HAND-TO-MOUTH BEHAVIOUR IN INFANTS AT 5 AND 9 WEEKS.

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Hand to Mouth Behaviour in Infants at 5 and 9 Weeks

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Abstract

Forty infants (20 males and 20 females) were observed individually at 5 and 9 weeks. The observation took place with the infant in both a supine and in an upright (30^0) position. The infant was fed just prior to the start of the trial, and was videotaped in one of the positions until he or she had cried continuously for one minute, as judged by two independent state raters. Videotapes were examined for hand-to-mouth and hand-to-face behaviours. Parents' 24-hour records of infant crying, sleeping and wake times were obtained for four days following each observation. The results did not support a link between rate of hand-to-mouth behaviour and crying at home, but some evidence of state differences was found. The results indicated that in the sitting position, infants had a higher rate of hand-to-face touches (exclusive of the mouth) in state 6 (fussing) than in state 7 (crying). No interpretable effects were found for hand-to-mouth behaviour. It was found that the mouth was more likely to be open when the hand actually touched the mouth than when the hand touched elsewhere on the face, providing support for the view that hand-to-mouth behaviour represents an early coordinative structure in motor development.

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Acknowledgments

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Hand-to-Mouth Behaviour in Infants at 5 and 9 Weeks.

Infant crying, although normal, is considered a serious problem. Excessive crying is aversive to parents (Wilkie & Ames, 1986), and may lead to child abuse (Frodi, 1981). In an effort to help parents cope effectively with infant crying, researchers have studied many common soothing techniques such as rocking, swaddling, sucking, and auditory stimulation (Birns, Blank & Bridger, 1966; Brackbill, 1971; Elliott, Fisher & Ames, 1988; Gordon & Foss, 1966). One class of soothing techniques, sucking, has been claimed to be particularly effective (Lester, 1985). In practice, however, parents do not find sucking on pacifiers to be an effective soothing method, likely because the pacifier falls out and the infant is unable to retrieve it (Ames, Khazaie, Gavel & Farrell, 1987).

Using the hand instead of an artificial pacifier overcomes the problem of the loss of the sucking stimulus. Hand-to-mouth behaviour, therefore, may be an effective soothing technique available to the infant at a very early time in development. Fogel and Thelen (1987) suggested that this relationship between hand-to-mouth behaviour and soothing be examined.

Using high-grade ultrasound equipment, deVries, Visser and Prechtl (1984) observed spontaneous hand-face contacting

as early as 10 weeks post-menstrual age, and presented reports of fingers in the mouth at 15 weeks (Ianneriberto & Tajani, 1988) and thumb sucking at 24 weeks (Birnholtz, Stephans & Farina, 1984). In addition, hand-to-mouth behaviour has been implicated in the development of handedness. Hopkins, Lems, Janssen, and Butterworth (1987) found a rightward bias in head position as early as the first hour after birth, and found that head position was related to hand-to-mouth contacting. Most infants touched their mouths with the ipsilateral hand, so in effect, most touches involved the right hand. This finding was not due to the difficulty of the hand crossing the midline and touching the face, as it was found that each hand was able to cross the midline and touch the other side of the face. Hopkins et al suggest that the use of the ipsilateral hand to touch the mouth, in conjunction with the rightward head bias, may be a possible determinant of handedness in later life.

It has been commonly observed that neonates and infants do occasionally engage in hand-face and hand-mouth contacting, and hand-to-mouth behaviour is assessed in the Brazelton Neonatal Behaviour Assessment Scale as an indicator of self-soothing ability (Brazelton, 1973) but traditionally, these behaviours have been viewed as random events. Piaget (1967) stated that the infant sucks at random and will suck the fingers when they are encountered

by chance but that the infant is not able to introduce the thumb to the mouth systematically until the second month of life.

Many infant behaviours have traditionally been viewed as chance occurrences, but recent evidence seems to indicate that early infant motor behaviour represents more than a collection of random events.

Coordinative Structures

Little is known about motor development, and traditional motor development researchers such as Gesell (1954) have focused upon detailed descriptions of the age related changes in motor ability. This has provided useful normative data, but little understanding of the underlying processes of motor development. Furthermore, we know little about the processes involved in producing motor actions and the refinement of motor skills, although several theoretical perspectives have been explored (Clark, 1982; Fentress, 1986; Schmidt, 1975; Smyth & Wing, 1984).

One of the persistent problems in the understanding of motor development is the large number of possible movements that can be made by humans. Burnstein (1967) addressed this 'degrees of freedom' problem and proposed that it was solved by the existence of coordinative structures, or subcortically controlled patterns of movement. Fogel and Thelen (1987) have described coordinative structures as a

functional grouping of muscles and joints whose movements are coordinated as a whole, rather than as a series of separate movements. The preferential linking of muscle combinations and joint angles produces actions that appear stable over time and between individuals.

Coordinative structures are an important aspect of Dynamic Systems theory. Dynamic Systems theory proposes that development arises from the self-emergent properties of the organism, which are in dynamic relation to the task context and the environment as a whole. Dynamic systems produce both stability of behavioural form and individual variation. Stability of behaviour comes from phylogenetic and environmental constraints. Certain attractor states, defined as arrangements of behavoiural outputs that the system prefers, are more resistant to perturbations so organisms will prefer these response modes, until such time as the demands of phylogeny, task, or environment push the organism beyond the outer limits of that attractor state.

A coordinative structure of motor behaviour provides both stability, as it is constrained by the preferential linkages of the joints and muscles of the organism, and change, because the coordinative structure can be mediated by task demands, environment, or physiological changes.

Kicking and Stepping

Research such as Zelazo and Kolb's (1972; 1984) and Thelen's (Thelen, 1985; Thelen, Fisher & Ridley-Johnson, 1984a; Thelen, 1984b) work on kicking and the stepping reflex has indicated that these infant behaviours may be part of early coordinative structures. When a newborn infant is supported under the arms and the feet are touching a flat surface, the infant will perform coordinated stepping movements. This walking reflex usually disappears at about 8 weeks. Zelazo, Zelazo, and Kolb (1972) found that practise can preserve this reflex beyond 8 weeks. The research involved 24, week-old infants. Six of the infants were in the experimental group, and the remainder were in three control groups. The experimental group engaged in exercises of the walking reflex 3 minutes per session, four sessions per day until the end of the 8th week. Infants in the passive exercise control group engaged in equal amounts of gross motor exercise and social stimulation, but did not engage in the stepping reflex. The third control group acted as a testing control, and the last control group was only examined at pre and post-test observation times. It was found that there was an increase in occurrences of the walking reflex for the experimental group, and that this group engaged in independent walking earlier than the other groups. Zelazo et al state that these results support the idea of continuity between reflex and voluntary behaviour. Thelen et al (1984a) have also studied the walking reflex, and argue that the disappearance of the stepping reflex is

due only to the increasing mass of the limbs without a concomitant change in the mass of the muscles needed to engage in the behaviour. The study (Thelen et al 1984a) found that infants will engage in the stepping reflex if the limbs are submerged in water to reduce their weight. Additionally, it was found that the kicking motions made by infants and the stepping reflex were spontaneous actions mediated by identical movement patterns. Added to these findings, Thelen (1984b; 1984c) provides evidence for the view that the stepping reflex and kicking are part of coordinated structures of the lower limbs, controlled at a subcortical level. Thelen (1984b; 1984c; 1985) states that although these movement patterns are present in newborn infants, there is little cortical maturity at that stage, and infants without a cerebrum show stepping movements. Furthermore, Thelen points out that there are highly predictable coordinations within the leg joints and regular patterns of muscle activity, indicating that the limb is moved as a whole, rather than as a series of separate problems of muscle control and coordination. There is also evidence that inter-limb coordination also occurs in the leg movements of infants. Steps and kicks seem to alternate between legs in the newborn, and older infants begin to make simultaneous movements. Thelen proposes that these movements of the lower limbs are controlled by coordinative structures at the sub-cortical level.

Emotions as Coordinative Structures

Coordinative structures are also proposed to underlie the expression of emotion in early infancy. Fogel (1985), in a case study of two infants, found patterns of emotional expressions thought to represent the control of functional synergies. Fogel proposed that sequences of facial and manual actions constitute coordinative structures of emotional expressions. Two different types of sequences were found. In one, a before-after sequence, categories of emotional expressions were likely to precede or follow one another. In the other, an alternating sequence, two categories of emotional expressions repeated in an alternating pattern. Fogel found consistency in the sequences of expressions, and these sequences were found to change systematically with age in a similar fashion for both subjects. One example of a sequence of expressions was the association of smile with rest and mouthing. Smile was much less likely to occur sequentially with cry, frown or hand-mouth behaviour, and Fogel states that this patterning suggests the presence of a higher order coordinative structure that regulates the expression of positive emotional expressions. Whether or not these sequences of emotions represent coordinative structures of emotional

expression remains to be more fully examined in a larger study; however, coordinative structures have been found in other areas of infant behaviour.

Eye-Hand Coordination

Another coordinative structure that is being investigated, hand-eye coordination, is very close to hand-mouth behaviour.

Traditionally, it was thought there were no coordinative structures of the hand and eye in the infant, but that the movements observed were merely the thrashing of limbs due to arousal. Hofsten (1982), however, pointed out that arm and hand movements are not entirely random and that there have been reports of coordinated eye-hand movements before any reaching has been actually accomplished. In his first study, Hofsten (1982) elicited prereaching behaviour in infants aged 5-9 days. Both the hand movements and looking behaviours were recorded. It was found that there were, in fact, more arm movements when no object was present. The number of forward arm-hand extensions, however, was the same whether or not an object was present. When an object was present, however, more forward arm-hand extensions occurred when the infant's gaze was fixated upon the object than when the infant was not fixating. Hofsten concluded that the presence of the object had a general

alerting effect, encouraging gaze fixation and arm-hand extensions.

Hofsten's (1982) second study attempted to determine if infants were able to visually direct arm movements. It was found that arm-hand movements were aimed more towards the object during gaze fixation than when gaze was not fixated, and that fixated reaches slowed as they got closer to the object. These results were not due to the direction of the infant's head but rather seemed to be part of a coordinative system of eye and hand, which Hofsten called prereaching.

Hand-to-Mouth Behaviour

It is possible that hand-mouth behaviour represents another early coordinative structure but its purpose has been debated. Some researchers have investigated the link between hunger and hand-mouth behaviour (Wolff, 1966) and others have proposed that hand-mouth behaviour is a precursor to self-feeding (Butterworth & Hopkins, 1988). Still other researchers have viewed hand-mouth behaviour as a possible self-soothing mechanism related to infant state. (Fogel, 1985; Korner, Chuck & Dontchos, 1968; Wolff, 1987). Infant state can be described as observable patterns of behaviours that may represent discrete modes of neurological functioning. Definitions of behavioural states are found in Table 1.

If hand-mouth behaviour is a precursor to self-feeding then the behaviour should be linked to levels of hunger. In his observational study of 11 neonates, Wolff (1966) discovered that hunger had a significant effect upon hand-mouth coordination during the first 5 days of life. Hand-mouth coordination was defined as the ratio of hand-mouth contacts to all hand-face contacts. There was a rise in hand-mouth coordination for 6 of the infants from the first period after feeding until the midpoint between feedings, as hunger increased, but no significant increase in coordination from the midpoint to just before the next feeding. Wolff stated that these findings provide some support for the hypothesis that hunger may have an initial augmenting effect upon goal-directed behaviour but that the effect may become disorganizing at later stages of hunger. It is not clear how the effect may have been disorganizing as hand-mouth coordination did not decrease, but it seems that hunger did show some effect initially on the hand-mouth behaviour of some of the infants.

In studying hand-mouth behaviour as a possible precursor to self-feeding, Butterworth and Hopkins (1988) observed hand, head and mouth postures in infants aged 20 to 182 hours. Arm movements fell into four different categories: direct movement of hand to mouth (14%), movements to the mouth after contact with the face (18%),

face contacts without mouth contact (44%), and movements that did not quite reach the face (24%).

Altogether, one third of arm movements resulted in contact with the mouth, either directly or after contact with the face. Furthermore, the mouth was more likely to be open or opening during the arm movement when the movement resulted in contact. Hand-mouth actions were not related to the posture of the hand so it was unlikely that the infants were triggering a Babkin reflex that resulted in an open mouth when the hand was present. The successful contacts did not seem to be related to whether the eyes were open or closed, and thus visual guidance of the hand did not seem necessary. Finally, it was found that the arm movements that progressed from face to mouth were more likely to be successful if the face contact began in the perioral region. The researchers decided that hand-mouth actions were not related to rooting as the hand moved to the mouth rather than the mouth moving to the hand. Butterworth and Hopkins also observed that the infants did not suck their fingers or hand once contact had occurred; instead, contact of the hand to the mouth was brief. Furthermore the number of successful contacts between the hand and the mouth was not related to state. As no state differences were found, and the behaviour was not linked to rooting or the Babkin reflex, Butterworth and Hopkins concluded that the hand-mouth coordinative structure is 'pre-intentional' in nature

and may be a precursor to self-feeding rather than a soothing mechanism as no state differences were found.

Further evidence for this point of view comes from a study by Rochat, Blass and Hoffmeyer (1988) that examined the effect of sucrose presentation upon hand-mouth behaviour in 10 infants aged 7 to 57 hours. The infants were supine with a 30^0 incline for filming purposes. They were observed for baseline purposes for 5 1 minute trials, which included a "psst" or "shhh" sound at the start of each minute. The infants were then given a sucrose solution every 2 minutes for 14 minutes. This phase was followed by another baseline phase of 7 minutes. The results indicated that the infants increased both the duration and frequency of hand-mouth contact during sucrose presentation, an increase that was not related to an increase in global activity of the hands. The researchers point out that the movements of the infants were quite smooth, and that the infants sometimes opened their mouths prior to the hand reaching the mouth, indicating possible anticipation.

The effect of sucrose presentation on hand-mouth behaviour has been taken as evidence supporting the view that hand-mouth behaviour is linked to self-feeding. Other researchers, however, question this link between hand-mouth behaviour and hunger, and its implications for the self-feeding hypothesis. Kessen, Williams and Williams (1961) did not find a relationship between feeding and hand-to-

mouth behaviour, and Koepke and Barnes (1982) found that infants will suck in the familiar burst-pause pattern even before the first feeding. In a study of at-risk infants between 48 and 95 hours old, Feldman and Brody (1978) examined non-elicited behaviours as a function of prandial condition and state. Hand-mouth and hand-face contacting were most frequent in Active Awake and Cry states. Prandial condition did not seem to have an effect that was separate from state effects and it would seem that the differences across prandial conditions found in previous studies can be accounted for by the concomitant change in the distribution of states. Korner, Chuck and Dontchos (1968) also found no relationship between hunger and finger sucking, hand-mouth or hand-face behaviour. Hendry and Kessen (1964) found that average length of each contact and the total time spent contacting was actually highest in the first hour after feeding, and in the second hour, the average length of each contact and the total time spent contacting dropped significantly. Over the next two hours before feeding, the total time spent contacting returned to the same level as just after a feed, but the average duration of each contact stayed at the decreased level. Again the differences found may have been linked to state changes but state was not recorded. Overall, however, hunger did not seem to precipitate a large increase in hand-to-mouth contacting as the levels of behaviour did not increase beyond the levels found just after a feeding.

The Effects of State on Hand-to-Mouth Behaviour

Taking these findings into account, it would seem that in the Wolff (1966) study, state could have been an influencing variable. State could have also influenced the results in Rochat et al (1988) but the researchers did not measure state. Butterworth and Hopkins, (1988), however, did measure state and claim to have found no differences in hand-mouth behaviour across state. Hopkins, Janssen, Kardaun and van der Schoot (1988) found no difference between the amount of hand-to-mouth behaviour during crying and fussing, and the amount of contacting during an equivalent amount of active awake time. These researchers, however, did not examine fussing as a separate state, and thus may have obscured any state differences that may have existed.

Several studies have found state differences in hand-to-mouth behaviour. Hand-mouth behaviour was found to be linked to state in a study by Koepke and Barnes (1982). They observed 20 infants for 3 hours per day for 4 days starting within the first few hours after birth. Each observation began 2 hours prior to the feeding of the infants, and continued for 1 hour after the feeding. The very first observation for each infant was made before the baby had ever received any milk.

One group of infants (Pacifier group) was given a pacifier when empty sucking, rooting, or mouthing behaviours were observed. The pacifier was left in the mouth until the infant rejected it. A control group of infants was also observed but with no pacifier offered. Behavioural state and oral behaviours were recorded for both groups. It was found that in the Pacifier group, each baby on each day engaged in pacifier sucking. The mean duration of sucking was 28 minutes per hour and all babies sucked on the pacifier before they had received any food. There were no differences in the duration of sucking across the 12 hours of observations so receiving milk did not have an effect on sucking duration. As they became hungry, however, the infants had more oral behaviours and thus had the pacifier inserted more frequently. When examining behavioural states it was found that the oral behaviours occurred during all states except regular sleep, but they occurred most often during the drowsy state.

In the control group, half of the infants sucked their fingers, usually before or after other oral behaviours, the most frequent of which were empty sucking and touching the mouth. The rate of oral behaviours for all control group infants did not vary across the 12 hours of observation, so having received milk or being hungry did not have an effect. The frequency of oral behaviours was highest in the drowsy state.

The results indicate that for both groups, the presence of a sucking object is important during the drowsy state, whether that object is a pacifier or the infant's own fingers. Koepke and Barnes indicate that sucking behaviours are not entirely for the purpose of nourishment, but rather may play some part in the mediation of attachment to the mother, especially as attachment behaviour may be activated by fatigue and the sucking and oral behaviours were prominent during the drowsy state.

Hand-to-Mouth Behaviour and Distress

Wolff (1987) found that hand-mouth behaviour was most frequent during fussing and more frequent during fussing and crying than during an alert active, drowsy or sleeping state. Hand-face and hand-suck behaviours were also found to follow much the same pattern, with the greatest frequency of hand-to-face actions during crying and the greatest frequency of hand-suck behaviours during fussing. Wolff (1959), in another study of neonates, observed complete cycles in which the infant was crying, moved the hand to the mouth, and stopped crying when the hand touched. These results indicate that during states of distress infants may utilize hand-mouth behaviour to soothe themselves. Wolff also pointed out that attempts at tension reduction are the earliest behavioural manifestations of problem solving. Additionally, Korner and Kraemer (1972) state that an infant's ability to self-comfort will influence his or her

level of discomfort and dependence on the caretaker, which in turn may influence the quality of infant-caretaker interactions, and ultimately, infant relationship formation.

Additional evidence concerning hand-mouth contact as a soothing mechanism comes from Fogel (1985). In a case study of two infants, observed from 2 weeks of age until 10 months, Fogel examined face to face interactions between the infants and their mothers. The results indicated that for both infants, there was a decrease in expressions of distress over time, and an increase in hand-mouth behaviour. In a sequential analysis, Fogel found that during the first 6 to 7 months of observations, when hand-mouth behaviour occurred it was likely to be preceded by rest. After about 6 to 7 months, when hand-mouth behaviour was observed it was followed by rest. Also at this time, frown and cry were likely to precede hand-mouth activity. It would seem that very young infants need to be in a state of rest to engage in hand-mouth behaviour, but that after 6 or 7 months of age infants are able to respond to distress with hand-mouth behaviour which in turn leads to rest and the suppression of distress. Fogel states that this pattern indicates the distress-supressing function of hand-mouth behaviour, observable at 6 or 7 months.

Fogel's findings conflict with that of Wolff (1954) who found a relationship between hand-to-mouth behaviour and soothing in neonates. Other researchers have found a link

between hand-to-mouth behaviour and soothing at an earlier age than when observed by Fogel.

Korner, Chuck and Dontchos (1968) found that hand-mouth behaviour was related to crying and shifts in state. They examined spontaneous oral behaviours in 32 neonates aged 45 to 88 hours. The infants were observed prior to, after, and between feedings. It was found that finger-sucking, hand-mouth and hand-face contacts were significantly related to each other. Mouthing, however, was not related to these actions and it was the only action that was significantly positively related to hunger.

According to Korner et al (1968), hand-mouth contacting seemed to be a reliable and individual trait: a few of the babies moved their hands directly to their mouths while others were less accurate. These individual differences in hand-mouth contacting may be related to differences in the types of motions used by the infants. There were significant individual differences in infants' ways of moving. Small or single motions consisted of two motions or less and single displacements of head, feet, arms, toes, etc. Small multiple motions were three or more body displacements of small proportions. Global movements were three or more motions with displacements of 90 or more of at least one body part. Diffuse motion was the infant's whole body in motion. Hand-face contacts, hand-mouth contacts,

and finger sucking were positively related to small multiple motions, but not to the other types of motion.

Finally, oral behaviours were related to levels of arousal, indexed by amount of crying and shifts in behavioural state. Finger sucking, hand-mouth and hand-face behaviours were all significantly positively related to shifts in states and amount of crying, whereas mouthing behaviours were only related to shifts in state. It would seem that hand-face, hand-mouth and finger-sucking behaviours can be isolated from other oral behaviours in that they show high individual differences, are related to the type of motions observed, and seem to function as tension reducing.

Hand-to-mouth behaviour and soothing has also been examined by Hopkins, Janssen, Karduan and van der Schoot (1988). The researchers examined hand-to-mouth behaviour in newborns and in a longitudinal sample of infants from 3 to 18 weeks. Quieting with hand-to-mouth contact was defined as follows: 1. a period of at least 1 minute in quiet or active awake before the start of crying. 2. at least 10 seconds of crying. 3. after crying (not lasting more than 4 minutes) quiet or active awake maintained for at least 1 minute. 4. a hand-to-mouth contact during crying that was maintained into the after-cry time. Even with this very stringent definition of quieting with contact, this behaviour series was observed in the group of newborns, and

crying bouts ending in a quieting with contact were in general shorter than crying bouts ending without a contact. In the longitudinal group, however, quieting with contact was not observed until 9 weeks of age. During the quieting behaviour sequences, the infants only sucked on their hands for 57% of instances in the newborn group, and 75% of instances in the longitudinal group from 9 to 18 weeks. This would indicate that sucking is not a necessary accompaniment to hand-to-mouth behaviour, but that infants increase their use of sucking during self-quieting after 9 weeks of age.

Quieting was not found to be accompanied by hand-to-face behaviour; however, infants in the newborn group showed higher rates of hand-to-face and hand-to-mouth behaviours in crying than did the longitudinal group.

In summary, although hand-mouth behaviour was most frequent in different states in different studies, it would seem safe to conclude from the studies reviewed that state is related to hand-mouth behaviour. If hand-mouth behaviour was found to be more frequent in behaviour states linked to distress, this would provide evidence that hand-mouth behaviour operated as a self soothing mechanism.

Hypotheses

The present study examined the relationship between state and hand-mouth behaviour, and the relationship of

hand-mouth behaviour to amount of crying. Both hypotheses are based upon the assumption that hand-to-mouth behaviour is a soothing technique used by young infants. First, it was predicted that the frequency of hand-to-mouth behaviour would be highest during fussing rather than during other states, as infants become distressed and attempt to soothe themselves. Second, it was also predicted that infants who exhibit high levels of hand-mouth behaviour have such a behaviour available as a self-soothing technique and should thus cry less.

Several related predictions will also be tested. It has been found in earlier research (Elliott, Fisher & Ames, 1988) that infants termed excessive criers fussed for a shorter period of time before starting to cry than did 'normal' criers. Posner and Rothbart (1980) have suggested that infants who fuss less before crying lack the opportunity to soothe themselves. It is expected that in the present study, infants with longer fussing intervals will cry less in the home than infants with shorter fussing times because the longer fussers will have more opportunity to engage in and learn hand-mouth behaviour. It is also expected that the frequency and accuracy of hand-mouth behaviour will increase over time from the first observation to the next as the infant becomes more coordinated and thus better able to engage this self-soothing mechanism.

Finally, a greater frequency of the mouth being open rather than closed during touches to the mouth may relate to the existence of hand-to-mouth behaviour as an early coordinative structure. It is expected that when the hand touches the mouth the mouth will be more likely to be open than when the hand touches the face. Butterworth and Hopkins (1988) found that the mouth was more likely to be open than closed when the hand touched it, but they did not examine the condition of the mouth when the hand touched the face. If it were the case that the mouth was just as likely to be open during touches anywhere on the face, than the Butterworth and Hopkins finding would be due to chance. The present study compares the condition of the mouth when the hand touches the mouth and when the hand touches elsewhere on the face.

In summary, the following hypotheses will be explored:

1a. Hand-to-mouth behaviour will occur at a higher rate during fussing than during crying or during active awake time.

1b. Hand-to-face behaviour (exclusive of hand-to-mouth behaviour) will occur at a higher rate during fussing than during crying or during active awake time.

2. The rate of hand-to-face behaviours within each state will increase from 5 weeks to 9 weeks.

3. It is expected that hand-to-mouth behaviour will be an early coordinative structure. It is predicted that when the hand touches the mouth, the mouth will be more likely to be open than when the hand touches elsewhere on the face.

4. The rates of hand-to-face and hand-to-mouth behaviour at both 5 and 9 weeks will be correlated negatively with amount of crying at home. The rate of hand-to-face behaviour at 5 weeks will correlate negatively with the recorded crying at 9 weeks.

5. The length of the observed fussing interval in the laboratory will be correlated negatively with crying at home, for both ages 5 and 9 weeks. The length of the fussing interval at 5 weeks will also correlate negatively with the crying recorded at 9 weeks.

Method

Subjects. Subjects were 40 full term healthy infants (20 male and 20 female) volunteered by their parents. An additional 61 subjects were unable to complete the study. Subject recruitment was as follows: The parents received information about the study from flyers distributed in local hospitals and in the Psychology Department, and through telephone canvassing of the local newspaper's birth announcements. From the people who responded to the flyers, 81 were called. 54 (64%) agreed to take part, and 27 (33%) refused. From the birth announcements, 78 were called, 16 (22%) agreed to take part and 62 (79%) refused. Eight subjects did not show up for their first visit, and therefore did not take part in the study. 20 subjects failed to complete the laboratory portion of the study: of these, 11 infants missed their second visit, due to illness, family vacations or other time restrictions, or the parent's loss of interest in completing the study; 5 infants were lost due to equipment failure or other technical problems; 3 infants were lost because they did not cry within 70 minutes; and 1 was lost because he did not settle between observations. Additionally, 5 subjects were lost because, although they had completed both laboratory observations, the parents failed to return sleep records showing how much the infant cried at home.

The weight of the infants ranged from 2721 grams to 4847 grams, with a mean of 3699 grams. None of the infants or mothers suffered from any serious complications during the pregnancy or birth. The mean age of the mothers was 29.2 years, with ages ranging from 21 to 40. Fathers' mean age was 31.5 years, with a range from 22 to 41. Years of education for mothers had a mean of 15.1, and ranged from 11 to 24 years. The mean number of years of education for the father was 14.4, with a range from 11 to 24.

Procedure. Subjects were observed first at 5 weeks (plus or minus 4 days). Observation 2 took place between 25 to 31 days later, when the infants were 9 weeks of age (plus or minus 4 days).

The observations took place in the Developmental Research laboratory in the Psychology Department of Simon Fraser University. The observation room itself was 5.5 meters by 5.8 meters, and was adjoined by a small room which contained the split screen generator. In the observation room, the videocameras were located in two adjacent corners of the room, on the wall just below the ceiling. The cameras faced the infant and were at a distance of 2.55 meters from the infant. The videocameras were positioned at 45^0 to the infant, so that videotape scorers would be able to see both sides of the infant's face at one time. The distance from each videocamera to the infant was approximately 2.5 meters. The wooden infant bed and

mattress was placed upon a table in the middle of the room, and for the seated observations, the cuddle seat was placed upon the bare bed.

The parent was asked to feed the infant upon arrival at the laboratory, and videotaping began after a minimum of four minutes had elapsed since the parent judged that the infant had finished feeding. The infant was videotaped, using the two videocameras and the split screen generator, once while seated in a cuddle seat inclined at approximately 30^0 and once while lying supine on a mattress in a wooden bed. The order of these positions was alternated within sex for the first session. For the second session each infant was run in the same order in which he or she was run in the first session.

During the observation, the parent was asked to remain silent and outside the infant's line of vision; however the parent was informed that she or he could end the observation at any time.

Seated Trial: With the videocameras running, the infant was placed in the cuddle seat by the parent. When the cameras were adjusted for the position of the infant, state recording began. The behavioural state scale used was based upon Prechtl (1974) and has been used in other research (Elliott, Fisher & Ames, 1988). The scale consists of seven behavioural states: Quiet Sleep, Active Sleep,

Drowsy, Quiet Awake, Active Awake, Fussing and Crying. Definitions of these states are found in Table 1. The infant was observed until he or she cried continuously for 1 minute, as judged by two independent scorers who stood behind the infant on either side of the infant's head. When only one scorer had a clear view of the infant's eyes, she would indicate to the other scorer the eye condition of the infant (open or closed) by imitating it. The scorers flipped switches to indicate behavioural state, and this was recorded on an Apple IIE computer in the room but out of the baby's sight. For a state change to be scored by the observers, the change had to last a minimum of 3 seconds. 79% of the trials were scored live, and 21% of the trials were scored for state from the videotape, due to computer failure during the actual observation. The time criterion for the length of cry for these infants was measured using a stopwatch. One infant was lost because during the later computer-aided state scoring, the two observers did not agree that the infant had cried for one minute.

After the computer program indicated that the infant had cried for one minute, the parent was asked to pick up the infant and soothe him or her in any way that was generally effective except for feeding, use of a pacifier, or other methods that involve the mouth. When the infant was no longer crying or fussing and a minimum of two minutes

has elapsed since the end of the first trial, the second trial began.

Table 1

State Coding Criteria

1.Quiet Sleep - eyes closed, no movement, no vocalization.

2.Active Sleep - eyes closed, movement, no vocalization.

3.Drowsy - eyes slowly opening and closing, no movement, no vocalization.

4.Quiet Awake - eyes open, no movement, no vocalization.

5.Active Awake - eyes open, movement, vocalization may or may not be present.

6.Fussing - eyes open or closed, movement may or may not be present, vocalizations are intermittent cries and/or whimpers, sounds conform to no distinct temporal pattern, sound separated by periods of silence lasting at least 2 seconds, or shorter than 2 seconds if sounds are of low intensity. Periods of silence can last longer than 3 seconds if the face is still contorted, the baby is taking a breath or hiccupping. The face is in grimace of discontent or pouting but not the cry face.

7.Crying - vocalizations are of high intensity and repetitive. Individual utterances are not separated by silence for more than 3 seconds. Pauses can be longer than 3 seconds if the infant is drawing breath, crying without audible vocalizations, or cry face is visible.

Lying Down Trial: With the videocameras running, the parent was asked to lay the infant in a supine position. The observation procedure was the same as for the seated trial.

Videotapes were scored for frequencies of hand-to-mouth, hand-to-face, and hand-in-mouth contacts. Definitions used by the coders are found in Table 2. Additionally, all hand-to-face and hand-to-mouth behaviours were scored as to whether the mouth was open or closed at the time of touch, and as to whether eyes were open or closed at the time of touch. The scoring for eyes was later dropped when it was calculated that, for the first ten subjects, the eyes were closed for only 21% of behaviours observed in states 4, 5 and 6. The scorers also recorded which hand was used, and in the case of hand-face contacts, the area of the face first contacted. These areas were divided into cheek, perioral, and eyes and forehead regions as in earlier work by Butterworth and Hopkins (1988). The area designations were later dropped from the scoring criteria because only 5% of the behaviours involved a move from one area to another.

Table 2

Scoring Definitions

Hand-any part of the hand below the wrist including the fingers.

Mouth-lips and the area under the nose, up to the corners of the mouth.

Face-the area inside what would be the hairline including the ears, the chin, jaw and neck.

Mouth Open-mouth is open at the time when the hand touches the face or mouth.

Mouth Closed-mouth is closed at the time when the hand touches the face or mouth.

Left or Right-the hand used in the movement is the left or the right.

Region of the Face:

Cheek-any part of either cheek from the chin and jaw up to the temple, including the ears.

Perioral-the mouth, chin, jaw area under the chin, and the area under the nose to the corners of the mouth.

Eyes and Forehead-eye socket, eyebrows, temple area, and forehead.

Criteria for counting frequency of behaviours:

Count one for each occurrence of the behaviour separated from the next by a minimum of 2 seconds from the time the hand loses contact with the surface until the hand re-establishes contact.

Each tape was scored by the principal investigator and by one of five trained scorers, who scored 20, 20, 20, 12 and 8 observations, respectively. Disagreements between the two scorers were further examined by a committee of three people, the principal investigator and two of the other scorers who had each scored 20 observations. The committee reviewed each disagreement and decided upon the behaviour observed. If agreement was still not obtained, the committee voted. Four percent of the decisions were made by voting.

To determine the rates of hand-to-mouth and hand-to-face behaviours, the behaviour totals for each state were divided by the amount of time the infant spent in the state.

To determine the usual amount of infant crying, the parents were asked to fill out a Sleep Record (Appendix A) detailing when the infant was crying or fussing, awake not crying, or sleeping. These activities were recorded for 4 days following each observation session. Parents were verbally asked to record these behaviours on days that would be considered 'normal weekdays' for their family. Appendix B contains the instructions to parents on how to complete the Sleep Record. Validity of the sleep record format has been obtained by Hunziker and Barr (1986). These experimenters correlated the recorded amount of crying on a seven day Sleep Record with actual audio recordings of infant crying. The amount of cry from the Record and from

the audio recordings were correlated positively (r = .89) after one poorly completed record was eliminated. The Sleep Record employed by Hunziker and Barr (1986) differed slightly from the one in the present study. Hunziker and Barr had the diary divided into 5 minute segments, the present diary is divided into 15 minute segments. Hunziker and Barr also included feeding as a separate code, and had a separate section for recording the carrying of the infant. The present Sleep Record did not include these elements and employs only four days of recording; however, in previous research conducted at Simon Fraser University, the four day total from the Sleep Record was found to correlate with the total for seven days (r = .97) (MacWilliam, personal communication)

The parents were asked to fill out a questionnaire covering a wide variety of topics concerning the infant (Appendix C) which was adapted from a questionnaire originally used by Ames, Gavel, Khazaie, & Farrell (1985). 25 out of 50 questions from the original questionnaire were used, and two questions about the use of pacifiers (question numbers 15 and 28) and a question about the responses of the parent to hand-to-mouth behaviour (number 23) were added.

Results

Inter-observer Agreement for State.

Kappa coefficients (Cohen, 1960) for each trial are found in Appendices D and E. The mean Kappa for trial 1 for observers 1 and 2 was .86, and the mean Kappa for trial 1 for observers 1 and 3 was .87.

Treatment of the Data.

Many infants at the beginning of their second trial quickly began to cry. This resulted in very low or non-existent durations for some states for many subjects. For this reason, the second trial of each observation was dropped from analysis. Seven zero durations (from six subjects) in the first trials were replaced by the group mean durations of the particular state.

Occasionally, the infants made a motor movement lasting less than 3 seconds while in state 4, Quiet Awake. This resulted in 15 hand-to-face movements and 17 hand-to-mouth movements being recorded in state 4, a state which is classified by the absence of movement. These 32 movements were, therefore, added to the totals for state 5, Active Awake.

Preliminary Analyses.

No correlations were found between age of mother, age of father, or weight of baby and amount of hand-to-face or hand-to-mouth behaviours. Additionally, no correlation was found between education of parents and the rates of

behaviours. There were also no significant differences in the rates of behaviours between males and females, or between only children and infants with siblings. Finally the hand used in the behaviours did not vary as a function of weeks, state, or position, and there was no overall difference in the frequency of behaviours with the left hand versus behaviours with the right hand.

Analysis of Hand-to-Mouth Behaviour

Mean rates of hand-to-mouth behaviour are found in Table 3. The overall rate of hand-to-mouth touches was 1.01 per minute. The rate of hand-to-mouth behaviour was analyzed in a 2 (sex) by 2 (position) by 2 (weeks) by 3 (state) analysis of variance (ANOVA). No interpretable effects were found for hand-to-mouth behaviour. A significant main effect for position was found, $F(1,36)=11.27$, $P < .001$, indicating that the rate of behaviours was higher in the sitting position but position was also part of a significant interaction among position, state, weeks, and sex, $F(2,72)=4.36$, $p < .05$.

Analysis of Hand-to-Face Behaviour

Hand-to-face behaviour exclusive of the mouth was analyzed separately. The mean rates per minute of hand-to-face (exclusive of mouth) behaviour for each state and position are found in Table 4. The mean rate of hand-to-face behaviours was 1.97 touches per minute.

Hypotheses 1a and 1b were not supported by the results obtained. Behaviour rates for hand to face touches

(excluding the mouth) were analyzed in a 2 (sex) by 2 (position) by 2 (weeks) by 3 (state) analysis of variance (ANOVA). The three states used in the analysis were states 5, active awake, 6, fussing, and 7, crying. A significant main effect was found for weeks, $F(1,36)=5.53$, $p<.05$, indicating that the rate of hand-to-face touches decreased from 5 weeks to 9 weeks, contrary to hypothesis 3. Another significant main effect was found for state, $F(2,72)=3.86$, $p<.05$, however, state was found to interact with position, $F(2,72)=4,48$, $p<.05$. Figure 1 shows the interaction of these two variables. Planned pairwise comparisons indicated that in the sitting position there was a significant difference in behaviour rate between state 6 and 7, with the rate being higher in fussing,. This finding partially supports Hypothesis 1 but no significant difference was found between fussing and state 5, active awake. Both square root and cube root transformations were applied to the data but they did not reveal significant differences between the states.

Table 3

Mean Rates Per Minute of Hand-to-Mouth Touches.

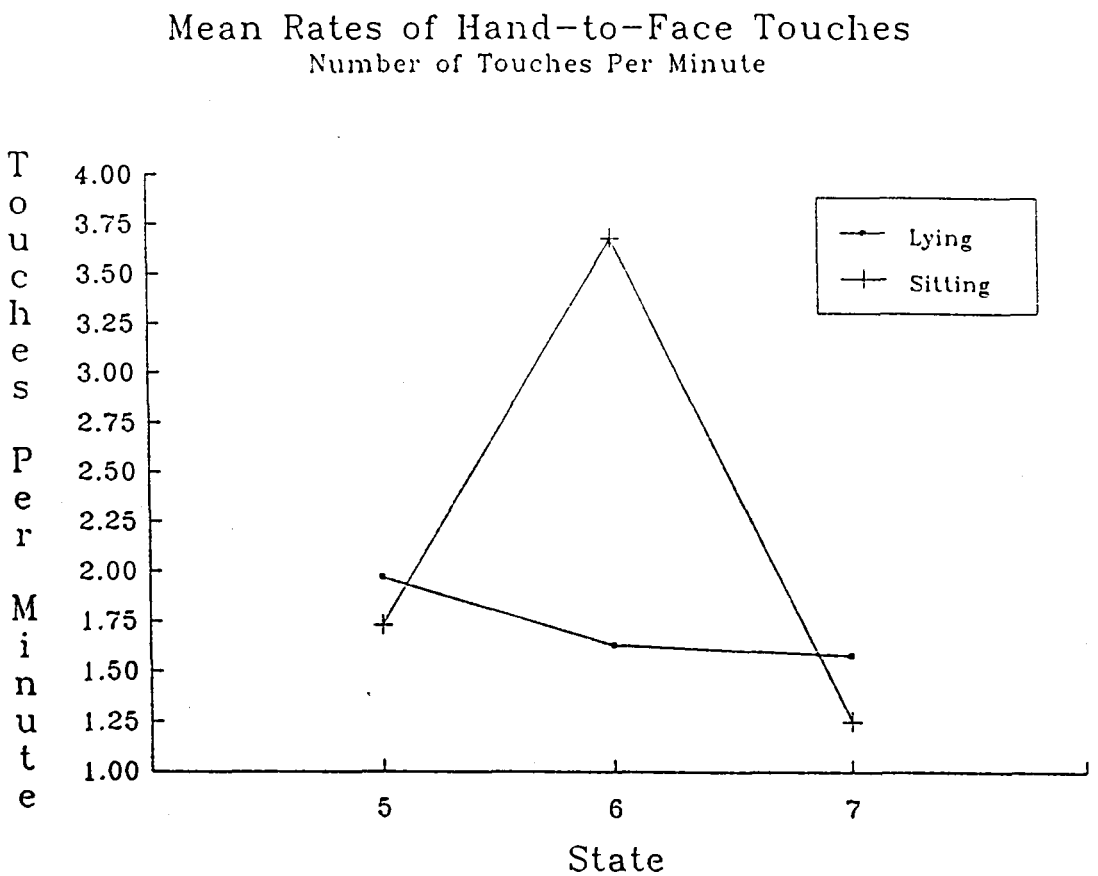
	Sitting Position		Lying Position	
	Week 5	Week 9	Week 5	Week 9
States				
5	1.85	1.03	.96	.61
6	2.24	3.08	.66	.46
7	2.08	.57	.62	.30

Table 4

Mean Rates Per Minute of Hand-to-Face Touches.

	Sitting Position		Lying Position	
	Week 5	Week 9	Week 5	Week 9
States				
5	2.54	.92	1.92	2.03
6	4.96	2.34	2.06	1.20
7	2.00	.50	2.01	1.16

Figure 1


Mean Rates of Hand-to-Face Touches
Number of Touches Per Minute
Touches Per Minute
4.00
3.75
3.50
3.25
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
5
6
7
State
Lying
Sitting

Relationship of Hand-to-Face and Mouth Behaviour to Cry at Home

The results did not support hypothesis 4, indicating that there was no relationship between crying in the home and rates of behaviour in the laboratory. No correlation was found between the rate of behaviours overall and amount of crying at home, or between the rate of behaviours in state 6 (fussing) and crying at home. In light of Barr's (1991) finding that evening cry is a more reliable and consistent measure of amount of infant crying than an average taken over an entire 24 hour period, the correlations were repeated using evening (5 p.m. to midnight) crying. No significant correlations were obtained between rates of behaviour and evening cry.

Relationship Between Observed Fussing and Cry at Home

Additionally, no correlation was found between amount of fuss observed in the laboratory and amount of crying at home (hypothesis 5), or between observed amount of fuss and evening cry in the home. An additional set of correlations was performed using the latency to cry at each observation time. Correlation coefficients are shown in Table 5. Only four of the correlations were significant at the .05 level, and after correcting for the multiplicity of tests, none remained significant.

Table 5

Correlations of Latency to Cry

With Hand-to-Mouth and Hand-to-Face Behaviour

	Latency To Cry	
Behaviour	5 Weeks	9 Weeks
5 Weeks HF	-.35 *	-.11
9 Weeks HF	.21	-.03
5 Weeks HM	.12	.02
9 Weeks HM	-.27	.34 *
5 Weeks HF6	-.32 *	-.13
9 Weeks HF6	.03	.13
5 Weeks HM6	-.37 *	-.25
9 Weeks HM6	-.13	-.18

* significant at .05 level.

HF=Hand-to-Face HM=Hand-to-Mouth 6=behaviour during fussing.

Analysis of Mouth Open versus Mouth Closed During Touches

The results did, however, support hypothesis 3. It was found that the mouth was more likely to be open when the hand touched the mouth than when the hand touched elsewhere on the face (Table 6). At 5 weeks, the mouth was open for 80% of touches to the mouth and for 66% of touches to the face. At nine weeks this pattern was repeated, with 76% of touches to the mouth occurring with the mouth open, and 64% of touches to the face occurring with the mouth open.

Chi square analyses (the most appropriate test available) indicated that the differences between the proportions were significant X^2 (1, 40)=26.910 , p <.001 for 5 weeks and X^2 (1, 40)=17.468, p <.001 for 9 weeks.

Table 6

Totals for Mouth Open and Mouth Closed During Hand-to-Mouth and Hand-to-Face Touches.

5 Weeks

	Mouth Open	Mouth Closed
Hand-to-face	622	323
Hand-to-mouth	311	77

$X^2 = 26.2, p < .001.$

9 Weeks

	Mouth Open	Mouth Closed
Hand-to-face	419	236
Hand-to-mouth	321	101

$X^2 = 17.5, p < .001.$

Discussion

There was no correlation found between the amount of fuss observed in the laboratory and recorded crying at home. Previous research has found a relationship between these two variables (Elliott, Fisher & Ames, 1988). However, in Elliott et al the fuss measure was the amount of fussing before the infant's first cry, whereas in the present study, the fuss measure was the amount of fussing in total before the infant cried continuously for a minute. In an effort to resolve the differences between the two studies, the fuss measure in the present study was changed to reflect the amount of fuss prior to the first incidence of crying, as in the Elliot et al study, but again the results failed to show a relationship between amount of observed fussing and crying recorded in the home. In the Elliott et al study, however, the comparison was between normal criers and excessive criers. The excessive criers had significantly less fussing prior to continuous crying than the normal criers. The present study was not concerned with excessive criers, so perhaps there is no relationship between length of fuss interval and amount of cry for normal criers, and it is only when infants from the extreme population are included in the analysis that a relationship to fussing interval is found.

Contrary to expectation, the overall rate of hand-to-face behaviour and hand-to-mouth behavior decreased from 5

to 9 weeks. It was expected that infants would increase their rate of hand-to-mouth behaviour as they began to learn to use this behaviour to soothe themselves. There may be several reasons why this increase was not observed. First, neonatal posture encourages the touching of the hand to the face and mouth because of the proximity of one of the hands to the ipsilateral side of the face (Adelson & Fraiberg, 1972). Additionally, some researchers have found that neonatal movements are more constricted, with the limbs moving in actions close to the body (Hopkins, Lems, Janssen, & Butterworth, 1987) This constriction of movements, combined with the usual posture of neonates, may have still been influencing the infants in the present study at 5 weeks of age, but may have lessened by 9 weeks, thus producing a decrease in the rate of behaviours as the hand became less likely to touch the facial area. A final reason why this decrease may have been observed is that it may be that the behaviour is not used by the infant to soothe itself so there is no reason for an increase to occur.

There was little evidence in the present results to indicate that infants use hand-to-mouth and hand-to-face behavior to soothe themselves. Although the means were in the expected direction for the sitting condition, only the difference between fussing and crying was significant, with the infants having a higher rate of hand-to-face behaviour in fussing. No significant difference was found, however, between active awake and fussing. Furthermore, no state

differences were found for hand-to-mouth behaviour. Finally, no relationship was found between rates of behaviour and crying in the home, indicating that infants with high rates of hand-to-face and hand-to-mouth behaviour were not using the behaviour to reduce the amount of their crying. These findings support that of Fogel, (1985) who found no evidence of a link to soothing until 6-7 months of age, and Butterworth and Hopkins (1988) who found no state differences in hand-to-mouth behaviour. It must be considered, however, that there was high variation in the individual rates of behaviour from infant to infant in the present study, (also found by Hendry & Kessen, 1964; Kessen, Williams & Williams, 1961; Korner & Kraemer, 1972) and these high standard deviations may have obscured state differences between active awake and fussing. The lack of state differences in hand-to-mouth behaviour may have been due to the fact that the infants were not yet adept at putting their hands to their mouths, and with time perhaps state differences would emerge, as the mean rates for hand-to-mouth behaviour were in the expected direction. Finally, crying is a behaviour mediated by many variables, and at approximately 6 to 8 weeks of age there tends to be an increase in the amount of crying (Lester, 1985) thought to be the result of a major reorganization of the central nervous system. This could possibly negate any effect of the use of hand-to-mouth behaviour for soothing in the age range of the present study.

Another consideration is that the behaviour itself may be in a period of fluctuation. In Dynamic Systems Theory, it is proposed that when behaviours are developing, there will be points at which the behaviour will be highly variable (Thelen, 1990). Behaviour will be variable when the control parameters are experiencing scalar changes or the control parameter itself is changing, and the behaviour is shifting from one attractor state to another. It may be that in the present study the variability of hand-to-mouth and hand-to-face behaviour is the result of such a fluctuation. To examine this possibility, several empirical techniques could be used in future. First, behaviours that are unstable will be affected to a greater degree than will behaviours in a stable attractor state. Therefore, one could introduce perturbations in the behaviour and observe the sensitivity of the behaviours to such interventions, as suggested by Thelen (1990). Second, areas of increased variability can be examined, because in an unstable system, the "noise" in the system will prod the underlying behaviour into a variety of forms. Finally, possible control parameters could be examined to determine if they too are undergoing change.

One control parameter may have been discovered in the present study. The results indicated that the state difference that did occur happened only in the sitting position. The rates of behaviour in the two positions were comparable, but it may be that in the lying position the

hand was more likely to touch the face fortuitously because of posture (hand of bent arm touching ipsilateral side of face, Adelson & Fraiberg, 1972) so that the touches would be more random across states, but in the sitting position the hand would be more likely to touch the face only when the infant engaged in a hand-to-face action. It would seem that in this study, position may have been acting as a control parameter for the state-related expression of hand-to-face behaviour.

Although there was only weak evidence of state differences in hand-to-face and hand-to-mouth behaviour, the results do indicate that hand-to-mouth behavior does represent a coordinative structure in infancy. The mouth was more likely to be open when the hand touched the mouth than when it touched elsewhere on the face, indicating that the mouth and hand function as a coordinated unit. This finding supports that of Butterworth and Hopkins, (1988) who found that the mouth was more likely to be open than closed when the hand touched the mouth. Butterworth and Hopkins, however, did not compare the hand-to-mouth touches with touches to other areas of the face. It may be that the mouth remains open a great deal of the time, so there would be a high probability that the mouth would be open when the hand touched it. The results of the present study indicate that this is not the case: the mouth was more likely to be open when the hand touched the mouth than when the hand touched elsewhere on the face. Other researchers have also

found evidence that hand-to-mouth behaviour operates as a coordinative structure (Fogel, 1985; Fogel & Thelen, 1987; Kessen, Williams & Williams, 1961; Korner & Kraemer, 1972; Rochat, Blass & Hoffmeyer, 1988).

What is the purpose of this coordinative structure? It may be used for self-soothing, and although others have supported this idea (Fogel, 1985; Fogel & Thelen, 1987; Wolff, 1959; 1987), the present study found only weak evidence for this view. Others (Rochat, Blass, & Hoffmeyer, 1988) think that the coordinative structure is for the purpose of self-feeding, even though some researchers have found no differences due to hunger (Feldman & Brody, 1978; Hendry & Kessen, 1964; Kessen, Williams & Williams, 1961; Korner, Chuck & Dontchos, 1968). Other views propose that the behaviour is one of the first primary circular reactions (Piaget, 1966), or that the behaviour serves to bring the hands to midline to facilitate exploratory behaviour of objects at a later age (Adelson & Fraiberg, 1972), and still others feel that the behaviour is linked to attention and looking behaviour (Korner & Beason, 1972)

Fogel (1985) has proposed that coordinative structures exist without a set function, but rather that these groupings of muscles are exploited by the organism for whichever need is prominent in the environment at the time. Fogel defines development as the reorganization of the structure and function of subsystems of behaviour, mediated

by the changes in the biogenetic organism and the demands of the environment. Coordinative structures represent subsystems of motor development that allow for both stability and change (Fogel & Thelen, 1987). Stability comes from the overall tendency of the behaviour to remain stable in spite of minor changes in the environment or organism. For example, the actions of the muscles in the stepping reflex remain very similar when the infant is lying down and kicking instead of being held upright. Coordinative structures allow for change when the elements controlling the behaviour change. One example is again the stepping reflex. This reflex seems to disappear because the control parameter of the ratio of muscle to overall leg mass has changed. Future research is needed to determine the control parameters for the coordinative structures of infant behaviour at any one point in time.

Future research may attempt to determine the control parameters of the use of hand-to-mouth behaviour as a self-soothing mechanism. Micro-analyses of infant behaviour such as Fogel's (1985) study of two infants could be replicated with a larger number of subjects, as is currently underway (Holtz, personal communication April, 1991). Additionally, the present study could be replicated with larger numbers of subjects to minimize the variance of the mean.

When examining a behaviour with high rates of individual variation, Thelen's (1990) comments concerning empirical focus need to be considered. Working within the

framework of Dynamic Systems Theory, Thelen suggests that it is not the collective variable that will tell the story of development, rather it is the noise in the system, i.e., the intra- and inter-individual variation. If this is so, then a case study approach is suggested, much like Fogel's work, but with the focus shifted from the similarities of behaviours and repeating patterns, to the examination of individual "bumps" in the developmental pathway.

One other consideration is that perhaps hand-to-mouth behaviour is a self-soothing mechanism but it is not mediated by state as currently measured. It may be that hand-to-mouth behaviour is useful at a lower level of arousal than during fussing and crying. If the infant's distress is such that fussing and crying is warranted, it would likely need assistance from the caretaker. It would, therefore, not be evolutionarily adaptive for the infant to be able to self-soothe at this point. Rather, self-soothing would perhaps be more effective at a lower level of arousal. Infants do need to learn to lower their arousal level, and sucking is an effective mechanism. Why, then, would hand-to-mouth behaviour not be a useful way to engage sucking behaviour? In order to determine if hand-to-mouth behaviour is used to soothe at lower levels of arousal than fussing and crying, researchers would have to measure arousal level more exactly than with a state scale and correlate this measure with the behaviour. Unfortunately, arousal is a

nebulous concept, whose operational definition has never been adequately determined.

In conclusion, it would seem that hand-to-mouth behaviour is readily observable in infants at a young age, and seems to represent an early coordinative structure. The purpose of this coordinative structure, however, remains to be determined.

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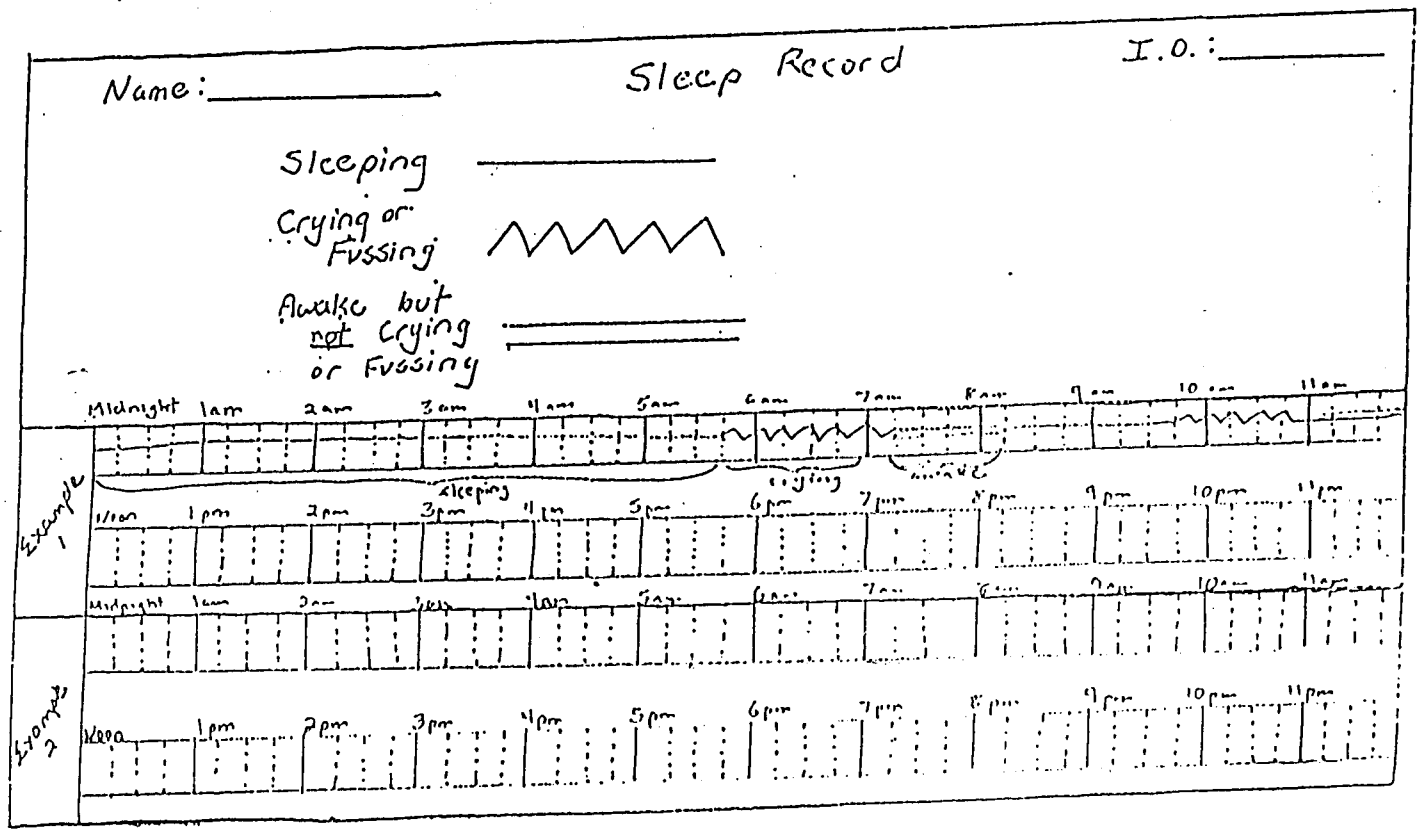
Name:
Sleep Record
I.O.:
Sleeping
Crying or Fussing
Awake but not crying or Fussing
Midnight 1am 2am 3am 4am 5am 6am 7am 8am 9am 10am 11am
Example 1
11am 1pm 2pm 3pm 4pm 5pm 6pm 7pm 8pm 9pm 10pm 11pm
Example 2
Midnight 1am 2am 3am 4am 5am 6am 7am 8am 9am 10am 11am
Noon 1pm 2pm 3pm 4pm 5pm 6pm 7pm 8pm 9pm 10pm 11pm

Appendix B

SLEEP RECORD INSTRUCTIONS-1

Please complete this sleep record for your baby on the first four weekdays following your visit to the University (for example, if you are here on a Wednesday, you would fill out the record from midnight Wednesday night until midnight Friday night, and then from midnight Sunday night until midnight Tuesday night).

Try to fill in the record as the day goes along - it may help to keep it in a handy place such as the kitchen counter.

Please return the completed sleep record and your questionnaire in the envelope provided. I will be in touch with you in the near future concerning your next visit to the University. If you have any questions, please feel free to call me, (Susan Thompson) at the Psychology department, 291-3354. Thank you for participating in the study.

Appendix B

SLEEP RECORD INSTRUCTIONS-2

Please complete this sleep record for your baby on the first four weekdays following your visit to the University (for example, if you are here on a Wednesday, you would fill out the record from midnight Wednesday night until midnight Friday, and then from midnight Sunday night until midnight Tuesday night).

Try to fill in the record as the day goes along - it may help to keep it in a handy place such as the kitchen counter.

Please return the completed sleep record in the envelope provided. Thank you for your valuable assistance in this project. When the study is completed we will provide you with the group results. If you have any questions please feel free to contact either myself (Susan Thompson, 291-3354) or Dr. Elinor W. Ames, 291-3362.

Appendix C

Name:_____

1. Baby's sex: ___Boy ___Girl

2. Baby's birthdate:_____

3. Baby's birthweight:_____gm or_____lb_____oz

4. Was the pregnancy normal? ___Yes ___No

If there were any problems during the pregnancy, what were they?

_____

_____

5. During the mother's pregnancy, how many cigarettes did she smoke?

_____ none

_____less than 1 per day

_____1-2 per day

_____3-5 per day

_____6-12 per day

_____13-20 per day

_____more than 20 per day

6. During the mother's pregnancy, how much cola, coffee and tea did she drink? (Do not include herbal teas or decaffeinated coffee.)

_____none

_____1-3 cups per month

_____1-6 cups per week

_____1-2 cups per day

_____3-5 cups per day

_____more than 5 cups per day

7. Was your baby's activity level before birth:

____less than average ____average ____more than average

8. Delivery was: (Check as many as apply)

_____vaginal

_____caesarean section

_____with problems. What problems?

9. Has the baby had any illness(es)? ___Yes ___No

10. While awake, how much of the time does your baby move his/her arms and legs?

_____almost all the time

_____most of the time

_____some of the time

_____very little of the time

11. Do you believe that babies should be picked up when they cry?

_____always

_____sometimes (When?_____)

_____seldom

12. During the day, if you think that the baby is going to start crying, what do you usually do?

___ do something to try to prevent the crying before it starts

___ wait for the crying to begin, and then attempt to soothe the baby immediately

___let the baby cry for a while before trying to soothe him/her

13. Overall, when your baby cries, what proportion of the time are you able to stop his/her crying with your soothing techniques?

____% of the time

14. Approximately how many times per day does your baby cry?

_____less than 5 times per day

_____between 5 and 9 times per day

_____between 10 and 15 times per day

_____more than 15 times per day

15. Please indicate the soothing techniques that you have used to try to stop your baby from crying when you knew he/she was not hungry.

	HAVE YOU DONE THIS?		HOW EFFECTIVE WAS THIS?			WHAT DID THE BABY DO?				
	Yes	No	Very	Somewhat	Not at all	Slept	Stopped crying	Cried/ Fussed but less	No change	Other - Specify
Talked to the baby	Y	N	V	S	N	SLEEP	STOP	LESS	NO	
Rocked the baby	Y	N	V	S	N	SLEEP	STOP	LESS	NO	
Walked the baby	Y	N	V	S	N	SLEEP	STOP	LESS	NO	
Sung to the baby	Y	N	V	S	N	SLEEP	STOP	LESS	NO	
Played music or other sounds	Y	N	V	S	N	SLEEP	STOP	LESS	NO	
Given the baby a pacifier	Y	N	V	S	N	SLEEP	STOP	LESS	NO	
Fed the baby	Y	N	V	S	N	SLEEP	STOP	LESS	NO	
Given the baby a heating pad or hot water bottle	Y	N	V	S	N	SLEEP	STOP	LESS	NO	
Patted the baby's back	Y	N	V	S	N	SLEEP	STOP	LESS	NO	
Changed the baby's position	Y	N	V	S	N	SLEEP	STOP	LESS	NO	
Wrapped the baby in a blanket	Y	N	V	S	N	SLEEP	STOP	LESS	NO	
Bathed the baby	Y	N	V	S	N	SLEEP	STOP	LESS	NO	
Taken the baby for a car ride	Y	N	V	S	N	SLEEP	STOP	LESS	NO	
Walked the baby in a buggy or stroller	Y	N	V	S	N	SLEEP	STOP	LESS	NO	
Placed the baby by or on a machine	Y	N	V	S	N	SLEEP	STOP	LESS	NO	
Given the baby medicine (What?_____)	Y	N	V	S	N	SLEEP	STOP	LESS	NO	
Other(Specify_____ _____)	Y	N	V	S	N	SLEEP	STOP	LESS	NO	

16. How long does the single longest crying episode last each day? (Do not count periods when baby is fussing but never actually cries)

_____less than 2 minutes

_____2 to 5 minutes

_____5 to 10 minutes

_____10 to 30 minutes

_____longer than 30 minutes

During this single longest crying period, do you try to stop the baby's crying?

_____always

_____sometimes

_____seldom or never

17. How long does an average crying episode last?

_____less than 2 minutes

_____2 to 5 minutes

_____5 to 10 minutes

_____10 to 30 minutes

_____longer than 30 minutes

18. When the baby starts to cry, does the crying usually

_____start suddenly?

_____start with fussing, and build up to crying?

19. What is the total amount of time your baby spends crying each day?

_____1 hour or less

_____more than one hour, but not more than 3 hours

_____more than 3 hours, but not more than 5 hours

_____more than 5 hours

22. During the mother's pregnancy, on the average how much

beer, wine or other alcoholic beverages did she drink?

_____none

_____less than 1 drink per week

_____1 drink per week

_____2 drinks per week

_____3 drinks per week

_____4 drinks per week

_____5 or more drinks per week

23. If you were to see your baby's hand or fingers in his/her mouth would you take them out?

___yes

___no

24. How many years of education has the baby's mother completed? (Starting at Grade One, count the number of years of formal education completed, including elementary, secondary, and post-secondary education - e.g., college, university, technical school, apprentice training.)

___years

25. How many years of education has the baby's father completed? (Count as in the previous question)

___years

26. How old is the baby's mother? ____

27. How old is the baby's father? ____

28. Some people feel that pacifiers (soothers, dummies) are a useful way to soothe an infant. Do you agree?

___yes

___no

THANK YOU for your help in our research on crying. If you would like to find out what we learn from these questionnaires, please fill in the information below, and we will send you a copy of our results when they are ready.

Baby's name _____

Parent's names _____

Address _____

Are you interested in participating in any future research on children? If so, please indicate below. Your signature indicates only that you are willing to be contacted in the future, it does not indicate your willingness to take part. At the time we contact you, we would explain the particular research project, and then you could decide whether or not you or your children wish to participate in it.

I would be interested in being invited to participate in future research projects on children or parenting.

_____ _____

signature phone #

Again, THANK YOU VERY MUCH for helping us to learn more about children.

Appendix D

Kappa Coefficients for Observers 1 and 2.

	5 Weeks		9 Weeks	
	Trial 1	Trial 2	Trial 1	Trial 2
AS	---	---	.92	.88
AW	.90	.00	---	---
BM	.76	.88	.95	.95
BS	.85	.86	---	---
CA	.83	.06	---	---
CM	.88	.87	---	---
CY	---	---	.88	.90
EB	.91	.71	.76	.85
GW	---	---	.94	*
HW	.82	.82	---	---
JB	.85	.61	.94	.98
JR	.89	.90	---	---
KB	.92	.85	.95	.77
KS	.93	.97	.99	.84
LK	---	---	.95	.89
MK	---	---	.81	.81
MS	.74	.97	.94	.95
MV	.73	.86	.81	.94
RB	.84	.88	---	---
SB	.83	.97	---	---
SF	---	---	.93	.91
SP	.62	.85	---	---
TH	.85	.88	.84	.89
ZD	---	---	.70	.85
Means	.83	.76	.89	.87

*unavailable due to equipment failure.

Kappa Coefficients for Observers 1 and 3.

	5 Weeks		9 Weeks	
	Trial 1	Trial 2	Trial 1	Trial 2
AS	.91	.83	---	---
AT	.95	.53	.96	.95
AW	---	---	.98	.94
BB	.77	.92	.80	.91
BF	.71	.69	.96	.95
BS	---	---	.92	.94
BT	.72	.88	.85	.89
CA	---	---	.75	.90
CM	---	---	.84	.76
CY	.86	.79	---	---
DC	.87	.90	.84	.82
DP	.74	.94	.86	.94
GW	.79	.89	---	---
HW	---	---	.88	.69
JH	.72	.93	.89	.95
JI	.97	.00	.94	.93
JR	---	---	.79	.98
KO	.86	.90	.88	.73
KT	.94	.91	.85	.95
LK	.92	.79	---	---
MH	.88	.76	.95	.76
MK	.83	.84	---	---
MM	.79	.92	.90	.79
NM	.97	.82	.96	.98
RB	---	---	.88	.92
SC	.95	.42	.91	.49
SB	---	---	.98	.17
SD	.60	.95	.91	.86
SF	.72	.75	---	---
SJ	.94	.9 3	.93	.93
SP	---	---	.91	.88
ZD	.88	.86	---	---
Means	.84	.79	.89	.84