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Original Article

Natural Parenting — Back to Basics in Infant Care

Regine A. Schön, Department of Psychology, University of Helsinki, Helsinki, Finland.
Email: regine.schon@helsinki.fi (Corresponding author)

Maarit Silvén, Department of Psychology, University of Tampere, Tampere, Finland.

Abstract: This review examines an age-old approach to parenting recently rediscovered in Western industrialized societies and known by names such as natural parenting, attachment parenting, and instinctive parenting. Its leading principle is utmost sensitivity to the child's innate emotional and physical needs, resulting in extended breastfeeding on demand, extensive infant carrying on the caregiver's body, and cosleeping of infant and parents. The described practices prevailed during the evolutionary history of the human species and reflect the natural, innate rearing style of the human species to which the human infant has biologically adapted over the course of evolution. An overview of research from diverse areas regarding psychological as well as physiological aspects of early care provides evidence for the beneficial effects of natural parenting. Cross-cultural and historical data is cited to reveal the widespread use of the investigated parenting style. It is concluded that the described approach to parenting provides the human infant with an ideal environment for optimal growth both psychologically and physiologically. It is yet to be determined how much departure from this prototype of optimal human parenting is possible without compromising infant and parental wellbeing. The review also invites a critical reevaluation of current Western childrearing practices.

Keywords: natural parenting, attachment parenting, infant carrying, breastfeeding, bed sharing, prototype of optimal human parenting.

Introduction

Approaches to infant care have changed throughout history, and even at the present time there is considerable variation in the ways different cultures handle the care of their infants. Even within a particular culture different subgroups may vary greatly in their typical childrearing practices. Although socialization has always aimed to mold children to fit a particular society at a certain time in history, the fundamental needs of a young infant, especially during the first few months of life, are universally the same: adequate nutrition, sufficient sleep, and fulfillment of basic emotional needs. This leads to the question of

whether any of the known child-caring approaches succeeds better than the others in providing the young infant with an optimal environment for physical and psychological growth. Or to phrase the question differently: What is the ideal way to care for infants?

An increasing number of parents and child-care experts in the industrialized West have come to view the prevalent Western approach to infant care as not sensitive enough to an infant's innate needs. Instead, they have turned to a childrearing approach that considers the children themselves to be the best experts in defining their own needs (Frissell-Deppe, 1998; Granju, 1999; Hunt, 2001; Sears and Sears, 2001). By closely observing the infants' communicative signs and by sensitively responding to their expressed needs, adherents of this parenting style believe they are laying the foundation for most favorable human development. Within this childrearing style, crying is always interpreted as a clear communication of a legitimate need, and the emotional demands of children are considered to be as valid as physiological ones. A further characteristic of this parenting approach is the belief that parents have an innate sensitivity to their child's cues and an instinctive knowledge of the required responses.

On a practical level this results in the infants being kept in close physical contact to their mothers for most of the day until the children start to become mobile, after which physical closeness gradually lessens. During the day the infants are carried on the caregivers' bodies, in the front, back, or on the hip, frequently with the help of a carrying device, and at night they sleep next to their parents. The children are breastfed on demand for at least 2–4 years and the process of weaning is child-led. Cosleeping of parents and children may continue for years.

This approach to parenting has been given many names: empathic parenting (Hunt, 2001), instinctive care (Granju, 1999), attachment parenting (Frissell-Deppe, 1998; Granju, 1999; Sears and Sears, 2001), natural nurturing (Natural Nurturing Network, n.d.), natural parenting, parenting from the heart (Hunt, 2001). Rather than advocating the application of a rigid set of guidelines, it calls for a parenting style geared to the individual child's unique personality, which is thought to result in the best possible care for the infant. Although many aspects of natural parenting are already currently implemented by many Western parents in varying degrees, approaches that combine all of its elements are nonetheless rare in the contemporary West.

The following account will describe the intricately related nature of mother–infant dyads that adhere to the principles of natural parenting, covering the age range from infancy to early childhood, with a focus on the first year of life. Different aspects of this dyad's functioning will be elucidated, and benefits associated with this age-old approach to parenting will be examined. This paper is organized in such a way that arguments have been grouped together under four main headings, starting with information pertaining to our evolutionary past, then proceeding to discuss physiological data, and finally turning to issues of a mainly psychological nature, followed by a cross-cultural and historical overview of parenting practices. A “summary and conclusion” section at the end of the paper ties up all arguments and concludes the review. For an outline of the article's structure and for an overview of the topics to be discussed, see Table 1. The approach taken in this work is multidisciplinary in nature and integrates a wide range of data from the fields of developmental psychology, evolutionary psychology, anthropology, pediatric medicine, physiology, and neuroscience. This paper further draws on data from both human and animal research, and both healthy and clinical populations, in order to use the broadest knowledge base possible for a comprehensive description of the current state of knowledge pertaining to optimal infant care in accordance with the innate needs of the human infant.

Table 1

Overview of Topics Discussed in This Paper

- Evolutionary Context
 - Evolutionary Function of Crying
 - Human Infants as “Carried Young”
 - Cosleeping
 - Breastfeeding
 - Exterogestation
 - Heartbeat and Uterine Sounds
 - Movement Stimulation
 - Swaddling
 - Continuous and Multi-Sensory Stimulation
- Health Aspects of Natural Parenting
 - Physiological Correlates of Crying
 - Skin-to-Skin Care for Preterm Infants
 - Touch Effects on Physiology
 - Physical Growth
 - Immunological Processes
 - Psychosocial Dwarfism
 - Thermal Regulation
 - Orthopedic and Other Health Aspects of Infant Carrying
 - Spinal Health
 - Hip Development
 - Characteristics of a Good Carrying Device
 - Microenvironment Inside a Carrier
 - Gastroesophageal Reflux and Otitis Media
 - Infant Toilet Training—Elimination Communication
 - Bed Sharing and SIDS
 - Breastfeeding
 - Benefits for the Child
 - Benefits for the Mother
 - On-Demand Feeding
 - Weaning
- Psychological Correlates of Natural Parenting
 - Mother–Infant Interaction and Attachment
 - Sensitive Parenting and Secure Attachment
 - Parental Responsiveness and Infant Crying
 - The Role of Physical Proximity
 - Natural Parenting, Sensitive Parenting, and Mother–Infant Attachment
 - Dependence—Independence
 - Brain Development—Physiology Meets Psychology
- Prevalence of Natural Parenting
 - Infant Carrying
 - Climatic Influences
 - Specifics of Infant Carrying: Who, How, and With What?
 - Cosleeping—Bed Sharing and Room Sharing
 - Bed Sharing Across the Globe
 - Bed Sharing in the Contemporary West
 - Room Sharing Across the Globe
 - Room Sharing in the Contemporary West
 - Infant Feeding
 - Wet Nursing
 - Artificial Feeding
 - The Industrial Revolution—Decline of Breastfeeding
 - Feeding Practices Reassessed
 - Current Situation
 - Specifics of Breastfeeding

Before moving on to the substance of this paper, the reader should be made aware that the position presented in this paper, although drawing upon evolutionary information in discussing infant care, is distinct from many other evolutionary approaches to parenting (e.g., Hrdy, 1999; Salmon, 2005; Soltis, 2004; Trivers, 1974), in that it is primarily focused on both psychological and physiological wellbeing of the individual infant, whereas traditional evolutionary approaches to infant care have typically examined the topic at the level of the gene and been concerned with issues such as reproductive success, parent–offspring conflict, parental investment decisions, and the role of various infant behaviors (e.g., crying) as means to increase the infant’s reproductive fitness. The subjective wellbeing of the infant has not been a major focus of the latter approaches, unless related to increased survival chances and future reproductive success. The present review, on the other hand, only uses evolutionary information to provide a description of what could be called an ideal-case scenario of infant care unconstrained by other competing demands. It thus presents only one side of the coin, with the central questions framed in terms of infant wellbeing rather than reproductive success.

The current perspective is also distinct from attachment theory (Ainsworth, Blehar, Waters, and Wall, 1978; Bowlby, 1982), although there is overlap between the two positions. Both stress caregiver sensitivity to infant needs and acknowledge the evolutionary roots of infant behavior. However, attachment theory in its focus on the infant’s psychological relationship with the caregiver has a narrower scope, excluding aspects of physiological wellbeing (except when referring to the survival function of caregiver attachment), and further gives the evolutionary context of caregiving mainly explanatory value, so that the dominant parenting paradigm of the modern West has remained relatively unchallenged within this research tradition. As a result, inherent infant needs are partly defined in different ways by the two approaches (cf. Zeifman, 2001, p. 280).

Finally, the current analysis acknowledges that cross-cultural differences in parenting are evolved adaptations to different contextual demands (e.g., climatic and geographical circumstances, environmental hazards, forms of subsistence, cultural values, and socioeconomic conditions; Kaplan and Dove, 1987; Keller, H., Borke, Yovsi, Lohaus, and Jensen, 2005; LeVine et al., 1996, pp. 247–256; Quinlan, 2007; Whiting, J. W. M., 1981), and that different survival strategies have also evolved in the child to meet different circumstances (cf. adaptiveness of different attachment strategies; Main, 1990; see also Belsky, Steinberg, and Draper, 1991; Chisholm, 1993, 1996). Yet, the main point of this paper is that not all of these adaptations have produced optimal outcomes for the infant, and it is thus argued that in situations where parents have some leeway as to how to parent, knowledge about the limits of optimal caregiving can be of invaluable assistance in the process of weighing different caregiving options.

Evolutionary Context

Evolutionary Function of Crying

When taking the stance that young infants signal genuine needs by crying (Zeifman, 2001), then the message infants convey to their environment is unmistakable: Extensive close contact with their caregiver is a necessary prerequisite for their wellbeing. However, the outdated advice that parents should not give in to their infant’s calls for closeness to prevent the child from learning “that crying will get him what he wants, sufficient to make a spoiled, fussy baby, and a household tyrant whose continual demands make a slave of the mother”—as recommended by the U.S. Children’s Bureau (U.S. Department of Labor, Children’s Bureau, 1926, p. 44) between 1920 and 1940 (Bell and Ainsworth, 1972; see also

Holt, 1943) and still commonly followed in the 1950s and 1960s (Small, 1998, pp. 146 and 175)—is surprisingly persistent in making mothers even today mistrust and resist their natural impulse to tend to their crying infant. Yet, theories on the evolutionary function of crying and resulting inferences pertaining to modern life, as summarized by Bell and Ainsworth (1972; see also Barr, 1999; Small, 1998; Zeifman, 2001) and described below, are directly counter to this view (Ainsworth, 1969, 1972, 1973; Ainsworth and Bell, 1970; Bowlby, 1958, 1982).

Beginning with our first human ancestors who roamed the savannas of Africa about 2 million years ago, the evolutionary environment of the human infant during most of human history is best described as that of small hunter-gatherer groups moving about in the country with an ever-present danger of predators (Barkow, Cosmides, and Tooby, 1992, p. 5; Fagan, 2002). To ensure the survival of the offspring, born in a neurologically immature state as a result of the female's narrowed birth canal brought about by bipedalism, continuous protection and care by the caregiver was a necessity. In a species where the progeny is as helpless as that of the human, attachment behavior on the infant's part alone is not sufficient to ensure continued existence; only in combination with reciprocal maternal behaviors is its protective function maximized. A strong emotional bond between infant and mother, as well as a feedback system that was activated if the contact was for some reason interrupted, were the mechanisms that maintained the mother's extensive involvement with her offspring. In this context, crying was a powerful trigger that alerted the mother when her offspring was hungry, otherwise unwell, or separated from her protecting influence. As predators might also be attracted by the crying infant, it was, however, an obvious advantage if the vocal signal was terminated as soon as mother and infant were reunited, or if the source of the distress was removed. On the other hand, it made sense to continue and possibly intensify the signal if there was no response from the caregiver. Under such circumstances it would also seem advantageous for an infant to cry only in the most alarming situations and to employ other, less dramatic, means of communication in all other cases.

As these conditions prevailed during most of our evolutionary history, survival-promoting behavior patterns associated with this evolutionary context, such as crying in infants, became a natural part of the human genetic makeup. Physically, modern human infants have changed very little since these times. Therefore, newborns today will insist on continuous care as vehemently as they did hundreds of thousand years ago when life was still a daily battle for survival. If some caregivers assume that constant physical contact is no longer necessary for an infant's smooth development, this may well be true in terms of present-day living conditions, but it is nonetheless in conflict with what infants have been biologically adapted for.

Human Infants as "Carried Young"

Modern notions in biology have also led to the human infant being classified as belonging to the "carried type of young" (i.e., infants that are typically carried on the bodies of their mothers), in contrast to the offspring of other mammals that are generally left in a hidden place (i.e., nested or cached), or to those that are physically developed enough to independently follow their mothers soon after birth (review: Kirkilionis, 1997a, 1997b). This view is based on evolutionary, particularly anatomical, considerations, and is substantiated by young infants' typical reactions when parted from their caregivers. Even though human infants no longer possess feet specifically designed for clinging, and despite the fact that their mothers are no longer covered by dense body hair, as is the case among our closest relatives in the animal world, human infants still display many striking characteristics of a carried young. Like a gorilla baby, the human infant, when lying on the back, frequently assumes a position where both legs are flexed and abducted (Figure 1). This position is also adopted

when the lying or sitting child is lifted up (Figure 2) and allows the child to be placed astride the caregiver's hip, nestled against the carrier's body (Figure 3). In addition, a newborn's spine, unlike the adult S-shaped spine, is slightly rounded and so restricts thigh movements to the front of the body. When lying on their backs, newborn are therefore incapable of bringing their thighs completely down to touch the surface underneath. This anatomical feature does not support upright walking, but is ideal for lateral sitting on the caregiver's hip, which was the most suitable infant carrying position following the emergence of bipedalism and the loss of body hair in the evolving human species. As a result, support of the infant's back by the caregiver became necessary, which, however, is also still observed among the grand apes, particularly during early infancy. Human infants also actively contribute to sustained carrying by pressing their legs against the carrier's body in reaction to unexpected or brisk movements. If the evolution of primates has progressed from non-infant-carrying to infant-carrying, as assumed by Kappeler (1998) and Ross (2001), then it is further noteworthy that of all primates the lineage leading to modern-time (Western) *Homo sapiens* is the only one where habitual infant carrying has been lost once it had evolved during an earlier stage of development (Ross, 2001).

Figure 1: An infant gorilla and a 3-month-old girl, both with their legs in a position of flexion and abduction. The photo of the gorilla baby is courtesy of E. M. Lang and depicts Goma, born in 1959 at the Basel Zoo in Switzerland. The photo of the infant is courtesy of E. Kirkilionis.



Figure 2: A 6-month-old girl assumes a leg position of flexion and abduction after losing contact with the ground. The photos are courtesy of E. Kirkilionis.

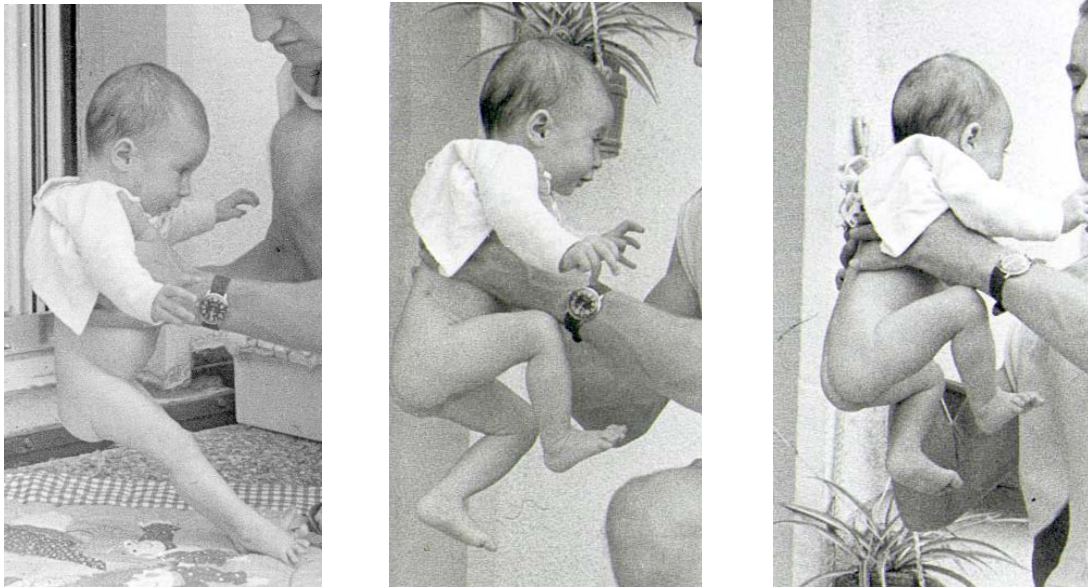
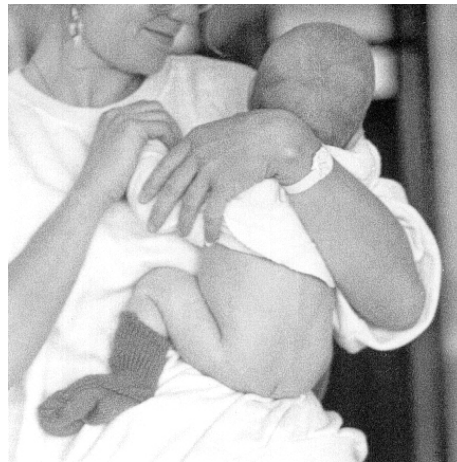


Figure 3: A 3-week-old infant straddling the mother's hip. The photo is courtesy of E. Kirkilionis.



Also, when examining a newborn's grasping and Moro (startle or embracing) reflexes, not in isolation from each other but as a pair, it becomes clear that when the startle response is elicited while the palmar grasp is active, and while a mild traction is applied on the arms, the result is strengthened clinging (Prechtl, 1965)—a useful response if considered in the context of an infant holding on to a caregiver who may have made an unexpected move, decreasing the infant's chance of falling from the caregiver's body.

Interspecies comparisons provide further clues regarding the human infant's preferred location. The composition of a species' breast milk (Ben Shaul, 1962) and the sucking speed of the offspring (Wolff, 1968) can be used as indicators of the ideal caretaking mode as well as the typical spacing of feeds (Ben Shaul, 1962; Blurton Jones, 1974). Mammals can be roughly divided into two groups. First, there are animals with a very high protein and fat content in their milk (e.g., rabbits) that nurse their young infrequently—every few hours or

only once a day. Between feedings the young are left in a secluded place while the mother spends extended periods of time away from them. Sucking rate tends to be high. In contrast, species whose milk is low in fat and protein feed their progeny at short intervals, or almost continuously. Further characteristic features of the latter group are extensive contact between the mother and her young (the infants follow the mother, are carried by her, or hibernate with her) and a comparatively lower sucking rate of the infants. Higher primates, who carry their offspring on their bodies and feed on demand, are typical representatives of this group. Human breast milk is low in fat and very low in protein (Lawrence, 1994), implying that human infants, too, are fairly continuous feeders adapted to extensive maternal contact.

Further evidence that human infants are of the carried rather than the nested or cached type of young is provided by known facts on other typical behaviors of mammals with intermittent vs. extensive maternal contact. For instance, young animals that are typically left alone for much of the day often do not defecate or urinate readily without assistance, probably in order to avoid attracting predators by scent (Ben Shaul et al., 1962; Blurton Jones, 1974, p. 313). Neither do they cry spontaneously during the absence of their mother (Blurton Jones, 1974, pp. 314–315). However both behaviors are common in the human infant.

In addition, it has been inferred from human infants' distribution of body fat that continuous ventral contact between infant and caregiver is the caretaking mode most supportive of the child's immature temperature regulation system (Als, 1977). As the dark lipid cells that insulate the body are much more densely distributed on the infant's back than on the ventral side, continuous frontal contact was an excellent guard against loss of body heat during most of human history. The same still appears to hold true today (Christensson et al., 1992; Färdig, 1980).

Cosleeping

A natural extension of infant carrying during the day is bed sharing at night. The practice of infant–mother cosleeping in the same bed is the predominant form of nighttime care in most cultures today (McKenna, 1993). It is further assumed to have been the context of evolutionary history in which child sleep physiology was shaped into its present state (Lozoff and Brittenham, 1979; McKenna, 1986). As described by McKenna (1986), bed sharing is therefore also believed to be the sleep environment to which the neurologically vulnerable human newborn and young child is best adapted. Taking the inference one step further, McKenna and colleagues (e.g., McKenna, 1986, 1996; McKenna and Mosko, 1990; McKenna et al., 1993) hypothesize that, if practiced safely, cosleeping may even reduce a child's risk of dying from at least some forms of sudden infant death syndrome.

Breastfeeding

It can be assumed that no effective alternative to breast milk existed before the domestication of animals and before humans had acquired the ability to make vessels that could hold liquids (Small, 1998, p. 183). Therefore, during the more than 99% of our human existence when hunting and gathering was the main form of subsistence (Fagan, 2002, e.g., p. 122) all infants would have been breastfed. Moreover, as the composition of mammalian milk is species-specific (American Academy of Pediatrics, 2005a; Ben Shaul, 1962), the milk of human mothers has evolved to uniquely complement the nutritional needs of their own offspring. Indeed, human milk is an exceptionally complex biological fluid with thousands of constituents (Picciano, 2001), the exact composition and dynamic quality of which artificial breast milk substitutes are unable to replicate (Rodriguez-Palmero, Koletzko, Kunz, and

Jensen, 1999). In this connection, it is noteworthy that in a study on odor preferences, 2-week-old newborns who had never been breastfed were found to exhibit an apparently inborn preference for the breast odor of a lactating, unfamiliar woman over the scent of their familiar formula (Porter, Makin, Davis, and Christensen, 1991).

Regarding the particulars of nursing to which human infants adapted over the course of evolution, their inherent need for shortly spaced feedings has already been discussed. The question of weaning age can also be answered by comparative analyses. According to Dettwyler (1995) who studied weaning patterns in nonhuman primates, a primate species' typical age of weaning can be inferred from a number of factors such as eruption of the first permanent molar, birth weight, adult body weight, and length of gestation. When applying these calculations to humans, our natural weaning age is estimated to fall between 2½ and 7 years (Dettwyler, 1995). In cultures where no artificial infant formulas are used and in societies where child-led weaning is the norm, children have been observed to nurse for 2–6 or more years, averaging 2–4 years in most cases (Barry and Paxson, 1971; Dettwyler, 1995; Nelson, Schiefenhoewel, and Haimerl, 2000; Stuart-Macadam, 1995), thus lending support to Dettwyler's inferences. A comparison of weaning ages in different primate species further indicates that those primates who habitually carry their infants on their bodies have later weaning ages than primates who cache their offspring in nests or on trees while foraging (Ross, 2001).

Exterogestation

A caretaking style that encourages continued contact between mother and child for the first few months after birth also presents the infant with an environment approximating that prior to birth, therefore making the transition and adaptation to extrauterine life as free from abrupt changes as possible. It has in fact been proposed that the exceptionally immature state in which human infants are born indicates that gestation is not complete with birth but needs to be completed outside the womb as a form of *exterogestation*—in contrast to *uterogestation*, the development that takes place inside the mother's uterus (Bostock, 1958a, 1958b, 1962; Montagu, 1986, pp. 49–57 and 293–294). Bostock (1962) suggested that gestation should be considered complete at around the age of nine months when effective crawling commences. In Montagu's (1986) view, the environmental conditions during this period of *exterogestation* should mimic those within the womb as much as possible—that is, the child should be kept in close contact with the mother's body in a tight and warm embrace—in order for the infant to feel most comfortable. Other researchers have also expressed the view that continued stimulation of a kind similar to that during the fetal period would facilitate neonates' adjustment to their new environment (Gatts, Fernbach, Wallace, and Singra, 1995; Ourth and Brown, 1961).

Montagu (1986) based his inferences on comparative data concerning mammalian species in general and the grand apes in particular. Humans are in a more immature state at birth, and continue to be dependent on their parents' care for a longer period than practically any other mammal. Moreover, compared with apes, each of the developmental periods such as infancy, adolescence, and old age last considerably longer in humans, with the exception of gestation. It therefore appears that the only reason humans are born at such an early stage of development is that the fast-growing head and large body size of the human fetus makes passage through the narrow birth canal at a later stage impossible, a disadvantage resulting from the erect posture of humans that necessitated a tightening of the pelvic outlet. Montagu (1986) describes human neonates as almost as immature as newborn kangaroos or opossums, which after birth continue their gestation in their mother's pouch until sufficiently matured. In the human case, no such external womb is available, despite the fact that the human infant

remains in an immature state for much longer than the marsupial infant. However, the close bond and intricate connection between mother and child can be viewed as the emotional frame that also drives the human mother to provide her infant with the equivalent of the kangaroo mother's pouch (Montagu, 1986).

Heartbeat and uterine sounds

Research data support the notion that young infants feel most comfortable in an environment approximating that before birth. One dominant stimulus in the prenatal environment is the constant rhythmical beat of the mother's heart (Lecanuet, 1998), perceived by the fetus from the beginning of the third trimester when functional hearing commences (Birnholtz and Benacerraf, 1983). Research has shown that the heartbeat sound continues to influence infants even after birth. In a classical study conducted in the U.S., Salk (1973) compared two groups of more than a hundred neonates during their first four days of life in the hospital nursery, one being exposed to the recorded sound of an adult's heartbeat 24 hr a day, the other receiving no particular treatment. After 4 days more newborns in the experimental group showed a weight gain relative to the control group, despite equal food intake. The control infants experienced a median loss of 20 g, compared to a median gain of 40 g for the treated group. The experimental group also cried less during these days, pointing to a soothing influence of the heartbeat. Yet, other research on 2- to 4-day-old-newborns has found no pacifying effect of the heart beat stimulus (Detterman, 1978a), and Salk's study design has also been criticized (Detterman, 1978a, 1978b; for a reply, see Salk, 1978). However, 5-day-old Japanese neonates who were presented with heartbeat sounds or white noise during a painful heelstick procedure also showed less intense behavioral responses and lower stress hormone (cortisol) levels than a control group presented with no sounds (Kawakami, Takai-Kawakami, Kurihara, Shimizu, and Yanaihara, 1996).

It further appears that the soothing effect is restricted to the heartbeat sound with all its typical properties, and is not applicable to an altered heartbeat. Salk (1973), for example, noticed that a heartbeat sound at 128 beats per minute—compared to the regular adult heartrate of 72 beats per minute—resulted in increased distress among the infants. Comparable reactions were observed when an accidental, constant hissing noise appeared in conjunction with the regular heartbeat sound. A possible reason why the white noise in the heelstick study (Kawakami et al., 1996) did not cause similar upset, but instead soothed the infants, could be that it resembled the steady background noise that is constantly present in the womb—a mixture of cardiovascular, gastro-intestinal, respiratory and other physiological sounds as well as movements of the mother and fetus (Lecanuet, 1998). Research has found that these sounds have a calming effect on neonates as well (Murooka et al., 1975; Murooka, Koie, and Suda, 1976; Rosner and Doherty, 1979).

It has also been found that mothers have a strong tendency to hold their infants on the left side of their bodies, close to their hearts, regardless of whether they are right- or left-handed (de Château, 1983; Saling and Cooke, 1984; Salk, 1973; Weiland, 1964). About 80% of mothers consistently position their children to the left of their chest, a number much greater than expected by chance. The same lateral bias applies to holding dolls (Bundy, 1979), but not to carrying other baby-sized objects of a neutral nature such as shopping packages (Weiland, 1964). The phenomenon has been observed in children as young as three years (de Château and Andersson, 1976; Souza-Godoli, 1996) and, to some degree, also in males (Bundy, 1979; de Château, 1983; Richards and Finger, 1975). The tendency appears to be stronger in new fathers and fathers with children over the age of one than in men without children of their own (de Château, 1983), and is also more pronounced in girls than in boys (de Château and Andersson, 1976). Bundy (1979) further reported it to be most marked among people having the greatest experience with infants.

An extensive review of pieces of art from various cultures such as paintings, photographs, and sculptures that depict adult–infant pairs largely confirms the universality of the left side preference (Finger, 1975; Richards and Finger, 1975; Salk, 1973), and so do some observations of infant carrying and cradling patterns in nonhuman primates (Hatta and Koike, 1991; Manning and Chamberlain, 1990; Salk, 1973; Tomaszycski, Cline, Griffin, Maestriperieri, and Hopkins, 1998). In addition, rhesus monkey infants have been found to exhibit a significant preference for their mother’s left nipple during the first few weeks of life (Tomaszycski et al., 1998). An instinctive knowledge of the beneficial effects of the heartbeat on infants is one possible, and frequent, explanation for the universal cradling preference observed. However, it has also been suggested that the described pattern may be attributable to the lateralization of brain functioning, particularly to the dominance of the right hemisphere in affective communication (Sieratzki and Woll, 1996). Others have linked the cradling bias to the right-side head-turning preference of most newborns (Ginsburg, Fling, Hope, Musgrove, and Andrews, 1979).

Movement stimulation

Another pervasive feature of the prenatal environment is the stimulation provided by the movements of the mother. A number of studies have investigated the effects of movement stimulation on young infants after birth. As in the case of presenting heartbeat sounds, the results indicate that rocking a distressed infant has a pacifying effect (Birns, Blank, and Bridger, 1966; Byrne and Horowitz, 1981), a finding that many caregivers will confirm. The effectiveness of rocking increases with increasing amplitude and frequency of the rocking movement, with amplitudes of 2 in. (5.1 cm) and 5 in. (12.7 cm) and frequencies of 30 and 70 cycles/min being the lower- and uppermost limits that were tested in experiments by Pederson (1975) and Pederson and Ter Vrugt (1973). Rocking of the child’s cot has further been shown to delay the onset of crying in content newborns cared for in the hospital nursery (Gordon and Foss, 1966). It should be pointed out that many studies in this field have used artificial stimulation sources such as moving cradles rather than human bodies, thus excluding the tactile component that is frequently present when the caregiver rocks the child on his or her body. It can therefore be concluded that rocking an infant in one’s arms has a calming effect not just because it is a form of physical contact, but also because it involves the additional component of movement (see also conclusion by Korner and Thoman, 1972). Byrne and Horowitz (1981) specifically compared the effectiveness of these two types of stimulation in soothing distressed newborns, and found that different forms of rocking while holding the child in an upright position on the experimenter’s body, quieted the 24- to 72-hour-old subjects more quickly than just picking them up and holding them at the experimenter’s shoulder. In another U.S. sample of 2- to 5-day-old newborns it was further found that changing the infant’s body position was a more powerful soothing method than physical contact alone (Korner and Thoman, 1972). Also, in an experiment on infant monkeys, some of the negative effects of isolation and maternal deprivation, especially the typical stereotyped body-rocking, could be prevented by providing the mother-deprived monkeys with a moving artificial mother surrogate, thus attesting to the central role of movement stimulation in healthy development (Mason and Berkson, 1975).

Swaddling

The fact that infant swaddling has been popular in many cultures and is generally well accepted by infants (Lipton, Steinschneider, and Richmond, 1965), is most likely because it provides a feeling of containment similar to that experienced in utero. Giacomani (1971) found that swaddling 5- to 6-week-old American infants significantly reduced their overall arousal level, including crying, whereas satiation did not have the same effect. These results

are similar to those of Harlow's (1958) classical studies on isolated infant monkeys whereby contact comfort was found to be a more attractive stimulus than food. Lipton, Steinschneider, and Richmond (1960), in their study of 2- to 5-day-old neonates, also observed lower activity levels, less crying, and lower heart rates in their subjects during a swaddling condition. These findings provide further support for the view that early postnatal experiences akin to the prenatal environment are perceived as comforting by the newborn. It should, however, be pointed out that, from the current orthopedic viewpoint, tightly swaddling an infant in a position where the legs are fully extended and adducted is considered detrimental to healthy hip development (Kutlu, Memik, Mutlu, Kutlu, and Arslan, 1992; Palmén, 1984, pp. 27–28).

Continuous and multi-sensory stimulation

In reviewing infant sleep research, Schmidt (1975) concluded that continuous stimulation is particularly effective in inducing sleep in infants. The observed effect does not seem to be restricted to any particular kind of stimulus, but has, among others, been found to apply to different auditory stimuli such as heartbeat sounds, metronomes or white noise, as well as rocking movements. Intermittent stimuli, on the other hand, frequently have the opposite effect. Brackbill (1971), too, reported that continual auditory stimulation in the form of a tape-recorded heartbeat sound, as well as swaddling, pacified 1-month-old infants, and that the soothing effect of continuous stimulation was cumulative across different sensory modalities. For the latter conclusion, Brackbill had also included illumination levels of 400 W and raised room temperature as other possible forms of "continuous stimulation". Furthermore, Gatts et al. (1995) tested the effects of a multi-sensory cradle that imitated the prenatal environment with a U.S. sample of infants aged 0–16 weeks. The cradle produced intrauterine sounds and random motion, offered tactile containment, and reduced the amount of light reaching the child. The intensity of the prenatal-like stimulation as generated by the animated cradle was gradually decreased over the 16-week study period until it finally reached zero. Compared to infants placed in regular cribs, infants exposed to the animated cradle cried significantly less throughout the time of the study, slept for longer periods at night, and showed more mature responses on parts of the Brazelton Neonatal Behavioral Assessment Scale at the age of 24 days. All in all, there is much evidence to support the view that young infants, whether awake or asleep, feel comfortable in a milieu that includes fairly constant auditory stimulation, movement and firm tactile contact, especially when the properties of the stimuli resemble characteristics of the prenatal environment.

Health Aspects of Natural Parenting

Physiological Correlates of Crying

Support for the view that crying is not a necessary part of an infant's behavioral expressions in everyday situations but rather an alarm signal reserved for critical circumstances is provided by an examination of the physiological correlates of crying in both the infant and the caregiver exposed to the signal. To begin with, crying is an activity that requires considerable physiological effort. It is an intense state of bodily arousal involving increased heart and lung activity as well as muscle movement and is associated with increased energy expenditure (Lester, 1985; Pillai and James, 1990; Prechtl, 1974; Rao, Blass, Brignol, Marino, and Glass, 1993). During crying episodes the child's heart rate rises (Pillai and James, 1990; Walsh and Gyulai, 1973) and augmented levels of plasma cortisol are observed (Anders, Sachar, Kream, Roffwarg, and Hellman, 1970), while at the same time blood oxygen level decreases (Huch and Huch, 1976; Levesque, Pollack, Griffin, and Nielsen, 2000; Treloar, 1994). During the first few days of life crying can even reestablish a

fetal pattern of blood flow in the heart, leading to poorly oxygenated blood being returned to systemic circulation rather than flowing to the lungs, with additional negative side-effects on cerebral blood flow (Anderson, G. C., 1988, 1989; Brazy, 1988; Walsh, Meyer, and Lind, 1974). On the whole, crying is a taxing experience for the child that is counterproductive to general wellbeing and potentially harmful to the organism (see also review: Ludington-Hoe, Cong, and Hashemi, 2002).

Similar reactions take place in the person hearing the crying sound. Exposure to an infant's cry generally triggers a response of increased blood pressure and changes in heart rate in adults and children of both sexes (Bleichfeld and Moely, 1984; Frodi and Lamb, 1978; Frodi et al., 1978; Frodi, Lamb, and Wille, 1981; Jones and Thomas, 1989; Zeskind, 1987). In addition, increased skin conductance is observed in the human physiological reaction to a crying infant, a further index of autonomic arousal (Frodi et al., 1978, 1981). For first-time parents of young infants, the autonomic response is particularly pronounced (Boukydis and Burgess, 1982). Also, the crying of one's own infant evokes more intense arousal than that of an unfamiliar child (Wiesenfeld and Klorman, 1978; Wiesenfeld, Malatesta, and DeLoach, 1981). This complex bodily activation can be interpreted as a general distress reaction, by which the individual concerned is alerted to take some critical action. Hearing an infant cry has further been found to activate brain areas assumed to be involved in nonhuman mammalian parenting behavior (Lorberbaum et al., 2002). Physiological data therefore provide further evidence for the view that the crying stimulus emitted by an infant is meant to trigger immediate action in the caregiver—an action that should restore physical contact between caregiver and infant.

Skin-to-Skin Care for Preterm Infants

For prematurely born infants, the beneficial effects of a postnatal milieu that closely resembles the womb experience have already been recognized. *Kangaroo mother care*, as this form of care has been termed, is characterized by extended periods of skin-to-skin contact between newborn preterm infants and their mothers or fathers (Anderson, G. C., 1991, 1995; WHO, 2003). The infant is usually held by the mother in an upright position beneath her clothing, between her breasts, and is clad with only a diaper and a hat. Kangaroo care can be practiced as soon as the neonate is medically stable enough to be temporarily taken out of the incubator, has been used on infants weighing less than 1500 g, and may last for anywhere between 1 and virtually 24 hours per day. The child's self-regulatory access to breastfeeding is encouraged. Research provides clear evidence that premature infants who have received kangaroo care in addition to regular hospital care, are advantaged with respect to many aspects of development (reviews: Anderson, G. C., 1991; Feldman, 2004). For instance, when held skin-to-skin their heart rate and respiration are more stable. In addition, they cry less, experience more deep sleep and alert inactivity, show greater weight gain and are discharged earlier from hospital. Kangaroo care further appears to accelerate neuromaturation. Lactation is also more successful and lasts longer. Equally important, parents practicing kangaroo care seem to bond more easily with their infants and to be more confident in their ability to care for them. Treatments which include only certain aspects of kangaroo care or a combination of these, such as 30–90 min of daily body stroking and passive movements of the limbs, rocking of the premature infant's bed, or the presentation of recorded heartbeat sounds or tapes of the mother's voice, administered over variable periods of time, have resulted in similar benefits and advances in development (Field et al., 1986; review: Harrison, 1985; review: Ottenbacher et al., 1987; Rice, 1977; Scafidi et al., 1990). Increasing evidence is also accumulating that full-term neonates derive similar benefits from skin-to-skin contact as preterm infants

(Anderson, G. C., Moore, Hepworth, and Bergman, 2003; Ferber and Makhoul, 2004; Gazzolo, Masetti, and Meli, 2000).

Touch Effects on Physiology

Physical growth

As already seen in the case of kangaroo care, physical contact is not only reassuring for infants, but also has distinct effects on physiological measures. Both human and animal research provide convincing evidence that tactile stimulation is also one of the factors regulating physical growth in the developing infant. Studies investigating the impact of massage on premature infants have repeatedly reported enhanced growth in infants that have received extra tactile stimulation (e.g., Field, 2001; Phillips and Moses, 1996; Scafidi et al., 1990). According to Field (1995), a certain amount of pressure, however, appears to be necessary for weight gain to take place. Similarly, research regarding the effects of handling on rats has found that gentled animals are more advanced in skeletal as well as body growth than ungentled ones (Ruegamer, Bernstein, and Benjamin, 1954; Weininger, 1954; Weininger, McClelland, and Arima, 1954). Yet, there has usually been no difference in food intake between the experimental and control groups in both human and animal studies.

The observed difference in weight gain between handled and unhandled individuals is also reflected in growth hormone levels. As described by Schanberg and Field (review: 1987; see also Evoniuk, Kuhn, and Schanberg, 1979), rat pups that are removed from their mother show a marked decrease in growth hormone secretion, which returns to normal after reunion with the mother. However, firmly stroking the pups with a moist paint brush during maternal separation, thus mimicking the mother's typical caretaking behavior (i.e., licking), has the same effect. Lighter stroking or stimulation of the vestibular or kinesthetic system, on the other hand, does not restore hormone values to their usual level, thus clearly attributing the growth-promoting effect of maternal presence to its tactually stimulating nature.

A number of other physiological processes in the rat pup are also affected by short-term maternal deprivation (reviews: Schanberg, 1995; Schanberg and Field, 1987). As in the case of altered growth hormone levels, these physiological changes are reversible by reunion of the pup with the mother or by heavy tactile stimulation of the pup's skin. For instance, separation from the mother's tactile influence has been found to lead to an immediate decrease in the activity of ornithine decarboxylase, an enzyme involved in the process of protein synthesis and a good indicator of tissue growth and differentiation. The observed change is not attributable to possible variations in body temperature or to the effects of exposure to a new environment resulting from maternal separation. Interruption of normal feeding patterns, and lack of olfactory, auditory, and visual maternal cues could be excluded as possible mediating factors as well. Further effects of tactual deprivation on rat pups include selective unresponsiveness of tissue to exogenous growth promoting hormones, decline in the synthesis of DNA in most organ tissues, slowing of insulin catabolism, and increases in corticosterone production—an indicator of stress level. Raised cortisol levels during mother–infant separation have also been observed in infant squirrel and rhesus monkeys (review: Coe, Wiener, Rosenberg, and Levine, 1985), and lowered levels in massaged human infants (Acolet et al., 1993; Field et al., 1996). However, all of these physiological changes in the rat pups are observed only when maternal separation takes place before the pups are weaned (Schanberg, 1995). After they reach adulthood it no longer affects their physiology. Schanberg (1995) describes the observed phenomenon as a switch to *survival mode*, a physiological state that aims to conserve energy and water to ensure the survival of the young in the absence of their mother—a reaction that makes perfect sense when considering that the pups are totally dependent on their mother as a food supplier.

Schanberg and colleagues (Schanberg, 1995) have also accumulated evidence that β -endorphin release in the brain is one of the central mechanisms mediating the touch deprivation syndrome, with alterations in gene expression being probable consequences in the resulting chain of reactions.

Other mechanisms underlying the growth-enhancing effect of touch have also been proposed. There is, for example, indication that tactile stimulation has an effect on the digestive process, as outlined by Field (2001). Massage is known to increase activity of the vagus. Parasympathetic vagal activity in turn facilitates gastric activity and stimulates the release of hormones responsible for food absorption such as gastrin and insulin (see also Uvnäs-Moberg, 1987; Uvnäs-Moberg, Widström, Marchini, and Winberg, 1987). Touch might therefore foster growth by making digestion more efficient (see also Uvnäs-Moberg, 1997, on the possible mediating effect of oxytocin linking sensory stimulation and increased secretion of vagally-controlled gastrointestinal hormones). Research assessing digestive functioning in massaged infants provides support for this view. For instance, blood samples of massaged preterm cocaine-exposed infants revealed significantly elevated insulin levels (unpublished data, T. Field, personal communication, 2003). Similarly, de Róiste and Bushnell (1995) found physiological evidence of enhanced digestive functioning in premature newborn infants undergoing a tactile stimulation program during their first month of life. Field (2001) has further reported preliminary results regarding significantly increased oxytocin levels in massaged preterm infants.

In addition, vagal activity is known to lower physiological arousal and stress hormone levels, and reduced cortisol levels have been observed in diverse groups of subjects following massage (Field, 1998). Decreased cortisol concentrations, in turn, are usually associated with augmented levels of oxytocin (Field, 2001), which appears to play a central role in the generalized *relaxation and growth response*, a psycho-physiological antistress pattern, the existence of which has been suggested by Uvnäs-Moberg (1997), as an antipode to the stress reaction of the fight-flight response. Uvnäs-Moberg speculates that the touch involved in human relationships as well as more general social support, might be important factors in increasing oxytocin release in humans, thus providing one explanation for the health-promoting effects of social networks. In the context of mother–infant interactions, the proposed antistress response, possibly activated by pleasant interpersonal experiences involving close physical contact, can thus be seen as the direct opposite of the survival mode of functioning, the physiological response pattern that is observed in mother-deprived (and therefore touch-deprived) rat pups.

Immunological processes

Immunological processes are also affected by touch. The outermost layer of the human skin, the epidermis, has been found to contain a substance akin to the thymus gland hormone involved in the process of T-cell differentiation, producing different types of T-cells with a variety of specific immune functions (Chu et al., 1983). A further possible link between touch and the immune system is cortisol secretion, as decreased cortisol levels, which have been associated with tactile stimulation, lead to enhanced immune function (Field, 1998). Direct investigations into the immunological competence of massaged individuals have confirmed this link. In a study on HIV positive and HIV negative men by Ironson et al. (1996), a daily massage program of one month's duration was associated with significantly improved immune function as well as reduced cortisol levels.

Psychosocial dwarfism

Although much of the research on the physiological effects of touch has been conducted on animals, it is conceivable that similar mechanisms operate in humans. For

example, the stunted growth and generally retarded development of apparently emotionally deprived children in the absence of any detectable organic disorder and in spite of adequate nutrition — often referred to as *nonorganic failure to thrive* or *psychosocial dwarfism* (Green, W. H., Campbell, and David, 1984; Money, 1992) — may be partly explained by these findings (Schanberg and Field, 1987; Schanberg and Kuhn, 1980). The biochemical abnormalities found in these children markedly parallel the physiological consequences of maternal deprivation in rat pups. Not only do these children usually exhibit abnormally low levels of growth hormone and a disturbance in evoked growth hormone secretion, both of which return to normal when the children are placed in a psychosocially more adequate environment, which also restores normal growth patterns, but they also frequently show a poor response to exogenous growth hormone (Albanese et al., 1994; D'Ercole, Underwood, and Van Wyk, 1977; Frasier and Rallison, 1972; Holmes, Blethen, and Weldon, 1984; Powell, Brasel, Raiti, and Blizzard, 1967; Rayner and Rudd, 1973).

While these studies do not allow us to infer how much touch human infants need for optimal growth, they do draw attention to the tremendous influence tactile stimulation has on many aspects of early development. Apart from the assumed direct effects of cutaneous stimulation on physiology, close contact between caregiver and infant also affects the infant's physiology on many other levels and via other pathways, which shall now be described.

Thermal Regulation

As already mentioned, the distribution of body fat of human infants suggests that particularly ventral contact with the caregiver helps to guard young infants against excessive loss of body heat (Als, 1977). This has been confirmed by research on preterm (Ludington-Hoe, Hadeed, and Anderson, 1991) and full-term (Bystrova et al., 2003; Christensson et al., 1992; Färdig, 1980) newborns. Färdig (1980), for instance, found in a U.S. sample of newborns that those who were transferred to a radiant-heated crib immediately after birth had an up to 1.7 °F (0.9 °C) lower mean skin temperature than newborns experiencing direct skin-to-skin contact on their mothers' stomachs, while ambient temperatures were equal in both conditions. Christensson et al. (1992) contrasted direct ventral contact between Spanish mothers and their newly born children with an arrangement where the child was kept in a cot next to the mother, observing higher temperatures in the skin-to-skin group, particularly towards the end of the monitored time period of one and a half hours.

In addition to serving as a convenient energy source, there are indications that a mother's body can even adjust its own temperature according to the infant's thermal needs. Bauer, K., Pasel and Versmold (1996) compared the chest skin temperature of mothers of newborns on days 1–5 postbirth to that of men, and of women without newborn children. They found that the new mothers' temperatures showed a steady increase over the examined period, so that from day 2 they were significantly higher than those of the two other groups. Moreover, it is known that a mother's skin temperature increases during breastfeeding, with oxytocin being one possible mediator of this effect (Marshall, W. M., Cumming, and Fitzsimmons, 1992). Preliminary analysis of simultaneous temperature recordings of mother–infant dyads during kangaroo care further suggested the presence of a phenomenon that Ludington, Anderson, and Hadeed (1989; see also Anderson, G. C., 1995) termed *thermal synchrony*. At the beginning of a contact period, a rise in skin temperature of both mother and infant was typically observed, with the mother's temperature increasing first, followed by that of the infant. For the child, the rise continued slowly and steadily for the first hour of skin-to-skin contact. When the child's temperature reached its optimum range, the mother's temperature would decrease again, returning to her own baseline level—unless there was a

drop in the infant's temperature, whereupon the mother's temperature would again rise, very much like a thermostat.

Orthopedic and Other Health Aspects of Infant Carrying

Spinal health

A commonly raised question in the context of infant carrying with the help of a carrying device is whether the practice has been associated with any detrimental effects on the child's health, particularly spinal development. Recommended age at the onset of carrying, daily carrying duration, and optimal carrying positions are frequent topics of inquiry. A survey by Kirkilionis (1989) of 190 infants who had been regularly carried throughout their first year of life, and often longer, found no relationship between infant carrying in an upright position and increased spinal problems. The proportion of children in the sample with problems during childhood was in fact considerably lower than that in the general population at the time of entry into school. During the child's first year of life, the majority of parents had carried their infants 1–3½ hours daily in a carrying device, with many of them having started the practice during the child's first month of life. A subgroup of infants, however, had been carried for considerably longer periods of time, 5–8 hours a day, in most cases from the first month onward. Even in this group no connection between prolonged carrying and increased spinal problems was found.

Hip development

As discussed earlier, anatomical details of human infants indicate that infants are best adapted to a lateral straddling position on the caregiver's hip (Kirkilionis, 1997a, 1997b). A detailed investigation into the specifics of this mode of infant transport among under-1-year-olds has further revealed that the angle between the child's thighs is on average 90°, irrespective of the body proportions of the carrying person and regardless of the child's age (Kirkilionis, 1992).¹ The measured values ranged between 35° and 58° for half the angle (see Footnote 1). The flexion of the legs generally reached about 90° or somewhat more (when the legs are totally extended the angle is 0°). It was further found that most children were not held exactly at the side of the caregiver's body, but were slightly displaced to the front. The farther away from the side they were held, the greater the average angle of abduction became (e.g., 41.5° at the side; 46° when displaced up to 30°). The position of the infant's legs while lying unconstrained on the back was similar to that in the straddling position. Abduction angles tended to be somewhat lower, particularly after the third month, but the flexion of the legs ranged predominantly between 90° and 110°.

It should be noted that abduction of 35°–40°, and flexion of 90°–120° is considered an ideal position for the optimal development of an infant's hip joints, a position where the strain of the ball-shaped head of the thigh bone is evenly distributed in the cup-shaped hip socket (Büschelberger, 1961, p. 50; Fettweis, 1992, p. 123). It is also the very position used to treat developmental dysplasia of the hip, a condition of an unstable hip where the head of the thigh bone has either slipped from, or is in the danger of slipping from its socket (Ihme, Schmidt-Rohlfing, Lorani, and Niethard, 2003). In these cases the thigh bones are secured in the correct position by holding the infant's legs in a flexed and abducted position, usually maintained by the wearing of a splint, harness or cast for prolonged periods of time. An increased incidence of hip dysplasia has been observed in cultures where infants' legs are kept in an unphysiological position of extension and adduction for extended periods of time,

¹ In a medically correct way this angle would be represented as 45°, half of the actual angle, the angle between one of the thighs and an imagined plane that cuts the body vertically at its midline.

as occurs when a child is swaddled or constrained in a cradleboard (review: Kirkilionis, 1997b; see also Kutlu et al., 1992; Palmén, 1984, pp. 27–28). Conversely, in societies where children are carried on their caregivers' bodies with their legs in flexion and abduction, hip dysplasia is rarely encountered (Bower, Stanley, and Krickler, 1987; Kirkilionis, 1997b; Tachdjian, 1990, p. 306). A further advantage of this form of infant transportation, particularly where the child is positioned on the adult's hip, is that impulses from the motion of the caregiver's body and from the child's own movements are continuously transmitted to the cartilaginous structure of the infantile hip joints, thus increasing local blood circulation and providing stimulation that is beneficial for the development of the hip (Kirkilionis, 2001). In sum, the carrying of an infant in the pictured way can be ascribed therapeutic as well as prophylactic qualities.

Characteristics of a good carrying device (Figure 4)

According to Kirkilionis (1998, 1999) one important criterion when assessing the suitability of a carrying device is thus whether it supports the anatomically healthy posture of flexion and abduction in the child's legs. While infants are able to sustain such a posture without assistance for a short while, particularly when sitting astride the caregiver's hip, they need support if the position is to be maintained for a longer period of time, or if they are carried face-to-face or on the caregiver's back. Many carrying devices on the market today do not fulfill this crucial feature. Front carriers in particular are often designed in such a way that the infant's legs hang straight down. Furthermore, when a child carried in this type of carrying device is positioned face-to-face and fairly low on the adult's body, then each step of the carrying person presses the child's legs backward, a movement totally counter to an infant's natural range of movements, which is restricted to the front of the body. The infant may try to accommodate to this unphysiological movement by tilting the pelvis forward, resulting in a slight "swayback" appearance, whereby the shoulders and head fall back, as well. The second important characteristic of a good carrying device is its ability to support the child's back in a sufficient way. When carried upright, the infant's upper body needs to be kept straight; this is achieved only when the fabric of the carrier holds the child tightly against the body of the carrying person. If the carrier leaves too much space between the two bodies, the child will assume an undesirable slouching position. Thirdly, the carrier should provide support for the child's head, which is important for young infants, and also when an older child falls asleep while being carried. While young children are usually carried upright, infants may also be carried in a horizontal cradling position.

Figure 4: An infant in a carrying device that fulfills the three key requirements of a good carrier: correct leg position and sufficient support of the child's back and head.



Microenvironment inside a carrier

In a German study, Stening, Nitsch, Wassmer, and Roth (2002) investigated the effects of carrying infants in a carrying device on their oxygen saturation and heart rate. The researchers compared the cardiorespiratory measures of term and preterm infants of 6–113 days postnatal age under three conditions: carried vertically or horizontally in an infant carrier, or placed laterally in a pram. They found that the use of the carrying device was not associated with any clinically relevant changes in the recorded measures.

Gastroesophageal reflux and otitis media

Tasker et al. (2002a, 2002b) have established that reflux of gastric contents into the middle ear can be a major factor in the development of otitis media with effusion in young children. Gastroesophageal reflux is common in young infants (Orenstein and Shalaby, 1996). As infants are frequently placed lying in the supine position, the immaturity and angle of the eustachian tube make possible further reflux of gastric juice from the nasopharynx into the middle ear (Tasker et al., 2002b). Damage to the eustachian tube and the mucosa of the middle ear are likely consequences, causing inflammation, and thus facilitating secondary bacterial colonization, finally leading to so-called glue ear (Tasker et al., 2002a, 2002b). Infant carrying on the body of the caregiver, which favors a nonhorizontal position in the child, can therefore be viewed as a potential preventive measure against such a condition.

Infant Toilet Training—Elimination Communication

Extended physical closeness between caregiver and child also facilitates a natural approach to toilet training that is still commonly used in many non-industrial societies (Bauer, I., 2001; Boucke, 2002; Rugolotto, Ball, Boucke, Sun, and deVries, in press).

Contrary to common belief, infants have been found to be aware of their elimination functions from birth, and to have some degree of control over their sphincter muscles from very early on. Most infants signal in some way immediately prior to, during, or right after urinating and defecating. Some cues are very obvious whereas others may be more subtle. Possible signals include different facial expressions, flushing, tightening of abdominal muscles, shivering, changes in breathing, behavioral changes such as momentary quieting or restlessness, and vocal cues such as grunting, crying, squealing, sighing, or uttering a special toilet sound. By being sensitive to the infant's elimination cues, and by becoming aware of the child's elimination patterns over the course of a day, it is possible for the caregiver to identify and respond to the infant's elimination needs. The response takes the form of supporting the child in a suitable position over a container while possibly giving the child an additional vocal or verbal cue, for instance, a "sssss"-sound or a short sentence such as "Do you have to pee?" (see Figure 5 for different possible elimination locations and positions). Within a short time, the child will learn to associate the particular position, location, or sound with toilet activity and start to eliminate on cue. Over time, the child will also communicate to the caregiver with increasing clarity his or her need for voiding and defecation in advance.

After caregiver and child have learned to tune in with each other regarding toilet matters, this mutual process of reading and responding to each other's clues will result in most eliminations taking place at the desired location or over the chosen receptacle. "Accidents" can be expected in the early training phase, but will decrease in frequency over time. In this context, many caregivers choose to use diapers as a backup in case they miss their infant's signals, during the night, or in situations where soiling or wetting would be troublesome, as during travel, or when they know that they will not be able to attend to their infant's toilet needs. Many parents using this approach, however, have their child go diaperless at least part of the time.

Children toilet-trained in this way complete toilet training anywhere between the age of 6 months and 2 years. Western parents practicing elimination communication commonly report reasonable daytime continence before the age of 18 months (L. Boucke, personal communication, 2006). In many non-industrialized societies where infants are frequently bare-bottomed and where suitable locations for evacuation are not as narrowly defined as in industrialized societies, many mothers will report toilet training to be completed at 6–12 months (see also deVries and deVries, 1977). Daytime dryness is usually accomplished before nighttime dryness. Even after the achievement of reasonable dryness, very young children obviously still need assistance from their caregiver with undressing and re-dressing, with transportation to the toilet place in time, and with positioning during elimination.

The approach in question can be implemented from birth, and should ideally be started during the first few months of life for its full benefits to be derived. When infants are instead allowed to eliminate into diapers as a rule, they gradually lose sensitivity to their elimination functions, thus rendering conventional toilet training later in toddlerhood more challenging. However, part-time toilet training in infancy on a fairly consistent basis is a possible alternative.

Elimination communication is a gentle and respectful way of dealing with one of the basic bodily needs of an infant, and is based on a team effort of mutual trust, intimacy, and continued communication. It asks for a committed and patient caregiver with a relaxed attitude towards the occasional slips that are an inevitable part of the process. It is pointed out that the described approach should not be confused with the harsh and rigid early toilet training method of the early 20th century informed by behaviorist psychology (as reviewed by deVries and deVries, 1977). Although toilet training in infancy is time consuming, it should be borne in mind that toilet training will take time whatever the approach. An advantage of starting early is that infants are well aware of their toilet needs, cooperative, and willing to be

part of the process, whereas toddlers typically show only little interest in complying with toilet training. Moreover, conventional toilet training can be confusing for the child: What used to be acceptable behavior (soiling diapers) suddenly becomes unacceptable after a certain age.

How gentle, early toilet training can be implemented within the context of Western industrialized societies has been described in detail in two recent popular books (Bauer, I., 2001; Boucke, 2002). In the professional literature regarding infant care, however, *infant* as opposed to *toddler* elimination training has, except for sporadic mentioning (e.g., Ainsworth, 1967; deVries and deVries, 1977; Gersh, 1978; Ravindranathan, 1978), received virtually no attention until recently. In those instances where the topic has been discussed, the authors have usually referred to parenting practices in non-Western cultures. Many of the reports have been anecdotal. However, contributions discussing infant toilet training in a Western context are now starting to appear (Rugolotto et al., in press; Sun and Rugolotto, 2004), and with the first large-scale study of infant toilet training based on a predominantly Western sample now completed (L. Boucke, personal communication, 2006), data is finally available to confirm many of the propositions made by earlier, less systematic reports. At the same time, these findings also challenge the current pediatric viewpoint that children are not ready for toilet training until the age of 18–24 months (American Academy of Pediatrics, 1998; Stadtler, Gorski, and Brazelton, 1999).

Figure 5: Elimination communication/infant toilet training: different possible elimination locations and positions for supporting an infant during urination or defecation. Photo a is from *Diaper free! The gentle wisdom of natural infant hygiene* (p. 145), by I. Bauer, 2001, Saltspring Island, British Columbia, Canada: Natural Wisdom Press. Copyright 2001 by Ingrid Bauer. Reprinted with permission. Photos b, c, and d are courtesy of A. Wrobel, M. Schmid-Drüner, and H. Päiväniemi, respectively.

a) A 2-month-old infant, in a cradling position in its mother's arms, eliminating into the bowl on the mother's lap (Canada). Photographer: Ingrid Bauer.



Natural Parenting

b) After a bath, Felix, almost 4 months old, relieves himself on the potty (Germany).
Photographer: Angela Wrobel.



c) Yuna, one and a half months old, with a concentrated look on her face while defecating into a small bowl (Germany).
Photographer: Marion Schmid-Drüner.



d) 3-month-old Voitto urinating into the bathroom sink (Finland).
Photographer: Harri Päiväniemi.



Bed Sharing and SIDS

Investigations into the sleep experience of breastfed infants who share their mothers' beds during the night have found it to be profoundly different to that of solitary sleeping children. In one study, cosleeping children spent 28–99% of the night in physical contact with their mothers, compared to only 2–14% when spending the night alone in a separate room (McKenna et al., 1994). Furthermore, bed sharing infants breastfeed about twice as often as regular solitary sleepers, with the total duration of nightly nursing episodes amounting to almost three times of what is observed in lone sleep conditions (McKenna, Mosko, and Richard, 1997). Cosleeping infants are also less likely to be placed in the prone position, and lie most of the night facing their mothers, commonly near breast level, which may be attributable to the facilitation of breastfeeding in such positions (Richard, Mosko, McKenna, and Drummond, 1996). Mothers, too, face their cosleeping infants about 74% of the time, and when lying face-to-face, the bed sharing partners are most typically at a distance of 11–30 cm from each other (Richard et al., 1996). In addition, mothers inspect and adjust their infants' sleep environment by actions such as repositioning or reblanketing considerably more often during bed sharing than when sleeping separately from their infants, and frequently display affectional behaviors such as hugging, rocking, kissing, patting, whispering, speaking or singing that are rarely exhibited when mother and child sleep in separate rooms. The great majority of these behaviors take place in reaction to infant movements or sounds (McKenna, Mosko, and Richard, 1999). Bed sharing is also associated with more frequent arousals during stages of deep sleep in the infant (Mosko, Richard, and McKenna, 1997a). While mothers also experience a greater number of arousals during bed sharing, these are shorter in duration than those occurring during solitary sleep (Mosko, Richard, and McKenna, 1997b). Therefore, mothers who cosleep with their children get as much sleep as non-cosleeping mothers (Mosko et al., 1997b). A substantial temporal overlap of maternal and infant episodes of arousal is also observed during cosleeping (Mosko et al., 1997a, 1997b). A further effect of bed sharing on the infant is an increase in light sleep and a decrease in deep sleep, and particularly a decrease in the mean duration of episodes of deep sleep (Mosko, Richard, McKenna, and Drummond, 1996). Lastly, cosleeping children have been found to have a higher incidence of central apnea and periodic breathing (Richard, Mosko, and McKenna, 1998), which seems to constitute the only potential disadvantage of mother–infant cosleeping. However, fewer obstructive apneas have been observed for routinely solitary sleeping infants during a night of bed sharing (Richard et al., 1998).

Even though the phenomenon of the Sudden Infant Death Syndrome (SIDS) is not yet fully understood, the major perceived causal deficit appears to be a delayed maturation, or maldevelopment, of the brainstem neural network responsible for cardiorespiratory control and functions regulating arousal (American Academy of Pediatrics, 2000, 2005b; see also Lipsitt, 2003). When the physiological equilibrium of infants with such a condition becomes compromised during sleep, these children may not be able to arouse sufficiently to survive a noxious insult to their system. Rebreathing of their own exhaled CO₂ and associated hypercarbia and hypoxia, as well as overheating, have been suggested as possible precursors to the fatal condition in these individuals. Within this context, the sensory-rich sleep environment of bed sharing, which leads to more frequent arousals during deep sleep and more light sleep, from which it is easier for the infant to arouse, appears to confer a survival advantage for children at risk of SIDS (McKenna, 1996; McKenna and Mosko, 1990; McKenna et al., 1993). In addition, cosleeping mothers usually place their infants in a nonprone position, a practice that has been associated with a decreased risk of SIDS (American Academy of Pediatrics, 2005b). While the reported higher frequency of central apnea and periodic breathing among bed sharing infants may seem a possible drawback of this type of sleeping arrangement, the evidence linking these events to an increased SIDS risk is far from conclusive. In a large-scale study of 757 SIDS cases and 1514 controls, for

instance, apnea did not emerge as a particularly strong risk factor (Hoffman, Damus, Hillman, and Krongrad, 1988). Findings from research on infant breathing and mechanisms of thermoregulation further suggest that periodic breathing is related to temperature control and is in fact normal and common in healthy infants (Johnson and Andrews, 1992).

Cross-cultural comparisons (review: Davies, D. P., 1994; Gantley, Davies, and Murcott, 1993; review: McKenna and Mosko, 1990) support McKenna's theory. Societies or parts of societies in which mother–infant cosleeping is widely practiced, generally have a relatively low incidence of SIDS compared to cultures that encourage solitary infant sleep. This is the case despite the fact that these people often live in suboptimal conditions, which would be expected to predispose them to increased infant mortality (Davies, D. P., 1994). Discrepancies regarding the way incidents of SIDS are defined and recorded in different countries, however, may also account for some of the differences in the reported rates (Knöbel, Chen, and Liang, 1995).

In instances where regular cosleeping has been linked to a heightened occurrence of SIDS, other known risk factors such as maternal smoking during or after pregnancy, or poor prenatal care were concurrently present or likely to be present and may thus have overridden the potential benefits of bed sharing (Blair et al., 1999; Carpenter et al., 2004; Fleming et al., 1996; McKenna and Mosko, 1990; Scragg et al., 1993). While infant suffocation as a result of overlying by the parent in a bed sharing environment is not unheard of, unsafe conditions such as parental intoxication with drugs or alcohol, parental disease, extreme parental fatigue, or marked parental obesity have been found to be present in many of these cases (Bass, Kravath, and Glass, 1986; Gilbert-Barness et al., 1991; see also Carpenter et al., 2004; Gessner, Ives, and Perham-Hester, 2001). There is therefore no reason to indiscriminately advise against bed sharing (McKenna and Gartner, 2000). All in all, when general safety recommendations are followed (American Academy of Pediatrics, 2000, 2005b), most of which apply equally to solitary as well as social sleep conditions (i.e., supine sleep position; use of a firm mattress in a tight-fitting frame, at a distance from the wall or other furniture to avoid entrapment; no waterbed, see also Gilbert-Barness et al., 1991; avoidance of loose bedding, pillows, stuffed toys, and other soft materials in the sleeping environment; avoidance of overheating; avoidance of smoking by the bed sharing parent who needs to ensure that her/his ability to arouse from sleep is not impaired; strict avoidance of cosleeping on a couch or an armchair), it seems that bed sharing can confer a number of benefits to the infant, including the emotional benefits of enhanced closeness, particularly when practiced in tandem with breastfeeding.

The American Academy of Pediatrics (AAP), while stating in the year 2000 (p. 654) that “there are insufficient data to conclude that bed sharing under carefully controlled conditions is clearly hazardous or clearly safe”, after having considered new evidence, now recommends against bed sharing in its latest policy statement on SIDS (American Academy of Pediatrics, 2005b). The AAP acknowledges that bed sharing facilitates breastfeeding and enhances mother–infant bonding, but refers to two studies in particular (Carpenter et al., 2004; Tappin, Ecob, and Brooke, 2005) showing that bed sharing remains a risk factor for SIDS even among nonsmoking mothers. In Carpenter et al.'s sample this association held true only for infant up to the age of 8 weeks, and in Tappin et al.'s study for infants aged 11 weeks or younger (in the latter case, the three examined age groups of <6 weeks, 6–11 weeks, and >11 weeks were chosen arbitrarily). Furthermore, data on all known factors involved in hazardous bed sharing were not available for inclusion in the analyses of either study. In addition to maternal smoking, Carpenter et al. included maternal alcohol and illegal drug use, but for instance mentioned that they had no data on maternal fatigue. Tappin et al. specifically stated that they had not collected data on alcohol consumption because of the difficulty of obtaining reliable information on this variable. This statement demonstrates a

fundamental problem inherent in investigations of SIDS cases: Information most critical for full understanding of the phenomenon is most difficult to obtain and is thus missing from many studies, thus rendering the results of such studies of limited use. Carpenter et al.'s study has further been criticized for assessing maternal smoking based on smoking status during pregnancy rather than at time of death, yet postpartum relapse to smoking is common among women who quit smoking when pregnant (UNICEF UK Baby Friendly Initiative, 2004b). Neither did Carpenter et al. distinguish between bed sharing in an adult bed and cosleeping on a couch or other sleep surfaces that are known to be hazardous (UNICEF UK Baby Friendly Initiative, 2004a). In sum, these two recent studies have raised as many questions as they have answered and have thus not been able to contribute much new information to advance our understanding of SIDS. See also McKenna and McDade (2005) for an excellent discussion of the cosleeping controversy.

Although the AAP recommends against parent–infant bed sharing, they do state that mothers may temporarily bring their infants into their bed for comforting or nursing until they are ready to go back to sleep. They also point to increasing evidence that infants who sleep alone in a separate room have an increased SIDS risk, and therefore advise parents to keep the infant's crib or bassinet in their own bedroom, close to the parental bed if desired, allowing for more convenient contact and breastfeeding. For those having reservations about bed sharing, keeping the infant outside the parental bed but within close proximity is thus a possible compromise that still allows parents to sensitively tend to their children's nighttime needs.

Breastfeeding

Benefits for the child

Proponents of natural parenting place great emphasis on the value of extended breastfeeding, and much scientific evidence has accumulated to support this view. Overall, there is general agreement that breast milk provides the ideal nutrition for a nursling, and is preferable to any kind of artificial formula (American Academy of Pediatrics, 2005a; Rodriguez-Palmero et al., 1999). Also, breast milk is not a uniform fluid— its composition changes according to the time of the day, within a feeding session, and as lactation proceeds (Lawrence, 1994). Changes in milk composition with stage of lactation appear to correspond to the changing nutritional needs of the growing child (Kunz, Rodriguez-Palmero, Koletzko, and Jensen, 1999).

Breast milk further forms easily digestible curds (Lawrence, 1994, p. 112) and is composed in such a way that its nutrients can be very well utilized by the body (Lönnerdal, 2003). It also protects the infant's intestines from infections by promoting a microflora of beneficial bacteria and by inhibiting the growth of potentially pathogenic organisms (Kleessen, Bunke, Tovar, Noack, and Sawatzki, 1995; Liepke et al., 2002). Moreover, breast milk provides the infant with a host of immunoactive substances that support the child's immature immune system and protect against infections (Garofalo and Goldman, 1999; Goldman, Chheda, and Garofalo, 1998). As mother and infant typically share a common milieu, the mother's milk is perfectly suited to offer protection against precisely those microorganisms that occupy the child's immediate environment. Even if the child is exposed to a germ the mother has not been exposed to, the intimate contact with the mother is likely to transfer the pathogen to the mother, who, as a result, will produce the correct antibodies and deliver them to her child via her milk (Goldman et al., 1998; Tronick, Winn, and Morelli, 1985). The protective nature of breast milk is also reflected in the fact that breastfed infants have repeatedly been shown to have reduced morbidity from a wide range of diseases (Beaudry, Dufour, and Marcoux, 1995; Cunningham, 1977; review: Cunningham, Jelliffe,

and Jelliffe, 1991; review: Heinig and Dewey, 1996). Sucking at the mother's breast also encourages proper development of facial structures, as reflected in its beneficial effects on dental development (Davis and Bell, 1991; Lobbok and Hendershot, 1987). Finally, traces of benzodiazepine²-like compounds have been detected in human breast milk, thus pointing to a relaxation effect in the infant following the ingestion of breast milk (Dencker, Johansson, and Milsom, 1992).

Benefits for the mother

The mother also benefits from nursing her infant. Women who breastfeed appear less likely to develop ovarian cancer (Gwinn, Lee, Rhodes, Layde, and Rubin, 1990; John, Whittemore, Harris, Itnyre, and Collaborative Ovarian Cancer Group, 1993) and breast cancer (review: Lobbok, 1999; McTiernan and Thomas, 1986; review: Micozzi, 1995; Newcomb et al., 1994). Moreover, the newborn's sucking at the mother's breast soon after birth causes the uterus to contract, decreases blood flow (Chua, Arulkumaran, Lim, Selamat, and Ratnam, 1994; Matthiesen, Ransjö-Arvidson, Nissen, and Uvnäs-Moberg, 2001) and thus speeds the mother's recovery. Extended, frequent breastfeeding also delays the onset of ovulation (Gray et al., 1990; Howie, McNeilly, Houston, Cook, and Boyle, 1982a, 1982b; Konner and Worthman, 1980; McNeilly, Tay, and Glasier, 1994; Stern, Konner, Herman, and Reichlin, 1986; World Health Organization Task Force on Methods for the Natural Regulation of Fertility, 1998), thereby decreasing the likelihood of a new pregnancy, and thus helping to ensure the mother's maximum attention for her youngest child. Breastfeeding further appears to have a relaxing effect on the mother (Altemus, Deuster, Galliven, Carter, and Gold, 1995; Amico, Johnston, and Vagnucci, 1994; Mezzacappa and Katkin, 2002; Uvnäs-Moberg, 1996) and as a result helps her to cope with the increased demands inherent in infant care. Even though the exact mechanisms underlying this effect are not yet fully understood, the beneficial effects of breastfeeding on maternal mood can most likely be attributed to prolactin, oxytocin, and cholecystokinin (Amico et al., 1994; Legros, Chiodera, and Demey-Ponsart, 1982; Uvnäs-Moberg, 1987, 1996, 1997), hormones that are released during breastfeeding (McNeilly, Robinson, Houston, and Howie, 1983; Uvnäs-Moberg, 1987; Uvnäs-Moberg, Widström, Werner, Matthiesen, and Winberg, 1990; Weitzman, Leake, Rubin, and Fisher, 1980).

On-demand feeding

In addition to its physiological advantages, breastfeeding has the added benefit of being cost-free and instantly available. At the same time, a mother's milk supply is generally able to fully meet her infant's nutritional needs, as long as the child is allowed to nurse on demand, because milk production is regulated by how much and how often the infant feeds (Daly, Owens, and Hartmann, 1993; Hartmann, Owens, Cox, and Kent, 1996; Wilde, Prentice, and Peaker, 1995; Woolridge, Phil, and Baum, 1993). The more the child nurses, the more milk is produced. Also, the storage capacity of the mother's breasts, which is related to her breast size, plays an important role in determining the optimal frequency of breastfeeds necessary to fulfill her infant's nutritional needs (Daly et al., 1993). Thus, restricting either the duration or the frequency of breastfeeds is likely to disturb the delicate balance of this self-regulatory system and can lead to problems such as breast engorgement or insufficient milk production (Hartmann et al., 1996; Powers, 1999; Woolridge et al., 1993). Restricting feeding length, in particular, may also lead to the infant receiving less of the fat-rich hindmilk, an important source of energy (Woolridge and Fisher, 1988). Keeping the child

² A class of drugs also known as tranquilizers

physically close during both day and night naturally facilitates the interactive process of feeding on cue.

The value of unrestricted feeding and the supporting role of close maternal–infant contact has been recognized by both the World Health Organization (WHO) and the United Nations Children’s Fund (UNICEF). In a joint statement they recommend on-demand breastfeeding and rooming-in around the clock as the desired form of care for all healthy neonates on maternity wards as a means of optimally supporting lactation (WHO, 1989). Recommendations by the American Academy of Pediatrics (2005a) for the neonatal period are along the same lines. The latter organization further states that crying is a late sign of hunger, and that behavioral indicators such as increased activity and alertness, rooting, or mouthing that precede it should be sufficient to alert the mother to the nutritional needs of her newborn.

Finally, nursing on cue leads on average to more frequent feedings than does feeding a child by schedule every 3–4 hr, with 10 or more nursing episodes a day being common during the first few months of life (Barr and Elias, 1988; Díaz et al., 1995; Elias, Nicholson, and Konner, 1986; Yamauchi and Yamanouchi, 1990). Reflections by Blurton Jones (1974, p. 317) on the possible relationship between widely-spaced feedings of relatively large quantities and the frequent vomiting of milk that is typically observed in young human infants also suggest that a pattern of shorter, but more frequent feeds may come closer to the innate feeding style of the human infant. The clinical recommendation to offer frequent feedings of relatively small size as a measure to reduce excessive gastroesophageal reflux in children (Herbst, 1981) supports Blurton Jones’ view. See also Gussler and Briesemeister (1980) for a comprehensive treatise of the complexities involved in successful breastfeeding and the possible pitfalls of a deviation from natural breastfeeding patterns.

Weaning

As to the optimum duration of breastfeeding, an investigation into the role of breast milk in the diet of children aged 2 years or younger has concluded that human milk can make a valuable contribution to the infant’s nutrition well beyond the age of 12 months (Dewey, 2001). It is further known that it takes a few years before the child’s own immune system achieves full maturity (Buckley, R. H., 2000; Davies, E. G., 1998), so that breastfeeding can be assumed to provide distinct health benefits to the breastfed child well into early childhood (Dettwyler, 1995; Goldman, Goldblum, and Garza, 1983).

The American Academy of Pediatrics’ (2005a) official policy statement on “Breastfeeding and the Use of Human Milk” concludes that breast milk is ideal and sufficient nutrition for approximately the child’s first 6 months of life. It further recommends “breastfeeding ... [to] be continued for at least the first year of life and beyond for as long as mutually desired by mother and child” (p. 499). The American Academy of Pediatrics also takes a clear position regarding toddler nursing by stating that “there is no upper limit to the duration of breastfeeding and no evidence of psychologic or developmental harm from breastfeeding into the third year of life or longer” (p. 500). WHO (2001, 2002; see also World Health Assembly, 2001, 2002) advises the cessation of exclusive breastfeeding and the introduction of appropriate complementary foods at the age of 6 months, while continuing breastfeeding until the age of 2 years or beyond.

Psychological Correlates of Natural Parenting

Mother–Infant Interaction and Attachment

Sensitive parenting and secure attachment

There is broad agreement that the quality of care a child receives early in life influences the child's chances of developing a secure attachment relationship to the caregiver (Ainsworth, Bell, and Stayton, 1974; Ainsworth et al., 1978; Bowlby, 1982, 1988). Secure attachment relationships in infancy, in turn, have been linked to different aspects of adaptive functioning later in life, particularly if parenting behaviors conducive to secure attachment continue to prevail during later stages of development (reviews: Thompson, 1999; Weinfield, Sroufe, Egeland, and Carlson, 1999; see also Carlson, Sroufe, and Egeland, 2004). Ainsworth, Bell, and Stayton (1971, 1974) identified the mother's sensitivity to her child's signals, as well as her acceptance, cooperation, and accessibility, as central factors in the development of attachment security, with maternal sensitivity playing a particularly important role. Ainsworth et al. (1974, p. 127) originally defined maternal sensitivity as "the mother's ability to perceive and to interpret accurately the signals and communications implicit in her infant's behaviour, and given this understanding, to respond to them appropriately and promptly". Ainsworth et al. (1974) further specified that the mother's sensitivity appeared to be a key indicator of the quality of maternal interactive behavior, in the sense that caregivers who were highly sensitive were also, without exceptions, rated high in the three other dimensions, whereas caregivers with low ratings in any of the three other dimensions also received a low rating in sensitivity. Studies among infant populations from different cultures have generally provided evidence for the universality of the sensitivity–security link, although the great majority of research has been conducted in Western industrialized societies and data from other cultural contexts are very limited (for overviews, see De Wolff and van IJzendoorn, 1997; Posada et al., 2002). Yet, experimental evidence from intervention studies aimed at enhancing maternal sensitivity also supports the causal link between sensitivity and attachment security (review: Bakermans-Kranenburg, van IJzendoorn, and Juffer, 2003).

The results of De Wolff and van IJzendoorn's (1997) meta-analysis on antecedents of infant attachment security, however, led the investigators to conclude that maternal sensitivity as originally defined by Ainsworth et al. (1974, p. 127) cannot be considered the only important factor influencing the development of secure infant attachment. Other related aspects of maternal interactive behavior such as synchrony, mutuality, emotional support, positive attitude, and stimulation were also identified as making significant contributions. De Wolff and van IJzendoorn further pointed out that the wider context of parenting needs to be taken into account as well.

Maternal sensitivity has indeed been operationalized in myriad ways in the wave of research that has followed the initial Baltimore study by Ainsworth et al. (1978), and has led to numerous interrelated caregiving attributes being associated with the concept (Nicholls and Kirkland, 1996). Critical voices in the field now call for a reassessment of its definition, urging a departure from a narrow conceptualization of maternal sensitivity and instead favoring a more holistic approach that views maternal sensitivity as a multifaceted dyadic concept that unfolds in the interaction between mother and child, manifesting itself in different ways depending on the developmental level of the child and on the exact nature of the situation in question (Nicholls and Kirkland, 1996; Thompson, 1997; van den Boom, 1997). More specifically, van den Boom views sensitivity as being relevant to all interactive behavior (i.e., play, instruction, stimulation, etc.) rather than as a parenting dimension existing apart from other dimensions. She describes appropriateness, promptness, and consistency of maternal behavior as the main constituent parts of sensitivity across all aspects of parenting. If defined in this broad way, maternal sensitivity would also encompass many, if not all, of the other significant maternal attributes identified in De Wolff and van IJzendoorn's (1997) research. In this sense, maternal sensitivity can still be seen as a key determining factor of an infant's attachment security. Confirming evidence comes from a

recent large-scale investigation (of more than 1,000 infants) that operationalized maternal sensitivity in exactly such a broad way and also found that sensitivity was the pre-eminent predictor of attachment security (NICHD Early Child Care Research Network, 1997).

Whereas infants with secure attachment relationships (as assessed by the traditional Strange Situation procedure developed by Ainsworth et al., 1978, where infants are observed during a short separation from their caregiver and their subsequent reunion) are able to rely on their caregivers as available sources of protection and comfort whenever needed, thus freeing energy for their expanding explorations of the surrounding world and encouraging a confident stance vis-à-vis the world (Bowlby, 1973, 1982), children with relatively insensitive mothers have quite different early experiences. Their attachment relationships are described as insecure, and their developing patterns of behavior can be viewed as adaptations to the deficient parenting strategies of their caregivers (Main, 1990). In normative populations, two basic forms of insecurity have been discerned on the basis of the Strange Situation assessment procedure.

Avoidant attachment develops in an atmosphere of relatively cold and rejecting caregiving (Ainsworth et al., 1978). Mothers of avoidantly attached infants have been portrayed as having an aversion to close bodily contact, as often showing a lack of emotional expressivity, as being insensitive to their infants' signals, as vocalizing frequently, but noncontingently, and as being fairly rigid, compulsive, interfering, and overstimulating in their interactions with their infants (Ainsworth et al., 1978; Belsky, Rovine, and Taylor, 1984; Isabella and Belsky, 1991; Tracy and Ainsworth, 1981). Their children typically show distant and self-reliant behavior (Ainsworth et al., 1978; Main, 1990).

Resistant attachment, in turn, is associated with inconsistent and unpredictable interactive behavior, apparent underinvolvement of the caregiver, and interference with infant exploration (Belsky et al., 1984; Cassidy and Berlin, 1994; Isabella and Belsky, 1991). According to Ainsworth et al.'s (1978) investigation, mothers of resistant infants are also relatively insensitive to their infants' signals (see also Belsky et al., 1984), but clearly less rejecting than mothers of avoidantly attached infants. Mothers of resistant infants have no aversion to close physical contact, but are inept in holding their infants, and manifest only little affectionate behavior during bodily contact (Ainsworth et al., 1978). In response to their inconsistently or minimally responsive parents, resistantly attached infants are found to apply a strategy of increased display of dependence on the caregiver, exaggerated signaling, and hypervigilance (Cassidy and Berlin, 1994; Main, 1990). More specifically, heightened monitoring of the mother as well as fearfulness and inhibition in exploration with both peers and toys are typical features of these children (Cassidy and Berlin, 1994). During the Strange Situation procedure, interaction- and contact-resisting behavior mixed with contact-seeking behavior, and angry, or conspicuously passive behavior have also been observed (Ainsworth et al., 1978).

Finally, a category of disorganized attachment (added later to complement the classical three-category classification; Main and Solomon, 1990) describes infant-caregiver relationships that are highly dysfunctional, with the children being at risk for later psychopathology (Carlson, 1998; van IJzendoorn, Schuengel, and Bakermans-Kranenburg, 1999). Infants with a disorganized pattern of behavior lack a coherent attachment strategy and display odd and chaotic behavior during the Strange Situation procedure (Main and Solomon, 1990). Disoriented, frightened, frightening, or extremely insensitive, disrupted parental behavior appears to lie at the roots of disorganized attachment (Carlson, 1998; Lyons-Ruth, Bronfman, and Parsons, 1999; Madigan, Bakermans-Kranenburg, van IJzendoorn, Moran, Pederson, and Benoit, 2006; Main and Hesse, 1990).

As infants with insecure attachment relationships have a less consistent experience of a reliably available caregiver who provides comfort in the face of possible threats, an

underlying anxiousness about the availability of their caregiver is thought to be the result, keeping them from exploring their environment without worry and thus preventing them from achieving the same mastery of their surrounding world and confidence in themselves that secure infants can (Bowlby, 1973, 1982; Cassidy and Berlin, 1994). All in all, Bowlby (1973) proposed that these early experiences of different degrees of insensitive or sensitive care contribute to the development of internal working models of relationships and the self, that is, internalized expectations regarding the responsiveness and accessibility of the caregiver and, ultimately, people in general, as well as beliefs concerning one's deservingness of such treatment. These mental representations are presumed to guide interpretations of one's social environment as well as social behavior, with the resulting interactions further consolidating one's assumptions about oneself and others, thus easily leading to a self-perpetuating feedback cycle (see also Thompson, 1999).

Parental responsiveness and infant crying

One aspect of sensitive caregiving, namely promptness of parental response to infant signals, has been researched in some detail. More specifically, there has been some debate in the field as to whether prompt responsiveness to infant distress would lead to a decrease or an increase in infant distress vocalizations. Overall, amount of crying is highest during the early weeks and decreases with increasing age (Bell and Ainsworth, 1972; van IJzendoorn and Hubbard, 2000). The position of researchers informed by a behavior analytical perspective has been that consistent and prompt responding should in fact increase crying by providing reinforcement for the behavior (e.g., Etzel and Gewirtz, 1967; Gewirtz and Boyd, 1977). Correspondingly, ignoring crying should result in a decrease in the amount of crying observed. Two basic types of crying have been identified in children: crying caused by physical distress, and so-called nondistress crying in the absence of any apparent physical concern (Gewirtz and Boyd, 1977). The latter type is frequently assumed to be easily amenable to parental reinforcement (i.e., consistent parental response), supposedly leading to increased crying and a "spoiled" child. The distinction made is problematic in that it discounts emotional causes for distress, such as an inherent need for physical contact with the caregiver for emotional security (Bowlby, 1982). In their experimental analysis of infant crying, Etzel and Gewirtz (1967) focused on nondistress or operant crying, and found that crying duration could indeed be changed by behavioral modification. However, their study was restricted to two institutionalized infants, and the extinction of crying had been coupled with the reinforcement of smiling.

In one of the first naturalistic, longitudinal studies exploring the connection between sensitive parental responsiveness and infant crying, Bell and Ainsworth (1972) conducted in-depth home observations of 26 mother–infant dyads spanning the children's first year of life. Their finding was that consistent and prompt maternal response to infant distress earlier on was associated with both a relatively low frequency and a relatively short duration of crying and fussing in subsequent months. However, the study has been criticized on methodological grounds (Gewirtz and Boyd, 1977).

In a replication of Bell and Ainsworth's seminal Baltimore study with a larger sample of 50 Dutch families, van IJzendoorn and Hubbard (2000) were able to use more reliable and powerful statistical methods in their analyses and were further able to control for possible confounding variables. Contrary to expectations, they observed that more frequent ignoring of the infants' crying by their mothers during the first 9 weeks of life was related to less frequent crying in the following 9 weeks. In general, however, throughout the first 9 months, earlier crying was the best predictor of later crying. Only during the first 18 weeks was maternal unresponsiveness able to explain an additional 10% of the observed variance in crying. Moreover, van IJzendoorn and Hubbard's study revealed that crying behavior at home

was not significantly related to attachment status at 15 months, whereas Ainsworth et al. (1978) as well as Belsky et al. (1984) had found that securely attached infants cried less at home than insecurely attached infants. Finally, van IJzendoorn and Hubbard also reported that mothers of infants classified as avoidant were most prompt in responding to their infants' crying.

In a number of other studies, prompt parental response to infant distress (in terms of both an attitude and explicitly measured behavior) has been associated with relatively lower frequencies and shorter durations of concurrently measured fussing and crying in the infant (Baildam et al., 1995; Belsky et al., 1984; Crockenberg and Smith, 1982; Grossmann, Grossmann, Spangler, Suess, and Unzner, 1985; Taubman, 1984, 1988). Observations by Bell and Ainsworth (1972) of the quality of infant–mother communication in their Baltimore sample further indicated that high maternal responsiveness not only reduced crying but was also associated with maternal sensitivity to other social signals of the child, thus resulting in more varied ways of communication. This result is congruent with the findings of a study on newborns 1–2 hr postbirth showing that the infants displayed many cues and signs of distress over a time span of 4–71 min ($M = 31$ min) before resorting to full-blown crying to communicate their needs (Gill, White, and Anderson, 1984).

If crying is viewed as an honest indicator of infant distress (either emotional or physical in nature), it appears plausible that prompt responding to a child's needs by a mother who does her best to correctly interpret her infant's signals should, over time, lead to increasingly refined communication between the two parties, and to only minimal crying and secure attachment in the child. Why, then, do some findings depart from the observed overall pattern? A few possible explanations are introduced in the following.

First, it should be considered that the absence of crying in an infant may mean different things under different circumstances. Whereas relatively little crying in a sensitively mothered infant would be interpreted as reflecting emotional security, nobody would argue that the apathetic appearance and minimal crying in socioemotionally deprived infants in institutional care (Provence and Lipton, 1962) is a positive outcome. In the latter case, the absence of overt distress signals can be attributed to resignation in the face of repeatedly ignored signaling behavior rather than emotional wellbeing. There is some indication that a similar mechanism could possibly also account for the relatively little crying in home-reared infants with a history of maternal unresponsiveness as observed in some cases. In a study assessing infants' cortisol levels after the Strange Situation (SS) procedure, infants with attachment classifications associated with intense separation distress during the SS had cortisol values that were not significantly different from those of infants with attachment classifications associated with little overt distress during the SS (Spangler and Grossmann, 1993). Moreover, despite their low levels of behavioral distress during separation from their mothers, avoidantly attached infants in this sample showed significant heart rate increases during the separation, indicating emotional arousal or activation. The level of overt behavioral distress, in the absence of other relevant information, may therefore not be sufficient to make a reliable conclusion about the child's underlying emotional state.

This assumption is supported by data from research on the behavioral and hormonal correlates of mother–infant separation in squirrel monkeys (Levine, Wiener, and Coe, 1993). Infant vocalizations typically decreased with increasing duration of separation, which can be interpreted as an adaptation to the ineffectiveness of the calling to reestablish contact with the mother. At the same time, however, cortisol levels kept increasing. Also, separated infant monkeys vocalized more when auditory and olfactory communication with the mother was permitted during the separation, compared to complete isolation from the mother, thus again confirming the assumed function of the distress vocalizations as a means of signaling to the

mother, as long as a rescue from the distressing situation is still perceived as potentially possible.

Second, it is worth noting that Grossmann et al. (1985) noticed in their home observations of German mother–infant dyads that the mothers of the 10-month-old infants dealt in diverse ways with distress in their infants. Observed reactions ranged from picking up the child, offering a pacifier or toy, talking to the child, offering food, and changing the diapers, to ignoring and even annoyed or angry responses. Similar observations were also made by Bell and Ainsworth (1972). According to both studies these different behaviors were variably effective in soothing the children, so that many mothers had to employ more than one intervention to calm their child. Interestingly, a subgroup of mothers in Grossmann et al.'s study who never ignored their infant's crying during the observation period had to resort to significantly fewer attempts at calming their infant than the rest of the sample—in other words, they were more effective in calming their child. Also, their children cried significantly less frequently and for shorter periods of time. Thus, given these observations that mothers can vary greatly in their ability to calm their distressed child, it may be too simplistic to assume that an infant's crying behavior could be exhaustively explained by promptness of maternal response alone. Bearing in mind that maternal sensitivity is defined as encompassing both promptness and appropriateness of response (Ainsworth et al., 1974, p. 127), it may be necessary to assess both aspects of maternal response for inferences about infant crying behavior to be valid.

In Grossmann et al.'s (1985) sample, promptness and effectiveness of maternal response were closely linked, and associated with less crying in the infant. It could therefore be presumed that only promptness and effectiveness of response in combination, that is, *sensitive* responsiveness, leads to relatively little crying, expanded modes of communication, and secure attachment. Apart from the body of research linking maternal sensitivity and secure attachment, a Dutch intervention study that also included measures of infant crying provides support for this assumption. In that study, mothers of irritable infants, preselected on low social class where fairly high rates of maternal insensitivity are known to predominate (Mey, 1992, as cited in van den Boom, 1994), participated in a 3-month-long program aimed at increasing maternal sensitive responsiveness to the child's signals (van den Boom, 1994). The intervention proved effective in that mothers in the experimental group were indeed more responsive than mothers in the nonintervention control group immediately after the intervention when the children were 9 months old. Moreover, relative to the control infants, infants in the intervention group cried and fussed less and exhibited more positive social behavior at 9 months, and further showed significantly more secure attachment at 12 months of age. If the above hypothesis is correct, the fact that most studies into this question have shown a link between prompt response to infant distress and reduced crying (with the appropriateness of the response often not being assessed) may, in effect, indicate that, in many cases, prompt maternal response and an ability to quickly soothe the infant go hand in hand. The latter may be largely dependent on the mother's ability to choose an appropriate response, although infants who have been crying for relatively longer periods of time before their mother intervenes may naturally be more difficult to soothe than infants who have cried for only little time. Findings where promptness of maternal response and infant cry behavior are not associated in the expected way, may consequently be indicative of samples where the two aspects of maternal sensitivity are not highly correlated. This explanation is likely to apply to van IJzendoorn and Hubbard's (2000) sample, because they found mothers of avoidant infants to show most prompt responses to their infants' distress, and mothers of avoidantly attached infants have been described as insensitive, interfering and intrusive in their interactive behavior (Ainsworth et al, 1978; Isabella and Belsky, 1991).

Yet, some inconclusiveness still persists. Bell and Ainsworth (1972) reported that maternal effectiveness in terminating her infant's crying was a less important determinant of crying behavior than promptness of maternal response. However, Bell and Ainsworth examined the association between effectiveness of response and frequency of crying clusters (series of distinct cries, separated by less than 2 min) rather than duration of crying (clusters), which is more likely to be affected by appropriateness of response. In any case, more research is certainly needed to clarify the relative contributions of promptness and appropriateness of maternal response to infant cry behavior.

Finally, an interaction between infant temperament and caregiving style during the first months of life may make predictive patterns regarding infant cry behavior during early life less likely, at least if infant temperament is not included in the equation. If degree of maternal sensitive responsiveness is an important determining factor of infant cry behavior, and in common with maternal responsiveness, is a fairly stable maternal characteristic (Bell and Ainsworth, 1972; van IJzendoorn and Hubbard, 2000), then it may not be surprising to find that individual differences in infant cry behavior also show moderate to high stability over the first year of life (Baildam et al., 1995; van IJzendoorn and Hubbard, 2000). The fact that infant cry behavior appears somewhat less stable than maternal caregiving characteristics, and, according to Bell and Ainsworth (1972), is not related to maternal unresponsiveness during the first quarter and only stabilizes during the second half of the first year of life, could consequently be attributed to an initial period of adaptation to the caregiving environment. For instance, irritable infants cry comparatively much (Blum, Taubman, Tretina, and Heyward, 2002; van den Boom, 1991), but when raised by a sensitive mother show a decrease in crying over time (Belsky, Fish, and Isabella, 1991; van den Boom, 1994), whereas infants with an easy temperament raised by insensitive mothers show a relative increase in crying (Fish, Stifter, and Belsky, 1991), until after some months a balance between influences from temperament and caregiving interventions is likely to be achieved.

In general, insensitive mothering appears to be a greater causal factor of infant fussiness or irritability than vice versa (Bell and Ainsworth, 1972; Belsky et al., 1984; Crockenberg and Smith, 1982; van den Boom, 1994), although persistent crying in the infant has been shown to make mothers more reluctant to promptly attend to their infants in the second half of the child's first year of life (Bell and Ainsworth, 1972). In combination with the findings of many workers that unresponsiveness leads to higher levels of infant crying, this suggests that a vicious circle can develop if high levels of crying persist beyond the first few months (Bell and Ainsworth, 1972). Dyads most at risk for such a development would be irritable infants with insensitive mothers. In such cases, anything that might reduce infant distress and increase maternal sensitivity may help to prevent the negative cycle from developing.

All in all, the conclusion emerging from this discussion appears to be that sensitive maternal responsiveness is as important in dealing with infant distress signals as it is in mother–infant interactions in general, forming a good starting point for a trusting relationship and supporting healthy emotional development in the child.

The role of physical proximity

As outlined by Bowlby (1982), the biological function of infants' attachment to their caregivers is assumed to be the attainment or maintenance of physical proximity with their primary care providers, which during the time when humans were evolving increased an infant's chances of survival by offering protection from predators. Attachment behaviors such as crying, smiling, following, and clinging are therefore viewed as infants' innate equipment designed to maintain or reestablish closeness with their caregivers. These behaviors are complemented by parental behaviors with the same goal (e.g., calling, following, retrieval,

holding). Activation of proximity seeking in the child is most likely under conditions of stress or potential danger, such as hunger, fatigue, illness, pain, absence or impending departure of the mother, maternal discouragement of proximity, or the presence of fear-provoking, natural clues to danger (see also Bowlby, 1973; e.g., loud noise, aloneness, darkness, anything strange/unfamiliar). The attachment system is counterbalanced by an exploratory system, that is, an inborn curiosity concerning the outside world and a concomitant desire to examine one's surroundings that provides the child with important learning experiences about his or her environment. Optimally, these systems are flexibly balanced, that is, the child is able to use the mother as a *secure base* in his expanding explorations of the surrounding world (see also Ainsworth, 1967, pp. 345–346, and 1972, pp. 117–118). The younger the child and the more potentially threatening a situation is, the greater is the child's need for direct contact with the caregiver. Lack of confidence on the child's part in the caregiver's accessibility and responsiveness, based on a history of inconsistent caregiving, can also lead to a heightened display of attachment behaviors, at the expense of exploratory behavior, whereas a history of consistent caregiver availability engenders confidence in the accessibility and responsiveness of the attachment figure whenever needed and thus encourages exploration (Bowlby, 1973, 1982). Consequently, answering an infant's need for proximity and care in early life is viewed as decreasing a child's need for close proximity later on, whereas resisting a child's dependency needs is likely to have the opposite result. Empirical evidence overwhelmingly confirms the central role of physical proximity between infant and caregiver in early infancy.

Contact comfort is universally perceived as reassuring by both human infants (e.g., Wolff, 1969) and infants of nonhuman primates (e.g., Harlow, 1958). This is also reflected in the observation that the first instinctive reaction of a mother to her infant's distress is to embrace, rock or pat, and, often, to hum or talk soothingly to the infant (Dzik, 1979). All over the world, mothers implicitly know that a combination of touch, movement, and speech calms an upset child. Newborns separated from their mothers, in particular, immediately stop crying upon reunion during the first hour after birth (Christensson, Cabrera, Christensson, Uvnäs-Moberg, and Winberg, 1995). In other studies the close presence of another person during the first few hours of life has also been associated with only minimal crying, whereas neonates who are isolated from direct physical contact and cared for in a hospital nursery show considerably higher levels of distress (Lambesis, Vidyasagar, and Anderson, 1979; Malecki, 1985; Read, 1989).

Bell and Ainsworth (1972), too, found that during the first three months of life the infants in their longitudinal study had a tendency to cry more often when the mother was out of auditory, visual, and physical range. Throughout the whole first year of life, the most effective means of soothing the crying infants, and also the most frequently employed intervention by the mothers, was close physical contact. Exactly the same was also reported by Grossmann et al. (1985) for their Northern Germany sample of 10-month-old infants. Bell and Ainsworth further pointed out that very young infants usually required holding to be soothed, whereas infants close to the age of one were more likely than earlier to be calmed by maternal responses such as entering the room, or approaching or touching the child, that simply decreased the distance between mother and infant but did not lead to close bodily contact. Grossmann et al., on the other hand, mentioned that verbal empathy was ineffective as a soothing strategy with their 10-month-old subjects, unless combined with close physical contact.

In a Canadian intervention study by Hunziker and Barr (1986), the amount of crying and fussing in infants during their second and third months of life was directly linked to the amount of time the children spent in close contact with their caregivers. Children of parents who had been instructed to carry their children for at least 3 hr a day in addition to routine contact, and who on average carried their infants 4 hr 25 min per day, were found to cry and

fuss significantly less than infants in a control group experiencing an average of 2 hr 40 min of bodily contact, with the greatest observed reduction being 43% at the time of peak crying (i.e., 6 weeks of age). Another study with a very similar design, however, did not find any significant differences in the amount of daily fussing and crying between the carrying intervention and control group (St. James-Roberts, Hurry, Bowyer, and Barr, 1995). However, high attrition rates, especially in the control group, were a problem in this study. Three further studies also failed to replicate Hunziker and Barr's results, with one of them, however, investigating a clinical sample of infants presenting with crying problems ("colic") (Barr, McMullan, et al., 1991), and with the remaining two suffering from a number of shortcomings leading to uninterpretable findings (Elliott, Reilly, Drummond, and Letourneau, 2002; Walker and Menahem, 1994). More specifically, neither of the two latter papers reported exact amounts of carrying in their experimental and control groups, thus failing to provide evidence for significant group differences on this key variable. Elliott et al. further stated that 43% of the parents in the supplemental carrying group had carried their infants at times less than the recommended three extra hours. Walker and Menahem had instructed participants in the intervention group to carry their infants for at least 2 hr daily, which may not have been considerably different from the carrying behavior of control group parents. Walker and Menahem's results were further contaminated by the presence of multiple confounding variables.

Anisfeld, Casper, Nozyce, and Cunningham (1990) investigated the effects of increased physical contact, as achieved through the regular use of a soft infant carrier, on the infant–mother relationship in a sample of Hispanic and Black mothers from a low-income population. They found that the experimental intervention significantly increased the mothers' responsiveness to their infants' vocalizations when the children were 3½ months old and further promoted the establishment of secure attachment at 13 months. Maternal sensitivity at 3½ months was also rated higher in the experimental group compared to a control group, with the difference being marginally significant. The researchers hypothesized that the extended physical closeness may have made it easier for the mothers to become aware of their infants' needs and to consequently act on these perceptions. This proposition is in line with the recognition by Ainsworth et al. (1974) that a necessary precondition for sensitive responding is exposure to the child's signals in the first place. Other research has also provided support for the link between maternal distance, insensitivity, and insecure attachment (Grossmann et al., 1985; Ainsworth et al., 1978).

Furthermore, a study evaluating the effects on the whole family system of 2 weeks of daily skin-to-skin contact (kangaroo care) between mothers and their premature infants, found significant interactional benefits associated with the intervention when the infants were 3 months old (corrected age), weeks after completion of the intervention (Feldman, Weller, Sirota, and Eidelman, 2003). More specifically, both the mothers, the actual providers of kangaroo care, and the fathers showed greater sensitivity, less intrusiveness, and higher levels of dyadic reciprocity in interactions with their infants compared to a control group that had received conventional care in the neonatal nursery. At the same time, infants in the experimental group showed less negative emotionality during interactions with their parents, and the parent–infant triads were judged to display higher cohesiveness. In the intervention group, both parents also provided their infants with more affectionate touch than control parents. The apparent spill-over effect of positive interactional patterns from the mother–infant dyad extending to the whole family is in line with assumptions from family systems theory, where changes in part of the system always impact the larger system. Follow-ups at 6 months and 2 years indicated continued higher levels of maternal sensitivity in the kangaroo care group (Feldman, 2004; Feldman, Eidelman, Sirota, and Weller, 2002).

Natural parenting, sensitive parenting, and mother–infant attachment

As a final step in the examination of issues related to mother–infant interaction and attachment, we will now consider how natural parenting practices relate to the discussed findings. Sensitivity to the child’s emotional and physical needs is a core principle of natural parenting, and crying in the infant is always interpreted as a clear sign of distress that needs to be taken seriously and responded to. This parental attitude coupled with the high levels of physical contact characteristic of these mother–infant dyads usually ensures prompt maternal response to infant distress. Extensive exposure to cues from the child further facilitates interpreting these cues, so that mothers with this parenting strategy can be assumed to react appropriately as well as promptly to signals from their infants. In this context, maternal responsiveness can be presumed to extend to precry signals and nondistress signals as well, thus leading to more refined and richer modes of communication between mother and infant. The fulfilment of the infant’s innate need for close physical proximity to the caregiver should also eliminate at least one source of distress in the infant. Consequently, the frequency of crying episodes would be expected to be relatively low and the duration of individual crying episodes fairly short in infants raised according to natural parenting principles. Yet, as infants have been shown to cry not only as a means to *request* some action from the caregiver but also to *protest* against certain caregiving behaviors (e.g., wiping the nose) or prohibitions (e.g., removal of a forbidden object) (Chen, X., and Gustafson, 2004), a certain amount of crying should still be expected even in infants who have their basic needs continuously fulfilled.

Parental responsiveness to infant distress in the context of natural parenting practices may, however, differ from the kind of responsiveness observed in a conventional Western childrearing context and discussed in studies on Western samples. Direct extrapolations from these studies to natural parenting environments should thus be considered with caution. The extended physical contact between caregiver and infant in the former case permits prompter caregiver responses than is possible under the circumstances prevalent in most Western families. Responsiveness to precry signals is also more easily accomplished under conditions of close proximity. This reality is also reflected in the following statement by Ainsworth and Bell (1977, p. 1214): “Under conditions of infant care in our society it is not feasible for a mother to be so constantly close to her baby that she can consistently avert cries by responding to signals that she has learned to interpret as precursors to crying.”

An investigation by Barr, Konner, Bakeman, and Adamson (1991), conducted among the !Kung San hunter-gatherers in North-Western Botswana, offers some insight into the crying patterns of infants raised in a natural parenting context. !Kung San infants are in virtually continuous physical contact with their caregivers and are very frequently fed, and caregivers respond immediately to infant signals (with under-3-month-olds, 92% of the infants’ cry/fret signals are responded to within 15 s; the corresponding rate during the second year of life is 82%; Barr, Bakeman, Konner, and Adamson, 1987). For comparison, Western mothers have been reported to deliberately ignore on average 26–47% of their infants’ distress signals (Bell and Ainsworth, 1972; Grossmann et al., 1985; van IJzendoorn and Hubbard, 2000). However, individual variability in responsiveness was high in the Western samples. Whereas the overall frequency of combined crying and fretting events in the !Kung San sample appeared to be similar to that observed in samples of Western infants, it is noteworthy that more than 60% of the infants’ distress signals lasted 5 s or less, and only 5–10% lasted more than 30 s during the first two years of life (Barr, Konner, et al., 1991). Moreover, crying represented only about 5% of total cry/fret duration throughout the first year of life. Overall duration of crying and fretting was only about half of that of Dutch infants. A comparison of two neighboring, but culturally distinct Central African peoples with different styles of infant care yielded similar results (Hewlett, Lamb, Shannon,

Leyendecker, and Schölmerich, 1998). The foraging Aka closely resemble the !Kung San in their caregiving practices, whereas the Ngandu farmers provide their infants with only about half as much physical contact, feed them less frequently than the Aka, and are also more inclined to let their infants fuss or cry. In line with Barr, Konner, et al.'s (1991) findings, Aka infants were found to fuss or cry less than half as much as Ngandu infants at the ages of 3–4 months and 9–10 months. Observations conducted among the Zinacanteco Indians of Southern Mexico draw a very similar picture (Brazelton, Robey, and Collier, 1969). All in all, intense and prolonged infant crying is a rare event in societies that follow natural caregiving practices.

It should be emphasized that infant care practices in these cultures are characterized not only by prompt reaction to infant distress and close physical proximity, but also by considerably more frequent feedings than what is typically observed in industrialized societies. As shortly spaced feedings are a biological need of the human infant, this feature may further increase the level of appropriateness of caregiver response to infant signals in this caregiving context compared to a conventional Western childrearing environment, and may thus also influence crying behavior. Indeed, in a U.S. study specifically investigating the relative contribution of these two variables on infant expressions of distress, both promptness of maternal response and feeding frequency emerged as important determinants of fussing and crying behavior in infants, at least at an early age (Barr and Elias, 1988). More specifically, Barr and Elias found that 2-month-old infants with a promptly responding mother, coupled with short interfeeding intervals, cried and fretted less often when compared to infants whose mothers only fed them at short intervals or only responded quickly, and particularly when compared to children whose mothers did neither. At 4 months, however, significant relationships between the variables were no longer evident.

Although natural parenting practices in a Western context may predominantly appeal to parents who would parent sensitively in any case, Anisfeld et al.'s (1990) study demonstrated that a simple intervention increasing the amount of physical contact between mother and infant can significantly improve the quality of the mother–child relationship, as reflected in more secure attachment in the infant. A study conducted among the Dogon of Mali, West Africa, provides rare data on attachment security of infants raised according to natural parenting principles (True, Pisani, and Oumar, 2001). As constant physical proximity between caregiver and infant, immediate response to infant distress, and frequent breastfeeding on demand are the norm in the Dogon culture, the studied sample is free from a possible bias towards a specific maternal personality type that feels particularly drawn to a natural approach to parenting, as could be the case in a Western sample. Despite the fact that a significant portion of the infants in the sample had their grandmother as the primary caregiver during the day, mothers still remained closely involved with their infants in these cases through frequent breastfeedings and cosleeping during the night. Hence, attachment classifications were also found to be uninfluenced by type of primary caregiver.

Using the Ainsworthian three-category classification system, 87% of the Dogon infants were classified as secure, none as avoidant, and 13% as resistant at the age of 1 year (True et al., 2001). This distribution differed significantly from that of an aggregated sample of 1990 children from 8 countries, mainly the U.S. and Western Europe, representing 32 different studies, where 65% of the children were securely attached, 21% avoidant, and 14% resistant (van IJzendoorn and Kroonenberg, 1988). Compared to the predominantly Western sample, Dogon infants were significantly more often securely attached and also showed significant differences regarding the prevalence of avoidant attachment. When the results were examined using the more recent four-category system, Dogon infants were classified as follows: 67% secure, 0% avoidant, 8% resistant, and 25% disorganized. Compared to four North American samples comprising a total of 306 children, where 55% of the children had

received a secure attachment classification, 23% an avoidant, 8% a resistant, and 15% a disorganized classification (van IJzendoorn, Goldberg, Kroonenberg, and Frenkel, 1992), the only statistically significant difference between these two distributions was the total absence of avoidant attachment among the Dogon infants. This particular feature was explained by the authors in terms of the incompatibility of Dogon caregiving practices with conditions typically associated with avoidant attachment in Western samples, that is, maternal rejection of attachment bids, intrusion, and lack of physical contact and tender holding. The authors further point out that the distribution of attachment classifications among the Dogon is also remarkable given their high infant mortality (25–45% of infants have been reported to die before the age of 5), as a connection between unresolved loss in the mother and disorganized attachment in the child has been reported given certain conditions (e.g., Hughes, Turton, McGauley, and Fonagy, 2006; Schuengel, Bakermans-Kranenburg, and van IJzendoorn, 1999). Yet, the proportion of disorganized infants in the Dogon sample was not significantly different from the rate in the aggregated Western sample. Dogon maternal sensitivity as assessed with Ainsworth's Maternal Sensitivity Scale was found to be modestly correlated with infant security ratings, with the correlation approaching statistical significance.

Two other studies conducted in cultures where responsive, close contact parenting is common practice draw a similar picture. One study examined a Black South African sample living in extreme poverty (Tomlinson, Cooper, and Murray, 2005) and found the following distribution of attachment classifications: 62% secure, 4% avoidant, 8% resistant, and 26% disorganized (three-way classification: 72% secure, 17% avoidant, and 11% resistant). The other study investigated Indonesian mother–child dyads of low and lower-middle socioeconomic status (Zevalkink, Riksen-Walraven, and Van Lieshout, 1999) that displayed the following distribution: 52% secure, 7% avoidant, 20% resistant, 20% disorganized, and 2% other (three-way classification: 59% secure, 7% avoidant, and 34% resistant). Compared to the aggregated global distributions, the Indonesian dyads demonstrated lower levels of avoidant and higher levels of resistant attachment. In both samples, attachment security was significantly associated with either maternal sensitivity or high quality of maternal support. On the whole, the two samples demonstrated similar rates of attachment security as those found in Western samples, and lower rates of avoidant attachment. In the Indonesian case, a relatively higher rate of resistant attachment was observed. The high levels of secure attachment are noteworthy, as both investigated groups were exposed to economic and social stress, the South African sample probably more so than the Indonesian sample. Both groups of investigators argued that such life stresses may negatively impact the quality of parenting. In the South African community living in pervasive socioeconomic adversity, for instance, levels of family violence and abuse were likely to be high, 35% of the mothers had been diagnosed with postpartum depression, and HIV/AIDS was a common source of concern. For comparison, aggregated data from samples characterized by maltreated mothers (9.1% secure, 28.5% avoidant, 14.5% resistant, 47.9% disorganized) or maternal depression (41.2% secure, 20.6% avoidant, 17.4% resistant, 20.9% disorganized) show significantly lower levels of attachment security in such circumstances (van IJzendoorn et al., 1999).

The limited data available to date thus suggests that naturally parented infants show a trend towards greater attachment security, and specifically an absence of avoidant attachment, relative to infants parented in the prevalent Western way. However, data on Western samples of naturally parented infants is not yet available, and will need to be collected before conclusive inferences can be made. Yet, if anything, rates of secure attachment in Western samples of naturally parented infants could be expected to be higher rather than lower than those in nonindustrialized societies, because factors such as high infant mortality or general hardship may bias the results in developing countries towards lower rates of secure attachment than what would be observed in the absence of these factors. Also,

differences in the early social experiences of infants with different backgrounds (i.e., differences in infant care practices) may significantly affect how infants experience the Strange Situation procedure, so that the resulting classifications may reveal as much about the infants' familiarity with situations similar to the test situation as it reveals about the quality of the dyads' relationships (LeVine and Miller, 1990). This equally applies to comparisons between cultures as to comparisons between different subgroups within the same culture, such as naturally parented and conventionally raised infants. Consequently, infants not used to playing in unfamiliar places outside the home, and unfamiliar with physical separation from the mother, meeting strangers, and being left alone by the mother, could be wrongly classified as insecurely attached when in fact they are merely reacting to an entirely novel, possibly great anxiety inducing situation (LeVine and Miller, 1990). Therefore, although assessments of the attachment security of naturally parented infants in the West would be important to conduct, there is justified doubt as to how valid a measure the Strange Situation is for this purpose. Additionally, results could possibly be confounded by maternal personality in the sense that women with certain characteristics (e.g., maternal sensitivity) may be more likely to choose natural parenting than others.

Dependence—Independence

Critics of natural parenting are frequently concerned that a mother's continuous involvement with her infant will cause the child to become overly dependent on her, and thus prevent the child from growing into an independent human being. Apart from the fact that early independence in a child as a developmental goal is mainly a feature of Western industrialized societies and is by no means shared by all cultures (Keller, H., 2003), there are clear indications that quite the opposite is true. The earlier discussion on the role of physical proximity in early life and on the link between sensitive caregiving, attachment security, and exploratory behavior has already introduced the issue.

More specifically, Ainsworth and colleagues (Ainsworth, Bell, and Stayton, 1972, 1974; Stayton and Ainsworth, 1973) made a number of detailed observations relevant to this topic in their comprehensive longitudinal study of mother–infant dyads covering the infants' first year of life. For instance, they reported that mothers who had given their infants relatively much affectionate, tender, and unhurried bodily contact during their early months, had infants who towards the end of the first year of life enjoyed affectional interaction during physical closeness with their mothers, but at the same time also were happy to be put down again, whereupon they would turn cheerfully to exploratory behavior and play activities, demanding relatively little contact under normal circumstances. In contrast, infants who had experienced only relatively brief episodes of holding, particularly if the contact was abrupt and inadequate, tended to protest against being put down and did not readily turn to independent play. They also showed great ambivalence about physical contact, sometimes seeking it, but not really enjoying it when getting it. Moreover, during the second half of the first year of life, infants with sensitively responsive mothers did not necessarily protest against brief absences of their mothers in a familiar home environment, such as when she left the room for a moment. It was more likely that the infants followed her rather than that they cried. These infants' behavior seemed to imply that they were confident that their mother would be available to them should they need her, and that she would be back soon in any case. Again, it was those infants who had experienced comparatively insensitive mothering who were more upset by everyday separations from their mothers. They were unwilling to let their mothers out of sight and were more often distressed by their departures. This behavior was described as a logical consequence of living with an inconsistently and unpredictably behaving attachment figure whom the child had not learned to trust, resulting in constant

monitoring of the mother's movements by the child and an immediate distress reaction whenever the mother moved out of sight.

Other research has also shown a clear link between insecure attachment in infancy and overly dependent behavior in preschool (Sroufe, Fox, and Pancake, 1983) and at age ten (Urban, Carlson, Egeland, and Sroufe, 1991). Moreover, routinely sharing the parents' bed in infancy has been associated with greater self-reliance and social independence at preschool age than a history of solitary sleeping (Keller, M. A., and Goldberg, 2004).

Comparisons between different cultures provide similar evidence. One study on toddlers, for example, found that Malaysian infants easily separated from their mothers at an earlier age than children in a U.S. sample (at the median age of 21 months vs. 36 months) (Chen, S. T., 1989). Malaysian infants are known to be carried a lot during their waking hours, and usually live in an extended family setting, while North-American infants spend significantly more time on their own. Furthermore, an examination of contemporary hunter-gatherer societies, whose approach to infant care is typically characterized by extensive and affectionate maternal involvement and a lot of physical contact, generally revealed early and gradually increasing autonomy and independence in the children, who by the age of 2–4 years spent more than 50% of the day in the company of their peers, away from their mothers (Lozoff and Brittenham, 1979). Konner (1976), who compared the behavior of English children aged 2–5 years to that of !Kung San hunter-gatherer children of the same age, also reported greater independence in the !Kung children. Reynolds' (1997) observations of children in different indigenous cultures for which close and extended maternal-infant contact is typical, are along the same lines.

In sum, the presented findings provide support for the assertion that a caring and affectionate approach to infant care that is sensitive to the child's needs and provides physical closeness is more likely to produce secure and ultimately independent children, than a parenting style that overemphasizes independence by limiting physical closeness, at an age when dependency needs are most natural and in fact a sign of healthy psychological development.

Brain Development—Physiology Meets Psychology

Human infants are born with a brain about 25% of its final adult size. By the first birthday the infant's brain has more than doubled in weight, and when the child turns three, has reached about 80% of its final weight (Caviness, Kennedy, Bates, and Makris, 1996). Growth continues until the middle of the second decade of life when full adult brain size is finally achieved. The fast rate of brain growth observed during the first year of life is thus unique to early development and will not be reached again during any later stage.

While the neurological development of the brain follows a genetically preprogrammed path that provides a crude framework for the process, it is at the same time also heavily influenced by experience (Anderson, V., Northam, Hendy, and Wrennall, 2001; Perry, 2002; Siegel, 1999). The number of neurons present at birth decreases somewhat during the months following birth, but it is mainly the structure and the activity of the developing brain that undergo profound transformations. Connectivity within the brain increases considerably during the first six months through augmented dendritic branching; new synaptic connections are generated, first unspecified in nature and greater in number than ultimately needed, then reducing to those utilized within the system in a process of elimination of redundant synapses which commences after the age of one. Myelination of axons, which peaks during the first eight months of life and continues well into early adulthood, finally substantially increases nerve conduction velocity. Experience enters the equation by stimulating different pathways in the brain, reinforcing existing connections by

repeated activation, as well as creating new ones, while unused circuits die away. Toxic conditions, such as those resulting from chronic stress, can also lead to the regression of synaptic contacts and neuronal cell death. Most importantly, by changing the very structure and the patterns of activity within the brain, experiences in early life also influence how subsequent information will be processed, thus affecting future functioning. Even though this shaping process continues throughout life, its effects are particularly critical during these early stages of development when the foundations for the brain's basic structure are laid.

For infants, their relationships with their main caregivers constitute the primary environment for their early development. In recent years, interdisciplinary approaches combining findings in neuroscience, biochemistry, developmental psychology, particularly attachment research, mental health, and related fields have provided increasing evidence for the crucial role of these early interactions in affecting early brain growth and subsequent human functioning (Gerhardt, 2004; Perry, 2002; Prescott, 1996; Schore, 2001a, 2001b; Siegel, 1999). These approaches bring together a vast amount of research ranging from investigations at a microscopic physiological level to the analysis of emotions and overt behavior, including animal research and findings from clinical as well as normal populations. Many hypotheses generated from animal models are now increasingly confirmed in human research. Within this complex framework, affectionate and responsive caregiving during infancy is clearly emerging as an important prerequisite for healthy brain development and later emotional wellbeing.

Most obvious examples of the link between adverse early social experiences and resulting deficits in brain and overall functioning can be found in clinical samples. For instance, former Romanian orphans, who had experienced severe early social deprivation, still showed long-term deficits in their cognitive and behavioral functioning after being adopted into U.S. families, with concomitant dysfunction in a group of limbic brain areas typically activated by stress and known to be damaged by prolonged stress (Chugani et al., 2001). In an Australian sample of extremely low birth weight infants, a history of childhood neglect was further associated with a smaller head circumference at ages 2 and 4, and with increasingly delayed cognitive development over the first four years of life compared to children who had not experienced neglect (Strathearn, Gray, O'Callaghan, and Wood, 2001). Another U.S. study on children and adolescents with past experience of maltreatment, and continued posttraumatic stress disorder, also found significantly decreased cerebral and intracranial brain volumes in the maltreated subjects when compared to matched controls (De Bellis et al., 1999). In addition, intracranial brain volume correlated positively with child's age at the time of abuse onset, and negatively with duration of abuse.

Milder forms of relational deficits in parenting have also been shown to produce distinct findings. In a study conducted by Dawson, Frey, Panagiotides, et al. (1999) in the U.S., 13- to 15-month-old infants of depressed mothers, when compared to infants of nondepressed mothers, showed a persistent atypical pattern of lowered activity in the left frontal brain area relative to the right frontal region. In typically developing children, increased left versus right frontal activity is usually observed. The abnormal condition also persisted during positive interactions with a nondepressed adult. The left frontal area is assumed to mediate positive affective expression and social approach behaviors. On a behavioral level, these children touched their mothers less than their age-matched controls, displayed less affection towards her, and with increasing duration of maternal depression were also more likely to behave in a hostile and aggressive manner (Dawson, Frey, Self, et al., 1999). A long-term prospective investigation into the activity of the hypothalamic-pituitary-adrenal (HPA) system involved in the stress response, further demonstrated that experiencing maternal stress, and particularly maternal depression, in infancy appears to increase the vulnerability of the child's HPA system to future stressors, resulting in elevated

cortisol levels at the age of 4½ when exposed to concurrent maternal stress (Essex, Klein, Cho, and Kalin, 2002). Exposure to only high levels of early or concurrent stress, on the other hand, did not result in elevated cortisol levels at the age of 4½ years. High cortisol levels at preschool-age were also predictive of dysregulated behavior more than two years later.

More research is still needed into the effects of subtle differences in caregiving behaviors within the normally accepted range of parenting practices to determine whether variations in these practices differentially affect neural development. A close examination of the developing stress response system is likely to yield particularly valuable information for this branch of inquiry. A review of research on neuroendocrine stress reactions in early life by Gunnar (1998), for instance, outlines how secure, sensitive, and responsive caregiving seems to play an important role in blocking, or at least buffering, increases in cortisol activity for infants and young children in potentially stressful situations, thus preventing possible adverse consequences of elevated cortisol levels on the developing brain (see also Gunnar and Donzella, 2002). Moreover, temperamentally vulnerable infants appear to show especially high cortisol reactivity to nonoptimal care, thus benefiting the most from this protective effect of warm and sensitive caregiving. Interestingly, rat pups that as part of naturally occurring variations in maternal care are licked and groomed relatively more by their mothers, have been found to show significantly reduced neuroendocrine reactivity to stress as adults, relative to control pups that are licked and groomed less (Liu et al., 1997). There is also evidence that the cortisol stress response stabilizes around the age of six months, after which individual differences appear to remain fairly constant (Lewis and Ramsay, 1995). Future research in this field combined with an increasing synthesis of already existing information from the different research traditions involved will hopefully help to clarify the kinds of experiences in early infancy that are likely to produce below-optimal outcomes in later life and identify children at greatest risk for negative outcomes.

Prevalence of Natural Parenting

This section concludes the overview of supportive evidence for the benefits of natural parenting by presenting numbers on the actual prevalence of the recommended practices from a historical and cross-cultural perspective. The reader should be aware that while many of the varied cultural practices that will be reported were true at the time when the observations were recorded, they may no longer be an accurate reflection of current practices. Yet, from an evolutionary perspective, even a hundred years represent only a blink of an eye, and the increasing contamination of many indigenous cultures with Western practices during the past few decades cannot mask the fact that at least until very recently, if not up till the present, natural parenting practices have been prevalent worldwide.

It is generally assumed that infant care during most of human history followed the principles of an approach based on constant contact and continuous care, which was most adaptive in the context of hunting and gathering, the mode of subsistence that prevailed during an estimated 99% of our species' history (Barkow et al. 1992, pp. 5 and 323; Fagan, 2002, e.g., p. 122; Lozoff and Brittenham, 1979). A review of the child-rearing practices of the few remaining contemporary hunter-gatherer societies in the tropics provides details of the used approach. All of the 10 tropical foraging groups examined by Lozoff and Brittenham (1979) carried or held their infants more than 50% of the day before the onset of crawling, and mother and child slept in the same bed or room in all cases. The mother was the principal caregiver, and weaning did usually not take place before the child's second birthday or well after (true for 86% of the societies). Furthermore, immediate response to infant crying was the rule, and care was generally affectionate. Similar infant-care patterns were also found among the 176 other nonindustrial societies reviewed by Lozoff and Brittenham (1979).

These were not hunter-gatherer societies, as they engaged in subsistence activities such as agriculture, fishing, or herding, which are more recent developments, having been used during less than 1% of our species' history. Cosleeping of mother and child in the same bed or room, extended nursing, and highly responsive care were also typical in the majority of these cultures. However, what distinguished this subsample from the nomadic hunter-gatherers is that only 56% of them (vs. 100% of the hunter-gatherers) provided their children with close physical contact for more than half of the time during early infancy.

In modern-day industrialized countries these practices have been mostly abandoned or at least greatly attenuated. They have been replaced by a more detached approach to infant care, characterized by less maternal involvement and an apparent concern about issues such as overindulging and spoiling the infant or encouraging too great a dependence of the child on the caregiver. While child-rearing practices during most of preindustrial European history were still much in accordance with natural parenting principles, societal changes in attitude that began in the 18th century and were accelerated by the industrial revolution led to a profound transformation in parenting attitudes by the early 20th century (review presented in Thevenin, 1987, pp. 51–63). The intimate connection between the lives of extended family members sharing small living quarters, which was characteristic during earlier times, had become more and more replaced by the nuclear family, and early independence of children had become an increasingly important concept in all aspects of child-rearing. Also, the emergence of parenting educators prescribing the “do’s and don’ts” of infant care, as well as advances in science and medicine, had made infant care a strongly regulated discipline and given it a distinctly sterile touch. Mothers were advised to refrain from picking up their crying child unless there was a “good reason”, and excessive displays of physical affection were strongly disapproved. Further aspects of this mindset were the increased popularity of bottle-feeding and the medicalized treatment of childbirth. Separate sleeping arrangements had already been recommended since the 1700s and the invention of the modern baby carriage, suitable for outdoor use, in the early 19th century in England (Fontanel and d’Harcourt, 1996/1997, p. 184) had also reduced the need for carrying infants in one’s arms.

The past few decades, however, have seen a return to more natural values in parenting as well as a change towards a more child-led form of care at all levels of Western society (Thevenin, 1987, pp. 61–63). This has also been reflected in an increasing number of parents adopting natural parenting as their parenting style of choice. Commercially manufactured carrying devices have become widely available (already noted in 1975 by Jelliffe), and an international network of associations and support groups for like-minded parents has formed. Popular literature and publications on natural parenting are available for actively interested parents, and professional circles have also started reevaluating their standpoints. Yet, this alternative parenting movement is still fairly small in scale, and the exact number of Western parents practicing natural parenting is unknown.

In order to gain a more detailed picture of the past as well as current worldwide distribution of natural parenting practices, the prevalence of each of the central elements of natural parenting will now be examined across different populations.

Infant Carrying

Great variations in the extent of close physical contact between caregiver and child during early infancy exist between cultures, with differences in lifestyle, modes of subsistence, economic conditions, and climatic factors playing a central role in determining how and where an infant typically spends the day. While all hunter-gatherer societies, and over half of the other nonindustrial societies that were inspected by Lozoff and Brittenham (1979), carried or held their offspring for more than 50% of the day during early infancy,

physical contact rates close to these numbers are still rare in industrialized nations. Japan is one exception, where physical closeness traditionally has played an important role in infant care (Latz, Wolf, and Lozoff, 1999; Miyake, Chen, and Campos, 1985; Rothbaum, Pott, Azuma, Miyake, and Weisz, 2000; Takahashi, 1990).

More typical of industrialized countries, infants in a Canadian sample were found to be carried by their caregivers for about 2 hr 40 min daily between the age of 3 weeks and 3 months (Hunziker and Barr, 1986). Two British studies collected data on the typical daily experiences of infants and also provide some insight into the extent of physical contact in early infancy in the industrialized West. Baidam et al. (2000), for instance, reported that the mothers in their sample spent on average 61 min per 24 hr holding their sleeping or crying infant of 6 weeks' age, with the figure decreasing to 17 min when the child turned one. However, considerable bodily contact also occurs during feedings, at least during early life, an activity that was included as part of the category of physical care, which also comprised activities such as bathing and changing. Mothers of 6-week-old infants spent a mean time of 3 hr 27 min on their infants' physical care, while mothers of 1-year-olds did so for only 2 hr 23 min daily. Two other categories that were assessed were play and interaction, distinct from any elements included in the two previously mentioned classes, on the one hand, and outings, on the other hand, both of which may or may not have included some physical contact. Mother and child spent approximately one hour daily in either activity throughout the child's first year of life. The same four activities involving fathers and other, non-parental, caregivers were also assessed, but comprised only a small part of the children's daily experiences. Variability of daily durations of the different activities at selected points during the child's first year of life between individual families was high. St. James-Roberts et al. (1995) assessed similar measures in their control group when the infants were 2 and 6 weeks old. Mean daily amounts of bodily contact between parents and infant appear to be higher in this study than in the two others. At the age of 2 weeks, infants were held or carried on average for 1 hr 57 min daily, and an additional 4 hr 12 min were spent feeding. At 6 weeks, daily duration of holding and carrying amounted to 2 hr 11 min, and that of feeding to 3 hr 38 min. The two other classes of typical interactions that were assessed included social stimulation (playing and talking) and basic care (bathing, dressing, changing). For infants raised in the United States, Ainsworth et al. (1972) reported close bodily contact for approximately 35% of the infants' waking time during the first quarter of their first year of life, decreasing to less than 10% in the fourth quarter.

Climatic influences

To investigate the relationship between customary methods of infant care and features of the natural environment across the globe, J. W. M. Whiting (1981) examined a cross-cultural sample of 250 societies, including the sample on which Lozoff and Brittenham (1979) had based their inferences. All data had been compiled before 1960 and covered all major ethnographic regions of the world. J. W. M. Whiting's analysis yielded a clear relationship between climatic region and type of infant carrying device used, which is a good index of the degree of physical closeness experienced by the child. He concluded that infants in cold climates tended to be transported in a cradle or cradleboard, which was also generally used as a sleeping place at night and as a resting device during the day. Use of heavy clothing for the infant, or swaddling, was common in these cultures. Close physical contact between preambulatory infants and their caregivers was infrequent and notably less extensive than among people living in warm climates, defined as regions with mean winter temperatures above 10 °C.

Infants in warm climates were typically carried in a shawl or sling on their caregiver's body for most of the day, wearing little or no clothing. Close body contact was frequently

maintained during naps and most often continued throughout the night when child and mother slept next to each other in the same bed. Carrying devices were not necessarily used in all instances, and at times the caregiver's arms were likely the only support when holding the child. Some societies used no carrying aids at all, and typically fell somewhere between cradle and sling cultures in terms of total contact time between caregiver and infant.

A few exceptions to this general pattern exist, the Eskimo and other native tribal groups of Northern America and Siberia being one (see also Reynolds, 1997). Despite their harsh living conditions Eskimos do not use transportable cradles or cradleboards when traveling with their infants. Instead young Inuit children are carried on their mothers' backs, inside a parka that is belted at waist-level, thus supporting the child under the buttocks and preventing slippage from the protective pouch formed by the mother's garment. However, the practice of swaddling and the use of shawls to carry infants, especially in summer or indoors, have also been observed among some Eskimo tribes (Honigmann and Honigmann, 1953). The traditional Greek method of combining heavy swaddling with the use of a sling was another observed variation (Mead, 1953, pp. 97–98). Some use of slings has also been reported for the medieval Western civilization, however, mainly for transportation rather than as a means of keeping the child close to the caregiver for extended periods of time (Fontanel and d'Harcourt, 1996/1997, p. 171).

Cultures where extensive physical contact occurs between infants and caregivers and for which exact measures are available, typically show mean body contact rates ranging between 70% and 95% of the time for young infants. The hunting and gathering !Kung San of the Kalahari Desert in Botswana, for example, hold or carry their infants about 80–90% of the time during the first few months of life (Konner, 1976). The Central African Aka, also a foraging people, hold their infants about 96% of the time at the age of 3–4 months, and 87% of the time at 9–10 months (Hewlett et al., 1998). Like the !Kung, Aka carry their infants on their hips, using slings. When sitting, they place their infants between their legs or on their laps. Data on Kenyan Gusii infants, collected in the mid-1970s, shows close physical contact rates of about 80% of daytime for the first 6 months of life, that is, all the time the infants are awake (LeVine et al., 1996, p. 160). For the Kipsigis, an African society where infants are carried in shawls on the caregivers' backs, the corresponding figure is 70% for infants under the age of 1 year (Super, C., unpublished fieldnotes, n. d., as cited in Whiting, J. W. M., 1981). Furthermore, in only 4% of the cases were these same infants ever found out of the reach of their caregiver (beyond 1 m). Similar results were reported for the East African Kikuyu, whose under-1-year-olds experience close bodily contact with their mother or another caregiver 68% of the observed time (Leiderman and Leiderman, 1973, as cited in Whiting, J. W. M., 1981). At the other end of the continuum are findings for cultures characterized by the widespread use of cradles. A review of relevant ethnographic data on Eurasian cradle cultures, where available, led J. W. M. Whiting (1981) to conclude that infants in all examined societies spent less than half the time in bodily contact with their mother or other caregiver.

Specifics of infant carrying: Who, how, and with what?

While infant carrying is a widespread practice among many cultures of the world, the specifics of how and by whom the infant is carried may vary considerably from one region to another. The mother, being the main caregiver in most cases, frequently has the main responsibility for carrying the child. However, other people such as other members of the family may share this task with her to varying degrees. Rather than attempting an exhaustive overview of worldwide practices, just a few illustrative examples will be mentioned here.

For the African continent, J. W. M. Whiting (1981) reported that, while it is usually the mother's task, an older sister may also sometimes carry her younger sibling. The

seminomadic Efé pygmies of the Ituri Forest of Zaïre, in contrast, present a very different picture (Tronick et al., 1985). In their society multiple caretaking is the rule, and women of the same band frequently hold, carry, and comfort each other's children, even when the infant's own mother is present. This exchange of caretaking responsibilities also extends to tasks such as breastfeeding other women's children. More intense involvement of siblings was reported by Firth in a description of the Tikopia of the Solomon Islands in 1936 (p. 141), where girls and boys as young as four years old carrying their younger brothers and sisters on their backs was said to be a common sight in the villages. Brazelton et al. (1969) reported similar participation of siblings in infant care for the Zinacanteco Indians in southern Mexico. In addition, women other than the mother were also mentioned sharing the task of infant carrying in this region of the world. Among the Dogon of Mali, firstborn sons are traditionally cared for by the maternal grandmother (True et al., 2001). Finally, the account by Mead and Macgregor (1951, p. 42) of child care practices in Bali included reference to the diverse interpersonal experiences of Balinese infants who in the course of their first year of life were carried by many different people of both sexes and all ages. Overall, such varied tactile experiences are not atypical for infants growing up in highly tactile cultures, as members of the extended family and wider community in these societies are frequently eager to interact with the newest family additions (see, for example, Geber, 1958, on Ugandan and other African infants; Marshall, L., 1976, pp. 315–318, on the !Kung; and Mead, 1963, pp. 40–48, on the Arapesh of New Guinea).

Regarding the carrying positions used in different cultures, the back position seems most widespread in Africa, even though carrying cloths may also be tied in a way that makes it possible to bring the child around to the side, for example for nursing (Whiting, J. W. M., 1981). This is the case among the !Kung San, where children are preferably carried astride the mother's hip (Konner, 1976). In societies on the islands of the Pacific and Indian Oceans the side position is more common than the back carry position (Whiting, J. W. M., 1981). In these cultures it is also more common than in Africa to use no carrying device at all. Furthermore, the carrying of older children in a pick-a-back fashion was mentioned by Firth (1936, p. 141) in his account of infant care in Polynesian Tikopia. The front position, while being less popular in combination with a carrier, is obviously a common choice when carrying a child in one's arms or as a temporary position during breastfeeding.

In most cases the carrying device is a simple piece of cloth—some kind of sling or shawl—that is hung or tied around the carrier's body, thus forming a pouch to contain the child. According to J. W. M. Whiting (1981), the material of the carrier may in some cultures also be an animal skin, as used by the !Kung (Marshall, L., 1976, p. 315), or a net bag as in New Guinea (see also Mead, 1963, p. 40). J. W. M. Whiting also mentions that many cultures, particularly back-carrying cultures, avoid the use of a carrying aid during the child's first months of life due to the belief that stretching apart the infants' legs to the degree that is necessary to carry them in the back position is harmful to the very young infant. While there is usually skin-to-skin contact between carried infant and caregiver in warm climates, children in cradle cultures, even when held or carried, are typically separated from their mother or other caregiver by layers of clothing (Whiting, J. W. M., 1981).

Cosleeping—Bed Sharing and Room Sharing

Bed sharing across the globe

The amount of physical contact experienced by infants during sleep at night is correlated with the extent of bodily contact they experience during the day. In cultures that practice extensive infant carrying, most typically mother and child also share the same bed at night (Lozoff and Brittenham, 1979; Whiting, J. W. M., 1981). Consequently, regional

variations in customary sleeping arrangements show a similar distribution across the globe as that presented for infant-carrying practices, with a close link to climatic features of the immediate environment. In a review of a worldwide sample of 136 cultures, 85% of societies in hot or mild winter climates were found to practice mother–infant cosleeping in the same bed, while the same was true for only 29% of cultures in cool or cold climatic zones (Whiting, J. W. M., 1964). When considering the sample as a whole, bed sharing with one or both parents was typical for young children in 66% of the examined cultures.

While the child's main bed sharing partner is usually the mother, with the father being variably present, it has not been uncommon in some cultures or during certain times in history for children to have shared a bed with individuals other than their parents, such as grandparents, servants, wet nurses, or siblings (Fildes, 1986, p. 195; Morelli, Rogoff, Oppenheim, and Goldsmith, 1992; Thevenin, 1987, p. 52; Whiting, B. B., and Edwards, 1988, p. 43). Such practices may stand or have stood as independent customs or, more commonly, may have followed at a later age after an initial period of cosleeping in the parental bed. Also, bed sharing appears to be a more persistent cultural habit than infant carrying, as it is, or used to be, common in a number of societies that did not necessarily provide their infants with extensive bodily contact during the day (Fontanel and d'Harcourt, 1996/1997, p. 171; Hogbin, 1943; Thevenin, 1987, pp. 52 and 58). Overall, the habit of infant–parent bed sharing has been the norm in virtually all cultures prior to the 18th to 19th century, with the vast majority of the world population today continuing the practice (McKenna, 1993; 1995; Thevenin, 1987).

Bed sharing in the contemporary West

Sleeping habits in contemporary industrialized countries have changed considerably from the traditional pattern. Parents and children sharing the same bed during the night is nowadays considered the exception rather than the rule in most parts of Western society. Concerns about disruption of the parental relationship, poorer quality of sleep, increased likelihood of sexual child abuse, infant suffocation, and the cultivation of “unhealthy” dependency needs in the child are frequently mentioned reasons for the general disapproval of parent–infant bed sharing (McKenna, 1993; Medoff and Schaefer, 1993; Shweder, Jensen, and Goldstein, 1995). An 18-year longitudinal study investigating possible effects of bed sharing in infancy and early childhood on later outcomes, however, found no indication of any strong associations of bed sharing with either negative or positive outcomes at ages 6 and 18 (Okami, Weisner, and Olmstead, 2002).

Japan is one of the few industrialized nations where cosleeping is still widely practiced (Hobara, 2003; Latz et al., 1999). Yet, occasional bed sharing is not as uncommon among Western families as public opinion might lead one to believe. Defining cosleeping as parents and children sharing the same bed for all or part of the night, at frequencies from once a month to every night, different studies on the sleeping habits of Western families have reported cosleeping rates of up to 65% for children aged three years or younger (Arnestad, Andersen, Vege, and Rognum, 2001; Ball, 2002; Crowell, Keener, Ginsburg, and Anders, 1987; Klackenberg, 1982; Madansky and Edelbrock, 1990; Nelson et al., 2001; Willinger, Ko, Hoffman, Kessler, and Corwin, 2003). Equivalent rates for 4- to 10-year-olds and 11- to 13-year-olds in Sweden are about 12–38%, and 3–10% respectively (Klackenberg, 1982).

When considering *customary all night bed sharing* only, the prevalence rate for American infants aged 7 months or less has increased from 5.5% in 1993 to 12.8% in 2000 (Willinger et al., 2003). The corresponding rate for 2- to 3-year-olds in Massachusetts in the mid-1980s was 11% (Madansky and Edelbrock, 1990). Rates in Norway between 1984 and 1998 have shown a similar rising trend (Arnestad et al., 2001). The prevalence of regular bed sharing in an urban Italian sample rose with increasing age of the child, with the respective

rates at the age of 1–5 months, 6–12 months, 13–24 months, 25–48 months, and 49–72 months being 0.2%, 2.3%, 9.6%, 14.4%, and 17.5% (Ottaviano, Giannotti, Cortesi, Bruni, and Ottaviano, 1996). Another recent Italian study reported decreasing rates after the age of 6, with only 7.9% of 6- to 7-year-olds, 4% of 8- to 9-year-olds, and 3.5% of 10- to 11-year-olds in the sample still regularly cosleeping with their parents (Cortesi, Giannotti, Sebastiani, and Vagnoni, 2004). In a British study, habitual parent–infant bed sharing was reported for 3.2% of the families during the child’s first month of life, and for 2% during the third month (Ball, 2002). Hanks and Reblsky (1977) conducted an inquiry into the views of a small sample of middle- to upper-middle-class mothers in suburban Boston who practiced cosleeping with their children with varying regularity. Most of the mothers considered the custom a cultural taboo, but generally felt it had positive effects on their children. However, some concerns about negative or mixed effects were voiced, too.

Differences in sleeping habits are also found between cultural subgroups within Western societies. In the United States, for instance, cosleeping is considerably more common in African American, Asian American, and Hispanic families than among Caucasians (Brenner et al., 2003; Lozoff, Askew, and Wolf, 1996; Madansky and Edelbrock, 1990; Schachter, Fuchs, Bijur, and Stone, 1989; Willinger et al., 2003; Wolf, Lozoff, Latz, and Paludetto, 1996), and the same is true of families of Asian origin living in the United Kingdom (Farooqi, 1994; Gantley et al., 1993) and of Pacific and Maori people in New Zealand (Abel, Park, Tipene-Leach, Finau, and Lennan, 2001; Tuohy and Smale, 1998). In the United States cosleeping has been found to occur more frequently in lower socioeconomic classes (Brenner et al., 2003; Lozoff et al., 1996; Willinger et al., 2003), a variable that is closely related to ethnic background. However, Lozoff et al. (1996) found that this tendency held true only for Whites, but not for Blacks, who collectively had a higher proportion of habitual cosleepers, irrespective of income level. Together with the findings of Willinger et al. (2003), this suggests that sleeping habits are more strongly determined by ethnicity and culture than by social status.

Some studies have reported a connection between cosleeping and sleep problems in the child or family stress in general (Lozoff et al., 1996; Lozoff, Wolf, and Davis, 1984, 1985; Madansky and Edelbrock, 1990). However, these are only correlational findings, which do not permit any conclusions regarding causal relationships. Furthermore, while such an association seems characteristic of White American families, it is less so for Blacks. Consequently, rather than indicating that customary cosleeping of parents and infants is likely to lead to sleep or any other problems in the child, these results may instead be a reflection of the differing attitudes towards cosleeping of the two investigated subcultures. In other words, bed sharing in the typically anticosleeping-oriented White American culture frequently may be the result of or the parental solution to an infant’s sleeping problems, whereas the same practice in the Black population is more likely to represent a widely accepted subcultural custom that is routinely practiced from very early in a child’s life (see also Young, 1970, p. 276) and is not specifically associated with sleep-related difficulties (Lozoff et al., 1984, 1985, 1996; Madansky and Edelbrock, 1990; compare terms *reactive* vs. *nonreactive cosleeping* coined by Madansky and Edelbrock, 1990). A study investigating the prevalence of sleep problems in cosleeping children in a sample of 6- to 48-month-old U.S. and Japanese children attested to the same asymmetrical distribution of sleep-related difficulties in the two examined cultures, which differ greatly in their customary sleeping practices (Latz et al., 1999).

A recent study has confirmed the existence of two distinct subtypes of cosleeping—early cosleeping and reactive cosleeping—in a U.S. sample of middle- to upper-middle-class families with preschool-aged children (Keller, M. A., and Goldberg, 2004). Both early cosleepers (children who started bed sharing in early infancy) and reactive

cosleepers (children who started bed sharing in their second or third year of life) had more frequent night wakings than solitary sleeping children. However, only mothers of reactive cosleepers found these night wakings problematic. There was also a tendency for mothers with reactive cosleeping toddlers to report a greater frequency of bedtime struggles than mothers in the two other groups. In addition, mothers of early cosleeping toddlers had the most positive attitudes towards bed sharing, mothers of solitary sleepers were most favorable towards solitary sleep, with mothers of reactive cosleepers falling in between these two groups.

Room sharing across the globe

When extending the examination of worldwide sleeping customs to include the practice of room sharing, the industrialized West still holds an exceptional position among all cultures of the world. In 1961, Burton and Whiting reported that U.S. middle class families were the only ones in a cross-cultural sample of more than 100 societies who put their young infants to sleep in a separate room. Barry and Paxson (1971) further presented data on the sleeping habits of 171 societies out of a representative cross-cultural sample of 186 societies compiled by Murdock and White (1969), showing that in every society, children slept in the same room with either one or both of their parents. More specifically, bed sharing was assuredly practiced in at least 76 of the 171 societies, room sharing with possible bed sharing occurred in 55 of the examined societies, and in the remaining 40 societies, children typically slept in their mother's or parents' room, but on a separate sleeping surface.

Room sharing in the contemporary West

Regarding the prevalence of nightly room sharing in Western industrialized countries, a study conducted in the U.S. found that 12% of the 2-year-old children in the studied sample slept in their parents' bedroom, while 40% of the children shared a room with a sibling (Ragins and Schachter, 1971). Crowell et al. (1987) reported a comparable figure (15%) of infant-parent room sharing for a sample of 18- to 36-month-old American infants. Results from a number of other studies provide similar evidence of the American preference for separate sleeping quarters. For instance, even though 15 out of 18 couples studied by Morelli et al. (1992) decided to share a room with their newborn child, only 42% of these children were still in the parents' bedroom by the age of 3 months, with the figure falling to 20% at 6 months. Upon moving out of the parental bedroom most second- and laterborn children were, however, located in a room with a sibling. A similar account given by Hong and Townes in 1976 reported room sharing rates of 45% for under-2-month-olds, decreasing to 25% after the age of 3 months, and further decreasing to 2% at the age of 6 months. Most of the room sharing rates as cited above are rates of sole room sharing that do not include any instances of bed sharing. Generally speaking, most middle-class U.S. infants have a sleeping place outside their parents' bedroom by the age of 6 months (see also Keener, Zeanah, and Anders, 1988; Latz et al., 1999; Richman, Miller, and Solomon, 1988). A similar trend was noticed in a sample of Australian families (Buckley, P., Rigda, Mundy, and McMillen, 2002), and parent-infant room sharing rates in a Swiss study also showed a decline from 20% at 1 month to 4% at age 1 (Jenni, Zinggeler Fuhrer, Iglowstein, Molinari, and Largo, 2003). In a White British sample, 61% of the children slept in the parents' bedroom during their first year of life (Farooqi, 1994). Regarding parent-infant room sharing rates in families with 3-month-old infants, an international study on typical sleeping arrangements in 17 countries reported high figures for most industrialized nations included in the investigation, with the reported values ranging between 46% (New Zealand) and 95% (Sweden) (Nelson et al., 2001). Again, room sharing rates for certain subcultures or rates in certain geographical regions in the

industrialized West can be considerably higher than the averages (see, for instance, Brenner et al., 2003; Farooqi, 1994; Hobara, 2003; Schachter et al., 1989).

Infant Feeding

The following account of past and present approaches to infant feeding mainly draws on the works of Baumslag and Michels (1995), Fildes (1986, 1995), Fontanel and d'Harcourt (1996/1997), Small (1998), Stuart-Macadam (1995), and Wright and Schanler (2001), which together provide a comprehensive historical overview of the changing trends in infant feeding practices in different parts of the world. When additional sources are used to fill in details, these are indicated.

Wet nursing

Breast milk, either that of an infant's own mother or of another woman, can with great certainty be assumed to have been the sole source of nourishment for human infants during most of our history. However in antiquity, the custom arose of specifically employing other women—so-called *wet nurses*—to nurse and care for one's children. In Egypt, wives of pharaohs are known to have delegated the task of nursing their infants to other women, and parents in ancient Rome could hire suitable young women at the market for this purpose. First restricted to the upper class, the practice slowly spread over the centuries, and finally also included the middle class. By the 18th century, wet nurses were common in much of Europe. In 1780, for example, only 1,000 of the 21,000 children born in Paris were reported to be nursed by their mothers; all others were cared for by wet nurses. Yet, the wet-nursing business was largely limited to families in urban centers, where the practice survived until the early 20th century. Also, given that Europe was mainly rural up to this point in history, the majority of infants were still breast-fed by their own mothers throughout these times.

Artificial feeding

From very early in history, ways had to be found to feed infants who for some reason could not be nursed by their mothers or wet nurses. When a mother was ill or too weak to nurse her child or when she had died in childbirth, for infants with a contagious illness such as syphilis and those in orphanages, substitute feeding was a necessity. Cow's milk, goat's milk, and donkey's milk were used, sometimes by feeding the infants directly from the animal's teats. More frequently, bottles manufactured of diverse materials such as glass, ceramics, porcelain, animal horns, leather, wood, and metal were utilized. To slow down the milk flow to a manageable rate, openings that were too big were partly obstructed with a piece of cloth or leather, or a sponge. The artificial nipple was only invented in the late 16th century in Sweden.

Some mothers also chose bottle-feeding voluntarily, depending on the sociocultural trend of the day. Others merely supplemented breast milk with animal's milk. Due to long-standing customs, infants in some areas of preindustrial Europe (e.g., parts of Germany, Austria, Northern Italy, Russia, and Scandinavia), for instance, were rarely or never breastfed, neither by their mothers nor by wet nurses. In some of these regions, the practice of artificial feeding from birth dated back to at least the 15th century. A common denominator of these areas was the cold, dry climate, which made the storage of substitute foods easier and thus made the foods less susceptible to spoiling. Throughout history, many cultures have also held that colostrum, a mother's first milk, is unsuitable for a newborn and have instead recommended another woman's more mature breast milk, various medicinal or ritual substances, or a purge such as the popular concoction of oil or butter of sweet almonds mixed with honey, sugar or syrup.

At the end of the 17th century in England bottle-feeding was considered best and was endorsed by the royal doctors. It also became increasingly popular in France, but the majority of the medical profession still mistrusted artificial feeding practices, as they undeniably led to higher infant mortality rates. This was attributable to the unsanitary conditions under which breast-milk substitutes were stored, prepared and offered, frequently leading to severe gastrointestinal infections and, ultimately, death. Nonetheless, bottle-feeding again became common in the late 19th century, and the first artificial formula was invented in 1867 by a German chemist.

In the Middle Ages, it was also popular to give infants, from their earliest days, a thick, soft cereal, *pap*, made of bread or flour cooked in milk or water, with the occasional addition of wine or beer, and sometimes honey. However, by the 18th century *pap* suffered mounting criticism from doctors who blamed it for increasing infants' risk of death. And indeed, the mortality of infants who were not breastfed was considerably higher than that of children who received breast milk, with figures over 50%, and up to 90%, being commonly reported. Yet, supplemental foods of the kind mentioned continued to be used until the first decades of the 20th century.

The industrial revolution—decline of breastfeeding

With the advent of the industrial revolution the incidence of breastfeeding declined most sharply in the urban centers, as many women left their children in the care of others in order to take paid work. In most of rural Europe, however, many women continued to follow the traditional pattern of nursing their infants, just as their own mothers had done. Data on infant feeding practices from the 1890s show that in many urban areas four out of five mothers still breastfed their infants, wholly or partially, particularly during the child's first three months of life, although rates for highly industrialized areas were lower. In some of England's centers of the textile industry, for instance, 40–50% of infants were totally weaned from the breast by the age of six months. In less industrialized towns, on the other hand, only 30% of the children had been totally switched to other foods during the second half of their first year. The situation in North America was comparable. Similarly, in the years 1907–1910 French infants in the more industrialized parts of the country were breastfed in less than 40% of the cases compared to more than 60% in rural areas.

It was, however, the development of evaporated and condensed milk, as well as the introduction of pasteurization and the increasing sterilization of feeding bottles, that finally made artificial feeding a relatively safe alternative to breast milk. The rapid commercialization of artificial baby food that followed contributed to the wide acceptance that infant formula soon found among the general public, reflected in the hundred varieties of substitute milk already available for sale in 1911. Doctors, too, endorsed the use of infant formulas, and within a relatively short time, bottle-feeding became the norm, and breastfeeding unfashionable. Also, the use of artificial milk was in many cases considered more convenient than breastfeeding.

The medicalization of the birth process at the beginning of the 20th century, increasing mother–infant separation, and the introduction of widely-spaced and scheduled feedings further tipped the scales in favor of artificial feeding, as these forms of interference seriously hamper the natural interplay between mother and newborn that is necessary to get breastfeeding off to a good start. Perceived milk insufficiency is a frequent consequence, resulting in the early termination of breastfeeding (Gussler and Briesemeister, 1980). In the 1940s, for example, only 20–30% of American infants were still breastfed by their mothers. In comparison, surveys in the United States, Great Britain, and Australia during the first two decades of the 20th century had reported overall breastfeeding rates of about 75–90% for infants less than one month old.

Breastfeeding rates in the industrialized West remained low during the following decades. The percentage of women in the U.S. who initiated breastfeeding after giving birth was 25% in the 1946–1950 cohort and remained around 30% from 1955 until approximately 1970. In 1972 initiation of breastfeeding reached an all-time low of only 22%. Other parts of the world were also affected by the expanding infant formula business. In developing countries the marketing of breast milk substitutes resulted in a substantial decrease in breastfeeding rates, which had traditionally been high. As hygiene and medical care are often poor in these countries, the introduction of artificial feeding has had devastating effects on infant mortality rates, continuing to this day.

Feeding practices reassessed

Starting in the 1960s and -70s, however, an increasingly strong counter-movement began to bring about noticeable change in the general attitude towards breastfeeding. The natural childbirth movement, which also emphasized the importance of nursing and early mother–child contact, a mounting body of knowledge about the benefits of breastfeeding, greater awareness among health professionals, as well as more recent changes at the level of public health policies all played a part. The 1970s saw major international efforts to restrict the marketing of breast milk substitutes in developing countries, culminating in 1981 in the WHO/UNICEF *International Code of Marketing of Breast-Milk Substitutes* (WHO). The Code's ultimate goal is to contribute to the provision of adequate and safe infant nutrition worldwide. It aims to protect and promote breastfeeding by underscoring its benefits and further suggests appropriate ways of handling the marketing and distribution of breast milk substitutes, where necessary, in order to ensure their proper and safe use. The work has shown results. In some less-developed countries, for example, a doctor's prescription is now needed to buy infant formula. Breastfeeding initiation rates in Western industrialized nations were also affected by the change in attitude, and the historically low figures of the mid-20th century were followed by a clear upward trend. In the U.S., after reaching their lowest point in the early 1970s, rates steadily increased to about 60% in 1984. Rates in the late 1980s did not reach the levels of earlier years, but the mid-1990s showed a return to the relatively high levels of the early 1980s.

Current situation

In 2001, in the U.S., the rate of children who were breastfed in the hospital after birth was 69.5%, but only 32.5% of mothers were still breastfeeding their infants at the age of six months (Ryan, Wenjun, and Acosta, 2002). A smaller-scale survey in the same year that had revealed somewhat lower figures for the immediate postpartum period and for the age of six months, reported that the rate dropped to 12.3% by the time the children reached their first birthday (Li, Zhao, Mokdad, Barker, and Grummer-Strawn, 2003). In this same survey, the exclusive breastfeeding rate at six months was 7.9%. For comparison, a study of Danish families with children born in 1987–1988 reported that 99.5% of the mothers initiated breastfeeding, and continued breastfeeding at 3, 6, 9, and 12 months was still observed respectively in 71%, 52%, 33%, and 19% of the cases (Michaelsen, Larsen, Thomsen, and Samuelson, 1994). The percentage of children exclusively breastfed at the age of six months was 9.7%. Overall, as data from the continuously updated *WHO Global Data Bank on Breastfeeding and Complementary Feeding* (WHO, n.d.) indicate, breastfeeding initiation rates in most of Europe are high at the turn of the 21st century. The ever-breastfed rate for under-1-year-olds in much of Northern Europe as well as in Austria, Romania, Croatia, and Slovenia ranges from 93% to 98%. Somewhat lower figures are reported for Luxembourg, Germany, the Netherlands, and the United Kingdom: 88%, 86%, 75%, and 69%, respectively, while the corresponding rate for France is 49%. Canada's rate (79%) is similar to the average

European figures. Even though rates of continued breastfeeding at later ages are available for only part of Europe, a consistent decline throughout the child's first year of life is noticeable. The average duration of breastfeeding in Croatia, Germany, Luxembourg, and Romania is 4, 6, 6, and 8 months, respectively. The respective proportions of 12 to 15-month-old children in Croatia, Iceland, the United Kingdom, and Norway that are still breastfed are 2%, 13%, 25%, and 40%. Exclusive breastfeeding rates for under-4-month-olds in those countries for which data are reported are as follows: 29% in the United Kingdom, 37% in the Netherlands, 51% in Poland, 54% in Luxembourg, 66% in Denmark, and 70% in Iceland.

Worldwide, it is estimated that about 35% of all infants under the age of four months are exclusively breastfed today, with the median duration of breastfeeding being around one and a half years (WHO, 1996). These estimates are based on information from nationally representative surveys that cover 58% of the world's infant population, with industrialized nations being heavily underrepresented in this sample. Local variations are great (WHO, 1996), with, for example, Niger having a 1% exclusive breastfeeding rate for under-4-month-olds (in 1998), compared to a rate of 93% for Mongolia (in 1997) (WHO, n.d.).

Specifics of breastfeeding

Regarding breastfeeding duration during most of human history, bone analyses of prehistoric skeletons, historical evidence dating back to antiquity, more recent ethnographic data from traditional societies, as well as research into the age at onset of lactose intolerance in various ethnic groups (a probable indicator of weaning age in ancient times) all point to the age range of two to three years as the most likely weaning age in prehistoric times. It is further assumed that weaning has usually been a gradual process during which breast milk was increasingly substituted by other foods. As far as feeding style is concerned, feeding on demand seems to have been the norm, during both day and night. Observations among modern hunter-gatherer societies confirm the commonness of this approach. The !Kung San in Botswana and Namibia and the Aka in Central Africa, for instance, suckle their infants on average four times per hour (Hewlett, et al. 1998; Konner and Worthman, 1980).

For the time period from the Middle Ages up till the 19th century, most infants in Europe were typically weaned between the age of one and two years, with some variation across regions and times. Up till the mid-18th century, demand feeding was still the most common approach to breastfeeding. After that, however, the idea of nursing according to a schedule was introduced and practiced to varying degrees. All in all, the present pattern in many industrialized countries of widely spaced and scheduled feedings, early elimination of night feedings, use of supplementation with artificial formula, and weaning before the child's first birthday, is a historically very recent development that is in conflict with the evolutionary environment in which the human infant's nutritional system was shaped into its present form.

Summary and Conclusion

The concluding historical and cross-cultural overview of the prevalence of (aspects of) natural parenting demonstrates how, in the course of history, Western societies have drifted away from what used to be the intuitive approach to taking care of our young. Although the most basic aspects of parenting are hardwired into the human caregiving system and have thus been preserved to the present day, many other facets of traditional caregiving have been overlaid by various cultural beliefs and customs. Yet, when considering all the evidence presented, natural parenting seems to provide the human infant with an ideal environment for optimal growth both psychologically and physiologically. For about a decade, the new discipline of ethnopediatrics, an evolutionary and cross-culturally informed

science, has been drawing attention to the interplay of biological and cultural influences on caregiving traditions and resulting consequences on the wellbeing of the child, and has been calling for a broader view of parenting and a reexamination of established Western childrearing beliefs (overview: Small, 1998). This paper represents one contribution to this developing field of science.

As in every new field of investigation, there are naturally still many gaps in knowledge to be filled. For some of the presented topics, data on humans is still scarce, and results from animal research relevant to the human case have been presented instead. In other instances, in the absence of data from healthy populations, data from clinical populations were used to illuminate general processes assumed to be largely unaffected by clinical status. On the positive side, extreme cases can also serve as a magnifying-glass, revealing connections between phenomena that may otherwise go unnoticed. Moreover, some of the reported findings have not yet been replicated, and contradictory results exist in a few of the discussed areas. However, in its entirety the large body of knowledge generated by independent studies from diverse disciplines, designed with many different, frequently unrelated, research questions in mind, conveys a strong message. Most importantly, the individual findings in combination reveal an intricately interwoven whole, where one aspect feeds into the other, and where all parts are connected.

Physical proximity between caregiver and infant embedded in a caregiving environment characterized by sensitivity to the child's needs is the substratum that allows the caregiver–infant relationship to blossom and is the central link to many other aspects of sensitive caregiving. By providing the newborn with an extended womb experience that gradually transforms into increasing independence one acknowledges the immaturity of human newborns due to evolutionary pressure and their innate need for continuous care during the early months of life. Close contact with the infant permits the mother to perceive and promptly respond to the infant's subtle signals and to get acquainted with the child's idiosyncratic preferences, thus fostering sensitive mothering. Frequent breastfeeding on demand is facilitated, therefore ensuring optimal nutrition for the child according to a natural schedule most suited to the dyad in question. Flexible breastfeeding on cue further ensures an adequate milk supply for extended breastfeeding and can prevent many potential breastfeeding problems. At the same time, breastfeeding is associated with emotional and health benefits for the mother and decreased morbidity in the child. Mother–infant cosleeping offers the child continuity of care around the clock, supports the breastfeeding process, and if practiced safely, possibly even decreases the infant's SIDS risk. Continuous proximity with the child also allows the caregiver to be aware of the child's elimination functions and to respectfully attend to these needs. Moreover, touch and skin-to-skin contact have been associated with many important physiological processes such as thermal regulation, physical growth, decreased stress hormone levels, and enhanced immune function.

When further considering that bodily touch, movement stimulation, and familiar sounds signal safety to a newborn, and given the fact that physical contact is often the only intervention in early life that can calm a distressed infant, then the development of basic trust in one's world (Erikson, 1963) and thus the formation of a secure attachment to one's caregiver can be concluded to be greatly facilitated by the provision of an immediate postnatal environment that recreates the familiar atmosphere of the womb. By offering the child such a *tangibly* secure and predictable environment for early growth, parents tailor their caregiving behaviors to match the emotional needs and the limited cognitive and perceptual abilities of their newborn. Over time, as close physical proximity as a sign of secure parental presence slowly decreases in importance and as distal interactions become more meaningful to the child, caregiving practices can be adjusted accordingly, with the whole process reflecting a secure and smooth transition from pre- to postnatal life. In that way, backed up by

such a history of emotional security, the child gradually grows and is released into increasing independence rather than being pushed to that stage abruptly and prematurely right after birth. Increasing knowledge regarding the decisive early stages of brain development further suggests that repeated positive experiences in early life leave distinct traces in the initially highly plastic physiological matrix that forms the basis for all subsequent development.

At its best, natural parenting is truly sensitive parenting in a narrow (Ainsworthian) as well as in a broader sense. Not surprisingly, then, there is also some indication that natural parenting indeed fosters secure attachment in the child. However, more research is needed before any definite statement on this subject is possible. The issue is further complicated by the possibility that parents with high levels of caregiving sensitivity may feel particularly drawn to a natural approach to parenting. Assessments of attachment security in cultures for which this approach is common practice may help to shed light on the possible interaction of parental characteristics and caregiving style in determining security of attachment. Although it is known that the quality of infants' attachment relationships with their parents is to a large part influenced by the parents' mental representations of their own childhood attachment experiences, which in turn are associated with parental responsiveness to the infants' signals (review: van IJzendoorn, 1995), a significant number of studies have shown that it is also possible to change parental caregiving behavior and thus influence infants' attachment security with specific interventions (review: Bakermans-Kranenburg et al., 2003). More specifically, interventions that were able to increase maternal sensitivity were usually also accompanied by a positive change in attachment security. It is therefore an interesting question how successful natural parenting could be as a preventive intervention starting at birth and aimed at enhancing parental sensitivity and fostering secure infant–parent attachment relationships in samples at risk for insensitive parenting and insecure attachment. In Anisfeld et al.'s (1990) study, the regular use of an infant carrier, in the absence of explicit teaching of other natural parenting strategies, already had significant beneficial effects on maternal behavior and infant attachment security in a sample of low-SES mothers and their infants.

There may be critical voices arguing that no single caregiving approach can possibly be adaptive in the wide variety of circumstances characterizing current human living. This view may seemingly receive support from the fact that human infants are astonishingly resilient beings that have adapted to and survived in diverse conditions of care (Small, 1998). There is no question that the details of caregiving will always reflect the particularities of the micro- and macroculture in which the child is raised. However, natural parenting is not a narrow prescription for parenting without room for individual variation. As examples from different societies demonstrate, there are many varied ways in which natural parenting principles can be put into practice. Whether multiple caregiving, including breastfeeding, among the Efé in Zaïre (Tronick et al., 1985), extensive involvement of maternal grandmothers in the care of firstborn sons among the Dogon in Mali (True et al., 2001), the delegation of a substantial portion of infant care to child caregivers among the Gusii people in Kenya (LeVine et al., 1996), or primarily mother-based care during the first year among the !Kung San (Konner, 1976), they all reflect different possible solutions to the task of reconciling natural infant care with other parental duties. The common denominator, however, is the acknowledgement of the infants' need for continuous care in all cases.

The purpose of this paper was to draw attention to the very basic, biologically and evolutionarily based, physical and emotional needs of the human infant, irrespective of cultural background, and to outline a general approach that can fulfill these needs. In that sense, we argue that there is indeed a “natural”, ideal way to care for infants, a way that is not culturally constructed, but emerges from the innate needs of human infants. At the same time, however, it is also clear that, if parents from different cultural backgrounds opt for natural

parenting, characteristics of the specific environment in which the child is raised will determine the exact details of how, or by whom, the individual aspects of the described approach will be implemented in actual practice, thus producing considerable variation on an overt level.

Culture-specific general ways of interacting with infants may further add a number of features to any basic parenting style. These different ways of interaction may not be inherently beneficial or detrimental to infant development but instead simply reflect the idiosyncrasies of the society in question, and so encourage the development of culture-appropriate behavior. Many African groups, for instance, believe that it is important to teach infants certain motor skills such as sitting or walking by exercising these skills, which contributes to advanced development in many African infants in these areas relative to their American and European peers (review: Super, 1981). Differences in approaches to mother–infant communication between Kenyan Gusii and Boston middle-class mothers are another example (LeVine et al., 1996). Mothers of the investigated U.S. sample were considerably more likely to look or talk to their infants than their Gusii counterparts, thus providing positive stimulation, whereas Gusii interactions typically aimed to minimize positive as well as negative infant arousal, with nonverbal soothing behaviors being predominant. In an investigation by Keller, H., Yovsi, et al. (2004), the frequency of mutual eye contact in mother–infant dyads was found to be positively correlated with the development of self-recognition in the infant, a feature that may or may not be considered an important developmental goal in different cultural environments. Another cross-cultural study by Keller, H., Lohaus, et al. (2004) revealed significant differences in the frequency of object stimulation used by mothers from different cultures (Cameroonian Nso, Indian Gujarati, Costa Ricans, Greeks, Germans) in interactions with their infants.

It is beyond the scope of this paper to discuss whether the proposed secure environment for early development should ideally be provided by only one or two main caregiving figures, as is the most likely arrangement in Western societies, or possibly by a more extended network of care providers, as is the case in certain other cultures, although, for obvious reasons, the mother lends herself most naturally as the main care provider, at least in early life. There is also no doubt that certain cultural milieus are more favorable for an implementation of natural parenting principles than others.

Fine-tuned research is thus needed to determine whether different ways of realizing natural parenting differentially affect later development. First and foremost, however, research is needed to provide first hand data on Western samples of natural parents and their infants so that the integrated concept of natural parenting in a Western context can be explored in detail. To date, the authors are aware of only four such studies, two of which are mainly descriptive in nature, providing information on the practices and beliefs of adherents of this approach (Bar-Yakov, 2002; Bobel, 2000). One of the studies also offers data on the extent of use of traditional transitional objects by naturally parented children, showing that the practice is considerably less common among these children compared to conventionally raised children (Green, K. E., 2001; Green, K. E., Groves, and Tegano, 2004). The fourth study explores the relationship between natural parenting and infant cry and sleep behavior (St. James-Roberts et al., 2006). However, more research is already in progress and should be able to add to our understanding of natural parenting in Western society in the near future. For a thorough evaluation of natural parenting practices, studies investigating their long-term effects will also be needed.

All in all, based on the abundant evidence accumulated in a number of different disciplines we now know that a natural approach to parenting as described in this paper reflects the innate, natural rearing style of the human species and thus provides infants with an optimal environment for psychological and physiological growth during early life. It is the

rearing style to which the human infant has biologically adapted over the course of evolution, with lifestyle changes in recent history being far too short in duration to have allowed any significant biological adaptation to the altered living conditions. What we, however, do not yet know exactly is how much we can deviate from this traditional caregiving pattern without suffering negative consequences. The crucial question therefore is, what are the minimum requirements for good care? At one extreme end, Scarr (1992) argues that parents have much less influence on their children's development than what is usually thought, and suggests that any kind of parenting short of abuse and neglect that provides the child with a wide range of experiences, that is, *good enough parenting*, represents a species-normal environment sufficient for normal development. According to Scarr, species-normal genes as well as individual variations in genes combine to produce certain individual characteristics leading the developing person to evoke, select, and construct a unique personal environment that further shapes development in accordance with the person's genotype. Genetic influences are thus given most weight, and variations in parenting approaches within the normal range are claimed to be of little relevance in determining variations in children's outcomes. Evidence for this position regarding personality and intellectual development is cited. It is, however, not at all clear, whether this also extends to other facets of development such as, for instance, emotional development and wellbeing. The consistent finding that only about two-thirds of all Western infants are securely attached to their primary caregiver and the fact that formula-fed infants have a higher morbidity than breastfed infants in fact suggest that the species-normal environment for developmental aspects other than personality traits, or at least some of them, may have a considerably narrower range than what is suggested by Scarr for personality and intellectual characteristics.

What has been argued in this paper is that conventional Western child-rearing approaches may have already crossed the line of optimal parenting in some areas of infant care. It is now up to researchers in the field of child development to empirically define the limits of optimal infant care in a three-step process. First, it is necessary to reach an agreement regarding the core needs of the human infant as they apply to all infants regardless of cultural background and to distinguish them from secondary developmental goals that are culture-specific. Second, the capacities of different versions of natural parenting to successfully meet the identified core needs have to be compared, particularly with regard to number of caregivers and different child care arrangements, with the aim of crystallizing a prototype of optimal basic caregiving. Finally, it needs to be determined how much deviation from the ideal practices is possible without compromising a child's psychological and physiological wellbeing. It is vital for infant temperament to be taken into account in this process, because infants with different temperaments have been shown to be differentially affected by rearing influences, with so-called "difficult" infants being particularly vulnerable to negative rearing influences (Belsky, 2005; Crockenberg, 1987; Gunnar, Larson, Hertsgaard, Harris, and Brodersen, 1992).

As a final point, the answer to the question "What is the ideal way to care for infants?" may remain a theoretical ideal in many cases, as parenting choices are always a trade-off between infant needs on the one hand and parental needs and resources on the other hand, with the two rarely completely overlapping. Yet, in order to be able to reach an informed decision on how best to parent a child, and on how to find a satisfying solution for all parties involved, knowledge about the human infant's intrinsic needs is paramount. In this paper no attempt has been made to offer the—ultimately impossible—answer regarding the type of parenting compromises that would be most suitable in any of the countless number of circumstances faced by families around the world. In the end, this decision rests with the individual parents, families, and societies in question, and depends on how much importance

they attach to the different issues involved. Knowledge about the limits of optimal infant care is the essential tool that can aid them in making this decision.

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