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Experimental studies of infant-parent co-sleeping: mutual physiological and behavioral influences and their relevance to SIDS (sudden infant death syndrome)

James McKenna*[a], Sarah Mosko[b], Christopher Richard[b], Sean Drummond[b], Lynn Hunt[b], Mindy B. Cetel[b], Joseph Arpaia[b]

[a]*Department of Sociology and Anthropology, Pomona College, Claremont, California 91711, USA*
[b]*Sleep Disorders Laboratory (SIDS Project), University of California, Irvine, Medical Center, 101 City Drive South, Orange, California 92668, USA*

Abstract

We hypothesize that maternal sensory exchanges, likely involving a combination of heat, sound, gas, smells, movement, and touch, induce important physiological changes, especially in the healthy infant's arousal patterns, body temperature, and sleep architecture as defined by standard physiological measures. We summarize the results of two preliminary physiological studies, and some early data from a third, in which mothers and infants are monitored using standard polysomnographic techniques as they sleep in the same bed, and then in adjacent rooms. Our data suggest that infant-parent co-sleeping alters the infant's sleep experience as, for example, the characteristics of arousals, the frequency and duration of nursing, infant sleep position and the number of maternal inspections. For example, while sleeping in the same bed, mothers nurse their infants three times more frequently than they do while their infants sleep in an adjacent room. These preliminary data demonstrate significant differences between routine co-sleeping and solitary sleeping environments. This work underscores the importance of studying infant sleep as it unfolds in the co-sleeping environment, the environment within which it evolved over at least 5 million years of human evolution. Should our preliminary findings be confirmed in future studies they will provide a beginning point for considering additional, possibly unconventional ways of helping to reduce SIDS risks.

Keywords: Arousals; Infant sleep; SIDS risk factors; Evolution; Co-sleeping; Mother-infant pairs

* Corresponding author.

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1. Introduction

"There is no such thing as a baby, there is a baby and someone"
D. Winnicott.

In Western industrialized societies, pediatric health professionals generally encourage child care practices believed to foster social and biological independence in their infants, as early in life as possible. Birth is commonly viewed as the moment in which the newborn becomes an independent being from the mother, since the mother's body is seen no longer to directly regulate the infant's physiology through the placenta. In these cultures, the establishment of early infant/child independence is the developmental goal, autonomy the desired outcome [1]. However, an important question raised by other disciplines, especially anthropology, is whether the historically recent recommended child care patterns which emerge from this view presume infants to be more physiologically independent from their caregivers than they actually are. By ignoring the infant's evolutionary history, are the more conservative aspects of the infant's biology mismatched with rapidly changing patterns of infant care, patterns that clearly promote the social best interests of parents, but not necessarily or always the psychological or biological best interests of infants [2]?

Since the human neonate is born so neurologically immature (only 25% of adult brain weight) we assume here that natural selection favored infant responsivity to post-natal parental sensory stimuli in much the same way that it favored fetal responsivity to, and regulation by, the mother prenatally. This perspective seems especially appropriate for human neonates born in an exceedingly altricial, non-ambulatory condition wherein, and relative to other mammals, they experience the slowest development toward nutritional, thermal, immunological, transportational and socio-emotional independence (reviewed in Ref. [3]). In response to infant dependence, in all but a limited number of cultural settings world-wide, breast feeding with infant parent co-sleeping are practiced in tandem as one integrated infant care system, inseparable and inevitable [4,5]. From a biological vantage point, it is odd to think that in Western industrial societies, especially since the inception of Freudian psychology, one half of this adaptive caregiving system i.e. infant-parent co-sleeping has come to be regarded as unhealthy and a significant hindrance to 'normal' development [6].

Using cross-species and cross-cultural data, as well as experimental studies, we examine this view critically. We assume for evolutionary reasons that the sensory-rich co-sleeping environment likely confers a range of social, physiological and psychological benefits both by the infant responding to (and returning) sensory stimuli and through the mother's protective interventions including visual monitoring and physical management of the infant's condition throughout the night. At the very least, a combined evolutionary and developmental perspective suggests that infant-parent proximity and intermittent contact throughout the night (and day) cannot be inherently harmful or dangerous to infants, as is generally assumed judging from the pediatric and psychiatric literature and popular press. Of course, we acknowledge that there are particular circumstances which are widely accepted as

endangering the co-sleeping infant. These include co-sleeping with the infant on a water bed, sharing a bed with an infant while under the influence of drugs including alcohol, or if the co-sleeping adult is obese [7]. Among the Maori of New Zealand, but not other ethnic groups there, Taylor et al., [8] found a positive correlation between co-sleeping mothers who smoke and SIDS. However, we take these circumstances to be exceptional and feel that generalizations about the overall safety of co-sleeping across all families, ethnic groups and cultures should not be drawn from these examples.

The point is that human infant developmental vulnerabilities evolved over 5 million years in the context of continuous parental contact which includes co-sleeping. This being so, infant proximity and contact with a parent throughout the night should be inherently beneficial for the vast majority of infants since this arrangement was specifically favored by natural selection to maximize infant survival and, hence, parental reproductive success [9,10]. What is difficult to answer, however, is whether our recent (western) cultural shift toward promoting solitary infant sleeping arrangements leads to significant physiological and/or neurodevelopmental differences between solitary and co-sleeping infants. If significant differences can be established, we are interested in considering how they might interact with known SIDS risk factors. While questions pertaining to whether or not the establishment of early solitary infant sleep behavior might increase infant morbidity and/or contribute to later adult physiological, social, or psychological disorders are legitimate, they are beyond the scope of our present research.

We hope that the intellectual rationale and supportive evidence justifying our research will help move pediatricians, health researchers and parents toward a less biased, more scientifically based conceptualization of what constitutes 'normal' infant sleep, and to some new ways of thinking about what kinds of environments potentially provide the healthiest context within which infant sleep can develop [3,11].

Our on-going sleep laboratory studies of same-bed infant parent co-sleeping are intended to provide a growing body of data needed to evaluate the possibility that sensory exchanges occurring in this sleep environment alter the infant's sleep experiences in ways potentially helpful in resisting some kinds of SIDS, the leading cause of non-accidental deaths of infants in the United States and other western countries in the first year of life [2,3]. The findings we report here for the SIDS and Ethnicity Symposium represent only very preliminary data from our most recent study, as well as summaries of preliminary data published elsewhere. While we are far from reaching any conclusions, we hope that these data can be used as a means to illustrate the kinds of questions that might be raised by acknowledging the legitimacy of the co-sleeping environment. Moreover, we intend here specifically to call attention to both the importance of the characteristics of the sleep environment as they relate to the species-wide (co-sleeping) pattern of normal infant sleep and to a variety of parental sensory stimuli to which co-sleeping infants have access that heretofore have been ignored or dismissed altogether in both SIDS research and pediatric medicine.

2. Methods

Our first study consisted of five mother-infant pairs (infant age between 2.5 and 4.5 months) who spent 1 night in our laboratory sleeping in the same bed while undergoing all-night, simultaneous polysomnography (see Ref. [12] for details). Our second study consisted of three mother-infant pairs who spent three consecutive nights in the laboratory. On the first 2 nights they slept in adjacent rooms, while on the third night they slept together in the same bed [13]. Regardless of sleep environment, mothers and infants were simultaneously monitored all night using standard polysomnographic procedures as described below [13].

We are now finishing the first year of a 3-year study of what eventually will include a total of 50 Hispanic mothers and their healthy, breast feeding, 3-month-old infants. As assessed by sleep logs kept by potential participants for a 2-week period before the study, eligible mother-infant pairs are either routine co-sleepers or routine solitary sleepers. A strict criterion is used to differentiate the two groups. Routine co-sleeping requires co-sleeping for at least 4 h per night, 5 days per week; routine solitary sleeping is defined as co-sleeping (same bed) no more than twice per week for any part of the night. All mothers had normal pregnancies and deliveries, and infants are healthy and have normal developmental histories.

Beginning with an 'adaptation night' in the laboratory, mother-infant pairs sleep as they routinely do at home. On one of the next 2 nights (the order being randomly chosen), the mother and infant sleep again in the routine condition and the other night in the non-routine condition. Continuous all-night polysomnographic and video recordings using infrared lamps are performed nightly. A single polygraph records all standard physiological parameters simultaneously in the mother and infant. Axillary temperature and oxygen saturation are also recorded in the infants.

Electrodes are attached first to the infant since they retire before mothers at home. Mothers position their infants for sleeping as usual each night with no instructions. Recordings begin when infants retire at their usual time. Mothers retire later, also at their normal bedtimes. They sleep in rooms adjacent to their infants' rooms on solitary sleeping nights with the bedroom doors open so that they remain in auditory contact. Mothers respond to infant crying, etc., on an ad lib basis, performing all caregiver interventions themselves each night.

Polygraphic recordings are scored for sleep stages in 30-s epochs according to accepted criteria. The Rechtschaffen and Kales [14] system for young adults is used for the mothers and the scoring system for 3-month-olds developed by Guilleminault and Souquet [15] is used for the infants. Identification of sleep-wake stages in both scoring systems depends on three simultaneous parameters: EEG, EOG, and chin EMG. Five sleep stages are identified in adults: Stage REM plus four stages of non-REM (NREM) sleep delineated as Stages 1, 2, 3 and 4. In the infant, only three stages are defined: Stage REM, Stage 1–2, and Stage 3–4. In the process of data reduction, Stages 1 and 2 in the adult are combined to obtain a combination Stage 1–2, and likewise Stages 3 and 4 are combined for comparability to infant sleep stages.

These epochal systems of sleep stage scoring assign to each 30-s epoch either

wakefulness (W) or one stage of sleep based on the predominant (greater than 50%) sleep or wakefulness pattern occupying the epoch. Although awakenings of 15 s or longer that meet these criteria (i.e. epochal awakenings, EWs) are automatically identified by the epochal system, shorter duration arousals occupying less than 50% of an epoch are not. Because of our interest in all arousal phenomena in sleep, we quantify these transient arousals (TAs), using accepted criteria [16].

Video recordings on all individuals across all nights are hand scored in real time in their entirety. Every observable behavior is recorded and where appropriate, their duration measured.

3. Results

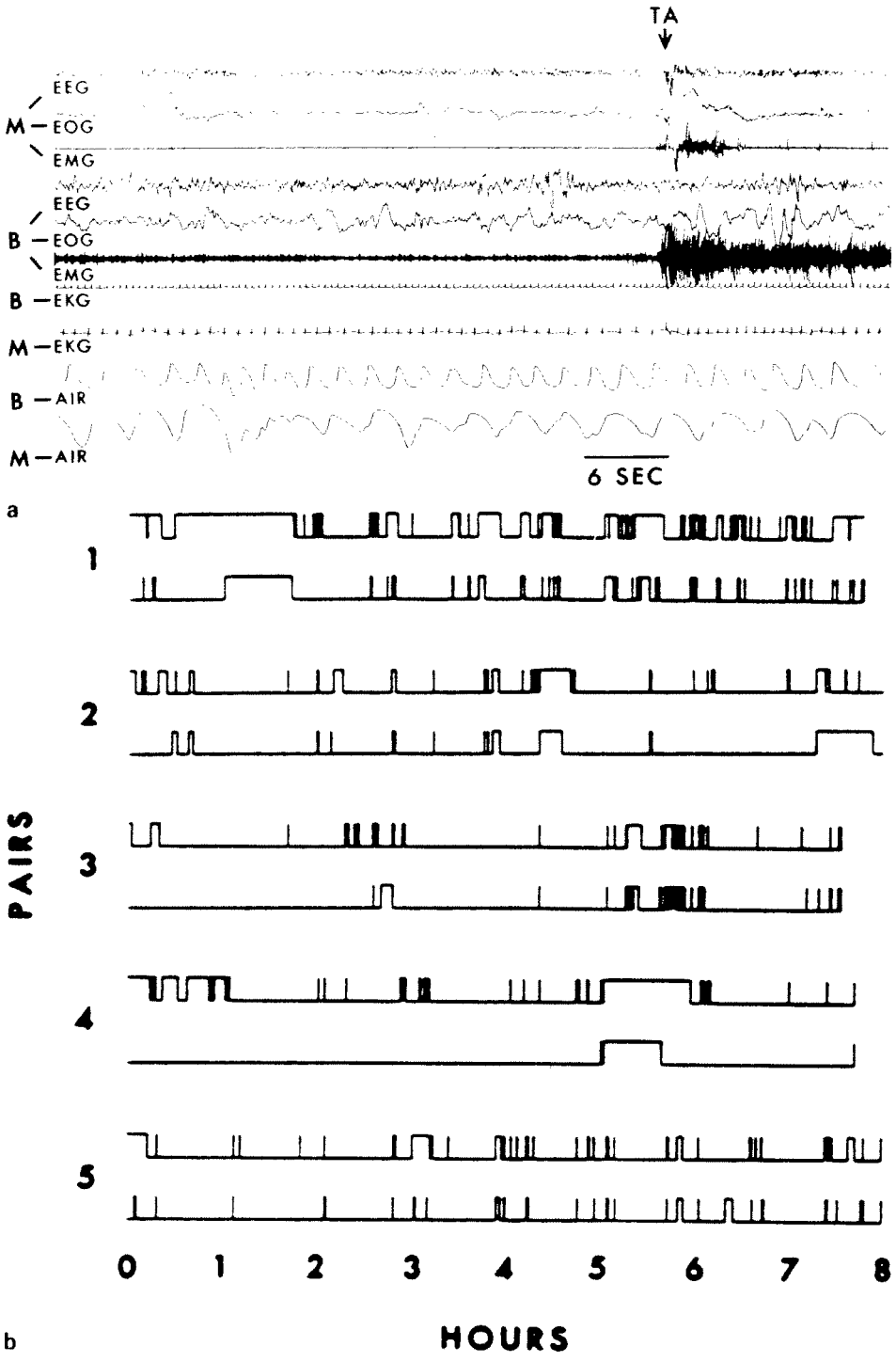
As described in more detail elsewhere [3,12,13] our first two studies showed that: (1) co-sleeping mothers and infant exhibit high levels of arousal overlap, including EWs and TAs (Fig. 1a,b); (2) infants exhibit more frequent stage shifts, i.e. they move from one stage of sleep to another, or awaken more frequently, while co-sleeping (Fig. 2); (3) co-sleepers [12,13] spent more time simultaneously in the same state of sleep or wakefulness while in the same bed (simultaneous activity time, SAT) than they did while sleeping in adjacent rooms; (4) compared to the solitary sleep night, on the co-sleeping night infants spent less time in deep stages of sleep (Stage 3–4) (Fig. 3).

Behavioral analysis of the video tapes of the first of six mother-infant pairs participating in our current study reveals that irrespective of the routine sleeping condition, (1) while co-sleeping, mothers intervened more frequently during the arousals of their infants, often prolonging the duration of those arousals; (2) infants and mothers face toward each other (face-to-face) for the vast majority of the co-sleeping night (72–99% of the time (Fig. 4)), especially after nursing; (3) the frequency of nipple contact and nursing sessions increases threefold while co-sleeping, but their average duration declines by over half (Table 1); (4) on average while co-sleeping, mothers induce (i.e. arouse first) between 10 and 27% of their infants' total behavioral arousals, while in turn, the infants induce over half of their mothers' total arousals (Fig. 5); (5) while co-sleeping, mothers inspect, re-blanket, reposition or otherwise adjust their infant's sleep environment on average more than four times more frequently than they do when each partner sleeps alone; (6) through a combination of nursing, active or passive embracing, enclosing and passive touching, co-sleeping infants and mothers are in physical contact ranging from 28 to 99% of the observed period compared with 2–14% on solitary sleep nights.

One additional observation is that when infants are positioned for co-sleeping mothers place infants in either the supine or lateral position. But on the solitary nights, when the same infants are placed in a crib by their mothers in an adjacent room, mothers often place them in the prone position.

4. Discussion

Our research is attempting to define and quantify the social and physiological dif-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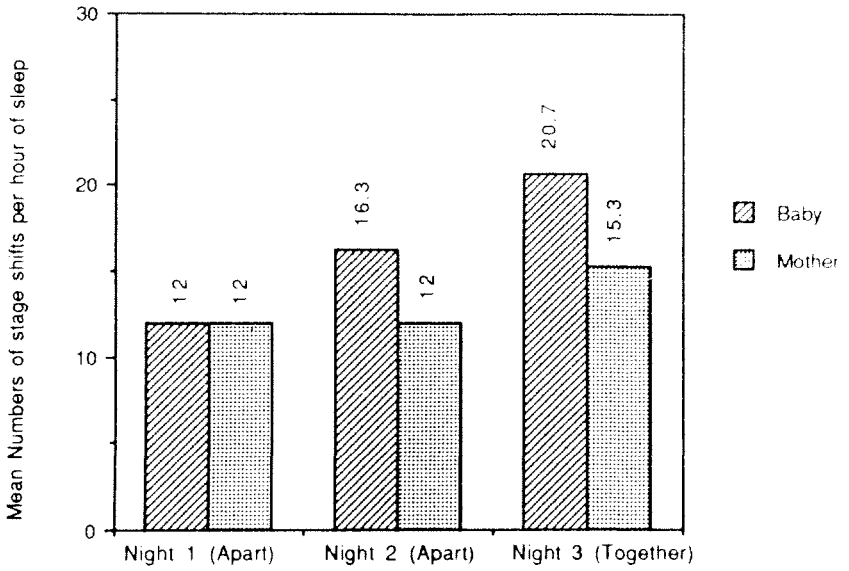

Fig. 2. Mean number of stage shifts per hour of sleep as mothers and infants sleep apart (Nights 1 and 2) and together in the same bed (Night 3). From Study 2, Sleep, Vol. 16(3), p. 268

ferences between exclusively breast feeding co-sleeping and solitary sleeping infants, and to evaluate these differences in terms of their relationship on known SIDS risk factors. At this early point in our research, the most robust and consistent finding under which more specific findings and their potential significance can be discussed is that co-sleeping mothers and infants exhibit overlapping (mutual) arousals, many of which appear to be partner-induced. Unfortunately, not a great deal is known about mutual arousals in co-sleeping environments since arousal phenomena in the laboratory have only been studied among solitary sleeping infants. Furthermore, clinical models of what constitutes 'normal' nocturnal sleep/wake patterns of infants are based exclusively on studies of solitary sleeping infants conducted in the early 1960s when breastfeeding in the United States was at an all time low. Bottle fed infants wake up less frequently than do breast feeding infants [2] suggesting that widely accepted models of 'normal' patterns of awakening are probably not appropriate for either breast feeding and/or co-sleeping infants.

Fig. 1 (a) Polygraphic recording showing overlapping transient arousal (TAs) among one co-sleeping mother (M) and baby (B). In this case the mother induces a corresponding arousal in her infant. From Study 1, Am. J. Phys. Anthropol., Vol. 83, p. 334, 1991. (b) Sleep-wake transitions of co-sleeping mothers and infants over an 8-h period. Note the number of synchronized awakenings and consolidated sleep. For each pair, the top line is the mother's sleep-wake patterns; the line underneath represents the infant's. Each spike represents an awakening of 1 min. A continuous horizontal line in its uppermost position is time spent awake; a continuous line in its lowermost position is consolidated sleep. From Study 1, Am. J. Phys. Anthropol., Vol. 83, p. 334, 1991.

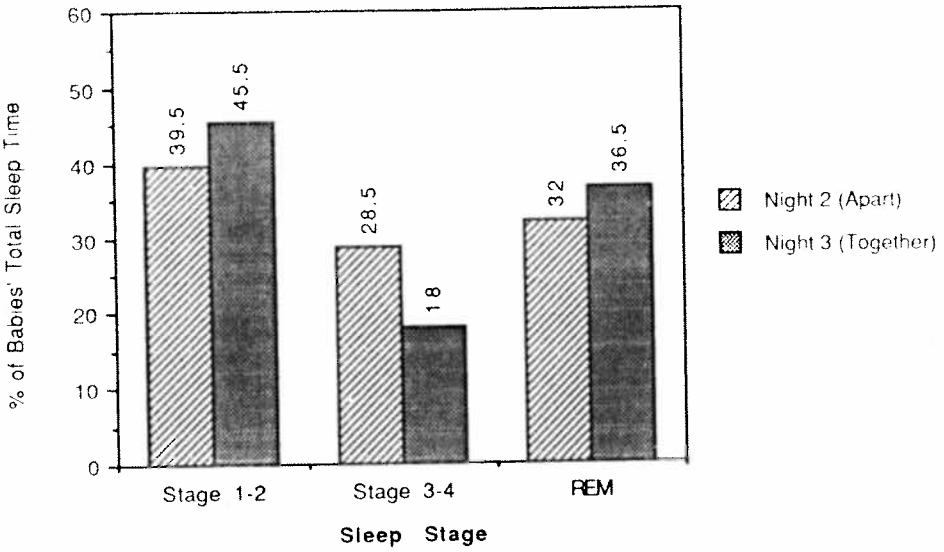

Fig. 3. Mean percentage of babies total sleep time spent in each sleep stage. From Study 2, Sleep, Vol. 16(3), p. 268. While co-sleeping, if babies are found to spend less amounts of time in deep stages of sleep (Stage 3 and 4) from which it is more difficult for them to arouse in response to apneas, this could mean that solitary sleep more severely challenges infants who are born with arousal deficiencies. From Study 2, Sleep, Vol. 16(3), p. 268.

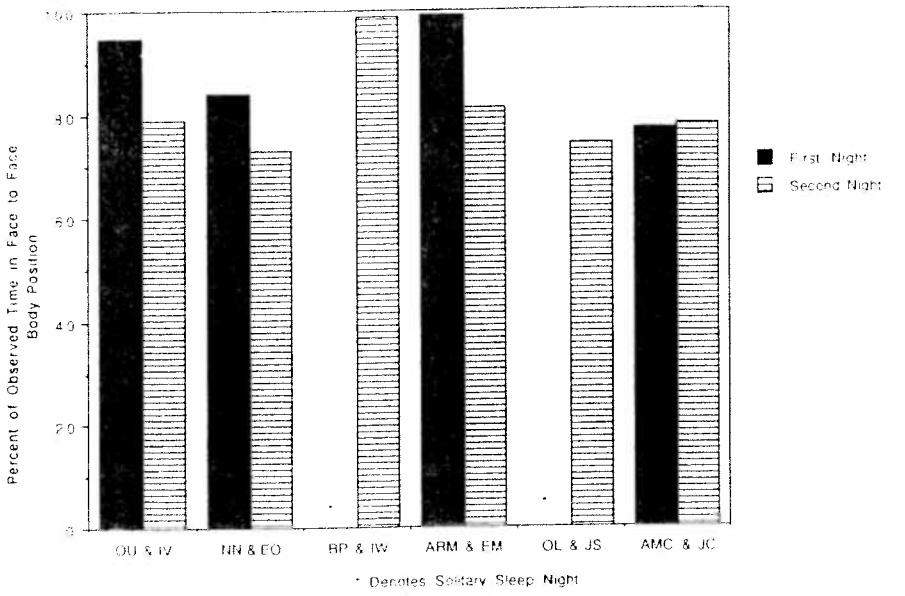

Fig. 4. The high percentage of face-to-face positions assumed by the mother and infant in the co-sleeping environment facilitates the infant's access to the breast, maternal protective intervention and management, as well as the infant's ability to inhale mother's CO_2, small amounts of which are known to stimulate more rhythmic breathing in mammals.

Table 1
Mean frequency and duration of breast feeding among six mother infant pairs as they sleep alone (adjacent bedrooms) and together (same bed) over three consecutive nights in a sleep laboratory

Pair	Night 1		Night 2		Night 3	
	Co-sleep	Solitary	Co-sleep	Solitary	Co-sleep	Solitary
OU and IV						
No. nursing episodes	5		10			3
Mean duration (min)	5.4		3.3			21.6
AMC and JC						
No. nursing episodes	3		6			2
Mean duration (min)	9.3		11.6			20.5
NN and EO						
No. nursing episodes	7			4	6	
Mean duration (min)	28.0			16.3	8.0	
AR and EM						
No. nursing episodes	4			2	4	
Mean duration (min)	10.7			19.5	14.0	
BP and IW						
No. nursing episodes		2		1	3	
Mean duration (min)		31		32	20	
OL and JS						
No. nursing episodes		2	7			1
Mean duration (min)		10.5	4.7			14

Mean frequency and duration of nursing when co-sleeping (all pairs): $\bar{X}$ = 5.3 sessions (range, 3–10) per night, for 12.2 min (on average), range 3.3–28 min. Mean frequency and duration of nursing when sleeping in separate rooms (all pairs): $\bar{X}$ = 2.3 sessions (range, 1–4) per night, for 23.4 min (on average), range 19.5–32 min.

Multiple factors may account for the high percentage of mother-infant overlapping arousals, not the least of which is their proximity to one another. For example, even though there is enough room in the bed to sleep without touching, the mother-infant pairs analyzed thus far spent between 28 and 99% of the night in direct physical contact (n = 6). This means that any kind of sudden sound or movement made by one co-sleeping partner is likely to be sensed by the other, although not all arousals elicit overt responses by the other. Moreover, co-sleeping results in mothers nursing their infants almost three times as frequently as they do when their infants are sleeping in adjacent rooms, just a few feet away. But they do so for a much shorter average duration. It seems as if the opportunity to nurse quickly and conveniently, to use nursing as a means of calming a fussy or restless infant, or to unintentionally stimulate infants to 'want' to nurse due possibly to emitted maternal odors [16] are all factors that could explain the increased frequency of nursing in the co-sleeping environment which contributes to a higher number of overlapping mother-infant arousals.

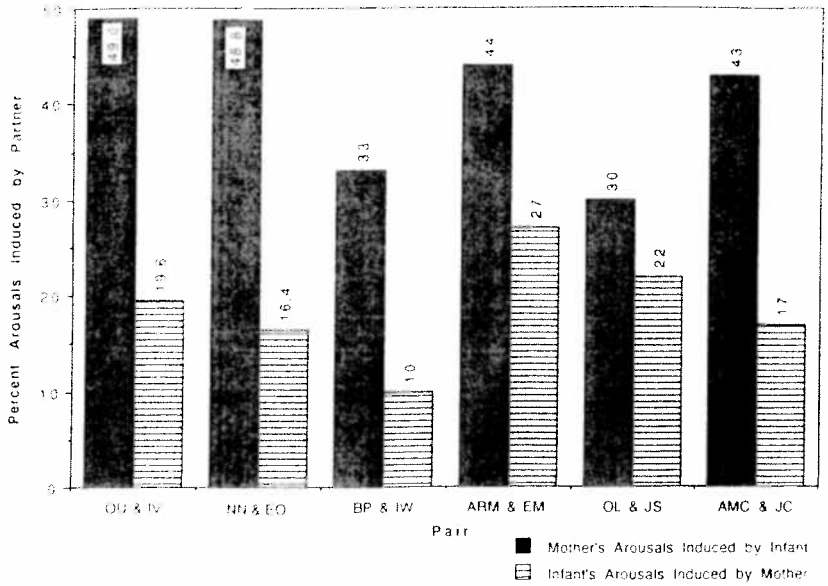

Fig. 5. Percent of behavioral arousals induced by co-sleeping partners on the first night of co-sleeping. These arousals were identified from an analysis of mother-infant co-sleeping interactions captured on videotapes. The significant numbers of mother-induced arousals illustrates how, while co-sleeping, infants arouse at times when, had they been sleeping alone, they would not have. These interactions demonstrate one mechanism by which the infant's sleep architecture is changed (perhaps beneficially) by contact with another during sleep.

Table 2
Percent of video recording time (approximately 8 h per night) mothers and their infants are in physical contact (either active or passive) while sleeping together (same bed) or alone (adjacent rooms)

Pair	Night	Sleep condition	Percent time in contact
AMC and JC	1	Co-sleeping	94
	2	Co-sleeping	40
	3	Solitary	9
BP and IW	1	Solitary	7
	2	Solitary	12
	3	Co-sleeping	28
OU and IU	1	Co-sleeping	18.2
	2	Co-sleeping	34
	3	Solitary	14.5
ARM and EM	1	Co-sleeping	79.5
	2	Solitary	11
	3	Co-sleeping	99
NN and EO	1	Co-sleeping	65
	2	Solitary	9
	3	Co-sleeping	78.9

Whether or not increased nursing sessions in the co-sleeping environment constitutes a benefit for the infant is difficult to determine. But one possibility is that the increased sucking and milk digestion that occurs during co-sleeping encourages more Stage 1–2 (light) sleep. It is easier for infants to arouse from lighter than from deeper (Stage 3–4) sleep, should it be necessary to do so. It is also possible that increased nursing sessions lead to more rapid daily infant weight gain, though future analysis will have to confirm this proposal.

Some investigators have suggested that neurological abnormalities may cause an 'arousal deficiency' which is manifested as SIDS in some infants [17–19]. If the arousal deficiency theory is supported by additional work, our finding that mothers appear to induce different types of arousals, including feeding arousals, is potentially important, especially since as two investigators remind us 'arousal constitutes a stimulus for breathing' [19].

DiPietro et al. [20] compared bottle fed with nursing infants and found that the nursing infants experienced longer heart beat intervals and increased heart rate variation, two physiological characteristics associated with reduced risk of an infant dying from SIDS (for discussion, see Ref. [2]), although it is not known if these characteristics are the result of inborn or environmental factors. DiPietro et al. do suggest, however, that breast fed neonates exhibit differences in physiological organization including 'elevated vagal tone'. They suggest that previous work 'showed a monotonic relation between vagal tone and severity of clinical dysfunction in at-risk neonates as well as lower vagal tone in at-risk infants compared with full term neonates, even when gestational age is corrected ... higher vagal tone is a reflection of better physiological status' (Ref. [20], page 471).

Mothers adjust their infant's body position more often while co-sleeping inducing infant arousals of a magnitude which can cause the infant to shift from one stage of sleep to another (Fig. 2), thereby potentially inducing more physiological variability in the infant's sleep experiences than it would otherwise experience if sleeping alone. We have speculated elsewhere that increased physiological variability during co-sleeping may facilitate maturational synchrony among developing neurological subsystems which underlie arousals (breathing, heart rate, and motor nucleii), systems which must function in concert to produce protective arousals in response to infant cardiorespiratory crises [2,3,13].

There is yet another reason why these infant-directed maternal manipulations during co-sleeping may be important. Studies from Great Britain, Norway, Belgium, Australia, New Zealand, Denmark, Ireland, and Tasmania found that placing infants in the supine position for sleep significantly reduces their chances of dying from SIDS (for review, see Ref. [21]). While our research cannot contribute directly to this discussion, it can elucidate the relationship between sleep environment and mother's choice of infant sleep position, and the effects that this choice has on infant sleep physiology. For example, observations made from the videotape recordings show that while the infant is always an active participant in its own care in the co-sleeping environment, it cannot feed from it's mother's breasts very easily, if at all, while lying prone. Interestingly, when placing their infants in cribs for solitary sleep, mothers can, and often do, place them in the prone position; but these same mothers place their infants in the supine or side position when sharing the same bed.

Our impression is that the supine (or safer) position permits the infant to assert more control over it's environment as, for example, in eliciting mother's attention (by whacking the blankets for example) or in gaining access to the nipples when hungry, and turning away from them when satiated. Use of the head, arms and legs by the infant to communicate needs is especially facilitated by the supine position. Insofar as breastfeeding and co-sleeping evolved in tandem and represent the evolutionary stable context of infant sleep, the fact that most of our mothers placed the infants on their backs for most of the night while sleeping next to them suggests that the supine sleep position may well be the more universal (species wide) preferred position. If so, then it should not be too surprising that it is safer than the prone position.

Over 20 years ago, Douthitt and Brackbill [22] found that supine sleeping newborns experienced twice as much motor activity during sleep and more awakenings than did prone sleeping newborns. Since the goal of both parents and health professionals has been to promote sleep, and not awakenings, these data provided an argument for why infants should sleep prone. We now recognize the risks of prone sleeping, and, while not yet known, it is hypothesized that some infants who die of SIDS cannot arouse to reinitiate breathing i.e. they may sleep too deeply before sufficiently mature arousal mechanisms in the brain are developed [19]. Based on this, one can speculate that the supine sleep position might well be safer than the prone position precisely because of the increased arousal and motor activity which accompanies it.

Also, the face-to-face orientation and proximity that occurs often during co-sleeping raises the possibility that the infant's atmospheric CO_2 is elevated enough at times to stimulate respiration (for discussion, see Ref. [3]). In addition to examining the actual distance between the mothers' and infants' faces from the videotapes, we are currently measuring the CO_2 content of air over a range of distances from women's faces (Mosko et al., in preparation). The concentration of CO_2 measured at distances comparable to those which often separate co-sleeping mothers and infants was within the range shown in steady state breathing studies to increase ventilation in young infants. We look forward to reporting these data next year.

Our finding that in the co-sleeping environment mothers continuously inspect, attend to, and more frequently (visually) 'checkout' their infant also elucidates another type of arousal occurring in the co-sleeping but not the solitary sleep environment. At least 6–10 times during the co-sleeping night, mothers lean over and inspect their infants. Often during these periods, mothers reposition their infant's blankets, sometimes repeatedly, as if ventilating. Mothers appear to be ensuring that the infant is not in any apparent danger or distress. Though we cannot say for certain what motivates this behavior, it seems reasonable to speculate that these infant-directed behaviors increase the likelihood of a mother discovering and intervening to reverse a potentially dangerous condition or situation. As mentioned above, perhaps these activities induce infant arousals at times when there would have been no arousal had the infant been sleeping alone. Such maternal induced infant arousals from diverse physiological states may provide the infant with practice in arousal [3,12,13].

Consider an integrated (albeit hypothetical) proposal as to the ways in which these different 'types' of arousals, induced by a co-sleeping mother, potentially providing practice in arousing, may coalesce to effect real or hypothesized SIDS risk factors. Infants who sleep with their mothers, who breast feed, are more likely to sleep on their backs, be aroused (by their mothers) at unexpected moments in their sleep, breathe in small amounts of their mothers exhaled CO_2, experience increased movement, feeding, and, consequently, exhibit greater vagal tone maturity [20]. The major potential consequence, then, of the enriched co-sleeping sensory environment is, in addition to having mother present who can react to dangerous situations, that the co-sleeping infants will, on average, spend less time in deep stages of sleep from which it is more difficult to arouse to reinitiate breathing should it be necessary to do so [3,12] and, therefore, be at less risk of dying from SIDS.

5. Conclusions

The last decade has witnessed an unparalleled development in SIDS research, resulting in quite unexpected findings. The discovery that merely by placing infants in the supine rather than prone sleep position, SIDS risks could be significantly reduced continues to astonish many SIDS researchers and has convinced some that the overall environment within which SIDS deficits find expression may be as important as the primary deficits themselves [21]. Previous to this discovery, if investigators were asked to prioritize SIDS research according to areas likely to yield clues as to how to reduce SIDS risk quickly and significantly, child care practices, over which both parents and/or health professionals have control, would not have been ranked very high, except for the importance of not smoking during and after pregnancy. This underscores the necessity of coming to understand both the range of the human infant sleep arrangements, as practised world-wide, and the kinds of research biases we hold regarding what constitutes 'normal' infant sleep. An evolutionary perspective provides an unbiased beginning point for infant sleep and SIDS research precisely because it forces us to consider the species-wide or universal context of infant sleep physiology, rather than how infant sleep is experienced only in our own geographical or cultural settings. In order to better understand the biology underlying infant sleep, or what factors might cause it to go awry, we must at some point study it in the social or co-sleeping environment within which it was designed and proved itself adaptive i.e. the co-sleeping context. Anthropological data including cross-cultural, paleontological and archaeological data is critical here. By beginning with an evolutionary perspective, we suggest also, that researchers are best able to appreciate the extent to which infant and maternal sleep physiology and behavior are entwined in adaptive ways, and that for the extremely altricial human infant, social care is physiological care.

We do not suggest that sensory contact in the form of co-sleeping can eliminate SIDS, or that it is always either practical or safe for all infants and families. In fact, at this point in our research, co-sleeping is neither to be recommended, nor advised against. The question is not whether we should co-sleep or not, but rather whether or not we should study co-sleeping. We believe we must. That being understood, we

argue that combined with developmental/experimental/epidimiological studies of parents and infants, anthropological data provide the basis for hypothesizing that for some subclass of SIDS-vulnerable infants, infant-parent contact and/or sensory access to one another throughout the night should help some infants override internal deficits involved in some cases of SIDS. While much research is needed to prove this hypothesis, it seems to us that a recognition of the adaptive and legitimate basis of diverse sleeping arrangements for infants, including co-sleeping, is necessary before we will ever be able to completely understand SIDS, an infant disorder for which existing research paradigms have proven inadequate.

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