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Manipulations of Verbal Instructions Provided to Mothers: Effects on 5.5-Month-Old Infants' Responses During Touch-Only Face-to-Face Interactions

Sharon Lynne Arnold

A Thesis

in

The Department

of

Psychology

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ABSTRACT

Manipulations of Verbal Instructions Provided to Mothers:
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Touch-Only Face-to-Face Interactions

Sharon Lynne Arnold

The contribution of maternal touch as a potential modulator of infant affect and attention during early face-to-face interactions has remained relatively unexplored, while the roles of maternal facial and vocal expression have been largely emphasized. The present study was designed to examine infants' responses to manipulations of instructions provided to their mothers during touch-only conditions. Sixty mother-infant dyads participated in a Normal (N) interaction during which mothers were instructed to interact with their infants as they normally would at home using their faces, voices and touch. For both the experimental and control groups, the Normal interaction was followed by three still-face with touch conditions during which mothers were instructed to be silent, still, and neutral in facial expression and to use only touch (SF+T). However, mothers in the experimental group (n = 36) were provided with additional instructions to use only touch to obtain the following responses from their infants: (1) get their infants to imitate them (SF+T+IM), (2) engage their infants in a reciprocal interaction or turntaking game (SF+T+TT) and (3) attract and maintain their infants' attention to their faces with as much eye-to-eye contact as possible (SF+T+AF). In contrast, while mothers in the control group (n = 24) were permitted to touch their infants, they were not further instructed on the types of responses to obtain from them (SF+T). High amounts of maternal touch were evidenced throughout the procedure by both groups.

Differences in infant responses, both between groups and across conditions within each group, were found, reflecting infants' responsiveness to changes in maternal tactile stimulation. For both groups, infant gaze shifted from mothers' faces in the Normal condition to their hands in the SF with touch conditions. Consistent with the hypotheses, infants in the experimental group gazed more at their mothers' faces and less at their mothers' hands than infants in the control group during the SF+T+AF condition and gazed more at their mothers' hands than infants in the control group during the SF+T+TT condition. Moreover, infants in the experimental group smiled more than those in the control group during the SF+T+TT condition. The results of this study contribute toward a better understanding of infants' responsiveness to touch and the role of touch during mother-infant face-to-face interactions.

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Early infancy is considered a formative period for social development because it represents the first phase of infants' learning about the complex and rapidly-evolving process of social interaction. It is remarkable that, within even the first six months following birth, infants have acquired a host of skills necessary for establishing and maintaining interpersonal interactions. Within this very short time span, infants develop a representation of the human face, voice and touch, and acquire the ability to discriminate the facial, vocal and tactile characteristics of their primary caregiver relative to those of other people. Moreover, they acquire the ability to recognize changes in facial features that represent different emotional expressions. In terms of actual interpersonal encounters, infants learn the temporal patterning of social interactions and are able to recognize changes, or variations, in tempo and rhythm. In addition, they learn some of the social skills and cues which are mutually effective in initiating, maintaining and modulating, terminating and avoiding social encounters, and learn the fundamentals of interpersonal turntaking (Stern, 1977). In essence, the process of learning social rules is beginning to take place, the development of which is critical to the formation of attachment and future relationships, but also important to cognitive development.

Infants' first exposure to the substance of human communication consists of what the primary caregiver, more often the mother, provides using her face, voice and touch. The ongoing flow of maternal behavior provides the infant with the material necessary to form a representation of interactions in the outside world, and enables the infant to acquire knowledge about the processes of human communication

and interpersonal relatedness (Stern, 1977). Moreover, it enables the infant to learn the relationship between their own behavior and another's and to acquire an understanding of the way in which their behavior influences that of their social partner. Thus, it can be argued that through these interpersonal interactions, infants come to acquire a sense of mastery over the world and come to understand their impact on other human beings.

One of the first ways in which infants and their mothers become familiar with one another is through the process of face-to-face interaction. Face-to-face interactions are reported to begin shortly after birth, peaking in frequency between three and six months of age (Stern, 1977; Trevarthen, 1974). Two constraints placed on the development of face-to-face interactions include the immature nature of infants' developing perceptual systems and the short amount of time infants spend in a waking state. Following birth, infants' perceptual systems are designed to guard against overstimulation, resulting in an inability to focus on objects much closer or much father away than eight inches (Stern, 1977). Furthermore, during the first weeks following birth, the majority of the infant's alert time is spent in feeding, potentially limiting the opportunity for face-to-face contact. However, Stern (1977) has noted that when the infant is in the normal breast- or bottle-feeding position, the infants' eyes are almost exactly eight inches away from the mothers' eyes, thereby providing even the youngest infant with an opportunity to engage in mutual gaze with the mother. Consequently, he suggests that, by natural design, the mother's face resides within the optimal range of the infant's visual field, thereby becoming the focal point

of the infant's visual regard. The mutual gaze that results between mother and infant serves as a starting point in the formation of human relatedness. It is within the context of these early social interactions that infants become familiar with, and begin to explore, the rules of social communication (Tronick, Als, Adamson, Wise & Brazelton, 1978). Consequently, these early face-to-face interactions between infants and their caregivers provide a foundation for the development of the infant's social and communicative skills.

Face-to-Face Interaction Studies - The Roles of Face and Voice

Given their importance, it is not surprising that researchers have attempted to examine these face-to-face interactions more systematically to reveal important information about infants' social and emotional capacities. The most frequently used procedure is the face-to-face paradigm where the mother and infant are seated facing each other at eye-to-eye level during a series of brief interaction periods (e.g., Field, 1977; Kaye & Fogel, 1980). The popularity of this paradigm in the infancy literature reflects the fact that face-to-face interactions are common between caregivers and their infants in Western culture. Studies employing the face-to-face paradigm have illuminated several important components of mother-infant social interchange, namely the sensitivity of each member of the dyad to the other's behavior, the differential patterns of infant affect and gaze across brief periods of interaction, and the influence of experimental manipulations of maternal behavior on subsequent maternal and infant responsiveness (e.g., Field, 1977; Kaye & Fogel, 1980; Symons & Moran, 1987). Face-to-face interaction studies can be categorized under the two main themes of

mutual sensitivity and experimental manipulation.

Mutual Sensitivity

Mothers' sensitivities to shifts in infant responsiveness have been examined in a number of studies which converge to suggest that mothers are adept at modifying their behavior in response to changes in their infants' behavior. Kaye and Fogel (1980) found that mothers were able to elicit greetings from their infants as early as six weeks of age. However, the duration of infant attention changed with mothers' use of different facial expressions, and the strategies that mothers used to elicit infant attention differed as a function of age. With younger infants between 6 and 13 weeks of age, mothers were more likely to gain their infants' attention by bouncing and touching them, whereas mothers of 26-week-old infants waited until their infants were attentive and only then used vocal and facial stimulation to elicit and maintain attention. Thus, mothers not only modified the type of stimulation they provided to their infants, but also adjusted their behavior to their infants' cycles of attention and timed their expressive displays accordingly. Interestingly, infants spent more time attending to the mother's face when her facial expression invited an interaction than when it did not, regardless of age.

Consequently, Kaye and Fogel (1980) argued that the quality of the mother-infant interaction is mediated by the mother's ability to read her infant's signals and rhythms and adjust her behavior accordingly. Failure of the mother to adjust her behavior results in gaze aversion and signs of distress on the part of the infant. Observations of eye-to-eye contact during mother-infant interactions tend to support

this view. Patterns of infant gaze during face-to-face interactions suggest that infant gaze serves as a signal indicating willingness or readiness to engage in interaction. Conversely, gaze aversion on the part of the infant serves as an indicator to alter or terminate the interaction (Brazelton, Koslowski & Main, 1974; Stern, 1974; Trevarthen, 1974). Thus, mothers who are sensitive to their infants' signals will modulate the amount and the type of stimulation accordingly, providing stimulation during their infants' periods of attention and withdrawing stimulation when the infants avert their gaze.

Brazelton, Koslowski and Main (1974) provided further support for the notion of maternal sensitivity and interpersonal coordination. They found that the most important rule for maintaining an interaction between mother and infant was that the mother possess a sensitivity to her infant's capacity for attention and need for withdrawal following a period of attention to her. This sensitivity was reflected in mothers' adjustments of the frequency, tone and intensity of their behavior to reflect the rises and falls in their infants' visual and motor activity levels. From their study, it appears that, during mother-infant interactions, mothers alter their behavior in synchrony with that of their infants in order to simultaneously provide them with an adequate level of stimulation and modulate their levels of arousal.

While these findings indicate the importance of maternal responsiveness, this is not to say that mothers are the sole members of the dyad to regulate the flow of interaction during face-to-face encounters. Stern (1977) argues that, from birth, infants possess a capacity to relate to others and that, while infants' behavioral

repertoires may seem immature, this is no reason to dismiss their behaviors as meaningless until more mature versions develop. Stifter and Moyer (1991) found that, by 5 months of age, infants are capable of using shifts in their gaze to regulate their affect during face-to-face interactions with their mothers. Infants who exhibited high levels of positive affect, as measured by the intensity of their smiles, engaged in more frequent and longer durations of gaze aversion relative to infants who exhibited lower levels of positive affect. The authors concluded that 5-month-old infants are capable of actively regulating the amount of positive arousal they experience by shifting their gaze away from the arousing stimulus. The implication that even young infants can control the degree of stimulation they experience during face-to-face interactions suggests that they play an active role during mother-infant social interchange.

Evidence that both mother and infant are active contributors during face-to-face interactions is underscored by a number of additional studies. For example, Tronick and Cohn (1989) evaluated the extent to which 3-, 6-, and 9-month-old infants and their mothers coordinate their behavior during face-to-face interactions by evaluating both the amount of time that infants and their mothers engaged in the same behavior simultaneously (matching), and the degree to which each member of the dyad changed their behavior in conjunction with the other (synchrony). Coordination was found in almost all dyads examined, including those involving three-month-olds, suggesting that even the youngest infants were active participants in these interactions. Moreover, the degree of coordination increased with age, likely reflecting the infants'

increasing interactive skill arising from greater experience with social encounters. Maternal behavior also changed across this time period, with an increase in object and social play and a decrease in attending toward their infants over time. These findings demonstrate that behavior is coordinated between mother and infant during face-to-face interactions and that it increases with age. In addition, as infants develop with age, mothers adopt different behavioral strategies to maintain interactions, while simultaneously preserving infants' needs for more complex stimulation.

Kaye and Fogel (1980) have noted a similar developmental progression in infants' abilities to coordinate their own expressions with those of their mothers. At 6 weeks of age, infants responded to their mothers' smiles, vocalizations, and facial exaggerations with corresponding smiles and vocalizations only 20 percent of the time. By 3 months of age, infants responded to their mothers' initiations approximately 35 percent of the time, but at this age they also began initiating smiles and vocalizations of their own. By 26 weeks of age, infants were just as likely to initiate a smile or vocalization as they were to respond to their mothers initiations. These findings suggest that infants possess the ability to recognize facial expressions early in life, are able to replicate these expressions when their attention is elicited, and become more proficient at synchronizing their responses with those of their partner with age, reflecting an increasing reciprocity between mother and infant behavior over time. Mothers, in turn, facilitate this development by adjusting both the type of stimulation they provide and the timing of their stimulation based on their infants' needs.

There is a growing body of literature to suggest that, even prior to 6 months of age, infants are active participants during face-to-face interactions with their mothers. Moran, Krupka, Tutton and Symons (1987) discovered that 13- to 16-week-old infants displayed social matching during face-to-face interactions with their mothers, similar to that found by Tronick and Cohn (1989) in 3- to 9-month-olds. Moran et al. (1987) found that infants were more likely to begin smiling and gazing at their mothers when their mothers had already begun smiling and gazing. On the basis of these findings, they suggested that even young infants are capable of imitating their mothers, and will do so during social interactions. Additional research has suggested that, as early as the second month of life, infants are capable of maintaining interactions with their mothers where both members of the dyad regulate the timing of their behaviors to that of their partner. For instance, Vos, van Wulfften Palthe, De Roos, and Hopkins (1990) found that, rather than being passive recipients of their mothers' stimulation, infants actively responded to their mothers' displays through imitation, smiling and gaze aversion. This would again imply that the social encounters of mothers and their infants are synchronous and mutually regulated in nature, with both members of the dyad actively participating in directing the flow of an ongoing interaction.

Recently, evidence has also been found to suggest that infants possess a remarkable ability to coordinate their behavior with that of adults other than their mothers. For instance, Feldstein, Jaffe, Beebe, Crown, Jasnow, Fox and Gordon (1993) examined vocal behavior during face-to-face interactions with 4-month-old

infants and illustrated an important temporal component of mother-infant and stranger-infant interactions. During adult-infant social interchange, both members of the dyad monitored the durations and patterns of their own and their partners' sounds and silences and made adjustments to their own behavior relative to those of the other person. For instance, it was found that as one partner's switching pause between vocalizations became longer or shorter, so did that of the other partner. The authors concluded that coordination of vocal temporal patterns between mothers, and other adults, and infants constitutes one important form of interpersonal monitoring and dyadic relatedness (Feldstein et al., 1993).

The results of the above investigations culminate to suggest that both mother and infant play a role in the communication process that occurs during face-to-face interactions. Mothers appear to be aware of the behaviors that will elicit certain responses from their infants and appear to be capable of reliably obtaining these responses. In turn, some would argue that infants appear to be aware of the intention of their mothers to communicate certain ideas to them through facial and vocal expression, and respond appropriately to these initiations when prompted to do so. However, others (e.g., Bornstein & Lamb, 1992) argue that social intention does not develop in infants prior to seven or eight months of age. Consequently, a decision on the issue of infants' abilities to perceive and respond to the social intent of their mothers may be better left until systematic studies directly addressing this issue have been conducted. Nevertheless, mothers and their infants appear to display behavioral synchrony during their interactions, reflected by the fact that one partner synchronized

their behavior to the rhythms and movements of the other partner with whom they were interacting. This is a particularly important finding given that synchrony is hypothesized to be an essential aspect of infant social and communicative development (Bernieri, Reznick & Rosenthal, 1988). Rather than acting as passive recipients of maternal stimulation, infants aid their mothers in mutually regulating the flow of interaction during social encounters, supporting theories that early interactions serve as the foundation for later communication and dialogue (e.g., Brazelton, Koslowski and Main, 1974).

Experimental Manipulations of Maternal Behavior: Differential Response Patterns

In addition to documenting the sensitivity of both mother and infant during normal face-to-face interactions, studies employing the face-to-face procedure have been designed to assess the effects of altering the normal patterns of mother-infant communication and the resulting consequences on both maternal and infant behavior. One way of altering the normal communication pattern is to experimentally manipulate the interaction by providing mothers with instructions on how to behave toward their infants. Studies of this nature have found that manipulations of the amount, or variety, of maternal activity appear to alter both mothers' responsiveness to their infants' signals, as well as patterns of infant affect and gaze.

Arco and McClusky (1981) examined experimental manipulations of the temporal organization of communication to young infants by instructing mothers to engage their 3- and 5-month-old infants in episodes of natural, slower-than-normal, and faster-than-normal play. They found that changes in even the temporal

organization of play sequences had a significant influence on the behaviors of both mothers and infants, a finding that has more recently been extended to fathers and infants (Arco, 1983). For instance, manipulations of the temporal pattern of play influenced the modality of communication that parents selected for their interactions. Although both mothers and fathers evidenced similar vocalizations and facial expressions during interactions with their infants, their vocalizations were higher in the faster than the slower play sequences. Moreover, parents' facial expressiveness declined during the slower play sequences. Both infants and their parents responded to these manipulations with high levels of activity during the natural and faster play sequences and lower levels of activity during the slower play condition. These results confirm the hypothesis that manipulations of the temporal structure of parent-infant play influence the modality which parents select during interactions with their infants, and subsequently influence their infants' responsiveness. What is unclear, however, is whether the influence on infant behavior occurred due to the change in parental activity level alone, whether it arose as a function of the different modalities employed by parents under differential instructional conditions, or whether both contributed simultaneously.

Another means of altering the normal pattern of mother-infant interaction is to provide the mother with instructions on how to interact with her infant. Studies employing such experimental manipulations have served to highlight changes in infant responses across brief periods, thereby suggesting infants' sensitivities to maternal social signals. For instance, Field (1977) examined the way in which experimental

manipulations of maternal behavior influence both the amount, and type, of gazing exhibited by 3.5-month-old term and preterm infants. The experimental manipulations consisted of instructions provided to the mothers, namely to attract and maintain their infants' attention or to imitate their infants. While no differences in patterns of gaze were found between term and preterm infants, differential amounts of gaze were evidenced across the experimental conditions. The attention-getting manipulation resulted in more maternal activity but lower amounts of infant gaze toward the mother than during a normal mother-infant interaction. In contrast, the imitation manipulation resulted in lower maternal activity levels and more infant gaze directed toward the mother. In sum, the infants' patterns of gaze varied as a function of their mothers' behavior during the conditions. The differential infant gazing results obtained during the two experimental manipulations were argued to reflect the decreased information processing demands inherent in the imitation condition, as well as the greater attentiveness and contingent responding of the mothers to their infants' signals during this condition. In contrast, infants may have averted their gaze in the attention-getting condition because of the increase in their mothers' activity which resulted in information overload for the infant.

In a subsequent replication of Field's (1977) study, Symons and Moran (1987) found that 13- to 16-week-old infants and their mothers were actively involved and highly responsive to changes in their partners' behavior during face-to-face interactions. Contrary to Field (1977) however, mothers successfully elicited and maintained their infants' attention when instructed to do so. In fact, there was a trend

for infants to gaze more at their mothers during the attention-getting episode than during either a normal or imitation interaction. Although both members of the dyad were animated and displayed the same amount of positive affect as during a normal play interaction, mothers seemed to be less responsive during the attention-getting condition, a finding which contradicts the results of Field (1977) who found increased responding on the part of mothers. Thus, in contrast to Field (1977), mean levels of infant responsiveness during the attention-getting episode were similar to those of their mothers, suggesting a contingent responsiveness in which infants reproduced the pattern, or level, of activity corresponding to that of their mothers. When mothers were instructed to imitate their infants, infants maintained similar amounts of gaze as in the other conditions, but displayed significantly less positive affect. Similarly, mothers evidenced less activity and positive affect and rated the condition as less communicative than the play or attention-getting episodes. Taken together, these results suggest that subtle manipulations in the instructions provided to mothers affected their performance and, subsequently, that of their infants. When instructed to elicit a particular response from their infants, mothers appeared to use specific strategies to accomplish this goal, reflected in subsequent changes in their infants' behavior.

Symons and Moran (1987) suggest that the inconsistent results found by a number of researchers (Arco, 1983; Arco & McClusky, 1981; Field, 1977) may be the result of methodological differences. They hypothesize that different experimental instructions may constrain or modify parental contingent behavior in a variety of

subtle ways, thereby differentially influencing the behavior of their infants. Consequently, they recommend the use of a variety of behavioral indices of infant involvement and responsiveness, rather than a single measure such as infant gaze which may be inadequate to detect these subtle variations (Symons & Moran, 1987). The value of examining a variety of behavioral indices of infant involvement and mother-infant responsiveness during face-to-face interactions proposed by Symons and Moran (1987) has been supported by the findings of Rutter and Durkin (1987). They found different developmental progressions in the behaviors of infant vocalizing and gaze in older infants of 9 to 24 months, suggesting that infant attention and vocalizing may develop asynchronously, a factor which should be taken into account in studies of early mother-infant interaction.

The results of Field (1977) and Symons and Moran (1987) converge to suggest that instructions provided to mothers during face-to-face interactions with their infants result in changes in maternal behavior and subsequent changes in infant responding. However, in neither of these studies were mothers directly asked to modify their own behavior. Rather, mothers were simply instructed to obtain a given response from their infants. In contrast, other studies have actively manipulated maternal behavior itself in order to observe the effects on infant affect and attention by instructing mothers to act in specific ways toward their infants. Researchers using this more systematic approach have often employed the still-face procedure, and studies of this type have aided in clarifying the contributions of maternal facial and vocal expression during face-to-face interactions.

Still-face (SF) studies.

One of the most striking illustrations of young infants' responsiveness to changes in maternal social signals and the importance of mothers' contingent responding to infant behavior occurs when maternal behavior is manipulated by instructing mothers to adopt a neutral facial expression and to refrain from talking to, or touching, their infants. This procedure, commonly referred to as the still-face (SF) procedure (Tronick et al., 1978), eliminates facial, vocal, and tactile stimulation directed by the mother toward the infant, while eye-to-eye contact is maintained. Mothers and their infants participate in a series of brief face-to-face interaction periods typically lasting 1 1/2 to 3 minutes in length. In the first of these periods, the mother is instructed to play with her infant as she normally would at home using face, voice and touch (Normal). In the second period, the mother is instructed to remain still-faced (facially neutral and unresponsive), silent, and not to touch her infant (SF). In the third and final period, the mother is once again instructed to play with her infant as she normally would at home.

The SF procedure is hypothesized to violate the normal communication process between mother and infant in that, although the two partners continue to face each other, the mother is uncommunicative, thereby not responding to the social signals of the infant (Tronick et al., 1978). This hypothesis was supported by results from Tronick et al. (1978) who studied 1- to 4-month-old infants and their mothers during a SF procedure. Infants became distressed during the SF period, demonstrated by a decrease in smiling, an increase in negativity and an increase in gaze aversion. The

authors suggested that the continuation of maternal gaze in conjunction with silence and unresponsiveness during the SF period creates a contradiction for the infant who expects an interaction. When subsequent attempts on the part of the infant fail to re-engage the mother, the social nature of the interaction breaks down, resulting in interactions which are not mutually regulated and lack synchrony. Consequently, the infant responds with negative affect such as crying or fussing. These negative displays are viewed as messages to the mother that the infant is not succeeding in achieving his or her goals. Since the mother does not respond to these signals during the SF period, the infant withdraws from the interaction and engages in coping behaviors designed to reduce the negative affect (Tronick, 1989).

Tronick's (1989) explanation for the SF effect suggests that the impetus behind mother-infant interactions resides in the distal cues mothers provide their infants, including facial and vocal expression. Consequently, the SF procedure provides an excellent example of what occurs when the mother fails to respond contingently by adjusting her behavior to conform to the rhythms and signals provided by her infant, resulting in an interaction which lacks synchrony. Furthermore, it contributes a new dimension to the study of face-to-face interactions by permitting the examination of perturbations in the natural communicative process and their consequences for both infant responses and maternal behavior.

Given the dramatic effect of the SF procedure on infant affect, a number of researchers have employed it to document the effects of perturbations of the natural pattern of mother-infant interaction on infants' capacities for emotional regulation, and

not all have found the same levels of distress. Mayes and Carter (1990) employed the SF procedure to evaluate the range of social regulatory behaviors available to infants during stressful interactions. They demonstrated that, during the SF situation, 3- to 4-month-old infants showed more neutral affect and increased gaze aversion relative to the normal face-to-face interactions. Their most consistent finding was that young infants' responded to their mothers' unresponsiveness with high levels of neutral affect and an increase in gazing away. However, their attempts to reengage the mother were often characterized by negative affect and severe protest.

A similar tendency toward neutral affect has also been noted by Toda and Fogel (1993) in their investigation of 3- and 6-month-olds and their mothers during the SF situation. Neutral affect was accompanied by an increase in gazing away from the mother and an increased amount of infant grasping and touching the self, clothing, or chair during the SF relative to other types of interactions at both ages and for both hands. Toda and Fogel (1993) concluded that what develops over time is the infant's ability to change the direction of their gaze and to coordinate their gaze to coincide with the actions performed by their hands. This would imply that both cognitive and motor maturation have a profound influence on infants' emotional regulation and, consequently, their responses to mild stressors such as that induced by the SF situation. The increase in gaze aversion demonstrated by infants in the Toda and Fogel (1993) study further supports the results of Stifter and Moyer (1991) who argue that infants are capable of actively regulating the amount of arousal they experience during face-to-face interactions by shifting their gaze away from the arousing

stimulus. Hence, the results of a variety of investigations (e.g., Mayes & Carter, 1990; Stifter & Moyer, 1991; Toda & Fogel, 1993) converge in suggesting that, during both natural and manipulated interactions, gaze is one behavior over which infants appear to have control, and infants will utilize shifts in gaze in order to both modulate arousal and influence the flow of an interaction.

A variety of explanations for infants' reactions to the SF procedure have been proposed. Tronick et al. (1978) argue that it is the discrepancy between the infant's social expectations and the mother's actual behavior during the SF procedure which results in infants' distress. In contrast, Lamb, Morrison and Malkin (1987) have argued that the negative reactions of infants in the SF situation result, not from a violation in social expectations but rather, from the presence or absence of stimulation available to them, again arguing for the importance of distal cues such as maternal facial and vocal expression in maintaining interactions. These authors found no indications of social expectations, as evidenced by the lack of surprise or puzzlement in 1- to 7-month-old infants exposed to the SF situation, which led them to conclude that infants were either uncomfortable or bored, rather than puzzled, by the unresponsiveness on the part of their mothers. As a result, the proposed discrepancy between maternal behavior and infant expectation, as hypothesized by Tronick et al. (1978), does not entirely explain the negative reactions of infants during the SF situation, particularly for infants younger than seven months of age. For example, others, such as Mayes and Carter (1990), found little distress.

The results of researchers such as Lamb, Morrison and Malkin (1987) have

suggested alternative hypotheses for the SF effect to that originally proposed by Tronick et al. (1978). However, although a variety of explanations have been proposed, the value of the SF procedure remains undisputed. Through its use, the importance of maternal contingent responding to infant signals has been documented, as well as the sophisticated nature of young infants' responses to manipulations of maternal behavior. The interpretations of the findings from studies employing the face-to-face procedure have often been confounded due to the uncertainty as to which component(s) of the mothers' facial, vocal and tactile behaviors have influenced infant responsiveness, and to what degree they have done so. The SF procedure has added a level of control to these naturalistic face-to-face interactions. Recently, researchers have attempted to isolate the various behavioral components comprising an interaction in order to determine how each component influences both maternal and infant responsiveness.

The Role of Touch

The majority of studies attempting to explore the SF effect have emphasized the roles of maternal facial and vocal expression. Thus, the potential role of touch as a communicative signal in the interchange between mother and infant, and its function as a possible modulator of the SF effect, remains to be addressed.

Gusella, Muir and Tronick (1988) examined the SF procedure in 3- and 6-month-old infants in order to document more specifically whether the SF effect occurred as a result of a change in maternal face and/or voice, and to determine what exactly infants were reacting to in the SF procedure. Resulting age differences

suggested that 6-month-old infants were particularly sensitive to changes in maternal face and voice, evidenced by their gaze aversion and decrease in positive affect during the SF period. In contrast, the responses of 3-month-old infants appeared to be dependent on maternal touch, leading the authors to conclude that touch may serve an important role in modulating the interaction and maintaining infant attention, especially for infants of younger ages. These findings suggested that the reactions of infants of different ages to the SF situation might be dependent upon the type of stimulation received, and underscored the importance of conducting a direct examination of touch.

The relative neglect of touch as a potential modulator of infant affect and attention is surprising given that the tactile modality is frequently employed by mothers during their interactions with their infants. Stack and Muir (1990) documented that touch occurred over 65 percent of the time during mother-infant social interaction in their study. Furthermore, in studies specifically examining the SF effect, touch has been permitted during the Normal interaction in which mothers interact with their infants as they normally would at home, but has been removed during the ensuing SF period along with the mother's facial and vocal stimulation. Consequently, to contend that maternal facial and vocal expression are the primary contributors to the reactions of displayed by infants during the SF procedure disregards the importance of touch to the communication between mothers and their infants. This oversight is even more perplexing given the unique qualities of the tactile system, the fact that it is the earliest sense to develop in the human embryo,

and given the amount of touching and physical contact known to occur over the first year of life (Montagu, 1986).

Research with both animals and humans has documented the importance of the tactile modality in early physical and social development. In animals, it has been established that specific forms of maternal tactile contact, specifically maternal washing, serve cutaneous functions necessary for the survival of young rats (Montagu, 1986; Schanberg & Field, 1987). In addition, the positive effects of tactile stimulation on high-risk infants has been well documented (e.g., Field, Schanberg, Scafidi, Bauer, Vega-Lahr, Garcia, Nystrom & Kuhn, 1986; Scafidi, Field, Schanberg, Bauer, Tucci, Roberts, Morrow & Kuhn, 1990; Schanberg & Field, 1987). However, despite the volume of literature delineating the positive effects of tactile stimulation on young infants, the role of touch as a modulator of mother-infant social interaction has remained largely unexplored. While it can be argued that touch is likely to serve a variety of important roles during mother-infant face-to-face interactions, research to systematically examine and document its specific contribution(s) is warranted. For instance, Koester, Papousek and Papousek (1989) suggest that mothers use a variety of nonvocal behaviors during face-to-face interactions with their three-month-old infants, including tactile, kinesthetic and vestibular stimulation.

In order to ascertain the true contribution of tactile stimulation during early mother-infant interactions, it is necessary to isolate tactile stimulation from the visual and vocal components of maternal behavior. Recently, Stack and Muir (1990)

explored the role of touch in the SF paradigm by comparing the standard SF with a modified SF procedure during which mothers were permitted to touch their infants naturally and spontaneously, while maintaining their neutral facial expression and silence (SF with touch). Their results indicated that 3-, 6- and 9-month-old infants smiled more and grimaced less during the SF condition when touch was permitted. Furthermore, while infants decreased their gaze at their mothers' faces during this condition, they increased their gaze at their mothers' hands. As a result, the total amount of gaze did not differ significantly from the Normal period in which face, voice and touch were permitted. The results of this investigation seem to contradict the hypothesis put forth by Tronick et al. (1978) that the increased negativity experienced by infants results from discrepant messages provided by the mothers' facial and vocal characteristics. Rather, Stack and Muir (1990) concluded that the increase in negativity observed in the SF condition was likely due to boredom, resulting from the absence of any stimulation and no interaction on the part of the mother. The results further suggest that touch can effectively modify the typical SF effect, at least during relatively brief interaction periods.

A limitation of these findings was that the mothers' hands were visible during the interaction. Thus, infants were receiving both tactile and visual stimulation. As a result, it was not possible to conclude that the tactile component alone was responsible for the sustained levels of infant affect and attention. This question was addressed in a subsequent study by Stack and Muir (1992), in which it was demonstrated that active and naturalistic adult touch substantially reduced the SF effect in 5-month-old

infants, even during conditions where the hands were not visible. When the hands were not visible but provided touch, infants continued to smile and gaze at the adult's still face. Furthermore, the negative affect (fretting/grimacing) usually evidenced by infants in the SF condition was reduced with touch from either mothers or female strangers. In contrast, when the hands were visible and active but did not provide touch during the SF condition, infant gaze was maintained, but there was little smiling. Thus, it was the tactile stimulation, and not the visual stimulation, provided by the hands that modified the SF effect, implying that tactile stimulation alone can modulate infant affect and attention and that the provision to mothers to touch their infants can modify the typical SF effect.

The ability of tactile stimulation to modulate infant affect and attention has been further documented by Stack and LePage (in press) who examined whether manipulations of verbal instructions provided to mothers would affect subsequent infant responses during brief SF with touch periods. Mother-infant dyads participated in four face-to-face interaction periods. For the experimental group, a period of Normal interaction, during which mothers were instructed to play with their infants as they normally would at home using their faces, voices and touch, was followed by three still-face with touch (SF+T) periods during which mothers were instructed to be silent and neutral in facial expression and use only touch to: (1) interact with their infants (SF+T); (2) elicit maximum smiling from their infants (SF+TS); and (3) touch their infants in only one area of the body (SF+T1). The responses of infants in the experimental group were compared to the responses of

infants in a control group who participated in four Normal face-to-face interaction periods. The results demonstrated that infants' gaze was directed toward their mothers' hands during the SF with touch periods but toward their mothers' faces during the Normal interaction periods. However, an important and interesting finding was that mothers in the experimental condition were able to elicit the same amount of smiling, when instructed to elicit maximum smiling using only touch, as mothers in the control group who interacted using face, voice and touch. Thus, infants' responses changed as a function of the instructions provided to mothers, suggesting that mothers are capable of directing their infants' responses using touch alone, at least for brief periods of interaction. However, it is important to note that Stack and LePage (in press) manipulated maternal behavior by directly instructing mothers to elicit a specific response from their infants only in the SF+TS period in which mothers were instructed to elicit maximum smiling from their infants. Consequently, it was of interest to extend these findings and determine whether infants' responses are differentially affected in periods where maternal behavior is manipulated by instructing mothers to elicit a variety of specific responses from their infants.

The results of Stack and Muir (1990, 1992) and Stack and LePage (in press) suggest that tactile stimulation can be effectively used in order to elicit infants' positive affect and to direct and sustain their levels of attention, implying that infants are sensitive to subtle manipulations in the instructions provided to mothers which were reflected in changes in maternal tactile behavior. Thus, contrary to previous expectations, adult vocal and facial stimulation are not the sole contributors to

mother-infant dyadic interactions.

The Present Study

Evidence for the importance of touch in the early social interactions between mother and infant is accumulating, however more research is needed to improve our understanding of the complexities of adult-infant social interaction and the role of touch therein. The present study was designed to extend and advance recent work on the effects of manipulations of instructions provided to mothers on subsequent infant responding. This was accomplished by providing mothers with direct instructions on the behaviors to specifically elicit from their infants. As a result, these instructions were more specific and varied relative to past studies, and were designed to elicit intricate and complex behaviors from infants, such as imitation and turntaking, necessitating more complex dyadic interactions between mother and infant.

In addition, systematic controls were incorporated to address specific hypotheses. While a Normal condition in which mothers and infants play together as they normally would at home has been used as a control for the SF with touch conditions in past studies, given the qualitatively distinct nature of Normal and SF with touch interactions, a more appropriate comparison is a control group consisting of several SF with touch conditions during which mothers are permitted to touch their infants but are not provided with instructions on how to make their infants behave. The addition of such a SF with touch control group provides a particularly strong and conservative comparison for the effects of manipulations of instructions provided to mothers on infants' responses, since the only difference between the two comparison

groups resides in the instructions provided to mothers of infants in the experimental group. As a result, this control group would allow a more definitive statement attributing the differences in infant responding between the two groups to changes in mothers' touch. Thus, the present study sought to determine whether manipulations of instructions provided to mothers influence the subsequent behaviors of both mother and infant, and whether infants can detect potentially subtle changes in their mothers' touch and respond with shifts in their attention, affect and vocalizing.

In light of recent developments in the research literature on the communicative role of maternal touch, the specific goals of the present study were to: (1) investigate whether, and how, manipulations of the instructions provided to mothers affect patterns of infant responding. This was accomplished by examining infants' responses during SF with touch conditions in which mothers were provided with specific instructions to use only touch and obtain specific responses from their infants, and comparing them to infants' responses during a series of SF with touch conditions in which mothers were permitted to touch but were not provided with further instructions, and (2) investigate whether infants are responsive to changes in their mothers' tactile behavior across specific touch-only conditions and whether this sensitivity is reflected in their own behavior. It is important to note that the term sensitivity is not meant to refer to perceptual acuity but, rather, is employed in its most general sense, referring to overall infant responsiveness.

A modified still-face (SF) paradigm, identical to that used by Stack and Muir (1990, 1992), was employed in the present study. Consistent with the typical SF

procedure (Tronick et al., 1974), mothers were instructed to be silent, still and neutral in facial expression, while using only touch, during a series of face-to-face interactions with their infants. However, during the SF conditions mothers were permitted to use touch, resulting in the term still-face with touch conditions (SF+T). A Normal (N) interaction condition in which mothers were instructed to interact with their infants as they normally would at home using their faces, voices and touch was followed by a series of three SF with touch conditions (SF+T) in which mothers were instructed to use only touch and to: (1) get their infants to imitate them (SF+T+IM), (2) engage their infants in a reciprocal interaction or turntaking game (SF+T+TT), and (3) get their infants to attend to their faces with as much eye-to-eye contact as possible (SF+T+AF).

These touch conditions were designed to enable observations of systematic changes in infants' responding during different touch-only conditions and to examine whether the amount of maternal touching was modified, both between groups and across the different conditions, as a function of instruction. The analysis of infants' responses to changes in maternal touch was made possible through the use of a SF with touch control group, during which mothers were instructed to be silent, still and neutral in facial expression and simply play with their infants using touch.

It was anticipated that the different touch instructions would lead to differential infant responding, thus providing indirect evidence that mothers changed their behavior as a function of the instructions provided them. The hypotheses related to the specific dependent measures are comprised under two main themes, one which

examines differences between the experimental and control groups and the other which documents changes across condition within each group.

Predictions for infants' responses as a function of Group.

A difference in infant gaze at mothers' faces was anticipated between the groups during the SF+T+AF condition in which mothers were instructed to attract and maintain their infants' attention on their faces with as much eye-to-eye contact as possible. During this condition, infants in the experimental group were expected to gaze more at their mothers' faces than infants in the control group.

Levels of infant gaze at mothers' hands were also expected to differ between the groups. Infants in the experimental group were anticipated to gaze at their mothers' hands more than those in the control group during the SF+T+IM and SF+T+TT conditions, reflecting the active nature of mothers' hands during conditions in which they were instructed to use only touch to achieve a specific goal. However, during the SF+T+AF condition in which mothers were instructed to attract and maintain their infants' attention on their faces with as much eye-to-eye contact as possible, infants in the experimental group were expected to gaze less at their mothers' hands than infants in the control group.

Infants in the experimental group were also expected to smile more than infants in the control group during the SF+T+TT condition when mothers were instructed to engage their infants in a reciprocal interaction or turntaking game.

Predictions for infants' responses as a function of Condition.

An increase in maternal touching was anticipated during all the SF with touch

conditions relative to the N condition for infants in both the experimental and control groups, given that it was the only mode of communication available to the mothers.

Shifts in infant gaze were expected to occur across the conditions, as found by Stack and Muir (1992), such that high levels of infant gaze at mothers' faces were expected during the N condition, with a shift to infant gaze at mothers' hands in all SF+T conditions for infants in both the experimental and control groups. An exception to this hypothesis was predicted to occur in the SF+T+AF condition for infants in the experimental group. In the SF+T+AF condition, during which mothers in the experimental group were instructed to attract and maintain their infants' attention on their faces with as much eye-to-eye contact as possible, it was hypothesized that the level of infant gaze at mothers' faces would be similar to, or higher than, that found in the N condition.

It was anticipated that less infant smiling would occur in the SF with touch conditions relative to the N condition for infants in the experimental group, except in the SF+T+TT condition during which mothers were instructed to engage their infants in a reciprocal interaction or turntaking game. During the SF+T+TT condition, levels of infant smiling were expected to be similar to those found in the N condition. Infant vocalizing was expected to increase in the SF with touch conditions for both the experimental and control groups, due to the fact that mothers were not permitted to speak to their infants, thus providing the infants with a potential opportunity to contribute to the 'conversation'.

Method

Subjects

The names of potential subjects were obtained from the birth records of the Sir Mortimer B. Davis Jewish General Hospital (Montréal, Québec). Caregivers of full-term infants who weighed at least 2,750 grams at the time of birth and were born between 38 and 41 weeks gestational age with uncomplicated medical histories were contacted and recruited by telephone. The original sample consisted of 80 5- to 6-month-old healthy, full-term infants. Twenty infants were excluded from analyses due to: fussiness (7), mothers' failure to follow instructions (6), less than 10% smiling in the first Normal condition (6), and equipment failure (1). Thus, the final sample consisted of 60 infants, with equal numbers of males and females (mean age = 5 months, 19 days; SD = 7.9 days), and their mothers, the majority of whom were White (78%) and from middle-class families (88%). Subjects were randomly assigned to experimental and control groups, with each group consisting of equal numbers of males and females. Power analyses (Cohen, 1977), conducted prior to data collection, determined that a sample of 44 infants would be necessary in order to ensure 90% power (Appendix A).

Five-and-a-half-month-old infants were selected for this study to maintain consistency with previous research in this area and because: (1) infants of this age possess the attentional capacities required for sustained social interactions, (2) at this age infants are able to initiate and maintain interactions with adults, and (3) face-to-face interactions between infant and caregiver typically begin in early infancy but

peak in frequency sometime between the ages of 3 and 6 months. Only mothers were included in the present study, due to the limited availability of fathers, and to maintain consistency with previous social interaction studies where predominantly mothers have been observed.

Apparatus

Infants were seated in an infant seat mounted and securely fastened to a custom-made box (75 cm high x 46 cm wide x 51 cm long) facing their mothers who were seated on an adjustable wooden stool at a distance of 70 cm from their infant and at eye level. Semi-circular black partitions, designed to eliminate distraction and noise, encircled each mother-infant dyad. A view of the infant's face and body and the mother's hands was obtained using a Hitachi Solid State Color Video Camera (VK-C350) located behind, above and to the right, of the mother. A second camera, located behind, above and to the left of the mother, captured a frontal view of the infant's body and the mother's hands. These were the only objects in the room within the infant's view. Appendix B depicts a schematic diagram of the apparatus and layout of the testing room.

The two camera images were transmitted through a split screen generator and were recorded on a Sony 8 mm video recorder located in an adjacent observation room which was separated from the testing room by a one-way mirror. All mother-infant interaction sessions were recorded on Sony 8 mm video cassettes. A time line was recorded on each infant's video record to permit precise calculation of the duration of each dependent measure in minutes, seconds and milliseconds, using a

Video Timer (FOR.J VTG-22). Frame-by-frame coding of the video records was facilitated by a Sony VTR/TV variable speed wireless remote with shuttle function.

The onset and offset of each interaction condition were timed using a stopclock, and were communicated to the mother by way of a knock on the one-way mirror separating the testing and observation rooms.

Experimental Instructions and Procedure

Each mother-infant dyad participated in four 90-second interaction conditions, separated by 20-second inter-trial intervals. For both the experimental (n = 36) and control (n = 24) groups, the first condition was a Normal (N) interaction between the mother and infant during which mothers were instructed to play with their infants as they normally would at home using their faces, voices and touch. The Normal interaction was followed by three SF with touch conditions during which mothers were instructed to be silent, still, and neutral in facial expression and to use only touch during their interactions with their infants (SF+T). Mothers in the experimental group were provided with additional instructions to obtain a specific response from their infants in each SF+T condition. Specifically, mothers in this group were instructed to use only touch and: (1) get their infants to imitate them (SF+T+IM), (2) engage their infants in a reciprocal interaction or turn-taking game (SF+T+TT) and, (3) attract and maintain their infants' attention to their faces with as much eye-to-eye contact as possible (SF+T+AF). Conditions 2, 3 and 4 were counterbalanced, according to a partial Latin Square design, to control for time effects. This approach resulted in three orders of presentation of the conditions:

Order 1 = SF+T+IM, SF+T+TT, SF+T+AF; Order 2 = SF+T+TT, SF+T+AF, SF+T+IM; Order 3 = SF+T+AF, SF+T+IM, SF+T+TT.

In contrast, while mothers in the control group were similarly instructed to be silent, still and neutral in facial expression and were permitted only to touch their infants during the SF with touch conditions, this group was not provided with additional instructions to obtain specific responses from their infants (SF+T). Given that mother-infant dyads in the control group participated in three identical SF with touch conditions, the order of presentation of these conditions was not counterbalanced. The detailed instructions provided to mothers can be found in Appendix C.

The SF+T conditions for the control group were designed to compare a typical SF with touch condition with a SF with touch condition during which mothers were instructed to elicit a specific behavior from their infants. Consequently, this control group served as a particularly strong and conservative comparison between the experimental and control groups given that the only difference was in the instructions provided to mothers in the experimental group. Because the procedure included both a baseline measurement (N) and a control for time effects through the counterbalancing of Order, it was not deemed necessary that the control group include the same number of subjects as the experimental group.

The final design of the study is illustrated in Table 1 and reflects a 2 (Group) x 2 (Sex) x 3 (Order of Presentation of Conditions) x 4 (Condition) mixed design with three between factors of Group (experimental, control), Sex (male, female), and

Table 1

Design of Study

GROUP	ORDER 1				ORDER 2				ORDER 3			
EXPERIMENTAL (n=36) Males (18) Females (18)	N	SF+T+IM	SF+T+TT	SF+T+AF	N	SF+T+TT	SF+T+AF	SF+T+IM	N	SF+T+AF	SF+T+IM	SF+T+TT
CONTROL (n=24) Males (12) Females (12)	N	SF+T	SF+T	SF+T	N	SF+T	SF+T	SF+T	N	SF+T	SF+T	SF+T

Note N = Normal condition

SF+T = SF with touch

SF+T+IM = SF with touch and instruction to get their infants to imitate

SF+T+TT = SF with touch and instruction to engage their infants in a reciprocal interaction or turntaking game

SF+T+AF = SF with touch and instruction to attract and maintain their infants' attention on their faces

Order (1, 2, 3) and one within factor of Condition (N, SF+T+IM, SF+T+TT, SF+T+AF).

Upon arrival, the mother and her infant were greeted and escorted into a waiting room. The experimenter reviewed the purpose and procedural details of the study and, barring any further questions, the mother was asked to read and sign an informed consent form in her preferred language of English or French (see Appendix D).

Once the mother determined that her infant was comfortable and ready to begin, the dyad was escorted into the testing room where the infant was placed in the infant seat with the mother seated facing the infant on an adjustable wooden stool. The experimenter provided the mother with instructions for the first condition, during which mothers were asked to interact normally with their infants, and subsequently the experimenter left the testing room to start the video equipment located in the adjacent observation room. The experimenter signalled the commencement of the condition to the mother by a knock on the one-way mirror separating the test and observation rooms. The stopclock was simultaneously set for 90 seconds, following which the experimenter again knocked on the one-way mirror to signal the end of the condition. The experimenter then re-entered the testing area and played with the infant for a 20-second period. During this time, the instructions for the following condition were provided to the mother. The same procedure was repeated for all remaining conditions. The experimenter viewed all portions of the interaction from the TV monitor located in the observation room as a reliability check to ensure that

the mothers maintained the still-face in all SF with touch conditions.

If, at any time during the session, the infant became distressed or cried for a sustained period of 20 seconds ($\underline{n}$ = 6), or if the mother desired to terminate a condition ($\underline{n}$ = 0), the session was interrupted and the mother and infant escorted to the waiting room where the infant was given an opportunity to rest, feed or be changed. Once the mother considered her infant was ready to continue the session, testing resumed and any condition(s) during which the infant was distressed were repeated.

Following completion of the testing session, the mother and her infant were again escorted to the waiting room where the experimenter asked the mother standardized questions regarding the infant's medical history and general demographic information (see Appendix E). Following the demographic information questionnaire, the mother was asked to respond to two additional questionnaires assessing the types of touch the infant typically enjoyed, and how communicative the mother believed she and her infant were during each of the conditions. The latter two questionnaires were not analyzed for the purposes of the present study.

Finally, the mother was thanked for their participation and was presented with an "Infant Scientist Award" as a token of appreciation for their participation in the study. The mother was informed that upon completion of the study a report detailing the general findings would be mailed to her home.

Behavioral Measures and Coding

The goal of the present study was to document infants' responses to

manipulations of instructions provided to mothers, thereby implying their sensitivity to changes in maternal touch. The indices of infant responsiveness were provided by three main categories of responses: Infant Attention, comprising the two dependent measures of Gaze at Mothers' Faces and Gaze at Mothers' Hands, Infant Affect, comprising the two dependent measures of Smiling and Fretting, and Infant Vocalizing which was coded in and of itself.

Multiple infant responses were included as dependent measures in the present study, since the proximal cues associated with the tactile modality may be presented to infants in a variety of ways. As a result, infants' response systems may be differentially affected by changes in maternal touch, resulting in the potential for infants to display asynchronous patterns of attention, affect and vocalizing.

The data were coded using frame-by-frame analyses of the video records for each of the dependent variables of: (1) Infant gaze at mothers' faces, (2) Infant gaze at mothers' hands, (3) Infant smiling, (4) Infant fretting, (5) Infant vocalizing and the maternal measure of (6) Touch. All measures have been reliably used in the past (Stack & Muir, 1990; 1992).

The measure of infant gaze at mothers' faces was coded when infants looked at their mothers' faces or surrounding facial areas. Infant gaze at mothers' hands was defined as gaze at the mothers' hand(s) and/or arm, up to the area of the elbow. A smile was operationally defined as an upturned mouth, either open or closed. Inclusion of an infant in the final sample was dependent upon the infant reaching a criterion of 10% smiling during the N condition. This criterion has been reliably

used in past studies of a similar nature (Stack & Muir, 1990; 1992). Fretting was recorded when the infant's mouth was turned down, curled, or the infant was crying. An infant vocalization was defined as any utterance or sound accompanied by positive or neutral affect, excluding physiological sounds such as burps, cries, sneezes, and hiccups, sounds accompanied by negative affect such as fussing or crying, or sounds expressing effort in combination with movement or state. Maternal touch was defined as any physical contact between mother and infant. Detailed descriptions of the operational definitions employed in the present study are located in Appendix F.

Several measures were taken to reduce potential bias arising from extraneous contextual cues during coding and to avoid the potential bias arising from the coder becoming aware of the condition being coded. The audio portion of the video record was turned off during the coding of all measures, except that of infant vocalizing. Furthermore, during the coding of infant smiling, fretting and vocalizing, the portion of the screen displaying the infant's body was covered so that the coder's attention was focused solely on the infant's face, thereby reducing the potential observer bias arising from maternal tactile cues. Four passes of each video record were performed using frame-by-frame analysis, one for infant gaze at mothers' faces and hands, one for infant smiling and fretting, one for infant vocalizing, and one for maternal touch.

Observers were trained on videotape examples prior to scoring the present data set until such time as they achieved a high level of reliability ($r > .90$) with experienced raters. Upon completion of coding, an independent rater, blind to the hypotheses of the study, coded 30% of the records to assess inter-rater reliability.

Intraclass reliability coefficients (Shrout & Fleiss, 1979) were extremely high for all measures ($r > .99$). To assess the reliability of onset and offset times for each measure, rather than merely overall duration, Kappa coefficients (Cohen, 1968) were also calculated and ranged from $r = .82$ to $r = .96$ (infant gaze at mothers' faces = .96; infant gaze at mothers' hands = .91; infant smiling = .82; infant fretting = .88; infant vocalizing = .90; maternal touch = .91).

Once coding was completed and reliability assessed, the raw data were reduced to obtain the percent durations of each measure as a function of condition, which were used for the purposes of statistical analysis.

Results

Two univariate repeated measures analyses of variance (ANOVA) were conducted on the percent durations of the five infant dependent measures: (1) Gaze at mothers' faces, (2) Gaze at mothers' hands, (3) Smiling, (4) Fretting (5) Vocalizing, and one maternal measure of (6) Touch, using the BMDP statistical package (Dixon, Brown, Engelman, & Jennings, 1990). The first ANOVA contained two between factors of Sex (male, female), and Order (1, 2, 3), and one within factor of Condition (N, SF+T+IM, SF+T+TT, SF+T+AF). The second ANOVA contained two between factors of Group (experimental, control) and Sex (male, female) and one within factor of Condition.

Descriptive statistics, designed to assess the normality of the distribution, were calculated on each dependent variable to determine whether significant skewness and/or kurtosis existed necessitating transformation of any of the variables. Both skewness and kurtosis were evaluated against the numerical criteria provided by Tabachnick and Fidell (1989) and transformations were conducted when the descriptive statistic exceeded the proposed numerical value in any condition for any measure. Transformations were also performed if significant outliers existed in the data. This latter approach has been proposed as a more viable alternative rather than eliminating subjects from the analyses altogether (Tabachnick & Fidell, 1989). To facilitate comprehension of the results, only significant findings will be reproduced in the text, while non-significant results can be found in the ANOVA tables summarizing the results of each measure located in Appendixes G through L. Furthermore, in

cases where transformations were necessary, raw means are included in the text while transformed means are located in the appendixes. However, when transformations were conducted, the F-scores and p-values cited in the text are taken from the analyses on the transformed data, as these are the findings on which the interpretations were based.

In order to control the experiment-wise probability level, the following set of analyses were conducted. As prior studies similar in nature to the present one have not found significant main effects or interaction effects for the factors of Sex and Order (e.g., Stack & Muir, 1990), it was expected that no such differences would exist in the present study. Potential Order main effects or interactions were analyzed for each variable, using a repeated measures ANOVA with Sex and Order as the between factors and Condition as the within factor. Since no Order main effects or interactions were obtained, this factor was removed from subsequent analyses and a repeated measures ANOVA with Group and Sex as the between factors and Condition as the within factor was conducted in order to analyze for potential Sex main effects or interactions. In the absence of Sex main effects or interactions, this factor was removed from subsequent analyses, leaving a two-way repeated measures ANOVA which was conducted on the remaining factors of Group as the between factor and Condition as the within factor.

If a significant interaction between Group and Condition was obtained, planned a priori simple effect analyses (Tabachnick and Fidell, 1989) were performed whereby the levels of the Condition factor were held constant to observe group

differences in each condition. This was followed by an additional simple effects analysis in which the reverse occurred; the levels of the Group factor were held constant to observe differences across conditions as a function of the experimental and control groups separately. These simple effect analyses were followed by Tukey HSD comparisons (Keppel, 1982; Winer, 1971) where applicable, to isolate the source of the significant interaction. A critical alpha level of .05 was selected as the criterion for statistical significance, with the more conservative Geisser-Greenhouse Adjusted F score being used to assess significance for within effects. In the absence of any significant Group by Condition interactions, the control group was removed, and analyses were conducted on the experimental group alone using a one-way repeated measures ANOVA to test for Condition effects. If a significant Condition main effect was obtained, Tukey HSD comparisons were performed to isolate the specific differences. While it is recognized that infants in the control group took part in a Normal followed by three SF with touch conditions, the results of any significant Group by Condition interactions will be labelled according to the corresponding acronym for Condition in the experimental group (e.g., SF+T+IM, SF+T+TT, SF+T+AF).

Analyses revealed no differences between the experimental and control groups during the first, Normal, condition for all measures, indicating that infants in both groups responded similarly at the outset of the study. Furthermore, no shifts in infant gaze at mothers' hands, smiling, fretting or vocalizing were evidenced across the SF with touch conditions for infants in the control group, indicating that infants in the

control group responded to the SF+T conditions in a stable and consistent fashion across time. The only exception to this stability occurred for the gaze at mothers' faces measure where infants in the control group gazed more at their mothers' faces during the second relative to either the third or fourth conditions. However, differences in the amounts of infant gaze at mothers' faces across these SF with touch conditions for this measure were small (i.e., all differences less than five percent), potentially attributable to individual variability. Each dependent measure will be reviewed separately, beginning with the infant measures of Attention consisting of Gaze at Mothers' Faces and Gaze at Mothers' Hands, Infant Affect consisting of Smiling and Fretting, Infant Vocalizing and finally, the maternal measure of Touch.

Infant Attention

Infant gaze at mothers' faces. A log transformation was conducted on the infant gaze at mothers' faces measure because the descriptive statistics revealed substantial positive skewness and significant outliers. The subsequent ANOVA on the transformed data (Table G1) revealed a significant main effect of Condition, ($F(3, 168) = 31.60$, $p < .0001$), as well as Group by Sex, ($F(1, 56) = 4.53$, $p < .05$), and Group by Condition, ($F(3, 168) = 5.14$, $p < .0001$), interactions.

Because a significant interaction between Group and Sex was found, Sex was retained in the analysis, and two two-way ANOVAs with Sex as the between variable and Condition as the within variable were conducted on the experimental and control groups separately (Tables G2 and G3 respectively), in order to isolate the source of the interaction. Results of these analyses revealed a significant Sex main effect for

the experimental group only, $F(1, 34) = 7.40$, $p < .05$, indicating that females in the experimental group spent more time gazing at their mothers' faces ($M = 27.70\%$) than did males ($M = 20.77\%$). In contrast, the responses of males and females in the control group were not found to differ. The Group by Sex interaction is illustrated in Figure 1.

The Group by Condition interaction was further analyzed by conducting a simple effects analysis whereby the levels of the Condition factor were held constant to observe group differences in each condition. This analysis revealed that the significant difference between the experimental and control groups occurred only during the SF+T+AF condition, $F(1, 58) = 4.18$, $p < .05$, where infants in the experimental group gazed more at their mothers' faces ($M = 27.62\%$) than infants in the control group ($M = 14.98\%$). The Group by Condition interaction is illustrated in Figure 2. An additional simple effects analysis, holding the levels of the Group factor constant to observe differences across the conditions for the experimental and control groups separately, revealed a significant Condition effect for both the experimental, $F(3, 56) = 31.37$, $p < .0001$, and control, $F(3, 56) = 14.76$, $p < .0001$, groups. Subsequent Tukey comparisons for the experimental group (Table G4) revealed that infants gazed more at their mothers' faces during the Normal condition ($M = 43.36\%$) than during any of the SF with touch conditions, SF+T+IM ($M = 10.90\%$), SF+T+TT ($M = 15.07\%$) and SF+T+AF ($M = 27.62\%$). In addition, infants in the experimental group gazed more at their mothers' faces in the SF+T+TT condition ($M = 15.07\%$) than in the SF+T+IM condition ($M =$

Figure 1. Mean percent duration of infant gaze at mothers' faces as a function of Group (experimental, control) and Sex (male, female).

Standard errors are shown by vertical bars.

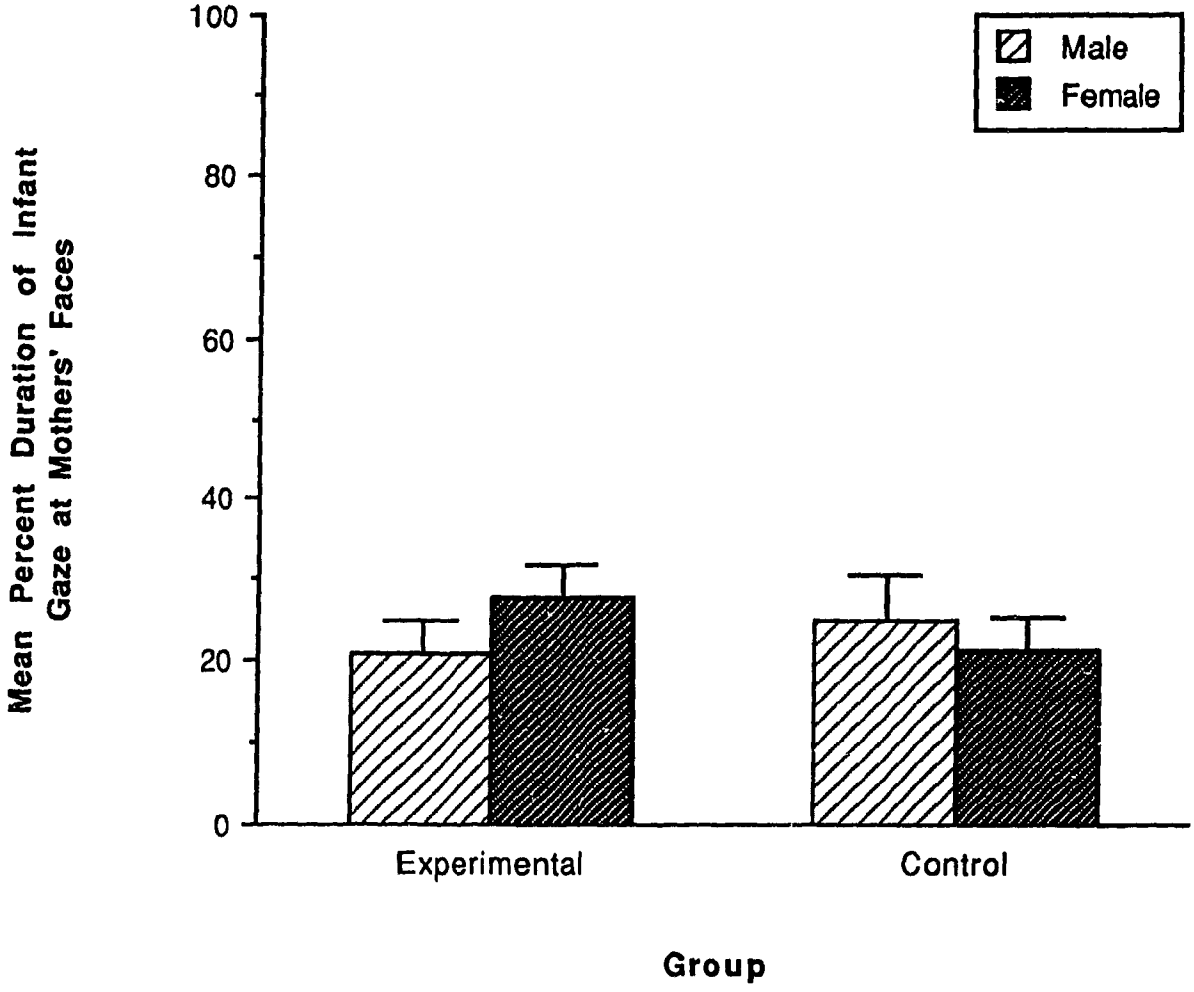
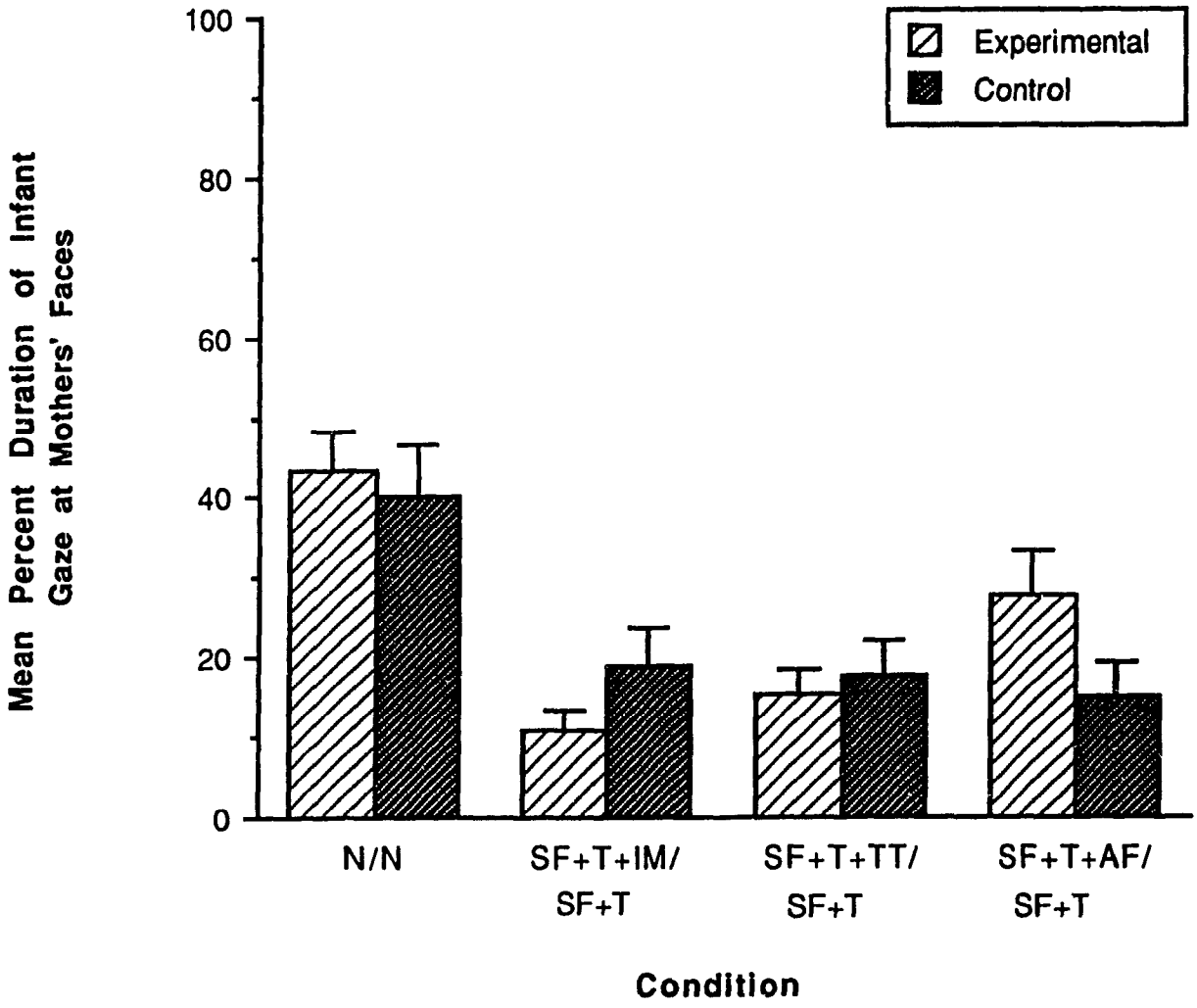

Mean Percent Duration of Infant Gaze at Mothers' Faces
100
80
60
40
20
0
Male
Female
Experimental
Control
Group

Figure 2. Mean percent duration of infant gaze at mothers' faces as a function of Group (experimental, control) and Condition (Experimental: N = Normal; SF+T+IM = SF with touch and instruction to get their infants to imitate; SF+T+TT = SF with touch and instruction to engage their infants in a reciprocal interaction or turntaking game; SF+T+AF = SF with touch and instruction to attract and maintain their infants' attention on their faces; Control: N = Normal; SF+T = SF with touch).

Standard errors are shown by vertical bars.

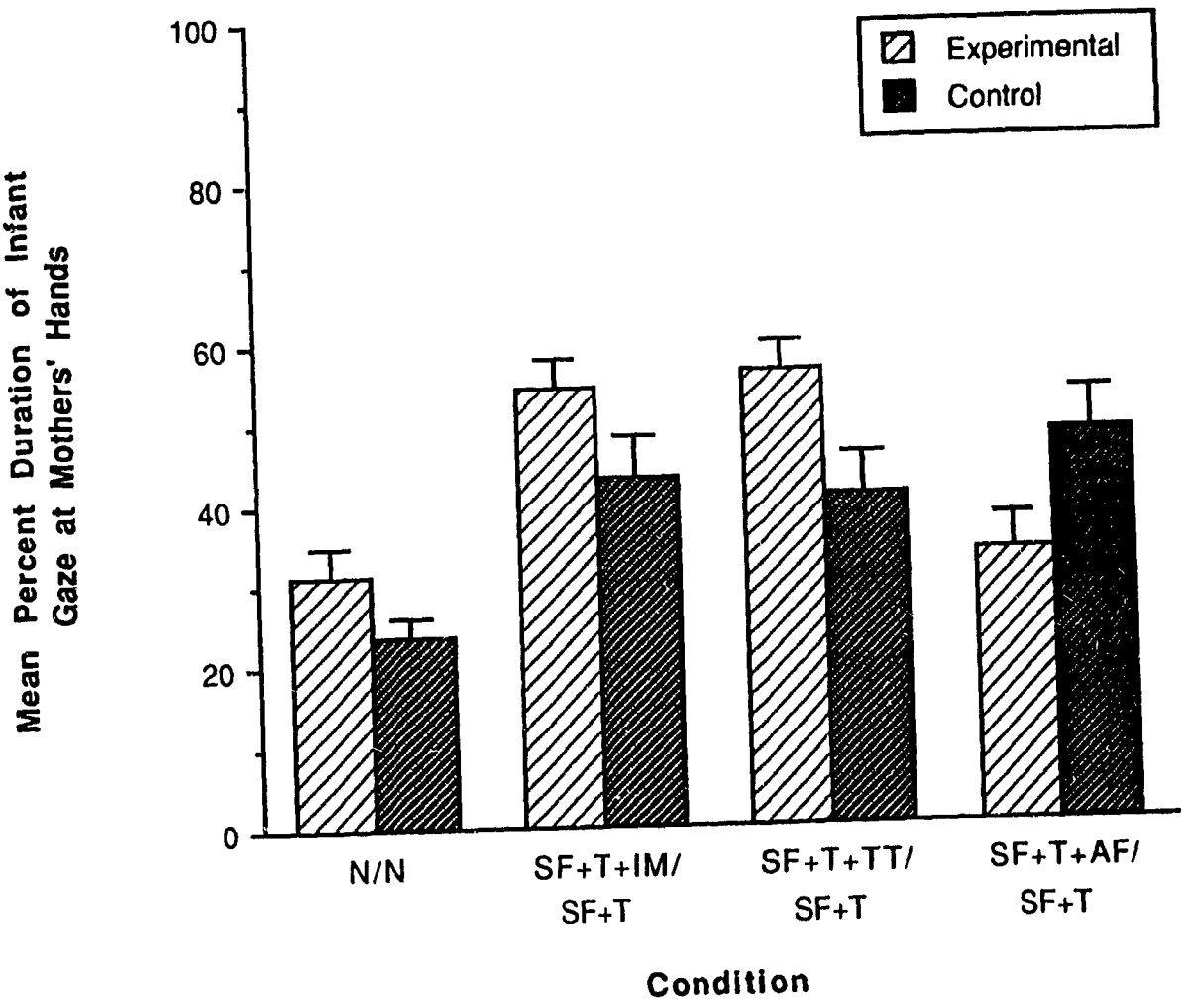

Experimental
Control
Mean Percent Duration of Infant Gaze at Mothers' Faces
100
80
60
40
20
0
N/N
SF+T+IM/ SF+T
SF+T+TT/ SF+T
SF+T+AF/ SF+T
Condition

10.90%) and in the SF+T+AF (M = 27.62%) than in the SF+T+IM condition (M = 10.90%). Tukey comparisons for the control group (Table G5) revealed that infants in the control group also gazed more at their mothers' faces in the Normal condition (M = 40.16%) than in any of the SF+T conditions (M = 18.75%, M = 17.83%, and M = 14.98% for the SF+T+IM, SF+T+TT and SF+T+AF conditions respectively). Moreover, infants in the control group gazed more at their mothers' faces during the SF+T+IM (M = 18.75%) relative to the SF+T+TT (M = 17.83%) condition and more during the SF+T+IM (M = 18.75%) relative to the SF+T+AF (M = 14.98%) condition. Transformed means are located in Table G6.

Infant gaze at mothers' hands. Descriptive statistics revealed no skewness or outliers, thus no transformation was conducted on this variable. No Sex or Order main effects or interactions were found, thus these variables were removed from the analyses and a two-way ANOVA with Group and Condition was conducted. Results of the Group by Condition ANOVA (Table H1) revealed a significant Condition main effect, $F(3, 174) = 15.15$, $p < .0001$, which was qualified by a Group by Condition interaction, $F(3, 174) = 6.84$, $p < .0001$, as illustrated in Figure 3. A subsequent simple effects analysis, holding the levels of Condition constant, revealed a significant difference between the groups during the SF+T+TT condition, $F(1, 58) = 6.38$, $p < .05$, where infants in the experimental group gazed more at their mothers' hands (M = 56.36%) than infants in the control group (M = 40.87%) and during the SF+T+AF condition, $F(1, 58) = 5.16$, $p < .05$, where the opposite occurred and infants in the experimental group gazed less at their mothers hands (M = 33.72%)

Figure 3. Mean percent duration of infant gaze at mothers' hands as a function of Group (experimental, control) and Condition (Experimental: N = Normal; SF+T+IM = SF with touch and instruction to get their infants to imitate; SF+T+TT = SF with touch and instruction to engage their infants in a reciprocal interaction or turntaking game; SF+T+AF = SF with touch and instruction to attract and maintain their infants' attention on their faces; Control: N = Normal; SF+T = SF with touch).

Standard errors are shown by vertical bars.


Experimental
Control
100
80
60
40
20
0
Mean Percent Duration of Infant Gaze at Mothers' Hands
N/N
SF+T+IM/ SF+T
SF+T+TT/ SF+T
SF+T+AF/ SF+T
Condition

than infants in the control group (M = 48.53%). There was also a trend for infants in the experimental group to gaze more at their mothers' hands than controls during the SF+T+IM condition, F(1, 58) = 3.35, p = .07, however this trend did not reach significance.

An additional simple effects analysis, holding the levels of Group constant, revealed a significant Condition effect for both the experimental, F(3, 56) = 14.48, p < .0001, and control, F(3, 56) = 6.97, p < .0001, groups. Subsequent Tukey comparisons on the experimental group (Table H2) indicated that they gazed less at their mothers' hands in the Normal condition (M = 31.38%) than in either the SF+T+IM (M = 54.39%) or SF+T+TT (M = 56.36%) conditions. Furthermore, infants in this group gazed more at their mothers' hands in the SF+T+IM (M = 54.39%) than in the SF+T+AF condition (M = 33.72%) and in the SF+T+TT (M = 56.36%) than in the SF+T+AF condition (M = 33.72%). Tukey comparisons on the control group (Table H3) indicated that infants in the control group gazed less at their mothers' hands in the Normal (M = 23.51%) than in any of the SF with touch conditions, (M = 43.38%, M = 40.88%, and M = 48.53% for the SF+T+IM, SF+T+TT and SF+T+AF conditions respectively).

Infant Affect

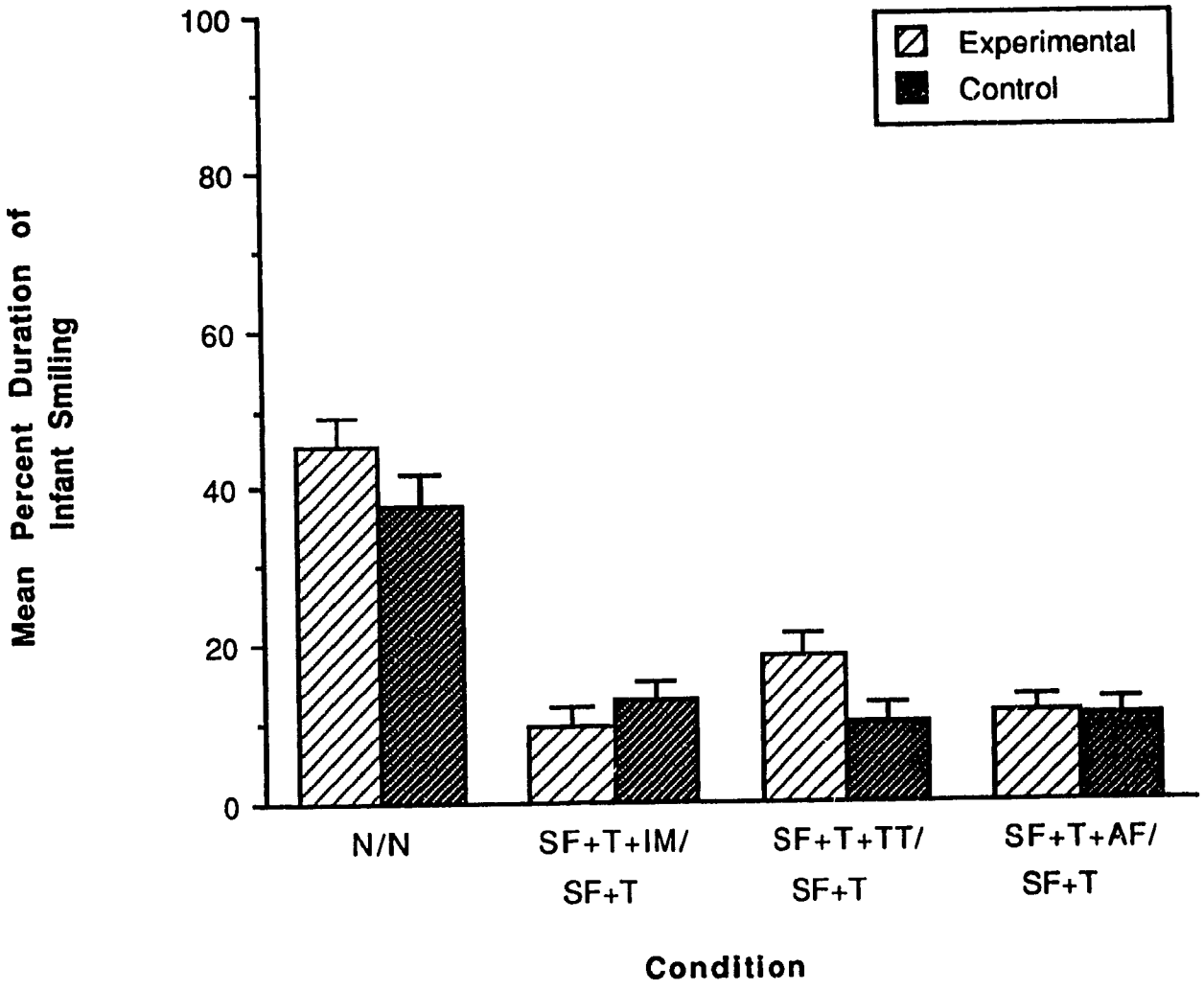
Infant smiling. Descriptive statistics revealed significant skewness and outliers, thus a log transformation was conducted on this variable. No Sex or Order main effects or interactions were found, thus these variables were removed from the analyses and a two-way ANOVA with Group and Condition was conducted. The

Group by Condition ANOVA (Table I1) revealed a Condition main effect, $F(3, 174) = 47.19$, $p < .0001$, which was qualified by a Group by Condition interaction, $F(3, 174) = 4.71$, $p < .0001$). As illustrated in Figure 4, a subsequent simple effects analysis, holding the levels of Condition constant, revealed that the responses of the experimental and control groups differed only during the SF+T+TT condition, $F(1, 58) = 4.94$, $p < .05$, where infants in the experimental group ($M = 18.37\%$) smiled more than those in the control group ($M = 9.93\%$). When a simple effects analysis, holding the levels of Group constant, was performed, a significant Condition effect was obtained for both experimental, $F(3, 56) = 45.57$, $p < .0001$, and control, $F(3, 56) = 20.66$, $p < .0001$ groups. Subsequent Tukey comparisons conducted on the experimental group (Table I2) indicated that infants smiled more in the Normal condition ($M = 45.32\%$) than in any of the SF with touch conditions ($M = 9.49\%$, $M = 18.65\%$, and $M = 11.32\%$ for the SF+T+IM, SF+T+TT and SF+T+AF conditions respectively), and smiled more in the SF+T+TT ($M = 18.65\%$) than in the SF+T+IM condition ($M = 9.49\%$). The Tukey comparisons on the control group (Table I3) revealed that infants' smiled more in the Normal condition ($M = 37.63\%$) than in any of the SF with touch conditions, $M = 13.04\%$, $M = 9.93\%$, and $M = 10.70\%$ for the SF+T+IM, SF+T+TT and SF+T+AF conditions respectively. Transformed means are located in Appendix I4.

Infant fretting. Due to the extremely low durations of fretting across the conditions for both groups, severe skewness and outliers were present in the data. However, given the potential floor effect, reflected in the fact that many infants never

Figure 4. Mean percent duration of infant smiling as a function of Group (experimental, control) and Condition (Experimental: N = Normal; SF+T+IM = SF with touch and instruction to get their infants to imitate; SF+T+TT = SF with touch and instruction to engage their infants in a reciprocal interaction or turntaking game; SF+T+AF = SF with touch and instruction to attract and maintain their infants' attention on their faces; Control: N = Normal; SF+T = SF with touch).

Standard errors are shown by vertical bars.


Experimental
Control
100
80
60
40
20
0
Mean Percent Duration of Infant Smiling
N/N
SF+T+IM/ SF+T
SF+T+TT/ SF+T
SF+T+AF/ SF+T
Condition

fretted, transformation of this variable was not conducted. No Sex or Order main effects or interactions were found, thus these variables were removed from subsequent analyses and a two-way ANOVA with Group and Condition was conducted (Table J1). The results indicated only a significant Condition main effect, $F(3, 174) = 3.62$, $p < 05$. Because a significant Condition main effect was found in the absence of a Group by Condition interaction, Tukey comparisons were conducted on Condition. The results of the Tukey comparisons (Table J2) indicated that, collapsed across Group, more fretting occurred during the SF+T+AF condition ($M = 4.32\%$) than the Normal condition ($M = 0.60\%$). Since no Group by Condition interaction was found, a one-way repeated measures ANOVA was conducted on the experimental group alone. The results of this analysis revealed no differences between the experimental conditions.

Infant Vocalizing

Descriptive statistics for the infant vocalizing measure revealed severe positive skewness and outliers, necessitating an inverse transformation. No Sex or Order main effects or interactions were obtained, thus these variables were removed from the analyses and a two-way ANOVA with Group and Condition was conducted. The results of the Group by Condition ANOVA (Table K1) revealed a significant Condition main effect, $F(3, 177) = 6.39$, $p < .0001$, and Tukey comparisons (Table K2) indicated that, collapsed across Group, infants in both the experimental and control groups vocalized more during the SF+T+AF ($M = 11.77\%$) relative to either the Normal ($M = 7.76\%$) or the SF+T+TT ($M = 8.78\%$) conditions. Infants

also vocalized more during the SF+T+IM (M = 11.73%) relative to the Normal condition (M = 7.76%). Since no Group by Condition interaction was obtained, a one-way repeated measures ANOVA with Condition as the within factor was conducted on the experimental group alone (Table K3). The only significant main effect was Condition, $F(3, 105) = 3.98$, $p < .05$. Subsequent Tukey comparisons (Table K4) revealed that infants in the experimental group vocalized more during the SF+T+AF (M = 12.36%) relative to either the Normal (M = 7.95%) or the SF+T+TT (M = 5.18%) conditions. Transformed means are located in Table K5.

Maternal Touch

Given substantial negative skewness in the data, a reflect and log transformation was conducted on the maternal touch measure. No Sex or Order main effects or interactions were obtained, thus these variables were removed from the analyses and a two-way ANOVA with Group and Condition was conducted. The two-way repeated measures ANOVA (Table L1) revealed a significant Group by Condition interaction, $F(3, 174) = 3.53$, $p < 0.05$, which is illustrated in Figure 5. A subsequent simple effects analysis, holding the levels of Condition constant, indicated that mothers in the experimental and control groups differed during the SF+T+IM condition, $F(1, 58) = 6.07$, $p < .05$, where mothers in the experimental group (M = 79.08%) touched their infants less than mothers in the control group (M = 87.79%), and during the SF+T+AF condition, $F(1, 58) = 5.14$, $p < .05$, where again, mothers in the experimental group (M = 77.43%) touched their infants less than mothers in the control group (M = 87.99%). Transformed means are located in

Figure 5. Mean percent duration of maternal touch as a function of Group (experimental, control) and Condition (Experimental: N = Normal; SF+T+IM = SF with touch and instruction to get their infants to imitate; SF+T+TT = SF with touch and instruction to engage their infants in a reciprocal interaction or turntaking game; SF+T+AF = SF with touch and instruction to attract and maintain their infants' attention on their faces; Control: N = Normal; SF+T = SF with touch). Standard errors are shown by vertical bars

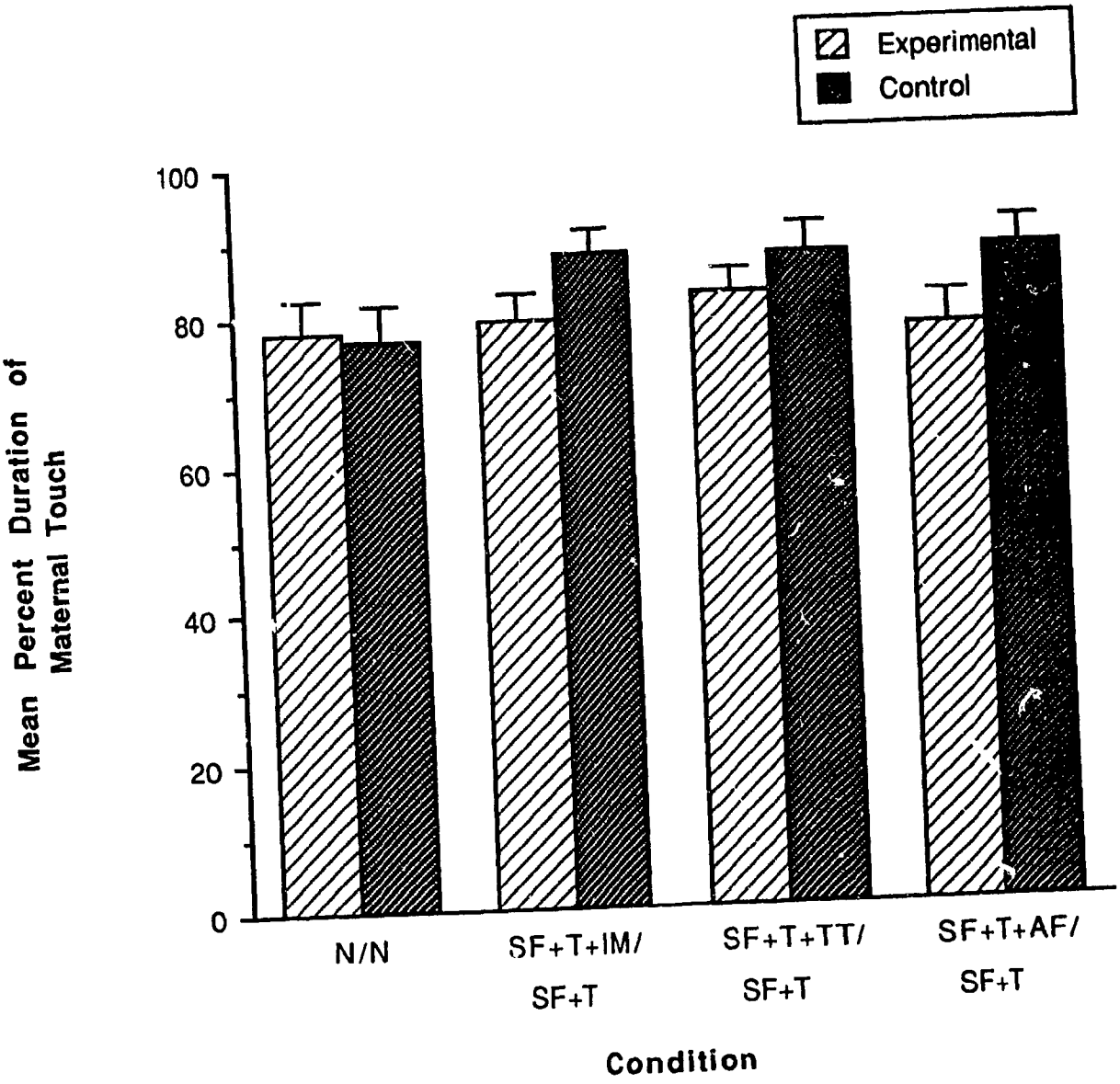

Experimental
Control
Mean Percent Duration of Maternal Touch
100
80
60
40
20
0
N/N
SF+T+IM/ SF+T
SF+T+TT/ SF+T
SF+T+AF/ SF+T
Condition

Table L2. A further simple effects analysis, holding the levels of Group constant, revealed no differences across condition for either the experimental or control group.

Discussion

The present study was designed to assess two objectives. The first was to investigate whether, and how, manipulations of instructions provided to mothers affect patterns of infant responding. This goal was accomplished by examining infants' responses during SF with touch conditions in which mothers were provided with instructions to use only touch and obtain specific responses from their infants, and comparing them to infants' responses during a series of SF with touch conditions in which mothers were permitted to touch but were not provided with further instructions. The second objective was to investigate whether infants are responsive to changes in their mothers' tactile behavior across conditions and whether this sensitivity is reflected in their own behavior.

While it was not anticipated that infants would perform complex behaviors, such as imitation, in response to maternal overtures, it was expected that the instructions to mothers to obtain specific responses from their infants would result in changes in maternal touching behavior and, consequently, observable and measurable changes in the levels of infant gaze at mothers' faces and hands, smiling and vocalizing. In general, the results from this investigation support the hypotheses and indicate that: (1) infants respond to manipulations of instructions provided to mothers with shifts in gaze, smiling and vocalizing, implying that mothers modified their touching as a function of the instructions provided to them, and (2) young infants appear sensitive to changes in maternal tactile behavior.

Infants' Responses as a Function of Group

No differences between the experimental and control groups were found during the first, Normal, condition for any of the measures, indicating that infants in both groups responded similarly at the outset of the study. However, as hypothesized, infant gaze and smiling differed between the experimental and control groups during the various SF with touch conditions, thereby highlighting the effectiveness of manipulations of instructions provided to mothers in influencing infant responsiveness.

Infants in the experimental group gazed more at their mothers hands in the Turntaking (SF+T+TT) condition relative to the control group. In contrast, however, they gazed less at their mothers' hands and more at their mothers' faces during the Attention-to-Face (SF+T+AF) condition relative to controls. While these three results support the hypotheses, the hypothesis that infants would gaze more at their mothers' hands during the Imitation (SF+T+IM) condition was not supported. While there was a trend for infants to gaze more at the mothers' hands during this condition, it did not reach significance.

Differences in infant attention were coupled with differences in affect. Infants in the experimental group demonstrated higher levels of smiling than their control counterparts during the SF+T+TT condition, again supporting the hypotheses and suggesting that infants were sensitive to changes in maternal touch. The levels of smiling found in this investigation are consistent with those of naturalistic interaction studies involving all modes of interaction (Symons & Moran, 1987). As Tronick (1989) has argued in the context of face-to-face interactions, infant smiling may have

served as a signal to the mother that the infant was succeeding in achieving his or her goals.

Taken together, the results are particularly strong, given the conservative design of the control group; the only difference between the two groups resided in the instructions provided to mothers in the experimental group. Consequently, the differential attention and affect displayed by the groups can be attributed to the instructions provided to mothers in the experimental group, suggesting that mothers modified their touching across the various conditions to comply with experimental instructions and to modify infant responsiveness.

This suggestion is underscored by the results from the maternal touch measure. Although consistently high levels of touch were evidenced throughout, some of the experimental manipulations resulted in lower levels of maternal touch in the experimental relative to the control group. Mothers in the experimental group touched their infants less than controls during both the Imitation and Attention-to-Face episodes, suggesting that the instructions provided to the mothers in the experimental group modified maternal behavior by suppressing the amount of touch in these conditions, perhaps in favor of other hand movements not involving maternal touch. However, without analysis of these maternal gestural hand movements it is premature to state this conclusion with any certainty. Analysis of this measure is thus warranted in the future. What is particularly noteworthy, however, is that the conditions during which mothers touched their infants less were the same ones in which infants gazed less at their mothers' hands, implying that infants were attuned to, and detected subtle

changes in, their mothers' behavior, and responded with corresponding shifts in infant attention.

That infants in the experimental group evidenced more gaze at their mothers' faces in the Attention-to-Face condition and higher levels of smiling in the Turntaking condition than controls as predicted, further indicates that mothers appeared to be successful in obtaining specific responses from their infants using only touch. Mothers could only have elicited these infant behaviors by modifying their touch from that employed in the SF with touch and no-instruction control condition, implying that mothers have an implicit or explicit knowledge of the types of touch that will elicit certain responses from their infants and can modify their tactile behavior in line with this knowledge. The suggestion that mothers have an implicit or explicit knowledge regarding the touching they can use to influence their infants' attention and affect is consistent with Papousek and Papousek (1987) who suggest that parents engage in intuitive parenting, employing a rich array of behaviors of which they are not consciously aware.

Infants' Responses as a Function of Condition

No shifts in infant gaze at mothers' hands, affect or vocalizing were evidenced across the SF with touch conditions for infants in the control group, indicating that infants in this group responded to presentations of the identical SF+T instruction in a stable and consistent fashion. The only exception to this stability occurred for the Gaze at Mothers' Faces measure where infants in the control group gazed more at their mothers' faces during the second relative to either the third or fourth conditions.

However, differences in the amounts of infant gaze at mothers' faces across the SF with touch conditions for this measure were small, potentially attributable to individual variability.

Support for the hypotheses that infants are sensitive to changes in maternal tactile behavior and that mothers modify their touch as a function of different instructional conditions was provided by the results of the infant measures for the experimental group which indicated differential attention, affect and vocalizing during the various conditions. As hypothesized, shifts in infant gaze from the Normal to the SF with touch conditions were found in both the experimental and control groups, such that infants gazed primarily at their mothers' faces during the Normal condition, and at their mothers' hands during the SF with touch conditions, presumably because the hands were dynamic and visible to the infant. However, while an exception to the latter finding was predicted to occur during the Attention-to-Face condition for infants in the experimental group, given the fact that the goal during this condition was to attract and maintain attention to the mothers' faces rather than their hands, this hypothesis was not supported. Nevertheless, the shifts in infant gaze from the Normal to the SF with touch conditions are consistent with the results of Stack and Muir (1990, 1992) and suggest that shifts in infants' gaze during face-to-face interactions may coincide with the areas of the mothers' bodies which are most dynamic or provide the most stimulation. This suggestion stands in contrast to that of Field (1977) who hypothesized that increases in maternal activity result in infant gaze aversion, and instead suggests that it is during just such conditions of maternal

activity that infant gaze is elicited and maintained. The discrepancy in the interpretations of the two studies may be attributed to the fact that mothers in the Field (1977) study used all modes of communication available to them while mothers in the present study used only touch.

Shifts in infants' gaze at mothers' faces during the various conditions further reflect infants' sensitivities to changes in their mothers' touch. Infants in the experimental group gazed more at their mothers' faces during the Normal condition relative to all SF with touch conditions, thereby failing to support the hypothesis that infants in the experimental group would gaze at their mothers' faces as much during the Attention-to-Face condition as in the Normal condition during which face, voice and touch were used. Nonetheless, infants demonstrated higher levels of gaze at mothers' faces during the Attention-to-Face relative to the Imitation condition and this result is consistent with the results of Symons and Moran (1987), who found that mothers successfully elicited and maintained their infants' attention when instructed to do so, and that infants gazed more at their mothers during this condition than during an Imitation condition.

The comparable findings from the Attention-to-Face condition in this study and that of Symons and Moran (1987) support the functional nature of the tactile modality. In the Symons and Moran (1987) investigation mothers were permitted to use their faces, voices and touch to accomplish their goal while mothers in the Attention-to-Face condition in this study accomplished the identical goal with the use of only one of these modalities - touch, thereby highlighting the effectiveness of touch

in directing infant attention and implying that touch-only interactions may approximate normal mother-infant interactions, at least for brief periods of time.

Shifts in infant smiling also differed across the various experimental conditions, with less smiling being demonstrated during the SF with touch conditions relative to the Normal. While the hypothesis that infant smiling would be no different between the Normal and Turntaking conditions was not confirmed, infants in the experimental group smiled more during the Turntaking condition relative to the control group. This finding, combined with the fact that infants in the experimental group gazed more at their mothers' hands during this condition relative to controls, suggests that mothers in the experimental group employed qualitatively different types of touch in this condition and that infants in the experimental group perceived these differences and found the hands qualitatively more stimulating relative to those in the control group.

However, while the results of the present study strongly suggest qualitative differences in the types of touch that mothers employed as a result of the various experimental manipulations, firm conclusions as to whether changes in maternal touch actually resulted in differential infant responses and whether specific types of maternal touch affected infants in different ways, cannot be made on the basis of the present data. While the quantitative nature of touch is important, the qualitative components warrant analysis in the future in order to afford a more complete view of the consequences of manipulations of maternal touch during mother-infant interactions. More specifically, a scale establishing the quality of maternal touch along various

dimensions, including type and intensity, would be required in order to conclusively establish these differences. Such a scale is presently being developed (Stack, LePage, Muir & Hains, in preparation) and these questions will be examined in detail in future studies.

The generally positive nature of these touch-only interactions was reflected in the higher levels of infant smiling and in the consistently low levels of fretting found relative to studies employing the traditional SF procedure. These findings bolster the suggestion proposed by Stack and Muir (1990, 1992) that maternal touch serves a greater function than merely that of maintaining infants in a content and alert state. Rather, the findings that the addition of maternal touch can increase smiling, decrease fretting and direct attention imply that touch is effective in modulating the typically negative effects associated with the standard SF situation, and that it may result in less need for infants to regulate their emotions.

Generally, the higher levels of infant vocalizing during the SF with touch relative to the Normal conditions for both groups is also consistent with low fretting, since only positive and neutral vocalizing were included, thereby eliminating any negative vocalizing including whining, fussing or crying. This shift in vocalizing from the Normal to the SF with touch conditions confirmed the hypothesis and can be interpreted in several ways. Tronick et al. (1978) argued that infant vocalizing serves as a signal to the mother that the infant wishes her to reengage in the interaction. Alternatively, infants may have vocalized more during these conditions because the corresponding silences of their mothers provided them with an opportunity to

contribute to the 'conversation'. Consequently, the mothers' silences may have been interpreted by the infants as a signal that it was his or her 'turn' to converse, implying mutuality in the relationship, whereby both members contributed to the flow of the interaction. This interpretation corresponds to that of Feldstein et al. (1993), who found that infants and adults coordinated their vocalizations and pauses in line with those of their partner, and interpreted the findings as evidence for the existence of coordinated interpersonal timing in the vocal parameters between mothers, as well as strangers, and infants.

Interpretation of the Findings in the Context of the Existing Literature

Taken together, the results of the present study contribute to the documentation of a functional context for the role of maternal touch during mother-infant interactions by demonstrating that infant behavior varied as a function of the instructions provided to mothers and that mothers appeared to easily and rapidly change their touch from one condition to another in order to elicit the behavior that was requested of them.

A comparison of the various infant responses employed in the present study suggests that they varied as a result of the experimental manipulations, but did not rise and fall in unison. Rather, high durations in one infant response measure, such as gaze at mothers' faces, were frequently associated with corresponding low durations in other response measures, such as infant smiling, suggesting that the infant's contribution during mother-infant interactions is highly complex. These asynchronous patterns of responses serve to underscore the argument put forth by Symons and Moran (1987) that a single behavioral index may be insufficient to

describe the subtle variations that occur during mother-infant interactions. Rather, these researchers propose that a number of infant behavioral indices be included in the assessment of infant involvement and mother-infant reciprocity, a suggestion which has also been proposed by Fogel (1990) as a critical component of dynamic systems theory. According to this theory, dynamic processes in interactions involve the joint construction of actions assembled in time and, as such, descriptions of these complex processes require an investigation of a variety of infant behavioral and motor patterns across the time span rather than at one static point.

The importance of touch during the face-to-face interactions in this study is highlighted by the consistently high levels of maternal touch across conditions, including the Normal, for both the experimental and control groups. Stack and Muir (1990) found that mothers touched their infants 65% of the time during their interactions with one another. Similarly, mothers in the present study consistently touched their infants over 75% of the time. Contrary to the hypothesis however, maternal touch did not increase from the Normal to the SF with touch conditions. This result likely reflects a ceiling effect, as high levels of maternal touch were shown across the conditions. Nonetheless, mothers touched their infants as much during the Normal interaction in which face, voice and touch were permitted as they did when touch was the only modality used, underscoring the fundamental contribution of touch during mother-infant interactions.

However, while sustained levels of maternal touch were evidenced throughout, the argument that mothers modified their touch during the individual SF with touch

conditions as a function of the experimental instructions is supported by the differences in infant gaze, smiling, fretting and vocalizing across conditions. These differences suggest that variations in experimental instructions may constrain or modify maternal contingent behavior in a variety of subtle ways, thereby differentially influencing the behavior of their infants. The fact that infants responded to these subtleties would support their role as socially competent interactors who are attuned, and respond contingently, to their mothers' shifts in behavior. Thus, in contrast to previous theorizing whereby infants were viewed as either needing protection from external stimuli or, at best, as passive recipients of stimulation, evidence from this study supports the more contemporary notion that infants will actively seek out, and respond to, stimulation.

The findings across condition underscore the considerable breadth of the tactile modality and its unique role during social interactions, lending support to the work of Koester, Papousek and Papousek (1989) who have emphasized the significant contribution of non-vocal communication during mother-infant interchange. In addition, the results from the present study support the argument of Papousek and Papousek (1987) that parents are equipped with a vast array of behaviors that, although not under conscious control, support and enhance infants' early adaptation to the social world.

The findings of the present study are consistent with, and can be explained by, a number of theoretical models. The finding that mothers appeared to change their tactile behavior across conditions and that infants responded to these changes,

modifying their behavior in turn, is consistent with Tronick's (1989) view that the infant and mother are both participants in an affective communication system, each modifying the emotional experience and behavior of the other. According to Tronick (1989), the infants' affective displays serve as signals, communicating to the mother whether the infant is succeeding or not in achieving his or her goals. Consequently, the shifts in infant gaze, smiling and vocalizing, both between groups and across conditions in the present study, suggest that mothers and infants were attuned to the behavior of their partners. The implication is that mothers and their infants display synchrony and mutuality in their interactions with one another, highlighting the reciprocal and mutually-regulated nature of mother-infant interactions.

The present findings also support a dynamic systems model (Fogel & Thelen, 1987). According to this theory, both mother and infant are attuned to one another and jointly contribute to the flow of the ongoing interaction which continually evolves over time. Fogel (1990) has argued that, in contrast to many developmental methodologies that seek independent measures of mother and infant responsiveness and assume that a sharp line can be defined between the individual and the social environment, the boundary between the individual and the context is defined in the dynamic interaction of the two.

The relative ease with which mothers appeared to modify their touch to meet the behavioral agenda provided them during the experimental situation suggests that they possessed an understanding of the types of touch that would elicit certain responses from their infants. That is, mothers knew, either consciously or

subconsciously, the types of touch that would elicit certain responses from their infants, further supporting the suggestion of intuitive parenting proposed by Papousek and Papousek (1987). Furthermore, infant responses found in this study, in which mothers used only touch, are comparable to levels of infant responding in past studies where all modes of communication were employed, and are consistent with the suggestion of Brazelton, Koslowski and Main (1974) that different behaviors can be substituted for one another to convey the same message. In others words, mothers may be capable of substituting touch for another modality, such as facial expression, and still achieve the same results. The fact that mothers were successful in eliciting desired behaviors from their infants using only touch supports this conclusion.

The findings of the present study may also be interpreted in line with information processing theory. The fact that infants detected changes in their mothers' behavior would imply an ability on their part to form complex cognitive representations. In particular, infants' differential gaze and smiling during the various SF with touch conditions suggest that they detected subtle variations in maternal touch. In order for infants to detect that the SF with touch interactions differed in some way from one another, they must have both manifested a mental representation of the interaction experienced during the previous condition and possessed an ability to retrieve this representation and hold it in short-term memory in order to compare the present interaction with the past one and note the discrepancy (Fogel, Diamond, Hoover Langhorst & Demos, 1982). As such, the smiling demonstrated by infants in response to maternal tactile stimulation in this study may have been related to their

developing cognitive abilities. The development of infants' abilities to form cognitive representations, especially the speed at which they form them, is meaningful because it correlates with later intelligence, implying that it taps central processing ability (Zelazo, Kearsley & Stack, 1995).

Cowan (1982) has suggested that, with this emerging capacity to form mental representations, the content of a given event takes on an even greater importance for the infant. The content of an event is central to the recognition assimilation hypothesis originally proposed by Piaget (1952) and later extended by Kagan (1967), in which a connection is made between cognitive processing and the development of positive affect. The key aspect of this theory suggests that the establishment of a connection between an external event and an internal schema will result in pleasure for the infant, reflected in a smile. Consequently, smiling is said to reflect successful problem-solving on the part of the infant in what is called "effortful assimilation" (Kagan, 1967). In a similar vein, the failure of the infant to assimilate will result in frustration or uncertainty, and a buildup of tension, reflected in behavior such as withdrawal and crying (Kagan, Kearsley & Zelazo, 1978). It follows, therefore, that the cognitive and affective components of infant behavior should be viewed as related and even interdependent.

The positive affect displayed by infants in the present study may have been related to these developing cognitive processes. More specifically, the different instructions provided to mothers in each of the conditions may have resulted in mothers using different types, or patterns, of touch across the conditions in order to

comply with experimental instructions. These changes in maternal touch from one condition to the next might have created discrepancies, or potential novelty, for the infants, and the cognitive maturity of infants to perceive and discriminate the novel stimulation resulted in smiling. In general then, the patterns of gazing, smiling and fretting in the present study would suggest that the types of touch that mothers chose to employ were cognitively complex and challenging enough to their infants, but not so complex as to cause the infants to be unable to assimilate them, thereby resulting in tension and causing the infants to withdraw from the interaction altogether. Infants were not perturbed by the removal of the facial and vocal stimulation and, instead focused on the tactile stimulation which was compelling, reflected in higher amounts of smiling than in typical SF procedures.

The finding that experimental manipulations of the instructions provided to mothers resulted in changes in infant smiling, fretting and vocalizing can also be viewed as consistent with a functionalist theory of infant emotion. According to the functionalist approach, emotions are intrinsically relational rather than intrapersonal, and cannot be understood by examining the individual or the environment in isolation; rather, these components constitute an indissociable whole (Campos, Mumme, Kermoian & Campos, 1994). As such, emotions represent an attempt on the part of the individual to either establish, maintain, modify, or terminate a relation with their environment (Campos, Campos & Barrett, 1989). One of the major postulates of this theory is that only those events which are significant to the individual are emotional (Campos et al., 1994). Given the fact that early mother-infant social

interactions have been implicated as the primary context for the development of the infant's social, emotional and cognitive development (Dunham & Dunham, 1990), it can be argued that these interactions are of great significance to young infants and would thus constitute meaningful emotional encounters. That manipulations of maternal touch via verbal instructions provided to mothers resulted in corresponding changes in infant responding would therefore support this theory, in that the emotions displayed by the infants were not intrinsically related but, rather, varied as a function of the context provided by experimental manipulations of the instructions to mothers.

In summary, the results of the present investigation provide support for theories of infant cognitive, communicative and social development. While these theories are not entirely inconsistent with one another, they do place their explanatory emphasis on different aspects of the developing infant's responses.

Conclusion

The results from the present investigation demonstrate the sophisticated nature of 5.5-month-old infants' social and cognitive abilities during the communication process between mother and infant but, more specifically, serve to reinforce the belief that infants are not simply passive recipients of information. Instead, they appear to be influential members in a goal-directed, bidirectional communication process in which both partners attend to, and influence, each other. Moreover, the results serve to document the potentially communicative functions of touch between mother and infant during face-to-face interactions and contribute to establishing and documenting a functional context for the tactile modality.

The results of investigations such as the present one offer new insight to parents and other caregivers regarding the role of touch and its importance as a communicative tool during adult-infant interactions. These results have implications not only for parents of normally developing infants but, in addition, hold special significance for parents of infants with sensory impairments, such as those with congenital blindness and deafness. The knowledge afforded by the results of the present study and that of future studies examining the communicative role of the tactile modality and, more specifically, the demonstration of the capacity of maternal touch to elicit, maintain and direct infant responses during dyadic interactions, can be applied to physically disadvantaged infants for whom the tactile modality takes on an even greater importance as a modality for communication than it does for normal infants.

The present study was directly motivated by the results of past studies (e.g., Stack & LePage, in press) which have examined the contribution of touch during face-to-face interactions. However, while these studies have significantly contributed to the development of a functional context for the role of touch, they have done so in a relatively general way, and have involved only minor manipulations of the instructions provided to mothers. In contrast, the present investigation has advanced recent work on the effects of manipulations of maternal behavior via verbal instructions on subsequent infant responding by providing mothers with instructions which were designed to elicit more intricate and complex behaviors from their infants, such as imitation and turntaking, thus necessitating more complex dyadic interactions

between mother and infant. The specificity of these instructions, in addition to the inclusion of a touch-only control group, have enabled more definitive conclusions on the contribution of maternal touch during mother-infant interactions, and have aided in documenting the flexible and responsive nature of both mother and infant during social encounters.

The shifts in infants' attentional, affective and vocalizing behaviors in the present study demonstrate infants' responsiveness to changes in maternal behavior and the positive nature of touch-only interactions. From these findings it can be inferred that infants are sensitive to changes in maternal touch which are engendered through manipulations of the verbal instructions provided to mothers. Once again, the contribution of touch in modulating the typically negative effects of the standard SF situation has been demonstrated, suggesting that touch plays a role in infant emotion regulation.

The present findings are rendered even more interesting, however, when we consider that naturally occurring mother-infant interactions rarely involve only touch but, rather, typically incorporate all modalities of communication simultaneously. Consequently, the fact that mothers were successful in eliciting responses from their infants using only touch underscores mothers' considerable proficiency and flexibility. Similarly, the fact that infants responded to their mothers' changes within the tactile modality alone highlights infants' sensitivities to maternal touch. These results, along with those of Stack and LePage (in press), suggest that mothers modify their behavior as a function of experimental instruction, even when touch is the only modality

available to them, and that infants can detect and respond to these changes in their mothers' touch.

That mothers and their infants were able to continue the interaction despite the removal of two modalities of communication (facial and vocal) and, further, that mothers were subsequently able to influence their infants' responses using only touch, strongly implicates a role for touch considerably greater than that of a proximal stimulus serving to keep mother and infant in close contact. Rather, the present results suggest that, in addition to serving as a proximal system, touch may also serve as a regulator of infant emotional state, elicit and direct infant attention, elicit positive and decrease negative infant affect and generally modify infant responsiveness, at least for brief periods of time. Consequently, results from the present study support the argument that maternal touch may be an effective mode of communication and may reflect reciprocity between mother and infant, and that touch as a form of communication between mother and infant appears to be both diverse and dynamic.

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Appendix A
Power Analyses

k = number of cells

n_c = subjects per cell

fmed = medium effect

a = critical alpha level

N = number subjects from table

u = degrees of freedom

p = probability level

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

Sample Size:

1. Group (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. Condition (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 Condition Interaction

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

N to detect = 58

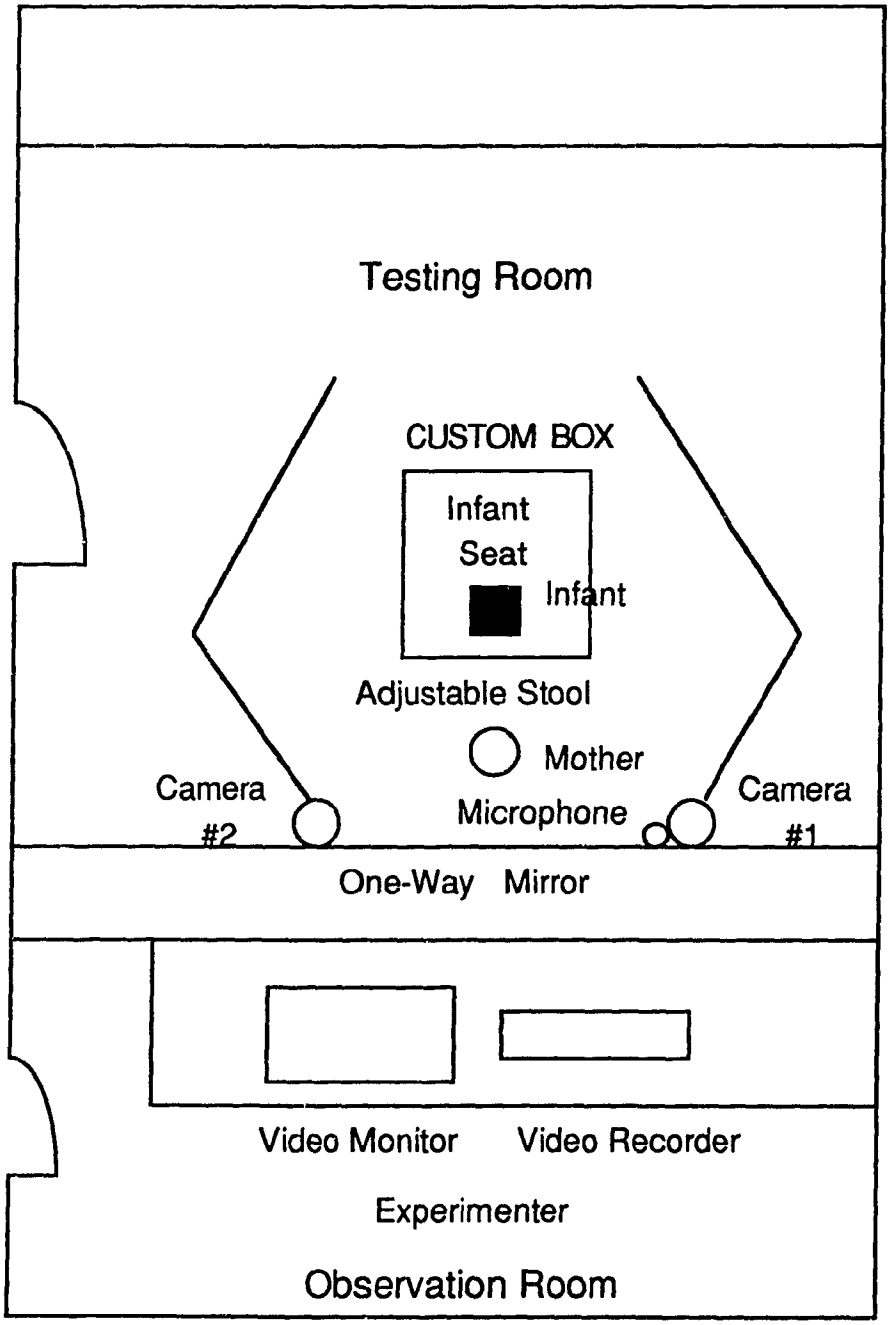
$$n_c = \frac{(N-1)(u+1)}{k} + 1$$

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

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

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

Appendix B
Schematic Diagram of
Apparatus and Layout of Testing Room


Testing Room
CUSTOM BOX
Infant
Seat
Infant
Adjustable Stool
Mother
Microphone
Camera
#2
Camera
#1
One-Way Mirror
Video Monitor
Video Recorder
Experimenter
Observation Room

Appendix C
Detailed Instructions to Mothers

Experimental Group

Normal:

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

SF+T+IM:

For this period, I would like you to be silent and have a still face but, using only touch, get your baby to imitate your hand and touching movements on and around his/her body.

SF+T+TT:

For this period, I would like you to be silent and have a still face but, using only touch, engage your baby in an interaction or turntaking game with you (anything that would have you and s\he playing something together).

SF+T+AF:

For this period, I would like you to be silent and have a still face but, using only touch, attract and hold your baby's attention on your face, with as much eye-to-eye contact as possible.

Control Group

Normal:

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

SF+T:

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

SF+T:

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

SF+T:

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

Appendix D

Consent Forms

Experimental Group

This study is designed to look at infants' responses to touch and to study the different types of touching used by caregivers and their role in social interchange. I understand that my baby and I will participate in a study lasting approximately 60 minutes. My baby will be seated in an infant seat directly facing me. The procedure will consist of several interaction periods, each lasting two to three minutes in length, during which time different tactile games will be 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. Under no circumstances will any manipulation be harmful to my baby. The entire session will be videotaped so that at a later point my baby's responses may be scored. However, these recordings are kept in the strictest of confidence and are not shown to others without my permission.

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 of my baby 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 the study, I may express these to Dr. Dale Stack (848-7565) of the Psychology Department at Concordia University. In addition, the patient representative of 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 Sharon Arnold at Concordia University, and with the cooperation of the Jewish General Hospital. A copy of this consent form has been given to me.

Signature: _____ Date: _____
Witness: _____ Date: _____

Control Group

This study is designed to look at infants' responses to touch and to study the different types of touching used by caregivers and their role in social interchange. I understand that my baby and I will participate in a study lasting approximately 60 minutes. My baby will be seated in an infant seat directly facing me. The procedure will consist of several interaction periods, each lasting two to three minutes in length, during which time I will be asked to play with my baby as I normally would at home. There will be brief breaks separating the interaction periods. Under no circumstances will any manipulation be harmful to my baby. The entire session will be videotaped so that at a later point my baby's responses may be scored. However, these recordings are kept in the strictest of confidence and are not shown to others without my permission.

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 of my baby 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 of 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 Sharon Arnold at Concordia University, and with the cooperation of the Jewish General Hospital. A copy of this 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 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, since when):
_____

Previous tactile games:_____
Amount relative to Aud. & Visual Games:_____

Comments:_____

Would you be interested in participating in future studies conducted at the Centre for Research in Human Development (CRDH)? ____

Appendix F
Operational Definitions

Gaze:

Infant gaze at mothers' faces and hands (recorded separately) was recorded for duration (amount of time spent looking at the mother's face or hands) as well as the frequency, by scoring the direction of the infant's eyes.

Smile:

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

Fret:

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

Vocalizing:

Infant vocalizing 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, effort vocalizations expressing effort in combination with movement or state, or other physiological sounds such as burps sneezes or hiccups. A criterion of a 1.5 second delay between sounds was required for the sounds to be coded as two vocalizations.

Maternal Touch:

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

Appendix G

ANOVA Summary Tables, Post-Hoc Comparisons and Transformed Means for the Infant Gaze at Mothers' Faces Measure

Table 1

Analysis of Variance for the Infant Gaze at Mothers' Faces Measure (Log Transformation): Analysis of Group, Sex and Condition

Source	df	SS	MS	F
		Between Subjects		
Sex	1	0.32	0.32	0.98
Group	1	0.01	0.01	0.03
S x G	1	1.46	1.46	4.53*
error	56	(18.05)	(0.32)	
		Within Subjects		
Condition	3	11.02	3.67	31.60**
C x S	3	0.05	0.02	0.14
C x G	3	1.79	0.60	5.14**
C x (SG)	3	0.16	0.05	0.47
error	168	(19.53)	(0.12)	

*$p < .05$. **$p < .0001$.

Table 2

Analysis of Variance for the Infant Gaze at Mothers' Faces Measure for the Experimental Group (Log Transformation): Analysis of Sex and Condition

Source	df	SS	MS	F
		Between Subjects		
Sex	1	1.96	1.96	7.40*
error	34	(9.00)	(0.26)	
		Within Subjects		
Condition	3	9.87	3.29	24.68**
C x S	3	0.19	0.06	0.48
error	102	(13.59)	(0.13)	

*$p < .05$. **$p < .0001$.

Table 3

Analysis of Variance for the Infant Gaze at Mothers' Faces Measure for the Control Group (Log Transformation): Analysis of Sex and Condition

Source	df	SS	MS	F
		Between Subjects		
Sex	1	0.17	0.17	0.42
error	22	(9.05)	(0.41)	
		Within Subjects		
Condition	3	4.10	1.37	15.19**
C x S	3	0.05	0.02	0.18
error	66	(5.94)	(0.09)	

*$p < .05$. **$p < .0001$.

Table 4

Tukey Multiple Comparisons on the Condition Effect for the Infant Gaze at Mothers' Faces Measure for the Experimental Group: Log Transformation

Comparison	Mean Absolute Difference	Critical Difference	Probability Level
N vs SF+T+IM	1.16	0.21	<.01
N vs SF+T+TT	0.53	0.21	<.01
N vs SF+T+AF	0.63	0.21	<.01
SF+T+IM vs SF+T+TT	0.63	0.21	<.01
SF+T+IM vs SF+T+AF	0.53	0.21	<.01
SF+T+TT vs SF+T+AF	0.10	0.18	N.S.

Note. N = Normal condition

SF+T+IM = SF with touch and instruction to get their infants to imitate

SF+T+TT = SF with touch and instruction to engage their infants in a reciprocal interaction or turntaking game

SF+T+AF = SF with touch and instruction to attract and maintain their infants' attention on their faces

Table 5

Tukey Multiple Comparisons on the Condition Effect for the Infant Gaze at Mothers' Faces Measure for the Control Group: Log Transformation

Comparison	Mean Absolute Difference	Critical Difference	Probability Level
N vs SF+T+IM	1.23	0.26	<.01
N vs SF+T+TT	0.69	0.26	<.01
N vs SF+T+AF	0.75	0.26	<.01
SF+T+IM vs SF+T+TT	0.54	0.26	<.01
SF+T+IM vs SF+T+AF	0.48	0.26	<.01
SF+T+TT vs SF+T+AF	0.06	0.22	N.S.

Note. N = Normal condition

SF+T+IM = SF with touch and instruction to get their infants to imitate

SF+T+TT = SF with touch and instruction to engage their infants in a reciprocal interaction or turntaking game

SF+T+AF = SF with touch and instruction to attract and maintain their infants' attention on their faces

Table 6

Transformed Means for the Percent Durations of Infant Gaze at Mothers' Faces: Log Transformation

Group	Condition			
	Normal	SF+T+IM	SF+T+TT	SF+T+AF
Experimental	1.58 (0.05)	0.89 (0.08)	1.02 (0.07)	1.26 (0.08)
Control	1.55 (0.05)	1.11 (0.09)	1.13 (0.09)	1.01 (0.09)

Note. Numbers in parentheses indicate standard errors

Appendix H

ANOVA Summary Tables and Post-Hoc

Comparisons for the Infant Gaze at Mothers' Hands Measure

Table 1

Analysis of Variance for the Infant Gaze at Mothers' Hands Measure: Analysis of Group and Condition

Source	df	SS	MS	F
		Between Subjects		
Group	1	1375.19	1375.19	1.67
error	58	(47678.77)	(822.05)	
		Within Subjects		
Condition	3	17440.99	5816.33	15.15**
C x G	3	7873.21	2624.40	6.84**
error	174	(66790.57)	(383.85)	

*p < .05. **p < .0001

Table 2

Tukey Multiple Comparisons on the Condition Effect for the Infant Gaze at Mothers' Hands Measure for the Experimental Group

Comparison	Mean Absolute Difference	Critical Difference	Probability Level
N vs SF+T+IM	23.01	14.37	<.01
N vs SF+T+TT	24.98	14.37	<.01
N vs SF+T+AF	2.34	11.85	N.S.
SF+T+IM vs SF+T+TT	1.97	11.85	N.S.
SF+T+IM vs SF+T+AF	20.67	14.37	<.01
SF+T+TT vs SF+T+AF	22.64	14.37	<.01

Note. N = Normal condition

SF+T+IM = SF with touch and instruction to get their infants to imitate

SF+T+TT = SF with touch and instruction to engage their infants in a reciprocal interaction or turntaking game

SF+T+AF = SF with touch and instruction to attract and maintain their infants' attention on their faces

Table 3

Tukey Multiple Comparisons on the Condition Effect for the Infant Gaze at Mothers' Hands Measure for the Control Group

Comparison	Mean Absolute Difference	Critical Difference	Probability Level
N vs SF+T+IM	19.87	17.60	<.01
N vs SF+T+TT	17.37	17.60	<.01
N vs SF+T+AF	25.02	17.60	<.01
SF+T+IM vs SF+T+TT	2.50	14.52	N.S.
SF+T+IM vs SF+T+AF	5.15	14.52	N.S
SF+T+TT vs SF+T+AF	7.65	14.52	N.S.

Note. N = Normal condition

SF+T+IM = SF with touch and instruction to get their infants to imitate

SF+T+TT = SF with touch and instruction to engage their infants in a reciprocal interaction or turntaking game

SF+T+AF = SF with touch and instruction to attract and maintain their infants' attention on their faces

Appendix I

ANOVA Summary Tables, Post-Hoc Comparisons

and Transformed Means for the Infant Smiling Measure

Table 1

Analysis of Variance for the Infant Smiling Measure (Log Transformation): Analysis of Group and Condition

Source	df	SS	MS	F
		Between Subjects		
Group	1	0.11	0.11	0.27
error	58	(23.32)	(0.40)	
		Within Subjects		
Condition	3	21.06	7.02	47.19**
C x G	3	2.10	0.70	4.71**
error	174	(25.88)	(0.15)	

*p < .05. **p < .0001

Table 2

Tukey Multiple Comparisons on the Condition Effect for the Infant Smiling Measure for the Experimental Group: Log Transformation

Comparison	Mean Absolute Difference	Critical Difference	Probability Level
N vs SF+T+IM	0.89	0.28	<.01
N vs SF+T+TT	0.53	0.28	<.01
N vs SF+T+AF	0.75	0.28	<.01
SF+T+IM vs SF+T+TT	0.36	0.28	<.01
SF+T+IM vs SF+T+AF	0.14	0.23	N.S.
SF+T+TT vs SF+T+AF	0.22	0.23	N.S.

Note. N = Normal condition

SF+T+IM = SF with touch and instruction to get their infants to imitate

SF+T+TT = SF with touch and instruction to engage their infants in a reciprocal interaction or turntaking game

SF+T+AF = SF with touch and instruction to attract and maintain their infants' attention on their faces

Table 3

Tukey Multiple Comparisons on the Condition Effect for the Infant Smiling Measure for the Control Group: Log Transformation

Comparison	Mean Absolute Difference	Critical Difference	Probability Level
N vs SF+T+IM	0.57	0.35	< .01
N vs SF+T+TT	0.75	0.35	< .01
N vs SF+T+AF	0.68	0.35	< .01
SF+T+IM vs SF+T+TT	0.18	0.29	N.S.
SF+T+IM vs SF+T+AF	0.11	0.29	N.S.
SF+T+TT vs SF+T+AF	0.07	0.29	N.S.

Note. N = Normal condition

SF+T+IM = SF with touch and instruction to get their infants to imitate

SF+T+TT = SF with touch and instruction to engage their infants in a reciprocal interaction or turntaking game

SF+T+AF = SF with touch and instruction to attract and maintain their infants' attention on their faces

Table 4

Transformed Means for the Percent Durations of Infant Smiling: Log Transformation

Group	Condition			
	Normal	SF+T+IM	SF+T+TT	SF+T+AF
Experimental	1.61 (0.04)	0.72 (0.09)	1.08 (0.09)	0.86 (0.08)
Control	1.52 (0.05)	0.95 (0.10)	0.77 (0.11)	0.84 (0.11)

Note. Numbers in parentheses indicate standard errors

Appendix J

ANOVA Summary Tables and Post-Hoc

Comparisons for the Infant Fretting Measure

Table 1

Analysis of Variance for the Infant Fretting Measure: Analysis of Group and Condition

Source	df	SS	MS	F
		Between Subjects		
Group	1	78.74	78.74	1.43
error	58	(3195.14)	(55.09)	
		Within Subjects		
Condition	3	478.96	159.65	3.62*
C x G	3	84.07	28.02	0.63
error	174	(7681.16)	(44.14)	

*p < .05. **p < .0001

Table 2

Tukey Multiple Comparisons on the Condition Effect for the Infant Fretting Measure

Comparison	Mean Absolute Difference	Critical Difference	Probability Level
N vs SF+T+IM	0.95	3.11	N.S.
N vs SF+T+TT	1.55	3.11	N.S.
N vs SF+T+AF	3.72	3.11	<.05
SF+T+IM vs SF+T+TT	0.60	3.11	N.S.
SF+T+IM vs SF+T+AF	2.77	3.11	N.S.
SF+T+TT vs SF+T+AF	2.17	3.11	N.S.

Note. N = Normal condition

SF+T+IM = SF with touch and instruction to get their infants to imitate

SF+T+TT = SF with touch and instruction to engage their infants in a reciprocal interaction or turntaking game

SF+T+AF = SF with touch and instruction to attract and maintain their infants' attention on their faces

Appendix K

ANOVA Summary Tables, Post-Hoc Comparisons and Transformed Means for the Infant Vocalizing Measure

Table 1

Analysis of Variance for the Infant Vocalizing Measure (Inverse Transformation): Analysis of Group and Condition

Source	df	SS	MS	F
		Between Subjects		
Group	1	0.19	0.19	1.04
error	58	(10.66)	(0.18)	
		Within Subjects		
Condition	3	1.44	0.48	6.10**
C x G	3	0.18	0.06	0.79
error	174	(13.72)	(0.08)	

*$p < .05$. **$p < .0001$.

Table 2

Tukey Multiple Comparisons on the Condition Effect for the Infant Vocalizing Measure: Inverse Transformation

Comparison	Mean Absolute Difference	Critical Difference	Probability Level
N vs SF+T+IM	0.16	0.16	<.01
N vs SF+T+TT	0.07	0.16	N.S.
N vs SF+T+AF	0.21	0.16	<.01
SF+T+IM vs SF+T+TT	0.09	0.13	N.S.
SF+T+IM vs SF+T+AF	0.05	0.13	N.S.
SF+T+TT vs SF+T+AF	0.14	0.13	<.05

Note. N = Normal condition

SF+T+IM = SF with touch and instruction to get their infants to imitate

SF+T+TT = SF with touch and instruction to engage their infants in a reciprocal interaction or turntaking game

SF+T+AF = SF with touch and instruction to attract and maintain their infants' attention on their faces

Table 3

Analysis of Variance for the Infant Vocalizing Measure for the Experimental Group: Inverse Transformation

Source	df	SS	MS	F
Condition	3	1.01	0.34	3.98*
error	105	(8.86)	(0.08)	

*$p < .05$. **$p < .0001$.

Table 4

Tukey Multiple Comparisons on the Condition Effect for the Infant Vocalizing Measure for the Experimental Group: Inverse Transformation

Comparison	Mean Absolute Difference	Critical Difference	Probability Level
N vs SF+T+IM	0.14	0.18	N.S.
N vs SF+T+TT	0.01	0.18	N.S.
N vs SF+T+AF	0.20	0.18	<.05
SF+T+IM vs SF+T+TT	0.12	0.18	N.S.
SF+T+IM vs SF+T+AF	0.06	0.18	N.S
SF+T+TT vs SF+T+AF	0.19	0.18	<.05

Note. N = Normal condition

SF+T+IM = SF with touch and instruction to get their infants to imitate

SF+T+TT = SF with touch and instruction to engage their infants in a reciprocal interaction or turntaking game

SF+T+AF = SF with touch and instruction to attract and maintain their infants' attention on their faces

Table 5

Transformed Means for the Percent Duration of Infant Vocalizing: Inverse Transformation

Group	Condition			
	Normal	SF+T+IM	SF+T+TT	SF+T+AF
Experimental	0.43 (0.06)	0.30 (0.05)	0.42 (0.05)	0.23 (0.04)
Control	0.43 (0.08)	0.24 (0.07)	0.27 (0.07)	0.21 (0.06)

Note. Numbers in parentheses indicate standard errors

Appendix L

ANOVA Summary Tables and

Transformed Means for the Maternal Touch Measure

Table 1

Analysis of Variance for the Maternal Touch Measure (Reflect and Log Transformation): Analysis of Group and Condition

Source	df	SS	MS	F
		Between Subjects		
Group	1	2.08	2.08	3.16
error	58	(38.21)	(0.66)	
		Within Subjects		
Condition	3	1.20	0.40	2.57
C x G	3	1.65	0.55	3.53**
error	174	(27.16)	(0.16)	

*$p < .05$. **$p < .0001$.

Table 2

Transformed Means for the Percent Duration of Maternal Touch: Reflect and Log Transformation

	Condition			
Group	Normal	SF+T+IM	SF+T+TT	SF+T+AF
Experimental	1.03 (0.10)	1.15 (0.07)	1.00 (0.09)	1.10 (0.09)
Control	1.13 (0.11)	0.84 (0.11)	0.76 (0.11)	0.79 (0.11)

Note. Numbers in parentheses indicate standard errors