Maternal Responsiveness and Infant Mental Abilities: Specific Predictive Relations

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Specific predictive relations between mothers' responsiveness to their 5-month-olds' nondistress activities and vocal distress and infants' attention span, symbolic play, and language comprehension at 13 months were examined in 36 dyads in a short-term prospective longitudinal study. Maternal responsiveness to infant nondistress activities at 5 months, but not responsiveness to infant distress, uniquely predicted infant attention span and symbolic play, but not infant language comprehension. Mothers' responsiveness at 13 months was positively and consistently, but not significantly, associated with all three infant abilities. The results support a view that the effects of maternal responsiveness on infant mental development are specific and indirect rather than generic and direct and recommend further differentiation of infant activity, maternal responsiveness, and child outcome in studies of children's early mental development.

Sensitive parental responsiveness has been identified as a significant general factor in child development since Bowlby (1969) and Ainsworth (Ainsworth, Bell, & Stayton, 1974; Ainsworth, Blehar, Waters, & Wall, 1978). Bornstein and Tamis-LeMonda (1989, p. 50) operationalized responsiveness as "mothers' prompt, contingent, and appropriate behaviors" that have identifiable, immediate, and direct antecedents in the behaviors of their infants. At present, a substantial developmental literature associates maternal responsiveness with advances in the socioemotional and cognitive domains of child growth (e.g., Beckwith & Cohen, 1989; Bell & Ainsworth, 1972; Bornstein, 1989a, 1995; Bradley, 1989; Coates & Lewis, 1984; Crockenberg, 1981, 1983; Fish & Crockenberg, 1981; Goldberg, Lohkasek, Gartner, & Corter, 1989; Hardy-Brown, Plomin, & DeFries, 1981; Isabella, 1993; Lewis, 1993; Lewis & Goldberg, 1969; Olson, Bates, & Bayles, 1984; Rheingold, Gewirtz, & Ross, 1959; Sigman, Neumann, Carter, Cattle, D'Souza, & Dwiibo, 1988; Yarrow, Rubenstein, & Pedersen, 1975).

Like other interaction processes, responsiveness may influence child development directly or indirectly. On one view, responsiveness operates directly on the growth of childhood competencies. Lewis and Goldberg (1969), for example, argued that, based on consistent and prompt reinforcement in mother--infant interactions, infants learn a "generalized expectancy" that their own behaviors have consequence in affecting the environment. In the same vein, Watson (1985; Watson & Ramey, 1972) proposed that infants learn more than simple associations when their behaviors are responded to: Infants' experiences, especially in controlling contingent stimulation, lead them to develop a sense of "effectance," and as they recognize that they can exert an effect on their environment infants become increasingly motivated to learn and to control and interact with that environment. It has also been hypothesized that responsiveness operates indirectly in child development: Responsiveness experiences engender feelings of "security" in children, and more secure children explore the environment more, leading indirectly to advances in socioemotional and cognitive competencies. Bowlby and Ainsworth theorized that the mother who is sensitive, responsive, and emotionally available...

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to her infant provides a secure base that enables the infant to separate easily and freely explore the surroundings (see also Frodi, Bridges, & Grolnick, 1985; Sorce & Emde, 1981), activities which in turn have been linked to exploration and advancing cognitive capabilities (e.g., Bell & Ainsworth, 1972; Jennings, Harmon, Morgan, Gaiter, & Yarrow, 1979; Main, Tomasini, & Tolan, 1979; Matas, Arend, & Sroufe, 1978). Whether via direct or indirect pathways, responsiveness may have specific or general implications for child development. Responsiveness could operate on infants by promoting general motivation or effectance, leading to the prediction that maternal responsiveness of different kinds exerts a broad influence on multiple measured outcomes. It could also be, however, that only certain or specific developing abilities are affected by specific kinds of responsive experience. Thus, directly and/or indirectly parental responsiveness may influence general or specific growth in infancy. Clear longitudinal demonstrations of responsiveness effects are, however, altogether few. Empirical studies of the predictive validity of maternal responsiveness have been constrained by one or more significant shortcomings. For example, maternal responsiveness is often confounded with other relevant behavioral or sociodemographic variables. In this study, we coded responsiveness particularly, as distinct from spontaneous stimulation and from contingent but intrusive or unrelated caregiving activities, and we also evaluated and accounted for associations between responsiveness and significant sociodemographic variables, like education and employment, in mothers. Additionally, relations between maternal responsiveness and child performance have often only been assessed at the same time, so that the interpretation of directional effects is compromised. In this 5- to 13-month prospective longitudinal study, we recorded child activities at two times in infancy, we evaluated age-appropriate and comparable forms of maternal responsiveness to those activities, and we used hierarchical regression techniques to isolate unique predictive vs. concurrent effects of responsiveness.

Furthermore, when maternal responsiveness specifically has been studied, it has often been conceived of as a global parenting pattern, when it may be that select forms of responsiveness are differentially meaningful in predictive validity (cf. Coates & Lewis, 1984). In this study, we coded separately and compared mothers’ responsiveness to their children’s positive or nondistress activities from mothers’ responsiveness to their children’s negative or distress activities. We partitioned maternal responsiveness into these component types, expecting that their effects would vary relative to different outcome measures. For example, the conduct of intelligible conversation imposes turn-taking constraints vis-à-vis nondistress vocalizing suggesting that responsiveness to certain infant nondistress activities might encourage language development; moreover, positive responsiveness to infant attention orientation is associated with verbal and cognitive development. Alternatively, mothers’ responding to infant distress—responsiveness to distress is thought to have evolved an adaptive significance for eliciting and maintaining proximity and care—was not hypothesized to exert the same positive influences over children’s representational abilities, except insofar as responsiveness in mothers might generically influence child development. Bowlby (1969) posited that child–mother attachment derives from maternal responsiveness to infant distress signals; parental regularity engenders trust and security, on the basis of which exploration and learning can proceed. Hence, the differentiation of mothers’ responsiveness to infant nondistress vs. distress activities speaks to the distinction between direct vs. indirect effects on general vs. specific abilities. Our observations of responsiveness began when infants were 5 months old because at this time the infant’s scope of apperception has broadened beyond the dyad; infants look to the environment, reach out, and grasp; and infants more actively engage mother and participate in verbal and nonverbal turn-taking exchanges (see Belsky, Gilstrap, & Rovine, 1984; Bornstein & Tamis-LeMonda, 1990; Case, 1985; Cohn & Itronick, 1987; Kaye & Fogel, 1980; McCall, Eichorn, & Hogarty, 1977).

In the same vein, the criterion outcomes of parental responsiveness in childhood have often been investigated as monistic (cf. Riksen-Walraven, 1978). Yet, different infant cognitive competencies, such as attention span, symbolic play, and language comprehension, may relate differentially to maternal responsiveness. The
start of the second year, when children and mothers were seen again, reflects a period of advances in diverse mental abilities in the child, and growth in these three domains of cognition is particularly notable. Among the main tasks of this period are the achievement of self-regulatory, symbolic, and communicative capacities (Belsky & Most, 1981; Bornstein & O’Reilly, 1993; deVilliers & deVilliers, 1992; Edwards, 1995; McCune, 1992), and so we focused on these early second-year achievements. Specifically, in this period children normally make great strides in coordinating attention (e.g., Bakeman & Adamson, 1984; Harding & Golinkoff, 1979) and in learning to disregard extraneous environmental intrusions (Kopp, 1987), and sustained attention becomes longer, more controlled, and more focused (Krakow, Kopp, & Vaughn, 1981). Children also move from undifferentiated exploration and functional manipulation of objects towards more sophisticated acts of pretense (e.g., Belsky & Most, 1981; Fein, 1981; McCall, 1979; O’Connell & Bretherton, 1984), and symbolic activity begins to appear in play (Bates, Bretherton, Shore, & McNew, 1983; Ungerer & Sigman, 1984). Furthermore, children start to understand sound sequences which function as true “naming” (e.g., Snyder, Bates, & Bretherton, 1981), and language comprehension is shifting from a “context-restricted” or purely performativity understanding of words or phrases to “flexible” understanding of words across contexts (Bates, Bretherton, & Snyder, 1988). Each of these abilities is characterized by considerable individual variation at this critical time. In this study, we explored the differential role of different types of maternal responsiveness in early infancy for the growth of these three cognitive skills at the end of infancy.

In brief, the main goals of the present study were to examine the predictive validity of maternal responsiveness, overcoming several shortcomings in extant research, and to isolate early vs. later predictive effects of different kinds of maternal responsiveness for different cognitive competencies in children. (A differentiated pattern of mother–child predictive relations would suggest that different underlying processes are at work in responsiveness’s role in the mental development of the child.) Cognitive growth turns on the active participation of the child in generating appropriate interactive experiences with significant others, as well as responsiveness and stimulation provided by primary social partners. The developmental model underlying this investigation presumed such transaction (Bornstein & Lamb, 1992; Sameroff, 1983), in that child and significant others, notably mother, influence the child’s development through time. By isolating different kinds of responsiveness and their differential temporal effects on multiple measures of cognitive development all essentially in the first year, this study design also highlights specific effects of specific types of parental responsiveness per se for specific childhood abilities.

METHODS

Participants

Thirty-six primiparous mothers and their children (14 girls and 22 boys), recruited from private obstetric and pediatric groups in a large metropolitan area, were visited in their homes twice, first when infants were 5 months old ($M = 161.8$ days, $SD = 8.2$) and then at 13 months old ($M = 402.9$ days, $SD = 4.3$). At both the 5- and 13-month observations, mothers completed questionnaires that supplied demographic information about their children’s health status, their own educational histories, employment status, and the like. All infants were term at birth ($M$ weight $= 3.4$ kg, $SD = 0.5$; $M$ length $= 50.8$ cm, $SD = 2.8$) and healthy throughout the course of the study. Families were middle- to upper-socio-economic status ($M = 59.9$, $SD = 5.4$, on the Hollingshead Four Factor Index of Social Status, 1975; Gottfried, 1985). Mothers averaged 33.2 years old ($SD = 4.0$) at the time of the 3-month observation and had an average of 6.3 years ($SD = 2.3$) post-high school education. At 5 months, 64% of mothers were homemakers, and 33% worked part- or fulltime outside the home; at 13 months, 39% of mothers were homemakers, and 58% worked part- or fulltime outside the home (data were missing for one mother at each age).

Procedures

Infant activity and maternal responsiveness were assessed during naturalistic interactions in the home at 5 months. At 13 months, dyads were observed again at home, and children’s attention span and symbolic play and maternal responsiveness were coded from a videotaped play session. Children’s language data were obtained from a maternal inventory. Home observations allowed mothers and children to be studied in surroundings familiar and comfortable to them. At both ages, mothers were told that the observer was interested in general dimensions of children’s development; they were asked to do whatever they ordinarily would do, disregarding the observer’s presence as far as possible; beside the observer, only mother and child were present; and all visits were scheduled during times when children were likely to be in states of quiet or active

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alert. Our purpose was to observe mothers and children under conditions appropriate to the ages involved, and not to standardize the contexts of data collection beyond what was normal and ecologically valid for that situation and age. Home visits were conducted by different observers at the two ages to minimize observer knowledge about child and mother performance at other times; data for each component of the study were also coded by different individuals, so that coders were blind to the nature of different data sets.

Data Collection at 5 Months

After a warm-up period, observations lasted 45 min and were conducted in real time using a sampling technique in which a 30-s observation was followed by a 30-s recording period (Seitz, 1988). The bounds of these periods were signaled to the observer by a covert automatic timer. Both maternal and infant activities were observed and recorded for analysis. The young infant’s visual and vocal behaviors serve as principal indicators of state of arousal and affect, as well as of perceptual, cognitive, and emotional functioning (Bornstein & Lamb, 1992). These are among the behaviors which mothers monitor closely. For these reasons, we examined maternal responsiveness to infant visual attention to the environment and to mother as well as to infant nondistress and distress vocal signals. Infant activities were constituted in two categories: (a) nondistress (operationalized as visual orientation to mother, to a property, object, or event in the environment, active hand contact with an object, or nondistress vocalization) and (b) distress vocalization. Frequency counts were obtained for infant activities in terms of the number of coding intervals in which an activity category occurred. Behavior codes were independent, that is, any code could occur in any coding interval. Infant state was also noted once per 30-s observation; infants were judged to be in states of quiet or active alert (modified from Brazelton, 1973) in an average of 91% of the sampling intervals.

Mother codes focussed on responsiveness to the two categories of infant activities. Responsiveness to infant nondistress was defined as mothers’ responding promptly, contingently, and appropriately in either a physical or verbal manner within the same 30-s coding interval to the above infant nondistress (exploration or vocalization) activities. Responsiveness met three criteria: (a) the infant acted or vocalized nondistress, (b) the mother displayed a change in the infant’s behavior within the 30-s time frame, and (c) the mother’s response was infant dependent and appropriate (vs. intrusive or controlling) in the sense that it related conceptually to the infant’s prior action. For example, a mother would be credited with responsiveness if her infant looked at an object and she then named the object, described it, or moved it toward the infant so that the infant could reach it, in contrast to her nonresponsive but contiguous movement of a different object into the infant’s view or offering unrelated comments (e.g., “Ok, let’s go have lunch”). We specifically and conservatively coded responses that elaborated for, rather than distracted, the infant in these ways. This coding resulted in frequency counts of responsiveness to infant nondistress, that is the number of sampling intervals in which maternal responsiveness occurred.

Responsiveness to infant distress was defined as mothers’ responding promptly, contingently, and appropriately within the same 30-s period to an infant distress vocalization. Mothers responded to distress predominantly by talking to, soothing, comforting, stroking and touching, or picking the infant up; less frequently, mothers attempted distraction strategies of encouraging the infant’s attention to properties, objects, or events in the immediate surround (see, too, Bornstein et al., 1992).

Prior to beginning the study, two observers were trained to a minimum of 90% agreement in each coding category. During the course of the study, observers were checked for reliability regularly (over approximately 25% of observations). Observer agreement about infant state and the occurrence or nonoccurrence of infant and mother activities was examined on an interval-by-interval basis. Agreement averaged 90% for all infant activities (range = 90%-97%). For mothers, agreement on responsiveness to nondistress averaged 82% (80%-93%), and responsiveness to distress averaged 94% (80%-100%). Base rates were skewed constraining the selection of percent agreement as the reliability index.

Two proportion variables for maternal responsiveness were defined. Maternal responsiveness to infant nondistress was calculated as the number of intervals in which a mother responded to her infant’s nondistress activity divided by the number of intervals in which an infant acted in a nondistress fashion. Maternal responsiveness to distress was calculated as the number of intervals in which a mother responded to her infant’s distress divided by the number of intervals in which her infant cried or fretted. Thus, the two responsiveness calculations took into consideration base rates of infant nondistress and distress (see Bornstein et al., 1992).

Data Collection at 13 Months

Each dyad was videotaped for 15 min during a free play interaction. A standard set of toys (doll, blanket, teapot with cover, two teacups, two saucers, two spoons, a toy telephone, toy train, two small picture books, four rubber balls, and a set of nesting barrels) was placed on the floor in front of the child and mother.

Attention Span

Each child’s visual orienting to the toys was divided into attention episodes, defined as visual orientation to a target toy/toy group lasting a minimum of 2 s. The offset of an episode was signaled when the child turned away from the target toy(s) for more than 2 s. The onset and offset of each episode were noted to the nearest 1 s based on the prerecorded time signal appearing on the videotapes.

For each child, the mean duration(s) of the two longest episodes of uninterrupted attention was calculated. This index represents children’s ability to focus on an object/object group for prolonged periods and is valid and reliable (see Power, Chapiesski, & McGrath, 1985). Interobserver reliabilities for attention span were obtained by having three independent coders score the attention of approximately 20% of the sample. Pearson reliabilities (r) calculated for the time data across attention episodes for each infant averaged .87 (range = .71-.97); a separate reliability showed good agreement in absolute level as well as rank order of attention, ICC = .98.
Symbolic Play

Child play was coded from videotapes in accordance with a mutually exclusive and exhaustive play category system that included 8 levels and a default (no play) category; these levels were derived from previous research on the progressive nature of play across the first and second years of life (see Bornstein, Haynes, O’Reilly, & Painter, 1996; Bornstein & O’Reilly, 1993; Tamis-LeMonda & Bornstein, 1991, 1994). Play levels 1 to 4 consisted of unitary functional, inappropriate combinatorial, and appropriate combinatorial activity as well as transitional play, and play levels 5 to 8 consisted of self-directed, other-directed, sequential, and substitution pretense. (The toys afforded the child the opportunity to exhibit all levels of play.) The play session was divided into 60 contiguous intervals of 15 s each. During a given 15-s interval, each play level that occurred was credited once, regardless of the number of times it occurred. All categorizations of child play, including symbolic play, were determined by children’s actions and nonverbal behaviors rather than by their language.

The number of different symbolic play levels (i.e., levels 5 through 8) was calculated within each interval and then summed across the 60 intervals to compute a total symbolic play score for each child. Intercoder reliabilities for play were obtained by having independent coders score 24% of the sample, randomly selected. For each child, observers were said to agree when they both coded the same level(s) of play for a given interval. Kappa agreement for the eight levels of play across intervals and children averaged .77.

Maternal Responsiveness

Maternal responsiveness was scored from the same videotaped play session. As at 5 months, responsiveness was coded whenever a mother responded promptly, contingently, and appropriately (not simply contiguously and not intrusively) to her child’s exploration or vocalization; however, at 13 months, the frequency of responsiveness was counted. The same definitions and constraints on child behavior and maternal responsiveness held at 13 months as at 5 months, except that at 13 months child distress did not occur, precluding a measure of maternal responsiveness to distress. Thus, maternal responsiveness to nondistress was operationalized similarly at the two ages, to conceptually matching age-appropriate exploratory and vocal behaviors. Two independent scorers coded 17% of the data in common. Reliability averaged 82% (range = 73%–91%).

Language Comprehension

Mothers were probed about their children’s receptive vocabulary using the Early Language Interview (ELI; Bates et al., 1988). This interview yields reliable language data and possesses concurrent and predictive validity for children’s language performance. During the language interview, an experimenter read specific lexical items taken from general verbal categories (e.g., food) and asked the mother whether her child understood each item, and if so, whether any specific gestural, vocal, or temporal cues were necessary for mastery of the item. The 6-week test-retest reliability for a later adaptation of the ELI, the MacArthur Toddler Vocabulary Production Scale (81% of the words in either word list are shared) is .90 (Fenson et al., 1991). At the time of the interview, children either played with their own toys or were free to continue playing with the toys the experimenter had provided. Mothers were free to respond to children’s bids during the interview.

Language data were scored according to procedures developed by Bates et al. (1988) and by Tamis-LeMonda and Bornstein (1994). Children were credited with comprehension if their behavioral response was appropriate to a particular word or phrase (e.g., stopping an action if mother said “no”). Comprehension of each word or phrase was further categorized as “restricted,” in cases where contextual or other cues were necessary for mastery of the item, or “flexible,” in cases where comprehension of a word or phrase was independent of context (Bates et al., 1988). For analysis, we used the number of flexible words and phrases children comprehended. This measure is thought to index the extent to which children actually understand the idea that things have names (Bates et al., 1988; Snyder et al., 1981; Tamis-LeMonda & Bornstein, 1994); it is reliable and valid for second-year language (see Bates et al., 1988; Tamis-LeMonda & Bornstein, 1994); and it was characterized by greater variability than its restricted counterpart, F(max) = 10.05, p < .001. Two coders independently scored audio recordings and transcripts of 10% of the language interviews. Agreement for numbers of words and phrases in comprehension was calculated by dividing the number of agreements by the number of agreements plus disagreements. They averaged 97% for comprehension (83%–98%). Agreement for the flexible-restricted language distinction averaged 90% (83%–98%).

RESULTS AND DISCUSSION

Prior to statistical appraisal, univariate data were inspected in box plots, and bivariate relations were examined in scatter plots (Tukey, 1977). (Data for two additional dyads were omitted from analyses: One child was an outlier on language, and one on play.) Inspection of bivariate distributions showed that pairs of child, mother, and mother–child activities were not systematically associated in any nonlinear fashion. Relations between sociodemographic variables and all measured variables were also examined: Neither maternal status (age, education, or employment) nor infant status (gender, weight at birth, or age at testing) was associated with any measures of infant activity, child attention span, symbolic play, language comprehension, or maternal responsiveness, and so these factors were not considered in further analyses. As no variables differed between girls and boys, analyses are based on the entire sample.

Results of this longitudinal research are organized as follows. First, descriptive statistics for infant activities, child attention span, symbolic play, language comprehension, and maternal responsiveness at the two ages are presented. Next, zero-order relations among these variables are assessed, and multiple hierarchical regres-
sion analysis used to evaluate the unique predictive validity of maternal responsiveness at the two ages to infant and child activities for the separate cognitive abilities.

Descriptive Statistics and Relations Among Variables

Means and standard deviations for all variables assessed appear in Table 1. At 5 months, infants were active (they explored visually or tactually or vocalized) in more than 75% of sampling intervals on average. Some infants were active in as few as 33% of intervals, others in as many as 95%. Infants vocalized distress in less than 13% of coding intervals on average (range = 0 to 16). At 13 months, children's average longest attention epoch lasted about 1.5 min. Some children maintained focus on a toy/toy group for less than 0.5 min, whereas others attended for nearly 3.5 min at a stretch. Differences in procedures, stimulus materials, and length of observation make it difficult to compare group trends in attention across studies, but the fact that individual children vary in attention is in agreement with prior research (e.g., Jennings et al., 1979; Power et al., 1985; Yarrow et al., 1982). Children varied on how sophisticated their ongoing symbolic play was, with some children never exhibiting symbolic play and others playing symbolically in as many as 1/3 of sampling intervals. These play data parallel extant studies on spontaneous play in toddlerhood (e.g., Belsky & Most, 1981; Bornstein et al., 1996; Vibbert & Bornstein, 1989). Children comprehended an average of 36 flexible words (10–75). These findings are consistent with general results obtained by Benedict (1979) and specific results of Bates et al. (1988) on a sample of 13-month-olds for the same language inventory.

At 5 months, mothers responded to infants' nondistress activities in approximately 33% of the sampling intervals on average, and they responded to infants' distress vocalizations in nearly 75%. This rate of responsiveness to infant nondistress approximately matches that reported by Bornstein et al. (1992) for a separate sample of American mothers. Moss and Robson (1968, cited in Wachs & Gruen, 1982) reported that 77% of 2,000 episodes of infant crying resulted in maternal interventions, and Stith and Davis (1984) reported rates of contingent responsiveness to infant distress among mothers at 72%–74%. The range of distress responsiveness betrayed wide individual variation among mothers: Some mothers were responsive in only 2% of intervals, whereas others were responsive in nearly 75%. However, the distribution was skewed with the majority of mothers clustered around consistent responsiveness. Bell and Ainsworth (1972) likewise reported a range of individual variation in maternal responsiveness to infant crying during the first 3 months of life; the least responsive mother ignored her infant

<table>
<thead>
<tr>
<th>TABLE 1</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Child at 5 months</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nondistress activity (intervals)</td>
<td>34.6</td>
<td>6.7</td>
</tr>
<tr>
<td>Distress (intervals)</td>
<td>5.7</td>
<td>4.4</td>
</tr>
<tr>
<td><strong>Child at 13 months</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attention span (s)</td>
<td>84.0</td>
<td>43.5</td>
</tr>
<tr>
<td>Symbolic play (sum of symbolic play levels)</td>
<td>5.0</td>
<td>5.3</td>
</tr>
<tr>
<td>Language comprehension (flexible words)</td>
<td>36.5</td>
<td>17.5</td>
</tr>
<tr>
<td><strong>Mother</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Responsiveness at 5 months</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nondistress (proportion)</td>
<td>0.33</td>
<td>0.15</td>
</tr>
<tr>
<td>Distress (proportion)</td>
<td>0.73</td>
<td>0.28</td>
</tr>
<tr>
<td>Responsiveness to nondistress at 13 months</td>
<td>46.9</td>
<td>17.0</td>
</tr>
</tbody>
</table>
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97% of time; the most responsive failed to respond to her infant only 4% of the time. At 13 months, mothers responded nearly 47 times in 15 min (19–90).

Relations Among Variables

The two kinds of maternal responsiveness at 5 months were correlated, $r = .33$, $p = .05$, but shared only 10% of variance. Child attention span related significantly to symbolic play competence, $r = .48$, $p < .01$, but attention did not relate to language comprehension, $r = .17$; and play related marginally, but not significantly, to language, $r = .28$. In general, these associations are consistent with others reported in the literature (e.g., Bates et al., 1988; Jennings et al., 1979; Power et al., 1985; Ungerer & Sigman, 1984; Vibbert & Bornstein, 1989; Yarrow et al., 1984). The three criterion measures shared only 3%–23% of variance. On the basis of these analyses, the two forms of maternal responsiveness and the three criterion measures were examined in separate predictive analyses.

Predictive Relations

We used correlation and hierarchical multiple regression analysis to identify the predictive validity of maternal responsiveness to distress and nondistress in infancy to each of the three child cognitive competencies at 13 months. Table 2 refers to maternal responsiveness to infant nondistress. Row A provides evidence for the unique concurrent association between maternal responsiveness at 13 months and that criterion child ability at 13 months (i.e., with maternal responsiveness at 5 months partialled). Row B provides evidence for the unique predictive association between maternal responsiveness at 5 months and the same child ability at 13 months (i.e., with maternal responsiveness at 13 months partialled). Maternal responsiveness to infant nondistress activities at 5 months uniquely predicted child attention span and symbolic play, accounting for approximately 15% of unique variance on average. The same patterns of results obtained for total maternal responsiveness at 5 months (the sum of the z-transformations of mothers’ proportions of responsiveness to infant nondistress activities and to infant distress vocalizations) as for maternal responsiveness to infant nondistress; it appears that maternal responsiveness to infant nondistress carries the effects for total maternal responsiveness. Although consistently and positively associated, maternal responsiveness to child nondistress activities at 13 months was never a unique predictor of attention span, symbolic play, or language comprehension. Maternal responsiveness to infant distress at 5 months (uncorrected for distress responsiveness at 13 months because no episodes of distress occurred then) never predicted a child outcome: $rs = .21$ to attention span, .24 to symbolic play, and −.04 to language comprehension, $ns$. Furthermore,

| TABLE 2 |

Child Cognitive Skills: Attention Span, Symbolic Play, and Language Comprehension as Predicted by Maternal Responsiveness to Infant Nondistress

<table>
<thead>
<tr>
<th>Criterion/Predictors</th>
<th>Predictive Zero-order Correlation</th>
<th>$R^2$ change</th>
<th>$F$ change</th>
<th>Model $F$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Attention Span</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Maternal responsiveness 13 mo.</td>
<td>.22</td>
<td>.03</td>
<td>1.29</td>
<td>4.43**</td>
</tr>
<tr>
<td>B. Maternal responsiveness 5 mo.</td>
<td>.43**</td>
<td>.16</td>
<td>6.79**</td>
<td>6.99**</td>
</tr>
<tr>
<td><strong>Symbolic Play</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Maternal responsiveness 13 mo.</td>
<td>.25</td>
<td>.05</td>
<td>1.79</td>
<td>2.73*</td>
</tr>
<tr>
<td>B. Maternal responsiveness 5 mo.</td>
<td>.44**</td>
<td>.08</td>
<td>3.08*</td>
<td>3.08*</td>
</tr>
<tr>
<td><strong>Language Comprehension</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Maternal responsiveness 13 mo.</td>
<td>.25</td>
<td>.05</td>
<td>1.92</td>
<td>1.92</td>
</tr>
<tr>
<td>B. Maternal responsiveness 5 mo.</td>
<td>.17</td>
<td>.02</td>
<td>.80</td>
<td>.80</td>
</tr>
</tbody>
</table>

Note. *$p < .05$; **$p < .01$
language comprehension was never a significant criterion. Mothers' education related to their total responsiveness, $r = .33$, $p < .05$, as expected (Goldberg et al., 1989); however, the same patterns of results, in terms of magnitude and significance levels, obtained when maternal education was entered first into separate follow-up regression analyses, and so maternal responsiveness per se mattered to outcome over and above education.

**CONCLUSIONS**

This study was designed to assess the predictive validity of two kinds of maternal responsiveness in early infancy—responsiveness to nondistress and distress at 5 months—for multiple domains of infants' later cognitive development—attention span, symbolic play, and language comprehension at 13 months. A higher level of maternal responsiveness in total did not predict higher child ability in all areas. Instead, individual variation in certain child abilities reflected individual variation in mothers' responsiveness to certain infant activities. The predictive findings demonstrated a clear effect of maternal responsiveness to infants' nondistress activities, but not distress, for the development of infant attention span and symbolic play. These findings lead to a differentiated perspective on the ways particular parenting experiences might foster specific abilities in young children (Bornstein, 1995). Although the overall effect sizes were modest, the findings are noteworthy because specific predictive relations obtained over developmental discontinuities that characterize infancy (see Emde, Gaensbauer, & Harmon, 1976; Fischer, 1980). Certainly responsiveness is embedded in an ongoing complex of caregiver social (e.g., Bell & Ainsworth, 1972; Bradley, Caldwell, & Elardo, 1979; Coates & Lewis, 1984; Lewis & Goldberg, 1969) and didactic activities (e.g., Bornstein, 1989b; Riksen-Walraven, 1978), which are themselves growth fostering. However, responsiveness in mothers predicted variation in child cognitive abilities independent of maternal education; Crockenberg (1983), too, found that maternal responsiveness (as measured by self-report) at 3 months predicted the Bayley Mental Development Index at 21 months even when maternal education was partialled. These findings confirm that relations among specific types of maternal responsiveness and specific childhood competencies reflect factors associated with parenting activities per se, and are not solely mediated by whatever contemporaneous general environmental stimulation mothers may offer. As isolated here, maternal responsiveness to infant nondistress activities accounted for advances in specific domains of child cognition.

Before discussing key facets of the results, we note that the families in this study were relatively restricted in terms of socioeconomic and educational status, and different patterns of results could emerge in mothers (and conceivably in infants) drawn from other socioeconomic groups. Nonetheless, infancy represents a generally crucial period of adjustment for mother and infant (e.g., Bornstein, 1995; Bornstein & Lamb, 1992); the behaviors observed were representative of common mother–infant interactions; and mothers and children were also observed at optimal times providing for optimal assessments of dyadic interaction. Moreover, neither maternal nor infant activities related to SES or employment status, and mothers and infants alike showed considerable variation in their activities.

Our findings raise three questions that may advance thinking about responsiveness and its differential effects. Why does maternal responsiveness to infant nondistress activities specifically predict attention span and symbolic play competence? Attention and symbolic play covaried. The two might both reflect exploratory competence or mastery motivation which itself underlies their predicted common variance (e.g., Hmcr, Speller, & West, 1985; Yarrow et al., 1982). Children's motivation to master their environments is believed to result in longer periods of object exploration (attention) and therefore increased competence in ongoing (symbolic) play (Jennings et al., 1979; Yarrow, McQuiston, MacTurk, Klein, & Vietze, 1983; Yarrow et al., 1982). Furthermore, it has been shown that play activity that continues over time (longer attention duration) is more likely to result in consolidation of information about play objects (Jennings et al., 1979). It is well established that mothers help to shape the patterns which infant and child attention sometimes follow (e.g., Bornstein & Tamis, 1990; Ruff & Rothbart, 1996), so that attentional processes, which are in force at both ages, could
carry their part of the shared variace. Specifically, responsiveness of environmental stimulation has been shown to influence selective attention and persistence, which reflect a motivation to learn about or master one's surroundings (Yarrow et al., 1982). Of course, mothers were present and engaged with their children during the 13-month assessment, and children have been shown to act in more and higher levels of symbolic play when in the presence of their mothers (e.g., Bornstein et al., 1996; O'Connell & Bretherton, 1984; Slade, 1987). It could be, therefore, that mothers who are responsive to their infants' nondistress behaviors also facilitate sophisticated play. Children engage in higher levels of exploration and play as a reflection of perceived maternal emotional availability, not mere physical availability; that is, mother must interact to exert an effect on child play (Sorce & Emde, 1981).

Relatedly, why does maternal responsiveness to infant nondistress not predict language competence? Bates, Benigni, Bretherton, Camaioni, and Volterra (1979) referred to the onset of communicative intentions and conventional signaling as the "First Moment" in language which does not occur until approximately 9–10 months old. At this time, infants show increased receptiveness to the communicative intent of others and intentionality of their own communications. This suggests that infants younger than 9 months may not recognize such conventional aspects of communication, a realization that is important to further gains in understanding (as well as producing) mature language. Recently, Baumwell, Tamis-LeMonda, and Bornstein (1997) found that mothers' verbal responsiveness to their 9-month-olds indeed predicted children's language comprehension at 13 months (see also Ho, 1987).

Together, these differential predictive associations could also be explained by assuming that maternal responsiveness in the first year exerts effects on attachment security that positively influence aspects of exploration, including attention and sophistication in play, but that secure base effects do not necessarily (or yet) generalize to language. The attention and play measures also both derived from the play observation, whereas the language measure derived from an interview; it could be that shared method variance helps to explain the differential prediction of attention and play vs. language. This methodological explanation loses force, however, because mothers contributed responsiveness data and also provided the data on their children's language; if anything, then, one would expect shared source variance to contribute to covariation between responsiveness and children's language scores.

Finally, why does maternal responsiveness to infant nondistress, but not to infant distress, affect children's cognitive growth? Mothers in this study produced a limited range of responsiveness to distress, indeed they responded very frequently. Given its theoretical significance (Bowlby, 1969), then, in the absence of longer observation times in more diverse samples, the potential influences of responsiveness to distress should not be dismissed. The question of effects of maternal responsiveness to infant nondistress, however, returns us to arguments concerned with direct vs. indirect effects of responsiveness. The observed differential effectiveness of the two responsiveness types at 5 months to different outcomes at 13 months tends to support "specificity" relations in the predictive validity of maternal interaction styles (Bornstein, 1989b, 1995; Bornstein & Tamis-LeMonda, 1990; Wachs & Gruen, 1982). These data appear to modify the view that responsiveness constitutes a generalized learning mechanism for infants. Instead, a specific type of responsiveness predicted specific child abilities. If maternal responsiveness generically mattered, then the nondistress-distress distinction would presumably not be critical, and responsiveness would directly inculcate feelings of generalized expectancy or self-efficacy and control in infants that would contribute to generic competencies (Lewis & Goldberg, 1969; Watson, 1985), promote self-regulation or motivation and persistence in children to facilitate attention and learning (Sigman, Cohen, Beckwith, & Topinka, 1987; Spangler, Schieche, Ilg, Maier, & Ackermann, 1994), or strengthen children's sense of security and so facilitate acquisition of information and success at problem solving (Matas et al., 1978). But, responsiveness to infant distress appeared not as effective at promoting cognition as responsiveness to infant nondistress.

Descriptively, infants vocalized, looked, or touched on average in nearly four-fifths of sam-
pled observation periods, providing their mothers more than ample opportunity to be responsive. At less than one-third a rate of responsiveness on average, however, mothers’ responsiveness to infant nondistress activities was circumscribed. Mothers in this sample were, by contrast, uniformly and highly responsive to infant distress. It could be that high levels of responsiveness to distress (a presumed foundation of mother–child security) constitute a gate that permits the function and effectiveness of responding to infant nondistress. It could also be that responsiveness covaries with maternal characteristics: Responsive mothers might be those who are more knowledgeable about child development or more sensitive to the developmental needs of their infants (responsiveness at 13 months was consistently and positively associated with 13-month child measures) (e.g., Pederson, Moran, Sitko, Campbell, Ghesquire, & Acton, 1990). Responsiveness is also associated with dyadic constructs like attunement and intersubjectivity (e.g., Stern, 1985; Trevarthen & Hubley, 1978): Responsive mothers might be more aware of their infant’s perspective and those mother–infant dyads more in tune with one another. Nondistress responsiveness as a dyadic construct could also provide caregivers and children with opportunities to learn about one another in cognitive promoting situations and thereby foster child mental development—in adults to structure experiences to enhance their informativeness, and in infants to learn. Of course, maternal responsiveness to infant distress presumably has its own consequences for children, some of which are noncognitive (e.g., Beckwith, Cohen, Kopp, Parmelee, & Marcy, 1976; Bell & Ainsworth, 1972).

Further disambiguating these different possible pathways of effects presents a challenge to future research. As noted, the lack of an association between maternal responsiveness and language comprehension may reflect an age effect, or a limitation in not differentiating verbal vs. nonverbal nondistress activities in the infant and verbal vs. nonverbal responses on the part of the mother. The development of language comprehension in the child may specifically turn on mother–infant verbal exchanges, and analyses designed to assess these more specific relations are warranted (see Baumwell et al., 1997). This study also divided maternal reactivity between responsiveness to nondistress and distress actions on the part of the infant. The division of maternal responsiveness into even finer gradations (degree of appropriateness, magnitude of response, and so forth), modalities (touching, vocalizing, looking, and so forth), as well as functions (stimulating, caregiving, and so forth) may prove useful (e.g., Bornstein et al., 1992). Finally, the timing of mothers’ responsiveness to infants’ provoking behaviors could be critical. How does it matter between mothers’ responding while their infants are still engaged in vocalizing or looking vs. waiting until their infants pause or have completed an action? We are at present pursuing these refinements in the infant and responsiveness on the part of mother in new cohorts.

The findings reported here support a multivariate and transactional view of specificity in mother–infant interactions across the second half-year of the infant’s life. Theoreticians and researchers have long believed that the child’s earliest interactive experiences affect later development, and the importance and pervasiveness of infant effects on caregivers are generally recognized, but not as well articulated. This study argues that specifying infant activity, maternal responsiveness, and child effect will lead to a greater understanding of the dynamics of early childhood socioemotional and mental growth.

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Footnote

1. A separate sample of mothers of 5-month-olds (n = 10) was observed twice, one week apart, for purposes of measuring short-term stability of responsiveness. Mothers showed significant stability of responsiveness to infant nondistress, r = .54, p = .05. Most mothers were uniformly responsive to
their infants' distress, however, precluding an assessment of short-term stability.

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