ATTACHMENT AND SEPARATION IN YOUNG CHILDREN

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ABSTRACT
Attachment theory is criticized for being based on momentary stressful situations, for being limited to behaviors that occur with the primary attachment figure, for including only overt behaviors in its paradigm, and for failing to consider multiple attachments at different stages of life. A model of psychobiological attunement is then presented and supported by several studies documenting behavioral, physiological, and biochemical responses to separations from parents and peers.

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INTRODUCTION
Attachment and separation have traditionally been studied in the context of mother-infant and mother-child dyads. However, more recent research sug-
gests the existence of bonds similar to those in mother-infant and mother-child dyads, between peers and between individuals of different ages both in humans (Field 1985) and in nonhuman primates (Reite & Capitanio 1984). Thus, attachment is increasingly considered a life-span phenomenon (Antonucci 1976, Field 1985). The physiological responses accompanying the major attachment behaviors—smiling and crying—are, in fact, independent of parenthood, age, and sex (Frodi 1985). Attachment is also considered a near-universal process. In this regard, Petrovich & Gewirtz (1985) have raised two important questions. What is the evolutionary explanation for the remarkable behavioral similarity among phylogenetically related or distantly related organisms? Why are there important behavior differences between phylogenetically related species? As an example of the latter question, they discuss the work of Cullen (1957) showing that certain cliff-nesting gulls, kittiwakes, do not learn to identify their offspring because their offspring must remain in the nest to survive. In contrast, ground-nesting gulls closely related to kittiwakes must learn to recognize their offspring because their offspring wander from the nest.

An example of cultural variation in human attachment behavior is provided by Tronick et al (1985). Although the Westernized version of attachment involves a single caregiver and its offspring, multiple caregiver attachments occur in other cultures, such as that of the Efe pygmies of Zaire. The mother is not the first to hold the newborn. Instead, the newborn is passed among several other women. Further, although the infant is constantly held and fed on demand, it is often fed by other lactating women. As a result, the infants were noted to develop multiple attachments. Tronick et al interpreted these multiple attachments as adaptive for the infant’s growth and group participation. The growth advantage for the small Efe newborn is that multiple nursing mothers can provide mature milk, which is richer than the colostrum of the infant’s biological mother. In this way fluid balance is maintained and growth is accelerated.

Cultural and ecological variation might explain much of the variance in attachment behavior, although individual differences have also been noted within the same cultural and ecological niches. These differences may have their origins in genetic, prenatal, or early environment variations.

Individual Differences

Bowlby’s (1969) seminal model of attachment was a normative one that did not deal with individual differences in attachment behavior, although Bowlby (1978) subsequently extended his model to include this variable. Mary Ainsworth (1967) facilitated the study of individual differences by devising what has been labeled the strange situation paradigm and a system for classifying individual differences in infants’ responses to reunions with their mothers following brief separations. Differences in infants’ responses were docu-
mented, and these were then related to behaviors of the mothers such as their sensitivity and responsiveness to infant signals during their earlier interactions. The paradigms for studying attachments in human infants (Ainsworth) and also in infant monkeys (the Harlows and their students) inspired dozens of studies. Most of these early studies were limited to the description of overt behavior.

More recently, studies enabled by improved monitoring devices have investigated subtle individual differences in biological mechanisms.

The Bowlby-Ainsworth Model of Attachment

Bowlby (1969) described the behaviors of infants and young children who were in residential nurseries and hospital wards and therefore separated from their mothers. The children who had experienced a secure relationship with their mothers showed a predictable behavior sequence during their separations. The sequence has three phases which Bowlby called protest, despair, and detachment. The initial phase (protest) began almost immediately and lasted a few hours to a week or more. Children in this phase appeared distressed, crying loudly, throwing themselves about, and looked eagerly toward any sight or sound that could be their missing mother. Some children clung to a nurse as a substitute. During the despair phase, the children showed increasing helplessness. They were withdrawn, physically active, and cried only intermittently. This was a quiet state and sometimes was mistaken for recovery. The phase of detachment was often welcomed because the children showed more interest in their surroundings, often smiled, and were sociable. When the children’s mothers visited, however, they remained remote and apathetic.

Ainsworth (1967) and her colleagues studied attachment behavior experimentally during a series of brief laboratory sequences labeled the “strange situation” and, as stated above, attended to differences in the infants’ behaviors. This situation starts with the mother and infant together in a strange room with toys and proceeds through a series of different experiences, each lasting about three minutes. First, a female stranger joins the mother and infant. Then, the mother leaves the infant with the stranger. Then the mother returns. Next, the mother leaves the infant alone, and after a brief interval the stranger returns. Finally, the mother returns. The infants are given an attachment classification on the basis of their avoidant, enthusiastic, or variable responses to the mother’s return.

Although the data reviewed by Bowlby (1969) and the strange situation studies by Ainsworth and her colleagues convincingly demonstrate a special attachment to the mother on the part of the infant, at least in the North American cultures, the model of attachment derived from these data has some limitations. First, in this model attachment is based on behaviors that occur during momentary separations (stressful situations) rather than during non-
stressful situations. A broader understanding of attachment requires observation of how the mother and infant interact and what they provide for each other during natural, nonstressful situations. The strange situation paradigm may simply be tapping individual differences in the children’s coping with momentary stress. What children do as the mother leaves and how they greet her when she returns may provide less insight into the functional significance of attachment than the way mother and child relate to each other when they are together and not stressed. An illustration of the problem with using the child’s response to separation from and return of the mother is that among children who are attached to their mothers as evidenced, for example, by their harmonious interactions together, some seem to have difficulty making transitions. These children cling to their mothers when they are dropped off at nursery school, and they ignore their mothers when they are picked up after school (Field et al 1984a). Both the clinging and the ignoring behaviors result in a classification of these children as having an attachment disorder. In addition, most young children following a more prolonged separation (three days instead of three minutes) reject their mothers rather than greet them and seek physical contact (Field & Reite 1984). This behavioral pattern implies either that most children have attachment disorders or that valid classification can only be made following a very unnatural, ecologically strange three-minute situation.

A second problem with the model is that, as in a circular process, attachment has been defined on the basis of those behaviors directed to the person referred to as the attachment figure during an impending separation (such behaviors as crying and clinging) and following reunion (proximity-seeking and greeting behaviors).

A third problem is that the list of attachment behaviors is limited to those that occur with the primary attachment figure, typically the mother. However, other attachments are not necessarily characterized by those same behaviors. For example, infants do not necessarily cling to peers or siblings, follow them, or cry during an impending departure, nor do they typically run to and cling to them as they return, yet infants are unquestionably attached to peers and siblings such that they lose sleep and become fussy when they are separated from their peers (Field et al 1984b).

A fourth limitation of the attachment model is that the behavior list only includes overt behaviors. Data reviewed below in this chapter show that physiological changes also accompany separations and reunions and may suggest alternative explanations for the attachment/separation phenomena.

A fifth consideration is that in the models and the data presented by Bowlby and Ainsworth, the mother is viewed as the primary attachment figure. Although both authors acknowledge that other attachments may occur, the mother is treated as the primary attachment object, and the father and other members of the family are considered only secondary attachment figures.
However, multiple, simultaneous attachments may occur between the child and the mother, father, and siblings that may also be considered primary attachments, particularly in families where fathers and siblings share in the caregiving. As in infancy, multiple attachments may occur simultaneously throughout adulthood; for example, to a spouse and friend, as well as to one’s children. That raises a sixth problem: In the model, attachment is confined to the infancy and early childhood period, ending, as noted by Bowlby, during puberty. It does not consider attachments that occur during adolescence (the first love), during adulthood (spouses and lovers), and during later life (the strong attachments noted between friends in retirement). Some may claim that the recently designed Adult Attachment Interview acknowledges adult attachment. However, it is not focused on adult attachments to other adults. Rather, it is a memory-based instrument used to assess adults’ attachments to their parents during childhood.

A parsimonious model of attachment would need to accommodate multiple attachments to a variety of figures at different stages of life. We have used a more psychobiological approach in formulating a model that focuses on the relationship between two individuals and what they share and what might then be missing when they are separated. In this model (Field 1985), attachment is viewed as a relationship that develops between two or more organisms as they become attuned to each other, each providing the other meaningful stimulation and arousal modulation. The loss of this important source of stimulation and arousal modulation, which occurs in separation, invariably results in behavioral and physiological disorganization. Both this model and the Bowlby-Ainsworth model will be considered throughout as I review the data on attachment and separation.

PHYSIOLOGICAL DATA ON SEPARATION

Physiological data recorded during the separations of young primates and children from their mothers confirm the biphasic response to separation noted by Bowlby (1969) as protest and despair, which is a period of agitation, followed by a period of depression. The primate data are based on mother-infant pigtail and bonnet monkey separations monitored by surgically implanted telemetry (Laudenslager et al 1982, Reite & Capitanio 1984, Reite et al 1981b, Reite & Snyder 1982). Generally, in these studies behavioral agitation was followed by depression during the separation period. Shortly after the separation, the infants exhibited agitation characterized by increased motor activity and frequent distress vocalizations. Depressed behaviors typically emerged shortly thereafter and persisted throughout the separation period. The infants moved more slowly than normal, and their play behavior was diminished. Sleep disturbances were characterized by decreased rapid eye movement.
REM) sleep as well as by increased arousals and time spent awake. The agitated behavior that occurred immediately after separation was accompanied by increased heart rate and body temperature followed by decreases in these values to below baseline (Reite et al. 1978).

In addition to behavioral and physiological disorganization, altered cellular immune responses were noted in the separated pigtail monkeys by Reite et al. (1981a) and in the squirrel monkeys by Coe et al. (1985). For example, during the separation of two pigtail monkeys who had been reared together, an altered cellular immune response occurred (Reite et al. 1981a). At five weeks following reunion, the cellular immune response of both monkeys was still slightly depressed. Pigtail infants separated from their mothers also experienced persistent separation effects. For example, although heart rate tended to return to baseline and arrhythmias tended to disappear following the infants’ reunion with their mothers, the altered cardiac activity persisted for some infant monkeys (Seiler et al. 1979). In another study, persistent decreases in infant heart rate and body temperature were noted following reunion with the mother (Reite & Snyder 1982). Thus, the effects of these separations often persisted even after reunion with an attachment figure such as the mother or a peer. Similar data have been reported for hospitalized preschool children who were receiving chemotherapy for childhood cancer (Hollenbeck et al. 1980). The disorganizing effects of separation generally paralleled those reported for primates. Behaviorally, the children first showed agitation and then depression, as manifested by their play behavior, behaviors that were paralleled by changes in body temperature and heart rate.

Stress and Coping with Separation

SEPARATION IN INFANTS AND CHILDREN In a study of preschool children’s responses to separation from the mother during the birth of another child (Field & Reite 1984), agitated behavior and physiology during the period of the mother’s hospitalization were observed. Depression then followed in the children after the mother’s return from the hospital. In the Field & Reite study, play sessions were videotaped, night-time sleep was time-lapse videotaped, and the parents were administered questionnaires on changes in their child’s behaviors. Increases in negative affect, activity level, heart rate, night wakings, and crying characterized the period of the mother’s hospitalization as one of agitation for the children (see Figures 1 and 2). Longer periods of deep sleep at this stage were interpreted as conservation-withdrawal (as if withdrawing from stimulation to conserve energy) (see Figure 2). Following the mother’s return, decreases were observed in positive affect, activity level, heart rate, and active sleep, suggestive of depression (see Figures 1–3). Changes reported by the parents included greater clinging and aggressive behaviors, eating and toileting prob-
lems, and disturbed sleep and illnesses that persisted following the mother’s return from the hospital (Figure 4). Examples of the child’s disturbance were revealed in parents’ comments that the child “wanted to be rocked and held,” “reverted to baby talk, whining, and screaming for attention,” and “threatened to run a truck across the baby’s head.” Elevated tonic heart rate in the children during the mother’s hospitalization and depressed heart rate following her return may have been mediated by the activity level changes, as in somatic coupling of activity and heart rate (Obrist 1981). These elevated levels have in turn been attributed to sympathetic adrenergic activation (Breese et al 1973). More prolonged periods of deep sleep during this phase may be the result of conservation-withdrawal noted to follow stress in infants and young children (Emde et al 1971, Engel & Schmale 1972).

Decreased activity, depressed heart rate, and shorter periods of active sleep, together with flat affect following the mother’s return may suggest depression. Depressed children have less active sleep (Kupfer et al 1979), and depression can be alleviated by depriving subjects of REM sleep (Vogel 1979). The decrease in active sleep may be a homeostatic coping mechanism.

Decreased activity and heart rate are commonly reported when individuals are in situations in which they are helpless, such as an avoidance task in which human subjects have no control, situations in which adrenergic influences are minimal (Obrist et al 1978). Bradycardia, associated with situations of helplessness, has also been attributed to parasympathetic activation or vagal tone (McCabe & Schneiderman 1983). The arrival of a new sibling; a less active, tired mother; and changes in children’s play interactions with their mother may have been viewed by the children in the Field & Reite (1984) study as situations over which they had very little control. The depressed behavior may

Figure 1  Mean activity level and heart rate in beats per minute (BPM) of children prior to their mother’s hospitalization (PREHOSP), during hospitalization (HOSP), and following her return from the hospital (POSTHOSP) (from Field & Reite 1984).
have been exacerbated in these children by the arrival of the new sibling and an altered relationship with the mother.

Heightened levels of arousal may stimulate the sympathetic adrenergic system, resulting in agitated behavior. This behavior is typically associated with active coping, in this case with attempting to recall the mother. Agitation during separation may occur because of heightened arousal in the absence of
the child’s principal arousal modulator, the mother. Depression may emerge as the separation continues because of the child’s failure to bring the mother back and of a lack of stimulation ordinarily provided by the mother. The depression may be an adaptive homeostatic mechanism offsetting the effects of sympa-
thetic arousal, or it may result from inadequate amounts of stimulation and limited beta-adrenergic activity. Confounds in the Field & Reite (1984) study on separation effects were the changed relationship between the mother and first-born because of the arrival of the new sibling, the exhaustion of the mother, and very frequently the postpartum depression of the mothers themselves. These confounds, coupled with the concern generated by data showing that repeated separations had cumulative effects on monkey infants, led us to perform a study looking at repeated separations of children from mothers.

![Figure 4](image-url)  
Figure 4  Number of children who experienced feeding, toileting and sleeping changes, and illness during the separation-reunion period.
going on conference trips (Field 1991). Although the preschool children in the study showed similar separation behavior as when the mothers went to the hospital, they did not continue to show depression-related behavior after their mothers returned. In addition, the first trip had the worst effect, and the effects were not cumulative. Perhaps it is not surprising that because of their cognitive coping skills, the children were able to adapt to that stress.

PEER SEPARATIONS A surprising finding for many attachment researchers is that early peer separations also are distressing for young children. A peer separation that occurs naturally and with some frequency results from the transfer of children to new schools. In a recent study, Field (1984) observed preschool children who had been together for three to four years and who were transferring to new schools. The observations were made during a two-week period prior to the separation from their classmates (Field 1984). The children who were leaving the school, as opposed to those who were staying, showed increases (compared with baseline observations three months earlier) in fantasy play, physical contact, negative statements and affect, fussiness, activity level, tonic heart rate, and illness, as well as changes in eating and sleeping patterns (see Figures 5–8). In addition to the changes in play behavior and in vegetative functions, the children’s drawings of themselves manifested agitation and disorganization. The drawings included distorted facial and body parts and sad faces (see Figure 8).

The anticipatory reactions to separation by these children appeared to mimic the immediate responses to peer separations by young monkeys (Reite et al 1981b). They were also very similar to the behaviors noted in young children immediately following the hospitalization of their mothers for the birth of another child (Field & Reite 1984). In these studies, the increase in fussiness, negative affect, aggressive behavior, physical activity level, and tonic heart rate are suggestive of agitation. Although changes in eating patterns were variable, with some children eating more and others eating less, sleep disturbances uniformly involved more frequent night wakings, crying, and delayed onset of sleep. Increased illness during the children’s separations is consistent with reports of changes in the immune system of young primates during mother and peer separations (Reite et al 1981a, Reite & Snyder 1982).

Separation stress occurs when peers even as young as 15 months are separated (Field et al 1984b). In the Field et al study, 15-month-old infants were transferred, following 14 months in an infant nursery, to a toddler nursery, and 24-month-old infants were graduated from a toddler nursery to a preschool nursery. Many of the same behavior changes occurred during the week immediately preceding the transfer and the week following the transfer. These included increased inactivity, negative affect, fussiness, and changes in eating and sleep behaviors. Nap-time sleep became more irregular with longer laten-
Figure 5  Proportion of peer-play-time negative faces, fussiness, and verbal and physical aggression occurring during the baseline (B) and preseparation (P) observation periods.
cies to sleep and more frequent arousals during nap time. In addition, erratic feeding patterns were noted as well as more frequent illness. A comparison between those infants and toddlers who were transferred to the new nurseries without close friends and those who were transferred with close friends suggested that transferring with close friends may buffer the stressful effects of the separation. Thus, the data from this group of studies are a poignant demonstration of the disorganizing effects of mother and peer separations on both the behavior and physiology of young monkeys and children.

**Biological Markers and Mechanisms in Animal Models**

Panksepp et al (1985) have advanced a model for attachment based upon opiate systems and derived from data on very diverse species including chicks, guinea pigs, and dogs. Because the social-separation state was similar to opioid withdrawal in their studies, opiate receptor agonists were expected to reduce separation distress. The opioid agonists Panksepp et al tested did alleviate separation distress, and when they blocked opioid receptors by naloxone, separation distress increased. They then evaluated the specificity of the opioid effects using a variety of agonists and antagonists for cholinergic, noradrenergic, dopaminergic, and serotonergic receptor systems. Only clonidine (which alleviates opiate withdrawal symptoms in humans) approached the level of efficacy of opioids.

*Figure 6* Mean activity level and heart rate in beats per minute (BPM) of children during peer play for the baseline (B) and preseparation (P) observation periods.
In another model, Kraemer (1985) postulated that early social deprivation may exert its effects through deprivation-induced (or denervation-induced) supersensitivity, possibly of noradrenergic systems. Isolated rodents, for example, become hyperactive when placed in a novel environment. This hyperactivity can be prevented by antidepressant agents. Kraemer stated that “the
Figure 8  Examples of self-drawings made prior to the departure of children attending new schools.
behavioral effects of antidepressant agents in previously isolated subjects may be due to their ability to reduce isolation-induced supersensitivity of cortical systems with noradrenergic inputs” (p. 152).

Coe et al (1985) have presented a separation model in which they argue that an acute response to separation may be adaptive, but data on sustained separations suggest that prolonged cortisol elevations can adversely affect the immune system (at least in squirrel monkeys). Sustained elevations of cortisol and the absence of behavioral symptoms may be a manifestation of depression not unlike the sustained elevations of cortisol frequently noted in depression.

Applications to the Human Infant

In Bowlby’s (1969) descriptions, protest was typically followed by despair during the child’s separation from its mother. The data reviewed in this chapter on the separations of young primates and young children confirm a biphasic response to separation with an agitated period typically followed by a period of depression. In the studies by Reite and his colleagues on infant monkeys, infants exhibited an agitation reaction that included increased motor activity, frequent distress vocalizations, and elevated heart rate and body temperature immediately after the separation. This agitation reaction was typically followed by depressed behavior and decreases to below baseline in both heart rate and body temperature. Similarly, in the Field & Reite (1984) study on children’s separations from their mothers during hospitalization for the birth of another child, agitated behavior occurred immediately following the separation, with increases in negative affect, activity level, heart rate, night waking, and crying. Following the mother’s return, decreases were noted in these measures, suggestive of depression.

Moves to new places were the only separation situations that did not result in a biphasic process of agitation followed by depression. For example, less depression was noted in separated monkeys moved away from their social group to an isolation cage (Reite 1983), and infants, toddlers, and preschoolers apparently did not experience depression when they were moved to a new classroom (Field et al 1984b) or a new school (Field 1984). In the study on infant monkeys, only approximately 15% of the infants became depressed when they were separated from both their mothers and their social group and placed in isolation, while as many as 80% of the monkeys became depressed if they remained in their social group without their mother (Reite 1983). Reite speculated that the pigtail infants who were separated from both their mother and peers and placed in isolation did not show behavioral and physiological depression perhaps because isolation is a fearful experience. Fear may counteract the expected decrease in beta-adrenergic activity typically associated with depression.
Remaining after separation in an environment that reminds the infant of its mother may be more distressing for the infant than moving to a different environment. The children who were leaving their peers for a new school (Field 1984) did not appear to experience the biphasic process of agitation followed by depression. The anxiety related to attending a new school and making new friends may have offset any expected depression. The stress of joining a new group may have compounded the separation stress, thus sustaining the agitated behavior and physiology. New stresses may present active coping opportunities for the departing children, while the remaining children may feel “stuck” in a passive coping or helpless situation of continually being reminded of their missing peers by those environmental features associated with them.

Coe & Levine (1983) have suggested that the absence or unpredictability of reinforcement under conditions where reinforcement has been continuously present will lead to a stress response. Similar to several other researchers, he has designated control or the ability to make a coping response as the primary mechanism in dealing with stress and the lack of control associated with helplessness (Seligman 1975, Weiss 1971a,b).

These propositions suggest that separation may be stressful to the infant and young child because of the loss of a major source of reinforcement; reinforcement is typically provided by the mother in the form of adequate stimulation and arousal modulation. Loss of control, feedback, and predictability, which are clearly important features of their interaction (Field 1978), could also occur during separation. An active coping response of the infant in the separation situation might be either to seek stimulation and reinforcement from other members of the group (as a substitute for mother) or to temporarily withdraw from interactions with the group and become inactive.

We have argued elsewhere (Field 1985) that separation distress occurs primarily because the infant has lost its primary source of stimulation and arousal modulation. Aunts in the case of infant monkeys and fathers in the case of human children may serve as substitute caregivers. However, they may not be as effective as the mother in providing stimulation and arousal modulation because they are typically not as familiar with the child’s individual needs for stimulation and arousal modulation. Thus, a monkey or human infant, already highly agitated because of the absence of the mother, may become even more agitated during any attempts made by substitute caregivers to provide stimulation and arousal modulation. In this case, the most adaptive response for the infant may be to withdraw and remain inactive in order to avoid the stimulation of others or the stimulation of its own activity. Depressed activity or conservation-withdrawal may continue at least until physiological equilibrium is restored or until conspecifics have become familiar with the individual’s unique stimulation and arousal modulation needs. In this model, temporary
depression and inactivity may be seen as adaptive behavior for warding off the highly stimulating behavior of other members of the group at a time when the infant is vulnerable to heightened arousal levels due to the absence of its primary arousal modulator, the mother.

Depression also serves as a period of physiological recuperation from the previous agitation phase. Depression, helplessness, and passive coping, however, are often considered unhealthy experiences that may contribute to disease and death. This may especially be the case when depression is experienced for prolonged periods. However, in the short term depression, helplessness, and passive coping may be the only immediately effective coping mechanisms available to the young organism separated from an attachment figure. Temporary depression or conservation-withdrawal may serve as effective coping mechanisms until physiological equilibrium is restored and the mother returns, or an effective substitute attachment figure becomes available.

PSYCHOBIOLOGICAL ATTUNEMENT: AN ALTERNATIVE ATTACHMENT MODEL

Research on attachment has been conducted in the separation context, and the proposed psychobiological mechanisms and theories of attachment have been inferred from separation effects. An attachment model derived from research on mother-infant separation effects is not only limited because it pertains to only one type of attachment but also because separation models do not specify what is ordinarily present in a relationship that is then missing during separation. Further, the disorganizing effects of the separation often persist following reunion of the attached pair. Thus, separation per se is not the only disruption to an attachment bond. As Field (1985, pp. 415–16) has noted:

A better understanding of the process may require the study of multiple kinds of attachments at different life stages and may include both overt and physiological behaviors that occur when attached individuals are both together and apart....Attachment might instead be viewed as a relationship that develops between two or more organisms as their behavioral and physiological systems become attuned to each other. Each partner provides meaningful stimulation for the other and has a modulating influence on the other’s arousal level. The relationship facilitates an optimal growth state that is threatened by changes in the individuals or their relationship or by separation and the behavioral and physiological disorganization that ensue. Thus, attachments are psychobiologically adaptive for the organization, equilibrium and growth of the organism. Because the organism’s behavioral repertoire, physiological makeup, and growth needs are an integrated multivariate complex that changes developmentally, multiple and different types of attachments are experienced across the lifespan.
In a similar vein, Reite & Capitano (1985) suggested that “attachment in fact represents a neurobiologically based and mediated biobehavioral system one of whose major functions is to promote the development and regulation (or modulation) of psychobiological synchrony between organisms” (p. 224). Support for this model comes from different species. In separated rats given substitute milk and heat, physiological and behavioral effects of separation persisted (Hofer 1981). Hofer suggested “a view of the mother as an eternal physiological regulating agent controlling autonomic cardiovascular balance by the level of milk she supplies.” Similarly, simulated maternal licking of rat pups reversed the growth hormone deficits associated with separation (Kuhn et al 1978). In human neonates, maternal caretaking and sleep-wake activity cycles became synchronized only in the presence of a consistent caregiver (Sander et al 1970). Similarly, behavior and heart rate of slightly older infants and mothers share a common variance during early interactions (Lester et al 1982) and during later strange situation sessions (Donovan & Leavitt 1985). This synchrony does not happen during interactions with strangers (Yogman et al 1983). Married couples share behavioral and heart-rate rhythms during interactions (Levenson & Gottman 1984) as well as cycling of cortisol levels (Lundberg et al 1981).

One of the most salient examples, perhaps, is that provided by Reite & Capitano (1985) on infant monkey peers. The heart rates of two attached pigtail infants who had been reared together were highly correlated. This relationship decreased during separation. Following reunion the correlations of their heart rates and body temperatures returned to baseline. In contrast, heart rate and body temperature were not correlated in two mother-reared monkeys who were not attached to each other. Similarly, time spent in delta sleep was highly correlated for the attached pair but not for the unfamiliar peers. Although Reite & Capitano offered these data as tentative evidence for the potency of reciprocal entrainment of rhythms in attached individuals who are attached, these investigators also raised important empirical questions: “If attachment facilitates synchrony of rhythms between individuals, is this central to attachment, a precondition for attachment, an outcome of attachment, or an epiphenomenon?” (p. 243). These questions offer future directions for research on the psychobiology of attachment and separation.

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