Parent–offspring relations in man

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Initial interest in the behaviour of human parents with their newborn infants has stimulated observations on the rearing patterns of various mammalian species, in particular those of the domestic goat. Domestic goats normally rear their young within a specific family structure. The suckling relationship between mother and young is typically limited to a particular mother and her kid and any attempt for a foreign kid to suck may result in the mother violently repelling the alien offspring. The experience of the mother goat immediately following birth is critical to the development of this pattern of rearing behaviour. Hersher, Moore & Richmond (1958) separated 24 domestic nannies from their newborn kids for periods of $\frac{1}{2}$ –1 h immediately after birth. The kids were then permitted or helped to suck on their own mothers teats when mother and kid were reunited. These goat pairs were compared with 21 control animals after 2 and 3 months. At this assessment the following significant differences from behaviour of mothers not separated from their kids were found during the period of observation: the separated goats (a) nursed their own kids for significantly shorter periods, (b) nursed alien kids for longer periods and (c) spent less time butting alien kids. None of the mothers in either group was noted to butt their own kids.

From this study and similar observations on other mammalian species, Klaus *et al.* (1972) highlighted the importance of the immediate post-partum period as a time of maternal–infant attachment which they called ‘bonding’. This happy term has been so powerful that it has allowed this new train of thought to develop very quickly—perhaps too quickly and uncritically—and become generally accepted. A large number of scientific papers has now been published which deal with various aspects of bonding ranging from the perils of ‘inadequate bonding’ to studies on the possible mechanisms by which bonding may take place.

Broken bonding

Lynch (1975) investigated the possibility that the phenomenon of child abuse could arise from disordered contact between the mother and her newborn baby in the immediate post-natal period. Lynch considered 25 unselected and unequivocally abused children who had one or more siblings. The siblings were used as the control group in comparing biographies with the probands. Abnormal pregnancy, abnormal labour or delivery, neonatal separation, other separation in the first 6 months, and illness of the infant or the mother in the first year after birth were all statistically significantly more frequent in the child-abused group. Indeed, the non-abused siblings seemed to have been exceptionally healthy and showed a lower than expected incidence of adverse factors. This study suggested that episodes of ill-health in vulnerable families during pregnancy, delivery and early childhood put the child/parent bond at risk. However, it would be an over-interpretation to conclude that the child abuse results only from broken neonatal bonding; it is probable that considerations such as maternal anxiety or fear of attachment to a baby who is ill and in danger of dying in the immediate post-natal period contribute to the distorted parent/child relationship.

Unbroken bonding

Only recently has the attention of psychiatrists, paediatricians and obstetricians been directed towards the family reaction to the loss of a baby in the perinatal period (Lewis, 1976). It is clear that mourning such a loss can be particularly difficult and is sometimes followed by prolonged psychiatric disorder. In a sense this represents an unbroken bond and the British National Stillbirth Study Group have recommended that certain humanitarian steps are taken routinely in hospitals in order to assist parents with the process of mourning and acceptance of their unbroken bond.

We are currently testing the hypothesis that psychological recovery from stillbirth or early neonatal death is enhanced by a planned programme of counselling and support in the initial stages of bereavement (Forest, Claridge & Baum, 1981). In a randomized control trial, 50 unselected newly bereaved parents, with equal numbers of stillborn and neonatal deaths, were allocated to a group to receive counselling and planned support or to a control group receiving routine hospital care only. The counselled group were encouraged to see, hold and name their dead baby; a photograph of the baby was taken and kept; the mother could choose to go back to her own post-natal ward, or to an isolated room; discharge from hospital was not hurried, allowing time for contact with the medical staff, social worker and community midwives. The child psychiatrist offered an interview with both parents for brief counselling after about 24 h and included in the interview a discussion of the necessary registration and funeral arrangements. If appropriate, the parents were seen again in hospital or at home, and offered further support for up to 3 months. Unfortunately it proved very difficult to maintain a strict control group because as the study proceeded changes in the Maternity Hospital routine care and attitude were made. Evaluation of the two groups of parents was carried out at 6 and 14 months after the baby's birth, assessing the parents' health by a variety of psychiatric scoring systems. In descriptive terms it was quite clear that the counselled parents appreciated the opportunity of sharing their grief, of searching for a reason why their baby died and with coming home from hospital without a baby and finding that friends and neighbours shied away, exacerbating the parents' sense of social isolation. There are suggestions that there may be more psychiatric disorder in the uncounselled group of parents. It seems likely that we should offer all perinatally bereaved parents assistance to cope with their unbroken bonding.

Super-bonding

In their initial investigations into bonding, Klaus *et al.* (1972) placed 28 primiparous mothers with normal term infants into one of two study groups. The 14 mothers in the control group were managed traditionally, i.e. given a glance of their newborn baby shortly after birth, followed by brief contact and identification 6–12 h after birth and then visits of 30 min every 5 h for bottle feeding. In the extended-contact experimental group, the 14 mothers were given their newborn babies for 1 h within 3 h of birth and additionally for another 5 h of contact each afternoon for the 3 succeeding days. The mother/infant interaction was assessed in a filmed session with the mother feeding her infant 30 days after delivery. The extended-contact group spent significantly more time fondling their infant and lining up their faces with their infant—the 'enface' position—than did the control group. This study suggested that some aspects of the additional period of contact in the immediate post-natal period had resulted in an alteration in the mother's behaviour which persisted for at least 30 days.

A longer term study was reported by de Chateau (1979) in which 22 healthy primiparous mothers with normal babies were given an extra period of naked contact with their baby sucking at the breast after delivery and compared with a control group of 20 healthy primiparous mothers who were given routine care. At 3 months after birth the extra-contact mothers spent

more time kissing and looking face-to-face at their infant, and their infants smiled more often and cried less frequently. At 1 year after delivery the extra-contact group of mothers showed more close body contact with their infants during the period of observation. Additional differences between the two groups included a longer duration of breast feeding in the extra-contact group, and a longer duration of, but fewer problems with, night-feeding. It appears that, despite the multitude of factors that influence a mother's behaviour (e.g. genetic and cultural background, her relationship with her husband and family, the planning of the pregnancy and her own mothering as an infant and experience with her own family), a period of extra contact in the early post-natal period has an effect on the mother's behaviour which may persist up to 1 year after birth. Presumably the strong mother/infant bonding facilitates the development of a bi-directional mother/infant attachment which sensitizes the mother to the infant's cues, thereby enhancing the quality of mother/infant interaction (Bowlby, 1958).

A particular behavioural characteristic of mothers with extended contact with their newborn infants is the left-sided preference in holding and carrying the infant (de Chateau, Holmberg & Winberg, 1978). In this study a left-sided preference for holding babies under the age of 1 year was observed which was independent of handedness. Separation of mother and baby within 24 h of birth was associated with an increase in right-sided holding and also an increase in the percentage of mothers who held their infant in their hands rather than cradling the infant in their arms; in contrast a group of mothers who received extra contact with their infants did not carry the infant in the hands and an increased proportion carried the infant to the left. There is no established explanation for this side preference in infant holding although it has been observed in female students (non-mothers) and also in a systematic study of infants being carried by their mothers as depicted in works of art. No such side preference exists in males holding their infants.

In a series of studies summarized by Sosa (1978), there is general agreement that additional contact between mother and infant in the immediate period after birth is associated with an increase in the percentage of mothers who continue breast-feeding for 2 months after birth. This is likely to be important, not only as a manifestation of enhanced mother/infant bonding, but also because it seems likely that breast-feeding itself will serve as a mechanism for enhancing the bond between a mother and baby.

Breast-feeding as a bonding mechanism

Olfactory communication has been demonstrated in all mammals and it is known that man has apocrine and sebaceous glands which produced secretions that serve an olfactory function in other animals. Russell (1976) studied 10 healthy term breast-feeding infants exposed to a breast pad from their own mother, another lactating mother or a clean moist pad. The pads were placed 1–2 cm from the nose of a quietly sleeping baby. On the 2nd day after birth there was no response; by the 2nd week there was no response to the moist clean pad, but the pad that had been in contact with a mother's breast produced an arousal which did not discriminate between the strange odour and that of the baby's own mother. By 6 weeks, however, only one infant responded to the strange mother while 7 responded to their own mothers by turning towards the pad and making a sucking response. Macfarlane (1975) had previously published similar experiments with the important difference that the babies showed a positive differential response to their own mothers' breast pad as early as 6 days after birth. These experiments demonstrate the existence of olfactory maternal attraction, suggesting that humans have a pheromonal system and that it operates at a very early age. Although the source of these odours is not clearly demonstrated, olfactory cues seem to generate behavioural responses in infants and it seems likely that in this way breast-feeding enables an infant to identify and interact with his mother.

Different milks also have different tastes. In an experiment with 6 unlabelled chilled milk samples a group of medical students were able to discriminate between the different milks. On a scale from 0 to 10 they awarded 10 to pasteurised cows' milk, 9 to fresh human milk, 8 to

pasteurised human milk, 4 to a variety of commercial cow milk-based formula milks and 0 to boiled human milk (J. D. Baum, unpublished observations). Can newborn infants discriminate by taste and does taste play a role in infant-mother interaction?

There have been a number of experiments which have been performed to indicate that newborn infants do have taste perception (Crook & Lipsitt, 1976; Crook, 1978). Crook (1978) used the technique of measuring the duration of sucking bursts in term infants sucking on a teat into which fluids of different tastes could be introduced. In an extensive series of randomized experiments it was shown that newborn infants could discriminate between sucrose solutions of various strengths and salt solutions. Up to a sucrose concentration of 0.4 M, the more concentrated the sucrose solution the longer the burst of sucking; conversely, salt solutions induced shorter bursts of sucking. These experiments were interpreted to show that sugar is hedonically positive and salt hedonically negative for the newborn infant.

The study by Johnson & Salisbury (1975) indicates that taste perception is not only present in the newborn but has widespread physiological effects, including an effect on integration of sucking, swallowing and breathing. In their observations made in the first week after birth (with a standardized feeding bottle incorporating an electromagnetic flow meter) Johnson & Salisbury were able to show that the feeding and breathing patterns of the infants were different when the bottle was filled with a cows' milk formula than with expressed human milk. This study indicates that not only can infants perceive different tastes, but that their response to different tastes is perhaps greater than 'like' and 'dislike' and is associated with far ranging physiological effects.

It seems to be established then that newborn infants can discriminate by taste. It remains unproven that taste plays an important part in infant/mother recognition and interaction. However, anecdotal evidence might lead one to suppose this was the case. For example, in one instance the amniotic fluid of an Indian mother was noted to smell of curry; and the milk of another mother with a particular liking for French foods smelt strongly of garlic (J. D. Baum, unpublished observations). It seems likely that the infant can identify his own mother's milk, possibly using cues more subtle than these.

Breast-feeding, more than a bonding mechanism

Human milk is a highly complex physiological fluid which, in addition to fulfilling the role of a food, contains, among other things a range of anti-microbial factors which appear to play an important part in the newborn infant's defence against infection. Such components include lactoferrin, immunoglobulins and a large number of cells predominantly of the macrophage variety but including a minority of lymphocytes of both the B and T series.

Bullen, Rogers & Leigh (1972) showed that the iron-carrying protein lactoferrin was bacteriostatic for *E. coli*. In these experiments the lactoferrin prevented the growth of *E. coli* in a milk culture medium while the addition of excess iron was associated with a reversal of this inhibition and a rapid growth of the bacteria. The conclusion from these experiments was that lactoferrin serves the dual role of an iron transport protein while at the same time, as a result of its affinity for iron, makes the iron non-available as a growth factor for Gram-negative bacteria in the intestinal tract of the baby.

In the case of the immunoglobulins, and in particular secretory IgA, present in human milk, there is specificity of anti-microbial effect for an individual mother and infant pair. Lodinova & Jouja (1977) showed that if newborn infants were colonized with a non-pathogenic identifiable strain of *E. coli* then some time later the milk of the mothers of these infants came to contain IgA specific to these organisms. The postulated mechanisms for this effect are that the colonized infant infects the mother by the hand-mouth route and that the intestinal tract lymph nodes of the mother identify the foreign organism and prime lymphocytes which migrate to the mother's breast to produce locally an antigenically specific IgA. In addition to the humoral factors there are very large numbers of cells present in human milk whose role is yet to be fully determined.

However, their presence and their daily transfusion in large numbers from mother to infant would suggest that they play some direct or indirect role in the biological interaction of the mother and her infant (Goldman & Smith, 1973).

These observations illustrate the complexity of human milk as an infant food in which the composition has much more subtle and broader influences on the baby than a simple biochemical solution of carbohydrate, amino acids, fats, vitamins and minerals. It is perhaps not surprising that the mother, in addition to sharing with her infant bacterial and viral flora, gives with her milk a comprehensive system of anti-microbial defence.

Finally, it is perhaps worth noting that for the infant feeding at the breast the physiological fluid that he drinks does not have a constant composition but that its composition varies from week to week, day by day, and also within a feed from suck to suck. Hytten (1952) showed that the milk at the end of the feed was richer in fat compared with milk at the beginning of the feed. We have devised a system in our own laboratory for investigating the changing composition of milk during the feed by interposing a latex shield between the mothers breast nipple and the baby's mouth (Baum, 1980). The latex shield is soft and supple enough to allow the infant to suck physiologically (Woolridge, Baum & Drewett, 1980) while providing access to the milk for micro-sampling during the course of a feed. Initial observations show that the fat content of human milk increases step-wise suck by suck during the feed and doubles during the course of a feed (Lucas, Lucas & Baum, 1980).

Conclusions

The study of infant/parent interaction is at an early stage in its development. It seems likely that all the senses contribute towards an exchange of information, both before and after the baby is born, to a form of bonding which has a cascade effect on the developing relationships, not only between mother and the baby but upon the family as a whole. It remains to be shown whether the simple ideas of critical periods for attachment or separation can exert an influence over and above the multitude of other interactive influences. Nevertheless, the very simplicity of the bonding idea has drawn attention to this most important field of human infant/parent behaviour.

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