

The Nature of the Mother's Tie to Her Infant: Maternal Bonding under Conditions of Proximity, Separation, and Potential Loss

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Attachment has generally been examined from the infant's perspective. We focused on mothers' post-partum thoughts and behaviors. Guided by an ethological approach, maternal bonding was examined under conditions of proximity, separation, and potential loss. Ninety-one mothers were interviewed: mothers of full-term infants who maintained continuous proximity to the infant, mothers of healthy premature infants who were separated from the infant, and mothers of very low birthweight infants who experienced potential loss and prolonged separation. Mothers of term infants reported medium-to-high levels of preoccupations with thoughts of infant safety and well-being. Preoccupations increased with separation (Group 2) and significantly decreased with impending loss (Group 3). Attachment behaviors and representations were the highest among mothers of term infants and declined linearly with the duration of mother–infant separation. Maternal trait anxiety and depression were related respectively to higher levels of preoccupations and reduced attachment behaviors and representations, independent of the infant medical condition and mother–child separation. Discussion focused on the comparability of maternal and infant attachment in relation to the neurobiological system underlying bond formation.

Keywords: Anxiety, attachment, bonding, maternal depression, mothers, prematurity

Abbreviations: LBW: low birthweight; VLBW: very low birthweight; YIPTA: Yale Inventory of Parental Thoughts and Actions.

Introduction

Attachment, the capacity to form selective and enduring bonds, is among the fundamental features of human experience and, according to some perspectives, the central developmental force throughout life (Bowlby, 1969; Bretherton, 1985; Hofer, 1995a). Since Bowlby's seminal paper *The nature of the child's tie to his mother* (1958), which introduced the principles of attachment theory, the study of attachment systems has become one of the most productive areas of research in developmental psychology. Hundreds of experiments in humans and animals have demonstrated the inborn propensity to form attachment, the physiological and behavioral correlates of bonding, the outcomes of secure and insecure

attachment, and the factors associated with disturbances in parent–infant attachment. Most studies, in line with Bowlby's initial focus, explored the child's developing tie to the mother. Maternal attachment behavior was typically examined as being a facilitator of infant attachment (e.g. Ainsworth, Blehar, Waters, & Wall, 1978). Little attention has been paid to the unique experience in the life of an adult of forming a selective and enduring bond with a baby: the mental, emotional, and behavioral changes that accompany the formation of the parent's tie to his or her infant.

One of the important steps in the development of attachment theory and research was Bowlby's link between human attachment and the empirical and theoretical framework of ethology (Bretherton, 1987; Hinde, 1974; Hofer, 1995b). From an empirical viewpoint, ethology lent attachment theory a set of tools that are prerequisite for theory building: the observation, assessment, and hierarchical categorization of behaviors

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that emerge or intensify during bonding. From a theoretical perspective, the ethological framework implied that behaviors characterizing the bonding stage are to be interpreted in relation to survival and evolutionary adaptation. In mammals, survival depends on the maintenance of parent–infant proximity and thus, the concept of proximity became the cornerstone of attachment theory. In his famous trilogy—*Attachment*, *Separation*, and *Loss*—Bowlby (1969, 1973, 1980) suggested that infant behavior is to be understood in reference to the degree of closeness or distance from the mother. Initial distance (separation) evokes protest and the intensification of attachment-related behavior; continuous distance (loss) results in despair and the disappearance or “dampening” of the attachment complex.

Adapting an ethological perspective on attachment, Hofer (1973, 1984, 1995a, b) examined the effects of initial and prolonged separation on the physiology and behavior of rat pups. Following separation, pups showed changes in autonomic, thermal, hormonal, and behavioral systems; each change was linked to a specific component of the pup–dam proximity, such as touch, nursing, or heat. By separating and experimentally manipulating these components, Hofer showed how mother–infant proximity constitutes a complex system of biobehavioral regulators. Moreover, physiological and behavioral changes in reaction to separation followed the increase–decrease pattern predicted by Bowlby (1969); initial separation led to increase in autonomic and behavioral reactivity, whereas prolonged separation resulted in low levels of activity. Proximity, separation, and loss were therefore viewed as distinct configurations of regulatory mechanisms: proximity referring to the synchronous function of the various regulators to maintain biological homeostasis, separation being a dynamic period in which attachment behaviors are intensified in reaction to initial separation, and loss indicating an altered biobehavioral state following prolonged separation.

The two configurations of infants’ reaction to initial and prolonged separation, anxiety and avoidance, were utilized in the “Strange Situation” paradigm and came to represent patterns of attachment in which there is a conflict between the desire for proximity and the fear of it (Ainsworth et al., 1978). The complementary hypothesis, that separation and loss of infant proximity may be related to the intensification or inhibition of maternal attachment behavior, has not been examined. This hypothesis is underlaid by the assumption that bond formation in mother and child rest on similar mechanisms and are moderated by the same physiological system (Insel, 1997). In light of Hofer’s (1995a) research, the complementary hypothesis may also imply that the conditions of proximity, separation, and loss are expressed in distinct configurations of maternal attachment behavior. Further, this hypothesis may suggest that the two insecure attachment configurations, anxiety and avoidance, may be related to a disturbed balance between the mother’s emerging tie to her infant and the fears and anxieties that may prevent the formation of a selective and enduring bond. Finally, similarly to the use of maternal separation to tap the working models of infant attachment, the complexities of maternal attachment

may be best studied in relation to separation from the infant. Examining these principles in relation to the mother’s attachment to her infant is the main goal of the present study.

In addition to the tools and concepts of ethology, which focus on observed behavior, the study of maternal attachment requires a reference to the mental domain. Hinde (1989), discussing the benefits and drawbacks in applying ethological principles to the study of human attachment, argues that cognitive structures, complex emotions, and cultural conducts are part of our adaptive heritage, have an evolutionary role, and must be included in theories of human attachment. Thus, whereas the ethological focus on observed behavior may be maintained in the study of maternal bonding, the mother’s mental states, thoughts, feelings, worries, hopes, and representations of the infant that are unique to the bonding period are as important to the understanding of maternal attachment as the specific behaviors that typify the formation of the mother–infant bond.

Two perspectives that support the need to examine attachment from a mother-to-child rather than a child-to-mother viewpoint are Insel’s (1997) neurobiological model on bond formation and Winnicott’s (1956) psychoanalytic account of the mother’s mental life during the bonding stage: the first considers behavior, the second mental representations. The integration of animal models and psychoanalytic thought has been advocated by Bowlby (1958) as the golden road to the understanding of infant attachment. Both perspectives suggest that maternal bonding is characterized by a unique mental set and behavioral repertoire that is directed to maintain the mother’s physical and psychological proximity to the child.

From a neurobiological perspective, Insel’s (1992, 1997) animal studies have suggested that all forms of social bonding (pair, filial, and parental) are moderated by a specific neurobiological system, possibly related to the mammalian neuropeptide oxytocin. The main functions of oxytocin are uterine contractions during parturition and milk production during nursing, and it is considered to play an important role in the development of maternal behavior, particularly at the initiation of bonding (Uvnas-Moberg, 1994; Carter & Altemus, 1997; Keverne & Kendrick, 1992). This neurobiological system has been implicated in a range of maternal bonding behaviors, such as nursing, grooming, and touch, and infant bonding behavior, such as proximity-seeking and the emission of an ultrasonic distress cry in reaction to separation (Insel & Shapiro, 1992; Insel, Winslow, Wang, Young, & Halihan, 1995; Insel, Young, & Wang, 1997). Relevant to our study, the importance of these findings is the reference to specific maternal behaviors that are typical to bonding in mammals. The findings also help specify the components of mother–infant proximity, such as nursing, grooming, and touch, which may be related to the activation of this neurobiological system in both mother and infant.

From a psychoanalytic viewpoint, Winnicott (1956) described the mother’s mental life during the immediate post-birth period by the term “primary maternal pre-occupations”. This condition refers to the mother’s obsessive-like involvement with thoughts of the baby,

compulsive checking of the infant, ritualistic behaviors during feeding and caregiving, and an exclusive mental focus on the child. Thus, Winnicott adds to the behavioral repertoire of mammals during bonding—repeated touching, grooming, and nursing—the mental dimensions of preoccupation, mental exclusivity, and anxiety. Winnicott maintained that although such high levels of obsessiveness would indicate a mental disorder at any other point in life, during bonding it is not only typical but critical to the formation of maternal attachment. Moreover, the mother's inability to become totally preoccupied with the infant is considered a risk signal to the emerging attachment, perhaps related to early loss suffered by the mother (Benedek, 1959).

In this study, we examine the applicability of Bowlby's (1958, 1969) theory of infant attachment to the mother's developing tie to her infant. Following Bowlby's suggestion, the methodological tools of ethology were applied and bonding was assessed through the specific behaviors and mental states that emerge or intensify during bonding. In line with Hofer (1973, 1984), mother–infant proximity was separated into discrete components and the conditions of proximity, separation, and loss were defined along a continuum.

Because mother–child proximity cannot be experimentally manipulated in human subjects, three groups of mothers who differed on six essential components of proximity were selected. The first component of proximity was mode of delivery, i.e. vaginal or Cesarean. Cesarean delivery precludes maternal contact for at least 24 hours and thus may disrupt the process of bonding (Klaus & Kennell, 1976). The second components of proximity was nurturing style; full breastfeeding, partial, or none. The third component was touch, defined as the availability of tactile contact within the first post-partum day. The fourth component was caretaking, referring to the mothers' full responsibility for activities such as diapering, feeding, and bathing within the first week of life. The fifth and sixth components of proximity considered separation and loss: if mother and child were separated overnight since birth and if loss of the infant was implied at any point since birth.

The three experimental groups were selected to reflect variations in these six components and thus to approximate the conditions of "proximity", "separation", and "loss" in the human mother. The first group included mothers of healthy term infants for whom all six conditions that promote attachment were present. These mothers delivered vaginally, nursed fully, touched, provided full care, and maintained proximity to the infant during day and night. The second group included mothers of healthy low-risk premature infants who delivered vaginally, nursed (part-time), and were able to have full contact with the infant from birth (defined as mother holding infant in arms). However, mothers underwent separation from the infants, as infants remained hospitalized after mothers were discharged, and were therefore not fully responsible for caretaking. Given their medical condition, the potential for loss was not implied by the medical team. The third group included mothers of very low birthweight premature infants for whom none of the six components of proximity existed. Mothers delivered by Cesarean section, did not nurse, touch, nor

care for the infant during the initial post-birth period, were separated from the infant, and the infant's medical condition was initially life threatening.

The underlying hypothesis being tested was that maternal attachment rests on the same mechanisms as those underlying infant attachment. Specifically, we expected that the "primary maternal preoccupation" complex, referring to thoughts, worries, and anxieties regarding infant safety, would increase among mothers who experienced initial separation. In those mothers who experienced prolonged separation and potential loss of the infant there would be diminished signs of attachment, expressed in both lower levels of preoccupations and decreased frequencies of bonding behaviors and mental representations. In addition, in both groups of mothers who experienced separation there would be a different balance between the positive indicators of maternal attachment and the signals of worries and anxieties as compared to mothers who maintained continuous proximity to the infant since birth.

In addition to group differences, we examined individual variation in maternal bonding, particularly the relations between maternal anxiety and depression and aspects of bonding. Bowlby (1960a, b) proposed a link between anxiety and the high arousal related to separation and between depression and disengagement from attachment relationships. He further suggested that the individual's stable personality traits and mood states stabilize on the basis of early experiences with the attachment figure, which are generalized to later attachment relationships. These propositions are in line with current neurobiological findings on the link between early modulation of arousal during mother–infant interactions and the emergence of stable patterns of emotional reactivity and psychopathology (Schore, 1994). We therefore examined whether maternal anxiety and depression, independent of the infant medical condition and length of mother–child separation, will be differentially related to aspects of maternal bonding. Maternal anxiety was expected to be related to the bonding components that index the heightening of anxiety and preoccupations following childbirth, and depression was hypothesized to be negatively linked to those aspects that assess the mother's special investment in the emerging attachment relationship.

Method

Participants

Ninety-one mothers in three experimental groups participated in the study. Group 1 consisted of 29 mothers of vaginally born full-term healthy infants. All such infants were discharged from the hospital with their mothers within 96 hours of their birth. Group 2 consisted of 30 mothers of vaginally born low birthweight (LBW) infants born at 34–36 weeks gestation and with birthweights ranging from 1650 to 1850 grams. None of these infants required intensive care and mothers were able to establish full mother–infant contact within the first 48 hours of their birth. Full maternal contact was defined as the mother's holding the infant in her arm outside the bassinet with or without monitoring devices. All the mothers were discharged from the hospital without their infant. Length of hospitalization of the infants ranged from 10 to 24 days. Group 3 consisted of 32

Table 1
Maternal Demographic and Infant Medical Information

	Group 1 Full-term infants		Group 2 LBW infants		Group 3 VLBW infants	
	Mean	SD	Mean	SD	Mean	SD
Mother age (yrs)	30.34	4.18	29.94	4.64	31.31	6.55
Mother education	14.73	2.32	14.91	2.16	15.01	2.82
Infant gender (m/f)	14/15		15/15		17/16	
Birth order (1st born/later born)	12/17		14/16		14/18	
Infant CA (weeks)	38.70	1.73	34.85	1.61	29.06	2.84
Birthweight (gr)	3464.06	540.20	1836.45	427.86	1174.32	357.03
Infant age at interview (days)	17.26	7.87	16.30	7.08	44.00	18.12
CRIB (severity of illness)	0.00	0.00	0.66	0.95	3.78	4.12

mothers of very low birthweight infants (VLBW) born by Cesarean section at 27–32 weeks gestation with birthweights ranging from 810 to 1400 grams. All these infants required maximum intensive care for potentially life-threatening respiratory insufficiency. None of the mothers in this group was able to touch the infant fully immediately after birth and the time until full maternal contact was available was between 12 and 48 days (mean = 28 days, $SD = 10$ days). None of these infants suffered from asphyxia, Grade 3 or 4 intraventricular/periventricular hemorrhage, or any metabolic or genetic disorder, and the neurologic examination and the Brazelton assessment (Brazelton, 1973) was normal at time of discharge. The infants were discharged after hospitalization that ranged from 4 to 11 weeks and at a post-conception age of 37–40 weeks (equivalent to term). Severity of illness scores (CRIB; The International Neonatal Network, 1993) for Groups 2 and 3 were completed by the senior physicians (JK and AIE) upon the infant's discharge from the hospital.

Mothers of the full-term infants were recruited through personal contacts and birth preparation classes. Mothers of LBW and VLBW infants were recruited in the nurseries of two medical centers in Israel. Mothers of LBW were recruited in one hospital and mothers of VLBW in the second hospital, and the two groups were matched for maternal age, education, parity, and infant gender. Mothers fitting the study criteria were approached and 93% agreed to participate. All but one of the study mothers graduated high-school and 82% had some or full academic education. Women were all married to the infant's father, all fathers were employed in skilled or semiskilled professions, and families were considered middle-class by Israeli standards (Harlap, Davis, Grower, & Prywes, 1977). None of the mothers had a history of psychiatric disorder or suffered from a serious physical illness. Maternal age and education, infant gender, birth order, chronological age, age at interview, birthweight, and severity of illness scores are reported in Table 1.

No differences in maternal age or education, infant gender, or birth order were found between the three groups. A univariate analysis of variance with post hoc Scheffé's test revealed significant differences in the severity of illness between the three groups [$F(2, 89) = 28.96, p < .001$]. LBW infants were considered at higher risk than the full-term infants and VLBW infants were significantly sicker than the LBW infants. Significantly more pregnancies in the VLBW group were considered high-risk pregnancies than in the other two groups [$F(2, 89) = 8.76, p < .001$]. Most mothers reported that the pregnancy was planned. Two mothers in the full-term group, two in the healthy preterm group, and one in the VLBW group described the pregnancy as unplanned but welcome and the difference between groups was not significant.

Procedure

Mothers were visited at home or in the nursery where the infant was hospitalized. Visits lasted between 60 and 90 minutes. Mothers were interviewed with the Hebrew version of the Yale Inventory of Parental Thoughts and Action (YIPTA; Leckman, Mayes, Feldman, Evans, & Cohen, 1994) by one of two clinical psychologists and interviews lasted between 45 and 75 minutes. Following the interview, mothers completed a battery of self-report measures. Interviewers were trained in conducting the interview on a pilot sample. Mothers of Group 1 were interviewed at home and mothers of Group 2 were interviewed in the hospital when their infants were approximately 2 weeks old, a day or two prior to discharge. Group 3, mothers of VLBW infants, were interviewed when infants were between 37 and 40 weeks post-conception. In order to examine the effect of the re-establishing of proximity following prolonged separation, half ($N = 16$) of the mothers in the VLBW group were interviewed in the hospital upon discharge and half were interviewed at home a few days after discharge. VLBW infants in the two subgroups were matched for gender, birthweight, birth order, and severity of illness.

Instruments

The Yale Inventory of Parental Thoughts and Actions. The YIPTA (Leckman et al. 1994) is completed during a semi-structured interview and assesses various aspects of parental bonding. The instrument was constructed and validated in a longitudinal study by Leckman, Mayes, Feldman, Evans, and Cohen (in press). In the original study mothers and fathers were interviewed with regard to special thoughts and actions that accompany the birth of a new infant at three time-points: eighth month of pregnancy, 2 weeks post-partum, and 3 months post-partum. Prior to the construction of the YIPTA and in line with the ethological approach, 25 mothers who had recently delivered (4 to 30 days post-partum) were asked to list recurrent thoughts, typical mental states, images, worries, typical actions, and caretaking behaviors that appeared to be intensified since the baby's birth. The final inventory included items listed by the mothers as well as additional theory-based items. Most of the items in the YIPTA were rated on a 5-point scale ranging from 0 = none to 4 = very much (e.g. how often do you think about your infant's physical comfort?); a few questions called for exact numbers (e.g. how many hours per day you spend in feeding your infant?); and still others were phrased as yes-no questions (e.g. do you have a nickname for your baby?).

Validation of the YIPTA is described at length in Leckman et al. (in press). Concurrent validity is shown by the substantial agreement between a composite scale of preoccupation derived

Table 2
Maternal Preoccupations and Attachment Behavior [Mean (SD)]

	Group 1 Full-term infants	Group 2 LBW infants	Group 3 VLBW infants	Univariate <i>F</i>
A: Frequency of Thoughts and Worries				
1. How baby feels	2.35 (1.13)	2.85 (1.20)	2.83 (1.23)	n.s.
2. How baby grows and develops	3.22 (1.25)	3.40 (0.98)	2.21 (0.88)	11.37***(<i>b</i> > <i>a</i> > <i>c</i>)
3. Baby's safety	3.21 (0.96)	3.70 (1.10)	2.90 (0.90)	5.65**(<i>b</i> > <i>a</i> > <i>c</i>)
4. Baby's physical comfort	2.55 (1.23)	3.23 (1.05)	2.46 (1.22)	5.15**(<i>b</i> > <i>a</i> , <i>c</i>)
5. Baby's future	1.49 (1.12)	1.53 (1.44)	1.31 (1.29)	n.s.
6. Forming relationship with baby	1.39 (1.17)	1.47 (1.48)	1.22 (1.16)	n.s.
7. Something bad happen to baby	1.83 (1.19)	2.77 (1.35)	1.26 (1.37)	9.78***(<i>b</i> > <i>a</i> > <i>c</i>)
8. Something bad happen to parent	0.65 (0.90)	0.43 (0.80)	0.46 (1.00)	n.s.
9. Baby's dependency and vulnerability	1.53 (1.30)	2.15 (1.41)	1.22 (1.18)	5.23**(<i>b</i> > <i>a</i> > <i>c</i>)
10. Global frequency composite	2.34 (0.81)	2.93 (0.54)	1.66 (0.61)	7.04**(<i>b</i> > <i>a</i> > <i>c</i>)
B: Distress Caused by Thoughts and Worries				
1. How restless thoughts make you	2.58 (1.01)	3.51 (0.44)	2.12 (1.24)	9.32***(<i>b</i> > <i>a</i> > <i>c</i>)
2. How unpleasant are thoughts	1.98 (1.24)	2.91 (1.34)	1.36 (1.13)	7.87**(<i>b</i> > <i>a</i> > <i>c</i>)
3. How disruptive are thoughts	1.92 (1.99)	3.57 (0.67)	1.17 (1.21)	8.77***(<i>b</i> > <i>a</i> > <i>c</i>)
4. Anxious if not think of baby by day	2.34 (1.51)	3.42 (0.41)	2.06 (0.37)	5.98**(<i>b</i> > <i>a</i> , <i>c</i>)
5. Anxious if not think of baby by night	2.46 (1.62)	3.25 (0.77)	2.03 (1.71)	5.09**(<i>b</i> > <i>a</i> > <i>c</i>)
6. Global distress composite	2.22 (1.39)	3.21 (0.87)	1.85 (1.21)	8.36***(<i>b</i> > <i>a</i> > <i>c</i>)
C: Distress Management				
1. Talk with spouse	3.45 (1.00)	3.02 (1.21)	2.45 (1.20)	6.14**(<i>a</i> > <i>b</i> > <i>c</i>)
2. Talk to friend	2.65 (1.33)	2.12 (1.52)	1.87 (1.22)	6.27** (<i>a</i> > <i>b</i> > <i>c</i>)
3. Check infant	2.93 (0.25)	1.73 (0.46)	1.60 (0.70)	5.42**(<i>a</i> > <i>b</i> , <i>c</i>)
4. Divert thoughts	1.17 (0.98)	0.91 (0.54)	0.98 (0.55)	n.s.
5. Global management composite	2.29 (1.39)	1.89 (1.49)	1.48 (1.49)	8.96***(<i>a</i> > <i>b</i> > <i>c</i>)
D: Compulsive Checking				
1. Frequency of checking infant by day	3.05 (0.91)	2.63 (0.91)	2.11 (1.15)	6.56**(<i>a</i> > <i>b</i> > <i>c</i>)
2. Frequency of checking infant at night	3.14 (1.21)	2.34 (1.32)	2.09 (1.37)	5.44**(<i>a</i> > <i>b</i> > <i>c</i>)
3. Anxious when checking prevented/day	3.43 (0.87)	2.54 (1.32)	2.21 (1.43)	6.36**(<i>c</i> > <i>a</i> , <i>b</i>)
4. Anxious when checking prevented/night	2.68 (1.87)	2.14 (1.32)	2.12 (1.12)	n.s.
5. Global checking composite	3.08 (1.55)	2.75 (1.35)	2.11 (1.14)	7.33**(<i>a</i> > <i>b</i> > <i>c</i>)
E: Affiliative Behavior				
1. Singing same tune to infant	2.40 (1.47)	1.22 (1.22)	1.19 (1.24)	5.63**(<i>a</i> > <i>b</i> , <i>c</i>)
3. Repeating special words to infant	2.71 (1.46)	1.44 (1.13)	0.98 (0.95)	7.25**(<i>a</i> > <i>b</i> > <i>c</i>)
4. Same pattern of actions at feeding	2.30 (1.47)	2.12 (1.49)	1.94 (1.55)	n.s.
5. Same pattern of actions at bathing	2.61 (1.32)	0.89 (0.67)	0.90 (0.56)	11.34***(<i>a</i> > <i>b</i> , <i>c</i>)
6. Comfort infant in a certain way	2.45 (0.68)	1.92 (1.60)	1.22 (0.92)	5.76* (<i>a</i> > <i>b</i> > <i>c</i>)
7. Global affiliative behavior composite	2.54 (1.23)	1.44 (1.12)	1.09 (1.35)	7.63**(<i>a</i> > <i>b</i> > <i>c</i>)
F: Attachment Representations				
1. Do you ever have images of infant	0.86 (0.22)	0.50 (0.68)	0.45 (0.51)	10.21***(<i>a</i> > <i>b</i> , <i>c</i>)
2. Do you have nickname for baby	0.53 (0.51)	0.40 (0.49)	0.12 (0.36)	7.86**(<i>a</i> > <i>b</i> > <i>c</i>)
3. Is infant the most beautiful baby ever born	0.85 (0.32)	0.54 (0.53)	0.25 (0.51)	11.23***(<i>a</i> > <i>b</i> > <i>c</i>)
4. Does infant resemble a family member	0.87 (0.25)	0.52 (0.49)	0.10 (0.38)	15.65***(<i>a</i> > <i>b</i> > <i>c</i>)
5. Global representations composite	0.77 (0.45)	0.48 (0.52)	0.23 (0.41)	11.35***(<i>a</i> > <i>b</i> > <i>c</i>)
H: Frequency of Caretaking Behavior				
1. Hours\day feeding	3.92 (2.40)	2.30 (1.82)	2.24 (1.73)	5.41**(<i>a</i> > <i>b</i> , <i>c</i>)
2. Hours\day talking to infant	1.76 (1.30)	3.20 (2.35)	2.01 (1.34)	5.62**(<i>b</i> > <i>a</i> , <i>c</i>)
3. Hours\day thinking of infant	5.00 (5.37)	12.76 (5.46)	6.44 (2.13)	13.31***(<i>b</i> > <i>a</i> , <i>c</i>)
4. Direct contact with infant	7.68 (4.45)	6.96 (4.45)	4.01 (3.21)	5.10**(<i>a</i> > <i>b</i> > <i>c</i>)
5. Hours\day away from infant	2.65 (2.33)	11.29 (4.43)	16.31 (5.51) ^a	11.43***(<i>a</i> < <i>b</i> < <i>c</i>) ^a
			6.35 (3.21) ^b	6.13***(<i>a</i> < <i>c</i> < <i>b</i>) ^b
6. Global caretaking [(1 + 2 + 3 + 4) – 5]	14.71 (6.31)	13.93 (5.67)	1.61 (4.53) ^a	15.43***(<i>c</i> < <i>b</i> , <i>a</i>) ^a
			8.35 (2.64) ^b	5.76**(<i>c</i> < <i>b</i> , <i>a</i>) ^b

^a Home.^b Hospital.***p* < .01; ****p* < .001.Univariate *F* scores: *a* = Group 1, *b* = Group 2, *c* = Group 3.

from the YIPTA and the parent's estimate of the amount of time spent thinking about the infant. Discriminate validity is shown by the distinct trajectories of the preoccupation composite and measures of mood states (state and trait anxiety,

depression). Factor analysis at each of the three time-points showed identical two-factor solutions with high loading for preoccupation and frequency of caretaking behaviour on the first factor and for mood states on the second. Finally, a more

stringent test of validity is shown by the significant correlations between the parents' rating of preoccupation collected at 8 months gestation and at 2 weeks post-partum and the parents' recollection at 3 months post-partum regarding preoccupation at these prior two time-points.

In adapting the YIPTA to Hebrew, several items were revised, omitted, and added on the basis of a pilot study. The Hebrew YIPTA was organized into seven sections, each addressing different aspects of maternal bonding. Each section included between four and nine items that were to be completed by the mother. In addition, interviewers were instructed to elicit the parent's free narratives on each of the seven topics and narratives were transcribed for later coding. The seven sections of the Hebrew YIPTA were; Frequency of Thoughts and Worries; Distress Caused by Thoughts and Worries; Distress Management; Compulsive Checking; Affiliative Behaviors; Attachment Representations; and Frequency of Caretaking Behavior. Items of the Hebrew YIPTA are listed in Table 2.

Items on each of the first six sections were averaged into global composites with acceptable internal consistencies ($\alpha = .76$ and above). The global composite for the seventh section, Frequency of Caretaking Behavior, was computed as the sum of the first four items (hours per day of feeding, talking, thinking, and direct contact with the infant) minus the fifth item (hours away from the infant).

The State-Trait Anxiety Inventory. Trait anxiety was measured with the State-Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene, 1970). This well-validated instrument (e.g. Blumberg, 1980) uses separate scales to measure stable individual differences in anxiety proneness (trait) and current states of anxiety. Mean Trait Anxiety scores (and SD) were 35.69 (8.41) for Group 1, 37.25 (5.42) for Group 2, and 36.11 (7.94) for Group 3. Analysis of covariance with infant medical condition (CRIB scores) as covariate revealed no significant differences in trait anxiety between groups. Anxiety scores were within the normal range for Israeli women and none exceeded the clinical cutoff (Teichman & Melnick, 1976). Internal consistency for trait anxiety was $\alpha = .87$.

Separation anxiety. Maternal separation anxiety was measured with the Maternal Separation Anxiety Scale (Hock, McBride, & Gnezdza, 1989). This instrument includes 35 questions that assess the mother's reactions and worries with regard to issues of separation. The Maternal Separation Anxiety factor was used in this study. Mean (SD) separation anxiety scores were 24.68 (3.94) for Group 1, 25.46 (4.20) for Group 2, and 24.33 (3.73) for Group 3. Analysis of covariance with infant CRIB score as the covariate showed no group differences for maternal separation anxiety and internal consistency for this factor was $\alpha = .82$.

Beck Depression Inventory. Mothers' depressive symptoms were assessed with the Beck Depression Inventory (BDI; Beck, 1978). This inventory includes 21 items that measure the level of depressive symptoms. The BDI is the most widely used self-report instrument for the assessment of depressive symptoms, with well-established reliability and validity (e.g. Bumberry, Oliver, & McClure, 1978). Mean (SD) BDI scores were 4.84 (3.21) for Group 1, 5.45 (4.14) for Group 2, and 5.47 (4.23) for Group 3. Analysis of covariance with infant medical condition as the covariate showed a trend toward higher levels of depression in Group 3 [$F(1, 89) = 3.15, p < .10$]. Internal consistency for this sample was $\alpha = .85$.

Coding

The transcribed maternal narratives for the first five sections of the YIPTA were coded by two independent coders. Items in the sixth section, Attachment Representations, called for yes-no answers and the seventh section, Frequency of Caretaking,

called for exact numbers, so narratives for these sections were not coded.

Coders read the mother's narratives on each topic and rated the narrative on a 5-point scale, with 0 presenting the lowest level and 4 the highest level for each section (e.g. how preoccupied is the mother with thoughts and worries of her infant). Coders were not given the mother's rating for individual items and were blind to the group membership of the mother. Following training in the coding of narratives on the pilot sample, inter-rater reliability was examined on 15 random narratives. Inter-rater reliability for the five sections was intra-class $r = .92$ (range = .89-.94). The score for the maternal narratives and the global averaged composites for the first five sections were highly related ($rs = .54-.76, ps < .001$) and the two scores were averaged into a single composite. Thus, the final global score for each mother on each of the first five sections was the average of the coded narrative for the section and the averaged response to the items on the same section ($\alpha = .72-.85$). The global score for the sixth section, Attachment Representations, was the average of the mother's response to the four items on this section ($\alpha = .82$).

Results

Prior to the analysis of group differences on the seven sections of the interview, differences between the mothers of VLBW infants who were interviewed at home and in the hospital were examined. Analysis of covariance for the seven global composites with infant birth order and severity of illness scores as covariates revealed no differences between the two subgroups on the first six sections of the interview. Differences were found for the Frequency of Caretaking Behavior. Analysis of individual items on this section indicated significant differences for one item; hours/day away from the infant [$F(1, 31) = 11.97, p < .001$]. Data for this section is therefore reported twice, once for the mothers who were interviewed at home and once for those interviewed in the hospital.

Multivariate analysis of covariance (MANCOVA) was used to examine differences between the three groups on each section of the YIPTA. Separate MANCOVAs were computed for the items of each section with the infant's birth order and severity of illness score used as covariates. All seven MANCOVAs indicated significant group effects. Next, univariate analysis of covariance with post hoc Scheffé's test was computed for each item in the interview. Because of the multiple comparisons, significance level was set at $p < .01$. Table 2 presents the means, standard deviations, and the values of the univariate F for each item in the interview according to group.

A: Frequency of Thoughts and Worries. Items in this section address the typical thoughts and worries mothers experience in the immediate post-partum period. Under conditions of proximity, mothers of full-term infants reported medium-to-high levels of preoccupations with thoughts and worries of infant safety and well-being. Following initial separation, mothers of LBW infants reported the highest levels of preoccupations. The level of thoughts and worries among mothers of VLBW infants, who experienced prolonged separation and potential loss, was the lowest among the groups. Significant differences between the groups were found on

items related to infant safety: thoughts of the infant's safety, physical comfort, how baby grows, something bad happening to infant, and baby's dependency and vulnerability.

B: Distress Caused by Thoughts and Worries. Five questions addressed the level of distress thoughts and worries cause the mother. Mothers in Group 1 experienced a moderate level of distress, mothers in Group 2 reported the highest level of distress, and mothers in Group 3 reported the lowest levels of distress caused by thoughts and worries of infant safety. Results of the first two sections, therefore, support our hypothesis by showing an increase-decrease pattern of maternal preoccupations in reaction to separation. Following initial separation, mothers reported an increase in thoughts and worries of infant safety, and following prolonged separation with potential loss mothers reported reduced levels of preoccupations and distress.

C: Distress Management. In this section, mothers were asked to rate the effectiveness of various strategies in managing the distress caused by thoughts and worries. Mothers of full-term infants reported the best distress management by talking to spouse, talking to friend, and checking the infant. Mothers of LBW infants reported medium levels of distress management and mothers of VLBW infants were the least able to manage distress using these strategies. Diverting thoughts was not an effective strategy for all mothers.

D: Compulsive Checking. Compulsive checking is the behavioral component of the "primary maternal preoccupation" phenomena described by Winnicott (1956) and is considered an adaptive mammalian behavior during the bonding period (Insel, 1997). Results indicate a declining pattern of compulsive checking with the increase in separation. Group 1 mothers reported the highest levels of checking, Group 2 mothers reported medium levels, and Group 3 mothers reported the lowest levels.

E: Affiliative Behavior. Items in this section address the repetitive behaviors typical of maternal caretaking and interactions with newborn infants. These behaviors are similar to the repetitive grooming of mammals and appear to promote the selectivity of the mother-infant bond (Insel, 1992). Results indicate that the frequency of these repetitive behaviors are highest when mothers and infants remain in close proximity, possibly as these behaviors require the intimacy of the home environment. Initial separation was associated with a decrease in repetitive behaviors and prolonged separation with potential loss was related to the lowest frequencies of affiliative behavior.

F: Attachment Representations. The mental indicators of bonding examined in this section are expressions of the mother's emerging internal model of her child. These representations, like affiliative behaviors, point to the uniqueness of the bond in the mother's mental life. Items in this section were phrased as yes-no questions and the results represent proportions of mothers in each group who answered positively. Significantly more mothers of full-term infants tended to have a nickname for the infant, find him the most beautiful baby, have images of the child, or find resemblance between the infant and family members. The prevalence of these forms

of baby endearment was lower among mothers of LBW infants, and lowest among mothers of VLBW infants. Thus, a similar pattern was observed for attachment behavior and representations; highest levels under conditions of proximity and linear decline with the increase in separation.

An additional question, "Is your infant less beautiful than you had expected him/her to be?" was included in the interview but not integrated into the attachment representation composite. None of the mothers in the first group answered yes to this question. Twenty per cent of the mothers in Group 2 and 87.5% of the mothers in Group 3 admitted they find the infant less beautiful than their expectations. Analysis of variance revealed highly significant differences between groups [$F(2, 89) = 50.5, p < .001$].

H: Frequency of Caretaking Behavior. In the final section, mothers were asked to estimate the cumulative time per day they devote to various caretaking activities. Results indicate that mothers of full-term infants spend the longest periods in feeding and direct contact and the shortest periods away from the infant. Mothers of LBW infants devote the longest periods to thinking and talking to their infants. These mothers report thinking of the infant approximately 13 hours a day, nearly all of their waking hours. The global frequency of caretaking for mothers of VLBW infants who were interviewed in the hospital was negative, indicating that these mothers spend more time away from the infant than in caretaking or thinking of the child. Mothers of VLBW infants who were interviewed at home devoted more time to caretaking than those interviewed in the hospital but the cumulative time of caretaking was still low as compared to mothers in the other groups. These findings point again to the diminished investment of mothers of VLBW infants in the attachment relationship following prolonged separation and potential loss.

Finally, it is important to note that group differences were not related to the level of support mothers received from their spouse. No group differences were found in the division of childcare responsibilities between spouses or in the tendency to share preoccupations and worries with spouse. Group differences were similarly not found in the mothers' report on the effects of childbirth on the marriage, which 87% described as ranging between good and excellent.

Individual Differences: Maternal Anxiety and Depression in Relation to Maternal Bonding

A series of hierarchical multiple regressions were computed to examine individual differences in maternal bonding. In each regression equation the infant's medical condition (CRIB score) was entered in the first step, followed by the time (in days) until full mother-child contact was available, and finally maternal personality measures, anxiety, depression, and separation anxiety were entered. Results of the regression models are presented in Table 3.

Results reported in Table 3 showed that five of the six models were significant. In all models, the infant medical conditions contributed unique variance to the prediction of maternal bonding, indicating that the child's illness

Table 3
Predicting Maternal Bonding

	Criterion					
	Thoughts & Worries	Distress Level	Distress Management	Compulsive Checking	Affiliative Behavior	Attachment Representations
Predictors						
Infant medical condition	-.40***	-.26*	-.24*	-.20*	-.33**	-.46***
Duration of separation	-.04	-.09	-.07	-.14	-.23*	-.22*
Trait anxiety	.25*	.32**	-.36***	.13	.12	.13
Maternal depression	.07	.14	-.35**	.12	-.22*	-.32**
Separation anxiety	.34*	.23*	-.22*	.10	.13	.16
R ² total	.26	.24	.33	.06	.23	.39
F (5, 84)	6.27***	5.18***	7.64***	n.s.	4.96***	10.21***

The coefficients are standardized betas.

p* < .05; *p* < .01; ****p* < .001.

and the ensuing separation affect the process of maternal attachment. The latency to full mother–infant contact added unique variance to the two composites that index the building of a selective bond: Affiliative Behavior and Attachment Representations, but not to the preoccupation composites. As hypothesized, maternal anxiety and depression were differentially related to components of bonding. Maternal trait anxiety and separation anxiety were each uniquely related to the Frequency of Thoughts and Worries, to Level of Distress, and to reduced Distress Management. Depression, on the other hand, was negatively related to the mother's Affiliative Behavior and Attachment Representations. Depression was also negatively related to Distress Management. Maternal trait anxiety and separation anxiety each explained unique variance in the preoccupation composites (Thoughts and Worries, Level of Distress, and Distress Management), suggesting that these two types of anxiety possibly tap different aspects of the mother's negative reactivity which are related to the "primary maternal preoccupation" complex. Generally, the findings lend empirical support and further specificity to Bowlby's well-known theory on the relations between attachment processes, anxiety, and depression. The results indicate that anxious mothers tend to experience higher levels of the worrisome aspect of bonding, the aspect that is directed to promote infant survival by maintaining maternal vigilance. Depressed mothers, in comparison, reported lower levels of investment in the relational aspect of bonding expressed in both lower frequencies of affiliative behavior and a reduced tendency to form clear representations of the infant and the attachment relationship.

Discussion

This study is among the first to examine attachment processes from the mother-to-child, rather than the child-to-mother, perspective and to map the thoughts, feelings, behaviors, and mental representations that often accompany the birth of a new infant. Maternal bonding was examined under conditions of proximity, initial separation, and prolonged separation with potential loss of the infant. Because attachment processes are theorized to be dialectically related to separation and loss and to be best understood in terms of this dialectic (Bowlby, 1969;

Hinde, 1989; Hofer, 1995b), the assessment of maternal attachment in relation to the principles of infant attachment may broaden our understanding of attachment systems and attachment processes.

Assessment of the wide range of maternal thoughts and behaviors during the post-partum period suggests that maternal bonding may be described as consisting of two global aspects: the first relates to preoccupations with infant safety, the second concerns the building of a unique and selective bond. Each aspect includes both mental and behavioral components: preoccupations and compulsive checking index the mother's focus on infant survival, and the repetitive behaviors and attachment representations are expressions of the developing uniqueness of the relationship in the mother's mental life. The behavioral component in both factors is comparable to the bonding behavior of mammals, such as repeated checking and grooming (Insel, 1997). The mental component in maternal bonding, however, is unique to the human adult. Much of attachment research over the past 40 years has focused on observed behavior and on the survival aspect of attachment, placing less emphasis on mental representations and on the internal processes that accompany the construction of a selective relationship (van IJzendoorn & Tavecchio, 1987). Viewing attachment from a perspective that includes both behavior and mental states and considers motivations for both survival and selective relationships may promote a broader understanding of the range of processes included in the formation of a selective and enduring bond.

With regard to the survival-related aspect of bonding, the increase–decrease pattern in response to initial and prolonged separation, previously reported for infants and young mammals (Bowlby, 1969; Hofer, 1995a), was also found in our mothers. Whereas mothers of normal healthy babies experience medium-to-high levels of thoughts and worries, initial separation increases these preoccupations. However, with prolonged separation and concerns with potential loss, these thoughts and worries significantly decrease. At a certain point on the continuum from proximity to loss, the highly arousing state of "separation" turns into the diminished reactivity characteristic of "loss". There is a paucity of empirical data on the exact conditions upon which infant separation anxiety turns into the depressed behavior charac-

teristic of loss. With regard to maternal attachment, our findings suggest that the four components of proximity that were present for mothers in Group 2 but not for mothers in Group 3—vaginal delivery, nursing, the availability of full mother–infant contact, and no impending loss—may be related, separately or in combination, to the shift from the highly anxious state characterizing “separation” to the disengagement and reduced involvement typical of “loss”. The results showing no differences between mothers of VLBW infants who were interviewed in the hospital or at home after the discharge of the infant suggest that the pattern of maternal disengagement following the possibility of infant loss is not immediately reversible, and future research is required to examine the long-term effects of prolonged separation on mother–infant attachment.

Regarding the relational aspect of bonding, which concerns the formation of a selective bond, a linearly declining pattern was observed with the increase in the duration of mother–infant separation. The frequencies of affiliative behaviors and attachment representations were highest when mothers and infants remained in close proximity, declined with initial separation, and further declined with the danger of loss. Thus, the balance between the survival and the relational aspects of bonding differed among the three groups. Hofer's (1995a) suggestion, that the conditions of proximity, separation, and loss are expressed in distinct configurations of attachment behavior, may therefore apply to maternal attachment as well. Under conditions of proximity, the components of maternal bonding work in synchrony to facilitate the formation of a selective and enduring bond. Although such mothers (Group 1) report being preoccupied with thoughts and worries of infant safety and development, they generally find coping strategies to deal with the distressing thoughts, and the burden of early infant care is moderated by the pleasurable experience of bond formation. Initial and prolonged separation, on the other hand, were expressed in a different balance between the anxious and pleasurable aspects of bonding. Separation was associated with heightened anxiety that was not buffered by a comparable increase in the relational component of bonding. Prolonged separation was expressed in low levels on all aspects of bonding, suggesting that these dyads are at a higher risk to the development of a secure bond.

The findings on individual differences in maternal anxiety and depression and their differential relations to the preoccupation and relationship-building aspects of bonding lend support to Bowlby's theory. Bowlby (1960a, b) related the individual's predominant mood to early experiences with the attachment figure. High negative reactivity is theorized to be linked to early and repeated separations, and depression, or the “giving up” of intimate ties is linked to prolonged separation and loss. Anxious mothers, who are generally prone to high arousal and are less capable of self-regulating negative states (Watson & Clark, 1984), were shown to be more affected by the anxiety-provoking task of monitoring infant survival, to experience higher levels of preoccupations and distress, and to be less efficient in managing this distress. Maternal depression, on the other hand, had an impact on the mother's ability to enter the endearing

mental state typical of the bonding stage and was associated with reduced affiliative behavior and attachment representations. Depression has been shown to affect the mother's availability to her infant, her ability to synchronize with micro-states of affective arousal, and her consistency of style and stimulation (Field, 1992; Murray & Cooper, 1997). The present results add to the literature on maternal depression by pointing to the depressed mothers' limited capacity to engage in the pleasurable, relationship-building aspect of bonding.

The infant's medical condition and the mother's personality traits each had an independent contribution to the prediction of maternal bonding. These findings suggest that infants who have been born ill, were separated from the mother, and whose mothers are highly anxious or depressed are at the highest risk for the development of mother–infant attachment. Recent research on prematurity has shown that the social and cognitive development of high-risk premature infants, as compared to low-risk ones, is particularly susceptible to the maternal interactive approach. Yet these infants place tremendous demands on their mother, often being described as difficult infants, sending unclear communicative signals, and suffering compromised health during infancy (Bendersky & Lewis, 1994; Landry, Smith, Miller-Loncar, & Wank, 1998; Minde, 1993; Stevenson-Barratt, Roach, & Leavitt, 1992). Because depression and anxiety tend to increase following premature birth (Brooten et al., 1988), it is the coupling of severe prematurity and maternal depression which may place these dyads at higher risk for the development of secure attachment.

Five of the six components of proximity that were examined—delivery, nursing, touch, caretaking, and separation—were shown to be related to oxytocin release in humans or mammals and possibly to the neurobiological system that participates in the initiation of bonding (Carter & Altenuus, 1997; Insel, 1997). It is possible that among mothers of VLBW infants, for whom none of the oxytocin-releasing conditions were met, oxytocin never reached the level required to activate the development of maternal behavior. Intervention efforts that aim to enhance proximity and touch in VLBW infants, such as skin-to-skin contact (kangaroo care), may be crucial for these mothers in order to initiate the bonding process. The findings support such methods by showing that the latency to full maternal contact was uniquely related to the relationship-building components of bonding, suggesting that the sooner mother and infant initiate full contact the better it is for the bonding process. In addition to promoting touch, skin-to-skin proximity has been shown to increase the volume of breast milk production (Hurst, Valentine, & Renfro, 1997), which is an oxytocin-related physiological process. Furthermore, oxytocin is quickly conditioned to the infant and thoughts of the infant often cause oxytocin release (Wakerley, Clarke, & Summerlee, 1994). Thus, the goal of intervention may be to enhance the mother's thoughts of her child. The positive skin-to-skin encounter provides an experience of bonding mothers choose to remember (Affonso, Bosque, Wahlberg, & Brady, 1993), as opposed to the experience of loss which, as the findings demonstrate, mothers choose to repress.

Finally, several limitations of the study should be mentioned that require further research. The focus of this work was on the reorganization of the mother's mental life to welcome a new relationship and thus, the link between representations and observed behavior was not examined and all measures here were collected from maternal reports. Whether or not internal processes are reflected in observed behavior or whether internal and external processes represent separate levels of experience is an issue of continuous controversy in attachment research (van IJzendoorn, 1995) and should be examined in relation to maternal bonding. A particularly interesting question is whether the mother's mental representations of the infant are related to observed mother-child interactions. In our laboratory, we continue to follow the high-risk VLBW infants and the data shows positive correlations between the level of affiliative behavior and attachment representation mothers report upon discharge and the degree of maternal sensitivity and dyadic mutuality during mother-infant interaction at 3 and 6 months ($r_s = .34-.39$, $p < .05$). However, these findings are limited to one third of the sample ($N = 32$) and should be replicated in larger samples of healthy and at-risk infants. A second limitation of the study is the variability in infant age at interview. Mothers of VLBW infants were interviewed at a significantly later period after birth than mothers in the other two groups. At 2 weeks after birth some of these infants were still in a life-threatening condition and the decision was to control for state of health of the infant and post-conception age (approximately 40 weeks). This decision, like many empirical decisions, should be taken into consideration in the interpretation of the findings. However, the alternative of controlling for chronological age would preclude studying the mother's state at a critical point from the bonding perspective, i.e. at the time of discharge, when mothers are about to assume full responsibility for the infant. Third, there was a trend toward higher depression among mothers in Group 3 and this may have colored their responses in relation to the bonding process. In this group there was also a larger proportion of at-risk pregnancies, a fact which may have contributed to their reduced investment. Finally, because oxytocin levels were not examined, the link between the neurobiological system underlying bond formation and the mental and behavioral indicators of maternal bonding is inferential and should be tested in animals and human models.

In general, the search for parallels between the principles underlying maternal and infant attachment is in line with the systemic view of attachment, proposed by ethologists, which suggests that the construct of "attachment" defines the mother-infant relationship and is not a characteristic that inherently resides within the infant (Bridges, Connell, & Belsky, 1988, Dawkins, 1976; Hinde, 1989). Thus, our data, which add to the knowledge of the processes and patterns of maternal attachment, may guide further research. Such research should focus on the ways by which maternal attachment representations shape and are shaped by the infant's behaviors and internal models; the degree to which attachment systems, like all living systems, are constrained by initial conditions; and whether disruptions in the early, perhaps critical stages of bonding may have

lasting effects on the emerging relationship between mother and child.

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