

## 7. Early mother-infant interaction and quality of attachment in preterm infants

### Abstract

This study focuses on the relationship between early mother-infant interaction and the quality of attachment in preterm infants. Interactive behaviors of a group of 41 mother-preterm infant pairs were observed at home at 6, 9 and 12 months of age. These behaviors were then related to quality of attachment at 12 and 18 months. Analysis of the relationships between early mother-infant interaction and Strange Situation classifications of attachment security revealed strong effects for maternal sensitive responsiveness, as well as level of activity and intrusiveness. The relationships found were generally in agreement with attachment theory. However, the strength of the relationships depended upon the age at which quality of attachment was assessed. Infant characteristics appeared also to be related to quality of attachment, but only at 12 months.

Maternal sensitivity or sensitive responsiveness<sup>1</sup> is viewed by attachment theorists as the central feature of mother-infant interactions enhancing the development of a secure attachment relationship (Ainsworth, Blehar, Waters & Wall, 1978; Bretherton, 1985). Conversely, insecure attachments are thought to develop as a function of the mother's insensitivity, that is her tendency to neglect her infant's signals or to interpret them incorrectly, and to respond inconsistently and inadequately.

Two different patterns of maternal insensitivity have been identified in the literature: a hostile, intrusive pattern and an inactive, uninvolved pattern (Ainsworth et al., 1978; Belsky, Rovine & Taylor, 1984; Crittenden, 1981; Isabella & Belsky, 1991; Lewis & Feiring, 1989; Lyons-Ruth, Connell, Zoll, & Stahl, 1987; Malatesta, Culver, Tesman & Shepard, 1989; Smith & Pedersen, 1988). An inactive, uninvolved mother appears to have a different impact on mother-infant attachment than a hostile intrusive mother (for a review see Cassidy & Berlin, 1994). The hostile, intrusive pattern of maternal behavior was found to be related to an insecure-avoidant attachment relationship. The inactive, uninvolved pattern has been related to an insecure-resistant attachment relationship (Belsky et al., 1984; Bohlin, Hagekull, Germer,

---

<sup>1</sup> In the literature the terms 'sensitivity' and 'sensitive responsiveness' are often used interchangeably. Sensitivity refers mainly to the mother's *attitude*: for example, is the mother able to view the infant as an individual in its own right? Sensitive responsiveness, on the other hand, refers to the mother's interactive *behavior*: does the mother respond adequately, contingently and promptly to the infant's signals?

Andersson & Lindberg, 1989; Isabella & Belsky, 1991; Lyons-Ruth et al., 1987).

Many researchers have predicted a greater incidence of insecure attachments in the preterm population than in the normal full-term population. Several reports have demonstrated that during the neonatal period and throughout the first year of life preterm infants are more passive and have problems regulating their arousal than full-terms. Preterm infants are prone to minimal attentiveness, less smiling and vocalizing, more gaze aversion, and fretting than full-term infants in interactions with their mothers (Barnard, Bee & Hammond, 1984; Beckwith & Cohen, 1981; Brown & Bakeman, 1980; Crawford, 1982; Crnic, Ragozin, Greenberg, Robinson & Basham, 1983; DiVitto & Goldberg, 1979; Field, 1977, 1982; Field, Dempsey & Shuman, 1981; Malatesta, Grigoryev, Lamb, Albin & Culver, 1986). While preterm infants are less alert, active and responsive, their mothers appear to be more active than the mothers of full-term infants in initiating and maintaining interaction, showing heightened levels of stimulation throughout the first year (Bakeman & Brown, 1980; Beckwith & Cohen, 1981; Crawford, 1982; Crnic et al., 1983; Field, 1977, 1979). The effects of this heightened stimulation, however, may be aversive. Field (1987; Field et al., 1981), for example, interpreted the mothers' high level of activity as overstimulating, intrusive and controlling. Their behavior was seen as inadequate and insensitive, because the high levels of activity frequently led to more gaze aversion and less attention in face-to-face interactions on the part of the preterm infant.

Given what is known about the development of secure attachment relationships in full-term infant-mother dyads, we

might expect mothers' greater activity or intrusiveness to be associated with an increased risk of insecure (avoidant) attachment in preterm infants. However, the results of studies investigating the impact of preterm birth on the quality of attachment do not support this prediction. The majority of these studies have found that preterm infants are not significantly more often insecurely attached than normal, healthy full-terms (Brown & Bakeman, 1980; Easterbrooks, 1989; Field, Dempsey, & Shuman 1981; Frodi & Thompson, 1985; Goldberg, Perrotta, Minde & Corter, 1986; Macey, Harmon & Easterbrooks, 1987; Rode, Chang, Fisch & Sroufe, 1981). This finding is surprising given the many well-documented differences in mother-infant interaction between these two groups of infants and the present authors were led to consider some possible explanations. One explanation could be that Field's interpretation that high levels of maternal stimulation represent overstimulation and intrusiveness is wrong. A recent alternative view suggests that the unique style of preterm dyads (i.e., high level of maternal stimulation and activity) represents an appropriate adaptation to the special needs of the preterm infant (Bakeman & Brown, 1980; Goldberg & DiVitto, 1983; Landry, Chapieski & Schmidt, 1986; Stevenson, Roach & Leavitt, 1992). Heightened maternal stimulation is an adequate and adaptive response to a passive, unresponsive preterm infant.

These contrasting interpretations can be evaluated through longitudinal study of the relationship between mother-infant interaction and the later security of attachment within a sample of preterm infants. Three studies have attempted to predict later security of attachment from

observations of mother-preterm infant interactions (Goldberg et al., 1986; Mangelsdorf, Mann & Plunkett, 1991; Wille, 1991). In these studies either prediction of quality of attachment was poor (Mangelsdorf et al., 1991) or significant relationships found to some extent contradicted findings in studies with normal, healthy infants (Goldberg et al., 1986; Wille, 1991). Goldberg et al., for example, reported that mothers of infants who were classified as marginally secure ( $B_1$  or  $B_4$ ) were rated least responsive in comparison to mothers of insecure (A or C) and secure infants ( $B_2$  or  $B_3$ ). The latter groups were rated, as predicted from the normative data, highly responsive.

There are, however, some methodological limitations in these studies. One problem is that levels of maternal activity and intrusiveness were not measured directly. Further, it is likely that, especially in the Goldberg et al. study, scoring of maternal behavior was not independent of infant behavior. Finally, Wille (1991) did not carry out separate analyses of the relationship between mother-infant interaction and attachment for the preterm group and the full-term group.

A second explanation, suggested by Goldberg et al. (1986), could be that the sensitivity rating scales used in their study were developed for healthy full-term populations and do not appropriately score some interactive features for the preterm dyads. Interaction patterns that receive low ratings on these scales are associated with later insecure attachment in full-term infants, but this association may not apply to preterm infants. A third explanation for studies finding that prematurity has little impact on security of attachment could be that preterm infants are treated as a homogeneous

group. For example, Plunkett, Meisels, Stiefel, Pasick, and Roloff (1986) found significantly more insecurely-resistant attached infants (36.4%) than expected in a sample of preterm infants with respiratory illness. It seems that the impact of conditions such as preterm birth on the quality of attachment is greater when conditions are more extreme (e.g., severe medical illness). Another example of such an extreme condition could be early problems in postural control, which frequently affect preterm infants, in particular those with very low birth weights or those who suffered from growth retardation during gestation (Aylward, 1982; Gorga, Stern & Ross, 1985; De Groot, Van der Hoek, Hopkins & Touwen, 1992). Adequate postural control in sitting and head control are important factors for a range of developmental achievements, for instance the coordination of attention and the development of visually guided reaching (e.g., Fogel, Dedo & McEwen, 1992; Van Wulfften Palthe & Hopkins, 1984). Lack of postural control, typically expressed in terms of hypo- and hypertonia, may lead to difficulties in exploration and learning. It may also have a negative influence on the quality of mother-infant interaction. For example, infants demonstrating postural problems, such as hyperextension (i.e., sudden, violent stretching due to problems in the regulation of muscle power), may be difficult to handle, be overaroused and irritable. Moreover, infants who have little control over their muscles may show less consistency in their behavior, they may make less eye contact with the mother and their behavior may be more difficult to interpret (see also Kalverboer, 1988, 1995; Kalverboer & Wijnroks, 1992; McGehee & Eckerman, 1983). Consequently, it will

be more difficult for mothers to respond sensitively to the infants' behavior and emotional state. It can be hypothesized that infants who show lasting problems in postural control are at risk of developing an insecure attachment relationship.

The present study aimed to further assess the impact of prematurity on mother-infant interaction and later attachment. It investigated the relationship between several aspects of maternal interactive behavior, including sensitive responsiveness, level of activity and intrusiveness, and the quality of infant-mother attachment, within a sample of preterm infants. Several questions were examined. First, is maternal behavior related to later attachment? And, if so, does the relationship differ from that predicted by attachment theory? If Field's interpretation is correct, attachment theory and empirical findings would lead us to expect a high level of maternal activity to be associated with later insecurity. If, on the other hand, Goldberg's interpretation is correct, we would expect a high level of maternal activity and stimulation to be related to later security. Moreover, according to Goldberg, it would be difficult to predict quality of attachment from maternal sensitive responsiveness.

Second, what role do infant interactive characteristics play in the prediction of later attachment? Although much depends upon the caregiver, who must be sensitive to the infant's emotional signals, the infant must be capable of presenting clear emotional displays for the caregiver to interpret its needs accurately (Sorce & Emde, 1982). Because preterm birth consistently affects infant interactive capacities and since these capacities may influence maternal behavior, this study inves-

tigated the contribution of infant behavior to quality of attachment. We expected infant responsiveness and positive emotions to be related to later attachment.

Third, what is the impact of early problems in postural control on later quality of attachment? We did not expect preterm birth to have a general effect on quality of attachment, but we did expect early problems in postural control to be related to a later insecure mother-infant attachment relationship.

## Method

### *Subjects*

This study formed part of the large collaborative follow-up study of infants at risk, the Dutch experimental longitudinal project (ELO)(Koops et al., this volume). The data presented here are from a sample of premature infants who were born at Groningen University Hospital (Obstetrical Department) after pregnancies of less than 37 weeks. The sample consisted of 66 mother-infant dyads, 25 of which participated in an intervention program. This chapter only reports the data from the remaining 41 dyads, which were used as a control group.

All 41 infants remained in the Neonatal Intensive Care Unit (NICU) of the Neonatology Department for at least 24 hours after birth. Additional criteria were: singleton birth; Dutch-Caucasian extraction; absence of major identifiable abnormalities or very severe medical complications, such as intraventricular hemorrhages (grade III and IV) and hydrocephalus; hospitalization for less than three months after term date; no adverse social or family conditions, and family resi-

dence within 150 km of the University Hospital. At three months of age, none of the infants were classified as 'abnormal' on the basis of a neurological examination. The primary caregivers throughout the project period were all mothers. Only four mothers (8.5 %) refused to participate, out of the 47 contacted. Two dyads dropped out of the study.

The average birth weight of the preterm sample was 1,723 g (range= 690-3,210 g). The average gestational age was 32 weeks (range= 25.6-36.6 weeks). The infants were hospitalized for an average of 55 days (range=8 to 139 days). Sixteen infants (39%) were girls. Seven infants were diagnosed with respiratory distress syndrome (RDS) and five with bronchopulmonary dysplasia (BPD). Twelve infants were small-for-gestational age (SGA), with a birth weight below the 10th percentile on standardized growth curves (Kloosterman, 1970). Only one of the mothers was single at the start of the study. The age of the mothers ranged from 18 to 41 years (mean = 27 years). The mother's education ranged from elementary to academic. The median score on the level of maternal education, was 2 on a 5-point scale which is representative of the community at large.

### *Design and procedures*

All dyads were visited at home when the infant reached the age of 6, 9 and 12 months (corrected for prematurity). At 6 months of age, infants were first observed for 15 minutes while they carried out an exploration task. The infant was seated in a baby car-seat before a small table. Various sets of play objects were on the table within the infant's reach. The camera was

located in front of the infant so that the infant's face, trunk and arms were visible.

After the exploration task, mothers and infants were videotaped while engaged in a five-minute, semi-structured play session. During these observations, the mother sat at the opposite side of the table from the infant to enable eye contact. She was asked to play with her infant using a standard set of ten age-appropriate toys. She was free to choose the objects, the length of time the infant played with each object or combination of objects, and the tempo at which it played. She was also free to end the session and to pick up the infant if it became upset and cried. This play session was repeated at 9 and 12 months. The positioning of the table, infant chair and camera was identical at each measurement point. Appointments were made in accordance with the mother's judgement that her baby would be alert. Mother-infant observations were completed for all dyads. Within a week of the final home visit at 12 months, each dyad was seen in the Ainsworth and Wittig (1969) Strange Situation in order to assess the quality of the infant-mother attachment relationship. The Strange Situation was repeated at 18 months of age.

### *Interaction measures*

Behavioral items used in coding were derived from previous research on mother-infant interaction (see also, Butcher, Kalverboer, Minderaa, Van Doormaal & Ten Wolde, 1993; Wijnroks, 1994). Maternal behaviors were rated on one 9-point sensitivity scale (Ainsworth et al., 1978) and nine 5-point rating scales which measured maternal responsiveness, level of activity, quality of handling, level

of engagement, frequency of vocalizations, frequency of positive emotional expression, timing, non-directiveness, and non-interference. Infant interactive behavior was rated on each occasion on six different 5-point rating scales which measured frequency of looking at the mother's face, duration of positive emotional state, peak positive, duration of negative emotional state, peak negative, and responsiveness.

#### *Scoring mother-infant interactions*

The videotapes were scored by the first author and a psychology graduate, who was blind to the hypotheses of the study and had no information on characteristics of the mother or infant. For the data at 6 and 12 months, half of the observations were conducted by the first observer, the other half by the second observer. The dyads were randomly assigned to one of the observers. To avoid halo-effects, the same observer did not observe the same dyad at both ages. The recordings at 9 months were scored six months later than the 6- and 12-month tapes, and only by the second observer. It is important to state that in scoring infant and maternal behavior the intention was to rate the behavior of each partner as independently as possible. That is, raters were instructed not to consider an infant's reaction to its mother's intervention in order to prevent confounding (see also Schneider Rosen and Rothbaum, 1993). In the same way, an infant's behavior was rated without considering its mother's responsiveness and sensitivity. An infant's behavior had to be taken into account occasionally, to obtain a reliable estimate of its mother's behavior, but the ratings were to be as

independent of the infant's characteristics as possible.

Fifteen percent of the dyads at 6 months and 25% of the dyads at 9 and 12 months respectively were scored by both observers to provide post hoc reliability checks. Interrater agreement was 100% for all scales if a difference of one scale point is accepted. In general, interrater reliability was sufficient to excellent ( $r = .78$  to  $.92$ ), except for one infant rating scale at 9 months, namely responsiveness ( $r = .50$ ). The unreliability was probably caused by observer drift and this particular scale was not used in the statistical analyses.

#### *Data reduction*

To reduce the number of interaction variables for analysis, behaviors were re-grouped to create three major clusters. The first cluster, *sensitive responsiveness*, was calculated by summing the unweighed scores on the scales 'sensitivity', 'responsiveness' and 'timing' (Cronbach's alphas: .88, .87 and .89 for 6, 9 and 12 months respectively). This measure was thought to reflect the mother's responsiveness, her sensitivity and the contingency of her response to the infant's emotional displays and changes in gaze behavior. The second cluster, *involvement*, was calculated by summing the unweighed scores on the scales 'level of engagement', 'frequency of vocalization', and 'frequency of positive emotional expression' (Cronbach's alphas: .82, .84 and .86 for 6, 9 and 12 months respectively). This measure refers to the extent to which the mother actively attempted to stimulate her infant's development by offering and demonstrating objects and by talking to and smiling at the infant.

The third cluster, *non-intrusiveness*, was created by summing the unweighed scores on the scales 'quality of handling', 'non-interference', and 'non-directiveness' (Cronbach's alphas: .85, .88 and .79 for 6, 9 and 12 months respectively). This measure refers to the degree of intensity with which the mother stimulated her infant. It was expected to correspond to the negative, interfering pattern of maternal rejection previously identified in the literature (Crittenden, 1981; Isabella, 1993). The results of a principal components analysis supported the validity of our clustering (Wijnroks, 1994).

To reduce the total set of infant interactive variables, the unweighed scores were summed on the scales 'duration of positive emotional state' and 'peak positive' to create a new variable, *positive behavior* (correlations: .69, .78, .56 for 6, 9, and 12 months respectively). A similar procedure was followed to create the variable *negative behavior*, i.e., the unweighed scores were summed on the scales 'duration of negative emotional state' and 'peak negative' (correlations: .60, .65, .66 for 6, 9, and 12 months respectively).

### *Infant-mother attachment*

Dyads were videotaped in the Ainsworth and Wittig (1969) Strange Situation when the infants were 12 months old and again when they were 18 months old. The Strange Situations were scored by the author and three female observers, all of whom were trained by Dr. D. van den Boom, who received her licence to train from Dr. A. Sroufe at the Institute of Child Development in Minnesota. The three observers were blind to the hypotheses of the study and had no access to the

data already collected on the dyads they were observing and scoring. The first of the three female observers scored only the sessions at 12 months, the second scored only the sessions at 18 months, while the third scored sessions at both ages. The first author also scored sessions at both ages.

The percentage of agreement for the three broad attachment classifications, computed on independent coding of all tapes, was above 90% for all observers (Cohen's Kappas averaged .79 and .77 for 12 and 18 months respectively). Disagreements were resolved by consensus. At 12 months of age, one infant was not classifiable in one of the three main categories. At 18 months of age, five infants were excluded from analysis. Two of the five showed a mixture of avoidant and resistant behavior during the reunion episodes with the mother and were therefore not classifiable. The videotape of one 18-month-old infant was lost. One infant was observed in the Strange Situation with only the father, while all other observations were with the mother. One infant was not classifiable in one of the three main categories.

### *Measures of postural control*

A global rating of the quality of the infant's posture (head, trunk and arms) was given, using two 3-point scales. The first scale, called *control of the head and trunk*, indicated whether the infant had adequate postural control of its head and trunk. An upright sitting position with the head held steady and the chin lifted off the chest was considered an adequate posture. Sitting partly to one side, or not fully upright but with the head up and forward, was considered less adequate or

partly inadequate. Sagging completely to one side, needing the full support of the back of the chair with the chin against the chest, was considered inadequate and was assumed to indicate signs of hypotonia or floppiness. The second rating scale was called *hyperextension*. It scored signs of hyperextension or hypertonia and ranged from no signs of hyperextension to clear signs of hyperextension. 'No signs of hyperextension' was scored when the infant explored objects with both hands in front of the body most of the time, the arms were flexed, and no signs of stretching or bouncing the back against the chair were observed. 'Small or minor signs of hyperextension' was scored when both arms were held alongside the body, the elbows were extended, and no indication of backward stretching of the body was observed. 'Clear signs of hyperextension' was scored when the infant stretched its body backward and lifted its arms in a sideway and upward direction from time to time.

The videotapes were scored by a trained psychologist who had no background information on the infants or the aims of the study. Interobserver reliability was calculated using Cohen's Kappa (posture: .89 and hyperextension: .88). Complete data were obtained for 40 infants. The exploration task could not be scored for one infant because of persistent fretting.

The majority of the infants had no problem controlling their head and trunk and showed no signs of hyperextension. Specifically, 24 infants (60%) had adequate control of the head and trunk (score 1), and 16 showed minor or clear signs of hypotonia. Twenty three infants (57.5%)

showed no signs of hyperextension, while 17 (42.5%) showed at least some signs of hyperextension. As only a few infants showed clear signs of postural control problems, we decided to combine the groups with small and clear signs, and to create two new groups: one with problems in postural control and one without.

## Results

### *Distribution and stability*

As can be seen in Table 1, at 12 months 32 (80%) infants were rated as secure, seven (17.5%) as insecure-avoidant, and one (2.5%) as insecure-resistant. The distribution at 18 months was similar, with 30 (78.9%) infants rated as secure, six (15.8%) as insecure-avoidant, and none as insecure-resistant. The proportions of secure and insecure attachments do not differ from those reported in other studies of preterm-mother attachment (Easterbrooks, 1989; Frodi & Thompson, 1985; Goldberg et al., 1986).

However, our distributions of secure and insecure attachments at 12 ( $\chi^2=3.96$ ,  $df=1$ ,  $p<.05$ ) and 18 months ( $\chi^2= 5.32$ ,  $df=1$ ,  $p<.02$ ) differed from those predicted on the basis of available normative data (see meta-analysis of Van IJzendoorn & Kroonenberg, 1988). At both ages our sample contained a greater number of securely attached infants (65%) and fewer insecurely attached infants (35%) than the normative studies had led us to expect. Twenty-five infants (67.6%) out of a total of 37 appeared to have the same classification at 12 and 18 months of age.



Table 1. Distribution of attachment classifications at 12 and 18 months.

		18 months				
12 months	Secure	Insecure A	Insecure C	Missing	Total	
Secure	23	4		5	32	
Insecure A	5	2			7	
Insecure C	1				1	
Missing	1				1	
Total	30	6	0	5	41	

Twenty-five infants (67.6%) out of a total of 37 appeared to have the same classification at 12 and 18 months of age. Only two of the infants classified insecure-avoidant (25 %) at 12 months of age received the same classification at 18 months. One insecure-resistant infant at 12 months became securely attached at 18 months. Twenty-three infants were securely attached at both ages (79%). When correcting for chance classification (Cohen's kappa), agreement between the attachment classifications at 12 and 18 months hardly exceeded chance level ( $\kappa=.11$ ).

The following analyses were used to determine whether differences in quality of attachment were related to the quality of early mother-infant interaction. Multivariate analysis of variance and then univariate analyses were conducted at each age point to examine the relationship between mother-infant interactive behavior and attachment classification. A second set of analyses examined the impact of postural control problems on the quality of attachment.

### *Mother-infant interaction and attachment classification*

As the number of insecurely-resistant attached infants at 12 months was too small, a single insecure group was created consisting of infants who received either an A or a C classification.

### *Maternal ratings*

Table 2 shows the mean maternal ratings and standard deviations for the secure and insecure groups at 12 and 18 months. The differences in mean scores for sensitive responsiveness, non-intrusiveness and tempo were in line with attachment theory and with Field's view that high levels of maternal activity represent insensitive behavior. In general, the mothers of securely attached infants scored higher on sensitive responsiveness and non-intrusiveness and lower on tempo than the mothers of insecurely attached infants. Significant multivariate effects on maternal ratings were found for attachment classification at 18 months. Analyses revealed significant effects at 6 months,  $F(4,31)=3.09$ ,  $p<.05$ , and at 12 months,  $F(4,31)=3.99$ ,  $p<.01$ .

Table 2. Mean maternal ratings by age and attachment group.

Scale	12 MONTHS		18 MONTHS	
	Secure (N=32)	Insecure (N=8)	Secure (N=30)	Insecure (N=6)
6 months				
Responsiveness	11.3 (3.7)	8.1 (2.7)*	1.2(3.9)	8.4 (3.8)
Non-intrusiveness	9.6 (2.9)	7.0 (2.7)*	9.4(2.8)	6.3 (2.6)*
Involvement	8.8 (2.8)	8.9 (2.7)	8.9(2.9)	9.4 (3.3)
Tempo	2.7 (0.9)	3.1 (0.8)	2.6(0.8)	3.8 (0.9)**
9 months				
Responsiveness	10.0 (3.4)	11.1 (3.0)	10.6(3.3)	11.0 (4.2)
Non-intrusiveness	8.8 (3.0)	8.3 (2.1)	9.2(2.8)	7.5 (2.2)
Involvement	9.0 (2.9)	9.8 (2.6)	9.0(2.9)	10.8 (2.8)
Tempo	3.0 (1.1)	3.3 (0.8)	2.9(1.1)	3.8 (0.8)*
12 months				
Responsiveness	11.9 (2.9)	9.5 (1.5)*	12.3(2.6)	8.2 (2.2)***
Non-intrusiveness	9.1 (2.2)	8.1 (1.9)	9.5(1.9)	6.7 (2.8)**
Involvement	9.8 (2.4)	9.6 (3.2)	9.8(2.7)	9.6 (3.1)
Tempo	2.9 (0.8)	3.3 (0.9)	2.9(0.8)	3.5 (1.3)

Note: Standard deviations are in parentheses.

Responsiveness= Sensitive responsiveness. \*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$

Univariate analyses indicated that at 6 months the primary contributions to this effect were from non-intrusiveness,  $F(1,34)=6.67$ ,  $p < .02$ , and tempo,  $F(1,34)=9.67$ ,  $p < .004$ .

At 12 months, sensitive responsiveness,  $F(1,34)=12.46$ ,  $p < .002$ , and non-intrusiveness,  $F(1,34)=9.36$ ,  $p < .004$ , were the two scales for which the univariate analysis showed a significant effect. The mothers of securely attached infants scored high on non-intrusiveness at 6 months and at 12 months they scored low on tempo and high on sensitive responsiveness. None of the multivariate analyses was significant for attachment at 12 months.

### *Infant ratings*

The four infant ratings, i.e., frequency of looking at the mother's face, positive behavior, negative behavior and responsiveness, were subjected to a multivariate analysis of variance at each of the three age points. The findings gave a measure of support to our second hypothesis that infant interactive behavior would be related to later attachment. The only significant effect was found for infant behavior at 12 months,  $F(4,35)=3.21$ ,  $p < .03$ , when responsiveness differed significantly between the groups,  $F(1,38)=8.13$ ,  $p < .01$ . As predicted, infants in the secure group received a higher mean rating (5.7,  $sd=1.8$ ) than infants in the insecure group (3.8,  $sd=1.4$ ).

## Postural control

Our hypothesis that problems in postural control would be related to insecure attachment was partly confirmed by the data. In a 2 (absence/presence) by 2 (secure/insecure) chi-square analysis, a significant relationship was found between 'observed control of the head and trunk' and attachment at 18 months ( $\chi^2=6.62$ ,  $df=1$ ,  $p<.01$ ). Infants who early on had problems controlling their head and trunk were more likely to be insecurely attached at 18 months (38.5%) than infants who had no such problems (4.5%). No significant relationship was found between hyperextension problems and quality of attachment.

## Discussion

Our data confirm the results of other preterm studies in finding that, in spite of early interactional problems, preterm infants are able to form secure attachments to their mothers. In line with Bowlby's attachment theory (1969) and Sameroff and Chandler's transactional model (1975), we conclude that the mother-infant relationship is strongly biologically buffered from perturbations in early development.

Our study not only demonstrated that preterm infants are well able to form secure attachment relationships with their mothers but, more importantly, it also found that a larger number of infants was securely attached than expected on the basis of data from normative studies. It may be that the birth of a preterm infant activates unexpected psychological resources within the caregiving environment. Perhaps the mother's sensitive re-

sponsiveness increases when she is confronted with a vulnerable child needing extra care. Illustrative in this case is a study conducted by Goldberg et al. (1986) which found that the largest number of secure attachments was observed in families with seriously ill infants. This generally attests to the ability of mothers to adapt to, and compensate for, their infant's limitations. Further support for our view is offered by a number of studies showing that, despite their high activity level, mothers of preterm infants are at least not *less* responsive to their infant's signals and needs for comfort and security than mothers of full-term infants (Green, Fox & Lewis, 1983; Stevenson et al., 1992). Only if a condition is so extreme that it pushes the family system out of balance, for example if the mother has to deal with an infant with postural problems (this study) or if she has an irritable infant and experiences a lack of support from her partner (Van den Boom, 1988; Crockenberg, 1981), it is likely to lead to an insecure attachment.

This study has shown that maternal behavior can provide a basis for predicting quality of attachment in a sample of preterm infants. Prediction was more accurate for attachment at 18 months than at 12 months. Furthermore, we found the same pattern of relationships in our preterm sample as is found in normal full-term populations. Our results contrast with the findings of Goldberg et al. (1986), Mangelsdorf et al. (1991), and Wille (1991) (though these authors measured quality of attachment up to 12 months). The strength of the relationship between maternal sensitive responsiveness and the quality of infant-mother attachment is striking. This relationship is generally in accordance with the tenet of

attachment theory that high levels of maternal sensitivity are related to secure attachment. This implies that preterm and full-term infants do not follow different pathways to security/insecurity, as Mangelsdorf et al. (1991) have suggested. It should be noted, however, that the preterm infants in this study were relatively more healthy and had higher mean birth weights than the infants in the study carried out by Mangelsdorf et al.. Our results do not support Goldberg's interpretation that heightened maternal stimulation is an adequate and adaptive response to a passive, unresponsive preterm infant, in so far as high levels of maternal activity (tempo) were associated with insecurity.

Maternal behavior played a more powerful role than infant behavior in shaping the quality of attachment, a finding which is consistent with the results of studies in clinical samples (e.g., Van IJzendoorn, Goldberg, Kroonenberg & Frenkel (1992). Furthermore, the relatively strong associations between maternal activity, intrusiveness, and attachment confirm in part the results reported by Belsky et al. (1984) and Lewis and Feiring (1989). These authors found that the mothers of insecurely-avoidant attached infants stimulated their children at a very high level compared with the mothers of securely attached and insecurely-resistant attached infants. According to Belsky et al. (1984) the anxious-avoidant pattern of attachment is a *response* to maternal overstimulation. This brings us back to our original question: why are preterm infants not significantly more often insecurely attached to their mothers than full-terms, considering the fact that the mothers of preterm infants are more active in stimulation? One explanation

could be that the differences between mothers of preterm infants and mothers of full-terms in terms of their levels of activity and stimulation are too small to affect the development of the attachment relationship. The somewhat heightened level of activity displayed by mothers of preterm infants does not reflect insensitivity. Indeed, our analyses showed that sensitive responsiveness and tempo were not significantly correlated. Moreover, some studies have shown that the mothers of preterm infants are generally not *less* responsive to their infants' signals and needs for comfort and security than the mothers of full-term infants (e.g., Green, Fox & Lewis, 1983; Stevenson et al., 1992). In studies of normal infants, on the other hand, maternal overstimulation and intrusiveness reflect a very consistent and stable interaction pattern, which will most likely co-occur with a lack of responsiveness. In other words, the pattern reflects a consistently insensitive parenting *attitude*. We suggest that the lack of responsiveness predicted an insecure attachment relationship, while the type of insecurity was predicted by the factor intensity of stimulation or intrusiveness. Furthermore, most studies of preterm infants have shown that the 'typically high' levels of maternal stimulation were usually temporary, contradicting the idea of a stable trait.

Another important finding of our study was that problems in postural control were associated with the development of an insecure attachment relationship. Early postural problems in preterm infants may thus seriously threaten the quality of the mother-infant relationship. The present study and a recent study by Van Beek (1993) are the first to examine the relationship between differences in

postural control among preterm infants and the quality of mother-infant interaction. Further research is needed in this area. In conclusion, a preterm birth in itself may not be a threat to later attachment, because most mothers are able to compensate for their infant's limited interactive capacities. However, this study suggests that early problems in postural control may increase the risk of an insecure attachment.

## References

- Ainsworth, M.D.S., Blehar, M.C., Waters, E. & Wall, S. (1978). *Patterns of attachment: A psychological study of the strange situation*. Hillsdale, NJ: Erlbaum.
- Ainsworth, M.D.S. & Wittig, B.A. (1969). Attachment and exploratory behavior of one-year-olds in a strange situation. In B.M. Foss (Ed.), *Determinants of infant behaviour*. Vol. 4. London: Methuen.
- Aylward, G.P. (1982). Forty-week full-term and preterm neurologic differences. In L.P. Lipsitt & T.M. Field (Eds.), *Infant behavior and newborn risk*. Norwood NJ: Ablex.
- Bakeman, R. & Brown, J.V. (1980). Early interaction: Consequences for social and mental development at three years. *Child Development*, 51, 437-447.
- Beckwith, L. & Cohen, S.E. (1981). Interactions of preterm infants with their caregivers and test performance at age 2. In T.M. Field, S. Goldberg, D. Stern & A. Sostek (Eds.), *High-risk infants and children: adult and peer interactions*. New York: Academic Press.
- Belsky, J., Rovine, M. & Taylor, D.G. (1984). The Pennsylvania infant and family development project, III. The origins of individual differences in infant-mother attachment: maternal and infant contribution. *Child Development*, 55, 718-795.
- Bohlin, G., Hagekull, B., Germer, M., Andersson, K. & Lindberg, L. (1989). Avoidant and resistant reunion behaviors as predicted by maternal interactive behavior and infant temperament. *Infant Behavior and Development*, 12, 105-117.
- Bowlby, J. (1969). *Attachment and Loss (Vol. 1). Attachment*, first edition. London: Hogarth.
- Bretherton, I. (1985). Attachment theory: retrospect and prospect. In I. Bretherton & E. Waters (Eds.), *Growing points of attachment theory and research. Monographs of the Society for Research in Child Development*, 50, 3-35. Chicago: The University of Chicago Press.
- Brown, JB & Bakeman, R. (1980). Relationships of human mothers with their infants during the first year of life: effects of prematurity. In R.W. Bell & W.P. Smotherman (Eds.), *Maternal influences and early behavior*. New York: Spectrum.
- Butcher, P.R., Kalverboer, A.F., Minderaa, R.B., Doormaal, E.F. van & Wolde, Y. ten (1993). Rigidity, sensitivity and quality of attachment: the role of maternal rigidity in the early socio-emotional development of premature infants. *Acta Psychiatrica Scandinavica*, 88, 4-38.
- Crawford, J.W. (1982). Mother-infant interaction in premature and full-term infants. *Child Development*, 53, 957-962.

- Crittenden, P.M. (1981). Abusing, neglecting, problematic and adequate dyads: differentiating by patterns of interaction. *Merill-Palmer Quarterly*, 27, 201-218.
- Crníc, K.A., Ragozin, A.S., Greenberg, M.T., Robinson, N.M. & Basham, R.B. (1983). Social interactions and developmental competence of preterm and full-term infants during the first year of life. *Child Development*, 54, 1199-1210.
- Crockenberg, S.B. (1981). Infant irritability, mother responsiveness, and social support influences on the security of infant-mother attachment. *Child Development*, 52, 857-865.
- DiVitto, B. & Goldberg, S. (1979). The development of early parent-infant interaction as a function of newborn medical status. In T.M. Field, A. Sostek, S. Goldberg & H. Shuman (Eds.), *Infants born at risk*. Holliswood, New York: Spectrum.
- Easterbrooks, M.A. (1989). Quality of attachment to mother and to father: Effects of perinatal risk status. *Child Development*, 60, 825-830.
- Field, T.M. (1977). Effects of early separation, interactive deficits, and experimental manipulations of infant-mother face-to-face interaction. *Child Development*, 48, 763-771.
- Field, T.M. (1979). Interaction patterns of preterm and term infants. In T.M. Field, A. Sostek, S. Goldberg & H.H. Shuman (Eds.) *Infants born at risk*. New York: Spectrum.
- Field, T.M. (1982). Interaction coaching for high-risk infants and their parents. In H.A. Moss, R. Hess & C. Swift (Eds.), *Early intervention programs for infants*. New York: The Haworth Press.
- Field, T.M. (1987). Interaction and attachment in normal and atypical infants. *Journal of Consulting and Clinical Psychology*, 55, 853-859.
- Field, T.M., Dempsey, J.R. & Shuman, H.H. (1981). Developmental follow-up of pre- and postterm infants. In S.L. Friedman & M. Sigman (Eds.). *Preterm birth and psychological development*. New York: Academic Press.
- Fogel, A., Dedo, J.Y. & McEwen, I. (1992). Effect of postural position on the duration of gaze at mother during face-to-face interaction in 3-to-6-month-old infants. *Infant Behavior and Development*, 15, 231-244.
- Frodi, A. & Thompson, R. (1985). Infants' affective responses in the Strange Situation. *Child Development*, 56, 1280-1290.
- Goldberg, S. & DiVitto, B.A. (1983). *Born too soon: Preterm birth and early development*. San Francisco: Freeman.
- Goldberg, S., Perrotta, M., Minde, K. & Corter, C. (1986). Maternal behavior and attachment in low-birth weight twins and singletons. *Child Development*, 57, 34-46.
- Gorga, D., Stern, F.M. & Ross, G. (1985). Trends in neuromotor behaviour of preterm and fullterm infants in the first year of life: A preliminary report. *Developmental Medicine and Child Neurology*, 27, 756-766.
- Greene, J.G., Fox, N.A. & Lewis, M. (1983). The relationship between neonatal characteristics and 3-month mother-infant interaction in high risk infants. *Child Development*, 54, 1286-1296.
- Groot, L. de, Hoek, A. van der, Hopkins, B. & Touwen, B.C.L. (1992). Devel-

- opment of the relationship between active and passive muscle power in preterms after term age. *Neuropediatrics*, 23, 298-305.
- Hoeksma, J.B. & Koomen, H.M.Y. (1991). *Development of early mother-child interaction and attachment*. Doctoral dissertation. Amsterdam: Free University.
- Isabella, R.A. & Belsky, J. (1991). Interactional synchrony and the origins of infant-mother attachment: A replication study. *Child Development*, 62, 373-384.
- Juffer, F. (1993). *Verbonden door adoptie. Een experimenteel onderzoek naar hechting en competentie in gezinnen met een adoptiebaby*. Doctoral dissertation. Amersfoort: Academische uitgeverij.
- Kalverboer, A.F. (1988). Follow-up of biological high-risk groups. In M. Rutter (Ed.), *The power of longitudinal data: Studies of risk and protective factors for psychosocial development*. Cambridge: Cambridge University Press.
- Kalverboer, A.F. & Wijnroks, L. (1992). Early intervention programs focussing on the parent-child system. In H. Nakken, G.H. Van Gemert & T. Zandberg (eds.), *Research on intervention in special education*. Lewiston: The Edwin Mellen Press.
- Kloosterman, G.J. (1970). On intrauterine growth, the significance of prenatal care. *International Journal of Gynecology and Obstetrics*, 8, 895-912.
- Landry, S.H., Chapieski, M.L. & Schmidt, M. (1986). Effects of maternal attention-directing strategies on preterms' response to toys. *Infant Behavior and Development*, 9, 257-269.
- Lewis, M. & Feiring, C. (1989). Infant, mother, and mother-infant interaction behavior and subsequent attachment. *Child Development*, 60, 831-837.
- Macey, T.J., Harmon, R.J. & Easterbrooks, M.A. (1987). Impact of premature birth on the development of the infant in the family. *Journal of Consulting and Clinical Psychology*, 55, 846-852.
- Mangelsdorf, S., Mann, J. & Plunkett, J. (1991). Precursors to attachment: Home observations of extremely-low-birth-weight infants. Paper presented at the biennial meetings of the ISSBD, Minneapolis.
- Meij, J.Th.H. (1992). *Sociale ondersteuning, gehechtheidskwaliteit en vroegkinderlijke competentie-ontwikkeling*. Doctoral dissertation. Nijmegen: Catholic University of Nijmegen.
- McGehee, J. & Eckerman, C.O. (1983). The preterm infant as a social partner: responsive but unreadable. *Infant Behavior and Development*, 6, 461-470.
- Plunkett, J., Meisels, S., Stiefel, G. Pasick, P. & Roloff, D. (1986). The relationship of respiratory illness to preterm infant-parent attachment. *American Journal of Child Psychiatry*, 25, 794-800.
- Sameroff, A.J. & Chandler, M.J. (1975). Reproductive risk and the continuum of caretaking casualty. In F.D. Horowitz, M. Heatherton, S. Scarr-Salapatek & G. Siegel (Eds.), *Review of Child Development Research*, 4, 187-244, Chicago, University of Chicago Press.
- Schneider-Rosen, K. & Rothbaum, F. (1993). Quality of parental caregiving and security of attachment. *Developmental Psychology*, 29, 358-367.

- Smith, P. & Pederson, D.R. (1988). Maternal sensitivity and patterns of infant-mother attachment. *Child Development*, 59, 1097-1101.
- Stevenson, M.B, Roach, M.A. & Leavitt, L.A. (1992). Early channels of mother-infant communication: Preterm and term infants. *Journal of Child Psychology and Psychiatry*, 33, 7, 1193-1204.
- Van Beek, Y.(1993). *The development of early communication in preterm infants*. Doctoral dissertation. Amsterdam: Free University of Amsterdam.
- Van den Boom, D.C. (1988). *Neonatal irritability and the development of attachment: observation and intervention*. Doctoral dissertation. Leiden: University of Leiden.
- Van IJzendoorn, M.H., Goldberg, S., Kroonenberg, P.M. & Frenkel, O.J. (1992). The relative effects of maternal and child problems on the quality of attachment: a meta-analysis of attachment in clinical samples. *Child Development*, 63, 840-858.
- Van IJzendoorn, M.H. & Kroonenberg, P.M. (1988). Cross-cultural patterns of attachment: A meta-analysis of the Strange Situation. *Child Development*, 59, 147-156.
- Wille, D.E. (1991). Relation of preterm birth with quality of infant-mother attachment at one year. *Infant Behavior and Development*, 14, 227-240.
- Wulfften Palthe, T. van & Hopkins, B. (1984). Development of the infant's social competence during early face-to-face interaction: a longitudinal study. In H.F.R. Prechtl (ed.), *Continuity of neural functions from prenatal to postnatal life*. Oxford: Blackwell.
- Wijnroks, L. (1994). *Dimensions of mother-infant interaction and the development of social and cognitive competence in preterm infants*. Doctoral dissertation. University of Groningen.