Infant Touching Behaviours during Mother-Infant Face-to-Face Interactions: Effects of Changes in Maternal Emotional and Physical Availability in Normative and At-Risk Populations

Robin Moszkowski

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ABSTRACT

Infant Touching Behaviours during Mother-Infant Face-to-Face Interactions: Effects of Changes in Maternal Emotional and Physical Availability in Normative and At-Risk Populations

Robin Moszkowski
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Mother-infant interactions are fundamental to infant socio-emotional development. Through mutually regulated exchanges in the first year of life, infants develop critical communicative and regulatory skills. Infant touch is a central channel through which infants communicate their underlying affective states, regulate their emotions, and explore their surroundings. Yet despite its importance, there is a paucity of research examining infant touch. The current dissertation was designed to investigate infants' touching behaviours during mother-infant face-to-face interactions.

A series of two studies investigating infant touch in the context of infants' other communicative modalities during interactions with variations in maternal availability was conducted. Study 1 examined how touch co-occurs with distal modalities (i.e. gaze, affect), and investigated the functions of touch (i.e. communicative, regulatory, exploratory). Findings revealed that touch is organized with gaze and affect into meaningful affective displays, and that infants use touch to self-regulate and explore when mothers are emotionally unavailable. The impact of the quality of the relationship (i.e. maternal emotional availability indicators, such as sensitivity and hostility) on infants' touching behaviours was also examined. Findings demonstrated greater engagement through touch in infants with more sensitive mothers.

Study 2 investigated infants' touching behaviours in an at-risk sample of depressed and non-depressed mothers exhibiting poor relationship indicators (i.e. sub-

optimal emotional availability). Touch was compared during periods of emotional versus physical unavailability, revealing greater reactive types of touch during physical unavailability. Findings also highlighted the impact of maternal risk on infants' touching behaviours: infants of depressed mothers exhibited more reactive types of touch compared to infants of non-depressed mothers, and negative relationship indicators (e.g. maternal hostility, intrusiveness) predicted regulatory tactile behaviours.

Taken together, the present findings contribute to current knowledge on touch during early socio-emotional development. Results underscore that infants are active participants during their social exchanges and that they vary their tactile behaviours as a function of maternal availability. The findings clarify how infants use touch (i.e. to regulate, explore) when mothers are unavailable, and imply that touch serves a communicative role during pre-verbal development. Finally, this research offers insight into the impact of maternal risk on infants' regulatory abilities and the dyadic processes of co-regulation.

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Chapter 1: Introduction

The importance of touch for infant development is uncontested. Transmitted through the largest sensory organ, the skin, touch is one of the first sensations experienced by infants and it is infants' first medium of communication (Montagu, 1986). Physiologically, touch contributes to infant growth and weight gain (Field, 2001; Scafidi et al., 1990; White & Labarba, 1976); psychologically, it is a medium through which infants and their caregivers convey emotion and affection, and establish a strong connection (Stack, 2001, 2004).

Touch plays a particularly pervasive role during parent-infant interactions as it is an important channel through which caregivers and infants communicate with one another (Stack, 2001, 2004). Although fathers also play an important role in infant socio-emotional development (Lamb, 1975, 2004), most of the research has focused on mothers. Different types of maternal touch have been found to relay different messages (Hertenstein, 2002; Tronick, 1995), to which infants are responsive (e.g. Stack, 2001, 2004). Moreover, infants themselves use touch to communicate, and in particular, to convey changes in their underlying affective states during pre-verbal development (Moszkowski & Stack, 2007). Infants also use touch to self-regulate, especially when mothers are unavailable (Moszkowski & Stack, 2007). Furthermore, touch is a means through which infants explore themselves and their surroundings, thereby contributing to their developing self-identities (de Koeyer, Fogel, & Hicks, 2008; Rochat, 2001). Given the important communicative, regulatory, and exploratory roles of touch during early socio-emotional development, it is surprising that there is a paucity of research examining infant touch. In light of the importance of early mother-infant social

exchanges for infants' developing socio-emotional skills, the present series of two studies was designed to investigate infant touching behaviours in a social interactive context.

Mother-Infant Interactions

Mother-infant interactions are primordial during the first year of life. Through frequent face-to-face exchanges, infants develop their communicative skills (Tronick, Als, Adamson, Wise, & Brazelton, 1978) and acquire knowledge of the basic rules of social engagement, such as turn taking behaviour and social reciprocity (Brazelton, Kowslowski, & Main, 1974; Cohn & Tronick, 1989; Kaye, 1982). Infants also learn about themselves and others around them, acquiring the ability to differentiate themselves from others, developing a sense of themselves as unique entities (Rochat, 2001), and increasing their self-awareness (Bigelow, 2001). As such, early face-to-face exchanges are central to infant socio-emotional and communicative development (Kaye, 1982).

Historical accounts of infant development portrayed infants as passive recipients of their external environments (James, 1890), viewing interactions as unidirectional processes that are initiated by the caregiver. However, that view is no longer upheld; research has demonstrated that infants are active and competent participants during their early social encounters (e.g., Adamson & Frick, 2003; Cohn, 2003). Louis Sander and Richard Bell played a pivotal role in initiating the shift in the conceptualization of mother-infant interactions from a one-way to a two-way process involving mutual influences from both interactive partners (Bell, 1968; Sander, 1962).

Following the shift away from linear models of development, theoretical models began characterizing mother-infant interactions as bi-directional and transactional in nature (Fogel & Thelen, 1987; Sameroff & Chander, 1975). The concept of bi-

directionality posits that both mothers and infants affect each other and interactions are viewed as having mutual and reciprocal influences (Kuczynaki, 2003). Perceiving interactions as circular processes is consistent with Bronfenbrenner's ecological model (1979), which stipulates that nested systems influence child development. Similarly, the transactional model of development specifies that change in an individual occurs within a larger system and that multiple sources of influence affect developmental outcomes. Thus, equal emphasis should be placed on infants' environments (or interactive partners, in the case of interactions) and infants themselves when considering influences on infant development (Sameroff & Mackenzie, 2003).

In line with this more complex view of human relationships, dynamic systems theory and process theories of emotion underscore that it is not the mother or the infant alone, but rather the relationship between the two that contributes to the development of infants' communicative abilities during the first year of life (Fogel, 1993; Hsu & Fogel, 2001). Communication between mothers and infants is a continuous and reciprocal process whereby each partner actively contributes to shared interactive moments or periods of primary intersubjectivity (Trevarthen, 1979). Interactive partners modify their behaviours at various times through their interactions, contributing to the creation of a shared dialogue. As such, communication amounts to more than the sum of its individual parts (Fogel & Thelen, 1987).

Working to achieve their mutual goal of coordinated states of interaction, mothers and infants jointly regulate their interactions by modifying their affective states according to changes in their social partner's behaviour (Gianino & Tronick, 1988). Mismatches between interactive partners occur and, according to the Mutual Regulation Model

(Gianino & Tronick, 1988), it is the process of repairing these mismatches that contributes towards the development of infants' sense of self-efficacy as well as trust in their social partners (Tronick, 1989; Tronick, Als, & Brazelton, 1977). As a result, through interactions with a sensitive social partner, infants develop social expectations of reciprocity (Brazelton & Cramer, 1990) which, when violated, disappoint infants' expectations and result in differences in their levels of arousal and interactive behaviours (Trevarthen, 1977).

In addition to striving to maintain periods of synchronized engagement, another primary goal of early interactions is the regulation of infants' states of arousal. Infants aim to achieve an optimal state of arousal, and their mothers alter their own interactive behaviours in order to enable infants to achieve this goal (Brazelton et al., 1974; Field, 1977; Fogel, 1982). Too much or too little stimulation by the interactive partner can result in the infant withdrawing from the interaction. Thus, mothers who are sensitive to their infants serve as external regulators of their infants' affective states, moderating their infants' levels of arousal and attention throughout interactions (Brazelton et al., 1974; Field, 1977; Tronick & Gianino, 1986). As infants develop over time through their interactions, they learn to tolerate increasingly higher states of arousal.

Still-face effect

By serving as important sources of external regulation during interactions throughout the first year of life, mothers facilitate and contribute towards the development of infants' own abilities to regulate their affective states. Thus, infants learn to regulate their emotions through interactions with available and sensitive mothers and, if mothers are unavailable to their infants, infants are forced to rely on their own

resources to self-regulate (Tronick & Gianino, 1986). An important method of studying infants' regulatory abilities during mother-infant interactions is the Still-Face (SF) procedure (Tronick et al., 1978). Mothers are emotionally unavailable during the still-face (SF) period, providing the opportunity to study infants' self-regulatory skills when mothers are not available as external sources of stimulation and arousal modulation (Tronick et al., 1978).

The SF procedure involves two normal face-to-face interaction periods separated by a period where mothers are instructed to continue to gaze at their infants while maintaining a still-face and refraining from touching their infants or vocalizing. As their gaze invites social interaction while their unresponsive faces reject it, mothers are providing conflicting information to their infants (Stack & Muir, 1990) and violating social norms of reciprocity (Adamson & Frick, 2003; Brazelton & Cramer, 1990; Tronick et al., 1978). Thus, in addition to investigating infants' regulatory abilities, the SF procedure allows for an examination of infants' social connectedness (Tronick, 2003), and their social competence and communicative behaviours (Adamson & Frick, 2003; Muir & Lee, 2003).

Results from numerous studies have reliably documented a "signature" SF effect (Adamson & Frick, 2003), whereby infants demonstrate less smiling and gazing at their mothers during the SF period. Although overlooking infants' tactile behaviours in response to the SF period, studies have also revealed that infants exhibit increased neutral to negative affect (Gusella, Muir & Tronick, 1988; Mayes & Carter, 1990; Muir & Lee, 2003; Segal et al., 1995) and vocalizations, and in some studies, increased grimacing during the SF compared to the Normal periods (Ellsworth, Muir, & Hains, 1993; Stack &

Muir, 1992). A carry-over effect has also been demonstrated during the Reunion Normal period, such that infants continue to exhibit both positive and negative affect once the SF is over. Moreover, they demonstrate an increase in fussiness and crying during the Reunion Normal period compared to the SF period (Cohn, 2003; Weinberg & Tronick, 1996).

Researchers have postulated many explanations for the "signature" SF-effect (Tronick, 2003). As mothers are simultaneously communicating "hello" and "goodbye" during the SF period, the SF violates infants' social expectations regarding the rules governing social interactions (Adamson & Frick, 2003). As such, it has been suggested that infants are left confused and "trapped" (p.11) in their mothers' contradictory social messages (Tronick et al., 1978), which results in elevated levels of arousal, negative affect, and distress (e.g. Ellsworth, Muir, & Hains, 1993). By exhibiting greater negative behaviours during the SF period, infants reveal themselves to be active participants during mother-infant interactions, sensitive to changes in their mothers' behaviour (Tronick, 2003; Tronick et al., 1978; Weinberg & Tronick, 1996), and potentially possessing an implicit understanding of themselves and others as social beings (Rochat, 2001).

As the SF procedure taps into infants' regulatory abilities, it has also been suggested that the SF effect supports Gianino and Tronick's (1988) Mutual Regulation Model (MRM). During the SF period, mothers are not available as external sources of infant regulation and infants are left on their own to self-regulate (Tronick & Gianino, 1986). By varying their interactive behaviours across periods of the SF procedure (i.e. SF

signature; Adamson & Frick, 2003), it appears that infants are engaging in self-regulation of their affective states as these states change as a function of maternal availability.

While providing a solid explanation for the changes in infants' behaviours during the SF, Tronick (2003) argues that the MRM fails to account for the carry-over in infants' distress during the Reunion Normal period, when mothers have resumed their regulatory role. Thus, Tronick (2003) expanded the MRM into the dyadic expansion of consciousness hypothesis (DEC). The DEC hypothesis states that infants acquire critical resources, such as meaning or knowledge about the world, through co-created social exchanges. Through these intersubjective experiences, infants become organized and develop increasingly complex and coherent states of consciousness. However, the SF period blocks infants' shared creation of meaning, leading infants to attempt to re-elicit affective exchanges with their mothers. Upon failing to re-engage their mothers in interaction, infants become disorganized and turn inwards to self-regulate. The DEC hypothesis incorporates current theories of mother-infant interactions, such as dynamic systems theory of communication, which specifies that interactive moments are jointly created through moment-to-moment changes in the behaviours of each partner in relation to one another (Fogel, 1993; Hsu & Fogel, 2003). As such, the DEC hypothesis provides a more complex, and perhaps more accurate account of the SF phenomenon than the MRM model.

Maternal Depression

A consensus on an accurate and comprehensive explanation for the changes in infants' behaviours across periods in the SF procedure has yet to be reached. Nonetheless, it is clear that the SF procedure represents a contrived situation because

otherwise available mothers are asked to display emotional unavailability during a brief interaction period. In at-risk populations, such as mothers who exhibit depression, emotional unavailability is frequently displayed during interactions with infants since maternal depression impairs mothers' abilities to regulate affect and behaviour, and thus to appropriately care for their infants (Field, 1994; Murray, 1997; Murray & Cooper, 1996). During interactions, depressed mothers display high levels of negative behaviours (Cohn, Matias, Tronick, Connell, & Lyons-Ruth, 1986; Field et al., 2007; Field, Healy, Goldstein, & Gutherz, 1990; Stanley, Murray, & Stein, 2004), including flat affect (Cohn et al., 1990; Field, 2002), diminished vocalizations and affectionate contact (Fleming, Ruble, Flett, & Shaul, 1988), and lower levels of involvement and play (Gotlib & Lee, 1996). Depressed mothers are also less attuned to their infants' needs (Murray, Fiori-Cowley, Hooper, & Cooper, 1996), responding less contingently during social exchanges (Cohn et al., 1990). As a result of these behaviours, depressed mothers may convey that they are emotionally unavailable during interactions with their infants (Field, 1994).

Cohn and Tronick (1983) sought to examine the impact of depression on infant behaviour by asking mothers to simulate being depressed. Infants responded by cycling through periods of protest and wariness, and gaze away from mothers. In contrast, infants in the control group cycled between states of positive affect and gaze at their mothers in a well-organized manner. While results from this study carry important implications for the impact of maternal depression on early social interactions, it relied on a normative sample. In order to better ascertain the impact of maternal depression on infant socio-emotional development, it is important to use a sample of depressed and non-depressed mothers.

Research comparing the behaviour of infants of mothers who were classified as depressed or non-depressed has revealed that infants of depressed mothers display less motor activity, gaze aversion, distress brow, and crying during the SF period relative to their non-depressed counterparts (Field, 1984; Field et al., 2007; Fogel, Diamond, Langhorst, & Demos, 1982). Based on this research, which focused on the examination of infants' distal modalities, it seems that infants of depressed mothers experience less distress during a brief period of emotional unavailability, such as the SF period, perhaps because they have become accustomed to their mothers' emotional unavailability (Field, 1984; Field et al., 2007; Fogel et al., 1982). Combined with research suggesting that infants of depressed mothers interact in a depressed manner even with non-depressed adult partners (Field et al., 1988), these findings imply that interactions with a depressed mother impair infants' communicative and regulatory abilities, at least in the short-term.

While infants of depressed mothers appear to respond to maternal emotional availability in a subdued manner, it is possible that they may respond differently to alternate forms of maternal unavailability experienced during their daily lives. In order to better understand how infants respond to variations in their mothers' interactive behaviour, and to elucidate infants' social and regulatory skills, it is important to examine the impact of different types of maternal unavailability on infant behaviour in normative and at-risk samples. For example, Field (1991) discovered that infants exhibit distress during periods of maternal physical unavailability, such as when they are separated from their mothers (Field, 1991). More specifically, when mothers were hospitalized due to their giving birth to a second child, infants exhibited agitation, and increased negative affect, activity levels, heart rate, night wakings, and crying (Field, 1985). Moreover, it

appears that infants continue to exhibit distress during maternal physical absence when they are toddlers and preschoolers, as revealed by research examining child behaviour when mothers were away at a conference (Field, 1991). These findings are consistent with research using rat pups, where it was revealed that rat pups exhibit a protest-despair response, indicative of distress, when separated from their mothers (Hofer, 2006).

Hofer (2006) suggests that separation may be stressful for rats because it entails the withdrawal of important components of the previous interaction with their mothers, including maternal regulatory influences on rat pup's activity level and heart rate. Similarly, it has been suggested that periods of maternal separation may be stressful for *human* infants since their primary source of stimulation and arousal modulation has been removed (Tronick & Gianino, 1986). However, the behaviour of children during maternal hospitalizations or attendance at conferences may be more extreme as these events might represent somewhat more prolonged and less typical forms of maternal physical absence than might be expected to occur in daily life.

The Separation procedure, which was adapted from the SF procedure, was established in order to investigate how infants respond to brief periods of physical unavailability (e.g. lasting between 90 and 120 seconds, and thus perhaps more representative of what occurs daily), occurring during periods of social engagement with mothers (Field, Vega-Lahr, Scafidi, & Goldstein, 1986). The Separation procedure (SP) consists of two Normal interaction periods separated by a period where mothers are instructed to hide silently behind a curtain for a brief period of time and to not interact or speak (i.e. Separation or SP period). In a study examining infants' verbal and non-verbal distal behaviours, results revealed that infants exhibit decreased smiling, and increased

motor activity and crying during the SP compared to the Normal periods (Field et al., 1986). These results suggest that even brief separation from mothers is distressing for infants.

When comparing infants' distal behaviours during the SF and SP procedures in order to determine the relative impact of maternal emotional versus physical unavailability, findings revealed greater infant gaze aversion, crying, motor activity and distress brow during the SF compared to the SP period (Field et al., 1986). Thus, it seems that while maternal physical unavailability may elicit distress in infants, infants experience maternal emotional unavailability as more difficult (Field et al., 1986).

The quality of the relationship and infant behaviour

The studies examining infant behaviour in response to maternal emotional and physical unavailability during the SF and SP procedures provide important evidence that infants are skilled social partners who adjust their behaviour according to their mothers' availability. Yet, an understanding of the interactive processes occurring between mothers and infants during interactions remains somewhat limited in these studies as they represent contrived situations where mothers are acting as unavailable based on instructions during an experimental perturbation.

Emotional availability, as measured by the Emotional Availability Scales (EAS; Biringen, Robinson, & Emde, 1998), is a relationship construct that reflects the degree to which each interactive partner expresses emotion during interactions and is attuned to the affective displays of the other partner (Easterbrooks, Lyons-Ruth, Biesecker, & Carper, 1996; Emde & Easterbrooks, 1985). During normal interactions, mother and infant pairs vary in the levels of emotional availability displayed. Sensitivity and responsiveness have

been isolated as important emotional availability characteristics that affect the behaviour of both interactive partners (Barnard, Bee, & Hammond, 1984; Bornstein & Tamis-Lemonda, 1989; Kaye and Fogel, 1980; Smith et al., 1996). These characteristics, in addition to maternal structuring, intrusiveness and hostility, reflect the overall quality of the mother-infant relationship (Biringen et al., 1998). By considering the behaviour of both interactive partners when investigating the level of emotional availability in dyadic interactions, important information regarding bi-directional influences in the mother-infant relationship can be gleaned.

Research has revealed that normal and at-risk dyads can be distinguished based on their level of emotional availability during interactions. Pipp-Siegal (1996) revealed that low- versus high-risk dyads differ in their levels of maternal sensitivity and hostility, and infant involvement. Mothers with childhood histories of aggression and withdrawal have been found to display higher levels of hostility during interactions with their children (Bentley, Stack, & Serbin, 1998; Crittenden, 1981, Girouard, Stack, Serbin, & Schwartzman, 2002) and depressed mothers exhibit low levels of maternal availability (Easterbrooks et al., 1996). The poor relationship quality indicators in these samples have been found to be associated with behavioural problems in childhood (Zahn-Waxler, Iannoti, & Cummings, 1990). Combined with studies documenting the short-term temporal and cross-context reliability and continuity of emotional availability as measured by the Emotional Availability Scales (EAS; Biringen et al., 1998), findings from the studies (e.g. Pipp-Siegal, 1996) on the quality of the relationship in high- versus low-risk dyads underscore the importance of optimal emotional availability characteristics for infants' social and emotional competence during normal and perturbed

interactions (Bornstein et al., 2006; Bornstein, Gini, Suwalsky, Putnick, & Haynes, 2006).

Touch During Mother-Infant Interactions: Regulatory and communicative roles

Results from studies using global measures of the quality of the relationship, such as the EAS, demonstrate that infants are sensitive to the degree to which their mothers exhibit optimal emotional availability characteristics during interactions. However, using only macroscopic observational techniques does not allow for an understanding of the impact of emotional availability on specific communicative behaviours, such as touch. Microscopic measures of particular communicative modalities have been utilized in studies of the SF and SP procedures in order to investigate the contribution of maternal unavailability on these infant behaviours. However, it has also been difficult in these investigations to isolate which aspects of maternal behaviour may be most strongly related to infants' distress and disorganization as mothers are refraining from communicating through a number of modalities (e.g. facial expressions, vocalizations, touching behaviours) when displaying emotional or physical unavailability during the SF or SP procedures. For this reason, researchers utilizing the SF procedure have suggested that the still-*face* effect may be more accurately labeled a still-*person* effect (Muir & Lee, 2003). Given that maternal touch is pervasive during interactions, occurring for between 55 and 81% of the time during brief interaction periods; Stack & Muir, 1990), combined with the fact that most investigations of interactive behaviours have focused on distal modalities (Stack, 2001), a few studies have been designed to investigate the specific contribution of touch during interactions using the SF procedure.

Gusella et al., (1988) compared the SF responses of 3- and 6-month old infants who had and had not received tactile stimulation during the baseline Normal period. Results revealed that infants of 3-months of age only displayed the SF effect if they had received tactile stimulation during the baseline period, providing evidence for the important role of touch during interactions. In another study focused on the role of maternal touch during interactions (Stack & Muir, 1990), a modified SF procedure was employed whereby mothers were permitted to touch their infants during the SF period (SF+T). As touch was the only means of communication allowed during the SF+T period, the effects of maternal touch on infant behaviour could be examined in isolation. Results revealed less distress in infants of mothers who used touch compared to infants of mothers who did not use touch during the SF period. Specifically, infants in the former group smiled more and gazed more at their mothers during the SF period compared to infants whose mothers had not touched them during the SF period. These results were then replicated and generalized to interactions with female experimenters (Stack & Muir, 1992), and to infants of depressed mothers, where it was found that touch was even more soothing for infants of depressed mothers than for infants of non-depressed mothers (Peláez-Nogueras et al., 1996). Finally, Stack and Muir (1992) found that it was the tactile and not the visual stimulation provided by the adults' hands that moderated the SF effect. These findings underscore that touch is an important and independent social component of adult-infant interactions, and highlight the role that it plays in reducing infant distress.

The regulatory role of touch has been further demonstrated through research revealing that mothers use touch to soothe their infants (Korner & Thoman, 1972) and to

moderate their infants' physiological and behavioural reactions (e.g. levels of attention and arousal; Brazelton 1990; Gusella et al., 1988; Stack, 2001). In a study assessing the impact of touch on dyadic co-regulation, relaxed and mutually attuned (i.e. asymmetrical or when one interactive partner predominates as the initiator while the other partner is attuned without being active) co-regulation decreased during interactions where touch was prohibited, supporting the soothing role of touch (Moreno, Posada, & Goldyn, 2006). While symmetrical co-regulation (i.e. when the infant gazed at mother and smiled, vocalized and reached) decreased when touch was present, this result was only significant for dyads exhibiting more affectionate and less stimulating touch. That is, infants' activity levels decreased when their mothers exhibited more soothing touch. These findings imply that the presence and quality of touch influences regulation at the dyadic level (i.e. co-regulation), and underscore that touch is a unique modality of dyadic communication (Moreno et al., 2006).

Touch has also been found to play an important communicative role, contributing to the development of interactive, synchronous dialogue between mothers and infants (Koester, Brooks, & Traci, 2000). The communicative role of touch has been investigated during face-to-face interactions where mothers have been instructed to use touch to elicit specific behaviours in their infants. For example, Stack and LePage (1996) examined infants' responses during interactions using a modified SF procedure (SF+T), and more specifically, during a period where mothers were instructed to use touch to elicit smiling from their infants (SF+TS period). Results revealed greater infant smiling during this period. Moreover, Stack and Arnold (1998) demonstrated that mothers were successful at using touch alone to draw their infants' attention to their faces and to engage infants in

playful interaction. Although gestures were not included in the instructions provided to mothers, mothers often combined their touch with gesturing behaviours in order to elicit particular responses from their infants. Results from these two studies suggest that infants are responsive to their mothers' touching and gesturing behaviours, and imply that these behaviours play a significant communicative role during social interchanges between mothers and infants.

Despite these important implications, these studies on touch during mother-infant social exchanges are limited because they only examined the overall duration of touch, while overlooking dimensions, such as the types, locations, intensity, speed, and extent of touch. It has been suggested that different types of touch convey different meanings (Tronick, 1995) and that an in-depth analysis of touch requires systematically investigating the qualitative and quantitative characteristics of touch (Hertenstein, 2002; Stack, 2001). Thus, in response to this gap in the research literature, Stack, LePage, Hains and Muir (2008) developed the Caregiver-Infant Touch Scale (CITS), which documents the qualitative and quantitative components of maternal touch during mother-infant interactions.

In one study, the CITS was applied to video records of mother-infant interactions during the modified SF procedure (i.e. SF+T). Results revealed that when mothers were instructed to obtain the maximum amount of smiling from their infants, they used more active forms of touch, such as tickling and stroking, and an increased intensity of lifting and stroking. In contrast, when mothers were instructed to touch their infants in one area of the body only, stroking behaviours increased and shaking decreased, most types of

touch that mothers used decreased in speed, and the intensity of tickling and shaking decreased (Stack et al., 2008).

In a longitudinal investigation, maternal touching behaviours during mother-infant interactions was carried out in two physical contexts (i.e. lap context, floor context; Jean, Stack, & Fogel, 2008). Findings revealed that mothers decreased their nurturing touch with increasing infant age across contexts, while they increased their playful touch with infants' age in the lap context and they increased their utilitarian touch with infants' age in the floor context. These findings suggest that mothers adapt their touching behaviours to the changing needs of their infants depending on their stage of development and the demands of the context.

Jean et al.'s (2008) study underscores the importance of examining maternal touching behaviours as a function of infants' age. Ferber, Feldman and Makhoul (2007) also carried out an investigation of maternal touching behaviours as a function of age, although they used a cross-sectional design. Consistent with Jean et al.'s (2008) study, findings revealed an overall decrease in maternal touch in the second half of the first year of life. Specifically, affectionate and stimulating touch decreased, although interestingly, the decrease in maternal touch was gradual. These results contribute to knowledge on the communicative role of maternal touch, further demonstrating how mothers' adapt their tactile behaviours to their infants' developmental needs with increasing autonomy (Ferber et al., 2007).

Taken together, the existing research on maternal touch suggests that it is an important and independent component of mother-infant interactions. Maternal touch is pervasive during early social interactions, and mothers use touch to regulate their infants'

affect and arousal, and to communicate with their infants. Moreover, it appears that mothers employ different quantitative and qualitative properties of touch (i.e. different types, locations, and intensities) depending on the age of the child, the physical context, and the social messages they wish to convey. An especially noteworthy finding from the research on maternal touch is that infants are responsive to the messages their mothers convey through touch, which underscores its communicative role during early social interactions.

Infant Touch

Given the important communicative and regulatory roles of *maternal* touch during interactions, combined with the fact that infants are active participants in their early social exchanges, it is critical to examine *infants'* touching behaviours in order to clarify its role during early mother-infant interactions. While only a limited number of studies exist that focus on *maternal* touch, even fewer studies have investigated *infant* touch, particularly in a social context. Most examinations of infant behaviour during mother-infant interactions have focused on infants' distal behaviours, such as their gaze and affect. For example, the SF "signature" described by Adamson and Frick (2003) consists of decreased smiling and gazing at mother. Moreover, investigations that have examined infants' touching behaviours have mainly conducted these investigations outside of the interactive context, focusing on infants' tactile exploration of objects (e.g. Rochat, 2001).

Providing a different focus than studies on mother-infant interactions, research on tactile exploration offers important advances in our understanding of the exploratory role of infants' manual activities, with implications for infants' sense of themselves and for their socio-emotional development. Through self-touch and haptic exploration of objects,

infants learn about the specific properties of the stimuli in their surrounding environments and the unique features of their own bodies. In this way, infants can differentiate themselves from others around them, thereby developing an awareness of what Neisser (1991) labelled the ecological self and contributing to their developing self-identities (de Koeyer et al., 2008; Rochat, 2001).

Exploration through touch begins even before birth, when the fetus is in utero. During the fifth and sixth months of pregnancy, studies have revealed that fetuses touch their faces and bodies in an exploratory manner (Flanagan, 1996). Moreover, from birth and within the first few days of life, infants touch their mouths, faces, ears, heads, noses and eyes (Kravitz, Goldenberg, Neyhus, 1978), and they engage in self-touch for most of their waking hours (Rochat & Senders, 1991). Labelled "double touch" (Rochat, 1995), it has been suggested that self-touch provides infants with a unique perceptual experience because they sense tactile stimulation on two parts of their bodies (i.e. their hands and the part of the body being touched). In this way, infants can distinguish their own touch from the tactile stimulation provided by another individual from birth (de Koeyer et al., 2008; Rochat & Hespos, 1997).

In addition to their self-exploration through touch, infants use touch to learn about their surrounding environments. Initially, when manual exploration by the hands and fingers is still undeveloped, infants explore objects with their mouths, given the high density of tactile receptors located in the mouth (Gibson, 1966; Rochat, 1983). Around two months of age, manual exploration begins to accompany oral exploration such that objects placed in infants' hands are frequently transported to the mouth (Rochat & Senders, 1991). This behavioural pattern increases in frequency between two and five

months of age (Rochat, 1989), while infants also develop increasingly sophisticated fine haptic exploratory behaviours (e.g. fingering; Bushnell & Boudreau, 1991; Rochat, 1989). Around the same time, infant exploration becomes increasingly multimodal, with gaze accompanying manual activities. Further, by four to five months of age, infants demonstrate their understanding of the symmetrical properties of the body by transferring objects between their two hands (Rochat, 1989). Then, by six months, the hands become the predominant instruments of haptic exploration (Bushnell & Boudreau, 1991; Rochat, 1997). Research has shown that infants of 6- and 7-months are adept at using their manual exploratory procedures to discriminate the textural properties of rough and smooth stimuli (Stack & Tsonis, 1999; Tsonis, 2002).

Taken together, the research on infant manual exploration highlights the exploratory role of infant touch in early development, elucidating how infants use touch to learn about themselves and objects in their environments. However, because infants spend a significant amount of their time engaging in social interaction during the first year of life (Kaye, 1982), this research is limited as its focus is almost exclusively outside of an interactive context. As such, it is critical to investigate touch within a social context in order to provide a more complete account of infant tactile exploration (i.e. clarifying how infants use touch to explore themselves and their social partners) and to provide an understanding of the communicative and regulatory roles of touch during infant socio-emotional development.

Only a few studies have investigated infants' manual actions or touching behaviours during mother-infant social exchanges. Legerstee, Corter, and Kienapple (1990) revealed that the sequential organization between infants' hand and arm

behaviours and their gaze and affect differs in social and non-social contexts. Although not investigating touch per se, these findings suggest that infants' manual activities are linked to their affective states. In their examination of infant responses to the SF procedure across modalities, Murray and Trevarthen (1985) included the study of touch. Results revealed that infants exhibited active gesturing of the limbs, increased handling of the clothes, touching the face and sucking the fingers (i.e. mouthing) during the SF period compared to the Normal periods. In line with these findings, Toda and Fogel (1993) demonstrated that infants of 3- and 6-months of age exhibited increased grasping, self-touch, and touching of their clothes and the infant seat during the SF compared to the Normal periods.

Collectively, these studies underscore the importance of including multiple channels of communication, such as touch, when studying infants' affective displays and infants' sensitivity to their interactive partner's behaviour. These findings also suggest that the "SF signature" might be expanded beyond its narrow definition of decreased gaze at mother and smiling, and should be extended to include infants' whole bodies (Fogel, 1992; Muir & Lee, 2003). Despite carrying implications for the importance of touch during social interactions, Toda and Fogel (1993) and Murray and Trevarthen's (1985) studies were limited to a more superficial examination of the types and locations of touch. It is essential to systematically and thoroughly examine these qualitative components of touch in order to obtain a deeper understanding of the communicative role of touch (Hertenstein, 2002; Stack, 2001; Stack, 2004). To address this limitation and to systematically investigate infant touching behaviours, Moszkowski and Stack (2007) developed the Infant Touch Scale (ITS). This systematic and reliable coding

measurement tool was designed to document the duration, types and locations of infant touch during mother-infant interactions. Documenting infant touch and comparing infants' tactile behaviours across periods of the SF procedure, results revealed that infants exhibited greater active (e.g. stroke, finger, pat, and pull) types of touch, and more self-touch during the SF compared to the Normal periods. These results suggested that infants are responsive to maternal emotional unavailability through touch and that they communicate changes in their underlying affective states through touch. Infants' greater use of active types of touch and self-touch during the SF period also suggests that touch may have served an exploratory role when mothers were unavailable. Finally, different types of touch were grouped together based on their hypothesized regulatory functions (i.e. soothing/regulatory, representing nurturing tactile behaviours, and reactive/regulatory, representing active tactile behaviours) and compared across periods. Results suggested that infants engaged in more soothing and reactive regulation when their mothers were not available to them, implying that infants self-regulate through touch during the SF period.

As the first study to systematically and more thoroughly investigate the types and locations of infant touch, Moszkowski and Stack's (2007) study provides a baseline for the touching behaviours of healthy, full-term infants during early social exchanges. Yet, touch was only examined in isolation, despite the fact that touch naturally occurs alongside other communicative modalities. Thus, an essential next step would be to examine how touch combines with other channels of communication in order to clarify the messages conveyed through touch. Moreover, the above study was limited as it only allowed inferences regarding the roles of touch (communicative, regulatory, exploratory)

during social exchanges. A more direct and systematic study of the functions of touch during interaction periods with changes in maternal availability is warranted in order to contribute to our understanding of the role(s) of touch in early social interactions. Such investigations should be carried out when mothers exhibit different forms of unavailability (i.e., emotional, physical) that are likely to occur in the natural environment in order to extend the study of touch to different interactive contexts. Finally, as a baseline for touch has been established, it is important to study touch in at-risk populations (e.g., depressed mothers), especially those exhibiting repeated and prolonged periods of emotional unavailability, and to examine the impact of the quality of the dyadic relationship on touch in order to elucidate the effects of positive and negative relationship indicators on infant tactile communication and regulation. By extending the study of touch in this way, the role of infant touch during social interactions and its contribution to infant socio-emotional development will be further clarified.

The present research

The present dissertation was designed to systematically investigate the role of touch in 4 and 5 ½-month-old infants during early mother-infant interactions with variations in maternal availability in normal and at-risk dyads. Infants between 4 and 5 ½-months were selected for investigation because at these ages, infants are active participants during their early social exchanges, initiating interactive sequences (Kaye, 1982) and engaging in turn-taking behaviours (Bornstein & Tamis-LeMonda, 1990). Moreover, infants are increasingly able to voluntarily control their levels of arousal (Calkins, 1994) and they have developed more consistent styles of coping around this age

(Brazelton et al., 1974; Cohn & Tronick, 1983), both of which are important when investigating infant behaviour during periods of maternal unavailability. Finally, at this age, infants' fine motor abilities are more developed, permitting them to use more sophisticated touching behaviours (e.g. fingering) and facilitating their manual exploration of their surrounding environments (Bushnell & Boudreau, 1991; Rochat & Senders, 1991; Stack & Tsonis, 1999).

The current research consisted of a series of two studies, both of which were designed to investigate infants' touching behaviours during social exchanges. The first study investigated the role of touch by examining how touch combines with infants' other communicative behaviours across periods of the SF procedure. Specific objectives were to examine: 1) how touch co-occurs with other communicative behaviours (i.e. gaze, affect) across interaction periods, 2) the communicative, regulatory, and exploratory functions of touch across interaction periods using a systematic coding scheme that operationally defined the functions of touch, and 3) the impact of the quality of the relationship (i.e. emotional availability characteristics - such as maternal sensitivity, maternal hostility, and infant responsiveness - as measured by the Emotional Availability Scales; Biringen et al., 1998) on the functions of touch across interaction periods. This study was designed to underscore infants' sensitivity to maternal *emotional* availability through their touching behaviours in a normative sample.

Building on this research, the second study investigated infants' touching behaviours as a function of two types of maternal unavailability (i.e. emotional, physical) and the quality of the dyadic relationship in an at-risk sample of depressed/non-depressed mothers. Specific objectives were to investigate: 1) the types, locations and functions of

infant touch across interaction periods of the SF and SP procedure, and 2) the impact of maternal depression and negative relationship quality indicators (i.e. emotional availability characteristics – such as maternal intrusiveness and maternal hostility – as measured by the Emotional Availability Scales) on infants' touching behaviours across interaction periods. As with Study 1, Study 2 served to examine and clarify the role of touch during interactions with changes in maternal *emotional* availability and as a function of the quality of the relationship. Yet, whereas Study 1 largely focused on how touch combines with infants' other behavioural modalities, the focus of Study 2 was to compare infants' tactile responses to *different* forms of maternal unavailability (both emotional and physical) in an at-risk sample of depressed and non-depressed mothers exhibiting poor relationship indicators.

Chapter 2: Study 1

Infant Touch with Gaze and Affective Behaviours During Mother-Infant Still-Face Interactions: Co-occurrence and Functions of Touch

Robin J. Moszkowski, Dale M. Stack, and Sabrina S. Chiarella

Centre for Research in Human Development

Department of Psychology

Concordia University

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Correspondence to: Robin J. Moszkowski or Dale. M. Stack
Centre for Research in Human Development
Department of Psychology, Concordia University
7141 Sherbrooke St. West, PY-170
Montreal, Quebec, Canada H4B 1R6
Fax: 514-848-2815; Telephone: 514-848-2424 ext. 7547
Email: robin.moszkowski@yahoo.ca or dale.stack@concordia.ca

Abstract

The current study was designed to investigate the role of touch during early mother-infant interactions with changes in maternal availability. Forty-four mother-infant dyads participated in the SF procedure, and infant touch was examined in the context of infants' other non-verbal behaviours. Specific objectives were to examine co-occurring behavioural pairs across periods, and to investigate the communicative, regulatory, and exploratory functions of touch in relation to the quality of the relationship. In addition to supporting the standard SF effect, findings revealed that both co-occurring behavioural pairs as well as the functions of touch varied across periods of the SF procedure. In particular, passive touch (i.e. static touch) co-occurred with gaze at mothers during the Normal periods, when infants also exhibited playful functions of touch. Soothing (i.e. stroke, finger, mouth) and reactive (i.e. grab, pat, pull) types of touch co-occurred with gaze away from mother during the SF period, and infants also exhibited more regulatory and exploratory functions during this period of maternal unavailability. These findings suggest that the way in which infant touch is organized with gaze and affect changes with the interactive context, and that touch serves different functions according to infants' momentary needs and underlying affective states. Results also revealed variations in the functions of touch according to indicators of the quality of the relationship (e.g. maternal sensitivity, hostility). While maternal sensitivity predicted playful functions of touch, maternal hostility was found to predict infants' disengagement through touch. Taken together, results from the current study imply that the quality of the relationship impacts on infants' touching behaviours and underscore the important regulatory, exploratory and communicative roles of touch during early socio-emotional development.

Infant Touch with Gaze and Affective Behaviours During Mother-Infant Still-Face Interactions: Co-occurrence and Functions of Touch

Most investigations of infant non-verbal communication during early mother-infant interactions have focused on distal modalities, such as gaze and affect. While important for our understanding of infant socio-emotional development, these studies have largely overlooked an important channel through which infants transmit information regarding their underlying affective states: that of touch (Herteinstein, 2002; Moszkowski & Stack, 2007, Stack, 2001; 2004). Yet, infant touch (i.e. touch carried out by infants) is pervasive during early social exchanges as infants spend roughly 85% of the time engaged in touching behaviours (Moszkowski & Stack, 2007). By combining with other non-verbal behaviours in meaningful ways, infants relay important messages regarding their needs and desires through touch (Stack, 2001; Weinberg & Tronick, 1994). Infants also use touch to regulate their emotions, particularly when mothers are not available, and to explore their surroundings (Moszkowski & Stack, 2007; Toda & Fogel, 1993). Given the importance of touch for infants' socio-emotional development, combined with the fact that infants spend a predominant portion of their time engaged in interactions during the first months of life, research investigating the role of infant touch during early social exchanges is warranted. Because touch occurs alongside other channels of communication, the current research sought to advance our understanding of touch by examining infant touch in the context of infants' other communicative behaviours.

Mother-infant interactions are an important context in which to study infant touch within the first six months of life since face-to-face social exchanges occur frequently during this time and they are central to infant socio-emotional, regulatory, and

communicative development (Tronick, Als, Adamson, Wise, & Brazelton, 1978). Infants' communicative and regulatory abilities have been extensively studied using the still-face procedure, which consists of a Still-Face (SF) period, where mothers exhibit emotional unavailability towards their infants, separated by two Normal interaction periods. A SF effect has been reliably documented in the literature: infants exhibit decreased gaze towards their mothers, and increased neutral to negative affect and vocalizations during the SF period (e.g., Muir & Lee, 2003; Segal, Oster, Cohen, Caspi, Myers, & Brown, 1995), suggesting that infants are responsive to variations in maternal emotional availability and they regulate their affect through changes in their own behaviours. However, as with most investigations of infant behaviour during early social interactions, measurement of infant touch has been largely neglected.

While there are some studies documenting the important communicative role of *maternal* touch in the extant literature (e.g. Franco, Fogel, Messinger, & Frazier, 1996; Fogel, Toda, & Kawai, 1988; Hertenstein, 2002; Stack & Arnold, 1998; Stack & LePage, 1996; Stack & Muir, 1992; Tronick, 1995), few studies on *infant* touch exist. Several studies have included a superficial examination of infant touch or gesturing in their investigations of infant behaviour during the SF procedure, revealing that infants spend more time actively gesturing with their limbs and engaging in mouthing and self-touch during the SF compared to the Normal periods (Murray & Trevarthen, 1985; Toda & Fogel, 1993). However, important components of infant touch (e.g. specific types and locations of touch) were not included in these studies (Hertenstein, 2002; Stack, 2001; Weiss & Campos, 1999). To address this gap in the literature, Moszkowski and Stack (2007) conducted a systematic examination of the types and locations of touch across

interaction periods using the SF procedure, where mothers displayed emotional unavailability to their infants. Results revealed that infants spent more time using reactive types of touch (i.e. active touching behaviours, such as grab, pat, pull), and touching themselves (e.g. faces, feet) during the SF period, with implications for the regulatory and exploratory roles of touch during periods of maternal unavailability.

Results from the Moszkowski and Stack (2007) study provided important information regarding the specific types and locations of touch used by infants during their early interactions, and how infants' touching behaviours vary across periods with changes in maternal availability. Although an important step in understanding touch, this research is limited by its investigation of infant touch in isolation. Since touch does not naturally occur in isolation, it is critical to examine the interplay between touch and other communicative behaviours. The current study sought to investigate how touch combines with infants' other communicative behaviours using two different methods.

It has been suggested that discrete behaviours do not reflect the complexity of infant communication (Symons & Moran, 1987) and that co-occurring behaviours serve to enhance the communicative messages infants convey (Weinberg & Tronick, 1994). Thus, the first part of the current study was designed to examine how infant touch co-occurs with infants' other behaviours in order to clarify the messages conveyed through infant touch, with implications for the functions that infant touch serves during interactions. That is, by using co-occurrence analyses to statistically determine significantly co-occurring behavioural pairs between touch and gaze or affect, knowledge regarding how infant touch is used to serve varying functions would be obtained.

Another important way to advance our knowledge regarding the functions of infant touch during social interactions, and the second method of examination used in the current study, is to observe infant touch in the context of their other behaviours (e.g. gaze, posture, affect, vocalizations, and gestures), and then use these behaviours as cues to conceptualize and operationally define the functions of touch (e.g. playful, regulatory, exploratory; Jean & Stack, 2008). Taking into account the behaviours that accompany each type of touch, and constructing a comprehensive and integrative observational measure of the functions of touch would bring us closer to a direct assessment of the functions of touch. As such, this would be an important step in our understanding of the diverse functions that infant touch serves during early social exchanges (Hertenstein, 2002; Jean & Stack, 2008).

To date, only two studies have conceptually defined and coded the functions of touch in this way. The first study investigated the functions of *maternal* touch, revealing that mothers engage in different functions of touch (e.g. nurturing, playful) during normal and perturbed interactions according to levels of infant affect and distress (Jean & Stack, 2007). The second study documented the functions of *infant* touch during periods of maternal emotional (i.e. SF procedure) and physical (i.e. SP procedure) unavailability in an at-risk sample. Findings revealed that infants used more solitary playful functions during the Still-Face period and more reactive/regulatory and disengaged functions during the Separation period (Moszkowski et al., 2008).

While providing an important first step in the investigation of the functions of infant touch, Moszkowski et al. (2008) did not examine the functions during normal periods of mother-infant interaction, but rather only during the SF and SP periods. As

such a comparison of the functions of touch during periods with variations in maternal availability could not be obtained. Therefore, the second part of the current study was designed to operationally define and investigate the functions of touch across periods of the SF procedure (playful/communicative, regulatory, and exploratory).

In addition to investigating variations in the functions of touch across periods, the second part of the current study addressed another important question regarding the functions of touch: indicators of the quality of the relationship (i.e. emotional availability characteristics, such as maternal sensitivity, maternal hostility, and infant responsiveness) were examined for their ability to predict various functions of touch across periods. Prior research has underscored that maternal emotional availability characteristics (e.g. maternal sensitivity, hostility) impact on infants' communicative and regulatory skills, demonstrating that infants experiencing optimal emotional availability during interactions are better able to regulate their emotions (Robinson, Emde, & Korfmacher, 1997). For example, in a study examining the contribution of maternal emotional availability to infant behaviour during the SF procedure, infants engaging in interactions characterized by high maternal sensitivity were more likely to resume playful interaction using a well-regulated interpersonal style during the Reunion Normal period (Kogan & Carter, 1996). In contrast, in the same study, infants of mothers exhibiting elevated levels of intrusiveness exhibited greater negativity during the SF period.

While the above research did not specifically examine the relationship between emotional availability indicators and infants' touching behaviours, Moszkowski and Stack (2008) took a first step in investigating the ability of negative relationship indicators to predict infants' self-regulation through touch in an at-risk sample. Findings

revealed that maternal intrusiveness and maternal hostility predicted regulatory types of touch, thereby underscoring that infants use touch to self-regulate when participating in poor quality interactions. While their study laid the foundation for future investigations examining emotional availability characteristics and touch, only negative relationship indicators were examined and an at-risk sample was used. In order to elucidate how the quality of the mother-infant relationship influences touch during normative socio-emotional development, an examination of a normative sample of mothers who are likely to display optimal emotional availability is warranted using both positive and negative relationship indicators (i.e. maternal sensitivity, maternal hostility) as predictors of infants' touching behaviours.

The present study

The present study was designed to contribute to the investigation of infant touch in two important directions, namely by examining how touch co-occurs with other modalities and by investigating the functions of touch in healthy, full-term 5 ½-month-old infants. As such, the current study consisted of two parts: the first part relied on statistical methods to determine significantly co-occurring behavioural pairs, with implications for the functions of touch. The second part used operationally defined categories to measure the functions of touch according to variations in maternal emotional availability.

Objectives for the first part of the current study were to examine 1) how the types and locations of infant touch co-occur together and 2) how the types of touch co-occur with infants' distal modalities of communication (e.g. gaze, affect) across interaction periods of the SF procedure. It was hypothesized that the co-occurrence between touch

(types and locations) and gaze or affect would vary across periods of the SF procedure. Specifically, it was expected that infant gaze at mother (face, hands, body) and smiling would co-occur with passive or reactive types of touch during the Normal periods, because infants would be engaged in interaction with their mothers. During the SF period, it was hypothesized that proximal gaze away from mothers would co-occur with reactive types of touch, suggesting that infants were engaging in tactile exploration when mothers were unavailable. Moreover, distal gaze away and neutral to negative affect were expected to co-occur with soothing types of touch, suggesting that infants were regulating their emotions (Moszkowski & Stack, 2007; Murray & Trevarthen, 1985; Toda & Fogel, 1993).

Objectives for the second part of the study were to investigate the role of infant touch across interaction periods of the SF procedure through the application of an observational coding scheme designed to operationally define and code the functions of infant touch (intense play, light play, passive play, soothing-regulatory, reactive-regulatory/attention-seeking, exploratory, regulatory/exploratory, dysregulated, partial engaged, disengaged; Functions of Infant Touch Scale; Chiarella, Moszkowski & Stack, 2007). The functions of touch were then examined according to changes in maternal emotional availability during the SF procedure, and in relation to maternal emotional availability characteristics (i.e. the quality of the relationship). Variations were expected according to changes in maternal availability. Since mothers would not be available as external sources of stimulation and regulation during the SF period, it was hypothesized that infants would engage in regulatory and exploratory functions of touch when mothers were emotionally unavailable. In contrast, it was hypothesized that infants would engage

in more playful functions (i.e. intense play, light play) during the Normal periods when their mothers were available. Consistent with the previously documented carry-over effect (Cohn, 2003; Weinberg & Tronick, 1996), it was also expected that infants would be more disengaged from their mothers during the Reunion Normal compared to the first Normal period, whereas they would use more intense play during the first Normal compared to the Reunion Normal period.

Finally, it was hypothesized that positive and negative dimensions of maternal Emotional Availability (EA; i.e. indicators of the quality of the relationship, such as maternal sensitivity and hostility) and infant responsiveness would predict specific functions of touch during interactions. In particular, maternal sensitivity and infant responsiveness were expected to predict playful functions of touch (e.g. intense play, light play), whereas maternal hostility was expected to predict disengagement during the Normal periods.

Method

Participants

Participants were recruited from a major community teaching hospital in Montreal, Quebec, Canada. Mothers of healthy, full-term infants, born between 38 and 41 weeks gestation and weighing more than 2750 g (approximately 6 lbs) at birth participated in the study. In total, there were 46 mother-infant dyads, of which 2 were excluded due to: 1) an obstructed view of the infant's hands on the videotape ($n = 1$); or 2) the mother not complying with instructions ($n = 1$). One infant was also excluded from the analyses for gaze and affect since it was difficult to view the infant's face on the video-record and gaze and affect could not be reliably coded. In the final sample of forty-

four dyads, there were 20 male and 24 female infants. Infants' mean age was 5 months, 13 days (*SD* = 7.63 days). Infants of 5 ½-months of age were selected for investigation since infants of this age have well-developed fine motor skills with which to engage in touching behaviours (Rochat & Senders, 1991), and they are increasingly active participants during social interactions (Kaye, 1982). Mothers' mean age was 30.5 years (*SD* = 5.15), and mothers' mean duration of education was 14.5 years (*SD* = 2.09). The majority of the sample was Caucasian (91%).

Procedure and Apparatus

Sessions took place at the participants' homes and were video-recorded for coding purposes. Testing was carried out in a spacious and well-lit room (usually the kitchen) and outside distractions were minimized. Televisions and radios were turned off, and siblings or pets remained outside of the room. Infants were securely fastened in an infant seat without toys or pacifiers; there was one blanket on the seat. The infant seat was positioned on a stable table top, facing mothers at eye-level and at a distance of 70 cm. A Sony Video camera was set up on a tripod in full view of the infant's face and body and the mother's hands. The mother's face was captured on video through a mirror.

Each dyad participated in the face-to-face SF procedure (Tronick et al., 1978), which consists of three periods. During the first and third (i.e. Reunion) Normal periods, mothers were instructed to: "Play with your baby as you normally would at home." During the second period, the SF, mothers were instructed to: "look at your infant with a still, neutral facial expression, and refrain from speaking to and touching your infant." The Normal interaction periods and the SF period were each 2 minutes in duration, commencing with a knock on the wall and terminating with the beep of a stop clock.

Intervals between periods lasted for 20 seconds. Mothers were informed that they were free to terminate the session at any point if desired. If infants fretted for 20 seconds (n = 1) or mothers wished to stop the session (n = 0), the session was interrupted. Maternal compliance with instructions was verified prior to coding by previewing the video records and observing maternal behaviour during the normal and SF interaction periods.

Behavioural Coding

Following the testing sessions, behavioural coding was carried out in the laboratory. All behaviours were coded independently, and each measure was assigned a code for each second of the interaction (i.e. behaviours were coded for one-second intervals). The percent duration of each dependent measure was defined as the percentage of time within a 120-second period.

Types and Locations of Touch. The types and locations of infant touch were coded in one pass of the video-record. These dependent measures were coded using the Infant Touch Scale (ITS; Moszkowski & Stack, 2007), a systematic and detailed observational coding measure designed to document the duration and location of infant touch during mother-infant interactions. Seven types of touch (e.g. static, stroke, grab, finger, mouth, pat, and pull) and eight locations of touch (e.g. face/shoulders, mouth, hand, trunk, feet, mother, infant seat, infant clothes) were coded. Twenty percent of the sample was double coded by a trained second coder who was blind to the hypotheses of the study. Inter-rater reliability was determined using kappa coefficients that were averaged for the seven types (k = 0.80) and eight locations (k = 0.84) of touch.

After coding, the seven types of touch were clustered into three larger touching clusters (passive, soothing, reactive touching) based on previous research suggesting the

regulatory roles of the different types of touch (Moszkowski & Stack, 2007). More specifically, stroke, finger, and mouth were clustered into a soothing cluster as it has been suggested that infants use these behaviours to calm or soothe themselves (e.g., Moszkowski & Stack, 2007; Toda & Fogel, 1993; Tronick, 1995). Grab, pat, and pull were combined into a reactive cluster as these are more active touching behaviours that infants may use to regulate. Static touch comprised the passive category as this type of touch does not involve any movement while the hands are in contact with an object.

In addition to the touching clusters, the eight locations of touch were also grouped into three clusters (self, mother, other). More specifically, the five areas on the infants' bodies where they used touch were combined into one cluster labelled *self*, and touching of the infant seat and clothes were combined into one cluster labelled *other*. These new clusters were used for the co-occurrence analyses. Table 1 provides a brief description of the individual and clustered categories of touch.

Functions of Touch. The functions of infant touch were coded using the Functions of Infant Touch Scale (FITS; Chiarella et al., 2007; Chiarella, Moszkowski, & Stack, 2008). The categories comprising this observational coding measure are based on the types of touch from the ITS, while using infants' other behavioural modalities (e.g. gaze, affect, posture, vocalizations, gestures) as cues in the determination of the functions of touch. That is, categories were defined according to the particular communicative behaviours that accompanied each type of touch. Ten functions of touch were defined for the Normal periods (intense play, light play, passive play, soothing-regulatory, reactive-regulatory/attention-seeking, exploratory, regulatory/exploratory, dysregulated, partial engaged, disengaged) and seven functions for the SF period (intense/solitary play,

light/passive play/quiet acceptance, soothing/regulatory, reactive/regulatory, attention seeking, exploratory, exploratory/regulatory). Although most functions of touch occurred in all three periods of the SF procedure, some categories differed due to contextual differences between periods (i.e. maternal emotional unavailability during the SF period). For example, the partial engaged and disengaged categories could only be included during the Normal periods when mothers were available for playful interaction. Moreover, the light play and passive play categories were coded separately during the Normal periods, whereas they were combined into one quiet acceptance category during the SF period. This was due to the fact that during the Normal periods, the light play category was distinguished from the passive play category based on whether infants were touching their mothers. This distinction could not be made during the SF period when mothers were unavailable. Table 2 provides operational definitions for the functions of touch. Twenty percent of the sample was double coded by a trained second coder who was blind to the hypotheses of the study. Inter-rater reliability averaged across the eleven functions of touch was $k = 0.94$.

Gaze and Affective Behaviours. Five types of infant gaze were coded, which were gaze to mother's face, to mother's hands, to mother's body, distal gaze away from mother, and proximal gaze away from mother. Proximal gaze was defined as gaze away from the mother, at something within infants' close surroundings (i.e. at self, their clothes, or the infant seat). Distal gaze was defined as infants gazing away from their mothers and into the distance. Three types of affect were coded: neutral, smile, fret. Infant gaze and affect have been reliably coded in this way and used in a number of studies (e.g. Stack & Arnold, 1998; Stack & Muir, 1992).

Emotional Availability Scales. The quality of the dyadic interactions (i.e. emotional availability; EA) was coded using the Emotional Availability Scales (EAS; Biringen et al, 1998). The construct of emotional availability assumes bi-directionality. Therefore, the behaviour of both mothers and infants was considered for each rating, and scores could only be assigned during the Normal periods when mothers were available. One global rating was made on each scale for each normal interactive period. Mothers were rated for their levels of sensitivity (appropriately responding to infants' cues), structuring (guiding infants' play), hostility (overt or covert expressed hostility), and intrusiveness (degree of directiveness and overstimulation); infants were rated for their level of responsiveness (i.e. degree of engagement in interaction). Since this observational coding measure was originally designed for toddlers and children, an adapted version of the EAS was used to code the interactions between young infants and their mothers in the present study (Carter, Little, & Garrity-Rokous, 1998; Little, 1995). The EAS was coded by a trained coder who was blind to the hypotheses of the present study. Twenty percent of the sample was double coded by a trained second coder who was also blind to the hypotheses of the study. Reliability was determined using intraclass correlation coefficients for each of the emotional availability characteristics; correlations ranged between 0.89 and 0.99.

Results

SF effect

Before addressing the current study's objectives, ANOVAs were conducted to assess for the standard SF effect for infant gaze, affect, and touch. A 3 (gaze at mother, gaze away/proximal, gaze away/distal) X 3 (interaction Period) repeated-measures

ANOVA examining infant gaze across periods revealed a significant interaction (F (2, 42) = 35.52, $p < 0.001$). Pairwise comparisons revealed that infants spent more time gazing at their mothers during the Normal and Reunion Normal periods compared to the SF period. Moreover, when gazing away from their mothers during the SF period, infants spent more time gazing away distally ($M = 44.73$) than proximally ($M = 33.06$).

In order to examine infant affect across periods, two one-way repeated measures ANOVAs were carried out for infant smiling and fretting. Infants exhibited decreased smiling (F (2, 78) = 61.06, $p < .001$, $\eta^2 = 0.61$) and increased fretting (F (2, 78) = 4.65, $\eta^2 = 0.21$, $p < .01$, $\eta^2 = 0.61$) during the SF compared to both Normal periods. Finally, infant touch was examined using a two-way repeated-measures ANOVA (7 Types of touch X 3 Period). Infants spent more time using stroke, finger, pat, and pull during the SF period, whereas they spent more time using static touch during the Normal periods (F (14, 602) = 8.92, $p < 0.001$, $\eta^2 = 0.21$). These findings confirm the SF effect that has been reliably documented in the literature (e.g. Jean & Stack, 2007; Moszkowski & Stack, 2007; Muir & Lee, 2003; Segal et al., 1995).

Part I: Co-occurrence Analyses

Following descriptive statistics, analyses were conducted to determine: 1) significantly co-occurring behavioural pairs between the types and locations of touch across interaction periods, and 2) significantly co-occurring behavioural pairs between the types of touch and infants' other communicative modalities (i.e. gaze, affect) across interaction periods. Following procedures outlined by Fogel and Hannan (1985) and Legerstee, Corter, and Kienapple (1990), Wilcoxon signed-ranks tests were performed in order to identify the co-occurring behavioural pairs (e.g. Type of touch – Location of

touch; Type of touch – Gaze, Type of touch – Affect) that occurred to a degree significantly greater than expected by chance. More specifically, in order to determine which behavioural pairs were significant across each interaction period, the degree to which particular behavioural pairs were observed to occur (i.e. observed/actual co-occurrence values) were compared with the expected degree to which those two behaviours were expected to co-occur based on chance alone (i.e. expected co-occurrence values). Expected co-occurrence values were determined by calculating the joint probability of the two behaviour categories of interest (i.e. multiplying the proportional session durations of the two behaviours). The actual and expected co-occurrence values were then compared using Wilcoxon signed-ranks tests and behavioural pairs were considered to be significantly co-occurring if the actual co-occurrence values were significantly greater than the expected co-occurrence values.

Types and Locations of Touch across Periods. Results revealed that self touch significantly co-occurred with passive and soothing types of touch across interaction periods, whereas touching 'other' (i.e. clothes, infant seat) significantly co-occurred with reactive types of touch across interaction periods. When interacting with their mothers during the Normal periods, infants used either passive or reactive types of touch. Moreover, soothing types of touch significantly co-occurred with touching of 'other' during the Normal periods. These findings are presented in Table 3.

Types of Touch and Gaze or Affect across Periods. Results revealed the following significantly co-occurring behavioural pairs. When gazing at their unavailable mothers during the SF period, infants did not use touch. Neutral affect significantly co-occurred with passive types of touch during the SF period, and neutral affect significantly co-

occurred with soothing types of touch during the SF and Reunion Normal period. In contrast, gaze at the proximal environment significantly co-occurred with reactive types of touch during the first Normal and SF periods, and with soothing types of touch during the Reunion Normal periods. Finally, gaze at mothers' bodies significantly co-occurred with reactive types of touch during the first Normal period. These results are presented in Tables 4 and 5.

Part II: Functions of Infant Touch across Periods

Two-way repeated measures analyses of variance (ANOVAs) were conducted to investigate the functions of touch across periods of the SF procedure. Planned comparisons were used to isolate the source of significant interactions, and Bonferroni corrections were performed to reduce the occurrence of Type I errors. Eta-squared statistics (η^2) were conducted to examine effect sizes. According to Clark-Carter (1997), an η^2 of .01 is a small effect, an η^2 of .06 is a medium effect, and an η^2 of .14 or greater is a large effect. Descriptive statistics were calculated for all variables and the data were screened for the presence of outliers, and for skewness and kurtosis. Outliers were brought in using the Tabachnick and Fidell (2001) method that allots each outlier a value of one unit higher from the next lowest extreme score in the sample. Following the procedure to bring in outliers, the distribution was examined for skewness and kurtosis. No transformations were necessary.

An 8 (Functions of touch) by 3 (interaction Period) repeated-measures ANOVA was performed[1], revealing a significant interaction between the Functions of infant touch and Period, F (14, 602) = 18.30, $p < 0.001$, $\eta^2 = 0.30$. As illustrated in Figure 1, infants engaged in more intense and light/passive play during the Normal periods (N1, M =

32.91%, *SD* = 16.23%; N2, *M* = 35.19%, *SD* = 21.09%) relative to the Still-Face period (*M* = 20.79%, *SD* = 12.52%). In contrast, infants spent more time engaged in soothing-regulatory, reactive-regulatory/attention-seeking, and exploratory functions in the Still-Face period (*Ms* = 22.10, 22.64, 16.90%; *SDs* = 12.05, 14.04, 18.19%, respectively) compared to the first Normal (*Ms* = 13.40, 3.40, 4.03%; *SDs* = 14.87, 3.99, 7.09%; respectively) and Reunion Normal (*Ms* = 13.98, 1.93, 3.64%; *SDs* = 17.06, 2.44, 7.11%, respectively) periods. Several differences in the functions of touch between the two Normal periods approached significance: infants tended ($p < 0.06$) to use more reactive-regulatory/attention-seeking functions in the first Normal (*M* = 3.40%, *SD* = 3.99%) compared to the Reunion Normal period (*M* = 1.93%, *SD* = 2.44%). Moreover, infants tended to exhibit more dysregulated functions of touch during the Reunion Normal (*M* = 0.47%, *SD* = 1.25%) compared to the first Normal ($p < 0.08$, *M* = 0.02%, *SD* = 0.15%) and Still-Face ($p < 0.06$, *M* = 0.00%, *SD* = 0.00%) periods.

INSERT FIGURE 1 ABOUT HERE

The partial-engaged and disengaged functions could not be examined during the SF period since infants could only engage/disengage with their mothers through touch when their mothers were available (i.e. during the Normal periods). As such, these two functions were compared during the Normal periods using a repeated-measures ANOVA (2 Functions of touch X 2 interaction Period). No significant differences emerged between periods.

To examine how infants who were more or less likely to be engaged/disengaged with their mothers during a baseline interaction would respond following brief maternal

unavailability, a median split was performed. Infants were subdivided into groups (high/low) according to the degree to which they used partial-engaged and disengaged functions of touch during the first Normal period. Infants were then compared regarding their functions of touch in the Reunion Normal period. Although no significant differences emerged between infants who exhibited high versus low disengaged functions of touch during the First Normal period, a 2 (Groups) X 11 (Functions of touch) between-subjects ANOVA revealed a significant interaction for infants who engaged in high versus low partial engaged functions, $F(10, 33) = 2.15$, $p < .05$, $\eta^2 = 0.05$. As illustrated in Figure 2, infants in the high PE group (i.e. high partial engaged (PE) group) were more likely to use disengaged functions of touch during the Reunion Normal period compared to infants in the low PE group (*Ms* = 15.56, 6.28%; *SD* = 11.39, 8.01% respectively). Infants in the low PE group were more likely than infants in the high PE group to engage in light play functions during the Reunion Normal period (*Ms* = 23.36, 15.18%; *SD* = 13.70; 10.46% respectively).

INSERT FIGURE 2 ABOUT HERE

Predicting Functions of Infant Touch from EA: Hierarchical Regressions. After examining group and individual differences in the functions of touch across periods, hierarchical linear regressions were used to investigate the ability of specific EA characteristics to predict particular functions of touch across periods. One positive (i.e. maternal sensitivity) and one negative (i.e. maternal hostility) EA characteristic were selected as predictors to determine the impact of both positive and negative relationship qualities on infants' touching behaviours. Maternal sensitivity was selected as the

positive EA indicator since research has isolated sensitivity as an important component of maternal emotional availability that affects dyadic behaviour (Kaye & Fogel, 1980). Hostility was selected as the negative indicator since it is associated with infants' difficulty in regulating their emotions during an emotional challenge (Little & Carter, 2005). Finally, infant responsiveness was also entered as a predictor in order to investigate the relationship between more global (i.e. responsiveness) versus micro-level (i.e. functions of touch) infant behaviours. Intense play, partial engagement, and disengagement were investigated in order to determine how the quality of the relationship influenced infants' levels of engagement with their mothers during two normal interaction periods (one of which preceded and one of which followed maternal emotional unavailability). Before conducting the regressions, descriptive statistics were carried out for the EA characteristics (see Appendix F, Table F7). While most variables were deemed to be normally distributed, hostility was positively skewed. However, due to the low frequency nature of this variable in the current sample, transformations were not conducted.

For the regressions in the first Normal period, predictor variables were entered in the following order: the positive and negative dimensions of EA (i.e. sensitivity, hostility) as rated during the first Normal period were entered in Step 1, followed by infant responsiveness in Step 2. For the regressions in the Reunion Normal period, predictors were similarly entered except that the EA variables rated during the Reunion Normal period were entered first, followed by the EA variables as rated during the first Normal period. This was done in order to examine the relative contribution of EA as exhibited during each of these periods to the functions of touch displayed during the Reunion

Normal period. To maximize power for each regression analysis, the number of predictors was kept to a maximum of five. Correlations ensured that the predictors were not significantly related to each other. Regression tables are presented in Appendix G (Tables G1-G6).

The first set of regressions investigated intense play functions. None of the predictors emerged as significant for intense play functions during the first Normal period. In contrast, the complete model accounted for 19.3% (8.7% adjusted, $F = 1.82, p < 0.05$) of the variance in intense play functions during the Reunion Normal period. Although sensitivity and hostility during the Reunion Normal were not significant predictors in Step 1 ($R^2_{ch} = 0.06$), sensitivity ($\beta = .60, p < .05$) and hostility ($\beta = .46, p < .05$) during the first Normal period were significant when entered in Step 2. When infant responsiveness was added in Step 3, these predictors only approached significance (β sensitivity N1 = .522, $p < .08$; β hostility N1 = .41, $p < .07$; $R^2_{ch} = 0.01$). These findings suggest that infants who had previously interacted with a sensitive or hostile mother (i.e. during the First Normal period) were more likely to engage in intense play during the Reunion Normal period.

The second set of regressions examined partial engaged functions of touch. Results for the first Normal period are as follows: for Step 1, sensitivity was a significant predictor ($\beta = -.45, p < .05$; $R^2_{ch} = 0.15$). The results were the same in Step 2, when infant responsiveness was added (β sensitivity = -.60, $p < .05$; $R^2_{ch} = 0.02$). The total variance accounted for by all predictors was 17.0% (10.8% adjusted, $F = 2.73, p < 0.6$). For the Reunion Normal period, both sensitivity and hostility during the Reunion Normal were not significant in Step 1 ($R^2_{ch} = 0.13$). When sensitivity and hostility from the first

Normal period were added in Step 2, sensitivity during the Reunion Normal emerged as significant ($\beta = -.52, p < .05$; $R^2_{ch} = 0.07$). Sensitivity during the Reunion Normal was the only significant predictor in Step 3 ($\beta = -.53, p < .04$; $R^2_{ch} = 0.01$), when infant responsiveness was added. Combined, the predictors accounted for 20.4% of the variance (9.9% adjusted, $F = 1.95, p > 0.05$). Taken together, these results appear to indicate that when interacting with sensitive mothers, infants were less likely to be only partially engaged with their mothers.

The third set of regressions for the Normal periods examined disengaged functions of touch. In the first Normal period, the complete model accounted for 24.5% (18.8% adjusted, $F = 4.33, p < 0.01$) of the variance in disengaged functions of touch. In Step 1, maternal sensitivity negatively predicted disengagement ($\beta = -.56, p < .01$, $R^2_{ch} = 0.23$), and maternal sensitivity remained significant in the second step, when infant responsiveness was added ($\beta = -.45, p < .05$, $R^2_{ch} = 0.01$). During the Reunion Normal period, 44.8% (37.6% adjusted, $F = 6.18, p < 0.001$) of the total variance was accounted for. In the first step, maternal hostility ($\beta = .30, p < .05$; $R^2_{ch} = 0.33$) and sensitivity ($\beta = -.38, p < .01$) during the Reunion Normal were significant. However, none of the predictors were significant in Step 2, when hostility and sensitivity during the first Normal period were added ($R^2_{ch} = 0.02$). In Step 3, infant responsiveness ($\beta = -.38, p < .05$; $R^2_{ch} = 0.09$) and hostility ($\beta = .31, p < .05$) during the Reunion Normal period were significant predictors. Taken together, these results suggest that infants of less sensitive and more hostile mothers were more likely to be disengaged through touch, whereas more responsive infants were less likely to be disengaged.

Discussion

The present study was designed to investigate infants' touching behaviours in the context of other channels of communication. The first part of the current study examined how touch combines with other modalities of communication, such as gaze and affect, using co-occurrence analyses. Results were consistent with the hypotheses, revealing that co-occurring behavioural pairs varied as a function of interaction period. In particular, self-touch co-occurred with passive and soothing types of touch across interaction periods, suggesting that infants touch themselves in a calm and soothing manner. In contrast, touching 'other' (i.e. clothes, infant seat) co-occurred with reactive types of touch across interaction periods, indicating high activity levels.

When interacting with their mothers during the Normal periods, infants used either passive or reactive types of touch. Infants may have elected to use different types of touch with their mothers depending on the level of stimulation provided. That is, infants may have used more active regulatory types of touch when highly stimulated by their mothers to reflect heightened states of arousal. Alternatively, infants may have used passive types of touch during moderate and calmer interactive sequences, signalling lower levels of arousal. Moreover, gaze at mothers' bodies co-occurred with reactive types of touch during the first Normal period, suggesting high activity levels when gazing at their mothers.

In contrast, neutral affect combined with passive types of touch during the SF period and with soothing types of touch during the SF and Reunion Normal period, suggesting that touch served a regulatory function during or following a period of maternal unavailability. Moreover, gaze at the proximal environment (e.g., gaze at the

self or infant seat) co-occurred with reactive types of touch during the first Normal and SF periods, and with soothing types of touch during the Reunion Normal period, suggesting that infants were exhibiting different forms of exploration when mothers were available or unavailable.

These results are consistent with previously demonstrated co-occurrences between infants' manual activities and other expressive behaviours (Fogel & Hannan, 1985; Toda & Fogel, 1993), and they contribute to the existing research literature by showing co-occurrences with specific clusters of touch (e.g. passive, soothing, and reactive). These findings also support previous assertions that infants' non-verbal communicative behaviours are organized into affective displays that are related to the interactive context (i.e. maternal availability; Legerstee et al., 1990; Weinberg & Tronick, 1994). In the current study, the results particularly elucidate how *touch* combines with other non-verbal channels of communication, thus underscoring the importance of touch in conveying infants' underlying affective states during pre-verbal development.

Building on the findings regarding how different types of touch statistically co-occur with infants' other behaviours, the second part of the current study examined the functions of touch. In support of the hypotheses, and consistent with the co-occurrence findings, results revealed that the functions of touch varied across interaction periods with changes in maternal availability. Infants engaged in more playful (i.e. intense, light, and passive play) functions of touch during the Normal periods, highlighting their engagement in interaction when their mothers were available. During the SF period, infants engaged in regulatory (soothing, reactive) and exploratory functions of touch, implying that touch is one channel through which infants cope with unavailability.

Infants may use touch to self-regulate and explore when their mothers are unavailable during the SF period in order to moderate their affective states (Moszkowski & Stack, 2007). By conveying conflicting information regarding their social engagement (i.e. inviting interaction through their gaze and rejecting it through their still-faces), mothers are violating social expectations of reciprocity (Brazelton & Cramer, 1990). Infants may become distressed in response, thereby resulting in their self-regulation via engagement in reactive (e.g. patting) and soothing (e.g. mouthing) types of touch while simultaneously exhibiting neutral affect and gaze away from their mothers. This collective combination of behaviours was defined as *regulatory* behaviours (see FITS operational definitions, Table 5) and may have been used by infants to either express affective disorganization or to calm themselves (Moszkowski & Stack, 2007). Although further support for the regulatory function of touch would have been provided if soothing types of touch would have been shown to significantly co-occur with fretting, the lack of significance of this behavioural pair is likely due to the low frequency of infant fretting behaviour in the current research. Moreover, infants' greater tactile exploration during the SF period may also serve to modulate their emotions, given that exploration has been suggested to be a means through which infants can divert their attention away from a stressful situation (Rothbart, Ziaie, & O'Boyle, 1992). Tactile exploration and regulation may also provide infants with much needed stimulation when their mothers are not available as external sources of stimulation (Gianino & Tronick, 1988).

In addition to exhibiting differences in functions during the SF period, variations were demonstrated between the two Normal periods. Consistent with previous research demonstrating a carry-over of negative infant behaviour (e.g. distress brow, crying,

elevated motor activities, decreased smiling) from the SF into the Reunion Normal period (e.g. Field, Vega-Lahr, Scafaldi, & Goldstein, 1986; Fogel, Diamond, Langhorst, & Demost, 1982), infants tended to display greater dysregulated functions of touch during the Reunion Normal compared to the first Normal period. At the same time, infants in the present study also engaged in greater reactive/regulatory functions in the first Normal compared to the Reunion Normal period. Although this finding was not expected, it may be that mothers were compensating for their unresponsiveness during the SF period by providing their infants with greater amounts of external regulation in the Reunion Normal period. As such, there may have been less of a need for infants to engage in tactile regulation during the Reunion Normal compared to the first Normal period (Chiarella et al., 2007).

Despite exhibiting these differences in functions between the two Normal periods, infants did not vary in their playful functions of touch. Although it was expected that infants would exhibit more disengaged functions during the Reunion Normal (compared to the first Normal period), and they would engage in more intense playful functions during the first Normal (compared to the Reunion Normal period), this was not the case. Mothers' interactive behaviour during the Reunion Normal may account for the lack of differences in these functions. That is, mothers may have been trying to re-engage their infants in interaction during the Reunion Normal period, which impacted on their infants touching behaviours and decreased the likelihood that they would use disengaged functions of touch.

Alternatively, it is possible that there was too much variability across individuals in the degree of infant engagement/disengagement, cancelling out any group differences

between periods. In fact, results revealed individual differences in the functions of touch in infants exhibiting high versus low levels of partial engagement during the first Normal period. Infants in the low partial engaged group in the first Normal period displayed light play functions in the Reunion Normal period, suggesting continuity in individual differences in the functions of touch across periods of the SF procedure (i.e. infants who are more likely to be engaged with their mothers in the first Normal will continue to be engaged with them in the Reunion Normal period). Interestingly, infants who were somewhat disengaged with their mothers through touch (i.e. high PE group) during the first Normal period exhibited disengaged functions of touch in the Reunion Normal period. This finding suggests continuity in individual differences across the Normal periods of the SF procedure. It also implies that mothers' emotional unavailability in the SF period may have led infants who were only partially unengaged to be disengaged in the Reunion Normal period.

By documenting these functions of infant touch, and demonstrating how the functions vary across interaction periods, the current findings have taken an important step in demonstrating how infants use touch to fulfill various roles. While researchers in the past have merely speculated regarding infants' ability to use touch to regulate and explore in response to the SF (i.e. by examining the individual types and locations of touch and making inferences about their functions; Moszkowski & Stack, 2007), in the current study infant touch was observed as it occurs alongside infants' other behaviours, these other behaviours were used to understand the context in which specific types of touch occur, and then the functions of touch were operationally defined. In this way, the

current research made a unique contribution to our knowledge of the diverse functions that infant touch may serve during early social interactions.

Another unique contribution made by the current research was its examination of how indicators of the quality of the relationship impacted on infants' touching behaviours. Previous research indicates that infants alter their interactive behaviours as a function of naturally occurring variations in emotional availability (Biringen et al., 1998; Kogan & Carter, 1996; Moszkowski et al., 2008), and findings from the second part of the current study support this research. Infants exhibited variations in the functions of touch according to positive (i.e. maternal sensitivity, infant responsiveness) and negative (i.e. maternal hostility) relationship indicators during the periods of the SF procedure. Results revealed that maternal sensitivity positively predicted intense playful functions of touch in the Reunion Normal period, and negatively predicted disengaged functions during the First Normal period and partial engaged functions during both Normal periods. In line with research demonstrating less negative affect in infants of sensitive mothers (Braungart-Rieker, Garwood, Power, & Notaro, 1998), these results indicate that infants of highly sensitive mothers are more likely to actively re-engage with their mothers following the disruption of the SF period.

Consistent with these findings, maternal hostility positively predicted disengaged functions of touch during the Reunion Normal period. These results were expected as infants participating in interactions characterized by sub-optimal emotional availability have difficulty re-engaging with their mothers in the Reunion Normal period (Kogan & Carter, 1996). Unexpectedly, maternal hostility during the first Normal period predicted intense playful functions in the Reunion Normal period. However, in light of the fact that

mothers' exhibited low levels of hostility in the Normal periods, these findings warrant replication in future research.

Finally, infant responsiveness was another important characteristic of the quality of the mother-infant relationship that predicted infants' tactile behaviours in the current study. Less responsive infants were found to display disengaged functions of touch in the Reunion Normal period. This finding was in the hypothesized direction given that responsiveness is an indicator of their level of engagement (Biringen et al., 1998).

Taken together, findings from the current study revealed that infants' touching behaviours during the SF are related to the quality of mother-infant interactions, thereby underscoring the contribution of maternal and infant emotional availability characteristics to the functions that infant touch serves. Results also demonstrated that the functions (e.g. playful/engaged, regulatory, and exploratory) of touch as well as how touch is organized with other behaviours (i.e. co-occurrence with gaze, affect) vary according to the interactive context, when mothers display variations in their emotional availability. Thus, findings suggest that infants' tactile behaviours are configured with their other communicative behaviours in meaningful ways, which serve to clarify and enhance the messages conveyed through touch. Moreover, touch appears to be used by infants in conjunction with their gaze and affect in order to interact with their mothers when they are available or to cope with their mothers' emotional unavailability. Taken together, these results highlight the important role of touch for infant communication, regulation, and exploration during early social interactions characterized by variations in maternal emotional availability.

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Footnotes

[1] For this analysis, the light play and passive categories in the Normal periods were combined to compare these categories with the one equivalent category (i.e. quiet acceptance) in the SF period. The light play and passive categories were coded separately for the Normal periods, where light play was coded when infants were touching their mothers and passive was coded when they were not touching their mothers. Touching/not touching their mothers was the only distinction between these two categories in the Normal periods (all other infant behaviours were the same). However, this distinction could not be made during the SF period, when mothers were still-faced and at a distance of 70 cm from their infants, effectively out of reach.

Table 1

Coding Criteria for the Infant Touch Scale (Moszkowski & Stack, 2007)

Type of Touch	Brief Description
No touch	Hand not in contact with anything.
Static or Passive	Hand remains still while in contact with a stimulus.
Rub/Caress/Wipe/Stroke	Lateral finger movement (back and forth or in circular motion), often repetitive. If just tip of finger is moving, finger category is used.
Grasp/Clutch/Clasp	Curling of fingers around a stimulus.
Finger/Scrumble	Running the tip of the fingers over a surface, often in random fashion.
Mouth	The hand/finger(s) come in contact with the mouth region (i.e. either inside or outside the mouth).
Pat/Tap	Up and down motion of the hand against a surface.
Pull/Push/Lift/Poke/Prod	Raising/lowering of a stimulus, or exerting pressure against an object.

Clusters of Types of Touch	Brief Description
Soothing/Regulatory	Cluster of rub/caress/wipe/stroke with finger/manipulate/ scrumble and mouthing; behaviours used by the infant to self-sooth or calm themselves
Reactive/Regulatory	Cluster of grasp/clutch/clasp, pat/tap, and pull/push/lift/poke/prod; active touching behaviours

Location of Touch	Brief Description
No area	Hand not in contact with anything.
Face/Head/Shoulder/ Neck	Touching of any part of the face or neck/shoulder region with the exception of the mouth.
Mouth	Touching of the inside or outside of the mouth, including the lips.
Hand/Arm	Touching of the hands, fingers, or arms up until the shoulders.
Trunk	Touching of the chest and stomach region.
Feet/Leg	Touching of the legs, feet, or toes.
Self	Touching any part of the body (face region, mouth, hand/arm, trunk, feet/leg)
Mother	Touching of any part of the mother, including her hands, face, hair, clothes, etc.
Other (chair, clothes)	Touching of the infant seat, the belt with which the infant is fastened to the seat, or the blanket on the seat. Or, touching of any clothes or footwear worn by the infant; if the infant is also touching a body part while touching their clothes, the body part is coded and not their clothes.

Table 2

Coding Criteria for the Functions of Infant Touch Scale (Chiarella et al., 2007)

Functions of touch	Period*	Brief Description
Intense Play	Normal and SF	Infant is playing with mom or by him/herself while gazing at mother, with neutral or positive affect/vocalizations; using active forms of touch
Light Play	Normal	Infant is playing with mom, with neutral to positive affect/vocalizations, gazing at her and touching her using less active types of touch
Passive Play	Normal	Infant is gazing at mom, affectively positive or neutral, using passive touch and NOT touching mother
Quiet Acceptance	SF	Infant remains passive while gazing at mother, with neutral or positive affect/vocalizations.
Soothing-Regulatory	Normal and SF	Infant is calming himself through soothing types of touch while gaze is away/distal from mother, with neutral to negative affect.

Functions of touch	Period*	Brief Description
Reactive-Regulatory/Attention-seeking	Normal and SF	Infant self-regulating by actively touching him/herself or his/her surroundings while gaze is away/distal from mother, with neutral to negative affect and vocalizations. Infant may be trying to regain mother's attention through active touch or gesturing.
Exploratory	Normal and SF	Infant is exploring him/herself or his/her surroundings through active forms of touch while gaze is proximal/at self, with neutral to positive affect and vocalizations.
Regulatory Exploratory	Normal and SF	Infant is exploring himself through touch, while exhibiting negative affect and vocalizations. (Infant may be fussing.)
Dysregulated	Normal and SF	Infant is crying while using any type of touch.
Partial Engaged	Normal	Infant's hands are in contact with mom while gazing away from her; mom is trying to regain infant's attention

Functions of touch	Period*	Brief Description
Disengaged	Normal	Infant is gazing away from mom, not touching mom, while mom is trying to regain infant's attention
No Function	Normal or SF	Infant is not using touch.

* It is important to note that some functions of touch (e.g. partial engaged, disengaged) could not be coded during the SF period since these functions require mother's availability in order to be coded. Other functions were operationally defined to be coded during periods of maternal unavailability. As such, the interaction period in which the functions of touch could be coded are specified in the above table.

Moreover, it should be highlighted that the light play and passive play categories were coded separately in the Normal periods according to whether the infant was touching the mother or not (i.e., the light play category was coded when infants touched their mothers). However, during the SF period when mothers were not available to be touched, the categories of light and passive play were combined (see Quiet Acceptance category).

Table 3

Co-occurrences Between Types and Locations of Touch across Interaction Periods

Behavioural Pair (Type/Location)	First Normal	SF	Reunion Normal
No touch-No area	42/0***	42/0***	42/0***
Passive-Self	31/13**	36/7***	32/12**
Passive-Mother	31/9***	0/0	28/11***
Passive-Other	6/34	13/31	7/35
Sooth-Self	36/8***	31/13**	37/7***
Sooth-Mother	6/34	0/0	7/32
Sooth-Other	28/12**	25/19	26/16**
Reactive-Self	14/30	20/24	13/30
Reactive-Mother	37/3***	0/0	33/6***
Reactive-Other	31/9***	37/7***	33/8***

Note. For each behavioural pair, the numerator represents the number of infants for whom the actual probability of co-occurrence was greater than expected by chance; the denominator represents the number of infants for whom the expected probability of co-occurrence was greater than the actual (act.>exp./exp.>act.). Not included in this table is the number of infants for whom the actual probability of co-occurrence was equal to the expected probability of co-occurrence. The values in the numerator and denominator, combined with the number of infants for whom the actual probability of co-occurrence was equal to the expected probability of co-occurrence add up to the total number of infants in the sample (i.e. 44). * p <.05, ** p <.01, *** p *<.001,* t $p < .10$.

Table 4

Co-occurrences Between Types of Touch and Gaze across Interaction Periods

Behavioural Pair (Touch/Gaze)	First Normal	SF	Reunion Normal
No Touch-Mother/Face	18/23	25/16**	25/16
No Touch-Mother/Hand	10/29	1/4	17/23
No Touch-Mother/Body	18/20	10/12	11/28
No Touch-Proximal/Away	11/23	14/27	12/21
No Touch-Distal/Away	19/21	16/25	13/25
Passive-Mother/Face	21/22	20/23	22/20
Passive-Mother/Hand	24/16	2/3	19/22
Passive-Mother/Body	17/22	4/18	24/15
Passive-Proximal/Away	8/26	16/27	11/31
Passive-Distal/Away	21/20	26/17t	20/19
Sooth-Mother/Face	16/27	16/27	22/20
Sooth-Mother/Hand	19/21	1/4	21/20
Sooth-Mother-Body	10/30	13/9	14/26
Sooth-Proximal/Away	18/17t	24/19	22/12**
Sooth-Distal/Away	19/21	25/18t	19/20
Reactive-Mother/Face	15/28	5/38	6/35
Reactive-Mother/Hand	21/20	2/3	18/21
Reactive-Mother/Body	26/14t	10/12	18/21
Reactive-Proximal/Away	20/15*	30/13**	17/17

Behavioural Pair (Touch/Gaze)	First Normal	SF	Reunion Normal
Reactive-Distal/Away	12/28	18/25	23/15

Note. For each behavioural pair, the numerator represents the number of infants for whom the actual probability of co-occurrence was greater than expected by chance; the denominator represents the number of infants for whom the expected probability of co-occurrence was greater than the actual (act.>exp./exp.>act.). Not included in this table is the number of infants for whom the actual probability of co-occurrence was equal to the expected probability of co-occurrence. The values in the numerator and denominator, combined with the number of infants for whom the actual probability of co-occurrence was equal to the expected probability of co-occurrence add up to the total number of infants in the sample (i.e. 44). * $p < .05$, ** $p < .01$, *** $p < .001$, t $p < .10$.

Table 5

Co-occurrences Between Types of Touch and Affect across Interaction Periods

Behavioural Pair (Touch/Affect)	First Normal	SF	Reunion Normal
No Touch-Neutral	22/19	25/15	18/24
No Touch-Smile	19/22	14/20	20/21
No Touch-Fret	1/40	5/31	3/39
Passive-Neutral	22/21	34/8**	22/20
Passive-Smile	25/18	7/29	23/19
Passive-Fret	1/42	2/36	3/40
Sooth-Neutral	24/19	29/13**	27/16*
Sooth-Smile	17/26	14/21	17/26
Sooth-Fret	2/41	6/33	2/41
Reactive-Neutral	22/21	24/18	23/19
Reactive-Smile	23/20	18/18	22/20
Reactive-Fret	2/41	6/32	2/40

Note. For each behavioural pair, the numerator represents the number of infants for whom the actual probability of co-occurrence was greater than expected by chance; the denominator represents the number of infants for whom the expected probability of co-occurrence was greater than the actual (act.>exp./exp.>act.). Not included in this table is the number of infants for whom the actual probability of co-occurrence was equal to the expected probability of co-occurrence. The values in the numerator and denominator, combined with the number of infants for whom the actual

probability of co-occurrence was equal to the expected probability of co-occurrence add up to the total number of infants in the sample (i.e. 44). * p <.05, ** p <.01, *** p *<.001,* t p < *.10.*

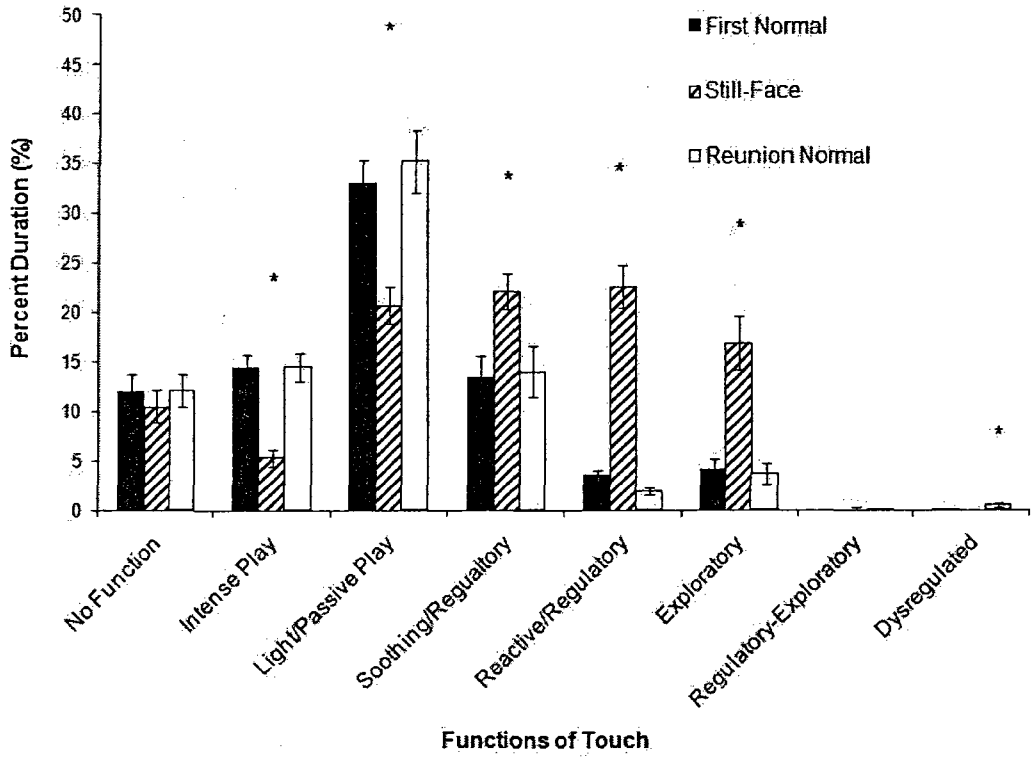

Figure 1. The mean percent duration of functions of touch across interaction periods. Standard errors are shown by vertical bars.

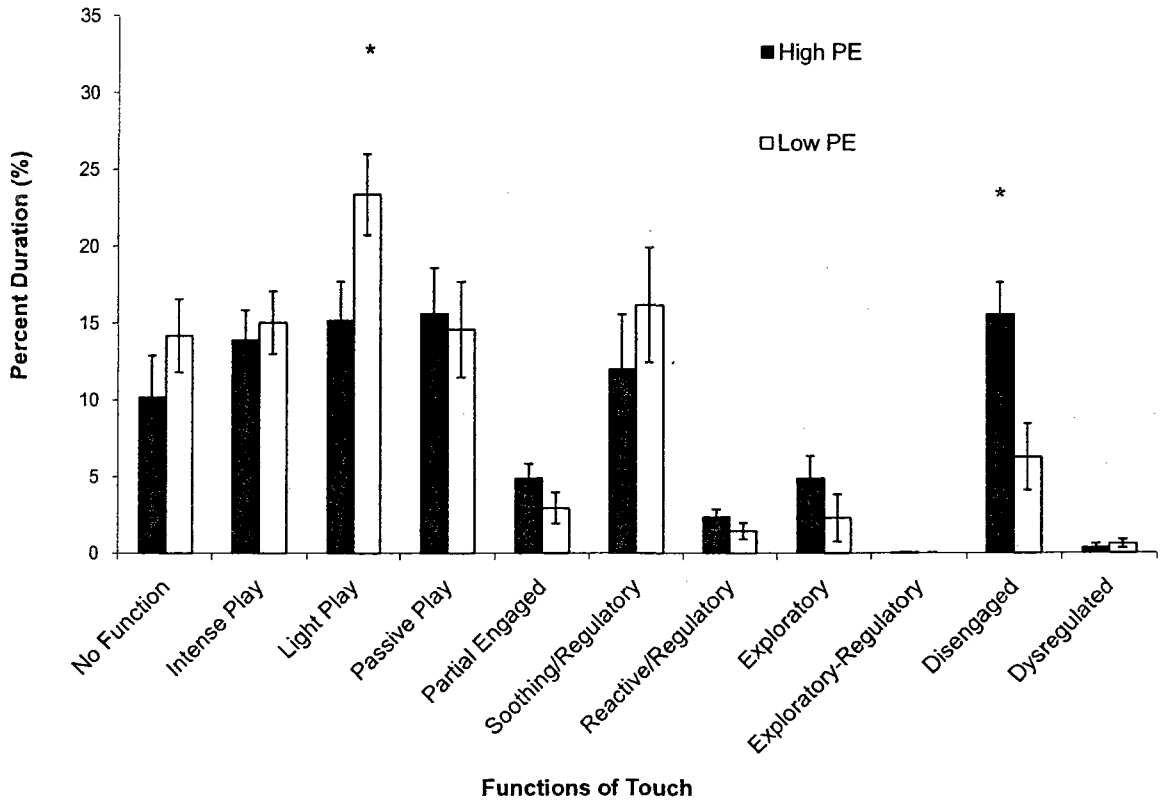

Figure 2. The mean percent duration of functions of touch during the Reunion Normal period for infants who engaged in high versus low partial engaged functions during the First Normal period. Standard errors are shown by vertical bars.

Chapter 3: Study 2

Running head: INFANT TOUCHING BEHAVIOUR

Touching Behaviours of Infants of Depressed Mothers during Normal and Perturbed Interactions

Robin J. Moszkowski, Dale M. Stack, and Nadine Girouard
Centre for Research in Human Development
Department of Psychology
Concordia University

Tiffany M. Field, Maria Hernandez-Reif, and Miguel Diego
Touch Research Institute
University of Miami School of Medicine

Manuscript under revision for
Infant Behavior and Development

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Correspondence to: Robin J. Moszkowski or Dale M. Stack
Centre for Research in Human Development
Department of Psychology, Concordia University
7141 Sherbrooke St. West, PY-170
Montreal, Quebec, Canada H4B 1R6
Fax: 514-848-2815; Telephone: 514-848-2424 ext. 7547
Email: robin.moszkowski@yahoo.ca or dale.stack@concordia.ca

Abstract

The present study investigated the touching behaviours of 4-month-old infants of depressed and non-depressed mothers during the Still-face (SF; maternal emotional unavailability) and Separation (SP; maternal physical unavailability) procedures. The sample was considered at-risk and all dyads, including depressed and non-depressed mothers, exhibited poor relationship qualities (e.g. poor maternal sensitivity, low infant responsiveness). Results indicated that infants exhibited more patting and pulling when mothers were unavailable. Moreover, depression appeared to negatively affect infants' tactile behaviours: infants of depressed mothers used more reactive types of touch (e.g. grab, pat, pull) than infants of non-depressed mothers during emotional and physical unavailability, suggesting less self-soothing behaviour. Negative relationship indicators, such as maternal intrusiveness and hostility, predicted soothing/regulatory (i.e. nurturing) and reactive/regulatory (i.e. active) types of touch, even after controlling for maternal depression. Taken together, these results underscore the importance of touch for infant communication and regulation during early social interactions.

Key words: infant touch, mother-infant interactions, maternal depression, maternal emotional availability, still-face and separation procedures

Touching Behaviours of Infants of Depressed Mothers during Normal and Perturbed Interactions

Researchers have investigated infants' emotional communication in response to variations in maternal unavailability using the Still-Face (SF) and Separation (SP) procedures. During the SF procedure, mothers display emotional unavailability by remaining poker-faced while continuing to gaze at their infants and refraining from touching and vocalizing. In response, infants have shown less smiling and gazing at their mothers during the SF period (Adamson & Frick, 2003; Muir & Lee, 2003; Tronick, Als, Adamson, Wise, & Brazelton, 1978). Moreover, their negative affect carries over into the Reunion Normal period following the SF period (Cohn, 2003; Weinberg & Tronick, 1996). Infants also become distressed during the SP procedure, where mothers leave the room for a brief period of time, thereby being physically unavailable to their infants. When these two situations were compared, infants became more distressed and disorganized during maternal emotional (the SF) versus physical (the SP) unavailability (Field, Vega-Lahr, Scafidi, & Goldstein, 1986). These findings suggest that infants are sensitive to variations in maternal availability, and alter their own behaviour accordingly.

The comparison between infants' responses to the SF and SP procedures was also made with infants of depressed mothers who exhibited less vocalizing during the SP period relative to infants of non-depressed mothers, and engaged in more smiling and vocalizing during the Reunion Normal period (Field, Hernandez-Reif, & Diego, 2007). This study (and other research on infants of depressed mothers) focused mainly on infants' distal communicative behaviours. Yet, infants' touching behaviours should also be investigated, given that they are pervasive during interactions, and they play a critical

role in infant communicative and regulatory development (Moszkowski & Stack, 2007; Stack 2001, 2004).

Using the videotapes from the Field et al. (2007) study, the present study investigated the touching behaviour of 4-month-old infants during the SF and SP mother-infant interactions in that same sample of depressed and non-depressed mothers. Touch was examined by addressing its functions in addition to the types, duration, and locations of touch. In earlier studies (e.g. Moszkowski & Stack, 2007) with full-term non-depressed dyads, the roles of touch were merely inferred by examining the individual types and locations of touch in isolation. As touch does not occur independently, but rather in the context of infants' other expressive behaviours (e.g. gaze, affect, vocalizations, posture), it is important to investigate how touch combines with these behaviours to tease apart its roles (e.g. communicative, regulatory, exploratory).

The objectives of the present study were to examine: 1) differences in the types, locations, and functions of touch in infants of depressed and non-depressed mothers, and 2) the impact of the quality of the relationship (i.e. maternal emotional availability, as measured by the Emotional Availability Scales; Biringen, Robinson, & Emde, 1998) on infants' touching behaviours. The quality of the relationship was examined since depressed mothers are less emotionally available (Easterbrooks, Lyons-Ruth, Biesecker, & Carper, 1996) and respond less contingently during interactions (Cohn, Campbell, Matias, & Hopkins, 1990; Field, 2002). Moreover, they typically display one of two negative interactive styles. Intrusive depressed mothers are often over-stimulating during interactions, and withdrawn depressed mothers are under-stimulating (Cumings & Davies, 1994; Field, Healy, Goldstein, & Guthertz, 1990).

With respect to the first objective, infants of depressed mothers were expected to engage in more static touch during the SF period of the SF procedure relative to infants of non-depressed mothers. Previous research has demonstrated that infants of depressed mothers exhibit less motor activity and distress behaviours when their mothers are unavailable during the SF period compared to infants of non-depressed mothers (Field, 1984; Field et al., 2007; Fogel, Diamond, Langhorst, & Demos, 1982), and it has been suggested that their muted response to the SF is a result of their having been more frequently exposed to maternal emotional unavailability (Field, 1994, Field et al., 2007). Given that static touch is passive in nature, it was thus expected that infants of depressed mothers would be more likely to demonstrate this passive tactile behavior during the SF period.

In contrast, during the SP period of the SP procedure, when mothers were physically unavailable, infants of depressed mothers were expected to engage in more reactive touching behaviours (i.e. active types of touch, such as grab, pat, and pull; Moszkowski & Stack, 2007). Separation from mothers has been found to be stressful for infants, even in normative populations, since their primary source of stimulation and arousal modulation has been removed (Field, Vega-Lahr, Scafidi, & Goldstein, 1986), and infants must therefore rely on themselves to regulate affect and arousal (Field, 1985; Tronick, 1989; Tronick & Gianino, 1986). Given that infants develop their behavioural and physiological organization in the context of early mother-infant interactions (Field, 1985; Field, 1991), infants of depressed mothers are at a significant disadvantage with regard to the development of their regulatory capabilities (Field, 1994) since depression impairs mothers' abilities to regulate affect and behaviour and appropriately care for their

infants (Weinberg & Tronick, 1998). Thus, in infants of depressed mothers, physical absence may be even more distressing as they likely have fewer internal resources with which to self-regulate and organize their emotions.

Regarding the second objective, group differences were expected in maternal emotional availability. Since depressed mothers exhibit negative interactive styles (e.g. Field et al., 1990), they were expected to show less optimal sensitivity and structuring and more intrusiveness compared to non-depressed mothers, and their infants were expected to be less responsive. It was also expected that negative maternal emotional availability characteristics (e.g. intrusiveness, hostility) would predict regulatory types of touch (i.e. soothing or reactive), and that maternal depression would contribute additional variance to the prediction of infants' regulatory types of touch beyond negative maternal emotional availability characteristics.

Method

Participants

The participants were recruited prenatally through ultrasound clinics at the University of Miami School of Medicine in Miami, Florida, USA and were videotaped during interactions at 4 months of age. Forty-nine dyads participated in the current study. The mothers averaged 25.54 years (SD = 6.27), and their four-month old infants averaged 17 weeks. Eight dyads were excluded from the present analyses due to: 1) an obstructed view of the infants' hands on the videotape (n = 2), 2) mothers not following instructions (n = 4), or 3) excessive infant fussiness or crying (>50% of the time, n = 2). The final sample consisted of 41 dyads, including 21 male and 20 female infants. Of this final sample, 46% was Hispanic, 46% African American, and 7% Caucasian. Level of

maternal education varied, with the mean level of education being high school completion. The mothers were lower socioeconomic status ($M = 3.66$ on the Hollingshead; Hollingshead & Redlich, 1958).

Measures

Center for Epidemiological Studies Depression Scale (Radloff, 1977). Mothers completed this reliable and valid self-report questionnaire (Wells, Klerman & Deykin, 1987). The CES-D measures the number of depressive symptoms (e.g. depressed mood, feelings of guilt, worthlessness, and helplessness) over the past week on a scale ranging from "rarely" to "most of the time" (Radloff & Teri, 1986). In the current study, maternal depression was based on a cut-off score of 16 or greater. Twelve mothers were classified as depressed ($M = 22.08$; $SD = 4.12$) and 29 mothers were non-depressed ($M = 7.96$, $SD = 4.60$).

Procedure and Apparatus

The videotapes were made in the laboratory at the Touch Research Institute at the University of Miami Medical School when the infants were 4 months old. For these sessions the infants were securely fastened in an upright infant seat, positioned on a table at eye-level to their mothers. Mothers and infants were seated face-to-face, and they were separated from each other by a distance of 46 centimetres. Two cameras were positioned approximately 2 metres away from the dyad, and they were angled in such a way as to be in the periphery of their fields of vision. A split screen generator was used in order to capture the mother's face and torso on one side of the screen and the infant's entire body on the other side.

After the mothers completed demographic and self-report questionnaires, they

participated with their infants in six face-to-face interaction periods as described in Field et al. (2007). Three of these periods comprised the Still-Face procedure (SF; Tronick et al., 1978) and three consisted of the Separation procedure (SP; Field et al., 1986). The SF and SP procedures were presented in counterbalanced order and they were separated by a three-minute break.

The SF segment of the session consisted of two Normal interaction periods separated by a SF period. During the baseline and Reunion Normal interaction periods, mothers were instructed to play with their infants as they normally would at home. During the SF period, the instructions were to look at their infants while maintaining a still and neutral facial expression, and refraining from vocalizing and touching their infants. The SP procedure comprised two Normal periods separated by the SP period, where mothers were instructed to be physically unavailable to their infants by going behind a curtain and being completely out of their infants' view. All periods were 90 seconds in duration and were signalled with a knock on the one-way mirror by the research associate. Mothers were informed that they were free to terminate the session at any point if desired. Maternal compliance with instructions was verified prior to coding by previewing the video records and observing maternal behaviour during the normal and SF interaction periods.

Behavioural Coding, Dependent Measures, and Data Reduction

In the present study, the types and locations of infant touch were coded using the Infant Touch Scale (ITS; see below) and the functions of touch were coded using the Functions of Infant Touch Scale (FITS; see below). Moreover, dyads were assessed for the quality of the mother-infant interactions using the Emotional Availability Scales

(EAS; Biringen et al., 1998).

Of the 41 dyads participating in the current study who were included in the data analysis, coding of touch for all six interaction periods was only possible for 24 dyads. For the remaining 17 dyads, interactions were coded for only the SF (n = 5) or the SP (n = 12) procedure because: 1) infants were excessively irritable or fussy following the first procedure (n = 13), 2) mothers did not comply with the experimenter's instructions (n = 3), or 3) there were technical difficulties (n = 1). As such, only the first three periods of all interactions were used in the data analyses and perturbation period (i.e. SF or SP) was entered as a between-subjects factor in the mixed-design ANOVA.

The dependent measures for touch were the percent of the interaction period that the types, locations, and functions of touch were present. Percent duration was defined as the percentage of time infants used a particular touching behaviour within each 90-second period. Coding for the types, locations, and functions of touch was conducted for each second of the interaction (i.e. second-by-second coding). A Sony VTR/TV remote control with slow speed shuttle function was used for frame by frame slow motion viewing and in order to start and stop the videotape at each second of the interaction.

Coders were blind to the mothers' scores on the CES-D. Twenty percent of the sample was double-coded by a trained second coder who was also blind to the hypotheses of the present study. Inter-rater reliability was determined using kappa coefficients for the types ($k = 0.93$), locations ($k = 0.95$), and functions ($k = 0.90$) of infant touch.

Infant Touch Scale (Moszkowski & Stack, 2007). The types and locations of infant touch were determined using the Infant Touch Scale (ITS; Moszkowski & Stack, 2007). With this scale, infant touch was defined as infant initiated contact with a stimulus. If

mothers initiated contact with their infants' hands, infant touch was only coded if the infant actively moved his/her hand(s). If, however, the infant remained passive while in contact with his/her mother's hand(s), infant touch was not recorded. Contextual biases were minimized by coding without sound. Seven types of touch (static, stroke, grab, finger, mouth, pat, and pull) and eight locations of touch (face, mouth, hand, trunk, feet, mother, infant seat, infants' clothing) were coded. No touch was coded when infants did not use touch. (See Table 1 for operational definitions.)

Functions of Infant Touch Scale (Chiarella, Moszkowski, & Stack, 2007). The functions of infant touch were coded using the Functions of Infant Touch Scale (FITS; Chiarella, Moszkowski, & Stack, April, 2006). This coding scheme was partly based on the Functions of Touch Scale (FTS; Jean & Stack, June, 2007), an operational measure of the functions of maternal touch. Operational definitions for the FITS were based on the types of infant touch (as determined by the ITS), and infants' other expressive behaviours (e.g. gaze, affect, vocalizations, gesturing, posture) were used as cues in determining the functions of different types of touch. Eight functions of touch (solitary play, quiet acceptance, soothing/regulatory, reactive/regulatory, attention seeking, exploratory, regulatory/exploratory, dysregulated) were determined. (See Table 2 for operational definitions.)

Emotional Availability Scales (Biringen et al., 1998). Global ratings were made on the quality of the mother-infant interaction by using the Emotional Availability Scales (EAS). Emotional availability is a relational construct reflecting the ability of mothers and infants to effectively regulate their interactions (Emde, 1980) and taking into account the behaviour of both partners (Biringen, 2000). The EAS has robust short-term temporal

and cross-context reliability and continuity (Bornstein et al., 2006; Bornstein, Gini, Suwalsky, Putnick & Haynes, 2006). An adapted version of the EAS coding guidelines (Biringen et al., 1998; Carter, Little, & Garrity-Rokous, 1998) for very young infants and their parents was used. Global ratings of the emotional availability of mothers were given for each dyad for the four Normal interaction periods (i.e. the periods preceding and following the SF and the SP periods); ratings were assigned for each of the four Normal periods as mothers and infants may have differed in their emotional availability in each of these periods. Ratings were not provided during the SF and SP periods as mothers were not engaged in interaction. Mothers were rated for their levels of sensitivity (appropriately responding to infants' cues), structuring (guiding infants' play), hostility (overt or covert expressed hostility), and intrusiveness (degree of directiveness and overstimulation); infants were rated for their level of responsiveness (i.e. degree of engagement in interaction). Coding of the Emotional Availability Scales was carried out in real time by a trained coder who was blind to the hypotheses of the study and to mothers' risk classification. Intraclass correlation coefficients were calculated for the five emotional availability characteristics in order to determine reliability, and ranged between 0.84 and 0.97.

Results

The first objective of the present study was to examine group differences in touch using mixed-design analyses of variance (ANOVAs) for each dependent measure (Types, Locations, Functions of touch). Perturbation (i.e. SF or SP) was entered as a between-subjects factor for the Types and Locations analyses due to missing data for one out of the two procedures for 17 participants (n = 5 infants participated in the SF procedure

only; n = 12 infants participated in the SP procedure only). For those participants who had participated in both procedures (n=24), only data from the first procedure in which they participated was included in order to rule out order and fatigue effects (n=15 for infants who participated in the SF procedure first; n= 9 for infants who participated in the SP procedure first). The number of infants who participated in the SF procedure (n = 20) was roughly equal to the number of infants who participated in the SP procedure (n = 21).

Maternal depression was also entered as a between-subjects factor to assess group differences. Planned comparisons were conducted to isolate the source of any effects, and Bonferroni corrections were performed to reduce the occurrence of Type I errors. Eta-squared statistics (η^2) were conducted to examine effect sizes. According to Clark-Carter (1997), an η^2 of .01 is a small effect size, an $\eta^2$of .06 is a medium effect size, and an $\eta^2$of .14 or greater is a large effect size. Effect sizes for this study mainly fell in the moderate to large range.

The second objective of the study was to investigate the relationships between maternal emotional availability and depression and the touch variables. This objective was addressed using bivariate correlations and hierarchical multiple regressions. Some of the significant relationships that emerged through correlations were selected for further examination based on the theoretical and empirical questions of the study.

Objective 1: Effects of Maternal Depression on Infant Touch during Normal and Perturbed Interactions

SF and SP Effects through Touch. Before examining group differences, two mixed-design ANOVAs were conducted to assess for differences in the types and locations of touch during the SF and SP periods of the SF and SP procedures, an effect

previously demonstrated by Moszkowski and Stack (2007) for the SF procedure. A 7 (Types of touch) by 3 (Interaction Period) ANOVA,, with Perturbation (SF, SP) as the between subjects factor, and an 7 (Locations of touch) by 3 (Interaction Period) ANOVA, with Perturbation (SF, SP) as the between subjects factor, revealed significant interactions [F for types of touch (12, 468) = 14.7, $p < .01$, $\eta^2 = .3$; F for locations of touch (12, 468) = 24.0, $p < .01$, $\eta^2 = .4$]. Specifically, infants exhibited greater patting and pulling, and touching of the face/shoulder region, feet, and 'other' stimuli (e.g. infant seat, chair) during the SF and SP periods. In contrast, infants showed more static touch and spent more time touching their mothers during the Normal periods. These findings confirm the SF effect through touch, and also reveal a SP effect through touch. No differences were found between the SF and SP procedures.

Types of touch across periods. Before examining group differences in the types of touch, the eight individual types of touch were clustered together into regulatory function clusters (passive, soothing/regulatory, reactive/regulatory) in order to provide more meaningful categories. In line with previous research examining the regulatory role of infant touch (Moszkowski & Stack, 2007), the soothing cluster consisted of stroke, finger, and mouth, since it has been suggested that infants use these types of behaviours to soothe themselves during periods of distress (e.g. mouthing; Toda & Fogel, 1993). Previous research on the regulatory role of infant touch has also included another cluster, labelled reactive types of touch (Moszkowski & Stack, 2007). The reactive types of touch cluster represents more active regulatory behaviours, such as grab, pat, and pull, since it has been shown that infants attempt to physically distance themselves from their mothers through turning and twisting in the infant seat (i.e. patting and pulling) in order to

moderate their distress during the SF period (Gianino, 1985). The passive touch category was comprised exclusively of static touch since this type of touch involves no movement, and is therefore non-active in nature.

A 3 (Clusters of touch) by 3 (Interaction Period) mixed-subjects ANOVA was conducted with type of Perturbation and Maternal Depression group as the between subjects factors. As illustrated in Figure 1, a three-way interaction between Clusters, Period, and Maternal Depression groups was revealed, F (4, 144) = 2.5, $p < .05$, $\eta^2 = .06$. Post-hoc comparisons revealed that infants of non-depressed mothers used more static touch (M = 9.9%, SD = 7.6) than infants of depressed mothers (M = 3.1%, SD = 3.6; $p <$ .05), whereas infants of depressed mothers exhibited more reactive types of touch (M = 69.0%, SD = 21.3) compared to infants of non-depressed mothers (M = 42.9%, SD = 22.9, $p < .05$). Results also revealed that infants of non-depressed mothers tended to exhibit more soothing types of touch during periods of unavailability compared to infants of depressed mothers, and that infants of depressed mothers exhibited more reactive types of touch in the First Normal period compared to infants of non-depressed mothers[3]. Taken together, these findings suggest that infants of depressed mothers were more active in response to maternal unavailability (i.e. using patting, pulling, and grabbing behaviours), suggesting that they were less able to self-sooth. In contrast, infants of non-depressed mothers were more passive and nurturing in their tactile behaviours during maternal unavailability, suggesting that they used touch to self-regulate during these periods.

INSERT FIGURE 1 ABOUT HERE

Locations of touch across periods. Differences in the locations of touch as a function of Maternal Depression group and Interaction Period were examined next. All locations on the body on which infants could touch themselves were combined into one cluster labelled S*elf.* A 3 (Self, Mom, Other) by 3 (Interaction Period) by 2 (Maternal Depression group) by 2 (Perturbation) mixed-design ANOVA was conducted. The *Other* cluster included touching of the infant seat and infants' clothing. A triple interaction between Locations of touch, Period, and Maternal Depression group emerged, F (4, 144) = 3.5, $p < .05$, $\eta^2 = .09$. Post-hoc comparisons revealed the following differences: infants of non-depressed mothers spent more time using self-touch during the Perturbation periods (M = 52.1%; SD = 27.4; M for other touch Perturbation = 38.9, SD = 28.6; M for other touch First Normal = 16.71, SD = 19.0), whereas infants of depressed mothers spent more time touching 'other' stimuli in their close surroundings during the Perturbation and First Normal periods (M perturbation = 72.1%, SD = 21.7; M First Normal = 34.5%, SD = 26.9; M for self touch = 21.8, SD = 15.4).[4] These results are illustrated in Figure 2 and suggest differences in the locations of touch between groups.

INSERT FIGURE 2 ABOUT HERE

In order to clarify the relationship between the locations used and the regulatory types of touch in infants of depressed and non-depressed mothers, bivariate correlations were carried out. For the depressed group, touching of 'other' was significantly positively correlated with reactive types of touch ($r = 0.9, p < 0.001$) and negatively correlated with static touch ($r = -.80, p < 0.001$) during the perturbation period. For the non-depressed group, self-touch correlated positively with soothing types of touch ($r = .80, p < 0.001$) and negatively with reactive types of touch ($r = -.80, p < 0.001$).

Functions of touch across periods. Since differences in the *types* and *locations* of touch in infants of depressed and non-depressed mothers did not emerge between the two Perturbation periods, an analysis was carried out to address whether differences emerged in the *functions* of touch between periods of maternal emotional versus physical unavailability (e.g. SF versus SP period) [1]. No differences emerged between groups. However, a two-way repeated-measures ANOVA (9 Functions of touch X 2 Interaction Period) collapsed across the two groups of infants of depressed and non-depressed mothers revealed an interaction between Functions of touch and Period, $F(8, 184) = 2.2$, $p < .05$, $\eta^2 = .09$. As illustrated in Figure 3, infants were more likely to use solitary play touch (i.e. using touch to play alone) during the SF period (M for the SF = 9.7%, SD = 11.5; M for the SP = 0.6%, SD = 1.6) whereas they were more likely to use reactive touch (self-regulation through active touch; M for SP = 25.0%, SD = 17.3, M for SF = 16.1%, SD = 12.2) and dysregulated touch (touch accompanied by fussing or crying; M for SP = 8.1%, SD = 14.9, M for SF = 2.1%, SD = 4.9) during the SP period. These findings suggest that maternal physical unavailability was more distressing to infants than maternal emotional unavailability.

INSERT FIGURE 3 ABOUT HERE

Objective 2: The relationship between maternal Emotional Availability (EA) and depression, and infants' tactile behaviours across interaction periods

The EA variables were examined during the Normal interaction periods before and after the SF and SP periods since the quality of the interactions could only be rated when both partners were available and engaged. Significant differences in the EA characteristics did not emerge as a function of maternal depression. Nevertheless, significant differences on the five EA dimensions were revealed between the Normal periods of the SF relative to the SP procedure. Five 4 (Interaction Period) by 2 (Perturbation) mixed-design ANOVAs revealed the following: mothers were more sensitive and structured more during the Normal periods of the SP (M = 6.9, 4.1%) compared to the Normal periods of the SF procedure (M = 5.5, 3.1%; F sensitivity (1, 28) = 3.7, $p < .06$, F structuring (1, 28) = 4.9, $p < .05$), whereas mothers were more intrusive during the SF (M = 2.0%) compared to the SP procedure (M = 1.2 %; F (1, 28) = 5.49, $p < .05$). No differences emerged between the SF and SP procedures for maternal hostility and infant responsiveness. For descriptive date on the EA variables, see Appendix J (Tables J12 and J14).

In addition to these differences in maternal sensitivity, structuring and

intrusiveness between the SF and SP procedures, it is important to note that mothers and infants demonstrated higher overall percentages of non-optimal behaviour (See Table 3) than typically noted in EAS distributions described in the literature (e.g. Aviezer, Sagi, Joels & Ziv, 1999[2]). Non-optimal maternal sensitivity, indicating maternal passivity in response to infants' cues, was displayed by 27% to 34% of mothers across the four Normal periods (scores of 1-4 on the EAS); these ranges represent the variations in the percentage of mothers exhibiting non-optimal sensitivity during the Normal periods preceding and following the SF period and the SP period. Moreover, moderate sensitivity, referring to flat mood and low interaction quality was displayed by 13 to 27% of mothers (scores of 4.5-6.5). Inconsistent structuring, which refers to maternal passivity and lack of support at various points during the interaction, was displayed by 62.5% to 68% of mothers (scores of 1-4). Elevated levels of intrusive behaviour, such as over-stimulating infants and leaving little room for infant exploration, was displayed by 16% to 25% of mothers (scores of 2.5-5). Moreover, 10% to 21% of mothers exhibited mild intrusiveness (scores of 1.5-2). Finally, high levels of hostility, referring to maternal displays of impatience and anger towards infants, were displayed by 2.5% to 5% of mothers (scores of 2.5-5); while, 3% to 10% of mothers exhibited minor hostility levels (scores of 1.5-2).

In observing the frequency distributions for infant behaviour across the four Normal periods, 47.5% to 73% of infants were rated as low on Infant Responsivity (scores of 1-4), suggesting that a majority of the infants in this sample expressed little positivity or pleasure during their interactions. They accepted few parental bids for attention and tended to avoid the interaction through their unresponsive behaviour. Ten

and a half percent to 30% of infants were only moderately responsive (4.5-5.5). The percentage of infants who were rated poorly on this dimension is extremely high in comparison with the distribution of scores typically assigned in previous studies (e.g., in Aviezer et al.'s 1999 study, only 9% of infants exhibited low responsiveness).

□ □ □ □ □ □ □ □ □□ □

INSERT TABLE 3 ABOUT HERE

Predicting infants' touching behaviour from maternal EA and depression. Hierarchical regressions were carried out for the Reunion Normal periods of the SF and SP procedures to clarify the relationships between maternal EA, depression and touch following periods of maternal emotional and physical unavailability. Specifically, negative EA dimensions (e.g. intrusiveness, hostility) were examined for their ability to predict soothing and reactive types of touch during the Reunion Normal periods in order to investigate the impact of sub-optimal maternal emotional availability on infants' regulatory tactile behaviours. Maternal intrusiveness and hostility were selected as predictors since depressed mothers have been found to exhibit negative interaction styles (e.g. over-intrusive; Field et al., 1990). Soothing and reactive types of touch were selected as outcome variables in order to investigate infants' regulatory tactile behaviours following maternal unavailability.

To maximize power for each regression analysis, the number of predictors was kept to a maximum of three. Intercorrelations were conducted to ensure that the predictors were not significantly related to each other (Tabachnick & Fidell, 2001).

Predictors were entered in the following order: the EA variable was entered in Step 1, followed by Maternal Education, which was entered as a control variable in Step 2. In Step 3, maternal Depression was entered to assess whether it provided additional unique variance in infant touching behaviours. In Step 4, interaction terms between the different predictors were entered to rule out their effects on the outcome variable under investigation. Since none of the interaction terms were significant, they were subsequently dropped from the analyses. Regression tables are presented in Appendix K (see Tables K1 to K4).

Two regressions examined variables predicting Soothing types of touch during the Reunion Normal periods. In the first regression, maternal Intrusiveness, Education, and Depression were entered as predictors during the Reunion Normal period following the SF period. The total variance accounted for was 57.5% (50.5% adjusted; $F = 8.1, p < 0.001$). Maternal Intrusiveness was the only significant predictor (Step 1: $\beta = .7, p < .05$; $R^2_{ch} = 0.5$), even when Education was entered in Step 2 (β for Intrusiveness = $.7, p < .05$; $R^2_{ch} = 0.02$), and Depression was entered in Step 3 (β for Intrusiveness = $.8, p < .05$; $R^2_{ch} = 0.01$). None of the predictors emerged as significant during the Reunion Normal period following the SP period. These findings suggest that when mothers were highly intrusive, infants were more likely to engage in soothing types of touch, but only during the Reunion Normal following maternal emotional unavailability (i.e. SF).

Two regressions examined variables predicting Reactive types of touch during the Reunion Normal periods. Maternal Hostility was entered as a predictor for these regressions given its significant correlation with Reactive types of touch. Although none of the predictors emerged as significant during the Reunion Normal following the SF

period, the total variance accounted for during the Reunion Normal following the SP period was 38.4% (27.5% adjusted; $F = 3.5, p < 0.05$). In Step 1, Hostility was significant ($\beta = .5, p < .05$; $R^2_{ch} = 0.21$). In Step 2, maternal Education approached significance as a predictor ($\beta = .4, p < .06$), and Hostility remained significant ($\beta = .5, p < .05$; $R^2_{ch} = 0.15$). In Step 3, when Depression was added, only maternal Hostility ($\beta = .5, p < .05$) and Education ($\beta = .4, p < .05$) were significant ($R^2_{ch} = 0.02$). These findings imply that infants of mothers with higher education and high levels of hostility were more likely to engage in active regulatory types of touch (e.g. patting, pulling, grabbing) following maternal physical unavailability.

Discussion

The present study examined the touching behaviours of 4-month-old infants during normal and perturbed interactions. While many of the hypotheses were supported, some results were contrary to predictions.

The primary unexpected finding was the particularly low ratings assigned to dyads on the EAS. These EAS ratings appear to be lower than the percentages documented in the literature (e.g. Aviezer et al., 1999). One third of mothers exhibited moderate to elevated levels of intrusiveness, and half to two thirds of mothers displayed poor sensitivity and sub-optimal structuring during the interactions. Moreover, up to three quarters of infants exhibited low responsiveness, which is particularly striking since responsiveness is an indicator of willingness to engage in interaction. Infants' low responsiveness was associated with mouthing and reactive types of touch, suggesting that rather then turning to their mothers for stimulation, most infants in the present study engaged in soothing and reactive regulatory tactile behaviours.

In line with expectations, infants in the present study displayed changes in their touching behaviours according to variations in mothers' availability across periods. These results replicated earlier research demonstrating changes in infant touch as a function of the SF period, but this time in an at-risk depressed/non-depressed sample (Moszkowski & Stack, 2007; Murray & Trevarthen, 1985; Toda & Fogel, 1993). Findings also revealed that infant touch changed as a function of the SP period. Specifically, results revealed that infants spent more time touching their faces and shoulders, their feet, the infant seat and their clothes during both perturbation periods compared to the Normal periods. Infants also engaged in more reactive (e.g. patting, pulling, and grabbing) types of touch during the SF and SP periods, implying that infants' used active types of touch to self-regulate when mothers were physically or emotionally unavailable.

Although no differences were found in the individual types and locations of touch between the SF and SP periods, differences were revealed in the functions that touch served. Infants spent more time engaged in solitary playful touch during the SF period, whereas they engaged in more reactive and dysregulated touch during the SP period. In contrast to our original hypothesis and previous work in this area (e.g. Field et al., 1986), these results imply that maternal physical unavailability was more distressing to infants than maternal emotional unavailability, at least as manifested by their touching behaviours.

Our findings may differ from previous studies comparing the SF and SP due to the distinct samples used. In the current at-risk sample, a majority of the interactions were characterized by poor EA and low infant responsiveness, in addition to the fact that 12 of the 41 mothers were classified as depressed. Thus, it may be that infants in the current

sample were more accustomed to maternal emotional unavailability, responding to the SF period in a muted fashion. This interpretation is consistent with Field et al.'s (2007) observations of other non-touch behaviours on the same data base where infants of depressed mothers were found to exhibit less distress during the SF period. Future research comparing the responses of normal and at-risk infants to the SF and SP procedures should be carried out to confirm this hypothesis.

Despite the lack of differences between infants of depressed and non-depressed mothers in the functions of touch, infants of depressed and non-depressed mothers differed in the types and locations of touch they used. During the perturbation periods, infants of non-depressed mothers used more static touch whereas infants of depressed mothers exhibited more reactive types of touch, suggesting that the latter group is more active in response to maternal unavailability. With respect to the locations of touch, infants of depressed mothers exhibited more 'other' touching (i.e. their clothes, the infant seat), and infants of non-depressed mothers displayed more self-touch. These findings support an interpretation of greater distress in infants of depressed mothers since their 'other' touching was positively correlated with reactive types of touch and negatively correlated with soothing types of touch during the perturbations. Based on these results, it also seems that infants of depressed mothers are less able to self-soothe during periods of distress.

While greater distress in infants of depressed mothers is consistent with Weinberg and Tronick's (1998) study of ill mothers (i.e. mothers exhibiting depression or anxiety), these results differ from research demonstrating that the SF period is *less* distressing for infants of depressed compared to non-depressed mothers (Field, 1984; Field et al., 2007;

Fogel et al., 1982). The low ratings on EA assigned to our entire sample may account for these differences. Or, the discrepancies in findings may be due to the fact that touch was examined for both periods of unavailability combined[3]. In fact, the SP appeared to be more distressing for infants in this study, and the greater level of distress experienced during the SP procedure may have further contributed to the differences in touching between infants of depressed and non-depressed mothers. Although infants experiencing greater distress during the SP appears to contradict research carried out using a similar sample (e.g. Field et al., 2007), the finding in Field et al.'s (2007) study was specific to the infants of depressed mothers and it was in comparison to their behaviour during the SF period. Moreover, the differences in the samples between the current study and Field et al.,'s study may account for these variations in results.

Results to this point made it difficult to isolate the particular contribution of maternal depression and the distinct dimensions of EA during the SF and SP procedures. It was therefore important to examine the relationships between these variables and infant touch. Findings from the Reunion Normal periods revealed that negative EA dimensions (e.g. intrusiveness, hostility) predicted regulatory tactile behaviours following both the SF and SP periods, but that depression did not add unique variance. Whereas, maternal intrusiveness predicted more adaptive regulation (i.e. soothing types of touch) in the Reunion Normal following the SF period, maternal hostility predicted active tactile regulation (i.e. reactive types of touch) in the Reunion Normal following the SP period. The finding that hostility predicted reactive, as opposed to soothing types of touch suggests that infants may have more difficulty self-regulating when interacting with mothers who exhibit hostility as opposed to intrusiveness. Previous research has

demonstrated that maternal hostility is associated with infants' difficulty in regulating their emotions during an emotional challenge (Little & Carter, 2005). Given the small sample size in the current study, these findings warrant replication.

Taken together, findings from this study makes a unique contribution in revealing the influence of maternal risk on infants' touching behaviours: maternal hostility and intrusiveness appear to differentially predict infants' self-regulation through touch following maternal unavailability, and maternal depression also appeared to have a negative impact on infant touching behaviours. As such, this study lays the groundwork for future research in this area, carrying important implications for the impact of maternal risk on infant socio-emotional development through its effects on touch during social interactions.

Footnotes

[1] Perturbation was not included as a between-subjects factor for the analyses on functions of touch. Functions were only examined during the Perturbation periods on participants who had participated in both procedures in order to directly compare the functions of touch during the SF and SP periods. Thus, Perturbation was a within-subjects factor for this analysis.

[2] In Aviezer et al. (1999), the sample was described as healthy and low risk. This sample was comprised of 93% of mothers who were highly sensitive, and two thirds of mothers who exhibited optimal structuring. No mothers exhibited overt or covert hostility.

[3] Since infants of depressed versus non-depressed mothers differed in their reactive types of touch during the First Normal period, an ANCOVA was carried out to ascertain whether the differences in infants' touching behaviours during the perturbation periods were due to the differences in their reactive types of touch during the First Normal period. A 3 (Clusters of touch) by 2 (Interaction Period) by 2 (Perturbation) by 2 (Maternal Depression group Classification) mixed-design ANCOVA was conducted, with Reactive types of touch during the First Normal period entered as a covariate. Consistent with the original ANOVA, results revealed a 3-way interaction between Clusters of touch, Interaction Period, and Maternal Depression group. Pairwise comparisons demonstrated that infants of depressed mothers exhibited more reactive types of touch than infants of non-depressed mothers during the perturbation periods, whereas infants of non-depressed mothers displayed more passive types of touch than infants of depressed mothers during the perturbation periods. As these results were the same as the original ANOVA, the original results are reported in the text.

[4] An ANCOVA was also carried out for the clusters of the locations of touch since infants of depressed and non-depressed mothers differed in their amount of touching 'other' during the First Normal period. Results of the ANCOVA were the same as the original ANOVA; thus, only findings from the original ANOVA are reported in the text.

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Table 1

Coding Criteria for the Infant Touch Scale (Moszkowski & Stack, 2007)

Type of Touch	Brief Description
Static	Hand remains still while in contact with a stimulus.
Rub/Caress/Wipe/Stroke	Lateral finger movement (back and forth or in circular motion), often repetitive. If just tip of finger is moving, finger category is used.
Grasp/Clutch/Clasp	Curling of fingers around a stimulus.
Finger/Manipulate/Scrumble	Running the tip of the fingers over a surface, often in random fashion.
Mouth	The hand/finger(s) come in contact with the mouth.
Pat/Tap	Up and down motion of the hand against a surface.
Pull/Push/Lift/Poke/Prod	Raising/lowering of a stimulus, or exerting pressure against an object.
Face/Head/Shoulder/ Neck	Touching of any part of the face or neck/shoulder region with the exception of the mouth.
Mouth	Touching of the inside or outside of the mouth.
Hand/Arm	Touching of the hands, fingers, or arms up until the shoulders.
Trunk	Touching of the chest and stomach region.
Feet/Leg	Touching of the legs, feet, or toes.
Mother	Touching of any part of the mother.
Other (chair, clothes)	Touching of the infant seat, belt or blanket. Or, touching

Type of Touch	Brief Description
	of any clothes or footwear worn by the infant; if the infant is also touching a body part while touching their clothes, the body part is coded and not their clothes.

Note. Published in its original, extended version as Table 1 in Moszkowski and Stack (2007).

Table 2

Coding Criteria for the Functions of Infant Touch Scale (Chiarella et al., 2007)

Category	Brief Description
Solitary Play	Infant is playing by him/herself while gazing at mother, with neutral or positive affect/vocalizations.
Quiet Acceptance	Infant remains passive while gazing at mother, with neutral or positive affect/vocalizations.
Soothing-Regulatory	Infant calming himself through soothing types of touch (e.g. mouthing, stroking) while gaze is away/distal from mother, with neutral to negative affect.
Attention-seeking	Infant is trying to regain his/her mothers' attention through active types of touch or gesturing, while gazing at mother.
Reactive-Regulatory	Infant self-regulating by actively touching him/herself or his/her surroundings (e.g. pulling, patting, grasping) while gaze is away/distal from mother, with neutral to negative affect and vocalizations.
Exploratory	Infant is exploring him/herself or his/her surroundings through active forms of touch while gaze is proximal/at self, with neutral to positive affect and vocalizations.
Regulatory Exploratory	Infant is exploring himself through touch, while exhibiting negative affect and vocalizations.
Dysregulated	Infant is crying while using any type of touch.

Table 3

Distributions for the Mean Percent Duration for the Dimensions of the Emotional Availability Scales (EAS) as a Function of Period (First Normal or N1 of the SF and SP; Reunion Normal or RN of the SF or SP)

	Periods			
Dimensions EAS	N1 of SF	RN of SF	N1 of SP	RN of SP
Maternal Sensitivity				
Low (1-4)	30.0%	27.3%	27.5%	34.2%
Moderate (4.5-6.5)	17.5%	27.3%	15.0%	13.2%
Optimal (7-9)	52.5%	45.5%	57.5%	52.6%
Maternal Structuring				
Low (1-4)	62.5%	63.6%	65.0%	68.4%
Optimal (4.5-5)	37.5%	36.4%	35.0%	31.6%
Maternal Intrusiveness				
Non (1)	62.5%	60.6%	65.0%	63.2%
Some (1.5-2)	15.0%	15.2%	10.0%	21.1%
High (2.5-5)	22.5%	24.2%	25.0%	15.8%
Maternal Hostility				
Non (1)	87.5%	93.9%	87.5%	86.8%
Some (1.5-2)	7.5%	3.0%	10.0%	7.9%
High (2.5-5)	5.0%	3.0%	2.5%	5.3%
Infant Responsiveness				
Low (1-4)	55.0%	54.5%	47.5%	73.7%
Moderate (4.5-5.5)	25.0%	27.3%	30.0%	10.5%
Optimal (6-7)	20.0%	18.2%	22.5%	15.8%

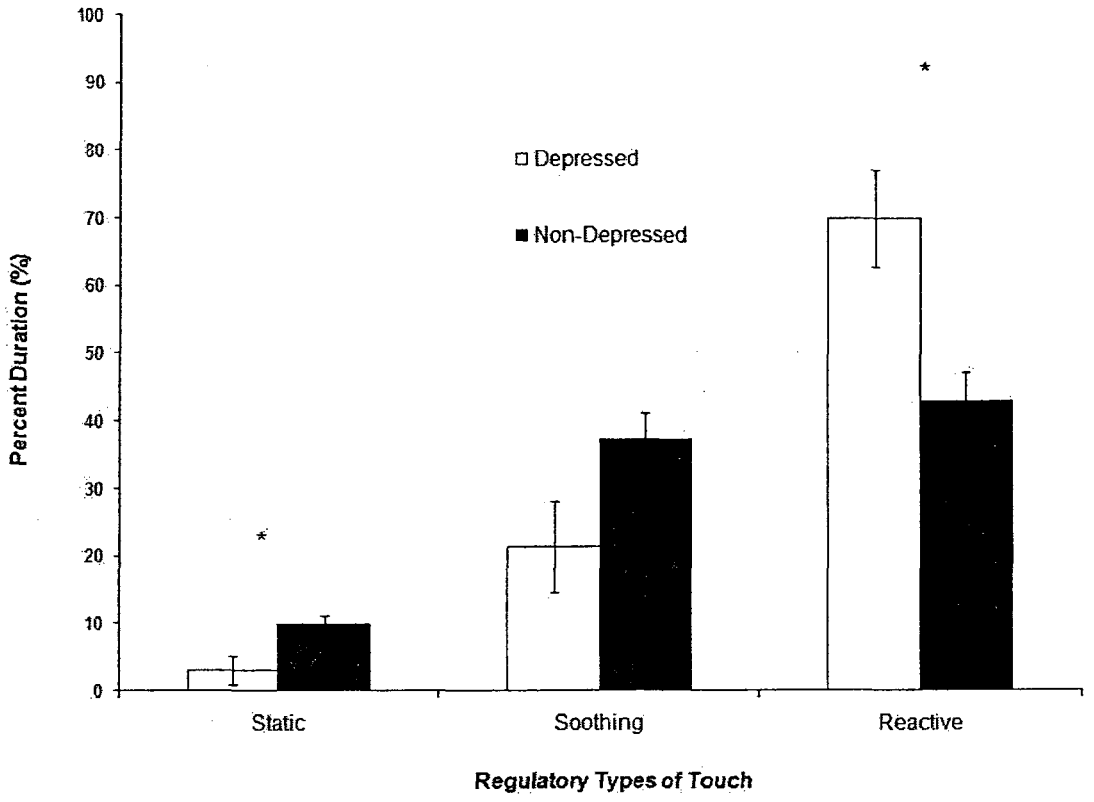

Figure 1. The mean percent duration of regulatory types of touch (static, soothing, reactive) during the perturbation periods in infants of depressed/non-depressed mothers. Standard errors are shown by vertical bars.

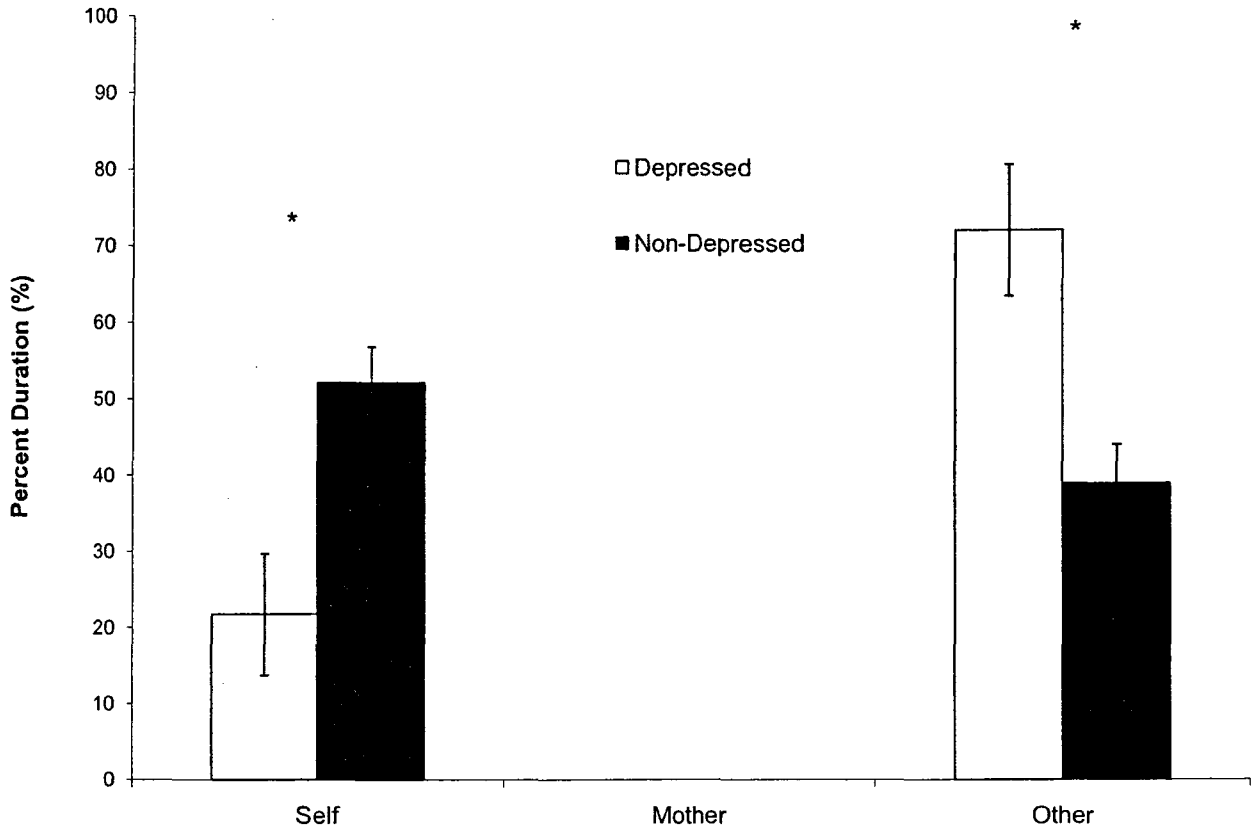

Figure 2. The mean percent duration of locations of touch (self, mother, other) during the perturbation periods in infants of depressed/non-depressed mothers. Standard errors are shown by vertical bars. Note that infants could not touch their mothers during the perturbation periods as they were unavailable. As such, the mean percent duration of touching mother during the perturbation periods was 0% for both the depressed and non-depressed groups.

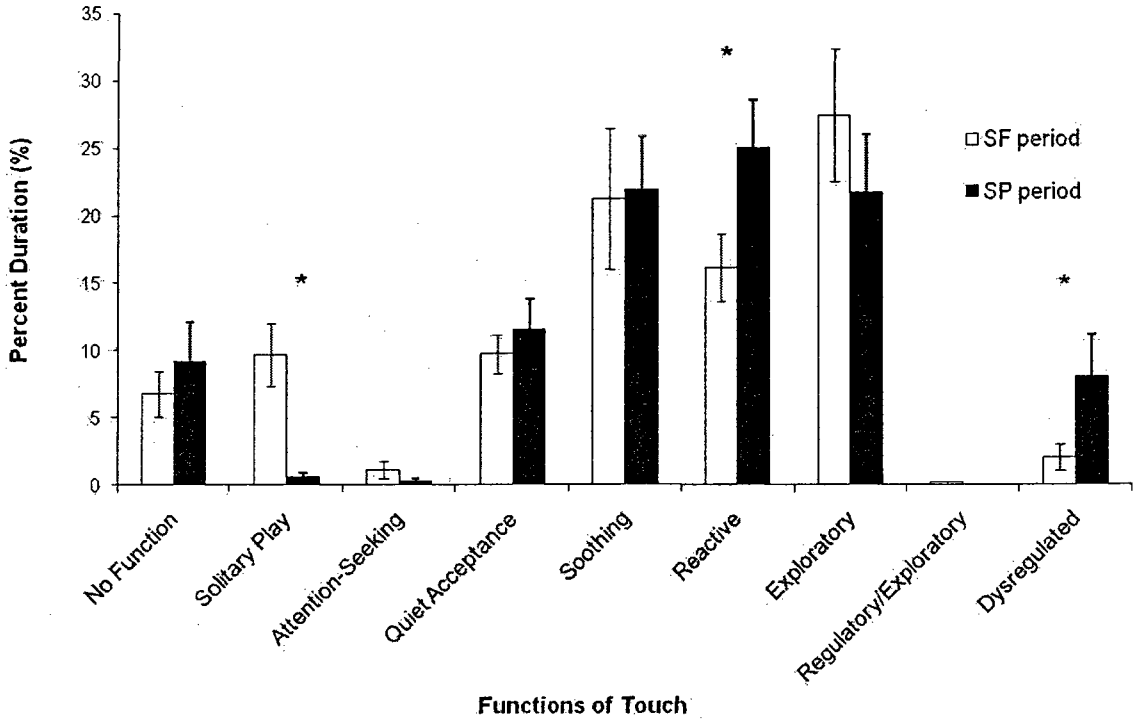

Figure 3. The mean percent duration of functions of touch across periods of maternal unavailability (SF and SP). Standard errors are shown by vertical bars.

Chapter 4: General Discussion

The present dissertation was comprised of a series of two studies that contribute to our understanding of infants' touching behaviours during early mother-infant interactions, by elucidating the communicative, regulatory, and exploratory roles of touch during early infant socio-emotional development. The first study investigated touch in the context of other infant non-verbal behaviours in order to demonstrate how touch co-occurs with gaze and affect during social exchanges. Findings revealed seemingly organized relationships of non-verbal behaviour that varied across interaction periods, suggesting that the messages infants convey through touch are elaborated through co-occurring behaviours in other modalities to create meaningful affective displays. Moreover, this study made an important contribution by operationally defining and systematically investigating the functions of infant touch during social interactions. The functions of touch varied across interaction periods, demonstrating that infants use touch to engage in playful interaction when mothers are available whereas they use touch to cope (i.e. regulate, explore) during periods of maternal unavailability. Finally, results from this study also provided an essential first step in revealing how the quality of the mother-infant relationship (i.e. emotional availability indicators) impacts on the functions of touch: infants who interacted with optimally sensitive mothers demonstrated greater engagement through touch.

Building on Study 1, Study 2 examined infants' touching behaviours as a function of changes in maternal availability and the quality of the relationship. Results from Study 2 add to the growing knowledge of the types, locations, and functions of touch during interactions, providing greater insight into the communicative, regulatory, and

exploratory roles of infant touch. Study 2 supported findings from Study 1 that variations in maternal emotional availability and the quality of the relationship impact on infants' touching behaviours. Yet, in addition to corroborating these findings, Study 2 made its own independent contribution by investigating the effects of different types of maternal unavailability (i.e. emotional, physical) on infants' touching behaviours. Moreover, this examination was uniquely carried out using an at-risk sample of depressed and non-depressed mothers and their infants. Findings revealed greater distress in infants in response to physical unavailability. Moreover, despite a small sample size, infants of depressed mothers tended to engage in more reactive/regulatory types of touch, suggesting less adaptive coping in comparison to infants of non-depressed mothers. Finally, results from Study 2 revealed that poor relationship indicators (e.g. maternal intrusiveness, hostility) are important predictors of regulatory types of infant touch. Taken together, results from Study 2 underscore the impact of maternal risk (e.g. depression, sub-optimal emotional availability) on infants' touching behaviours, with implications for their communicative and regulatory abilities during early socio-emotional development.

SF and SP effects through touch: Infant communication through touch

The changes in infants' touching behaviours across periods of the SF and SP procedures underscore that infants are sensitive to the availability/unavailability of their social partners. As such, these findings support at least one explanation regarding the distress infants exhibit during the SF period (i.e. SF effect), which is that they are attuned to violations of social expectations of reciprocity (Adamson & Frick, 2003; Tronick, 2003). Consistent with previous investigations of infants' tactile behaviours during the SF

procedure (e.g. Moszkowski & Stack, 2007; Murray & Trevarthen, 1985; Toda & Fogel, 1993), infants in both studies exhibited greater reactive types of touch, and engaged in more exploratory and regulatory functions of touch during periods of maternal unavailability. These results also support the Mutual Regulation Model (MRM) explanation of the SF effect that infants are active interactors who are forced to use their own resources when mothers are not available as external regulators during the SF period (Gianino & Tronick, 1988; Tronick, 2003). As the MRM model has recently been expanded into the DEC hypothesis, it is important to also consider the results according to this explanation. The DEC hypothesis relies on the systems theory principle that the failure to acquire resources during interactions (such as when mothers are unavailable) results in disorganization and a lack of coherence during the SF period (Tronick, 2003). While the results can be viewed as consistent with this theory, the current research does not specifically address the tenets of the DEC hypothesis. Future work on this comparatively new explanation of the SF procedure should be carried out in order to clarify how infants' responses during the SF period may or may not be consistent with this theory. Results from the present studies nevertheless imply that the well documented SF signature (i.e. decreased smiling and gaze at mother, increased neutral to negative affect; Adamson & Frick, 2003) should necessarily include infants' touching behaviours.

The current research extends previous research on touch during social interactions by demonstrating that infants are also sensitive to maternal *physical* unavailability as displayed during the SP procedure. Results from Study 2 showed that infants exhibited more reactive types of touch during the SP compared to the Normal periods, suggesting that infants respond to maternal physical unavailability in an active manner through

touch. Differences in infants' touching behaviours during the SP period are consistent with prior research, which has demonstrated differences in infants' distal behaviours during the SP period and implied a SP effect (Field et al., 1986). Study 2's findings on touch therefore emphasize that future work examining infants' response to maternal physical unavailability should include an investigation of infant touch.

In addition to highlighting the importance of touch during maternal physical unavailability, Study 2 provided an important comparison of infants' responses to *emotional* versus *physical* unavailability. Although no differences emerged between the types and locations of touch between the SF and SP periods, differences were noted in the functions of touch. Specifically, infants appeared to be more distressed during the SP relative to the SF period, as manifested by their greater use of reactive and dysregulated functions of touch during this period.

That infants in the current study exhibited greater distress during physical unavailability contrasts with previous research where infants have responded more negatively to *emotional* unavailability (e.g. Field et al., 1986). The different samples used may account for these inconsistencies. Whereas Field et al. (1986) used a normative sample, the sample in the present research was at-risk (i.e. mothers were depressed and non-depressed and exhibited poor EA characteristics). Infants of depressed mothers frequently encounter their mother's emotional unavailability. As such, their comparatively more muted response to the SF may have been a result of their having become accustomed to this form of maternal behaviour (Field, 1994). Alternatively, infants in Study 2 may have become more distressed and aroused during the SP period because they have a history of interacting with mothers who exhibit negative behaviours

(e.g. Cohn, Matias, Tronick, Connell, Lyons-Ruth, 1986; Cohn et al., 1990; Stanley et al., 2004). As infants develop their communicative and regulatory skills during interactions with their mothers (Cohn & Tronick, 1989; Kaye, 1982), and depression impairs mothers' abilities to appropriately interact with their infants (e.g., Murray & Cooper, 1997), infants of depressed mothers may have thus developed fewer internal resources with which to cope with the stress of maternal physical absence in an unfamiliar laboratory setting. It is difficult to compare the present results with Field et al.'s (1986) study, as different measures were used. Study 2 of the present dissertation focused on infant touch, however touch was not examined in Field et al. (1986)'s study where infants' distal modalities (e.g. gaze, affect) were examined. The different infant behaviours investigated may thus also explain the inconsistencies in infants' responses to maternal unavailability. Future research comparing the reactions of normal and at-risk infants to the SF and SP procedures, including infant touch as a measure, should be carried out to clarify our understanding of infants' responses to different forms of unavailability.

The fact that differences between perturbation periods emerged only when examining the functions of touch underscores the importance of investigating touch in the context of infants' other communicative modalities. In line with previous suggestions (Hertenstein, 2002; Jean & Stack, 2008; Jean et al., 2008; Stack, 2001), the functions of touch in the current research were determined by taking into account infant gaze, affect, posture, and vocalizations. This examination thus provided additional information regarding infants' underlying affective states that could not be determined through the coding of types or locations of touch alone. Research on maternal touch also supports an

integrated approach to the study of touch in order to capture changes in maternal touch in response to infants' affective behaviour. Moreover, since the same type of touch may have a different meaning depending on the context, studying the functions of touch thereby elucidates the communicative properties of touch (Jean & Stack, 2008).

The importance of investigating *infant* touch in the context of their other modalities (i.e. the functions of touch) was also highlighted in the current research through the carry-over effect from the SF to the Reunion Normal period that was demonstrated in Study 1. More specifically, Study 1 revealed more dysregulated functions of touch in the Reunion Normal period compared to the first Normal period. However, it is important to note that a carry-over effect was not revealed in Study 1 when examining types of touch in isolation. A carry-over effect was also not found in a previous study using the same sample that studied infant touch alone (e.g. Moszkowski & Stack, 2007). As such, the current research emphasizes the importance of examining infant touch in combination with multiple channels of communication, while also supporting the documented carry-over effect in the SF procedure (e.g. Cohn, 2003; Weinberg & Tronick, 1996).

Touch and non-verbal behaviour: The communicative role of touch

By investigating touch in the context of infants' other non-verbal communicative behaviours, the current series of two studies elucidates the communicative role of touch during early social interactions with variations in maternal availability. In particular, Study 1 addressed how infant touch is organized with gaze and affect through its investigation of how these behaviours co-occur across periods of the SF procedure. In line with previous research on the co-occurrence of infants' *distal* non-verbal

communicative behaviours (e.g. Symons & Moran, 1987; Weinberg & Tronick, 1994), results revealed meaningful displays that varied with changes in maternal availability. The co-occurrence of infants' behaviours across modalities serves to enhance and clarify the messages infants convey to their caregivers, thereby increasing the chances that caregivers will appropriately interpret and respond to these messages (Weinberg & Tronick, 1994). Moreover, that infant behaviours combine in an organized way underscores that studying isolated behaviours does not capture the complexity of infants' responses during face-to-face interactions, such as the SF and SP procedures (Symons & Moran, 1987).

Exhibiting organized behavioural configurations that vary across interactive contexts strengthens the view that infants are communicative during pre-verbal development (Cohn & Tronick, 1989; Kaye, 1982; Kaye & Fogel, 1980). By altering their *tactile* behaviours in conjunction with distal modalities across periods, infants are imparting information regarding their underlying affective states, needs and goals (Moszkowski & Stack, 2007). These findings are consistent with a functionalist perspective of communication, which argues that tactile communication does not depend on intention or the ability to interpret any such intention (Hertenstein, 2002). Rather, modifications in infants' tactile behaviours occurring as a function of interactive context implies that touch is being used to communicate. In addition, by varying their tactile behaviours alongside other channels of communication and as a function of maternal availability, these findings support the functionalist argument that infants' emotions serve to organize their behaviours during transactions with the environment (Barrett & Campos, 1987; Thompson, 1993).

That infants are communicating through touch during their early social interactions strengthens the view that infants are active participants during their early social exchanges (Adamson & Frick, 2003; Cohn, 2003). Moreover, by highlighting their active involvement in social exchanges, the current research supports a dynamics systems perspective of interactions where each interactive partner is believed to exert an influence over the behaviour of the other through ongoing changes in their affective displays (Fogel, 1993; Hsu & Fogel, 2001; Kuczynski, 2003). The bi-directionality of mother-infant interactions is especially apparent in the current research given the focus on touch. Although examining only *infants'* tactile behaviours, touch is a relational modality and it is bi-directional since touching a social partner necessarily involves the sensation of being touched (Merleau-Ponty, 1962). Thus, when infants touched their mothers, they were actively contributing to their ongoing dynamic social exchanges. Moreover, the particular type of touch used likely altered the dynamics of the interaction (e.g. reactive touches may have increased the intensity of play).

In order to further unravel the bi-directional contribution of infant touch during interactions, future work should examine the sequencing of infant touch in relation to specific maternal behaviours (e.g. affect, gaze, touch). By examining what maternal behaviours follow particular types of infant touch, sequential analyses may help to clarify the impact of infants' touching behaviours on their partners during social interactions, underscoring the communicative role of touch. Another important avenue for future work would be to adopt relational approaches to the coding of non-verbal behaviour, such as touch. Relational coding follows a dynamic systems perspective since it takes into consideration the behaviour of both interactive partners as they continuously influence

one another on a moment-to-moment basis (Fogel, 1993). The relational coding of touch might include an examination of the synchronicity of mothers' and infants' touching behaviours, as well as the contribution of touch to co-regulation in the dyad. Examining touch at the dyadic level would permit a better understanding of *how* infants (and mothers) use touch to contribute to bi-directional exchanges.

Touch and non-verbal communication: The functions of infant touch

While relational coding was not carried out in the present work, the communicative role of touch was nonetheless implied. By investigating the changes in infants' tactile behaviours across interaction periods and examining touch in the context of infants' other communicative modalities, findings from the present dissertation highlighted that touch is communicative during dynamic, bi-directional interactions. Yet, in addition to being communicative, previous research has shown that touch plays other roles during social interactions, such as exploration and regulation (Moszkowski & Stack, 2007). Since these roles have merely been inferred based on the study of individual types and locations of touch in isolation (e.g. Moszkowski & Stack, 2007), results from the current series of studies brought our understanding of the functions of touch to the next level by using different methods to study touch in the context of infants' other behaviours.

First, the study of how touch co-occurs with other behaviours (e.g. gaze, affect) in Study 1 provided implications for the possible functions of touch by examining how touch differentially combined with other infant behaviours across interactive contexts. Second, a systematic observational coding measure was created, operationally defining the functions of touch. It has been suggested that the qualitative and quantitative

components of touch (e.g. speed, intensity, extent of touch), as well as infants' other behaviours (e.g. gaze, affect, body posture), provide an important context for the study of touch (Jean & Stack, 2008). Because context is instrumental in deriving the meaning of touch (Hertenstein, 2002), these behaviours were built into the operational definitions of the functions and then directly applied through the coding of touch.

Findings regarding the possible functions of touch were consistent based on the co-occurrence analyses and the systematic coding of the functions. That is, both methods of study (and findings from both Studies 1 and 2) demonstrated that infants spent more time engaged in playful functions when their mothers were available during the Normal periods. In contrast, infants spent more time using regulatory and exploratory functions during the SF and SP periods, when their mothers were unavailable to them.

Infants' greater use of regulatory functions during periods of maternal unavailability is consistent with previous research on infant touch during the SF procedure (Moszkowski & Stack, 2007; Murray & Trevarthen, 1985; Toda & Fogel, 1993). By revealing that infants spend more time using regulatory functions during the SF period relative to the Normal periods, the current research supports arguments that infants may experience the SF period as stressful, and they resort to internally driven regulatory behaviours to cope with maternal unavailability (Braungart-Rieker, Garwood, Power, & Notaro, 1998). Moreover, the use of touch to self-regulate during periods of maternal unavailability provided infants with the opportunity to develop their emotion regulation skills, thereby setting the stage for organized behaviour, adaptive functioning, and positive relationships in later development (Sameroff & Emde, 1989; Sroufe, 1996). Thus, by demonstrating that touch is organized with other non-verbal behaviours to serve

a regulatory role during a distressing period, the findings contribute to the growing body of literature on infants' emotion regulation skills and provide support for a functionalist perspective of emotion regulation in infancy (Thompson, 1993). In order to provide additional support for the regulatory role of touch during periods of maternal unavailability, future work should examine infants' regulatory tactile behaviours in relation to their levels of distress. Determining whether particular touching behaviours lead to increased or decreased levels of infant distress during or following periods of maternal unavailability (i.e. the SF or SP and Reunion Normal periods) would enhance our understanding of which types of touch are regulatory in nature (Jean & Stack, 2008).

Shapiro, Fagen, Prigot, Carroll, and Sholan (1998) suggested that infants' emotion management strategies convey information to caregivers about their underlying affective states. As such, infants' greater use of reactive functions of touch during periods of unavailability may have communicated distress. In contrast, their passive types of touch during the Normal periods may have conveyed that they were calm and sufficiently aroused by their mothers. That infants used touch in different ways according to the interactive context (i.e. during periods of maternal availability/unavailability) suggests that they were relaying important messages to their social partners, thereby providing further support for the communicative role of touch.

In addition to the regulatory role of touch demonstrated in the current series of two studies, infants also spent more time in exploratory functions of touch when mothers were unavailable. Tactile exploration carries important implications for infants' developing self-identities (Rochat, 2001). By touching themselves and their environments in an exploratory manner when mothers are not available, infants learn about themselves

and the stimuli around them. Neisser (1991) labelled infants' implicit knowledge of the self 'the ecological self,' and this self develops as infants produce actions on objects and self-explore (Rochat, 2001). For example, when infants touch themselves, they experience a unique perceptual experience, called 'double-touch,' whereby both infants' hands and the area on the body on which they are touching receive tactile stimulation. This experience enables infants to distinguish between their own bodies and objects around them.

In a study carried out by Rothbart, Ziaie, and O'Boyle (1992), it was found that infants who were better able to focus their attention on objects during laboratory situations exhibited less distress. Thus, by diverting their attention away from the source of distress (i.e. their unavailable mothers) in the present series of studies, infants are actively engaging in alternate and more positive sources of stimulation, which may allow them to modulate their levels of arousal (Gianino & Tronick, 1988; Rothbart et al., 1992; Tronick, 1989). As such, the current research suggests that, in addition to contributing to infants' developing sense of selves, engaging in tactile exploration may also serve a regulatory function.

Taken together, results from Studies 1 and 2 suggest that infant touch serves a number of important functions for infants during their early social interactions. By examining the different qualitative components of touch, and considering touch in the context of infants' other modalities through co-occurrence analyses and the application of the Functions of Infant Touch coding scheme, the present research contributes to our understanding of the communicative, regulatory, and exploratory roles of touch during infant socio-emotional development. Moreover, by demonstrating that the functions of

touch vary across interaction periods, the present findings further imply that touch is used to communicate with caregivers during early social development. In other words, by engaging in different functions across interactive contexts, infants are also communicating about themselves to their social partners.

Yet, despite taking an important step in demonstrating the communicative, regulatory, and exploratory roles of touch, it was not possible to unravel infants' intentions based on the findings from the current research. Touch is a non-verbal modality, and the fact that infants in the present study were in the pre-verbal stage of development meant that infants could not verbalize their needs and wants. As such, that touch is being used for communication was deduced from the present findings. In order to provide further support that touch is indeed communicative, and to shed more light on *how* infants communicate through touch, future research should examine infant touch in relation to and in conjunction with maternal touch. Specifically, by examining the social context (e.g., active or contingent mother, passive or non-contingent mother; Legerstee et al., 1990) in which particular tactile behaviours occur, and determining the sequential relationship between infant touch and maternal touch (or other communicative behaviours), the communicative role of touch could be better elucidated and the messages conveyed through particular tactile behaviours clarified. Furthermore, as it has been suggested that an examination of the speed, intensity, and extent of infant touch is necessary for a complete understanding of the communicative role of touch (Hertenstein, 2002; Stack, 2001; Tronick, 1995), future research should incorporate these facets of touch into investigations of infants' touching behaviours.

In addition to making inferences regarding the communicative role of touch, inferences were inevitably also made regarding the regulatory and exploratory roles of touch. Without taking away from the contribution of the current work in providing a vital step in elucidating the role of touch, it is nonetheless important to recognize that it was not possible to absolutely determine what functions infant touch was *serving* at particular moments of the interaction. In future studies, it will be important to statistically examine how independent measures of infant behaviour (gaze, affect, vocalizations) cluster together with the various types of touch in a larger sample. While the current research examined how independent non-verbal behaviours, such as gaze and affect, co-occur with various types of infant touch, co-occurrence analyses are limited because they only look at how two behaviours occur together, rather than investigating how multiple non-verbal behaviours combine at any particular moment.

In order to further elucidate how touch is used to fulfill regulatory and exploratory functions, future work might also examine the relationship between infant touch and particular physiological indicators, such as heart rate, vagal tone, and cortisol levels. In addition to the paucity of research on infants' physiological responses to the SF (Moore & Calkins, 2004), to-date there is no research examining the temporal relationship between infants' tactile behaviours and their heart rate and vagal tone, or levels of cortisol. Such examinations are important to help clarify which tactile behaviours serve to modulate levels of arousal and infants' stress response during periods of infant distress (e.g. SF or SP procedures). Moreover, carrying out research involving infants' behavioural and physiological indices will clarify the relationship between these two

types of responses (Bazhenova, Plonskaia, & Porges, 2001; Haley & Stansbury, 2003; Weinberg & Tronick, 1996).

Impact of risk and the quality of the relationship on infants' touching behaviours

There are clearly many avenues for future research in this area, which can advance the contributions made by the current series of two studies and strengthen our understanding of the communicative, regulatory, and exploratory roles of touch during early social exchanges. Yet, in addition to providing a solid foundation for future work on the diverse roles of touch in a normative sample, another distinct and significant contribution made by the current work was the examination of touch in an at-risk sample. That is, whereas Study 1 employed a normative sample of healthy, full-term infants, Study 2 involved an at-risk sample of infants of depressed and non-depressed mothers. In this way, Study 2 built on Study 1 and provided insight into the touching behaviours of normative versus at-risk infants.

Study 2 revealed that infants of depressed mothers exhibit more reactive/regulatory touching behaviours when their mothers are unavailable (i.e. SF and SP periods), whereas infants of non-depressed mothers display comparatively more passive touching behaviours during these periods. These results imply that infants of depressed mothers were more active, and possibly more distressed, in response to their mothers' unavailability and are consistent with research suggesting that maternal depression is an important caregiver characteristic that is associated with individual differences in infants' abilities to self-regulate (Rosenblum, McDonough, Muzik, Miller, & Sameroff, 2002). By demonstrating group differences in reactive/regulatory types of touch, Study 2 builds on the existing depression literature, which has revealed more

negative *distal* communicative behaviours in infants of depressed compared to non-depressed mothers (e.g., Cohn et al., 1986; Cohn et al., 1990; Field et al., 1990). The current findings of greater distress in infants of depressed mothers is consistent with Weinberg and Tronick's (1998) study, where infants of psychiatrically ill mothers (i.e. mothers exhibiting depression or anxiety) displayed more negative affect during the SF period and they had a harder time re-engaging during the Reunion Normal period. However, results from Study 2 also differ from other research that has demonstrated that the SF period is *less* distressing for infants of depressed compared to non-depressed mothers (Field et al., 2007). Notably, touch was not measured in Field et al.'s (2007) study.

It is important to note that infants in the current research demonstrated greater distress during both periods of unavailability combined, as the effects of emotional versus physical unavailability were not parcelled out. While the fact that infants' responses to emotional and physical unavailability were not examined separately may account for the differences with previous research (i.e. Field et al.'s (2007) study), the findings of greater distress during *both* perturbation periods in the current research may also be explained by the low relationship quality exhibited by participants in Study 2 (e.g. maternal hostility, sub-optimal sensitivity). More specifically, participants in Study 2 were assigned EAS ratings that were significantly lower than the percentages typically documented in the literature. It seems plausible that the poor relationship indicators displayed by mothers in Study 2 might explain infants' greater distress in response to maternal unavailability, especially as emotional availability characteristics have been found to be important

determinants of infants' abilities to self-regulate (Easterbrooks, Chaudhuri, & Gestdottir, 2005).

Since the sample in Study 2 was considered to be an at-risk sample both because it was comprised of a sample of depressed and non-depressed mothers and due to the poor relationship indicators displayed by the dyads, this study provides important insight into the impact of maternal risk status on infants' touching behaviours. Findings revealed that negative maternal EA characteristics, such as maternal intrusiveness and hostility, predicted infants' regulatory tactile behaviours and these variables were more important predictors than maternal depression. Specifically, maternal intrusiveness predicted soothing regulatory types of touch in the Reunion Normal period following maternal emotional unavailability, and maternal hostility predicted reactive/regulatory types of touch in the Reunion Normal following maternal physical unavailability. These findings are consistent with Kogan and Carter's (1996) study, which demonstrated that infants experience difficulty re-engaging with mothers who display sub-optimal EA following the SF period. Moreover, depression did not add to the prediction of infants' tactile regulation, suggesting that depression has a limited impact on tactile regulation once relationship variables are taken into account.

These results warrant replication using a larger sample in order to further clarify the impact of maternal depression and emotional availability on infant communication and regulation through touch. It would be particularly interesting to determine whether mothers experiencing chronic depression (i.e. during pregnancy and continuous since the birth of their child) might have a stronger impact on infants' touching behaviour, even after taking into account the quality of the relationship. Moreover, future research should

clarify the differential impact of various forms of maternal risk that were not isolated in the present work (i.e. depression, sub-optimal emotional availability) on infants' abilities to self-regulate through touch. More specifically, by selecting distinct risk groups (i.e. mothers exhibiting sub-optimal emotional availability without depression, mothers exhibiting sub-optimal emotional availability with depression) and comparing them with infants of mothers exhibiting optimal emotional availability, future research would help tease apart the contribution of these maternal risk factors on infant behaviour. Finally, future research might also examine infant touch in dyads characterized by other risk variables (e.g. poverty, psychopathology) in order to advance our understanding of how various risk factors affect mother-infant interactions and infant socio-emotional development.

In contrast to Study 2's focus on negative Emotional Availability indicators in a sample exhibiting poor relationship qualities, Study 1 provided an opportunity to examine the impact of optimal EA characteristics on the functions of infant touch in a normative sample. Focusing on the Normal periods when mothers were available to their infants, findings revealed that positive EA indicators (i.e. Maternal Sensitivity) predicted playful functions of touch and negatively predicted infants' disengagement through touch. Maternal hostility was also investigated in this study and found to predict disengaged functions of touch. Moreover, infant responsiveness negatively predicted infants' disengagement through touch. These findings make intuitive sense as they demonstrate that infants are more likely to use touch to engage in interaction with emotionally available mothers, and they are consistent with research demonstrating that mothers who

are not attuned to their infants fail to involve them in interaction (Schaffer, 1984; Symons & Moran, 1987).

Although direct comparisons cannot be made regarding the investigations of the relationship between emotional availability and infant touching behaviours in Studies 1 and 2, important implications can be drawn from the two studies collectively. Both studies provide strong support for the importance of the quality of the relationship with regard to its influence on infant behaviour, and more specifically how infants use touch during interactions. In the current research, infants varied their levels of interactive engagement using touch based on their mothers' emotional availability, and they used touch to self-regulate when interacting with a social partner exhibiting sub-optimal emotional availability. These results are consistent with previous work demonstrating that maternal sensitivity is associated with less negative infant affect, more adaptive infant behaviour (Braungert-Riecker, Garwood, Powers, & Wong, 2001; Cohn, Campbell, & Ross, 1991; Tronick, Ricks, & Cohn, 1982), and greater infant orientation towards parents (Braungert-Rieker et al., 1998; Miller, McDonough, Rosenblum, & Sameroff, 2002). Taken together, the results suggest that infants' responses to the SF procedure are related to maternal behaviour. Therefore, the manner in which infants respond to the SF (i.e. such as through touch) can be used as an indicator of the quality of the mother-infant relationship (Tarabulsy et al., 2003).

While the current research underscores that sub-optimal emotional availability has an immediate impact on infant behaviour, longitudinal research is required to determine whether negative relationship indicators have long-standing effects on infants' socio-emotional development. Future research might examine the effects of maternal emotional

availability on infants' regulatory behaviours (including self-regulation through touch) over time, such as during the second and third years of life in order to determine if suboptimal maternal emotional availability has long-term consequences on the development of infants' regulatory skills. Furthermore, by investigating mediators and moderators of the relationship between maternal emotional availability characteristics and infants' regulatory behaviours over time (e.g. path models), insight into the mechanisms through which maternal risk impacts on children's socio-emotional development can be obtained, carrying implications for clinical practice. Finally, by examining the relationship between emotional availability and touch, additional clarification regarding the role of touch in infant self-regulation would be provided.

Yet, more than just highlighting the influence of emotional availability on infant behaviour across periods of the SF and SP procedures, which lays the foundation for future work in this area, the current results emphasize the utility of incorporating global measures of dyadic behaviour into investigations of communication during early mother-infant social exchanges. Whereas the study of infants' touching behaviours provides important information about infants' communicative skills and their underlying affective states, its ability to shed light on our understanding of communication at the dyadic level is limited. In contrast, examining the quality of the mother-infant relationship, as measured via emotional availability indicators (e.g. maternal sensitivity, hostility, and infant responsiveness), takes into account processes at the dyadic level, thereby adding to our knowledge of bi-directionality and co-regulation in mother-infant interactions (Bakeman & Gottman, 1997; Miller et al., 2002; Schaefer, 1989; Thomas & Clark, 1998). Further, by examining the relationship between micro- (i.e. touch) and macro-analytic

(i.e. EA indicators) behaviours, the current research reveals the organization of interactive behaviours at these two levels, highlighting that communication is a continuous process that cannot be reduced to the sum of its individual parts (Fogel & Thelen, 1987). As such, findings from the current research continue to support the dynamic systems perspective that the mother-infant relationship provides a framework for the development of infants' communicative abilities within the first year of life (Fogel, 1993).

Conclusions

The overarching objective of the current research was to examine infant touch in the context of infants' other communicative behaviours during early face-to-face mother-infant interactions in order to elucidate the role of touch during these social exchanges. This examination was carried out over a series of two studies, addressing similar questions but building on one another and using different samples (normative versus at-risk). A number of conclusions can be drawn from the current research with implications for infant socio-emotional development.

Both studies demonstrated that infants are sensitive to various forms of maternal unavailability (physical, emotional) and that they respond to changes in their mothers' behaviours during the SF and SP procedures through touch. These findings carry implications for the signature SF and carry-over effects, suggesting that future work on the SF and SP procedures is incomplete without including an investigation of infants' touching behaviours.

During periods of maternal unavailability, infants used touch to serve particular functions that were different from the functions of touch used during the Normal

interaction periods. As revealed through co-occurrence analyses and the systematic coding of operationally defined functions of touch, infants used touch to self-regulate and explore when their mothers were unavailable, with implications for infants' emotion regulation skills and their developing self-identities. In contrast, infants engaged in playful interaction through touch when their mothers were available. Moreover, the level of engagement infants displayed through touch depended on the quality of the interactions, implying that emotional availability indicators impact infants' responsiveness through touch.

Examining the functions of touch in two different ways (i.e. co-occurrence analyses, FITS coding scheme) added to the understanding of how touch combines with other channels of non-verbal communication. That infants exhibited different tactile behaviours with changes in maternal availability, and that touch was organized with other behavioural modalities to create meaningful affective displays which varied according to the interactive context, implies that touch serves an important communicative role during pre-verbal development when infants cannot verbalize their needs and wants. As such, touch appears to be a central modality through which infants convey their emotions and needs, and infants use touch in conjunction with their other behaviours to specify and clarify these messages.

Finally, as the current research was carried out using both normative and at-risk samples, findings carry implications for the impact of different forms of maternal risk on infants' touching behaviours. The present research was the first to examine infant touch in a sample of depressed and non-depressed mothers and to examine the impact of the quality of the relationship on infants' touching behaviours. Both maternal depression and

the quality of the relationship (i.e. emotional availability indicators) appeared to influence infants' touching behaviours.

Taken together, the current research makes a substantive contribution to the growing body of literature on infants' touching behaviours during mother-infant interactions, underscoring the importance of touch as a modality of infant communication, regulation, and exploration during early socio-emotional development.

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Appendix A

Study 1 Consent Form

Consent Forms
Mother-Infant Interactions

This study is designed to look at infants' responses during social interaction and to study the different types of interaction used by caregivers and their role in social exchange.

I understand that my baby and I will participate in a study lasting approximately 60 minutes. In the first part, 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 interact in different ways with my baby. During some periods I will be asked to interact with my baby as I normally do, while in others I will be asked to pose a neutral, still facial expression and remain silent for a brief period. There will be brief breaks separating the interaction periods. In the second part, my baby and I will play together on a carpeted floor for approximately 8 minutes in a designated area, during which time I will be asked to play with my baby as I normally would at home. Under no circumstances will any manipulation be harmful to my baby. Finally, I will be asked to complete several brief questionnaires.

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 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. I am also aware that I may be asked to participate again when my baby is 12 and 18 months of age.

In the event that I have any unanswered concerns or complaints about this study, I may express these to Dr. Dale Stack (848-2424, ext. 7565), Dr. Lisa Serbin (848-2424, ext. 2255) or Dr. Alex Schwartzman (848-2424, ext. 2251) of the Psychology Department at Concordia University. In addition, the patient representative of the Jewish General Hospital is Mrs. Laurie Berlin (340-8222, ext. 5833). She can be contacted should I have any questions regarding my rights as a research volunteer.

Thank you for your cooperation.

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

Parent's signature on behalf of child: _____ Date: _____
Parent's signature: _____ Date: _____
Witness: _____ Date: _____

Appendix B

Demographic Information Questionnaire

Mother-Infant Interaction
(Revised, August 28, 1997)

Demographic Information

Order:

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

Infant's Name: _____

D.O.B.: _____ E.D.O.B.: _____
Age: _____ Sex: _____

Mother's Name: _____ Age: _____

Languages Spoken: _____

Father's Name: _____ Age: _____

Languages Spoken: _____

Ethnic origin: _____

Phone #: _____

Address: _____
_____

Birth Weight: _____ Length of Labour: _____

Pregnancy Complications and Delivery Status: _____
_____

Medical History: _____
_____
_____

Breast fed: _____ Bottle fed: _____

Siblings:	Age	Sex
	_____	_____
	_____	_____
	_____	_____

Mother's Occupation: _____ Education: _____

Father'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):

_____

_____

Comments: _____

_____

_____

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

In 6 months: _____ In 12 months: _____

Date: _____

Appendix C

Operational Definitions for the Infant Touch Scale (ITS)

THE INFANT TOUCH SCALE (ITS):

A coding scheme designed to document infant touch during their early social interactions

Moszkowski, R., & Stack, D. M. (2007)

This systematic coding scheme is designed to document the types and locations of touch in 5 ½-month-old infants during their interactions with their mothers. This coding scheme complements the Caregiver Infant Touch Scale (CITS), which documents the quantitative and qualitative components of maternal touch within the context of early mother-infant interactions.

Note: Though this coding scheme was specifically developed to document the tactile behaviour of 5 ½-month-old infants, the categories of touch in this scheme are broad enough to be applicable to younger and older infants.

CODING OF INFANT TOUCH

Infant touch is only coded if the infant has initiated contact with a stimulus or if the infant has actively manipulated his/her hands when in contact with a stimulus.

For example, when the mother and infant are in contact with each other, infant touch should only be coded if the infant has actively manipulated his/her hand(s). Alternately, if contact between mother and infant has been initiated solely by the mother while the infant remains passive, then infant touch is not coded so as not to be redundant with the Caregiver-Infant Touch Sale.

If contact with the mother has been initiated by the infant and the mother is actively manipulating the infant's hand, the static touch category of infant touch should be used.

TYPES AND LOCATIONS OF INFANT TOUCH

Types of Touch

1. Static Touch
2. Rub/Caress/Wipe/Stroke
3. Grasping/Clutching/Clasping
4. Manipulating/Fingering/Scrumble
5. Mouthing
6. Tap/Pat
7. Pull/Push/Clap/Lift/Poke/Prod
8. No code
0. No touch

1. Static Touch

Static touch is defined as the infant's hand touching a stimulus without movement.

All or part of the infant's hand is pressed down on a part of the body, the chair, or the mother's body. The palm can be face down, face up, or the side of the hand can be touching a stimulus, the fingers can be extended or curled, and the hands or fingers can be encircling a stimulus.

If the palm is resting on a surface while the fingers are moving in the air, this category is still used because the movement of the fingers is not on a stimulus. If the infant's hand is pushing against a stimulus, the Pull/Push/Clap/Lift category, and not this one, should be used.

2. Rub/Caress/Wipe/Stroke

Rub: Strong, repetitive back and forth or circular motion over a stimulus with the hand not breaking contact with the stimulus.

Caress: Soft, gentle, repetitive back and forth or circular movement of the infant's hand or finger(s) over a surface.

Wipe: Rubbing motion of the front or back of the palm against a stimulus (e.g. wiping the eyes).

Stroke: Lateral or flat, repetitive movements involving one or more finger(s) that are typically soft, light, gentle, and slow.

All or part of the infant's hand(s) or finger(s) are moving laterally over a surface in a back and forth or circular repetitive motion. The palm may be face up or down.

If only the tip of the finger is moving over the surface, the manipulate/finger/scrumble category, and not this one, should be used.

3. Grasp/Clutch/Clasp

Grasp/Clutch/Clasp: Seizing, firmly gripping, or holding with the hands or fingers.

The infant curls all or some of his/her fingers, including or excluding the thumb, around a stimulus.

If one of the infant's hands is gripping all or part of the other or if one or more finger(s) from both hands are intertwined, this category is used. If the infant is repeatedly curling his/her finger(s) around a stimulus, this category is also used. In contrast, if the hands or fingers simply brush one another or make any haphazard contact, this category is not used.

4. Manipulate/Finger/Scrumble

Manipulate: Handling with the fingers.

Finger: Running of the fingertip(s) over the surface of a stimulus.

Scrumble: Flexing and extending of the fingers in a repetitive manner over the surface of a stimulus. The wrist is usually anchored and there is minimal arm and shoulder movement.

The infant runs the tip of his/her finger(s) over a surface, usually in random fashion.

If the infant's palm(s) is resting on a surface while the fingers are clearly moving over this surface, this category should be used.

5. Mouthing

This category is used when a stimulus (e.g. infant hand or fingers) comes into contact with the infant's mouth, including the lips and outside of the mouth. The infant's hands or fingers may be static, moving around or rotated in the mouth, or they may be pressed against the outside of the infant's mouth.

6. Tap/Pat:

Tap: Focal, light, quick movement using mainly the fingertips. Gentle hitting with a quick light blow.

Pat: Up and down motion of the hand against a surface. This type of touch typically involves slight sweeping movements that are unidirectional and often reflexive.

The pat or tap may occur once or repetitively. The hand may be open or closed.

7. Push/Pull/Clap/Lift/Poke/Prod:

Push: Pressing of all or part of the hand against a surface with varying degrees of pressure. If the infant pushes the chair with his/her hands in order to readjust his/her position on the chair, this category is used.

Pull: Pulling of a stimulus with the hands.

Clap: Striking of the hands against each other.

Lift: Raising a stimulus to a level higher than its original position.

Poke/Prod: Motion of putting pressure over a small surface with one or more finger(s) or part of the hand. Usually involves repetitive motion.

8. No code

The type of infant touch cannot be coded because part or all of the infant's hand(s) are obstructed or the area where the infant is touching is obstructed.

0. No touch

The infant is not touching a stimulus.

Locations of Infant Touch

1. Face/Head
2. Mouth
3. Hands/Arms
4. Shoulder/Neck
5. Trunk (chest/belly)
6. Feet/Legs
7. Mother
8. Chair
9. Clothes
10. No code
0. No touch

CODING DETAILS

Coding is done by one second intervals. That is, for each second of the interaction, one type and one location of touch is coded for the hand that is the most active.

A touching behaviour must be a minimum of one third of a second to be coded. A tactile behaviour is considered to begin when the hand begins to move, even if it is before the hand comes into contact with a stimulus. For example, a pat is considered to begin when the hand is in the air and moving toward a stimulus.

When coding the locations of touch, the clothing category is only used when it is clear that the infant is touching only the clothing and not a part of his/her body with the clothes. That is, if the infant is touching both the clothing and a body part, then the body part is coded. If the infant's hand is resting on clothing, the specific body location being touched, and not the clothes, should be the area coded.

If the infant's hands are partially obstructed (approximately 75% or more) by part of the infant's body (e.g. the feet/legs), a part of the mom's body (e.g. hands), or the chair, do not code for that hand.

Coding should be done with the volume of the coding rig turned off to avoid bias from contextual cues.

SPECIAL CASES AND DECISION MAKING

Dominant touch

One hand: If one hand is using two types of touch within a one second period, code the type of touch that is considered to be more active based on the list of dominant types of touch. If both types of touch employed by the hand are equally active, code the behaviour of longer duration.

Two hands: If both hands are touching an area for 0.5 seconds or longer, the hand that is employing the more active form of touch, based on the list of dominant types of touch, should be coded. If both hands are employing types of touch that have been ranked as equally active, the behaviour of longer duration should be coded.

Most to least dominant types of touch

1) Tat/Pat, Pull/Push/Clap/Lift/Poke/Prod, Mouth
2) Rub/Caress/Wipe
3) Manipulating/Fingering/Stroke/Scrumble, Grasp/Clutching/ Clasping
4) Static touch
5) No touch

Dominant location

Area of the body: If two locations of the infant's body are being touched simultaneously, the location being touched by the more active hand should be coded. If both hands are using the same type of touch, or one hand touches two locations with the same type of touch, the location of the body on which the touch is of longer duration should be coded. In the rare event of this duration being equal, locations should be coded in the following order: mother, face/head, shoulder/neck, mouth, hands/arms, trunk, feet/legs, chair, and clothes. This order has been adopted in order to ensure that low frequency events are captured.

Appendix D

Operational Definitions for the Functions of Infant Touch Scale (FITS)

THE FUNCTIONS OF INFANT TOUCH SCALE (FITS):

A coding scheme designed to document the functions of infant touch during their early social interactions

Chiarella, S., Moszkowski, R., & Stack, D.M. (2007)

The functions of infant touch are based on the types of touch and determined by taking into account the following:

- Infant Gestures
- Infant Gaze
- Infant Affect
- Infant Vocalization
- Infant Body Posture

NORMAL INTERACTION PERIODS

A) Interactive Functions

The infant is interacting or not interacting with their mother during Normal interaction periods. The dominant cue used to in determining these functions of infant touch is INFANT GAZE AT THE MOTHER.

1. Intense Play

The infant is gazing at the mother (face, body, hands) or is in joint attention with the mother (i.e. they are both looking at the same object) while touching him/herself, his/her surroundings, or his/her mother (i.e. any location of touch).

The following types of touch are included in Intense Play:

- Grab
- Pull/Push
- Pat/Tap
- Reaching towards the mother

- The infant's affect is neutral to positive.
- The infant's vocalizations (if present) are neutral to positive.

2. Light Play

The infant is gazing at the mother (face, body, hands) or is in joint attention with the mother (i.e. they are both looking at the same object) while touching him/herself, his/her surroundings, or his/her mother (i.e. any location of touch).

The following types of touch are included in Light Play:

- Stroke
- Finger
- Static touch on the mother

- The infant's affect is neutral to positive.
- The infant's vocalizations (if present) are neutral to positive.

3. Passive Play

The infant is gazing at the mother (face, body, hands) or is in joint attention with the mother (i.e. they are both looking at the same object) while touching him/herself, his/her surroundings, or his/her mother (i.e. any location of touch).

The following type of touch is included in Passive Play:

- Static touch

- The infant's affect is neutral to positive.
- The infant's vocalizations (if present) are neutral to positive.
- For static touch to be coded as Passive Play, the infant cannot be touching the mother. Otherwise, the Light Play category is used.

4. Partial Engagement

The infant is gazing away from the mother (proximal or away) while actively touching her. Thus, the infant seems engaged with the mother based on his tactile behaviours.

The following types of touch ON THE MOTHER are included in Partial Engagement:

- Stroke
- Grasp
- Finger
- Pull/Push
- Pat/Tap
- Static touch on the mother

- The infant's affect is neutral to positive.
- The infant's vocalizations (if present) are neutral to positive.

5. Disengagement

The infant is gazing away from the mother while she is trying to regain the infant's attention (i.e. she may be gazing at her infant while vocalizing and touching her infant). The infant is rejecting the mother's attempt at engaging the infant in play.

Gaze away from the mother (proximal or distal) with neutral to negative affect is accompanied by any of the following:

- The infants' hands are in contact with the mother.
    - Despite there being physical contact between the mother and the infant, the touch was initiated by the mother. As such, the no touch category was coded for infant touch.
- The infants' hands are static on the mother.
    - This behaviour must occur for at least 2 seconds in order for the Disengaged category to be used. If infant static touch occurs for only 1 second, the Partial Engaged category is coded.
- The infants' hands are static and the infant is not touching the mother.
    - This touch is not serving a soothing, reactive, or exploratory function because it is a passive type of touch.
- The infant is pulling away from or pushing the mother away with his touch.

B) Regulatory or Exploratory Functions

The infant is using touch to regulate or explore. The dominant cue used in determining these functions of infant touch is INFANT GAZE AWAY FROM THE MOTHER.

6. Soothing-Regulatory

The infant is regulating him/herself by touching him/herself or his/her surroundings. The infant's hands are not in contact with the mother, and the infant is not using static touch.

The following types of touch are included in Soothing-Regulatory:

- Stroke
- Finger
- Mouth

- The infant's gaze is distal away from the mother.
- The infant's affect is neutral to negative.
- The infant is producing little or no vocalizations.
- *Exception*: If the infant is mouthing, this behaviour is considered soothing no matter where the infant is gazing.

7. Reactive-Regulatory

The infant is regulating him/herself by actively touching him/herself or his/her surroundings. The infant's hands are not in contact with the mother, and the infant is not using static touch.

The following types of touch are included in Reactive-Regulatory:

- Grab
- Pull/Push
- Pat/Tap

- The infant's gaze is distal away from the mother.
- The infant's affect is neutral to negative.
- The infant is producing little or no vocalizations.

8. Exploratory

The infant is exploring him/herself or his/her surroundings. The dominant cue that is used for this category is proximal gaze (i.e. the infant is looking at what is being touched). The infant's hands are not in contact with the mother, and the infant is not using static touch.

The following types of touch are included in Exploratory:

- Stroke
- Grab
- Finger
- Pat/Tap
- Pull/Push

- The infant's gaze is proximal away from the mother.
- The infant's affect and vocalizations are neutral.

9. Exploratory/Regulatory

The infant is exploring him/herself or his/her surroundings. The dominant cue that is used for this category is proximal gaze (i.e. the infant is looking at what is being touched). The infant's hands are not in contact with the mother, and the infant is not using static touch.

The following types of touch are included in Exploratory/Regulatory.

- Stroke
- Grab
- Finger
- Pat/Tap
- Pull/Push

- The infant's gaze is proximal away from the mother.
- The infant's affect and vocalizations are negative, lasting at least 2 seconds.

10. Dysregulated

The infant is fussing or crying and appears to be Dysregulated. All types of touch are included in this category.

- The infant is gazing at or away from the mother.
- The infant's affect and vocalizations are negative.

C) Other functions

11. No Touch/No Apparent Function

If the infant is not touching anything, or if the infant's hands are hidden from view, this category is used.

STILL-FACE PERIOD

A) Accepting Functions

The infant is accepting that the mother is no longer responsive (i.e. emotionally unavailable). The dominant cue used in determining these functions of infant touch is INFANT GAZE AT THE MOTHER.

1. Intense/Solitary Play

The infant is actively playing by him/herself while looking at the mother. The infant may be touching him/herself, the infant seat, or his/her clothes (i.e. any location of touch) and the infant is using active types of touch.

The following types of touch are included in Solitary Play:

- Grab
- Pat/Tap
- Pull/Push

- The infant's affect is neutral to positive.
- The infant's vocalizations (if present) are neutral to positive.

2. Light/Passive Play/Quiet Acceptance

The infant is passively playing by him/herself while looking at the mother. The infant may be touching him/herself, the infant seat, or his/her clothes (i.e. any location of touch) and the infant is using less active or passive types of touch.

The following types of touch are included in Quiet Acceptance:

- Stroke
- Finger
- Static touch

- The infant's affect is neutral to positive.
- The infant's vocalizations (if present) are neutral to positive.
- *Exception*: Static touch is coded as Quiet Acceptance even if the infant gazes proximally or distally away from the mother, and no or neutral vocalizations are present. If gesturing or fussiness are present with the static touch, then the behaviour is considered to serve an attention-seeking/regulation-seeking function.

B) Regulatory or Exploratory Functions

The infant is using touch to regulate or explore. The dominant cue used in determining these functions of infant touch is INFANT GAZE AWAY FROM THE MOTHER.

3. Soothing-Regulatory

The infant is self-regulating while the mother is unavailable. The infant's hands are not in contact with the mother, and the infant is not using static touch.

The following types of touch are included in Soothing-Regulatory:

- Stroke
- Finger
- Mouth

- The infant's gaze is distal away from the mother.
- The infant's affect is neutral to negative.
- The infant is producing little or no vocalizations.
- *Exception*: If the infant is mouthing, this behaviour is considered soothing no matter where the infant is gazing.
- *Exception*: If gesturing combines with any of the above types of touch, then the function is Reactive-Regulatory.

4. Reactive-Regulatory

The infant is self-regulating while the mother is unavailable. The infant's hands are not in contact with the mother, and the infant is not using static touch.

The following types of touch are included in Reactive-Regulatory:

- Grab
- Pull/Push
- Pat/Tap

- The infant's gaze is distal away from the mother.
- The infant's affect is neutral to negative.
- The infant is producing little or no vocalizations.

5. Attention-Seeking

The infant is trying to obtain the mother's attention during the SF period. The infant physically touches him/herself, the infant seat, or gestures towards the mother.

The following types of infant touch are included in Attention-Seeking:

- Grab
- Stroke
- Pat/Tap
- Pull/Push
- Static touch with gesturing
- *Gesturing/Reaching*

- The infant's gaze is at the mother.
- The infant's affect is neutral to positive.
- The infant may be using vocalizations in order to try to regain the mother's attention.

6. Exploratory

The infant is exploring him/herself or the surroundings. The dominant cue that is used is proximal gaze (i.e. the infant is looking at what is being touched). The infant's hands are not in contact with the mother, and the infant is not using static touch.

The following types of touch are included in Exploratory:

- Stroke
- Grab

- Finger
- Pat/Tap
- Pull/Push

- The infant's gaze is proximal away from the mother.
- The infant's affect and vocalizations are neutral.

7. Exploratory/Regulatory

The infant is exploring him/herself or the surroundings. The dominant cue that is used is proximal gaze (i.e. the infant is looking at what is being touched). The infant's hands are not in contact with the mother, and the infant is not using static touch.
The following types of touch are included in Exploratory/Regulatory:

- Stroke
- Grab
- Finger
- Pat/Tap
- Pull/Push

- The infant's gaze is proximal away from the mother.
- The infant's affect and vocalizations are negative, lasting at least 2 seconds

8. No Touch/No Apparent Function

If the infant is not touching anything, or if the infant's hands are hidden from view, this category is used.

Coding Details:

- To warrant a change in the direction of the function of touch, the function must occur for MORE THAN ½ a SECOND during the interaction.
- When a static touch occurs within a continuous bout of a function (e.g. Exploratory) and the gaze is still in the same direction, the static touch must occur for AT LEAST 2 seconds for the Light/Passive Play or Attention-seeking functions to be coded.

Appendix E

Emotional Availability (EA) Scales

ADAPTATION OF EA SCALES FOR YOUNGER INFANTS

***Modified by Biringen to fit the format of the third edition**

Little (1995)

This adaptation of EA provides some additional guidelines for coding the dyadic behaviour of very young infants and their parents. This is necessary due to the developmental differences between young infants and toddlers that influence parent-infant interaction. Emotionally available parenting involves understanding a particular infant's level of developmental abilities and needs. The procedure for observing parent-infant interaction for young infants often includes a short face-to-face play period with the infant in an infant seat. The parent has the option of using toys to play with her infant.

PARENTAL SENSITIVITY

Overall, young infants may require a greater level of attention to their states of arousal than is necessary for older infants and toddlers. A more sensitive parent will be attuned to the infant's ability to regulate emotional and physiological states, and provide stimulation or soothing as needed. In comparison with toddlers, young infants may express needs, or their interest in objects or games, by using more subtle cues. A sensitive parent is able to interpret and respond to the young infant's signals with little confusion as to what the infant is attempting to express. This is partially due to other past experience in attending to, and learning to decipher, that particular infant's style of communication. With a young infant, a more sensitive parent will adjust his/her language and speak in "motherese" as well as imitate the infant's vocalizations in a positive manner.

Certain games and objects tend to be interesting and informative for a young infant. For example, a young infant enjoys visually tracking objects. A sensitive parent might hold a toy where his/her infant can comfortably gaze at it and comment positively on the infant's interest and affect as s/he slowly moves the toy back and forth. Also, the methods of exploration that a young infant employs may be different than those of an older infant. The parent can introduce objects by remarking specifically on their visual, auditory, and tactile properties in a manner that is developmentally sensitive. For example, rubbing a soft terry cloth animal along the infant's body and face, or gently ringing a bell. A less sensitive parent may expect the young infant to recognize properties of objects such as colors and shapes in a non concrete manner. In terms of conflict with a young infant, a highly sensitive parent will set limits in a gentle manner. For example, infants often mouth or suck on toys. A sensitive parent who is uncomfortable with this type of exploration, but acknowledges that it is age-appropriate, may gently and smoothly use nonthreatening words or actions to prohibit it. In addition, a sensitive parent will provide an alternate way for the infant to explore in a manner that is acceptable. Parental sensitivity is rated from 9 (highly sensitive) to 1 (highly insensitive), as described next.

9. Highly sensitive. This parent is predominantly positive and helps to regulate the infant's affective and physiological states. S/he reads the nuances of the infant's cues accurately and responds appropriately. His/her play reflects an understanding of the developmental interests and capabilities of infants, such as the ability to reach or grasp.

7. Generally sensitive. This parent is very similar to a highly sensitive parent, but there is a qualitative difference within one of the components of sensitivity. For example, this parent may create an enjoyable atmosphere, but have a less adequate sense of timing. This rating refers to "good enough" parenting.

5. Inconsistently sensitive. This parent's behaviour with the infant fluctuates. For example, s/he may switch from a positive state to a slightly harsh prohibition. Although there is some sensitivity, there are also clear problems.

3. Somewhat insensitive. This parent typically reflects one of two general styles. The first is overly active, harsh, and overbearing. The other is non-interactive, passive, and silent. However, this parent exhibits some positive signs, such as a desire to be playful.

1. Highly insensitive. This parent displays few strengths in interaction with the infant.

PARENTAL STRUCTURING

This scale directly assesses the degree to which the parent structures her infant's play, follows the infant's lead, and sets limits. For young infants, the parent must be quite active in play in terms of selecting games or toys, demonstration and reaching, and encouraging the infant's involvement. This scale ranges from 5 (optimally structuring) to 1 (no structuring), according to the following criteria.

5. Optimally structuring. This parent is an active play partner, and also supports the infant's own activity. S/he allows play space and maximizes the infant's ability to enjoy and explore toys and games.

3. Inconsistently structuring. The parent may be optimally or overly active for a part of the play, but then becomes passive and leaves the infant without support. S/he may give the infant toys, but provide little facilitation for productive exploration.

1. Non-optimal structuring. This parent appears passive and provides no structuring for the infant's ability to use and enjoy toys and activities.

PARENTAL NONINTRUSIVENESS

Intrusiveness refers to the extent of directiveness, overstimulation, or overpowering of interaction, and is rated from 5 (nonintrusive) to 1 (intrusive) as follows.

5. Nonintrusive. Parent shows no intrusive behaviours.

3. Somewhat intrusive. This parent too frequently directs the course of play and often does not leave the infant space to be active. S/he may break into the infant's exploration, or take toys away. The quality of this play seems overly "educational" rather than controlling or over stimulating, and may be performance-oriented.

1. Intrusive. This parent is highly over stimulating, and leaves the infant little space for exploration. S/he may present, or take away, numerous toys, thereby disrupting the infant's interest in them, and may never allow or encourage the infant to explore. In addition, the overstimulation can be produced by physically intrusive behaviours such as a large degree of tickling, poking the infant, or physically looming over the infant.

PARENTAL NON-HOSTILITY

The parental non-hostility scale assesses the presence and degree of overt and covert hostile behaviour expressed during the interaction with the infant. Forms of hostility can range from openly threatening to subtle behaviour. The highest point (5) refers to the observation of no hostile parental behaviour. The rating criteria are as follows.

5. Non-hostility. This parent shows no overt or subtle signs of hostile behaviour.

4. Slightly hostile. This parent shows a diffuse level of discontent or boredom within the interaction. Impatience with the infant may be observed by parental behaviours such as rolling eyes, or making disparaging remarks. This parent may tease the infant by using negative language or poking and tickling invasively. However, this teasing contains more obvious humour and warmth than in covertly hostile behaviours.

3. Markedly but covertly hostile. This parent shows covert forms of impatience, resentment, and anger. S/he may give the infant cold stares or become sarcastic. Teasing behaviour contains an angry edge.

2. Intermittently but overtly hostile. This parent is not consistently harsh and abrasive. S/he may act under involved and then emit a startling statement or act. Abrasive teasing, such as name-calling, tickling, or poking may be observed.

1. Markedly and overtly hostile. This parent is harsh, abrasive, and demeaning. S/he may show physical signs of anger such as throwing toys at the infant, or pounding on the table.

INFANT RESPONSIVENESS

The infant's responsivity to the parent reflects two aspects of the infant's behaviour: (a) willingness to engage with parent and follow his/her bids; (b) clear pleasure within the interaction with parent. In comparison with older infants and toddlers, young infants must rely on certain types of responsive behaviours that are developmentally salient, especially if they are confined to an infant seat. For instance, young infants have less ability to move their bodies physically toward, or away from, the parent. Rather, to show engagement, a

young infant may gaze at the parent's face, reach out to him/her, and babble. To avoid interaction with the parent, a young infant may avert gaze, turn head or body to the side, or slump down in the seat. In addition, there will be individual differences between infants' developmental level of behaviour such as reaching to parent or holding toys. Each infant's apparent level of ability should be taken into account when coding responsiveness. Infant responsiveness is rated from 7 (highly responsive) to 1 (unresponsive) as follows.

7. Highly responsive. This infant is consistently responsive to parental bids, seems eager to engage with her vocally and physically, and expresses a large degree of positive affect. Occasionally, a parental bid may be ignored by a responsive infant who is heavily engaged in exploration of an object.

5. Moderately responsive. The infant shows one of three patterns of behaviour: (a) the infant accepts a moderate degree of parental bids, and shows a moderate degree of pleasure within the interaction; (b) the infants accepts a large degree of parental bids, but shows a low level if positivity; or (c) the infant is tremendously positive with the parent but is not as interested in responding to parental bids.

3. Somewhat responsive. This infant accepts few parental bids and expresses little positivity within the interaction. Neutrality or low-level negativity will be the dominant affective state. Some avoiding behaviours, such as gaze aversion, may be present.

1. Unresponsive. This infant never shows pleasure within the interaction with the parent and there may be a large degree of negativity. A reluctance to engage with the parent may be exhibited by clear avoidance behaviours or by consistent visual, postural, and verbal unresponsiveness. The infant may exhibit strong negative behaviour that seems out of context

Appendix F

ANOVA Summary Tables

Table F1

Analysis of the Percent Duration of the Functions of Infant Touch across Interaction Periods

Source	*df*	*F*	η_p^2	*p*
Function (F)	7	62.91***	.59	.00
error	301	(187.42)		
Period (P)	2	39.41***	.48	.00
error	86	(14.43)		
F X P	14	18.30***	.30	.00
error	602	(99.31)		

Note . Values enclosed in parentheses represent mean square error.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table F2

Means and Standard Deviations for the Percent Duration of Functions of Infant Touch across Interactions Periods

	First Normal		SF		Reunion Normal	
Period	*M*	*SD*	*M*	*SD*	*M*	*SD*
Functions of Touch						
No Function	11.92	12.06	10.5	11.02	12.09	10.94
Intense Play	14.39	8.99	5.37	5.69	14.43	9.25
Light/Passive Play	32.91	16.23	20.79	12.52	35.19	21.09
Soothing-Regulatory	13.41	14.87	22.1	12.05	13.98	17.06
Reactive-Regulatory	3.4	3.99	22.64	14.04	1.93	2.44
Exploratory	4.03	7.09	16.9	18.19	3.64	7.11
Regulatory-Exploratory	0.00	0.00	0.164	0.63	0.023	0.15

Period	First Normal		SF		Reunion Normal	
	M	*SD*	*M*	*SD*	*M*	*SD*
Dysregulated	0.023	0.15	0.00	0.00	0.467	1.25

Table F3

Analysis of the Percent Duration of the Partial Engaged and Disengaged Functions of Infant Touch during the Normal Periods

Source	*df*	*F*	η_p^2	*p*
Function (F)	1	31.48***	.42	.00
error	43	(93.59)		
Period (P)	1	1.27	.03	.27
error	43	(46.77)		
F X P	1	1.00	.02	.32
error	43	(43.87)		

Note. Values enclosed in parentheses represent mean square error.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table F4

Means and SD of the Percent Duration of the Partial Engaged and Disengaged Functions of Infant Touch during the Normal Periods

	First Normal		Reunion Normal	
Period	*M*	*SD*	*M*	*SD*
Functions of Touch				
Partial Engaged	4.11	4.39	3.95	4.70
Disengaged	13.29	12.78	11.13	10.87

Table F5

Analysis of the Percent Duration of the Functions of Infant Touch during the Reunion Normal Period According to High/Low Partial Engaged Groups in the First Normal Period

Source	*df*	*F*	η_p^2	*p*
Function (F)	10	20.25***	.33	.00
error	420	(101.90)		
F X Group	10	2.15*	.05	.02

Note. Value enclosed in parentheses represents mean square error.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table F6

Means and SD of the Percent Duration of the Functions of Infant Touch during the Reunion Normal Period According to High/Low Partial Engaged (PE) Groups in the First Normal Period

	High PE		Low PE	
Period	*M*	*SD*	*M*	*SD*
Functions of Touch				
No Function	10.19	10.28	14.17	11.50
Intense Play	13.88	8.83	15.03	9.88
Light Play	15.18	10.46	23.36	13.70
Passive Play	15.62	13.78	14.58	14.76
Partial Engagement	4.87	5.31	2.93	3.80
Soothing-Regulatory	11.98	15.27	16.16	18.97
Reactive-Regulatory	2.37	2.53	1.44	2.29
Exploratory	4.87	8.22	2.29	5.54
Regulatory-Exploratory	0.04	0.21	0.00	0.00
Disengagement	15.56	11.39	6.28	8.01
Dysregulated	0.34	1.21	0.60	1.32

Table F7

Means and SD for EAS Characteristics as a Function of the Normal Interaction Periods

	Period			
	First Normal		Reunion Normal	
EAS	*M*	*SD*	*M*	*SD*
Sensitivity	7.88	0.85	7.86	0.97
Structuring	4.43	0.57	4.50	0.48
Intrusiveness	1.14	0.38	1.08	0.26
Hostility	1.02	0.15	1.06	0.27
Responsiveness	4.98	1.63	5.22	1.28

Appendix G

Regression Tables

Table G1

Summary of Hierarchical Regression Analysis for Variables Predicting Infants' Intense Play Functions of Touch during the First Normal (N1) Period

Variable	B	t	R^2_{ch}	F_{ch}
Step 1			.05	1.17
Maternal Sensitivity during the N1 period	.27	1.52		
Maternal Hostility during the N1 period	.17	0.96		
Step 2			.01	0.48
Maternal Sensitivity during the N1 period	.16	0.68		
Maternal Hostility during the N1 period	.14	0.76		
Child Responsiveness during the N1 period	.14	0.69		
	R = .26	R^2 adj. = -.01		F = 0 .93

Note. * $p < .05$. ** $p < .01$. *** $p < .001$. $t < .1$.

Table G2

Summary of Hierarchical Regression Analysis for Variables Predicting Infants' Intense Play Functions of Touch during the Reunion Normal (RN) Period

Variable	β	t	R^2_{ch}	F_{ch}
Step 1			.06	1.25
Maternal Sensitivity during the RN period	.10	0.62		
Maternal Hostility during the RN period	-.18	-1.07		
Step 2			.12	2.96t
Maternal Sensitivity during the RN period	-.33	-1.32		
Maternal Hostility during the RN period	-.33	-1.90t		
Maternal Sensitivity during the N1 period	.60	2.22*		
Maternal Hostility during the N1 period	.46	2.26*		
Step 3			.01	0.55
Maternal Sensitivity during the RN period	-.35	-1.38		
Maternal Hostility during the RN period	-.32	-1.79t		
Maternal Sensitivity during the N1 period	.52	1.81t		
Maternal Hostility during the N1 period	.41	1.90t		
Child Responsiveness during the N1 period	.14	0.74		
	R = .44	R^2 adj. = .09		F = 1.82

Note. * $p < .05$. ** $p < .01$. *** $p < .001$. $t < .1$.

Table G3

Summary of Hierarchical Regression Analysis for Variables Predicting Infants' Partial Engaged Functions of Touch during the First Normal (N1) Period

Variable	B	T	R^2_{ch}	F_{ch}
Step 1			.15	3.56*
Maternal Sensitivity during the N1 period	-.45	-2.64*		
Maternal Hostility during the N1 period	-.29	-1.70t		
Step 2			.02	1.07
Maternal Sensitivity during the N1 period	-.60	-2.67*		
Maternal Hostility during the N1 period	-.33	-1.90t		
Child Responsiveness during the N1 period	.20	1.03		
	R = .41	R^2 adj. = .11		F = 2.73t

Note. * $p < .05$. ** $p < .01$. *** $p < .001$. $t < .1$.

Table G4

Summary of Hierarchical Regression Analysis for Variables Predicting Infants' Partial Engaged Functions of Touch during the Reunion Normal (RN) Period

Variable	B	T	R^2_{ch}	F_{ch}
Step 1			.13	2.96t
Maternal Sensitivity during the RN period	-.20	-1.23		
Maternal Hostility during the RN period	.22	1.40		
Step 2			.07	1.73
Maternal Sensitivity during the RN period	-.52	-2.08*		
Maternal Hostility during the RN period	.10	0.60		
Maternal Sensitivity during the N1 period	.44	1.67		
Maternal Hostility during the N1 period	.12	0.58		
Step 3			.01	0.32
Maternal Sensitivity during the RN period	-.53	-2.11*		
Maternal Hostility during the RN period	.12	0.66		
Maternal Sensitivity during the N1 period	.39	1.35		
Maternal Hostility during the N1 period	.08	0.36		
Child Responsiveness during the N1 period	.10	0.57		
	R = .45	R^2 adj. = .10		F = 1.95

Note. * $p < .05$. ** $p < .01$. *** $p < .001$. $t < .1$.

Table G5

Summary of Hierarchical Regression Analysis for Variables Predicting Infants' Disengaged Functions of Touch during the First Normal Period

Variable	β	T	R^2_{ch}	F_{ch}
Step 1			.23	6.18**
Maternal Sensitivity during the N1 period	-.56	-.35*		
Maternal Hostility during the N1 period	-.30	-1.88t		
Step 2			.01	0.72
Maternal Sensitivity during the N1 period	-.45	-2.08*		
Maternal Hostility during the N1 period	-.27	-1.62		
Child Responsiveness during the N1 period	-.16	-0.85		
	R = .50	R^2 adj. = .19		F = 4.33*

Note. * $p < .05$. ** $p < .01$. *** $p < .001$. $t < .1$.

Table G6

Summary of Hierarchical Regression Analysis for Variables Predicting Infants' Disengaged Functions of Touch during the Reunion Normal Period

Variable	β	t	R^2_{ch}	F_{ch}
Step 1			.33	10.23***
Maternal Sensitivity during the RN period	-.38	-2.72*		
Maternal Hostility during the RN period	.30	2.17*		
Step 2			.02	0.68
Maternal Sensitivity during the RN period	-.25	-1.12		
Maternal Hostility during the RN period	.35	2.24		
Maternal Sensitivity during the N1 period	-.18	-0.74		
Maternal Hostility during the N1 period	-.21	-1.16		
Step 3			.09	6.38*
Maternal Sensitivity during the RN period	-.20	-0.95		
Maternal Hostility during the RN period	.31	2.09*		
Maternal Sensitivity during the N1 period	.03	0.14		
Maternal Hostility during the N1 period	-.07	-0.37		
Child Responsiveness during the N1 Period	-.38	-2.53*		
	R = .67	R^2 adj. = .38		F = 6.18***

Note. * $p < .05$. ** $p < .01$. *** $p < .001$. $t < .1$.

Appendix H

Study 2 Consent Form

Informed Consent
Preventing Depression in Infants

We are doing a study on how being depressed may affect your baby, the ways to reduce depression in mothers, and how to prevent it in infants. During your pregnancy, after your baby is born and during your baby's first two years of life, we will interview you and test your baby. The tests are strictly for our study and will be confidential.

During Pregnancy

If you agree to be in the study, between your 3rd and 9th month of pregnancy you will be asked to complete questions on alcohol and smoking and your general health during pregnancy. In addition, we will ask you some questions regarding your feelings of depression, anxiety, stress, anger, daily hassles and your attitudes and knowledge about being pregnant and raising children. These will take between 1-2 hours to complete. We will ask for a urine sample to look at different hormones. You will be asked if we can observe two of your ultrasounds and/or if you are interested in having your significant other or family member learn a pregnancy massage and provide twice weekly 20-minute massages during pregnancy. The massage may be a moderate or light pressure or you may be in a group that receives no massage. If you are in a massage group, and if you prefer, massage therapists can conduct your massages at the U.M. Touch Research Institutes. Ultrasound sessions will take place in the prenatal clinic during your second and third trimesters of pregnancy and will last approximately 25-50 minutes. In order to record how your baby moves inside you. Head, foot or hand massage at the ultrasound clinic will last 3 to 5 minutes and we will watch your baby for 4 minutes during the ultrasound to see how he/she moves.

After you give birth

Shortly after birth, a psychologist will test your baby's alertness, behaviour and physical activity and we will ask you how you feel. We will also videotape your baby and record the baby's heart rate. Heart rate will be recorded at the same time we collect brain wave information through electrodes (little round stickers) placed on your baby's chest. We will take recordings of you and your baby's brain waves to see if they are affected by your moods. For the brain wave test we will place a few sensors on your baby's head and a cap on your head. We will also place 3 sensors on your chest area, arm, or neck to record heart rate. This will not cause any discomfort. There are no risks to these procedures. These recording only take a few minutes. We will also record you and your baby during a feeding, ask you questions about breast feeding and we will ask for a sample of you and your baby's urine. This visit will take approximately 2-2½ hours. We may also show you how to massage your baby and ask you to do a bedtime massage every night.

During the first 6 months

Once a month, for the first 6-months of your baby's life, we will ask you to come back to our video lab where we will videotape you while you and your baby play together for about 5 minutes. One video camera will be focused on your baby's face and record your baby's expressions and another will be focused on your face and record your expressions. We will also videotape your baby's responses to a Raggedy Ann doll's face (at the 4-month visit), to another baby's face and your baby's own face in a mirror (at 5 months), and to an object (e.g., a star versus a round-shaped object at 6 months). We will erase the videotapes after we finish analyzing them. We will ask for another urine sample from you and your baby at one of these visits and ask you some questions about stress. When your baby is 6 months we will give him/her a developmental test and a physical examination.

We will pay $20.00 for each visit. If we find any medical problems we will refer you to a doctor, your records and results will be given a number instead of your name and will be kept confidential to the extent permitted by law. If you decide to take part in the study with your baby, we will ask you for permission to review your medical records at delivery and your baby's medical records at birth. The results of this study will be reported as group results to protect your identity. Your records may also be bound by the same provisions of confidentiality. The Department of Health and Human Services (DHHS) may review these research records.

Your participation is voluntary and if you do not want to be in the study, you can leave at any time and it will not hurt your treatment. Feel free to ask questions at any time. For questions regarding this study contact Dr. Tiffany Field at 305-243-6781. You will receive a copy of this consent form for your records. If you have any questions about your rights as a research subject you may contact Maria Arnold, IRB Director, University of Miami at 305-243-3195.

_____ _____

Signature of Mother Date

Appendix I

Centre for Epidemiological Scale for Depression (CES-D)

Radloff, L.S. (1977)

CES-D

Please circle the number that best corresponds to how you felt this past week.

0 = Rarely (less than a day) 1 = Some of the time (1-2 days)
2 = Occasionally (3-4 days) 3 = Most of the time (5-7 days)

1.	I was bothered by things that usually don't bother me.	0	1	2	3
2.	I did not feel like eating. I was not hungry.	0	1	2	3
3.	I felt I could not shake the blues even with the help from my family and friends.	0	1	2	3
4.	I felt that I was just as good as other people.	0	1	2	3
5.	I had trouble keeping my mind on what I was doing.	0	1	2	3
6.	I felt depressed.	0	1	2	3
7.	I felt that everything I did was an effort.	0	1	2	3
8.	I felt hopeful about the future.	0	1	2	3
9.	I thought my life had been a failure.	0	1	2	3
10.	I felt fearful.	0	1	2	3
11.	My sleep was restless.	0	1	2	3
12.	I was happy.	0	1	2	3
13.	I talked less than usual.	0	1	2	3
14.	I felt lonely.	0	1	2	3
15.	People were unfriendly.	0	1	2	3
16.	I enjoyed life.	0	1	2	3
17.	I had crying spells.	0	1	2	3
18.	I felt sad.	0	1	2	3

19.	I felt like people disliked me.	0	1	2	3
20.	I could not get going.	0	1	2	3

Date: _____ SCID: _____ Score: _____

Appendix J

ANOVA Summary Tables

Table J1

Analysis of the Percent Duration of the Types of Infant Touch as a Function of Interaction Period and Perturbation

Source	*df*	*F*	η_p^2	*p*
Period (P)	2	8.12***	.17	.00
P X Perturbation (Pert)	2	0.12	.00	.89
error	78	(24.41)		
Types (T)	6	21.37***	.35	.00
T X Pert	6	0.90	.02	.50
error	234	(343.42)		
P X T	12	14.74***	.27	.00
P X T X Pert	12	0.37	.01	.97
error	468	(140.89)		

Note. Values enclosed in parentheses represent mean square error.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table J2

Means and Standard Deviations for the Percent Duration of the Infant Types of Touch as a Function of Interaction Period and Perturbation

Perturbation	SF Procedure			SP Procedure		
Period	Normal	SF	Reunion Normal	Normal	SP	Reunion Normal
Type of Touch						
Static	30.12	7.42	31.81	32.02	8.03	26.68
	(21.83)	(5.60)	(18.53)	(21.06)	(8.85)	(23.38)
Stroke	8.10	9.31	10.35	2.27	11.16	9.87
	(6.03)	(7.51)	(8.27)	(6.44)	(8.79)	(8.75)
Grab	4.23	4.27	3.93	4.26	2.52	4.63
	(3.56)	(6.31)	(3.59)	(3.45)	(4.29)	(4.48)
Finger	8.67	9.88	8.41	7.50	9.57	7.32
	(7.67)	(6.71)	(6.78)	(6.86)	(8.38)	(6.11)

Perturbation		SF Procedure			SP Procedure		
Period		Normal	SF	Reunion Normal	Normal	SP	Reunion Normal
	Mouth	9.96	15.28	7.71	1.66	11.96	4.21
		(14.86)	(26.02)	(13.71)	(4.76)	(23.98)	(9.36)
	Pat	4.82	10.77	4.94	6.62	10.94	8.99
		(4.93)	(7.41)	(4.18)	(6.81)	(9.89)	(8.32)
	Pull	16.00	33.27	13.01	21.48	37.68	19.29
		(16.49)	(24.88)	(16.84)	(21.33)	(32.09)	(16.46)

Table J3

Analysis of the Percent Duration of the Locations of Infant Touch as a Function of Interaction Period and Perturbation

Source	*df*	*F*	η_p^2	*p*
Period (P)	2	10.48***	.21	.00
P X Perturbation (Pert)	2	0.20	.01	.82
error	78	(23.40)		
Locations (L)	6	32.47***	.45	.00
L X Pert	6	1.41	.45	.00
error	234	(492.57)		
P X L	12	24.01*	.04	.21
P X L by Pert	12	0.54	.01	.89
error	468	(196.83)		

Note . Values enclosed in parentheses represent mean square error.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table J4

Means and Standard Deviations for the Percent Duration of the Locations of Infant Touch as a Function of Interaction Period and Perturbation.

Perturbation	SF Procedure			SP Procedure		
Period	Normal	SF	Reunion Normal	Normal	SP	Reunion Normal
Locations of Touch						
Face/Shoulder	0.17 (.76)	1.95 (3.09)	1.05 (2.92)	0.18 (0.60)	2.06 (2.75)	1.21 (2.83)
Mouth	10.07 (14.83)	15.33 (26.11)	7.48 (13.14)	1.66 (4.76)	11.96 (23.98)	4.10 (8.90)
Hand	4.69 (6.26)	7.54 (12.36)	3.72 (4.10)	1.61 (3.51)	5.17 (10.70)	1.84 (3.51)
Trunk	4.94 (6.65)	4.40 (3.87)	5.53 (6.10)	2.44 (4.26)	2.43 (4.11)	1.82 (2.52)

Perturbation		SF Procedure			SP Procedure		
Period		Normal	SF	Reunion Normal	Normal	SP	Reunion Normal
	Feet	7.57 (10.65)	17.34 (22.05)	7.81 (11.15)	9.54 (11.69)	19.12 (21.05)	7.71 (8.91)
	Mother	32.27 (30.06)	0.00 (0.00)	37.64 (24.33)	39.94 (28.38)	0.00 (0.00)	34.36 (28.33)
	Other	20.11 (20.58)	42.85 (30.97)	16.29 (20.30)	25.15 (25.01)	52.83 (30.35)	30.32 (27.43)

Table J5

Analysis of the Percent Duration of the Regulatory Types of Infant Touch as a Function of Interaction Period, Perturbation, and Maternal Depression Group

Source	*Df*	*F*	η_p^2	*p*
Period (P)	1	4.16*	.10	.05
P X Depression Classification (CESD)	2	0.28	.01	.76
P X Perturbation (Pert)	2	0.16	.00	.85
P X CESD X Pert	2	1.37	.04	.26
error	74	(55.96)		
Regulatory Types (RT)	2	9.01***	.20	.00
RT X CESD	2	3.90*	.10	.03
RT X Pert	2	2.28	.06	.11
RT X CESD X Pert	2	1.77	.05	.18
error	74	(761.65)		
P X RT	4	19.93***	.36	.00
P X RT X CESD	4	2.47*	.06	.05
P X RT X Pert	4	0.54	.02	.70

Source	*df*	*F*	η_p^2	*p*
P X RT X CESD X Pert	4	1.02	.03	.40
error	148	(331.97)		

Note . Values enclosed in parentheses represent mean square error.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table J6

Means and Standard Deviations for the Percent Duration of the Regulatory Types of Infant Touch as a Function of Interaction Period, Perturbation, and Maternal Depression Group

Perturbation		SF Procedure			SP Procedure		
Period		Normal	SF	Reunion Normal	Normal	SP	Reunion Normal
Type of touch							
Depressed Group							
	Static	36.62	3.81	35.76	23.06	2.28	29.17
		(29.84)	(4.68)	(21.74)	(15.78)	(3.16)	(28.05)
	Soothing	25.06	22.72	28.63	15.57	20.01	18.52
		(21.65)	(9.02)	(18.01)	(10.37)	(20.03)	(14.27)
	Reactive	21.53	62.93	24.34	54.68	76.87	38.90
		(14.66)	(22.25)	(13.36)	(23.24)	(20.57)	(28.74)

Perturbation		SF Procedure			SP Procedure		
Period		Normal	SF	Reunion Normal	Normal	SP	Reunion Normal
Non-Depressed Group							
	Static	28.50	8.33	30.83	36.73	11.48	27.39
		(20.28)	(5.56)	(18.30)	(23.30)	(9.58)	(21.32)
	Soothing	27.41	37.41	26.25	17.89	36.92	22.25
		(15.58)	(22.72)	(17.60)	(13.78)	(22.74)	(12.72)
	Reactive	25.94	44.79	21.62	21.49	41.03	32.23
		(17.49)	(22.86)	(20.10)	(10.26)	(23.67)	(16.13)

Table J7

Analysis of the Percent Duration of the Locations of Infant Touch (Self, Mother, Other) as a Function of Interaction Period, Perturbation, and Maternal Depression Group

Source	*df*	*F*	η_p^2	*p*
Period (P)	2	4.79*	.12	.011
P X Depression Classification (CESD)	2	0.31	.01	.73
P X Perturbation (Pert)	2	0.31	.01	.73
P X CESD X Pert	2	1.12	.03	.33
error	74	(55.33)		
Locations (L)	2	3.27*	.08	.04
L X CESD	2	5.30**	.13	.01
L X Pert	2	1.58	.04	.21
L X CESD X Pert	2	0.07	.00	.93
error	74	(1179.01)		
P X L	4	22.64***	.39	.00
P X L X CESD	4	3.453**	.09	.01
P X L X Pert	4	0.56	.02	.69

Source	*df*	*F*	η_p^2	*p*
P X L X CESD X Pert	4	0.13	.00	.97
error	148	(498.31)		

Note. Values enclosed in parentheses represent mean square error.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table J8

Means and Standard Deviations for the Percent Duration of the Locations of Infant Touch (Self, Mother, Other) as a Function of Interaction Period, Perturbation, and Maternal Depression Group

Perturbation	SF Procedure			SP Procedure		
Period	Normal	SF	Reunion Normal	Normal	SP	Reunion Normal
Location of Touch						
Depressed Group						
Self	29.51	23.68	27.77	16.30	19.82	17.27
	(24.42)	(18.50)	(20.60)	(11.90)	(14.79)	(12.76)
Mother	25.20	0.00	33.14	33.85	0.14	31.12
	(43.32)	(0.00)	(39.23)	(26.21)	(0.38)	(30.03)
Other	28.49	65.79	27.81	40.46	78.36	38.20
	(18.18)	(29.90)	(27.92)	(31.36)	(16.53)	(33.61)

Perturbation		SF Procedure			SP Procedure		
Period		Normal	SF	Reunion Normal	Normal	SP	Reunion Normal
Non-Depressed Group							
	Self	30.85	53.42	26.53	16.98	50.81	14.73
		(20.10)	(29.23)	(16.98)	(13.89)	(26.00)	(11.46)
	Mother	34.03	0.00	38.76	43.73	0.00	38.74
		(27.43)	(0.00)	(20.87)	(30.96)	(0.00)	(27.60)
	Other	18.02	37.11	13.41	15.40	40.76	28.40
		(21.14)	(29.33)	(17.94)	(16.70)	(28365)	(23.92)

Table J9

Analysis of the Percent Duration of the Functions of Infant Touch across Perturbation Periods

Source	*df*	*F*	η_p^2	*p*
Period (P)	1	1.47	.06	.24
error	23	(15.13)		
Functions (F)	8	16.71**	.42	.00
error	184	(248.65)		
P X F	8	2.21*	.09	.03
error	184	(162.18)		

Note. Values enclosed in parentheses represent mean square error.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table J10

Means and Standard Deviations for the Percent Duration of the Functions of Infant Touch across Perturbation Periods

Perturbation	SF Period	SP Period
Functions of Touch		
No Function	6.77 (8.26)	9.21 (14.10)
Solitary Play	9.71 (11.48)	0.62 (1.60)
Attention-Seeking	1.11 (3.05)	0.27 (0.87)
Quiet Acceptance	9.75 (7.15)	11.58 (10.99)
Soothing/Regulatory	21.25 (25.56)	21.90 (19.42)
Reactive/Regulatory	16.14 (12.24)	25.02 (17.31)
Exploratory	27.47 (24.03)	21.79 (20.71)
Regulatory/Exploratory	0.15 (0.53)	0.00 (0.00)
Dysregulated	2.07 (4.93)	8.10 (14.88)

Table J11

Analyses of Emotional Availability Characteristics (Maternal Sensitivity, Structuring, Intrusiveness, Hostility, and Infant Responsiveness) as a Function of the Four Normal Interaction Periods and Perturbation .

Source	*df*	*F*	η_p^2	*p*
Maternal Sensitivity	3	0.21	.01	.89
Perturbation (P)	1	3.67t	.12	.07
error	28	(15.27)		
Sens X Pert	3	1.73	.06	.17
error	84	(1.28)		
Maternal Structuring	3	0.47	.02	.70
Pert	1	4.90*	.15	.04
error	28	(6.31)		
Struc X Pert	3	0.42	.02	.74
error	84	(0.78)		
Maternal Intrusiveness	3	0.19	.01	.91
Pert	1	5.49*	.16	.03
error	28	(3.99)		
Intrus X Pert	3	0.38	.01	.77
error	84	(0.61)		

Source	*df*	*F*	η_p^2	*p*
Maternal Hostility	3	1.07	.04	.37
Pert	1	0.07	.00	.79
error	28	(0.30)		
Host X Pert	3	1.12	.04	.35
error	84	(0.11)		
Infant Responsiveness	3	2.69*	.09	.05
Pert	1	0.83	.03	.37
error	28	(5.06)		
Resp X Pert	3	1.00	.03	.40
error	3	(1.52)		

Note . Values enclosed in parentheses represent mean square error.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table J12

Means and Standard Deviations for Emotional Availability Characteristics (Maternal Sensitivity, Structuring, Intrusiveness, Hostility, and Infant Responsiveness) as a Function of the Four Normal Interaction Periods

	Period							
	First Normal (SF)		Reunion Normal (SF)		First Normal (SP)		Reunion Normal (SP)	
EAS	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Maternal Sensitivity	6.20	2.18	6.18	2.25	6.18	2.23	6.0	2.41
Maternal Structuring	3.65	1.54	3.42	1.55	3.57	1.55	3.47	1.51
Maternal Hostility	1.17	0.44	1.05	0.27	1.10	0.40	1.17	0.44
Maternal Intrusiveness	1.58	1.24	1.65	1.18	1.75	1.35	1.70	1.28
Infant Responsiveness	4.38	1.55	4.15	1.59	4.68	1.48	3.85	1.57

Table J13

Analysis of EAS characteristics as a Function of Depressed and Non-Depressed Groups

Source	*df*	*F*	η_p^2	*p*
Sensitivity (Sens)	3	0.19	.01	.91
error	84			
Sens X Depression Classification (CESD)	3	0.97	.03	.41
Structuring (Struc)	3	0.38	.01	.77
error	84			
Struc X CESD	3	0.21	.01	.89
Hostility (Host)	3	1.25	.04	.30
error	84			
Host X CESD	3	0.57	.02	.64
Intrusiveness (Intrus)	3	0.21	.01	.89
error	84			
Intrus X CESD	3	0.37	.01	.78
Responsiveness (Resp)	3	2.35	.08	.08
error	84			
Resp X CESD	3	0.12	.00	.95

Note. Values enclosed in parentheses represent mean square errors.

* $p < 0.05$, ** $p < 0.01$, ***$p < 0.001$.

Table J14

Means and SD for EAS Characteristics as a Function of Depressed and Non-Depressed Groups

	Period							
	First Normal (SF)		Reunion Normal (SF)		First Normal (SP)		Reunion Normal (SP)	
Period	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Group								
Depressed								
Sensitivity	6.10	2.37	5.90	2.46	6.55	2.02	6.20	2.50
Structuring	3.50	1.78	3.20	1.58	3.45	1.64	3.50	1.53
Hostility	1.25	0.54	1.00	0.00	1.10	0.32	1.25	0.54
Intrusiveness	1.45	1.26	1.75	1.48	1.60	1.29	1.55	1.26
Responsiveness	4.30	1.51	4.00	1.70	4.50	1.35	3.50	1.43

		Period							
		First Normal (SF)		Reunion Normal (SF)		First Normal (SP)		Reunion Normal (SP)	
Period		*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Non-Depressed									
	Sensitivity	6.25	2.15	6.33	2.18	6.00	2.36	5.90	2.43
	Structuring	3.73	1.45	3.53	1.57	3.63	1.54	3.45	1.54
	Hostility	1.13	0.39	1.08	0.34	1.10	0.45	1.13	0.39
	Intrusiveness	1.65	1.26	1.60	1.03	1.83	1.41	1.78	1.32
	Responsiveness	4.43	1.61	4.23	1.57	4.78	1.57	4.03	1.64

Appendix K

Regression Tables

Table K1

Summary of Hierarchical Regression Analysis for Variables Predicting Infants' Soothing Types of Touch during the Reunion Normal Period of the SF Procedure

Variable	β	t	R^2_{ch}	F_{ch}
Step 1			.54	23.90*
Maternal Intrusion during the RN period	.74	4.89*		
Step 2			.02	1.08
Maternal Intrusion during the RN period	.73	4.87*		
Maternal Education	.16	1.04		
Step 3			.01	0.27
Maternal Intrusion during the RN period	.75	4.81*		
Maternal Education	.14	0.85		
Depression	-.08	-0.52		
	R = .76	R^2 adj. = .51		F = 8.13***

Note. * $p < .05$. ** $p < .01$. *** $p < .001$. $t < .1$.

Table K2

Summary of Hierarchical Regression Analysis for Variables Predicting Infants' Soothing Types of Touch during the Reunion Normal Period of the SP Procedure

Variable	β	t	R^2_{ch}	F_{ch}
Step 1			.00	0.07
Maternal Intrusiveness during RN period	.06	0.27		
Step 2			.10	1.83
Maternal Intrusiveness during RN period	.06	0.25		
Maternal Education	-.32	-1.35		
Step 3			.00	0.04
Maternal Intrusiveness during RN period	.04	0.17		
Maternal Education	-.33	-1.33		
Depression	-.05	-0.20		
	R = .33	R^2 adj. = -.07		F = 0.61

Note. * $p < .05$. ** $p < .01$. *** $p < .001$. $t < .1$.

Table K3

Summary of Hierarchical Regression Analysis for Variables Predicting Infants' Reactive Types of Touch during the Reunion Normal Period of the SF Procedure

Variable	β	t	R^2_{ch}	F_{ch}
Step 1			.04	0.76
Maternal hostility during the RN period	-.19	-0.87		
Step 2			.04	0.82
Maternal hostility during the RN period	-.23	-0.20		
Maternal Education	-.20	-0.91		
Step 3			.03	0.50
Maternal hostility during the RN period	-.25	-1.08		
Maternal Education	-.25	-1.06		
Depression	-.17	-0.71		
	R = .32	R^2 adj. = -.048		F = 0.68

Note. * $p < .05$. ** $p < .01$. *** $p < .001$. $t < .1$.

Table K4

Summary of Hierarchical Regression Analysis for Variables Predicting Infants' Reactive Types of Touch during the Reunion Normal Period of the SP Procedure

Variable	β	t	R^2_{ch}	F_{ch}
Step 1			.21	5.03*
Maternal hostility during the RN period	.46	2.24*		
Step 2			.15	4.33t
Maternal hostility during the RN period	.47	2.47*		
Maternal Education	.39	2.08t		
Step 3			.02	0.59
Maternal hostility during the RN period	.47	2.45*		
Maternal Education	.41	2.14*		
Depression	.15	0.77		
	R = .62	R^2 adj. = .28		F = 3.53*

Note. * $p < .05$. ** $p < .01$. *** $p < .001$. $t < .1$.