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Manipulations of Maternal Touch During Mother-Infant Interactions: Effects on Five and a Half-Month-Old Infants' Affect and Attention

Diane E. LePage

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ABSTRACT

Manipulations of Maternal Touch
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Infants' Affect and Attention

Diane LePage
Concordia University, 1992

Infant social development has often been studied in the context of face-to-face interactions between mothers and infants. This research has focused on vocal and facial expressions used by mothers with their infants, however, little analysis has been extended to the role of touch. The communicative and reciprocal nature of touch during mother-infant face-to-face interactions was assessed using a series of still-face (SF) with touch situations. The experimental group consisted of mothers and their 5 1/2-month-old infants who participated in one Normal period and three SF periods in which mothers were; (1) allowed to touch their infants (SF+T), (2) asked to get the most smiling from their infants using only touch (SF+TS), and (3) asked to touch their infants only in one area of the body (SF+T1). A control group participated in four Normal periods. Nonsequential analyses revealed a shift in infant gaze from their mothers' faces in the Normal periods to their hands in the SF periods, and the same amount of smiling occurred in the SF+TS period for the experimental relative to control infants. Sequential analyses revealed that infants tended to be gazing at their mothers' hands before they smiled, and their gaze shifted to their mothers'

faces once infants had smiled. These findings indicate that maternal touch may be an effective mode of communication and may reflect reciprocity between mother and infant. Implications for the relevance of touch in the socio-emotional development of normal and at risk infants are suggested.

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The newborn's world is a confusing combination of sight, sound, touch and movement, and making sense of it all is a difficult task for such a young organism. In the past, infants were often considered incapable of understanding and demonstrating social responses until they were at least 2 years of age. Recently, however, researchers have begun to discover that the infant does experience the world socially, and the more interesting question has become one of describing the infant's social world. It now seems likely that young infants quickly learn to identify the various types of stimulation around them, and are soon able to socially regulate the amount of that stimulation to their own level of comfort.

Through interactions with others, primarily their parents, infants develop the skills they require to affect their social environment in more complex and varying ways. Initially, these skills are limited, but effective. For example, the newborn communicates with cries and smiles, although these are directed towards any adult within range. By 2 to 3 montns of age, however, infants are discriminating between people, and by 7 months of age they understand and observe the rules of reciprocity in their social interactions with adults. At this point, more intentional social behaviour is possible, as infants are learning how to crawl, and can initiate or terminate interactions with others with greater ease (Lamb & Bornstein, 1987).

The general trends of the human infant's social development are therefore known, however, some of the specific components of these developmental processes are still missing from our knowledge. Adult-infant social interactions are considered necessary for normal socio-emotional development to occur, but it is often the more salient features of these interactions, namely the adults' facial and vocal expressions, which are emphasized in the subsequent manipulations and examinations. Although most researchers would agree that tactile stimulation does play a role in social interactions with infants, its importance and relevance in the communication between adults and infants has not been extensively studied. To obtain a more complete understanding of the infant's socio-emotional development, adult tactile stimulation during adult-infant social interactions requires isolation from the visual and vocal components. The present study was designed to isolate the tactile modality in mother-infant face-to-face interactions and to examine its role in the socio-emotional development of the infant.

Given the diversity of the relevant literature which is required to delineate the research in infant social development, the literature review is divided into four subdivisions. A brief description of the infant's perceptual and cognitive capabilities will first be discussed. The importance of understanding these abilities

will be highlighted so that inferences can be drawn from the responses of infants in these situations to more social situations. Second, the infant's early social interactions, and the influence of the face-to-face and still-face procedures in examining the infant's social development will be developed. Third, the importance of touch and its significance in the young infant's social and emotional development will be emphasized. Finally, a general description and the specific hypotheses of the present study will follow. Throughout this review, the intent is to provide a thorough understanding of the infant's social and emotional development while clearly outlining the importance of touch in both face-to-face interaction and early socio-emotional development.

The Importance of Perceptual-Cognitive Abilities to the Social World

In order to adequately study the quality of human infant social interaction, it is important to first demonstrate that the infant is capable of cognitive perceptions of, and reactions to, social stimuli. Early work in this area focused on documenting the fact that the human face elicits smiling from the infant and explaining the possible mechanisms for this ability (e.g., Bowlby, 1969). This smiling, however, was thought to be a purely reflexive, socio-emotional response, encouraging contact and nursing (e.g., Ainsworth, 1967, as cited in Zelazo, 1972;

Bowlby, 1969; also see Murray & Trevarthen, 1985). Voluntary smiling has been thought to occur by 4- to 6-weeks of age, to a wide variety of stimuli which are gradually limited to more social contexts (Lamb & Bornstein, 1987). Work on the development of infant smiling has found that 12- to 16-week-old infants will smile predictably to nonsocial stimuli, both visual and auditory, in the same way they do to social stimuli (Zelazo, 1972; Zelazo & Komer, 1971). This suggests that infant smiling is indicative of more than a reflexive response to encourage contact; smiling in infants can indicate perceptual and cognitive awareness of their environment. In his study, Zelazo (1972) observed vocalizing as well as smiling to nonsocial stimuli in 9 1/2- and 11 1/2-month-old infants, again suggesting that infants do not require social reinforcement in order for them to respond to stimuli. Thus, the infant's smiles and vocalizations are not "innate" reflexes performed purely for the purpose of survival; but rather, they contain cognitive elements, suggesting that by at least 12 weeks of age the infant is actually perceiving the stimuli, and reacting on that perception (Zelazo, 1972; Zelazo & Komer, 1971).

To further the argument that infant smiling can reflect both cognitive and social capabilities, evidence derived from studies of infants' reactions to the human face is relevant. This evidence suggests that infants are able to discriminate the expressions on adults' faces at a young

age. For example, Caron, Caron, and MacLean (1988) assessed discrimination in infants as young as 4 to 5 months of age. Their results suggest that infants are capable of discriminating between facial expressions as early as 5 months, but that they seem to rely more on vocal cues than facial cues. It was suggested that as they age and their visual systems mature, infants begin to rely more on their vision in discriminating facial expressions (Caron et al., 1988). Indeed, it appears that at 5 months infants are able to discriminate facial expressions only through the combination of vocal and facial cues, whereas at 6 months they are able to respond to vocal emotional expressions alone, and at 7 months facial cues alone are sufficient to stimulate appropriate behavioural or emotional expressions (Campos, Barrett, Lamb, Goldsmith, & Stenberg, 1983).

Caron et al. (1988) further established that 4-month-old infants are able to differentiate between at least three different facial expressions (happy, sad and angry), especially if presented with accompanying vocal cues. This discrimination could be a step towards understanding what the different expressions mean. In fact, by 7 months, infants are reliably producing anger expressions to frustrating stimuli (Stenberg, Campos, & Emde, 1983), are beginning to reproduce the expressions seen on the adult faces they have encountered, and are reproducing these expressions in similar contexts. Therefore, it appears that

the smile of the young infant can reflect both cognitive and social processes, and that, at least by 4 months of age, the infant is exhibiting cognitive awareness of stimuli, and producing smiles in reaction to this awareness. The smile of the infant can therefore be used as a measure of cognitive appreciation of, for example, a change in stimuli, as well as an index of social enjoyment of a situation. The infant's smile can be a valuable tool in the inference and exploration of both the cognitive and social worlds of the infant. Indeed, the smile of the infant, along with infant gaze, is often used in examining the social world of infants, particularly in the context of adult-infant interactions.

Early Social Interaction

In studying infant social interactions, many paradigms and procedures have been used. The face-to-face paradigm is a popular one, frequently represented in the literature (e.g., Field, 1977; Kaye & Fogel, 1980). Here, the adult and infant are seated at eye-level to each other during a series of brief interaction periods. The popularity of this paradigm may in part be due to the fact that face-to-face games among infants and adults are common in many Western countries, and it is during these interactions that young infants begin to learn and clarify the rules of social interaction (Lamb & Bornstein, 1987; Tronick, Als, Adamson, Wise, & Brazelton, 1978). In a sense, the face-to-face

interaction between parents and their infants can be labelled a researcher's "window into the social abilities of the infants", as it can aid the researcher in observing and measuring the communication that occurs between the infants and their parents.

The use of the face-to-face procedure in recent research has provided evidence to document three important components of mother-infant interactions, among others; the overall responsiveness of both the infant and the mother during face-to-face interactions in the laboratory, the differential patterns of gazing in infants, and the effectiveness of instructions on mothers' behaviour and subsequent infant responses (e.g., Kaye & Fogel, 1980; Field, 1977; Sifter & Moyer, 1991; Symons & Moran, 1987). For example, Kaye and Fogel (1980) studied face-to-face communication between mother and infant, and they found that mothers were able to elicit greetings from their infants beginning as early as 6 weeks. In this study, the duration of infant attention differed as the mothers' facial expressions changed, and as infants aged, mothers used different strategies to obtain their attention. For the 6- and 13-week-old infants, mothers were more likely to use touching and bouncing to gain their infants' attention, whereas when the infants were 26-weeks-old, mothers waited until their infants were attentive, and then they used facial and vocal expressions to maintain their attention.

However, when the mothers' facial expressions were inviting an interaction with their infants, regardless of age, infants would spend more time looking at them than they would when their mothers' expressions did not invite their responses (Kaye & Fogel, 1980). These findings suggest that the infants were aware of the intention of their mothers' facial expressions, once their attention was gained, and this awareness was reflected in their appropriate greeting responses. As well, mothers apparently relied on tactile stimulation more with their younger infants than their older ones, especially when attempting to obtain their attention, indicating that mothers use different strategies in their interactions with their infants, as their infants age.

Field (1977) studied both the amount and type of gazing exhibited by both preterm and term infants at 3 1/2-months of age during face-to-face interactions with their mothers. Mothers were asked to either elicit and maintain their infant's attention, or to simply imitate the infant. No differences were found between the preterm and term infants in their patterns of gaze, however there were differences in amount of infant gaze during the various experimental manipulations of the study. During the attention-getting condition, the mothers were more active, yet infant gaze directed toward the mothers was decreased. During the imitation condition, however, the mothers were less active, and the infants' gaze at their mothers was increased (Field,

1977). Therefore, the infants' patterns of gaze shifted differentially, depending on their mothers' behaviours during the conditions. It was suggested that the infants averted their gaze during the attention-getting condition because of the increase in their mothers' activity, which may have presented the infant with too much information. During the imitation condition, however, there was a decrease in maternal activity, thus the infants needed less time to process the incoming information, and their gaze duration may have consequently increased (Field, 1977).

In a subsequent replication of Field's (1977) study, Symons and Moran (1987) found that both mothers and their 13- to 16-week-old infants displayed active involvement and were responsive to changes in each other's behaviour in the face-to-face interaction. Contrary to Field (1977), mothers successfully maintained their infants' attention when they were instructed to do so, even though they seemed to be less responsive to their infants during this condition. Thus, when given the instructions, mothers appeared to use specific strategies with their infants, and a change in their infants' behaviours subsequently occurred. Also contrary to Field, during the imitation condition there was less positive affect in the infants, and the mothers reported that there was less communication than during the spontaneous play or the attention-getting periods (Symons & Moran, 1987). Symons and Moran suggest that the

discrepancies between their study and Field's may have resulted from methodological differences, and also because the use of gaze as an indication of the infants' involvement during interactions may not be sufficient. They recommend that more than just a single behaviour be used as an indicator when studying early mother-infant interactions to ensure that the activities of both mother and infant are accurately assessed during those interactions (Symons & Moran, 1987).

Indications that both the mother and the infant play a role in their face-to-face interactions with each other has also been evidenced by other researchers. For instance, Rutter and Durkin (1987) found that by 18 months of age infants are beginning to show an adult pattern of signalling through the coordination of their vocalizations and gaze. This pattern is somewhat present in the younger infant as well, and appears to be gradually developing so that it is fairly mature in the 18-month-old infant. Indeed, Tronick and Cohn (1989) evaluated the degree to which mothers and infants coordinate their behaviour during face-to-face interactions, and they found that coordination, as measured by social matching and synchrony, increases with age, and is especially prevalent by 6 months. However, it appears that the infant younger than 6 months is still capable of actively participating in social interactions. For instance, by 5 months, infants are using shifts in their

gaze to regulate their affect during interactions with their mothers (Sifter & Moyer, 1991). In their study, Sifter and Moyer (1991) found that when the positive affect level of their 5-month-old infants was highly intense, as measured by the intensity of their smiles, they were more likely to engage in more frequent and longer bouts of gaze aversion than those infants exhibiting lower positive arousal. Similar to Field's (1977) conclusions, this gaze aversion was suggested to be evidence that infants by this age are actively regulating the amount of positive arousal they can endure by turning themselves away from the arousing stimuli. Thus, by 5 months of age, infants appear to be active participants in face-to-face interactions with their mothers.

Evidence has been generated that active participation occurs in face-to-face interactions with infants even younger than 5 months. Moran, Kurpka, Tutton, and Symons (1987) found that the 13- to 16-week-old infants in their study displayed social matching during their face-to-face interactions with their mothers. They found that the infants were more likely to commence smiling and gazing at their mothers when their mothers were already smiling and gazing at their infants, thus suggesting that young infants are capable of, and do engage in, imitation of their mothers. Further research has suggested that the infant as young as 2 months of age is also capable of actively

participating in social interactions (Murray & Trevarthen, 1985; Vos, van Wulfften Palthe, De Roos, & Hopkins, 1990). In their sequential analysis, Vos et al. (1990) found evidence that at or around the second month of life, when significant developmental changes are taking place, infants are able to engage in an interaction with their mothers in which both members regulate the timing of their behaviours to each other. Thus, infants, rather than passively watching their mothers, are reacting to their displays through imitation, smiling, and gaze aversion. This suggests that the face-to-face interactions between mothers and their infants are two-way sequential interactions, which may commence as early as 2 months of age. Thus, some communication, including multiple responses from both partners, appears to be occurring when the infant is as young as 6-weeks-old.

The usefulness and adaptability of the face-to-face procedure in studying the development of communication skills in infants has made it an important research tool, particularly for use with young infants. The adaptability of the face-to-face procedure has been demonstrated by Tronick et al. (1978) in their "still-face" (SF) procedure. This procedure consists of three periods of about 1 1/2 to 3 minutes each, during which there are different patterns of face-to-face interaction between the mother and her infant. During the first and third periods the mother is asked to

interact as she typically would with her infant, permitting the use of facial, vocal and tactile expression ("normal"). During the second period, however, the mother is asked to keep a still, or neutral face (SF), while maintaining eye contact with her infant, but not speaking to or touching him or her (Tronick et al., 1978). Tronick et al. (1978) used this procedure with mothers and their 1- to 4-month-old infants. The negative responses and eventual withdrawal of the infants during the SF situation lent support for the hypothesis that the interaction occurring between mother and infant is both reciprocal, and goal-directed, and that the infant is indeed playing a significant role (Tronick et al, 1978). Tronick et al. hypothesized that during the SF situation, the continuation of maternal gaze towards the infant, coupled with her lack of responding, causes a contradiction; the infant expects an interaction, yet the mother is unresponsive. This may lead to a breakdown of social expectations, and the infant reacts with negative affect and other coping behaviours (Tronick et al., 1978). Thus the infant may be aware of and have expectations about a face-to-face interaction, as assessed by the SF procedure.

Since its development, the SF procedure has been used fairly extensively in examining the nature of face-to-face interactions between mother and infant. As a modification of the standard face-to-face procedure, the SF procedure provides the researcher the opportunity to isolate the

different aspects of mother-infant interaction. For example, Gusella, Muir, and Tronick (1988) used the SF procedure to assess whether changes in the infants' responses were a function of the change in the mother, or if other factors were present. Through their various manipulations, they confirmed that by 6 months of age infants were recognizing the change in their mothers' behaviour during the SF situation, as evident through their aversion of gaze and decrease in positive affect. By comparing their still-faced group to no-change controls, they were further able to establish that the infants' change in affect and gazing during the SF condition was due mainly to the mothers' change in voice, face or both, but not to any other unrelated variables, such as fatigue (Gusella et al., 1988).

These affective responses of the infants to their mothers in the different conditions suggest that changes in maternal expressive behaviour are cognitively and socially meaningful to the infant by 6 months of age. This conclusion is contrary to Field's (1977) suggestion that it is the activity level of the mother that determines infant attention and affect. The results of the study by Gusella et al. (1988) indicate that changes in a 6-month-old infant's gaze and affect are governed by the quality of maternal facial affect rather than the quantity of stimulation she is supplying. In their second study,

Gusella et al. (1988) found differences between the reactions of 3-month-old and 6-month-old infants when the type of stimulation they were receiving changed. The 3-month-old infants in the SF groups responded significantly differently from the control group only when mothers in the experimental group were permitted to touch them in the previous normal period. When touch was not permitted for either group, the 3-month-old infants in the control groups did not continue to gaze and smile at their mothers, and therefore were acting similarly to the infants in the SF group. Thus, it was concluded that attention in the 3-month-old infant seems to be dependent on maternal touch. Once again, it appears that it is the quality, or type of stimulation the infants are receiving which is important in maintaining their attention and affect. Moreover, the tactile modality may play a larger role in these interactions than was once thought.

Mayes and Carter (1990) used the SF paradigm to study the range of social regulation behaviours available to 3- to 4-month-old infants during stressful periods. During the SF situation, they found that the infants generally showed more neutral affect and increased gaze aversion than in normal face-to-face situations. If infants attempted to engage their mother in an interaction, they would protest at her unresponsiveness, and show more negative affect (Mayes & Carter, 1990). Therefore, as Tronick et al. (1978) found,

it appears that even the young infant is disturbed in some way by the SF situation, as evident in their display of negative affect, and/or decreased gazing (e.g., Carter, Mayes, & Pajer, 1990; Gusella et al., 1988; Mayes & Carter, 1990; Tronick et al., 1978).

Explanations for the reactions of infants to the SF situation are many. For instance, Gusella et al. (1988) suggested that the mother's voice and face, although distal, are the more salient features, and therefore when she is not responsive, the infant will lose interest In an examination of both distal and proximal cues, Roedell and Slaby (1977) examined the different characteristics of interactions in 6-month-old infants. In particular, they looked at the differences between more distal aspects, such as face and voice, and more proximal aspects of interactions, namely touch. They presented 8-month-old infants with three types of interactors; a distal interactor who smiled and talked to the infant from a distance, a proximal interactor who used only rocking, patting and other tactile behaviours but did not maintain eye contact with the infant, and a neutral interactor who did not respond to the infant at all. When given the choice between spending time with a proximal, distal, or neutral interactor, the infants gazed more at the distal interactor, and spent more time with both the distal and the neutral interactors. Thus, it was concluded that responsive visual and auditory components

seemed to play a more important role in the formation of social preferences during interactions than did the more proximal aspects of interaction. It was further suggested that human infants are innately predisposed to seek social information primarily from the face of the interactor (Roedell & Slaby, 1977).

However, there are a number of difficulties with this study. For example, the situation that was used was unlike normal social interactive situations in that no eye contact was permitted between the proximal interactor and the infant; the infant did not need to make eye contact with the proximal interactor in order to receive stimulation (Stack & Muir, 1990). Because of this more constrained situation, the results and subsequent conclusions of Roedell and Slaby (1977) may not be accurate postulations for the importance of the different components of human interaction.

A further explanation for infants' reactions to the SF situation came from Tronick et al. (1977), as discussed above, who argued that the discrepancy between the infants' social expectations and their mothers' actual behaviour during the SF situation both confuses and disturbs them, causing them to react negatively. Lamb, Morrison, and Malkin (1987), however, found evidence suggesting that the negative responses of infants to the SF situation may have more to do with the presence or absence of the stimulation available to the infant, than the infants' expectations of

what that stimulation should be. They did not find indications of surprise or puzzlement in their 1- to 7-month-old infants, which led them to postulate that the infants were either bored or uncomfortable, rather than perplexed, by their mothers' unresponsiveness. Therefore the contradiction hypothesis by Tronick et al. (1977) for the negative reactions of infants during the SF situation does not appear to be appropriate for infants at least younger than 7 months.

Although there have been a number of hypotheses about infants' reactions to the SF situation, there has been very little attention paid to the possible role of touch in mother-infant interactions and specifically its potential role in modulating the SF effect. Further, the importance of touch in the young infants' social and emotional development has not been extensively examined, although its use in the daily life of the infant is ubiquitous. Recently, the potential of the tactile modality as a significant component of communication between and mother and infant is being discovered, and research has begun to develop new means of examining this component of mother-infant interactions.

The Contribution of Touch to Early Interactions

Human beings, as other species, use tactile stimulation as a form of communication for expressions such as joy, anger, sadness or comfort. Examination of the touch used by

a mother on her infant in early interactions could provide important information and a more complete understanding of adult-infant social interaction, as well as increased comprehension of the socio-emotional development of the infant. Tactile stimulation has been examined in many different subject populations, including the aged, high-risk infants, and various animal species. In studies concerning stress reactions in rats, for example, it has been found that tactile stimulation, particularly from the mother, can regulate rat pups' reactions, both physiologically and behaviourally, and perhaps aid in their survival (Bornstein, Terry, Browde, Assimon, & Hall, 1987; Hamnett, 1921; Smotherman, 1983; Stanton & Levine, 1990). Many studies have focused on the large amount of adult-infant physical contact between various primate species during the infants' first few months of life (Engel, 1985; Horwich, 1989; Johnson, 1986; Karssemeijer, Vos, & Van Hooff, 1990; Kemps, Timmermans, & Vossen, 1990; Rapaport & Mellen, 1990; Small, 1990). As well, communication through tactile stimulation has been demonstrated in sheep, with the teat-seeking behaviours of the lambs (Billing & Vince, 1987; Vince, 1987). Therefore, tactile stimulation appears to be a prevailing, and important form of mother-infant interaction in the nonhuman species.

In humans, the study of tactile stimulation has, until recently, emphasized its potential for aiding in the

development of high-risk infants. For instance, intervention techniques involving tactile/kinaesthetic stimulation have had, for the most part, beneficial effects on the high-risk infants' future growth potential, and in their future sensory performance (e.g., Anderson, 1986; Giddings, 1986; Helders, Cats, & Debast, 1989; Ross, 1984; Scafidi, Field, Schanberg, Bauer, Tucci, et al., 1990; Scafidi, Field, Schanberg, Bauer, Vega-Lahr, et al., 1986; Watt, 1990). Further studies have indicated that the amount, or quantity of tactile stimulation in itself is not sufficient for beneficial effects in development to occur. Rather, the quality of touch is what is important. More specifically, the way the tactile stimulation is presented to the infant depends on the individual needs of that infant, and the stimulation should be contingent on that infant's needs at the time (Anderson, 1986; Harrison, 1985; Pohlman & Beardslee, 1987).

Many researchers, including de Château (1967, 1977), note, however, that many of the benefits of the intervention techniques may depend on the characteristics of the specific parent-infant pair. For instance, the differential temperaments of the infants, and the varying backgrounds of the parents may have an impact on how much, or what type of intervention is appropriate; what may be beneficial for one infant may disturb another. de Château emphasizes the importance of the establishment of mother-infant synchrony

in the development of their relationship. This synchrony can be best established, de Château suggests, by early, prolonged skin-to-skin contact of newborn and mother. This early contact may provide the basis for emotional attachment of mother and infant, and further it helps establish the synchrony in behaviour between the mother and her infant, which can aid in future infant development (de Château, 1976, 1977). Brazelton (1990) also discusses the potential importance of early tactile contact between mother and infant, and agrees with other researchers who view tactile stimulation as aiding in the behavioural organization of infant development, for example, by regulating arousal levels (Gottfried, 1990; Weiss, 1988). Thus, tactile stimulation appears to be an important aspect in the physical and sensory development of the human infant, as well as other nonhuman species. Further, it appears to be an important form of communication between members of a species (e.g., Small, 1990; Vince, 1987).

Although suggestions have been made as to the importance of touch in human interactions, little research has been devoted tc extensively examining the potential role of this modality in communication. Research has focused on both the vocal and facial expressions used by the mother in these interactions, and although tactile stimulation was used in many of the earlier face-to-face interaction studies (e.g., Kaye & Fogel, 1980), rarely was it uniquely

addressed. Thus the capacities of the infant during face-to-face interactions are not yet fully documented.

Touch has been studied in habituation paradigms, however, and the tactile modality has thus been extended into the perceptual realm of infant research (Kisilevsky & Muir, 1984; Stack & Bennett, 1990). It has been demonstrated that infants react to tactile stimuli much the same way as they do to auditory, and especially visual stimuli (Kisilevsky & Muir, 1984; Stack & Bennett, 1990). However, it is still unclear how, or what information is communicated through these tactile manipulations. Touch may serve to maintain attention in young infants (Gusella et al., 1988), and in the fetus and newborn (see Kisilevsky, Stack, & Muir, 1991), but the role of touch in mother-infant face-to-face interactions is less clear.

In an empirical investigation of the role of touch, Stack and Muir (1990) used the SF procedure in a series of studies designed to isolate maternal touch during interactions with 3-, 6-, and 9-month-old infants. They first established that touching occurs frequently (greater than 65% of the time) during normal face-to-face interactions, and then compared the standard SF situation with a SF in which the mother was permitted to touch her infant. They included six 90-second periods in which periods 2 and 5 were both SF periods, counterbalanced for order. Period 2 was a standard SF period, however, during

Period 5, the mothers were still-faced, but allowed to touch their infants (SF with touch). Stack and Muir found that across infant ages, there was more smiling and less grimacing during the SF with touch than there was during the SF without touch. Therefore, it was concluded that maternal touch may modulate the SF effects by eliciting positive affect and attention. The results of this study seem to contradict hypotheses that the increase in distress in the infant during the SF situation is due to the discrepant messages from the maternal facial characteristics (Tronick et al., 1978). By including some form of stimulation to the infant, through touch, during the SF periods, the negative reactions were significantly decreased. This lead the researchers to conclude, in a similar fashion to that of Lamb et al. (1987), that the negative affective responses from the infants in the SF periods occurred because no form of reciprocal interaction was available to the infant, or they were due to boredom because all forms of stimulation were withdrawn from the infant (Stack & Muir, 1990). These findings also suggest an important role for touch in social interactions.

Stack and Muir (in press) further established the role of touch in adult-infant interactions by demonstrating that negative affect in 5-month-old infants in the standard SF situation could be reduced with the inclusion of touch from either mothers or even female strangers. As well, infant

distress was reduced and positive affect increased in SF conditions containing active, rather than passive touch, and even during situations in which the infant was unable to observe the hands touching him or her. Thus, it was not the visual component of the moving hands that decreased the SF effects, but the actual tactile stimulation that maintained infant positive affect. Thus, the results from Stack and Muir (1990, in press) suggest that tactile stimulation plays an important role in modulating social interaction and directing attention between the infant and adult, and therefore adult facial and vocal expressions are not necessarily the only influential aspects of communication in face-to-face procedures.

Although the importance of touch during interactions between mothers and their infants is becoming established, more research is necessary in order to discover the theoretical underpinnings of the role of adult touch in the socio-emotional development of the infant. Recently more attention has been given to the tactile modality in the social and emotional development of the infant, however, further examination of the touch used by a mother on her infant could provide important information towards a more complete understanding of adult-infant social interaction. While touch is used daily in an infant's life in the form of caregiving, its potential importance in the social development of the infant is not well documented. Further,

the importance of touch with normal infants might have implications for intervention strategies used with disadvantaged infants, to aid their parents in maintaining their interactions so that the socio-emotional development of the infant can progress relatively normally. Extensions of recent research to determine the potential communicative aspects of touch between a mother and her infant in a face-to-face interaction are therefore warranted.

Description and Specific Hypotheses of the Present Study

In the present study, a modified SF procedure was used to further explore the effects of maternal touch on infants. The effects of instruction on maternal behaviour during face-to-face interactions with their 5 1/2-month-old infants and subsequent infant responses were examined. One "Normal" period was followed by a series of SF with touch periods where mothers were given instructions on how to interact with their infants, using only touch. During the three touch-only periods, the mothers were asked to (1) play with their infants using only touch (SF+T), (2) touch their infants such that they maximized positive affect from their infant (SF+TS), and (3) touch their infants in one area of the body (SF+T1). The last manipulation was included so that the importance of reciprocity in more restricted interactions with 5 1/2-month-old infants could be assessed. These manipulations made it possible to observe and measure whether the amount of maternal touching changed, and whether

infants differentially responded to the manipulations in maternal touch, using both nonsequential and sequential analyses.

It was anticipated that the instructions would differentially affect maternal behaviour, and, given the reciprocity in interactions, changes in infant behaviour would also occur. More specifically, it was hypothesized that infant positive affect would decrease in the SF+T and SF+T1 periods relative to the Normal period, but that infants would maintain their levels of smiling in the SF+TS period, relative to the Normal. Thus, as a result of directly asking the mothers to achieve maximum smiling from their infants, it was hypothesized that further modulation of the SF effect would occur. The amount of infant fretting was expected to increase in the SF+T1 period, due to the constraints placed on the interaction in addition to the potential lack of contingency and reciprocity in maternal behaviour. Further, it was hypothesized that shifts in infant gaze would occur such that while infant gaze at mother's face would be high during the Normal period, it would decrease, with a subsequent increase in infant gaze at mother's hands during all of the SF with touch periods to follow. This was expected given the results of previous studies (e.g., Stack & Muir, 1991) where infant attention was directed at the focus of the stimulation. Infant vocalizing was expected to increase from the Normal to the

SF with touch periods as the mothers would no longer be speaking to the infants, providing the infants with an opportunity to "speak" themselves or to "request" an increase in maternal stimulation. It was further expected that the amount of maternal touching would increase from the Normal to the SF with touch periods, as this was the only form of communication available to the mothers during these periods.

Through the use of the sequential analysis, an exploratory investigation concerning the dynamic nature of the mother-infant interactions was conducted. Analyzing the sequences of events permits a different view and provides a better understanding of the interaction, specifically addressing what behaviours occurred both before and after other target behaviours, during the interaction (Bakeman & Gottman, 1986). Sequential analysis has been suggested as an appropriate means of further delineating the interactive aspect of the components of interactions between mothers and their infants (e.g., Symons & Moran, 1987).

Through these experimental manipulations the communicative properties of touch will be advanced by observing the responses of the mothers to the experimenter's instructions, and the subsequent changes in the infants' responses to their mothers' tactile behaviour. This will further our knowledge and understanding of the communicative aspects of touch in mother-infant face-to-face interactions.

Method

Subjects

The names of potential subjects were obtained from the Sir Mortimer B. Davis Jewish General Hospital birth records (Montréal, Québec, Canada), and mothers were contacted and recruited by telephone. The sample consisted of 64 5- to 6-month-old full-term, healthy infants (mean age = 5 months, 14 days, sd = 14 days), and their mothers. Sixteen infants were excluded from analyses due to fussiness (8), maternal failure to follow instructions (3), less than 10% smiling in the first period (4) and equipment failure (1). The final sample consisted of 48 infants (mean age = 5 months, 13 days, sd = 16 days). The majority of the subjects were white (89%), and middle-class. The control and experimental groups were randomly assigned, with equal numbers of boys and girls within each group. Power analyses conducted before the commencement of subject recruitment confirmed that sufficient power would be obtained with 44 subjects (Cohen, 1977) (Appendix A).

Five 1/2-month-old infants were used in this study as by this age the infants are alert, social, and there is evidence that by this age they are able to effectively initiate interactions with the adult. Further, Stack and Muir (1990) found no age differences in 3- to 9-month-old infants in their reactions to the SF situation. Only mothers were used in the present study given the difficulty

in availability of fathers and to be consistent with the majority of studies conducted on adult-infant interactions, where mothers have mainly been used.

Apparatus

The infants were seated in a car seat mounted on a custom made box (75 cm high x 46 cm wide x 51 cm long) facing their mothers who were seated on an adjustable stool, at eye level, 70 cm away. The testing chamber was enclosed by two black partitions placed in a semi-circle around the mother and her infant. An Hitachi camera was located behind and to the right of the mother, and it recorded primarily the infant's face, as well as the infant's body and the mother's hands. A Sony camera was located above and to the left of the mother, and it recorded the mother's hands and the infant's body. These were the only objects visible to the infant (see Appendix B for a schematic diagram of the testing situation). The cameras were connected to an 8mm video-cassette recorder located in the control room. A time-line was recorded on each video record, and was used to score the duration of each response in minutes, seconds, and milliseconds when the video records were subsequently analyzed. An adjustable speed remote control with shuttle function was used to score both the frequency and the duration of each infant behaviour, and of maternal touching.

A stopwatch timed the interactive sessions, and the onset and offset of the interactive periods was indicated to

the mothers by the experimenter, with a tap on the wall.

Design

The design was a two (Group) x two (Sex) x three (Order) x four (Period) between-within-subjects whereby each mother-infant pair participated in four 90-second interaction periods, separated by 20-second inter-trial intervals. There was an experimental and a control group. For the experimental group (n = 36), the first period consisted of a normal interaction between the mother and infant, where mothers could use facial expression, voice and touch. The second period consisted of a SF with touch period in which the mothers were instructed to use only touch to interact with their infants (SF+T). Period 3 was another SF period, during which the mothers were asked to use the touch that would elicit the most smiling from their infants (SF+TS). Period 4 was a SF period in which the mothers were asked to touch their infants in only one area of the body (SF+T1) (see Appendix C for the detailed instructions given to mothers). Periods 2, 3 and 4 were counterbalanced to control for time and fatigue effects, resulting in three orders. Thus, the sequence of periods in Order 1 was Period 2 (SF+T), Period 3 (SF+TS), Period 4 (SF+T1), the sequence for Order 2 was Period 4 (SF+T1), Period 2 (SF+T), Period 3 (SF+TS), and the sequence for Order 3 was Period 3 (SF+TS), Period 4 (SF+T1), and Period 2 (SF+T). The design of the study is illustrated in Table 1.

Table 1

Design of Study

GROUP	ORDER 1				ORDER 2				ORDER 3			
EXPERIMENTAL (n=36)												
Boys	N	SF+T	SF+TS	SF+T1	N	SF+T1	SF+T	SF+TS	N	SF+TS	SF+T1	SF+T
Girls												
CONTROL (n=12)												
Boys	N	N	N	N	N	N	N	N	N	N	N	N
Girls												

Throughout the remainder of the text, the periods will be generally referred to in a standard order whereby Period 1 will indicate the Normal period, Period 2 will indicate the SF+T period, Period 3 will indicate the SF+TS period and Period 4 will indicate the SF+T1 period.

For the control subjects (n = 12), the four periods consisted of normal face-to-face interactions between the mother and her infant, as a control for time and fatigue effects. The control group was included primarily to control for the latter effects, but also to establish a baseline of maternal touching and infant responses in a normal face-to-face situation. Subsequent studies will then make use of this normative data. Since the within subjects nature of the procedure for the experimental subjects included both a baseline period and a control for fatigue and time effects by counterbalancing orders, it was not deemed essential that the control group include the same number of subjects.

Procedure

Upon arrival, the mother and her infant were met and taken into a waiting room where the experimenter briefly summarized the procedures of the study. The mother was then asked to sign an informed consent form (see Apperdix D). Once both mother and infant were relaxed and comfortable they were taken into the testing room. The infant was placed in the infant seat, and the mother sat in front of

her infant on the adjustable stool. For the first period, the experimenter asked the mother to interact normally with her infant, using facial, vocal and tactile expression. The experimenter then left the testing room for the observation room, signalling the mother to commence the period by knocking on the wall. The timer was set for 90 seconds, after which the experimenter knocked on the wall, indicating the end of the period. The experimenter then re-entered the testing area and played with the infant for 20 seconds, to maintain infant state and provide a break between the periods. During this interval the instructions for the next period were given to the mother. This was repeated for the third and fourth periods. A reliability check was made on 1/3 of the subjects, to ensure that the mothers were maintaining a still-face throughout the SF with touch periods.

At the end of the testing session, the mother and her infant were taken back to the waiting room where the experimenter asked the mother a number of questions concerning her infants' history, and family demographics (Appendix E), as well as a short questionnaire concerning how the mothers used touch with their infants in the home situation (Appendix F). Each mother then received an "Infant Scientist Award" as a token of appreciation for participating in the study, and was informed that upon completion of the study a letter would be mailed to them

outlining the general findings.

It should be noted that if the infant was distressed during any of the periods, and cried for more than 20-seconds, or if the mother felt uncomfortable in the testing situation for any reason, the session was interrupted (3 subjects). The mother and infant were then taken back to the waiting room, and infants were given the opportunity to feed, be changed, or rest. When the mother was ready, testing would resume, beginning with a replication of any periods in which the infant had been overly upset.

Data Reduction and Statistical Analyses

The video records were examined using a frame by frame analysis. The behaviours that were measured from the videotapes were: (a) Infant Gazing at maternal face and hands, (b) Infant Smiling, (c) Infant Fretting, (d) Infant Vocalizing, and (e) Maternal Touch.

The infants' Total Gaze time was the percentage of time the infant spent gazing at the mother. This was scored separately by coding the frequency and duration infants spent gazing at their mothers' hands or at their mothers' faces. A smile was recorded if the infant's mouth was 'upturned', either open or closed. A fret was recorded if the infant's mouth was turned down, curled, or the infant was crying. A vocalization was any positive or neutral sound the infant made, except for burps, cries, sneezes, and hiccups (Stack & Muir, in press) (see Appendix G for

operational definitions). The frequency and duration of maternal touch, defined as any physical contact between infant and mother, was also measured.

Observers were trained on videotape examples prior to scoring the present data until they achieved high reliability ($r > .90$) with experienced raters. Inter-rater reliability was assessed for one-third of the records upon completion of coding, with intraclass reliability coefficients (Shrout & Fleiss, 1979) ranging from $r = .9989$ to $r = .9999$ (gaze at face= .9997; gaze at hands= .9995; smiling= .9997;fretting= .9999; vocalizations= .9989; maternal touch= .9997).

Nonsequential Analyses. Repeated measures analyses of variance (ANOVA) with three between variables and one within variable were used to analyze the data, using the BMDP statistical package (Dixon, Brown, Engelman, & Jennings, 1990). The between variables were Group (experimental, control), Sex of infant (boy, girl), and Order (1, 2, 3). The within variable was Period with four levels of interaction (N, SF+T, SF+TS, SF+T1). There were seven dependent variables: percent durations of (a) Total Infant Gaze, (b) Infant Gaze at mother's hands, (c) Infant Gaze at mother's face, (d) Infant Smiling, (e) Infant Fretting, (f) Infant Vocalization and (g) Maternal Touch.

For each dependent variable descriptive statistics designed to assess the normality of the distribution were

first conducted to determine if significant skewness and/or kurtosis were present necessitating transformation of any of the variables. Transformations were also used if significant outliers were present in the data, as this is typically considered a better strategy relative to eliminating them from the analyses altogether (Tabachnick & Fidell, 1989). For the majority of the variables a square root transformation was performed when the data indicated slight, but significant skewness. However, because of substantial significant skewness in the measure of Infant Fretting, a log transformation was necessary to render the distribution normal (see Tabachnick & Fidell, 1989).

Only significant findings will be reproduced in the text, while non-significant results can be found in the ANOVA summary tables for each variable, in Appendices K to R. To facilitate comprehension, when transformations were conducted on the variables, the raw means will be cited in the text, while the transformed means are available in the appendices, along with the ANOVA summary tables. However, when transformations were conducted, the F-scores and p-values cited in the text are taken from the transformed analyses, as these are the findings upon which the interpretations are based.

As Sex and Order have previously been found to have no significant main effects, nor any significant interaction effects (e.g., Stack & Muir, 1990), they were not expected

to reveal any differences in the present study. Any potential Sex or Order effects or interactions were tested for each variable, using a repeated measures ANOVA with Sex and Order as the between factors, and Period as the within factor. If no Sex or Order effects or interactions were obtained, these variables were collapsed and a two-way repeated measures ANOVA was conducted with Group as the between factor and Period as the within factor. These variables were collapsed across factors for all of the dependent variables except Infant Fretting, where a significant Period by Order interaction was revealed, $F(6, 90) = 3.74$, $p < .0001$.

If an interaction was significant, planned a priori simple effect analyses, followed by Tukey HSD comparisons where relevant, were conducted to isolate the source of effects contributing to the interaction (Keppel, 1982; Linton & Gallo, 1975; Tabachnick & Fidell, 1989; Winer, 1971; Zwick, 1986). A critical alpha level of .05 was chosen as the criterion for statistical significance, and the more conservative Greenhouse-Geisser Adjusted F-score was used to assess significance. If no significant Group by Period interactions existed in the final ANOVA's, the control group was removed from the analyses, and the experimental group was analyzed separately, with a one-way repeated measures ANOVA, to test for any Period effects. Since the experimental subjects were acting as their own

controls, as discussed earlier, the removal of the control group in this situation was deemed appropriate. If a significant Period effect was obtained, Tukey HSD comparisons were conducted to establish where the differences existed.

Sequential Analysis. Further data reduction was necessary to organize the coded behaviours for the sequential analysis. The six infant and mother behaviours (Infant Gaze at face and hands, Infant Smiling, Fretting and Vocalizing, Mother Touching) plus a blank code (no behaviours were present) created 30 mutually exclusive and exhaustive codes. For each period, each experimental infant and mother behaviour sequence was determined and coded using the coding scheme developed for the analysis (see Appendix H). These codes were then pooled over infants within the periods, and each period was analyzed separately.

The target behaviour selected for analysis and interpretation was Infant Smiling. This behaviour was chosen because of the potential information that could be gained when assessing what was occurring before and after the infants smiled, especially when comparing between the periods. For example, it was considered intriguing to establish where the infants were gazing when they smiled, and what mother or infant behaviour occurred before infants began to smile, for the different periods. These exploratory questions could be answered through the

sequential analysis of Infant Smiling. Sequential analyses were also conducted on the target behaviours of Infant Vocalizations and Maternal Touching. The results from these analyses are available in Appendix I.

An event sequence analysis was conducted on the target behaviour using the PC Elag program (Version 4, 1986) developed for sequential analyses by Bakeman (1983) (see Appendix I for a brief summary concerning sequential analyses). Behaviours occurring both before and after Infant Smiling (given behaviours) were assessed by using lags of -1 and +1, so that 2 two-event sequences were created for the target and each given behaviour (see Bakeman & Gottman, 1986). Due to the large number of possible codes, and therefore the large number of possible event sequences, the 30 codes were collapsed, and the number of codes included in the analysis was thus reduced. Therefore, all codes including Infant Smiling (e.g., infant gaze at hands while infant smiled) were collapsed into the single code of Infant Smiling. This permitted a more complete analysis of the behaviours occurring around the target behaviour without including too many codes in each analysis such that the results obtained would be uninterpretable. For a more complete description of the codes and which codes were included in the analysis, refer to Appendix J.

The target behaviour of Infant Smiling was assessed for each of the SF with touch periods and the Normal period.

The Normal period was included in the analysis with caution, however, since in this period the mothers were doing more than touching their infants (e.g., smiling and speaking), thus much of the information about maternal behaviour during these normal interactions was missing. Nevertheless, an analysis of the Normal period was included to establish what behaviours occurred before and after Infant Smiling during this period, as compared to the SF with touch periods.

Upon completion of the analysis, the computer generated z-scores were then analyzed for each target-given behaviour pair. Because the analysis was exploratory, two-tailed z-score significance levels were chosen. Finally, the more conservative Sackett z-scores were chosen for analysis (see Bakeman & Gottman, 1986).

Results

The results section is sub-divided into two sections. First a discussion of the findings from the nonsequential analyses will be presented, followed by the results obtained through the sequential analysis.

Nonsequential Analyses

For the nonsequential analyses each dependent variable will be discussed separately, beginning with Infant Gaze. Total Gaze will be discussed first, followed by Gaze at mothers' face and hands, respectively. Infant Affect, consisting of Infant Smiling and Fretting, will then be discussed, followed by Infant Vocalizing and Maternal Touching.

Initial analyses revealed no differences between the control and experimental groups in the first, Normal period, for all measures, indicating that infants were similar at the beginning of the study. Further analyses were conducted on the control infants alone only when a Period main effect, and no Group by Period interaction was present in the data. These analyses revealed no Period effects for the control infants, suggesting that fatigue did not play a significant role in the responses of the infants in this study (see Appendix K, Table 1).

Maternal Touching

A square root transformation was conducted on the data to control for significant skewness and outliers. The two-

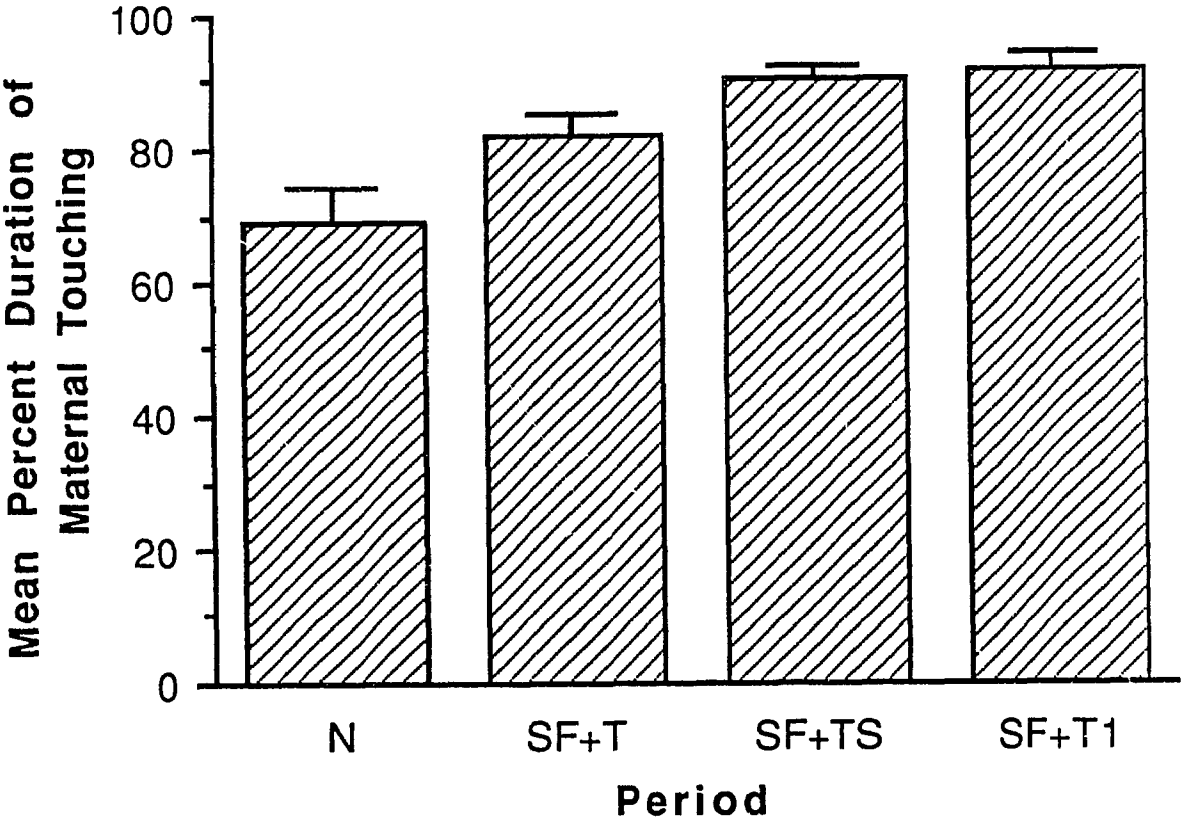
way repeated measures ANOVA for Group by Period revealed a main effect for Group, $F(1, 46) = 5.77$, $p < .05$ and Period, $F(3, 138) = 3.72$, $p < .05$, but no significant Group by Period interaction. Mothers in the experimental group (M = 83.12%) touched their infants more than those in the control group (M = 70.24%), and Tukey's comparisons revealed that more maternal touching occurred during the last three periods (M = 79.63%, M = 84.97%, M = 86.89%, for periods 2, 3, 4 respectively) than in the first, Normal period (M = 68.12%). Since no Group by Period interaction was found, the experimental group was analyzed alone, with a one-way repeated measures ANOVA for Period (Appendix L, Table 1). As Figure 1 illustrates, a significant Period effect was found, $F(3, 105) = 9.62$, $p < .0001$, and subsequent Tukey's comparisons (Appendix L, Table 2) revealed that the mothers in the experimental group touched their infants more in the SF with touch periods (M = 81.99%, M = 90.33%, M = 91.46% for SF+T, SF+TS, SF+T1 respectively) than in the Normal (M = 68.71%) period (for transformed means see Appendix L, Table 3). A subsequent one-way repeated measures ANOVA for Period was conducted on the control group alone, but no significant effects were obtained, $F(3, 33) = 0.46$, $p > .05$.

Infant Gaze

Total Gaze. Descriptive statistics revealed no significant skewness or outliers, therefore no transformation of the variable was conducted. A significant

Figure 1. Mean percentage of time mothers in the experimental group spent touching their infants as a function of Period (N = normal; SF+T = SF with touch; SF+TS = SF with touch and maximum smiling; SF+T1 = SF with touch in one area).

Standard errors are shown by vertical bars.

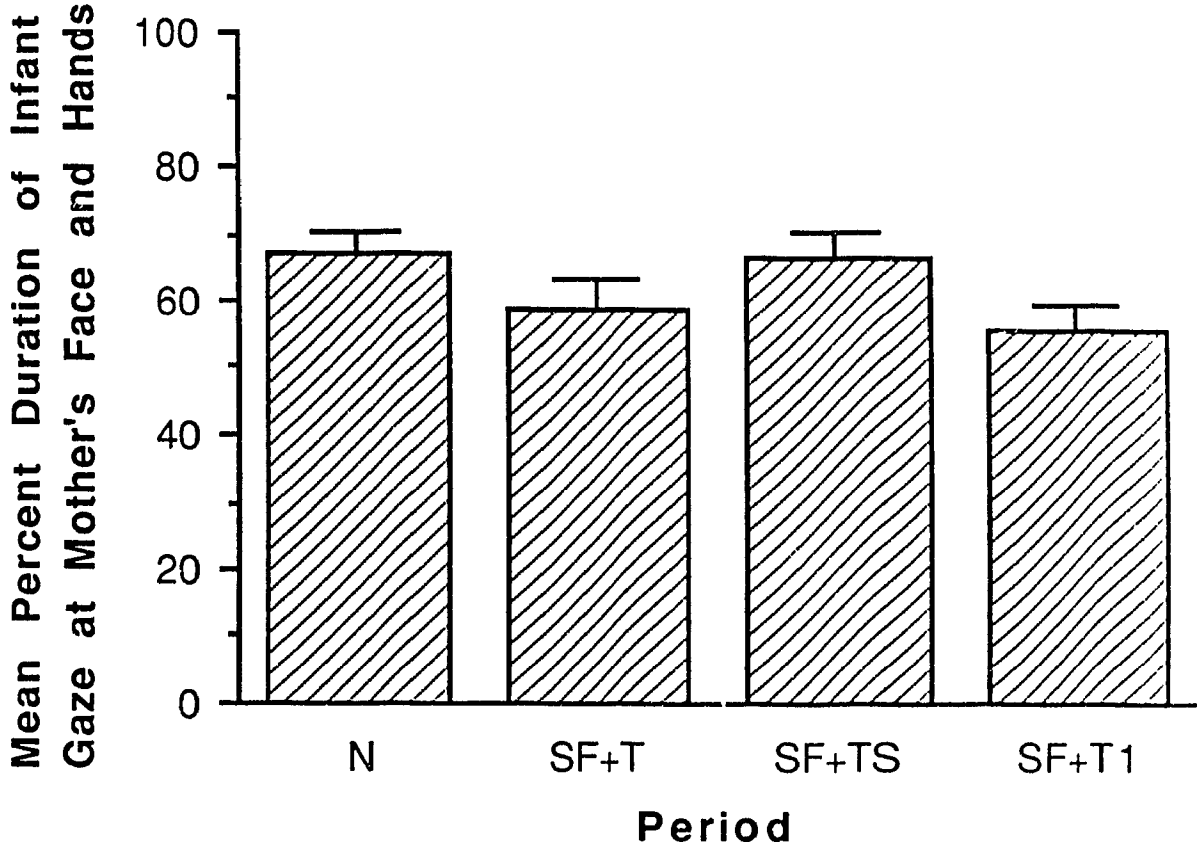

Mean Percent Duration of Maternal Touching
100
80
60
40
20
0
N
SF+T
SF+TS
SF+T1
Period

Sex by Order interaction, $F(2, 30) = 3.81$, $p < .05$, was obtained in the experimental infants, however a simple effects analysis revealed no significant effects of Sex or Order. The data were therefore collapsed across Sex and Order. The Group by Period repeated measures ANOVA revealed no significant main effects or interactions. As discussed above, because there was no Group by Period interaction, a one-way repeated measures ANOVA with Period as the within factor was conducted on the experimental group alone (Appendix M, Table 1). This analysis revealed a significant Period effect, $F(3, 105) = 2.73$, $p < .05$, however a subsequent Tukey's comparison (Appendix M, Table 2) revealed no significant differences between the periods. This is illustrated in Figure 2.

Gaze at face. A square root transformation was conducted on the Gaze at face variable, as the descriptive statistics revealed significant skewness. The subsequent ANOVA revealed significant main effects for both Group ($F(1, 46) = 5.46$, $p < .05$) and Period ($F(3, 138) = 4.49$, $p < .01$), and a significant Group by Period interaction, $F(3, 138) = 2.95$, $p < .05$ (Appendix N, Table 1). A subsequent simple effects analysis holding Period constant revealed no differences between the groups in the Normal period, $F(1, 46) = 0.27$, $p > .05$, however, in all of the SF with touch periods, infants in the experimental group ($M = 18.59\%$, $M = 23.51\%$, $M = 17.78\%$) gazed at the mothers' faces less than

Figure 2. Mean percentage of time infants in the experimental group spent gazing at their mother's face and hands combined as a function of Period (N = normal; SF+T = SF with touch; SF+TS = SF with touch and maximum smiling; SF+T1 = SF with touch in one area).

Standard errors are shown by vertical bars.


Mean Percent Duration of Infant Gaze at Mother's Face and Hands
100
80
60
40
20
0
N
SF+T
SF+TS
SF+T1
Period

those in the control group (M = 32.51%, M = 38.58%, M = 31.35%), $F(1, 46) = 4.00$, $p < .05$ for Period 2 (SF+T), $F(1, 46) = 6.76$, $p < .01$ for Period 3 (SF+TS), and $F(1, 46) = 6.03$, $p < .05$ for Period 4 (SF+T1). This is illustrated in Figure 3. A simple effects analysis holding Group constant revealed a significant Period effect for the experimental infants, $F(3, 44) = 13.96$, $p < .0001$, and a subsequent Tukey's comparison (Appendix N, Table 2) found that there was more gazing at their mothers' faces in the Normal period (M = 38.36%) than in the SF with touch periods, SF+T, SF+TS, SF+T1 (for transformed means see Appendix N, Table 3).

Gaze at hands. Descriptive statistics revealed no significant skewness or outliers, thus no transformation was conducted on this variable. Since no significant Group or Period main effects or interactions were obtained, a repeated measures ANOVA for Period (Appendix O, Table 1) and subsequent Tukey's comparisons (Appendix O, Table 2) were conducted on the experimental group alone. Figure 4 illustrates the significant Period effect, $F(3, 105) = 3.27$, $p < .05$, indicating that infants in the experimental group gazed more at their mothers' hands in the SF+TS (M = 43.20%) than in the Normal period (M = 28.45%).

To summarize the gaze measure, Figure 5, where both Gaze at face and Gaze at hands are illustrated, reveals the shifts of the infants' gaze from the mothers' faces to their hands across the periods.

Figure 3. Mean percentage of time infants spent gazing at their mother's face as a function of Group (experimental and control) and Period (experimentals: N = normal; SF+T = SF with touch; SF+TS = SF with touch and maximum smiling; SF+T1 = SF with touch in one area; controls: N for all periods). Standard errors are shown by vertical bars.

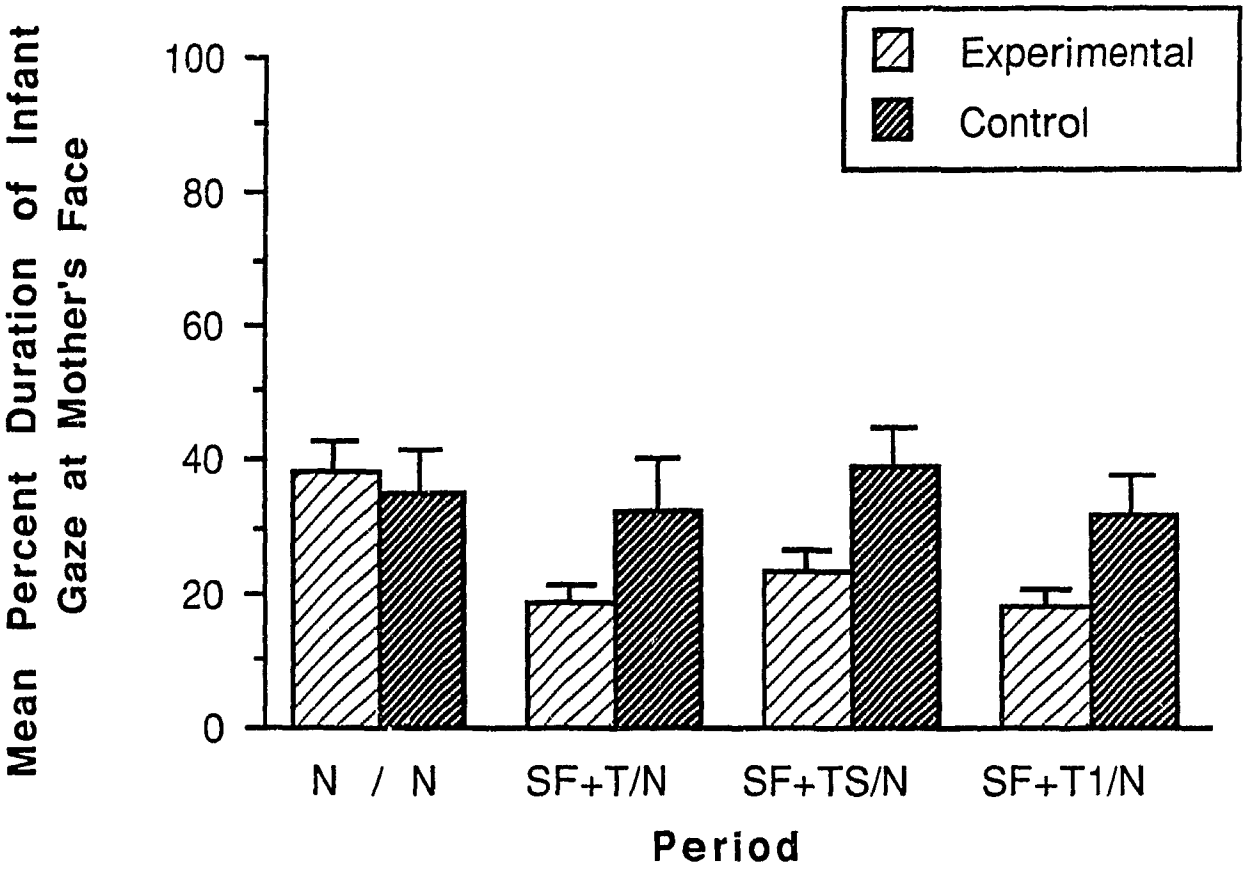

Mean Percent Duration of Infant Gaze at Mother's Face
100
80
60
40
20
0
Experimental
Control
N / N
SF+T/N
SF+TS/N
SF+T1/N
Period

Figure 4. Mean percentage of time infants in the experimental group spent gazing at their mother's hands as a function of Period (N = normal; SF+T = SF with touch; SF+TS = SF with touch and maximum smiling; SF+T1 = SF with touch in one area).
Standard errors are shown by vertical bars.

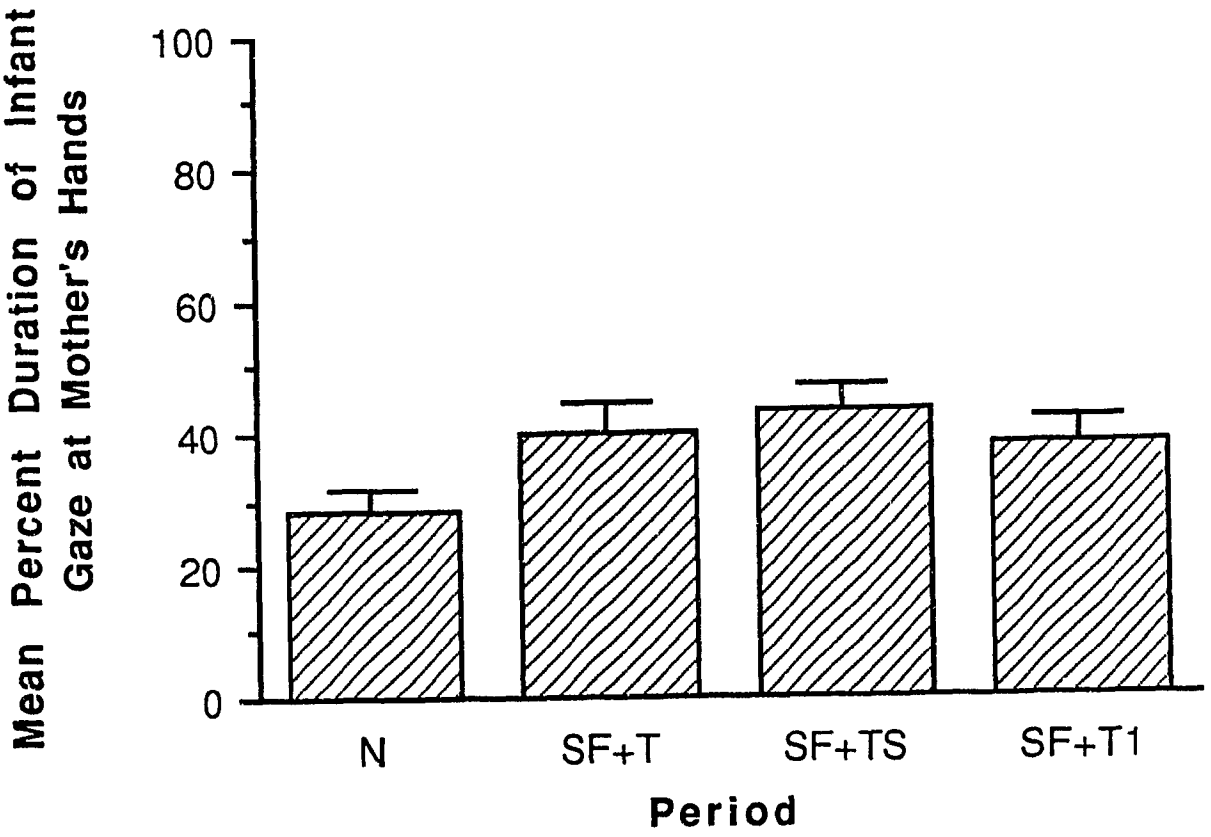
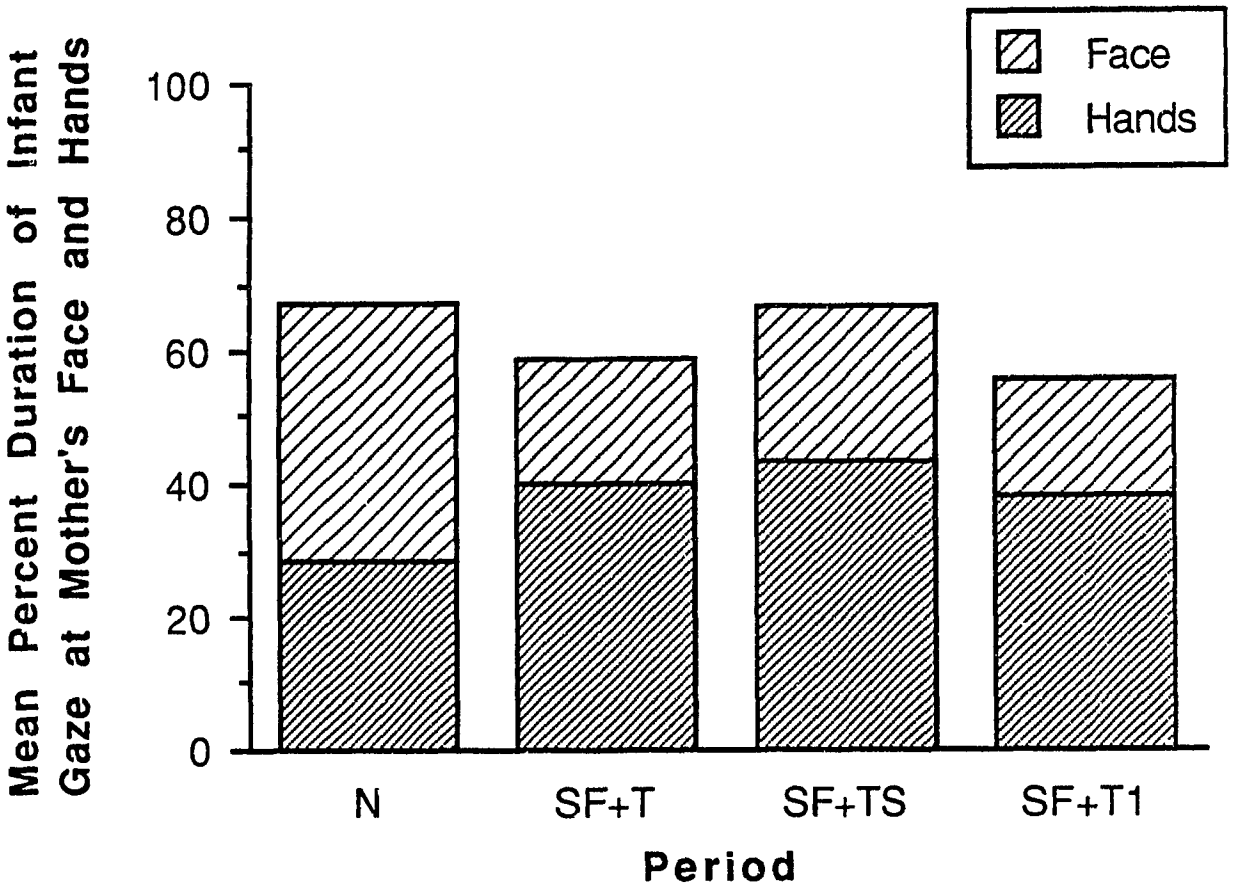

Mean Percent Duration of Infant Gaze at Mother's Hands
100
80
60
40
20
0
N
SF+T
SF+TS
SF+T1
Period

Figure 5. Mean percentage of time infants in the experimental group spent gazing at their mother's face and hands as a function of Period (N = normal; SF+T = SF with touch; SF+TS = SF with touch and maximum smiling; SF+T1 = SF with touch in one area). Infant gaze at mother's face or hands is indicated by hatched bars. Standard errors are shown by vertical bars.

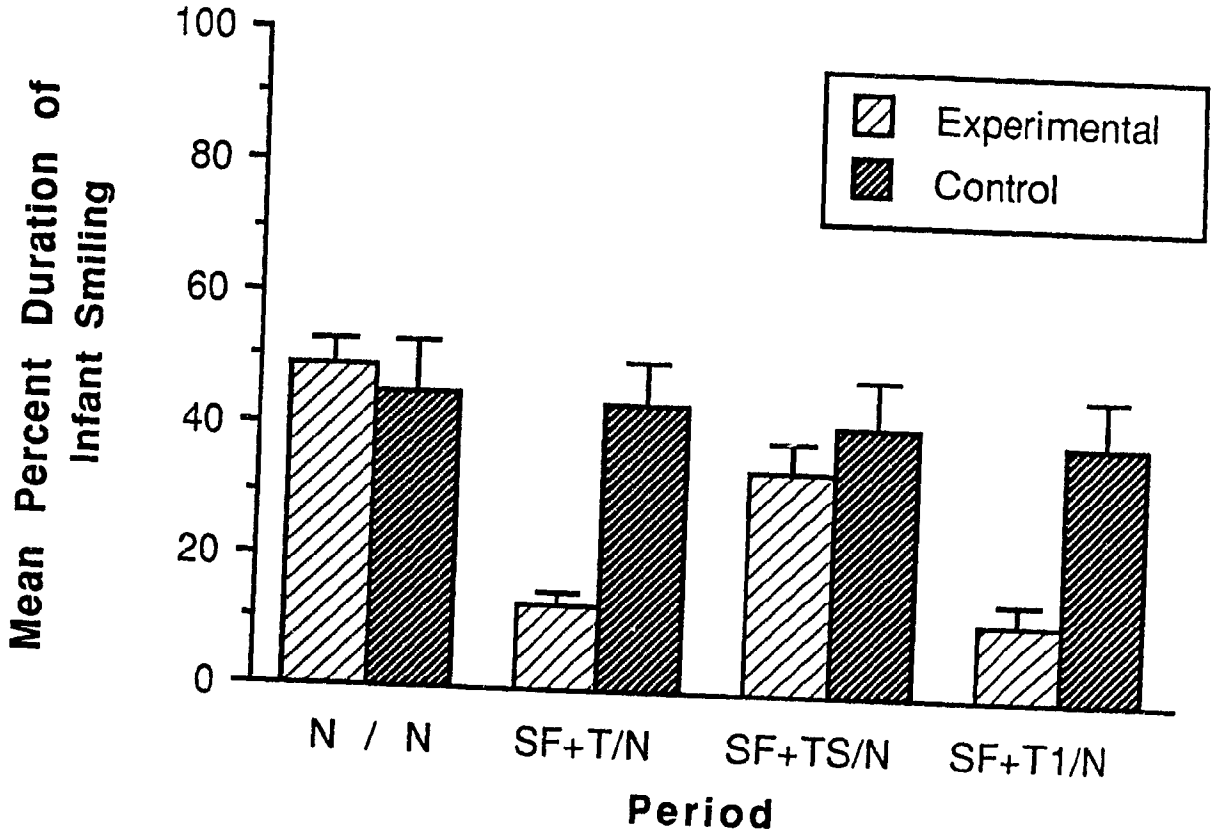

Face
Hands
Mean Percent Duration of Infant Gaze at Mother's Face and Hands
100
80
60
40
20
0
N
SF+T
SF+TS
SF+T1
Period

Infant Affect

Smiling. Descriptive statistics revealed significant skewness and outliers, so a square root transformation was performed on the data. The Group by Period ANOVA revealed a significant Group effect, $F(1, 46) = 15.43$, $p < .0001$, a significant Period effect, $F(3, 138) = 11.72$, $p < .0001$, and a significant Group by Period interaction, $F(3, 138) = 8.88$, $p < .0001$ (Appendix P, Table 1). As can be seen in Figure 6, subsequent simple effect analyses holding Period constant found no difference in amount of smiling between the experimental (M = 49.27%, M = 34.24%) and control (M = 45.25%, M = 41.60%) groups in the first (Normal; $F(1, 46) = 0.38$, $p > .05$) or the third (SF+TS for the experimental group; $F(1, 46) = 1.32$, $p > .05$) periods, but more smiling was obtained in the control group (M = 43.74%, M = 39.30%) than in the experimental group (M = 12.96%, M = 11.81%) for the second, $F(1, 46) = 25.08$, $p < .0001$, and the fourth, $F(1, 46) = 19.61$, $p < .0001$ periods, respectively (SF+T and SF+T1 periods for the experimental group). When a simple effects analysis was conducted holding Group constant, no differences in smiling were found between the periods for the infants in the control group, $F(3, 44) = 0.14$, $p > .05$. The simple effects analysis and a subsequent Tukey comparison revealed that the experimental infants exhibited more smiling in the normal period than in the SF+T, the SF+TS, and the SF+T1 periods, $F(3, 44) = 52.15$, $p < .0001$

Figure 6. Mean percentage of time infants spent smiling as a function of Group (experimental, control) and Period (experimentals: N = normal; SF+T = SF with touch; SF+TS = SF with touch and maximum smiling; SF+T1 = SF with touch in one area; controls: N for all periods).

Standard errors are shown by vertical bars.


Mean Percent Duration of Infant Smiling
100
80
60
40
20
0
Experimental
Control
N / N
SF+T/N
SF+TS/N
SF+T1/N
Period

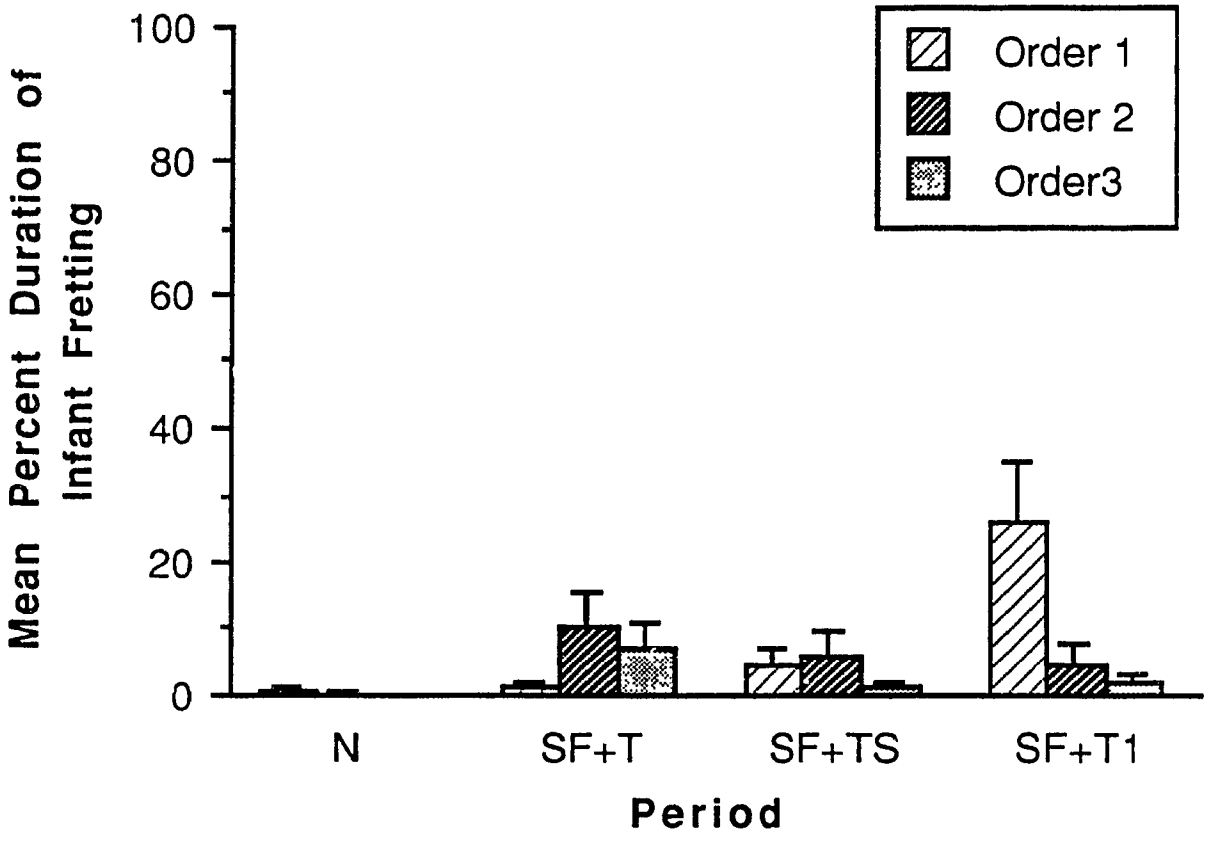
(Appendix P, Table 2). However, as can be seen in Figure 6, the experimental infants exhibited more smiling in the third (SF+TS) period than in the other SF with touch periods, $p < .05$ (for transformed means see Appendix P, Table 3).

Fretting. Due to severe positive skewness and outliers, a log transformation was deemed necessary to control for both deviation from normality and outlier effects. No Sex or Order main effects were found, however a significant Period by Order interaction was present, $F(3, 90) = 3.74$, $p < .0001$ in the experimental infants. Order was consequently retained in the analysis, and a two-way ANOVA was conducted on the experimental group alone, with Order as the between variable and Period as the within variable. This analysis revealed a significant Period main effect, $F(3, 99) = 7.38$, $p < .0001$, and a significant Period by Order interaction, $F(6, 99) = 3.64$, $p < .0001$ (Appendix Q, Table 1). Subsequent simple effects holding Period constant revealed that, for the experimental infants, an Order effect was present only in the SF+T1 period $F(2, 33) = 4.42$, $p < .05$. Figure 7 illustrates that more fretting occurred in the SF+T1 period ($M = 26.08\%$) when it was in the fourth position (i.e., in Order 1) (for transformed means see Appendix Q, Table 2).

Infant Vocalizations

Descriptive statistics revealed positive skewness and outliers, therefore a square root transformation was

Figure 7. Mean percentage of time infants in the experimental group spent fretting as a function of Order (1, 2, 3) and Period (N = normal; SF+T = SF with touch; SF+TS = SF with touch and maximum smiling; SF+T1 = SF with touch in one area).
Standard errors are shown by vertical bars.


Mean Percent Duration of Infant Fretting
100
80
60
40
20
0
Order 1
Order 2
Order3
N
SF+T
SF+TS
SF+T1
Period

conducted. No significant Group by Period main effects or interactions were found, thus a one-way repeated measures ANOVA for Period was conducted on the experimental group's data (Appendix R, Table 1). As illustrated in Figure 8, the significant Period effect, $F(3, 105) = 5.62$, $p < .0001$ and subsequent Tukey's comparisons (Appendix R, Table 2) revealed that experimental infants vocalized more in the SF+T and SF+TS periods ($M = 13.38\%$, $M = 13.48\%$, for SF+T and SF+TS respectively) than in the Normal ($M = 6.19\%$) or SF+T1 ($M = 12.64\%$) periods, although the difference between the SF+T1 period and the other SF with touch periods was marginal (for transformed means see Appendix R, Table 3).

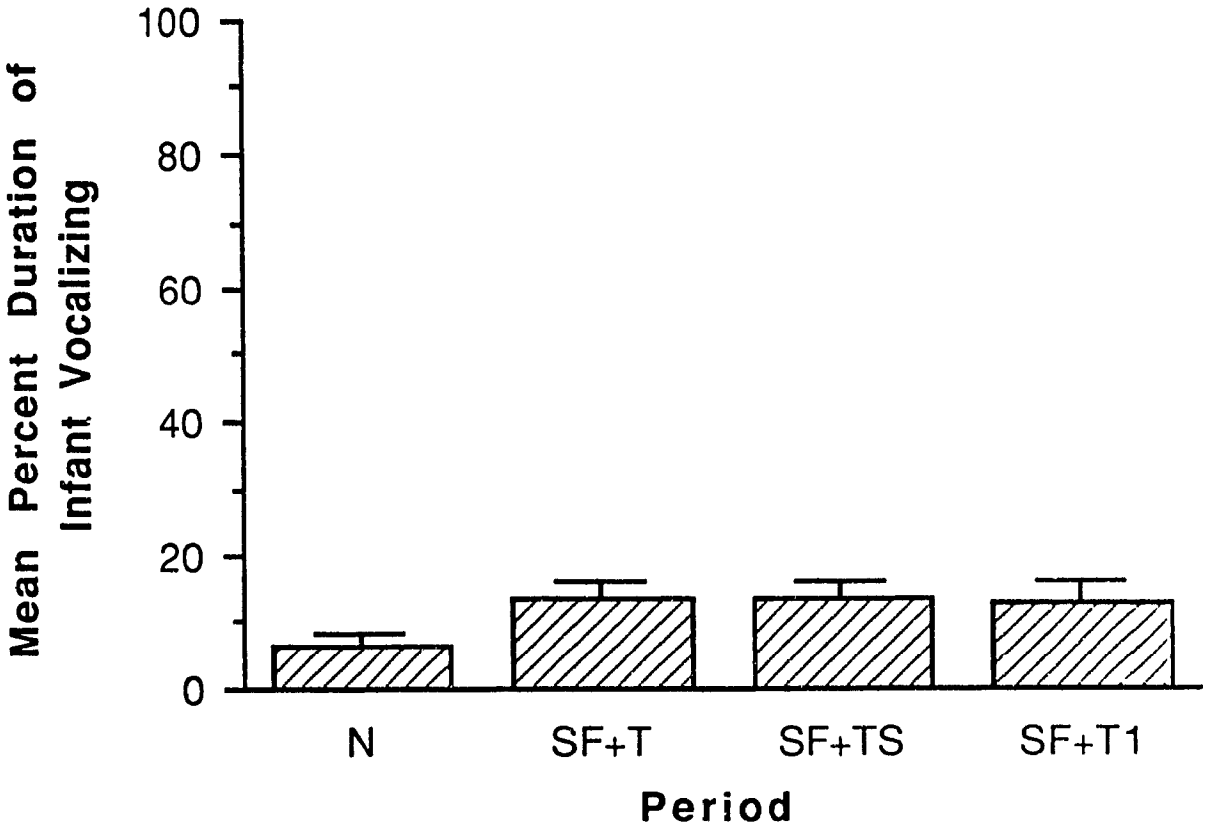
Sequential Analysis

For the sequential analysis each period will be discussed separately, in terms of the significant given behaviours that were found to occur before (i.e., at lag -1), and after (i.e., at lag +1) the target behaviour of Infant Smiling. Statistical significance is based on the Sackett, two-tailed z-scores, with absolute z-scores at or above 1.96, 2.58, and 3.30 reflecting alpha levels of .05, .01 and .001 respectively. The sign of the z-score (i.e. + or -) does not provide any additional information, therefore only the absolute values will be provided in the tables.

Infant Smiling

Period 1 (N). The z-scores and p-values for the significant infant and mother behaviours occurring before

Figure 8. Mean percentage of time infants in the experimental group spent vocalizing as a function of Period (N = normal; SF+T = SF with touch; SF+TS = SF with touch and maximum smiling; SF+T1 = SF with touch in one area). Standard errors are shown by vertical bars.


Mean Percent Duration of Infant Vocalizing
100
80
60
40
20
0
N
SF+T
SF+TS
SF+T1
Period

and after Infant Smiling during the Normal period, in descending order of significance, are presented in Table 2. Before they smiled, infants were likely to be gazing at their mothers' hands while their mothers were touching them, and the mothers were likely touching their infants. After they had smiled, infants were likely to be gazing at their mothers' faces, whether their mothers were touching them or not. Mothers were likely to be touching their infants, after the infants had stopped smiling.

Period 2 (SF+T). As can be seen in Table 3, in the SF+T period infants were likely to begin smiling when their mothers were touching them, or when they were gazing at their mothers' hands. Further, infants were likely to begin smiling when they were gazing at their mothers' faces, or when they were gazing at their mothers' hands, while their mothers were touching them. Once they had stopped smiling, infants were likely to be gazing at their mothers' faces while they were touching their infants. Mothers were likely to be touching their infants, and the infants were likely to be gazing at their mothers' faces (without maternal touch) after they had stopped smiling.

Period 3 (SF+TS). As Table 4 illustrates, in the SF+TS period infants were likely to begin smiling when their mothers were touching them, and when they were gazing at their mothers' hands, with or without touch. After infants had stopped smiling, mothers were still touching them, and

Table 2

Significant Infant and Mother Behaviours Occurring Before and After Infant Smiling for Period 1 (N), in Descending Order of Significance

Lags	Given Behaviours	z-scores	p-values
Before (Lag -1)			
	Hands and Touching	3.22	$p < .01$
	Maternal Touching	2.58	$p < .01$
After (Lag +1)			
	Face and Touching	7.69	$p < .001$
	Face	7.16	$p < .001$
	Maternal Touching	5.45	$p < .01$

Table 3

Significant Infant and Mother Behaviours Occurring Before and After Infant Smiling for Period 2 (SF+T), in Descending Order of Significance

Lags	Given Behaviours	z-scores	p-values
Before (Lag -1)			
	Maternal Touching	3.15	$p < .01$
	Hands	2.69	$p < .01$
	Face and Touching	2.61	$p < .01$
	Hands and Touching	2.31	$p < .01$
After (Lag +1)			
	Face and Touching	5.70	$p < .001$
	Maternal Touching	4.33	$p < .001$
	Face	1.96	$p < .05$

Table 4

Significant Infant and Mother Behaviours Occurring Before and After Infant Smiling for Period 3 (SF+TS), in Descending Order of Significance

Lags	Given Behaviours	z-scores	p-values
Before (Lag -1)			
	Maternal Touching	3.55	$p < .001$
	Hands and Touching	2.41	$p < .05$
	Hands	2.16	$p < .05$
After (Lag +1)			
	Maternal Touching	3.85	$p < .001$
	Hands and Touching	3.50	$p < .001$
	Face and Touching	3.15	$p < .01$

infants were gazing either at their mothers' hands or at their mothers' faces, while they were still touching them.

Period 4 (SF+T1). Table 5 illustrates the significant given behaviours for Infant Smiling, in descending order of significance, along with the z-scores and p-values associated with them. Infants were likely to begin smiling in this period only when their mothers were touching them, which occurred frequently. After they had stopped smiling, the infants tended to be gazing at their mothers' faces while their mothers were touching them. Infants' mothers appeared to be touching their infants after they had stopped smiling, and infants also tended to be gazing at their mothers faces, when the mothe. , were not touching them, after the infants had stopped smiling.

Summary

The patterns in behaviour occurring before and after Infant Smiling appeared to be similar for all of the periods. Both before and after the infants smiled their mothers were touching them. There was an overall shift in infant gaze when they smiled, however, from their mothers' hands before they smiled, to their mothers' faces after they smiled. This generally occurred for all the SF with touch periods, as well as in the Normal period, where the mothers were able to speak to and smile at their infants. Thus, the infant and mother behaviours tended to occur in similar patterns around infant smiling, regardless of what other

Table 5

Significant Infant and Mother Behaviours Occurring Before and After Infant Smiling for Period 4 (SF+T1), in Descending Order of Significance

Lags	Given Behaviours	z-scores	p-values
Before (Lag -1)			
	Maternal Touching	2.88	$p < .01$
After (Lag +1)			
	Face and Touching	3.97	$p < .001$
	Maternal Touching	2.87	$p < .01$
	Face	2.19	$p < .05$

forms of expression the mothers were able to use.

As stated above, sequential analyses were also conducted using the target variables of Maternal Touch and Infant Vocalizations, and can be found in Appendix I. To summarize these findings, it appears that the more frequent behaviours that occurred before Maternal Touching were Infant Gazing at mothers' hands, Infant Gazing at mothers' faces, and Infant Smiling. These three behaviours were also present with relatively high frequency after maternal touching ended, although there was a slight shift from infants gazing at mothers' faces before they began touching them, to infants being more likely to gaze at their mothers' hands after touching ended. Infant Fretting occurred both before and after Maternal Touching, however this was only present in the SF+T period. Infant Vocalizing occurred only before Maternal Touching, and only in the SF+T and SF+TS periods.

Maternal touching occurred both before and after infants vocalized, and, when only the SF with touch periods were analyzed, infants tended to be gazing at their mothers' hands both before and after they vocalized. When the Normal period was included in the analyses, however, there was a slight shift from infant gaze at mothers' hands before they vocalized, to mothers' faces after they finished vocalizing.

Discussion

In general, the results from the nonsequential analyses of the present study support the hypotheses generated, and indicate that tactile stimulation both moderated the typical SF effect, and may serve an important role in mother-infant communication. No differences were found between the control and experimental infants in the Normal periods, and no changes in the control group were found over time, suggesting that the two groups were similar at the onset of the study, and that the infants in the control group were not fatigued by the number of periods in the study. Shifts in infants' gaze patterns occurred such that they were gazing primarily at their mothers' faces during the Normal periods, and at their mothers' hands during the SF with touch periods. Relatively low levels of infant fretting were obtained in the SF with touch periods, and infant smiling was high, particularly in the SF with touch period in which mothers were attempting to elicit their infants' smiling (SF+TS). The infant smiling elicited by the mothers in the SF+TS period was higher than that obtained in the other two SF with touch periods, and was just as high as the amount of smiling elicited in the control infants, when the mothers were using face, voice and touch to interact with their infants. Furthermore, in all SF with touch periods there was evidence for more maternal touching, and more infant vocalizing, relative to the Normal period.

The results obtained in the present study have important implications for the significance of touch as a modulator of the SF effect, and for its potential role in communication between infant and adult. Further evidence has been obtained for the shifts in infants' gaze from maternal faces to hands during the SF with touch period. As hypothesized, based on Stack and Muir's findings (1990, in press), the infants gazed more at their mothers' expressive faces in the Normal periods than at their non-expressive faces in the SF with touch periods in the present study. There was a trend for the infants to gaze more at their mothers' active hands during the SF with touch periods, however, this reached significance only in the SF with touch period where the mother was asked to elicit the most smiling from her infant (SF+TS). The higher levels of infant gaze at mothers' hands during the SF+TS period could suggest that the infants were more interested in their mothers' hands only during that period, when their mothers were potentially touching them more actively, while remaining neutral in facial expression. This interpretation contrasts with the view that infants avert their gaze when an increase in maternal activity is exhibited (e.g., Field, 1977). It is, however, consistent with the view that infant attention is maintained during high levels of maternal activity (e.g., Symons & Moran, 1987).

Moreover, the trend for infants to increase gaze at

their mothers' hands during the SF with touch periods is consistent with Stack and Muir's (1990, in press) findings where infant gaze was directed more at the mothers' hands during all SF conditions, when the hands were visible, relative to the mothers' faces. In one study by Stack and Muir (in press) their infants participated in SF with touch periods in which they could not see the adults' hands. During these periods, infants were more likely to spend time gazing at the adults' unexpressive faces, although the hands were the only expressive part of the adult. Stack and Muir (in press) discuss the fact that the positive affect elicited from the infants during those periods was therefore not due to the visual stimulation of the hands, but it was due to the actual sensation of touch from the hands. Given the findings from Stack and Muir (in press), it could be argued that the positive affect obtained in the SF with touch periods in the present study was due to the tactile stimulation rather than from the visual entertainment the mothers' hands were providing the infants. Therefore, some stimulation and expression, may be communicated to the infants through their mothers' touch, without any other form of expression.

It appears from the data obtained in both Stack and Muir's (1990, in press) work and in the present study that merely the amount of stimulation was not sufficient to maintain the infants' attention; the quality of the

stimulation was also important. Because the infants were spending significantly more time gazing at the mothers' hands during the SF+TS period than in the Normal period, and more than in the other SF with touch periods, it may be that they found the mothers' hands qualitatively more stimulating during that period. Thus, it appears that the mothers may have been doing something different with their hands during that period. The instructions given for this period asked the mothers to elicit the most smiling from their infants. The fact that the infants gazed at the mothers' hands in this period more than any other is an indication that the mothers changed their touching, probably due to the instructions given to them, and that this change elicited a corresponding change in infant attention. Thus, it could be argued that the infants noticed the change in mothers' touching behaviour, and were intrigued by that change. This is indicated not only by the higher amounts of attention from the infants to the mothers' hands, but also by the higher amounts of smiling exhibited by the infants in this period, regardless of the order in which the SF with touch periods were presented.

The fact that the mothers were able to elicit the most smiling from their infants during the SF+TS period provides further support for the argument that mothers may have changed their style of touching their infants during this period, and this change in maternal touching was reflected

in a change in infant response. The infants did smile more when their mothers were asked to elicit that smiling, and this increased smiling occurred when the only form of expression available to the mothers was touch. Thus, the results from the smiling measure lend credence to the interpretation for the gaze results. That is, it is possible that the mothers may have been doing something qualitatively different in the SF+TS period relative to the other SF with touch periods, and perhaps something that is comparable to what the control mothers were doing when they were able to use face and voice along with touch.

Although the hypothesis that infant smiling would not differ between the Normal period and the SF+TS period was only partially supported in the present study, more smiling was obtained in this period than in the other SF with touch periods. The amount of smiling elicited from the experimental infants in the SF+TS period was less than in their own Normal period, however, it appears that the mothers were able to elicit higher amounts of smiling from their infants during the SF with touch periods when asked to do so. Furthermore, the amount of infant smiling in the experimental group did not differ in the SF+TS period from the amount of smiling obtained by the control infants. Thus, when mothers were only using touch to interact with their infants, the infants smiled just as much as when the mothers used all forms of expression with their infants.

The positive role of maternal touch during the SF with touch periods is also evidenced by the low amounts of overall infant fretting. Thus, as evidenced by Stack and Muir (1990, in press), and replicated here, touch appeared to be effective in modulating the negative effects of the standard SF situation in the present study. By adding touch to the standard SF situation infants' negative affect decreased, and positive affect increased. Thus, touch, even when alone, appears to be a powerful means of interacting with an infant such that the infant's affect is more positive, and less negative. However, due to an interaction between the Order and Period variables, the hypothesis that infants would exhibit more fretting in the SF with touch period when the mother touched her infant only in one area of the body could not be clearly examined. Since more fretting was obtained in the SF+T1 period when it occurred last in the testing session, this suggests that the possible distressing effects of that period were heightened due to infant fatigue. That is, when the SF+T1 period occurred last in the session the infants were much more likely to exhibit fretting, due to the compounding effect of fatigue. The fact that infants did not vocalize as much in this period than in the other SF with touch periods also indicates that the infants were exhibiting more fretting in this period. Since only positive or neutral sounds were coded as vocalizations, and crying and fussing sounds were

included in the fretting variable, the fact that there were fewer vocalizations in the SF+T1 period suggests that the infants were either as silent as they were in the Normal period, or that they were crying and fussing more in this period than in any of the other SF periods.

Unfortunately, since negative vocalizations were not included for analysis as a separate variable in the present study, this hypothesis can not be statistically tested. It appears, however, through an examination of the videotapes, that the latter hypothesis may be the more accurate one. When they were not fussing or crying, infants, when in the SF+T1 period, appeared to vocalize as much as they did in the other SF periods, and more than they did in the Normal period. Indeed, when looking at the means for Infant Vocalizations, there is only a marginal difference between the amount of vocalizations in all of the SF with touch periods, and the amount of infant fretting overall was very low indicating that the addition of tactile stimulation to the standard SF situation is enough to regulate the infants' affect, at least for short periods of time.

The argument that touch can modulate the SF effect and even differentially elicit positive affect as a function of instruction is even more compelling when viewed in the context of the low fretting observed. In addition, the fact that infant smiling was greater in the SF+TS period, and just as great as infants in the control group, is

encouraging when comparisons are made to other studies in which infant smiling has been seen to decrease, even when all forms of expression are available to the mothers. Symons and Moran (1987), for example, found that infant positive affect decreased significantly from the natural face-to-face interaction to the imitative interactions between mothers and their infants. During the periods in which mothers were playing with their infants normally, the infants displayed significantly more smiling than when mothers were asked to imitate their infants. It is noteworthy that in both conditions mothers were able to use all forms of expression to interact with their infants (Symons & Moran, 1987), whereas in the present study, mothers were allowed to use only touch, and yet the results were comparable. Further, the fact that the mothers in the experimental group in this study were able to elicit the same amount of smiling from their infants, using only touch, compared to the mothers in the control group, suggests that touch, when used alone and for brief periods of time, can effectively maintain positive affect at least equal to the combination of face and voice in the imitative condition of Symons and Moran's (1987) study. In their study, Symons and Moran noted that their mothers indicated that the imitative situation was less communicative than the other periods, and this was perhaps reflected in the infants' less positive responses. This suggests, further, that the mothers in the

present study were able to maintain an appropriate level of communication with their infants when they were using only touch in their interactions with them. The fact that the mothers in the present study were able to maintain some form of reciprocity, through touch, in their interactions with their infants, which was lacking in the imitative condition of Symons and Moran's (1987) study, may explain the levels of infant positive affect found in the SF+TS period in this study.

The results discussed thus far are those obtained from the more traditional analyses conducted on both the mother and infant behaviours assessed in the present study. To further establish the interactive and reciprocal components of maternal touch, the results obtained from the sequential analysis warrant examination. As discussed above, through the shifts in infants' gazing and their increased smiling in the SF+TS period, it appears that the mothers may have been able to maintain a level of communication with their infants, when using touch alone. The results from the sequential analysis are consistent with these findings, as they also revealed some shifts in infants' gaze around the target behaviour of Infant Smiling. More specifically, when infants began to smile they tended to be gazing at their mothers' hands, which were most likely touching them. Once they had smiled, however, infants tended to be gazing at their mothers' faces, also while their mothers were touching

them. This shift in infant gaze before and after smiling suggests that the infants were initially smiling because of the tactile stimulation from their mothers' hands. That the infants gazed at their mothers' faces after they had begun smiling is intriguing, and suggests several possible explanations in line with the communication hypotheses.

One interesting hypothesis was generated from Sifter and Moyer's (1991) study in which they found that 5-month-old infants would use gaze aversion to regulate the intensity of their positive arousal. These authors suggested that infants would actively regulate the amount of positive arousal they were experiencing by turning away from the arousing stimuli. Thus, it could be hypothesized that the infants in the present study were attempting to regulate their positive affect by gazing away from the stimulating event. Several difficulties with this hypothesis arise, however. For instance, as Stack and Muir (in press) have suggested, it is not the visual aspect of the moving hands that increases infants' positive affect in the SF with touch periods; the actual tactile stimulation, which the infants in this study were receiving even when they gazed away from the hands, is the component which is necessary for the modulating effects of the SF situation. Further, there is little justification in this explanation for why the infants would be more likely to choose the mothers' faces to gaze at when turning away from the mothers' hands, than other

aspects of the testing environment. Therefore, the hypothesis that the infants were exhibiting gaze aversion when they were smiling may not be appropriate in the present study's interactive periods.

Another hypothesis for the shift in infant gaze from their mothers' hands to their mothers' faces when the infants smiled is that they were exhibiting social matching and synchrony. Tronick and Cohn (1989) defined social matching as "the degree to which infant and mother are in the same behavioral state at the same time" and synchrony is defined as "how consistently the pair are able to move together over time regardless of the content of their behaviour" (p. 86). In their study on the coordination of mother-infant face-to-face interactions they found that both social matching and synchrony were prevalent in infants by 6 months of age. It could be suggested, then, that the infants in the present study were gazing at their mothers' faces, once they were smiling, to see what their mothers' responses were, and if they matched their own. Thus, infants were gazing at their mothers hands while they were touching them, and the tactile stimulation elicited positive affect in the infants. They then may have wanted to see what their mothers' responses were, perhaps to confirm synchrony with them, thus they gazed at their mothers' faces. The infants may have been gazing at their mothers' faces after smiling, not only to gain synchrony with them,

but because they may have had some level of expectation of their mothers' responses. Therefore, the infants may have anticipated a reaction from their mothers when they smiled, because of previous interactions in which their mothers may have reacted to their infants' positive affect, probably by smiling themselves.

A further, perhaps more compelling hypothesis for this shift in infant gaze around their smiling in the SF with touch periods, is that the infants may have been referencing their mothers' faces when the infants smiled, thus indicating that they could make the link from their mothers' hands to their mothers' faces. In other words, the infants knew that the hands belonged to their mothers' faces, and thus were smiling at their mothers' faces to show that they were "enjoying" the tactile stimulation their mothers were providing. This hypothesis gains some credence from Stack and Muir's (in press) findings that when the mothers' hands were not visible to the infants, the infants would spend more time gazing at their mothers' unexpressive faces than they would in a SF with touch period when the mothers' hands were visible. This could also have been an indication that the infants knew that the tactile stimulation was coming from their mothers, and thus were gazing at their mothers' faces, even though they were neutral. This hypothesis suggests that, at a relatively young age, infants are able to link parts of their mothers' bodies into an integrated

whole, and thus may have more awareness of what their mothers are doing and where stimulation is coming from than previously thought. Further research concentrating on this aspect of infant awareness and mother-infant interactions is warranted.

The sequential analysis also revealed that before the infants began to smile, their mothers were most likely touching them. Thus, it appears that, at least in the SF with touch periods, the infants were smiling because of the tactile stimulation they were receiving from their mothers, and not because of other, perhaps less relevant stimuli, such as the testing room or chair. This interpretation is perhaps more difficult to accept for the Normal period, however, as the mothers were likely using vocal and visual stimulation with their infants at the same time as touching them, however, it is worth noting that the infants were still more likely to smile in the Normal period when their mothers were touching them. This again indicates the importance of tactile stimulation during social interactions with infants, and it indicates that the tactile modality is used often by mothers with their infants.

Returning to the nonsequential analyses, maternal touching was fairly prevalent during the Normal period in the present study, but, as hypothesized, it increased significantly during the SF with touch periods. There was no difference between the SF with touch periods in the amount

of maternal touching, however, the overall increase in maternal touching in the SF with touch periods relative to the Normal appeared to evoke a corresponding change in infants' responses. Although the quality of maternal touching was not statistically analyzed, through visual examination of the sessions it appears that mothers were more likely to use more kinaesthetic types of touch with their infants during the SF period when they were attempting to elicit their infants' smiling, and they appeared to be more likely to use softer, more stroking types of touch in the other two SF with touch periods. Only with further analyses and subsequent studies will these hypotheses be confirmed or disconfirmed.

The increase in maternal touching during the SF periods was not surprising, as this was the only form of expression available to the mothers during these periods. However, the possible change in the quality of maternal touching and the subsequent change in infant responses has both theoretical and practical implications for teaching new mothers more beneficial ways of interacting with their infants. Researchers have previously used instructions to mothers in their research on child and infant abilities and compliance (e.g., Lollis, 1990; Stack & Muir, in press; Symons & Moran 1987). Lollis (1990), for example, found that mothers changed their behaviour according to the experimenter's instructions, and this change appeared to strongly influence

their children's subsequent behaviour. Thus the abilities and apparent willingness of mothers to follow experimenters' instructions has been evidenced, but also the subsequent effects of these changes on the children or infants involved has been documented.

It appears, then, that instruction can influence adult behaviour towards their infants, and the results of the present study, along with previous findings (e.g., Lollis, 1990; Symons & Moran, 1987), suggest that this change in parental behaviour can result in a subsequent change in the child or infant's behaviour. Therefore, instructional programs for parents with high-risk infants (e.g., Barrera et al., 1986) might be beneficial in the resulting normal development and general well-being of the infant. Furthermore, there is strong evidence that high-risk infants can benefit from these programs, both physically (e.g., Harrison, 1989) and behaviourally (e.g., Scafidi et al., 1986; Watt, 1990). For instance, Watt (1990) noted that intervention information given to their mothers affected their behaviour, and that of their infants. They further speculated that their small for gestational age infants were able to attain state organization through the potential changes in their mothers' touching behaviour, and this enabled the infants to engage more easily in the social interactions with their mothers. Thus, infants can and do respond to changes in their mothers' behaviour, even when,

as in the present study, the only form of expression available to the infants is their mothers' touch. It appears that maternal touch, alone, at least for brief periods of time, is able to elicit changes in infants' responses, and thus it may arguably be a useful and effective form of communication between a mother and her infant.

The results from the present study have invoked some intriguing hypotheses about mother-infant interactions and, more importantly, about the influence of maternal touch and the communication that this mode of expression adds to these interactions. Future research concentrating on the hypotheses that were generated will aid in further clarifying the intricacies of mother-infant interactions. For example, as previously mentioned, because negative vocalizations were not coded and statistically analyzed the interpretation of the results found both for infant vocalizations and for fretting cannot be clearly defined. Also as previously mentioned, no empirical evaluation was conducted on the quality of maternal touching, and so again the potential differences in the types of touch the mothers used with their infants cannot be adequately assessed. Both of these limitations can be addressed in future research through the separation of infant fretting with and without vocalizations, and through a qualitative analysis of the types of touch, in addition to an analysis of when the

different types of touch are used by mothers with their infants.

Because only mothers were used in this study, the results can not be generalized to fathers, or non-parent adults. The generalizability of the findings would be increased in future research, however, by including fathers, and eventually non-parent, male and female strangers in the modified SF condition to assess if there is a difference in infant response depending on the adult interactor, and if there is a difference in adult interactor's behaviour depending on the sex of the infant. Some of this research has already been conducted. For example, in Stack and Muir's (in press) study they used female strangers to interact with the infants for a direct comparison with the infants' mothers. The use of fathers and male strangers, however, could extend researchers' knowledge to the potential differences between the reactions of male and females, parents and non-parents, to young infants. Although the use of normal infants in the present study also limits generalizability of the results, because the modality of touch has previously been less emphasized in the research literature it is first necessary to obtain a baseline of its influence on the normal infant's socio-emotional development before it can be adequately assessed with regard to disadvantaged or high risk infants.

With the results of the present study implications

arise both for the direction of future research on the communicative aspect of touch, and for the significance and importance of touch in the socio-emotional development of both normal and disadvantaged infants. Future research might emphasize the contingency between maternal touching behaviour and infant responses. Further examination of the potential coordination of infant gaze and maternal touching behaviour, in terms of the infant's awareness of the connection between the mother's hands and her face, also warrants empirical attention. Once more is learned about the importance and the communicative aspects of the tactile modality in the infant's socio-emotional development, this knowledge can be extended to disadvantaged infants, such as physically disabled, or blind infants, where touch may be even more important as a modality for communication and socio-emotional development than it is with normal infants.

In summary, the results of the present study indicate that the reactions of infants during face-to-face interactions with their mothers demonstrate their ability to reciprocate their mothers' behaviours. Once again the effects of touch in modulating the standard SF effects have been exhibited. Moreover, these results have been extended in the present study to include the importance of instruction on mothers' behaviours, even when touch is the only behaviour available to them, and the differential responses of infants' to that change in maternal touching.

Mothers appear to be able to elicit specific responses from their infants, such as smiling, using touch alone. Thus, the importance of instruction on maternal behaviour has been indicated, and the resulting change in infant behaviour has also been demonstrated. However, perhaps most intriguing is the fact that all of this has occurred with touch alone. Therefore, it appears that maternal touching is a potentially diverse form of stimulation, and further, that the mother seems to be able to communicate her desires (i.e., to get the infant to smile) to the infant through this modality alone. Touch, as a form of communication between a mother and her infant, appears to be both diverse and dynamic, and on the basis of these findings, an important component of the socio-emotional development of the infant.

References

Anderson, J. (1986). Sensory intervention with the preterm infant in the neonatal intensive care unit. The American Journal of Occupational Therapy, 40, 19-26.

Bakeman, R. (1983). Computing lag sequential statistics: The ELAG program. Behavior Research Methods & Instrumentation, 15, 530-535.

Bakeman, R., & Gottman, J.M. (1986). Observing interaction: An introduction to sequential analysis. Cambridge: Cambridge University Press.

Barrera, M.E., Rosenbaum, P.L., & Cunningham, C.E. (1986). Early home intervention with low-birth weight infants and their parents. Child Development, 57, 20-33.

Billing, A.E., & Vince, M.A. (1987). Teat-seeking behaviour in newborn lambs. II. Evidence for the influence of the dam's surface textures and degree of surface yield. Applied Animal Behaviour Science, 18, 315-325.

Bornstein, B.H., Terry, L.M., Browde Jr., J.A., Assimon, S.A., & Hall, W.G. (1987). Maternal and nutritional contributions to infant rats' activational responses to ingestion. Developmental Psychobiology, 20(2), 147-163.

Bowlby, J. (1969). Attachment and Loss: Vol.1. Attachment. New York: Basic Books.

Brazelton, T.B. (1990). Touch as a touchstone: Summary of the round table. In K.E. Barnard, & T.B. Brazelton (Eds.), Touch: The foundation of experience. Connecticut: International Universities Press, Inc.

Campos, J.J., Barrett, K., Lamb, M.E., Goldsmith, H.E., & Stenberg, C. (1983). Socioemotional development. In M.M. Haith, & J.J. Campos (Eds.), P.H. Mussen (Series Ed.), Handbook of child psychology: Vol.2. Infancy and developmental psychobiology (pp.783-915). New York: Wiley.

Caron, A.J., Caron, R.F., & MacLean, D.J. (1988). Infant discrimination of naturalistic emotional expressions: The role of face and voice. Child Development, 59, 604-616.

Carter, A.S., Mayes, L.C., & Pajer, K.A. (1990). The role of dyadic affect in play and infant sex in predicting infant response to the still-face situation. Child Development, 61, 764-773.

Cohen, J. (1977). Statistical power analysis for the behavioral sciences (rev. ed.) New York: Academic Press.

Cohn, J.F., & Tronick, E.Z. (1987). Mother-infant face-to-face interaction: The sequence of dyadic states at 3, 6, and 9 months. Developmental Psychology, 23(1), 68-77.

de Château, P. (1976). The influence of early contact on maternal and infant behaviour in primiparae. Birth and the Family Journal, 3(4), 149-155.

de Château, P. (1977). The importance of the neonatal period for the development of synchrony in the mother-infant dyad -- A review. Birth and the Family Journal, 4(1), 10-22.

Dixon, W.J., Brown, M.B., Engelman, L., & Jennings, R.I. (1990). BMDP statistical software manual (vols. 1,2). Berkeley: University of California Press.

Engel, C. (1985). Observations on the interaction between adult infant-carrying animals and group members without rearing experience in the common Marmoset, Callithrix jacchus. Folia Primatology, 45, 225-235.

Field, T.M. (1977). Effects of early separation, interactive deficits, and experimental manipulations on infant-mother face-to-face interaction. Child Development, 48, 763-771.

Giddings, C. Cochrane. (1986). Vestibular-proprioceptive and tactile-kinesthetic intervention for premature infants. Physical and Occupational Therapy in Pediatrics, 6(2), 87-94.

Gottfried, W.A. (1990). Touch as an organizer of development and learning. In K.E. Barnard, & T.B. Brazelton (Eds.), Touch: The foundation of experience. Connecticut: International Universities Press, Inc.

Gusella, J.L., Muir, D.W., & Tronick, E.Z. (1988). The effect of manipulating maternal behavior during an interaction on 3- and 6-month olds' affect and attention. Child Development, 59, 1111-1124.

Halliday, S., & Leslie, J.C. (1986). A longitudinal semi-cross-sectional study of the development of mother-child interaction. British Journal of Developmental Psychology, 4, 211-222.

Hamnett, F.S. (1921). Studies in the thyroid apparatus: I. American Journal of Physiology, 56, 196-204.

Harrison, L. (1985). Effects of early supplemental stimulation programs for premature infants: Review of the literature. Maternal Child Nursing Journal, 14(2), 69-90.

Harrison, M.J. (1989). A comparison of parental interactions with term and preterm infants. Research in Nursing and Health, 13(3), 173-179.

Helders, P.J.M., Cats, B.P., & Debast, S. (1989). Effect of a tactile stimulation/range-finding programme on the development of VLBW-neonates during the first year of life. Child Care, Health and Development, 15(6), 369-380.

Horwich, R.H. (1989). Cyclic development of contact behavior in apes and humans. Primates, 30(2), 269-279.

Johnson, R.L. (1986). Mother-infant contact and maternal maintenance activities among free-ranging Rhesus monkeys. Primates, 27(2), 191-203.

Karssemeijer, G.J., Vos, D.R., & Van Hooff, J.A.R.A.M. (1990). The effect of some non-social factors on mother-infant contact in long-tailed Macaques (macaca fascicularis). Behaviour, 113(3-4). 273-291.

Kaye, K., & Fogel, A. (1980). The temporal structure of face-to-face communication between mothers and infants. Developmental Psychology, 16, 454-464.

Keller, H., & Schölmerich, A. (1987). Infant vocalizations and parental reactions during the first 4 months of life. Developmental Psychology, 23(1), 62-67.

Kemps, A., Timmermans, P., & Vossen, J. (1990). Developmental trends in mother-infant interactions in Java macaques (Macaca fascicularis) during the first ten days of life. Primates, 31(1), 65-77.

Keppel, G. (1982). Design and analysis: A researcher's handbook (2nd. ed.). Englewook Cliffs, NJ: Prentice-Hall.

Kisilevsky, B.S., & Muir, D.W. (1984). Neonatal habituation and dishabituation to tactile stimulation during sleep. Developmental Psychology, 20(3), 367-373.

Kisilevsky, B.S., Stack, D.M., & Muir, D.W. (1991). Fetal and infant response to tactile stimulation. In M.J.S. Weiss and P.R. Zelazo (Eds.), Newborn attention: Biological constraints and the influence of experience. New Jersey: Ablex Publishing Company.

Lamb, M.E., & Bornstein, M.H. (1987). Development in Infancy, (Second Edition). New York: Random House.

Lamb, M.E., Morrison, D.C., & Malkin, C.M. (1987). The development of infant social expectations in face-to-face interaction: A longitudinal study. Merrill-Palmer Quarterly, 33(2), 241-254.

Linton, M., & Gallo, Jr., P.S. (1975). The practical statistician: Simplified handbook of statistics. Monterey: Brooks/Cole Publishing Company.

Lollis, S.P. (1990). Effects of maternal behavior on toddler behavior during separation. Child Development, 61, 99-103.

Mayes, L.C., & Carter, A.S. (1990). Emerging social regulatory capacities as seen in the still-face situation. Child Development, 61, 754-763.

Millot, J.L, Filiatre, J.C., & Montagner, H. (1988). Maternal tactile behaviour correlated with mother and newborn infant characteristics. Early Human Development, 16, 119-129.

Moran, G., Krupka, A., Tutton, A., & Symons, D. (1987). Patterns of maternal and infant imitation during play. Infant Behavior and Development, 10, 477-491.

Murray, L., & Trevarthen, C. (1985). Emotional regulation of interactions between two-month-olds and their mothers. In T.M. Field & N.A. Fox (Eds.), Social perception in infants. New Jersey: Ablex Publishing Corp.

Pohlman, S., & Beardslee, C. (1987). Contacts experienced by neonates in intensive care environments. Maternal Child Nursing Journal, 16(3), 207-226.

Rapaport, L., & Mellen, J.D. (1990). Parental care and infant development in a family group of captive Sichuan golden monkeys (Thinopithecus roxellanae): First 20 days. Primate, 31(1), 129-135.

Roedell, W. Conklin, & Slaby, R.G. (1977). The role of distal and proximal interaction in infant social preference formation. Developmental Psychology, 13(3), 266-273.

Ross, E. Fromm. (1984). Review and critique of research on the use of tactile and kinesthetic stimulation with premature infants. Physical and Occupational Therapy in Pediatrics, 4(1), 35-49.

Rutter, D.R., & Durkin, K. (1987). Turn-taking in mother-infant interaction: An examination of vocalizations and gaze. Developmental Psychology, 23(1), 54-61.

Scafidi, F.A., Field, T.M., Schanberg, S.M., Bauer, C.R., Tucci, K., Roberts, J., Morrow, C., & Kuhn, C.M. (1990). Massage stimulates growth in preterm infants: A replication. Infant Behavior and Development, 13, 167-188.

Scafidi, F.A., Field, T.M., Schanberg, S.M., Bauer, C.R., Vega-Lahr, V., Garcia, R., Poirer, J., Nystrom, G., & Kuhn, C.M. (1986). Effects of tactile/kinesthetic stimulation on the clinical course and sleep/wake behavior of preterm neonates. Infant Behavior and Development, 9, 91-105.

Shrout, P.E., & Fleiss, J.L. (1979). Intraclass correlations: Uses in assessing rater reliability. Psychological Bulletin, 86(2), 420-428.

Sifter, C.A., & Moyer, D. (1991). The regulation of positive affect: Gaze aversion activity during mother-infant interaction. Infant Behavior and Development, 14, 111-123.

Small, M.F. (1990). Alloparental behaviour in Barbary macaques, Macaca sylvanus. Animal Behaviour, 39, 297-306.

Smotherman, W.P. (1983). Mother-infant interaction and the modulation of pituitary-adrenal activity in rat pups after early stimulation. Developmental Psychobiology, 16(3), 169-176.

Stack, D.M., & Bennett, E.M. (1990). Infants' affective and attentional responses to tactile and auditory stimuli varying in complexity. Infant Behavior and Development, 13, 627.

Stack, D.M., & Muir, D.W. (1990). Tactile stimulation as a component of social interchange: New interpretations for the still-face effect. British Journal of Developmental Psychology, 8, 131-145.

Stack, D.M., & Muir, D.W. (in press). Adult tactile stimulation during face-to-face interactions modulates 5-month-olds' affect and attention. Child Development.

Stanton, M.E., & Levine, S. (1990). Inhibition of infant glucocorticoid stress response: Specific role of maternal cues. Developmental Psychobiology, 23(5), 411-426.

Stenberg, C.R., Campos, J.J., & Emde, R.N. (1983). The facial expressions of anger in seven-month-old infants. Child Development, 54, 178-184.

Symons, D.K., & Moran, G. (1987). The behavioral dynamics of mutual responsiveness in early face-to-face mother-infant interactions. Child Development, 58, 1488-1495.

Tabachnick, B.G., & Fidell, L.S. (1989). Using Multivariate Statistics, 2nd ed. New York: Harper & Row.

Tronick, E., Als, H., Adamson, L., Wise, S., & Brazelton, T.B. (1978). The infant's response to entrapment between contradictory messages in face-to-face interaction. Journal of the American Academy of Child Psychiatry, 17, 1-13.

Tronick, E.Z., & Cohn, J.F. (1989). Infant-mother face-to-face interaction: Age and gender differences in coordination and the occurrence of miscoordination. Child Development, 60, 85-92.

Vince, M.A. (1987). Tactile communications between ewe and lamb and the onset of suckling. Behavior, 101(1-3), 156-176.

Vos, J.E., van Wulfften Palthe, T., De Roos, B., & Hopkins, B. (1990). Information statistics as applied to social interaction between mother and infant: Synergic covariability vs. partial cross-covariability. International Journal of Biomedical Comput, 25, 33-45.

Watt, J. (1990). Interaction, intervention, and development in small-for-gestational-age infants. Infant Behavior and Development, 13, 273-286.

Weiss, S.J. (1988). Touch. In J.J. Fitzpatrick, R.L. Taunton, J.Q. Benoliel (Eds.), Annual review of nursing research (Vol. 6). New York: Springer Publishing Company.

Winer, B.J. (1971). Statistical Principles in Experimental Design, 2nd ed. New York: McGraw Hill.

Zelazo, P.R. (1972). Smiling and vocalizing: A cognitive emphasis. Merrill-Palmer Quarterly, 18, 349-365.

Zelazo, P.R., & Komer, M.J. (1971). Infant smiling to nonsocial stimuli and the recognition hypothesis. Child Development, 42, 1327-1339.

Zwick, R. (1986). Testing pairwise contrasts in one-way analysis of variance designs. Psychoneuroendocrinology, 11(3), 253-276.

Appendix A

Power Analysis

k = number of cells N = number subjects from table

n_c = subjects per cell u = degrees of freedom

fmed = medium effect p = probability level

a = critical alpha level

Study: Groups (2 levels) x Periods (4 levels)

Sample Size:

1. Group Effect (2 levels)

$u = df_{gp} = 1$ a = .05 $f_{med} = .25$ p = .90

N to detect = 85

$$n_c = \frac{(N-1)(u+1)}{k} + 1$$

$$= \frac{(84)(2)}{8} + 1$$

= 22 subjects per cell, therefore 44 subjects are needed in total to obtain 90% power.

2. Periods (4 levels)

$u = df_p = 3$ a = .05 $f_{med} = .25$ p = .90

N to detect = 58

$$n_c = \frac{(N-1)(u+1)}{k} + 1$$

$$= \frac{(57)(4)}{8} + 1$$

= 30 subjects per cell, therefore 30 subjects are needed in total to obtain 90% power because this is a within subjects variable.

3. Group by Period Interaction

$u = df_{gp} = 3$ $\alpha = .05$ $f_{med} = .25$ $p = .90$

N to detect=58

$$n_c = \frac{(N-1)(u+1)}{k} + 1$$

$$= \frac{(57)(4)}{8} + 1$$

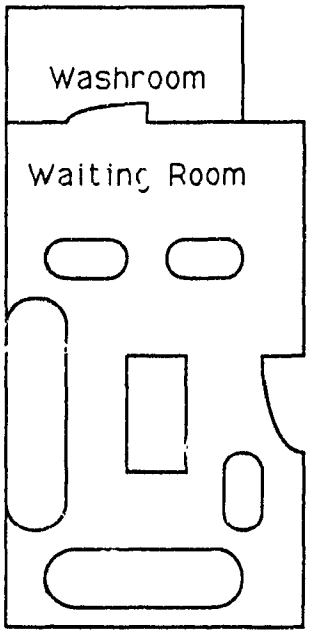
= 30 subjects per cell, therefore 30 subjects needed in total to obtain 90% power.

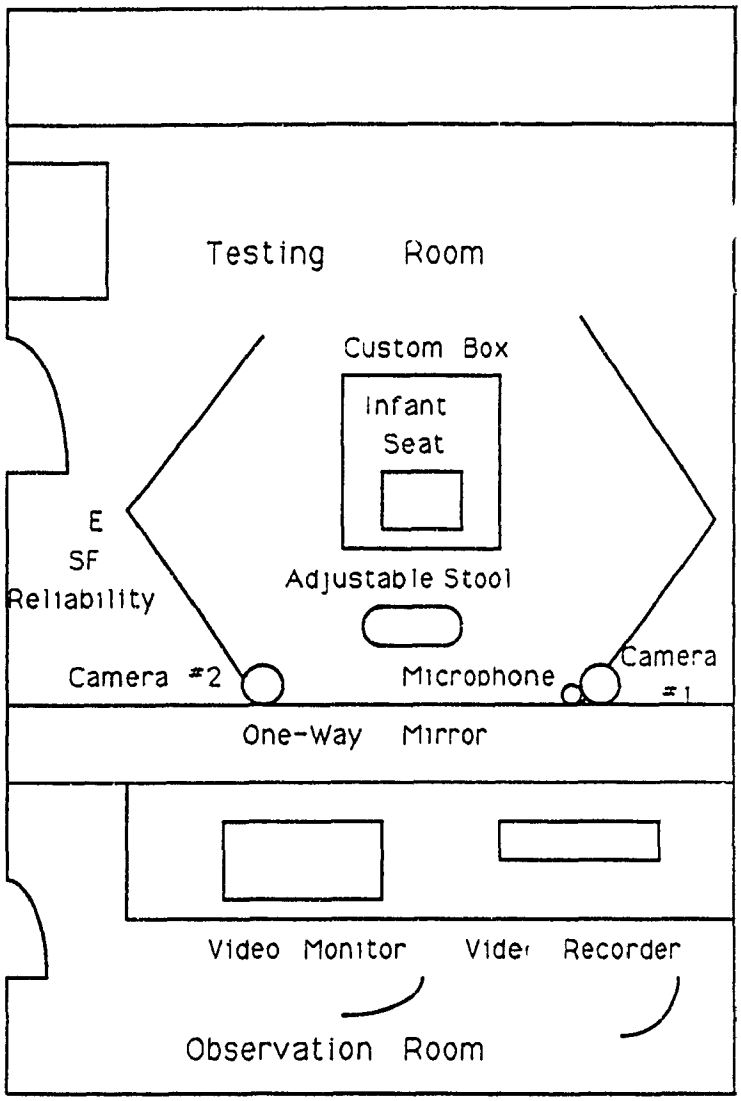
Therefore, we need 44 subjects in total for a 90% chance of detecting a medium effect size at a = .05.

Appendix B

Schematic Diagram of

Testing Situation and Apparatus





E=Experimenter

Appendix C

Detailed Instructions to Mothers

Normal:

1. For this period, I would like you to play with your baby as you normally would at home.

SF+T:

2. For this period, I would like you to be silent and have a still face, but you may touch your baby.

SF+TS:

3. For this period, I would like you to be silent and have a still face, but, using only touch, try to get the most smiling from your baby.

SF+T1:

4. For this period, I would like you to be silent and have a still face, while touching your baby only in one area of his/her body.

Appendix D

Consent Forms

CONSENT FORM(experimental)

This study is designed to look at infants' responses to touch and to study the different types of touching used by caregivers. I understand that my baby will participate in one session lasting about 60 minutes. My baby will be seated in an infant seat directly facing me. I understand that heart rate recordings may be taken. The procedure will consist of four 90 second interaction periods where different tactile games will by presented on my baby's body. I will be asked to be neutral and unresponsive in facial expression and silent in several of the periods, while using different touch games to interact with my baby. There will be brief breaks separating the interaction periods. No manipulation will be harmful to my baby. The entire session will be videotaped so that at a later point my baby's responses can be scored. However, the recordings are kept in the strictest of confidence and are not shown to others without my permission. In any case, all recordings will be destroyed after 4 years.

I understand that my participation in this study is totally voluntary. I know that I may withdraw at any time and for any reason. I also understand that I may request that the videotape recording be erased. In the event that the results of the study are published, my name and the name of my baby will be kept confidential.

In the event that I have any unanswered concerns or complaints about this study, I may express these to Dr. Dale Stack (848-7565) of the Psychology Department at Concordia University. In addition, the patient representative at the Jewish General Hospital is Roslyn Davidson (340-8222, local 5833).

Thank you for your cooperation.

I _____ do hereby give my consent for my baby _____to participate in a study conducted by Dr. Dale Stack and Diane LePage at Concordia University, and with the cooperation of the Jewish General Hospital. A copy of the consent form has been given to me.

Signature: _____ Date: _____

Witness: _____ Date: _____

DECLARATION DE CONSENTEMENT

Cette étude a pour but d'observer les reactions des nourrissons à des stimulations tactiles et de documenter les différents types de touchers utilisés par les parents. Je comprends que mon enfant devra participer à une session d'environ 60 minutes. Mon enfant sera assis dans un siège pour enfant qui me fera face. Je comprends qu'il se peut que les battements cardiaques de mon enfant soient mesures. La session consistera en quatre brèves périodes d'interaction (quatre-vingt dix secondes) où on me demandera de pratiquer différent jeux tactiles sur le corps de mon enfant. Il se peut qu'on me demande d'assumer une expression faciale neutre et d'être silencieuse durant les jeux tactiles avec mon enfant. Il y aura de courtes poses entre chaque seance tactile. Les manipulations experimentales ne seront d'aucun danger pour mon enfant. La session entière sera enregistree sur vidéo afin de permettre la codification des réactions de mon enfant à une date ultérieure. Cependant, j'ai ete assuré(e) que les enregistrements vidéos demeureront confidentiels et ne seront montrés à d'autres personnes que si je le permets. Ces enregistrements seront détruits après une période 4 ans.

Je comprends que ma participation à cette étude est volontaire et que je peux soustraire mon enfant de l'etude en tout temps et cela, sans avoir à donner d'autres explications. Je comprends aussi que j'ai le droit d'exiger que le ruban magnétoscopique soit détruit. Je permets que les resultats obtenus soient publiés, sachant que mon nom et le nom de mon enfant seront gardés confidentiels.

Dans l'éventualité où j'aurais des questions ou une plainte à formuler concernant cette étude, je peux m'adresser au Dr. Dale Stack (848-7565) du Département de Psychologie de l'Université Concordia. Je peux aussi communiquer avec Roslyn Davidson (340-8222, ext.5833), représentante des patients à l'Hôpital Général Juif.

Merci pour votre coopération.

Je _____ par la présente,

consent à ce que mon enfant _____

participe à une étude conduite par le Dr. Dale Stack et Diane LePage à l'Université Concordia, en coopération avec l'Hôpital Général Juif. Une copie de la déclaration de consentement m'a été remise.

Signature:_____ Date:_____

Témoin: _____ Date:_____

CONSENT FORM (control)

This study is designed to look at infants' responses to touch and to study the different types of touching used by caregivers. I understand that my baby will participate in one session lasting about 60 minutes. My baby will be seated in an infant seat directly facing me. I understand that heart rate recordings may be taken. The procedure will consist of four 90 second interaction periods where I will be asked to play with my baby as I normally would at home. There will be brief breaks separating the interaction periods. No manipulation will be harmful to my baby. The entire session will be videotaped so that at a later point my baby's responses can be scored. However, the recordings are kept in the strictest of confidence and are not shown to others without my permission. In any case, all recordings will be destroyed after 4 years.

I understand that my participation in this study is totally voluntary. I know that I may withdraw at any time and for any reason. I also understand that I may request that the videotape recording be erased. In the event that the results of the study are published, my name and the name of my baby will be kept confidential.

In the event that I have any unanswered concerns or complaints about this study, I may express these to Dr. Dale Stack (848-7565) of the Psychology Department at Concordia University. In addition, the patient representative at the Jewish General Hospital is Roslyn Davidson (340-8222, local 5833).

Thank you for your cooperation.

I _____ do hereby give my consent for my baby _____to participate in a study conducted by Dr. Dale Stack and Diane LePage at Concordia University, and with the cooperation of the Jewish General Hospital. A copy of the consent form has been given to me.

Signature: _____ Date: _____

Witness: _____ Date: _____

Appendix E

Demographic Questionnaire

Demographic Information

Order:

Study #:_____
Infant #:_____
Test Date:_____

Infant's Name:_____ D.O.B.:_____ E.D.O.B.:_____Age:___

Mother's Name:_____ Age:_____

Lang.'s Spoken:_____

Father's Name:_____ Age:_____

Lang.'s Spoken:_____

Phone #:_____

Address:_____
_____

Sex:_____ Birth Weight:_____ Length of Labour:_____

Preg. Complications and Delivery Status:_____
_____

Medical History:_____
_____

Breast fed:_____ Bottle fed:_____

Siblings:	Age	Sex
	_____	_____
	_____	_____
	_____	_____

Father's Occupation:_____ Education:_____

Mother's Occupation:_____ Education:_____

Mother's Recent Work History (full/part-time/home):_____

Father's Recent Work History (full/part-time/home):_____

Hours spent with infant all day:

Mother:	all day	3/4	1/2	1/4	< 1/4
Father:	all day	3/4	1/2	1/4	< 1/4

Caretaking History (# of caretakers, day/homecare, hours):__
_____

Comments:_____

Appendix F

Touch Questionnaire

Subject No. _____

1. When asked to touch your baby only in one area of his\her body where did you choose?

_____

_____

2. Why did you choose this area?

_____

_____

3. Where, on his\her body, does your baby like to be touched the most?

_____

_____

4. What type of touch do you think your baby likes the most? (e.g. stroke, pat, tickle)

_____

_____

5. How does your baby express his\her preference for or satisfaction with a specific type of touch?

_____

_____

6. a) How many hours in a day do you spend touching your baby, other than for caregiving purposes? When does this occur (i.e. during what activities)?

_____

_____

b) During games and other such activities how much do you touch your baby, relative to using sights and sounds?

_____

_____

7. How does your baby respond to your touch at these times?

_____

_____

8. What are all the types of touch that you would use with your baby?

Caregiving:_____

_____

Social/Interactional:_____

_____

Types of tactile games:_____

_____

Appendix G

Operational Definitions for Coded Behaviours

Smile: A smile was recorded if the infant's mouth was upturned, either open or closed.

Grimace: A grimace was recorded if the infant's mouth was turned down, curled, or the infant was crying.

Vocalization: A vocalization was defined as any utterance or sound accompanied by positive or neutral affect. It excluded sounds accompanied by negative affect, such as whining, fussing, and crying, or effort vocalizations expressing effort in combination with movement or state, or other sounds such as burps sneezes or hiccups.

A criteria of a 1.5 second delay between sounds was required for the sounds to be coded as two vocalizations.

Gaze: Infant gaze at both maternal face and hands (recorded separately) was recorded for duration (amount of time spent looking at maternal face or hands) as well as the frequency, by scoring the direction of the infants' eyes.

Maternal Touch: Duration of maternal touch with infant was recorded when the mother and infant were in physical contact with each other.

Appendix H

Behaviour Codes for Sequential Analyses

Code	Behaviour
1	Maternal Touch (Touch)
2	Infant Gaze at Face (Face)
3	Infant Gaze at Hands (Hands)
4	Infant Smiling (Smile)
5	Infant Fretting (Fret)
6	Infant Vocalizations (Vocs)
12	Touch and Face
13	Touch and Hands
14	Touch and Smile
15	Touch and Fret
16	Touch and Vocs
124	Touch, Face and Smile
134	Touch, Hands and Smile
125	Touch, Face and Fret
135	Touch, Hands and Fret

Code	Behaviour
126	Touch, Face and Vocs
136	Touch, Hands and Vocs
146	Touch, Smile and Vocs
1246	Touch, Face, Smile and Vocs
1346	Touch, Hands, Smile and Vocs
24	Face and Smile
25	Face and Fret
26	Face and Vocs
34	Hands and Smile
35	Hands and Fret
36	Hands and Vocs
46	Smile and Vocs
246	Face, Smile and Vocs
346	Hand, Smile and Vocs
88	Blank (no behaviour occurring)

Appendix I

Summary of Sequential Analysis and Results from Maternal Touch and Infant Vocalizations

Behavioural Codes Used for each Target Behaviour

Maternal Touching

1. Infant Gaze as given behaviours:

   1 (Touch), consists of all codes which include Maternal Touch

   2 (Face), consists of 2 and 26

   3 (Hands), consists of 3 and 36

   24 (Face and Smile), consists of 24 and 246

   34 (Hands and Smile), consists of 34 and 346

   25 (Face and Fret), consists of 25

   35 (Hands and Fret), consists of 35

   88 (Blank, residual codes), consists of all remaining codes

2. Infant Affect as given behaviours:

   1 (Touch), consists of all codes which include Maternal Touch

   4 (Smile), consists of 4 and 46

   5 (Fret), consists of 5

   24 (Face and Smile), consists of 24 and 246

   34 (Hands and Smile), consists of 34 and 346

   25 (Face and Fret), consists of 25

   35 (Hands and Fret), consists of 35

   88 (Blank, residual codes), consists of all remaining codes

3. Infant Vocalizations as given behaviour:

1 (Touch), consists of all codes which include Maternal Touch

6 (Vocs), consists of 6

26 (Face and Vocs), consists of 26

36 (Hands and Vocs), consists of 36

46 (Smile and Vocs), consists of 46

246 (Face, Smile and Vocs), consists of 246

346 (Hands, Smile and Vocs), consists of 346

88 (Blank, residual codes), consists of all remaining codes

Infant Vocalizations

1 (Touch), consists of 1, 14 and 15

2 (Face), consists of 2, 24 and 25

3 (Hands), consists of 3, 34 and 35

12 (Touch and Face), consists of 12, 124 and 125

13 (Touch and Hands), consists of 13, 134 and 135

6 (Vocs), consists of all codes which included Infant Vocalization

88 (Blank, residual code), consists of all remaining codes

Description

Through sequential analyses, the intricacies of mother-infant interactions can be further delineated. As Bakeman and Gottman (1986) state, "... when we want to know how behaviour works, or functions, within an ongoing interaction, some form of sequential analysis is probably required" (p. 9). With sequential analyses both the maternal and infant behaviours can be assessed in terms of which behaviours follow which other behaviours during an interaction. Past researchers have implemented forms of sequential analyses in their studies on mother-infant interactions, and have come up with intriguing results (e.g., Cohn & Tronick, 1987; Keller & Scholmerich, 1987; Halliday & Leslie, 1986; Rutter & Durkin, 1987; Symons & Moran, 1986; Tronick & Cohn, 1989; Vos et al., 1990). For example, as discussed earlier, the coordination of behaviours between mothers and their infants have been found in 6-month-olds (Tronick & Cohn, 1989), and in infants as young as 2 months of age (Vos et al., 1990). Symons and Moran (1987), in their replication of Field's (1977) study, noted that using only one indicator (e.g., gaze) of infant involvement in social interactions is probably not sufficient to obtain an accurate assessment of mother-infant reciprocity. They also discuss the importance and meaningfulness of including some form of sequential analysis in interactive research to extend the indications of infant participation and contributions in their interactions with others.

Results

The Normal period was included in the sequential analysis for the target behaviour of Infant Vocalizing only. The normal period was not included in the analysis of Maternal Touch, since in this period the mothers were doing more than touching their infants (e.g., smiling and speaking), thus much of the information about maternal behaviour during these normal interactions was missing. Therefore, an analysis of this period would provide an inaccurate assessment of the sequence of mother-infant behaviours during those interactions because the maternal vocal and facial behaviour could not be scored. The Normal period was included for Infant Vocalizing, however, as this analysis could provide interesting information on where the infants were gazing when they vocalized, when the mothers were able to vocalize as well.

Maternal Touch

Period 2 (SF+T). The z-scores and p-values for the significant infant behaviours occurring before and after Maternal Touching, in descending order of significance, are presented in Table 1 of Appendix I. As can be seen, during the SF+T period mothers tended to touch their infants when the infants were gazing at their mothers' hands. Mothers also tended to touch their infants when they were fretting, or when the infants were gazing at their mothers' faces while fretting. Further, infants tended to be gazing at their mothers' hands while vocalizing, or they tended to be smiling,

Table 1

Significant Infant Behaviours Occurring Before and After Maternal Touch for Period 2 (SF+T), in Descending Order of Significance

Lags	Given Behaviours	z-scores	p-values
Before (Lag -1)			
	Hands	6.50	$p < .001$
	Fretting	3.71	$p < .001$
	Face and Fretting	2.64	$p < .01$
	Hands and Vocalizations	2.25	$p < .05$
	Smiling	2.16	$p < .05$
After (Lag +1)			
	Hands	7.02	$p < .001$
	Face and Fretting	3.59	$p < .001$
	Hands and Smiling	2.69	$p < .01$
	Hands and Fretting	2.21	$p < .05$
	Smiling	2.16	$p < .05$

before their mothers touched them. Once the mothers stoppedtouching their infants, the infants gazed at their mothers' hands, or they were gazing at their mothers' faces while fretting. Infants were apparently almost as likely to gaze at their mothers' hands while smiling, as they were to be gazing at their mothers' hands while fretting. Infants also smiled after their mothers touched them.

Period 3 (SF+TS). Table 2 of Appendix I illustrates the significant given behaviours, in descending order of significance, which occurred both before and after the infants' mothers touched them. As Table 2 reveals, during the SF+TS period mothers appeared likely to touch their infants when the infants were gazing at their mothers' hands, and when the infants were gazing at their mothers' faces while smiling. Mothers also tended to touch their infants when they were gazing at their mothers' hands while smiling, or when they were gazing at their mothers' faces. When infants vocalized, their mothers also seemed likely to touch them. Once their mothers had stopped touching them, infants appeared to be gazing either at their mothers' hands or at their mothers' faces. They also tended to gaze at their mothers' hands, while smiling, after their mothers had touched them.

Period 4 (SF+T1). As illustrated in Table 3 of Appendix I, it appears that during the SF+T1 period mothers tended to touch their infants when they were gazing at their mothers' hands, or at their mothers' faces. Mothers were also likely

Table 2

Significant Infant Behaviours Occurring Before and After Maternal Touch for Period 3 (SF+TS), in Descending Order of Significance

Lags	Given Behaviours	z-scores	p-values
Before (Lag -1)			
	Hands	6.36	$p < .001$
	Face and Smiling	4.19	$p < .001$
	Hands and Smiling	4.10	$p < .001$
	Face	3.70	$p < .001$
	Vocalizations	2.81	$p < .01$
After (Lag +1)			
	Hands	7.91	$p < .001$
	Face	5.46	$p < .001$
	Hands and Smiling	4.10	$p < .001$

Table 3

Significant Infant Behaviours Occurring Before and After Maternal Touch for Period 4 (SF+T1), in Descending Order of Significance

Lags	Given Behaviours	z-scores	p-values
Before (Lag -1)			
	Hands	4.63	$p < .001$
	Face	2.93	$p < .01$
	Face and Smiling	2.21	$p < .05$
After (Lag +1)			
	Hands	3.67	$p < .001$
	Face	2.67	$p < .01$
	Face and Smiling	2.21	$p < .05$

to touch their infants when their infants were gazing at their faces while smiling. Once their mothers had stopped touching them, the infants were likely to gaze at their mothers' hands or faces, or they were likely to be gazing at their mothers' faces while smiling.

Infant Vocalizations

Period 1 (Normal). As previously mentioned, the Normal period was included in the analysis of Infant Vocalizations because it was considered interesting to observe the changes between the Normal and SF with touch periods in terms of where the infants gazed when vocalizing, when the mothers could or could not vocalize themselves. Table 4 of Appendix I presents an illustration of the significant given behaviours occurring both before and after the infants began vocalizing, in descending order of significance. In the Normal period, whenmothers were able to use all forms of expression available to them, infants were likely to begin vocalizing when they were gazing at their mothers' faces, while their mothers were touching them. They also tended to vocalize when their mothers were touching them, and they tended to vocalize when they were gazing at their mothers' hands. Once they had finished vocalizing, infants tended to gaze at their mothers' faces while their mothers were touching them. Mothers tended to touch their infants after the infants had vocalized, and infants tended to be gazing at their mothers' faces when they had stopped vocalizing.

Table 4

Significant Infant and Mother Behaviours Occurring Before and After Infant Vocalizing for Period 1 (Normal), in Descending Order of Significance

Lags	Given Behaviours	z-scores	p-values
Before (Lag -1)			
	Face and Touching	5.69	$p < .001$
	Maternal Touching	3.38	$p < .001$
	Hands	2.71	$p < .01$
After (Lag +1)			
	Face and Touching	5.19	$p < .001$
	Maternal Touching	3.02	$p < .01$
	Face	2.00	$p < .05$

Period 2 (SF+T). As Table 5 of Appendix I illustrates, infants were likely to vocalize when their mothers were touching them, or when they were gazing at their mothers' hands during the SF+T period. Once they had stopped vocalizing, their mothers tended to be touching them, and the infants tended to be gazing at their mothers' hands. Infants also tended to be gazing at their mothers' hands and faces, while their mothers were touching them, once they had finished vocalizing.

Period 3 (SF+TS). Table 6 of Appendix I illustrates the significant given behaviours, in descending order of significance, which occurred before and after the infants began vocalizing in the SF+TS period. It appears that infants tended to vocalize when their mothers were touching them, or when they were gazing at their mothers' hands. When the infants had finished vocalizing, their mothers tended to be touching them.

Period 4 (SF+T1). As Table 7 of Appendix I illustrates, infants appeared to vocalize when their mothers were touching them, and it appears that the mothers continued to touch their infants after they had completed their vocalizations.

Overall, it appears that infants were as likely to vocalize when their mothers were touching them in the Normal and in the SF with touch periods. However, after they had vocalized, infants tended to be gazing at their mothers' faces more in the Normal periods than in the SF with touch periods,

Table 5

Significant Infant and Mother Behaviours Occurring Before and After Infant Vocalizing for Period 2 (SF+T), in Descending Order of Significance

Lags	Given Behaviours	z-scores	p-values
Before (Lag -1)			
	Maternal Touching	3.45	$p < .001$
	Hands	2.74	$p < .01$
After (Lag +1)			
	Maternal Touching	3.46	$p < .001$
	Hands	3.04	$p < .01$
	Face and Touching	2.75	$p < .01$
	Hands and Touching	2.18	$p < .05$

Table 6

Significant Infant and Mother Behaviours Occurring Before and After Infant Vocalizing for Period 3 (SF+TS), in Descending Order of Significance

Lags	Given Behaviours	z-scores	p-values
Before (Lag -1)			
	Maternal Touching	2.85	$p < .01$
	Hands	2.24	$p < .05$
After (Lag +1)			
	Maternal Touching	3.04	$p < .01$

Table 7

Significant Infant and Mother Behaviours Occurring Before and After Infant Vocalizing for Period 4 (SF+T1), in Descending Order of Significance

Lags	Given Behaviours	z-scores	p-values
Before (Lag -1)			
	Maternal Touching	3.30	$p < .001$
After (Lag +1)			
	Maternal Touching	3.29	$p < .01$

where it appears that infants were more likely to be gazing at their mothers' hands when they had finished vocalizing.

Appendix J

Behaviour Codes Included in the Sequential Analysis

Behaviour Codes for Infant Smiling

1 (Touch), consists of 1 and 16

2 (Face), consists of 2 and 26

3 (Hands), consists of 3 and 36

4 (Smile), consists of all codes which include Infant Smiling

5 (Fret), consists of all codes which include Infant Fretting

12 (Touch and Face), consists of 12 and 126

13 (Touch and Hands), consists of 13 and 136

6 (Vocs), consists of 6

88 (Blank, residual code), consists of 88

Appendix K

ANOVA Summary Table for

Maternal Touching, Control Group

Table 1

Maternal Touch: Analysis of Period for Control Group

Source	df	SS	MS	F
Period	3	2.53930	0.84643	0.46
Error	33	60.56720	1.83537	

Appendix L

ANOVA and Tukey Summary Tables and Transformed Means for Maternal Touching

Table 1

Maternal Touch, Transformed Data: Analysis of Period

Source	df	SS	MS	F
Period	3	57.25	19.08	9.40*
Error	105	213.26	2.03	

*$p < .01$.

Table 2

Tukey Multiple Comparisons on Period for the Maternal Touch Measure (Experimental Group)

Comparisons	Mean Absolute Difference	Critical Difference	Prob. Level
N vs SF+T	1.02	.86	<.05
N vs SF+TS	1.55	1.06	<.01
N vs SF+T1	1.58	1.06	<.01
SF+T vs SF+TS	.53	.86	N.S.
SF+T vs SF+T1	0.55	.86	N.S.
SF+TS vs SF+T1	0.03	.86	N.S.

Note. N = Normal period

SF+T = SF with touch

SF+TS = SF with touch and maximum smiling

SF+T1 = SF with touch in one area

Table 3

Transformed Means for the Percent Duration of Maternal Touch: Square Root Transformations

	Periods			
Group	Normal	SF+T	SF+TS	SF+T1
Experimental	7.94(0.40)	8.96(0.22)	9.49(0.10)	9.51(0.17)
Control	7.97(0.50)	8.42(0.39)	8.04(0.63)	8.50(0.290

Note. Numbers in parentheses indicate standard errors.

Appendix M

ANOVA and Tukey Summary Tables and Means for Infant Gaze at Mother's Face and Hands

Table 1

Infant Gaze at Mother's Face and Hands: Analysis of Period

Source	df	SS	MS	F
Period	3	3451.14	1150.38	2.73*
Error	105	44272.82	421.65	

*$p < .05$.

Table 2

Tukey Multiple Comparisons on Period for the Infant Gaze at Mother's Face and Hands Measure (Experimental Group)

Comparisons	Mean Absolute Difference	Critical Difference	Prob. Level
N vs SF+T	7.98	12.59	N.S.
N vs SF+TS	0.10	12.59	N.S.
N vs SF+T1	11.18	12.59	N.S.
SF+T vs SF+TS	7.875	12.59	N.S.
SF+T vs SF+T1	11.08	12.59	N.S.
SF+TS vs SF+T1	3.20	12.59	N.S.

Note. N = Normal period

SF+T = SF with touch

SF+TS = SF with touch ard maximum smiling

SF+T1 = SF with touch in one area

Table 3

Means for the Percent Duration of Infant Gaze at Mother's Face and Hands

Group	Periods			
	Normal	SF+T	SF+TS	SF+T1
Experimental	66.81 (3.39)	58.83 (4.13)	66.71 (3.81)	55.63 (3.90)
Control	57.99 (7.33)	60.12 (7.01)	67.16 (5.83)	69.15 (5.46)

Note. Numbers in parentheses indicate standard errors.

Appendix N

ANOVA and Tukey Summary Tables and Transformed Means for Infant Gaze at Mother's Face

Table 1

Infant Gaze at Mother's Face, Transformed Data: Analysis of Period and Group

Source	df	SS	MS	F
Group	1	41.31	41.31	5.46*
Error	46	347.94	7.56	
Period	3	37.79	12.60	4.49**
P x G	3	24.77	8.26	2.95*
Error	138	386.80	2.80	

*p < .05. **p < .01.

Table 2

Tukey Multiple Comparisons on Period for the Infant Gaze at Mother's Face Measure (Experimental Group)

Comparisons	Mean Absolute Difference	Critical Difference	Prob. Level
N vs SF+T	2.04	1.23	<.01
N vs SF+TS	1.36	1.23	<.01
N vs SF+T1	2.26	1.23	<.01
SF+T vs SF+TS	0.67	1.00	N.S.
SF+T vs SF+T1	0.22	1.00	N.S.
SF+TS vs SF+T1	0.90	1.00	N.S.

Note. N = Normal period

SF+T = SF with touch

SF+TS = SF with touch and maximum smiling

SF+T1 = SF with touch in one area

Table 3

Transformed Means for the Percent Duration of Infant Gaze at Mother's Face: Square Root Transformations

	Periods			
Group	Normal	SF+T	SF+TS	SF+T1
Experimental	5.88(0.33)	3.84(0.33)	4.51(0.30)	3.61(0.37)
Control	5.52(0.61)	5.23(0.68)	6.03(0.45)	5.34(0.51)

Note. Numbers in parentheses indicate standard errors.

Appendix O

ANOVA and Tukey Summary Tables for Infant Gaze at Mother's Hands

Table 1

Infant Gaze at Mother's Hands: Analysis of Period

Source	df	SS	MS	F
Period	3	4395.07	1465.02	3.27*
Error	105	47014.88	447.760	

*$p < .05$.

Table 2

Tukey Multiple Comparisons on Period for the Infant Gaze at Mother's Hands Measure (Experimental Group)

Comparisons	Mean Absolute Difference	Critical Difference	Prob. Level
N vs SF+T	11.80	12.98	N.S.
N vs SF+TS	14.75	12.98	<.05
N vs SF+T1	9.46	12.98	N.S.
SF+T vs SF+TS	2.96	12.98	N.S.
SF+T vs SF+T1	2.39	12.98	N.S.
SF+TS vs SF+T1	5.35	12.98	N.S.

Note. N = Normal period

SF+T = SF with touch

SF+TS = SF with touch and maximum smiling

SF+T1 = SF with touch in one area

Appendix P

ANOVA and Tukey Summary Tables and

Transformed Means for Infant Smiling

Table 1

Infant Smiling, Transformed Data: Analysis of Period and Group

Source	df	SS	MS	F
Group	1	126.92	126.92	15.43*
Error	46	378.35	8.22	
Period	3	129.59	43.20	11.72*
P x G	3	98.19	32.73	8.88*
Error	138	508.77	3.69	

*$p < .01$

Table 2

Tukey Multiple Comparisons on Period for the Infant Smiling Measure (Experimental Group)

Comparisons	Mean Absolute Difference	Critical Difference	Prob. Level
N vs SF+T	3.85	1.50	<.01
N vs SF+TS	1.58	1.50	<.01
N vs SF+T1	4.40	1.50	<.01
SF+T vs SF+TS	2.27	1.50	<.01
SF+T vs SF+T1	0.55	1.23	N.S.
SF+TS vs SF+T1	2.82	1.50	<.01

Note. N = Normal period

SF+T = SF with touch

SF+TS = SF with touch and maximum smiling

SF+T1 = SF with touch in one area

Table 3

Transformed Means for the Percent Duration of Infant Smiling: Square Root Transformations

Group	Periods			
	Normal	SF+T	SF+TS	SF+T1
Experimental	6.81(0.28)	2.97(0.35)	5.23(0.44)	2.42(0.41)
Control	6.45(0.58)	6.36(0.55)	6.19(0.55)	5.94(0.60)

Note. Numbers in parentheses indicate standard errors.

Appendix Q

ANOVA Summary Tables and

Transformed Means for Infant Fretting

Table 1

Infant Fretting, Transformed Data: Analysis of Period and Order

Source	df	SS	MS	F
Order	2	0.27	0.14	0.40
Error	33	11.18	0.34	
Period	3	4.52	1.51	7.38*
P x O	6	4.45	0.74	3.64*
Error	99	20.20	0.20	

*p < .01.

Table 2

Transformed Means for the Percent Duration of Infant Fretting: Log Transformations

Group	Periods			
	Normal	SF+T	SF+TS	SF+T1
Experimental				
Order 1	0.07(0.07)	0.16(0.11)	0.34(0.16)	0.95(0.23)
Order 2	0.05(0.05)	0.59(0.19)	0.34(0.16)	0.32(0.16)
Order 3	0.03(0.03)	0.54(0.18)	0.21(0.10)	0.30(0.11)
Control	0.00(0.00)	0.18(0.13)	0.27(0.18)	0.36(0.19)

Note. Numbers in parentheses indicate standard errors.

Appendix R

ANOVA and Tukey Summary Tables and

Transformed Means for Infant Vocalizations

Table 1

Infant Vocalizations, Transformed Data: Analysis of Period

Source	df	SS	MS	F
Period	3	38.87	12.96	5.62*
Error	105	242.13	2.31	

*$p < .01$.

Table 2

Tukey Multiple Comparisons on Period for the Infant Vocalization Measure (Experimental Group)

Comparisons	Mean Absolute Difference	Critical Difference	Prob. Level
N vs SF+T	1.02	0.93	<.05
N vs SF+TS	1.55	1.14	<.01
N vs SF+T1	1.58	1.14	<.01
SF+T vs SF+TS	0.53	0.93	N.S.
SF+T vs SF+T1	0.55	0.93	N.S.
SF+TS vs SF+T1	0.03	0.93	N.S.

Note. N = Normal period

SF+T = SF with touch

SF+TS = SF with touch and maximum smiling

SF+T1 = SF with touch in one area

Table 3

Transformed Means for the Percent Duration of Infant Vocalizations: Square Root Transformations

Group	Periods			
	Normal	SF+T	SF+TS	SF+T1
Experimental	1.72(0.30)	2.91(0.38)	3.07(0.34)	2.61(0.41)
Control	1.70(0.46)	1.95(0.51)	1.56(0.38)	2.61(0.49)

Note. Numbers in parentheses indicate standard errors.