et al., 1992). Because the correlations indicated that the amount of mother negative increased as the child was more active, this less positive social environment may be caused by the greater activity and distractibility of children with attention problems, making them less satisfying social partners.

Thus, the findings in all three developmental domains support the concept of a reciprocal relationship between child developmental status and the quality of the social environment as theorized in the developmental systems framework (Cairns et al., 1996; Crowell & Feldman, 1988; Bloom et al., 1996; Thoman et al., 1983). Not only was the quality of maternal interactive behaviors related to the child's developmental status, but for cognition and attention, there were differences in child behaviors that could not be accounted for by the overall quality of the social environment. Also, maternal and child behaviors during naturalistic observations were correlated. Even for language, some of the differences in maternal behaviors could well be caused by the effect of child developmental problems on the mother.

Overall, we obtained related, but different, findings with the three measures of mother-child interaction—the observation, the HOME, and the NCATS. Nurses should not expect that single measures will be able to capture the complexity of the parent-child relationship. Therefore, multiple measures of the social environment are needed to gain an understanding of the factors that contribute to the developmental status of prematurely born children. This is an area that needs additional study. In addition, because most of our children with developmental concerns had problems in multiple domains, additional research is needed with children with problems in single areas to determine whether particular interactional difficulties are related to specific developmental problems.

Our findings also support the research indicating that nursing interventions with developmentally delayed children will be more effective if their mothers are helped to provide a more positive social environment (Bennett, 1987; Spiker, Ferguson, & Brooks-Gunn, 1993). One way to

accomplish this is to include parental education about normal growth and development, appropriate play with their children, and ways to stimulate their children's cognitive and language abilities during each contact with prematurely born children and their families.

Nurses also need to conduct ongoing developmental assessments of prematurely born children at least until school age because developmental problems may not be diagnosable at early ages and parents may be reluctant to acknowledge the presence of problems because of their need for their children to be healthy (Huber et al., 1993; Miles & Holditch-Davis, 1995). If developmental problems are identified, nursing interventions need to focus on helping a mother maintain positive interactions despite the effects of the child's limitations on the interactions. Given the importance of the exposure to speech in the development of language and cognition (Baumwell et al., 1997; Berlin et al., 1995; Bloom et al., 1996; Bornstein, 1989), parents need to be particularly encouraged to talk to children with low cognitive or language abilities. Spending time with the child and playing with the child (particularly engaging the child with play that involves new skills) provide an opportunity for conversation and for parental teaching, and as shown in our findings, increased parental interaction and increased play are associated with better language and cognitive outcomes. Perhaps a useful strategy for parents experiencing difficulties in interacting with their children would be to read to the children. Reading aloud provides the desired exposure to language for the child and gives the parent a basis for providing this verbal stimulation until such time that the parent feels more comfortable with simply talking and playing with the child.

Finally, when early attention problems are evident in a child, helping a parent to develop the skills necessary to deal effectively with the child's increased motor activity is important. Parents may also need nursing support to maintain a high level of positive interactions with the child and to provide appropriate stimulation to foster emotional growth despite the sometimes negative behaviors of children with attention problems.

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