MATERNAL SENSITIVITY WITH THEIR INFANTS: THE ROLE OF EMOTION STATES, FATIGUE, AND INFANT ENGAGEMENT

by

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DEDICATION PAGE

This dissertation is dedicated to my parents, my partner, and my enchanting daughter, without whom none of this would have been worth achieving.

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ABSTRACT

Early sensitive caregiver (typically mother)-infant interactions form an important foundation for infant development. When sensitive, mothers behave with the apparent goal to keep their infants happy and engaged. Mutual enjoyment is thought to motivate proximity and continued interactions. The main focus in the literature has been on the influence of stable/pathological maternal negative emotions on parenting, with parenting often assessed on one occasion, in an unnatural setting, or with a researcher present. The primary objective of this research was to explore what accounts for the variability in typical mothers' sensitivity with their 15- to 28-week-old infants across interactions. Specific goals were to develop a novel methodology to increase the ecological validity and acceptability of assessments by having mothers themselves videotape their infant interactions in their homes, to explore the effect of mothers' emotion states and fatigue on their ensuing sensitivity, and to evaluate if infant engagement determined whether mothers felt better (i.e., were reinforced) the more sensitively they behaved. A feasibility study was conducted with 9 mother-infant dyads, and a main study with an additional 40 dyads. Mothers completed a brief emotion and fatigue rating scale (Profile of Mood States – 15; Cranford et al., 2006) before and after each interaction, twice daily, over five to seven days. Interviews with feasibility study mothers indicated that most found the procedure acceptable, though not representative of their typical interactions. Little data were missing or uncodeable. Methodological changes are proposed to enhance the representativeness of observed interactions and to further minimize data loss. Contrary to predictions, pre-interaction emotion and fatigue states did not individually or jointly account for the significant within-subject variability in sensitivity across interactions. Mothers felt better after interacting and, the more sensitively they behaved, the more engaged their infants were, and the more positive mothers felt thereafter. However, infant engagement did not account for the relationship between sensitivity and how mothers then felt. Results suggest mothers can behave sensitively irrespective of how they feel; then, upon behaving sensitively, feel better regardless of their infants' engagement. Interacting effects of maternal stress, cognitions, specific emotion behaviour relations, and methodology remain to be further investigated.

LIST OF ABBREVIATIONS AND SYMBOLS USED

PPD	Postpartum Depression
r	Estimate of the Product-Moment Correlation Coefficient
NS	Not Statistically Significant
IWK	Izaak Walton Killam
M	Mean
SD	Standard Deviation
n	Number of Cases
POMS-15	15-Item Profile of Mood States (Cranford et al., 2006)
p_{pos}	Observed Proportion of Positive Agreement
p_{neg}	Observed Proportion of Negative Agreement
POMS	Profile of Mood States (McNair, Lorr, & Droppleman, 1992)
R_C	Reliability of Change
MSE	Matthews Studio Equipment
cm	Centimeters
ICC	Intraclass Correlation Coefficient
p	P-value for Significance Testing
sec	Seconds
PASW	Predictive Analytics Software for Windows
SAS	Statistical Analysis Software
a	Effect of the Predictor on the Mediator
b	Effect of the Mediator on the Outcome, Accounting for the Predictor
c'	Direct Effect of the Predictor on the Outcome
c	Total Effect of the Predictor on the Outcome
b	Unstandardized Parameter Estimates of Individual Fixed Effects
t	Sample Value of the t-Test Statistic for Individual Fixed Effects Parameter
N	Total Number of Cases
PI	Pre-Interaction
SE	Standard Error
r_s	Spearman Rank Order Correlation
CI	Confidence Interval
VIF	Variance Inflation Factor
m	Average Number of Outcome Ratings Per Participant in VIF Formula
ρ	Intra-Class Correlation Coefficient in VIF Formula

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CHAPTER 1: INTRODUCTION

1.1 Mother-Infant Interaction: Overview

Early highly affective interactions between infants and their primary caregivers are thought to form an important foundation for infants' development (Bornstein & Tamis-LeMonda, 2001; Tronick, 2007). Sixty-six percent to 82% of infants' contact and interactions with adults in the first 12 months of life occur with their mothers (Baildam et al., 2000; Wille, 1995). By two months of age, infants have typically developed clear responsivity to faces and voices, making them capable of meaningfully participating in face-to-face interactions. At this age, infants and their mothers engage in relatively coordinated back-and-forth interactions with each other, involving reciprocal and contingent emotional exchanges, touch, gestures, and vocalizations (Lock, 2001; Moore, 2006; Trevarthen & Aitken, 2001). In these early face-to-face "proto-conversations" (Bateson, 1971), mothers typically try to engage their infants' attention, increase their children's positive emotion and decrease negative emotion (Cohn & Tronick, 1987). These interactions become progressively more coordinated with time (Tronick & Cohn, 1989), with infants and mothers developing clear expectations of each other by age three or four months (Moore, 2006; Kaye & Fogel, 1980). By about six months of age, based on their earlier interactive experiences, infants typically prefer interacting with their mothers, and display different emotional reactions to their mothers than to others (Adamson & Bakeman, 1985). These behaviours indicate that by this stage of development, infants have effectively formed relationships with their mothers (Moore, 2006).

Evidence suggests that the quality of early face-to-face interactions between infants and their primary caregivers – typically their mothers – predicts a host of significant relational and developmental outcomes. Infants who have been observed to have a history of prolonged emotionally positive and contingent interactions with their mothers are significantly more likely to develop healthy emotional bonds with their mothers (i.e., secure attachment; Ainsworth & Bell, 1970; Ainsworth, Blehar, Waters, & Wall, 1978; Blehar, Lieberman, & Ainsworth, 1977), setting the foundation for infants' socialization and contributing to their budding sense of identity (Escalona, 1968), self-confidence (Bowlby, 1988; Tronick, 2007), cultural and language learning (Trevarthen & Aitken, 2001), and socio-cognitive development (Bakeman & Brown, 1980; Cohen & Beckwith, 1979; Meins et al., 2003; Meins et al., 2002; Ramey, Farran, & Campbell, 1979). On the other hand, infants with a history of recurrent brief, unengaged, and unpleasant early interactions, marked by maternal unresponsiveness and non-contingent, rough/jerky, and/or affectively flat behaviour, tend to develop insecure relationships with their mothers (Blehar et al., 1977), contributing to problems in their development (e.g., Brumariu & Kerns, 2010). Individual differences in the patterns of early mother-infant interactions have not only been found to differentially predict socio-emotional and cognitive development and attachment, but also to help account for or mitigate the effects of various risk factors on infants' development (e.g., De Wolff & van IJzendoorn, 1997; Kennedy & Bakeman, 1984; Laucht, Esser, & Schmidt, 2001; National Institute of Child Health and Human Development [NICHD] Early Child Care Research Network, 1999a, 1999b; Raikes & Thompson, 2005; Tomlinson, Cooper, & Murray, 2005; Warren & Simmons, 2005).

In sum, repeated positive mother-infant interactions over time are widely thought to facilitate healthy infant attachment and development. To grow up mentally healthy, "the infant and young child should experience a warm, intimate, and continuous relationship with his mother (or permanent mother substitute) in which both find satisfaction and enjoyment" (Bowlby, 1951, p.13). Such mutual enjoyment motivates proximity and continued interactions, which in turn provides infants with the opportunities to become attached to and learn from their mothers. When interactions between infants and their mothers are brief, unengaged or unpleasant, negative infant outcomes are more likely. It is therefore important to understand what helps to optimize the interaction and to make it mutually pleasing for both partners across time, particularly between infant ages two to six months. This is the focus of the present dissertation.

1.2 Mothers' Role in Driving Early Interactions and Promoting Their Infants' Enjoyment

Although infants are active participants in early interactions with their mothers (Bornstein & Tamis-LeMonda, 2001; Cohn & Tronick, 1988; Moore, 2006; Trevarthen & Aitken, 2001), it is mothers who are primarily responsible for establishing and maintaining these interactions (Blehar et al., 1977; Dix, 1991; Shin, Park, Ryu, & Seomun, 2008), due to their greater relative control over their own behaviour. Indeed, there is evidence that when mothers begin engaging in vocalizations and positive expressions during interactions, their infants largely follow suit (Anderson et al., 1977; Beebe & Gerstman, 1980; Cohn & Tronick, 1989; Fafouti-Milenkovic & Uzgiris, 1979; Kaye & Fogel, 1980; Kozak-Mayer & Tronick, 1985; Stern, Jaffe, Beebe, & Bennett,

1975; Tronick, Als, Adamson, Wise, & Brazelton, 1978). Maternal sensitivity, in particular, is considered a key indicator of a positive interaction (e.g., Shin et al., 2008) and is significantly associated with infants' active engagement in the interaction (r = .49, Murray, Fiori-Cowley, Hooper, & Cooper, 1996). For example, in a seminal longitudinal observational study of 26 mother-infant dyads in their homes, Blehar et al. (1977) found that between infant ages 6 and 15 weeks, the more mothers were contingently responsive, lively, and encouraging of interactions, the more likely their infants were to vocalize and express positive affect (i.e., smile and bounce). Conversely, maternal abrupt/intrusive, unresponsive, and affectively flat behaviour was associated with infants not responding, merely looking, or terminating the interaction.

Although there is variability across studies in how sensitivity is conceptualized and assessed, based on a review of the literature, Shin et al. (2008) identified the main components of sensitivity as involving mothers responding contingently and appropriately to their infants' cues – apparently with the aim to maintain their infants' positive emotional state within an optimal level of arousal to keep them engaged (i.e., attentive and communicative) in the interaction (Cohn & Tronick, 1987; Stern, 1974). When sensitive, mothers also positively connect with their infants and mirror their behaviour. In so doing, infants must convey their needs and reactions, and mothers must perceive and accurately interpret their infants' cues, determine how to respond appropriately, and then implement this response (Ainsworth et al., 1978; Main & Solomon, 1990; Shin et al., 2008). Responding contingently to their infants' behaviour permits mothers and infants to develop a sense of self-efficacy in producing expected outcomes (Brazelton & Yogman, 1986; De Wolff & van IJzendoorn, 1997; Field, 1995;

Shin et al., 2008; Tronick, 2007). Over time, repeated highly sensitive and affectively positive interactions are thought to contribute to infants' development of a relationship with their mothers (Ainsworth et al., 1978; Blehar et al., 1977; De Wolff & van IJzendoorn, 1997; Goldsmith & Alansky, 1987) and interactive skills (Tronick, 2007), and serve as a critical context for infants to learn about people, language, and objects (Moore, 2006; Papoušek & Papoušek, 1986; Trevarthen & Aitken, 2001).

Despite the importance placed on mothers' continued sensitive behaviour in interactions over time, most investigations have assessed sensitivity based solely on a single measurement (e.g., Moore et al., 2009; Murray et al., 1996), often in an unnatural setting (e.g., McElwain & Volling, 2004; Meins, Fernyhough, Fradley, & Tuckey, 2001), likely due to the cost and time commitment involved in repeated-measures naturalistic designs. This is concerning given that sensitivity has only been found to be moderately consistent across observations (Ainsworth et al., 1978; Lindhiem, Bernard, & Dozier, 2010; Pauli-Pott, 2008) and that the more observations being summed across, the higher the effect sizes found between sensitivity and related variables (Ainsworth et al., 1978; Lindhiem et al., 2010). Although often treated as a trait, sensitivity is also a *state* (Lindhiem et al., 2010*)*. Utilizing assessments based on single observations is conceptually problematic as it is *repeated* highly sensitive interactions that predicts healthy attachment and development, rather than any one such interaction in isolation. Indeed, maternal inconsistency in sensitive behaviour with their infants across time may be predictive of serious problems in their relationship. For example, Lindhiem et al. (2010) found that mothers who demonstrated high variability in their sensitive behaviour

across observations were much more likely than more consistent mothers to have their infants removed from their homes by a social service agency.

In sum, repeated mutually enjoyable interactions over time predict infants' healthy attachment and development, and mothers are largely responsible for initiating and structuring these interactions. Mothers are thought to encourage optimal interactions by behaving sensitively, with the implicit goal to foster their infants' engagement and positive emotion state. Given the importance of maternal sensitive behaviour across time in promoting positive infant outcomes, it is important to understand what facilitates such behaviour in the moment, and what increases the likelihood that mothers will engage sensitively in future interactions (i.e., what makes behaving sensitively reinforcing to mothers). Application of a theoretical model of parenting would be helpful in developing predictions regarding these processes.

1.3 The Role of Emotions in Motivating and Facilitating Maternal Sensitive Behaviour

1.3.1 The Affective Model of Parenting.

There have been many theories of parenting advanced, with considerable variability in terms of their focus and explanatory model. Certain theories focus more on describing between-person differences in parenting, such as Baumrind's Authoritative, Authoritarian, and Permissive parenting styles which vary on dimensions of demandingness and responsiveness (1967). The Mutual Regulation Model (Tronick, 2007) focuses on emotions and within-interaction processes, most notably on the back-and-forth occurring between mother-infant dyads moving between uncoordinated and

coordinated states. The Dynamic Systems Perspective (Fogel, 2011; Fogel & Thelen, 1987) and Belsky's (1984) Determinants of Parenting Model may be more pertinent in accounting for changes in parent-child interactions over time. Both posit that parents and children reciprocally influence each other in interactions, however, Belsky places children's role as more secondary in predicting parenting. Specifically, the Dynamic Systems Perspective focuses on the role of microscopic changes in behaviour and interactions culminate into larger developmental and relationship changes, such as those changes in interactive patterns underlying the transition between dyadic to triadic mother-infant communications (Fogel, Garvey, Hsu, & West-Stroming, 2006). Belsky (1984) posits three sources of influence on parenting. These are, in order of purported importance, parent personality or characteristics, broad social context (e.g., marital relationship, social network, and work), and child characteristics. This model may be applied to accounting for between-person differences in parenting, as well as shifts over time. For example, it has been applied to the prediction of changes in parenting from infant ages three to nine months, with Feldman, Greenbaum, Mayes, and Erlich (1997) finding that a decrease in maternal trait anxiety and in infant difficult temperament ratings over this period predicted an increase in observed maternal sensitivity.

Drawing from basic research and theories of emotion (e.g., Frijda, 1988; Izard, 1977; Izard, Kagan, & Zajonc, 1984; Lazarus & Folkman, 1984), Dix (1991) proposed a three-component model of parenting, with parents' emotions as central in organizing and motivating their in-the-moment behaviour with their children. Unlike most other theories of parenting (e.g., Baumrind, 1967; Belsky, 1984; Tronick, 2007), Dix proposed an explanation for within-subject variability in parenting motivation and behaviour from one

interaction to the next, rather than for between-subject variability or (potentially successive) changes in parenting occurring over a period of time. The model emphasizes the factors immediately preceding the activation of parents' emotions (i.e., activation), the effects of parents' emotions on their behaviour once aroused (i.e., engagement), and the role of parents' understanding and regulation on their emotions and behaviour (i.e., regulation). The following is a summary of Dix's affective model of parenting (1991).

Emotions are sometimes activated innately or automatically, as in the case of children's cries being inherently aversive. However, in the majority of cases, emotions are triggered when adults believe (consciously or unconsciously) that current events are advancing or hindering their interests. When interacting with their children, because parents care what outcomes occur for themselves and their children, they experience positive emotion when they believe these goals are being achieved and negative emotion when they are being obstructed. Parents' interactive goals vary depending on the parent (i.e., trait) and the situation (i.e., state).

Parents' success at achieving their objectives and experiencing positive emotion in a given interaction is determined by their parenting skills and the compatibility of their current goals with those of their children. When parents adopt an empathic orientation (i.e., want to promote their children's happiness) and are adept at using empathic strategies (i.e., follow their children's lead), they are more likely to have harmonious and mutually enjoyable interactions, as both partners are working together to achieve the same end. However, negative emotion is sometimes inevitable as parents' goals are not always in line with their children's goals, such as when they want their children to behave appropriately (i.e., child-rearing goals) or want to get something accomplished outside of

the interaction (i.e., self-oriented goals). Such incongruence results in parents having more difficulty achieving their objectives, as they are working at cross-purposes with their children. To the extent that parents can quickly and easily elicit cooperation or force their children to comply at a given time, parents will experience little negative emotion. However, these cooperative and forceful strategies are much less likely to produce compliance in infants compared to older children due to the infants' limited control over their own behaviour.

The specific negative or positive emotion activated and its intensity are determined by parents' appraisals of the importance of their current goals, the reasons their goals are being promoted or blocked (i.e., stability and generality), and the possible courses of action and personal resources they have to ensure their goals are met (i.e., controllability). To illustrate, consider three situations in which an infant engages in the same behaviour with his mother, but in different contexts. In the first, the mother is on the phone trying to broker a deal with an important client and her child is in her arms, flailing his limbs and babbling loudly. In this case, the mother's goal is to arrange the deal with her client (i.e., a self-oriented goal), which is extremely important to her, as she works on commission and needs the revenue to meet her basic expenses. She believes her child is intentionally interfering and that his behaviour will annoy her client and lead her to lose the deal. She feels that she has a limited ability to force him to quiet down quickly. These appraisals result in the activation of anger. In the next situation, it is the weekend and this same mother is playing with her infant on the floor. She begins playing peek-a-boo with him, and he waves his arms in excitement and vocalizes loudly. This time, the mother's goal is for her child to be happy and engaged (i.e., an empathic goal), as she values spending

"quality time" with him. She interprets his behaviour as reflecting his enjoyment of her contribution to the interaction. Her goal is being attained and she is confident she has the ability to maintain his engagement. This results in activation of happiness. In the third situation, it is the evening and the mother wants her infant to go to sleep as it is his bedtime and he has a doctor's appointment the next morning (i.e., a child-rearing goal). She puts him to bed but when she returns, he is looking at his mobile and waving his limbs and vocalizing in lieu of sleeping. She does not know how to get him to fall asleep and is too exhausted to fathom dealing with the crying that will ensue if she removes his mobile. She feels sad.

Upon being activated, parents' emotions affect their ability to engage effectively with their children. Emotions influence parents' communicative behaviour, such as smiling when happy, engaging in quick and forceful movements when angry, and speaking in a quiet or monotone voice when sad; these behaviours communicate to children how their parents are feeling. Emotions activate motivations to maintain or alter children's behaviour to ensure parents' concerns are promoted. Parents' emotions also bias cognition toward goal-salient cues, leading to more efficient processing of emotion- and goal-congruent information. For example, when anxious, a mother may selectively attend to and process her child's signs of displeasure or disapproval of her behaviour (e.g., looking away from her, fussing), and largely dismiss his smiles and coos. Finally, emotions prepare parents to perform distinct patterns of behaviour, such as approaching children when happy and withdrawing when sad.

Parents' emotions can contribute to maladaptive behaviour with children when their emotions are insufficiently activated, are excessive (especially if negative), or are poorly

matched to the parenting task at hand. For example, a mother who is extremely angry with her boss may behave forcefully when feeding her child.

However, just because parents' emotions prepare them to engage in a given way with their children, does not mean resultant behaviour is fixed. Rather, this relationship between emotions and behaviour is influenced by parents' ability to understand and control their emotions and their expression (i.e., regulation processes). For example, believing that mothers ought never express anger with their infants, a mother is disturbed to realize she is experiencing this emotion with her crying baby. She therefore tries to inhibit this feeling and its expression by taking a deep breath, and cuddling and kissing her baby. Another empathically oriented mother may feel sad and exhausted but recognizing her child wants to play, so she feigns a smile and bounces him on her knee. Parents with poor regulation skills may not be able to modulate the intensity of their emotions or their expression, resulting in less coordinated interactions.

To summarize, Dix (1991) proposed that parents are emotionally invested in achieving certain outcomes for themselves and their children in interactions, and therefore structure their behaviour to achieve these ends. Individual parent's goals and emotions differ across situations, as does their parenting behaviour. Their in-the-moment emotions reflect their beliefs about whether the interaction is advancing their goals, why this is the case, and the courses of action and personal resources they have to get their interactive goals met. Their emotions affect how they will interpret events and behave to get their goals achieved. When parents want to promote their children's interests and are able to effectively regulate their emotions and their behaviour with their children, mutually enjoyable and positive interactions are likely. When parents pursue outcomes

their children do not want and are unable to control their own emotions and behaviours, conflict and negative emotions will occur.

1.3.2 Relevance of the Affective Model of Parenting to Mother-Infant Interactions.

The affective model may be particularly pertinent in understanding mothers' in-the-moment behaviour and enjoyment of interactions with their infants, and indeed, this model is used to conceptually frame the present dissertation. Early mother-infant interactions are very emotional (Garvey & Fogel, 2008; Moore, 2006; Trevarthen & Aitken, 2001; Tronick, 2007), arguably more so than at later stages of development. Two- to 6-month-old infants have yet to develop spoken language and joint attention, and therefore lack the ability to engage with persons and objects simultaneously (Moore, 2006; Trevarthen & Aitken, 2001). Rather than communicating about a topic or object, as occurs in most interactions between older participants, early exchanges between mothers and infants lack an external referent. They are not *about* anything but the current behaviour and experience of the partners (Moore, 2006). Reciprocal emotional expressions and gestures are the primary mode of communication between infants and their mothers at this stage (Demos, 1986; Izard, 1991; Moore, 2006). When sensitive, mothers focus their energies on having their infants experience and express increased enjoyment and minimized discomfort (e.g., Stern, 1974; Tronick, 2007). To the extent that mothers are successful in achieving these ends, they are presumed to experience positive emotion and an increased sense of self-efficacy (Moore, 2006; Tronick, 2007). The resultant shared enjoyment and resolution of infants' distress are thought to be

critical in motivating proximity and promoting their developing relationship (e.g., Blehar et al., 1977). “Often what provides the opportunity for a series of interactions over time is a desire to continue the emotional connection established in a previous interaction” (Moore, 2006, p. 74).

Given the importance of mutual enjoyment in early mother-infant interactions, it is of concern that mothers are more likely to experience negative emotions and psychopathology in the postpartum period. In the days following childbirth, 50% to 80% of women experience “postpartum blues,” marked by tearfulness, crying, emotional lability, fatigue, and sleep disturbances (for review, see Henshaw, 2003; Hopkins, Marcus, & Campbell, 1984). At three months postpartum, 34.2% to 39.5% of typical mothers report feeling more anxious or nervous since their infants’ births, 26.8% indicate feeling more irritated/angry against others, 16.8% more sad, and 14.1% more exhausted (Righetti-Veltema, Conne-Perréard, Bousquet, & Manzano, 2002). Approximately 20-28% of mothers report elevated depressive symptoms in this period (Gotlib, Whiffen, Mount, Milne, & Cordy, 1989; O’Hara, Neunaber, & Zekoski, 1984; Seimyr, Edhborg, Lundh, & Sjgören, 2004) and about 13% suffer from postpartum depression (i.e., PPD; see meta-analysis by O’Hara & Swain, 1996). The risk of the onset of depression is three times higher than normal in the first 5 weeks after delivery (Cox, Murray, & Chapman, 1993). PPD is marked by depressed mood and/or loss of pleasure most of the day nearly every day (American Psychiatric Association, 2000). Additional symptoms distinguishing women with PPD from those without include, from most to least common, fatigue and loss of energy, difficulties concentrating, psychomotor agitation or slowing, feelings of worthlessness, sleep disturbance, thoughts of death or suicide, and increased appetite

(Kammerer et al., 2009). Compared to well mothers, those with a PPD diagnosis or symptoms are also more likely to behave insensitively with their children (e.g., Field, 2010; Murray, 1991), particularly their infants (see meta-analysis by Lovejoy, Graczyk, O'Hare, & Neuman, 2000). The affective model may be helpful in elucidating the relationship between typical and pathological maternal emotional disturbances and interactive difficulties in the postpartum period.

1.3.3 Maternal Emotion States and Sensitive Behaviour.

Dix, Gershoff, Meunier, and Miller (2004) suggested that three emotions are particularly salient to supportive or sensitive parenting (i.e., supporting children's wants and interests): joy, anger, and sadness. Given the inconsistency across studies in the terms used to describe similar positive emotion states (e.g., happiness, joy, excitement, cheerfulness, and vigour), for simplicity's sake, these will henceforth be referred to as positive emotions. Positive emotion reflects the appraisal that an event is pleasant and controllable, and the tendencies to approach, attend, and be prepared to engage with the environment (Frijda, Kuipers, & ter Schure, 1989). Dix et al. (2004) proposed that the experience of positive emotion might increase parents' motivation and readiness to attend to and support their children's interests. Anger is activated when goals are frustrated or events are deemed unpleasant, unfair, and caused by someone else, and results in the tendency to be more attentive and antagonistic (Dix et al., 2004; Frijda et al., 1989). This emotion is thought to have a negative impact on relationships (Scherer & Wallbott, 1994). The experience of anger may motivate and ready parents to resist and be unsupportive of their children (Dix et al., 2004). Finally, events interpreted as unpleasant

and uncontrollable are associated with sadness (Frijda et al., 1989). When sad, people tend to feel helpless (Frijda et al., 1989), introspective (Lazarus, 1991), and withdrawn (Andersen & Guerrero, 1998; Scherer & Wallbott, 1994). Therefore, feeling sad may increase the likelihood that parents will withdraw, disengage, and be unresponsive to their children (Dix et al., 2004).

Although not specifically discussed by Dix et al. (2004), anxiety may also have strong adverse effects on sensitive parenting. Events considered unpleasant, with uncertain yet modifiable outcomes, tend to result in anxiety (Frijda et al., 1989). Anxiety tends to impair executive functioning (Derakshan & Eysenck, 2009) and triggers increased attention to threat cues (Matthews & MacLeod, 2005), inhibited or withdrawn behaviour (Frijda et al., 1989), and disruption to interactions (Andersen & Guerrero, 1998). Anxiety may make it difficult for mothers to behave sensitively with their infants: "The disruption follows directly from the formulation that increases in anxiety are likely to disrupt complicated behavioural tasks, and interacting with an infant, though "natural," is complicated indeed" (Tronick, 2007, p. 207).

There is little to no research directly exploring the effect of mothers' current emotion states on their behaviour with their infants. However, there is a large body of literature suggesting high depressive symptoms or PPD interferes with mothers' ability to behave sensitively. PPD is marked by increased sadness, as well as anxiety (McMahon, Barnett, Kowalenko, Tennant, & Don, 2001), anger (i.e., irritation with others; Righetti-Veltema et al., 2002), and decreased positive emotion (Peeters, Berkhof, Delespaul, Rottenberg, & Nicolson, 2006). Exploring the interactive difficulties of mothers with PPD may provide insight into the effect of these negative emotions and diminished positive emotions on

mother-infant interactions. Indeed, rather than depression *per se,* Lovejoy et al. (2000) suggested that disturbances in negative and positive emotion may best account for the interactive problems observed in mothers with PPD.

In a meta-analysis of 19 studies, Beck (1995) found that PPD had a moderate effect on mothers' interactive behaviour with their infants (r = .32-.36). As a group, mothers with depressive symptoms or PPD are less sensitive (Broth, Goodman, Hall, & Raynor, 2004; Crockenberg & Leerkes, 2003), less empathic (Reck et al., 2004), and more negating of their infants' experience than well mothers (Murray et al., 1996). Their ability to perceive, accurately interpret, and respond appropriately and contingently is impaired (for review, see Reck et al., 2004). Compared to non-depressed mothers, they are more likely to express negative affect or behave intrusively, be more withdrawn or disengaged, and less positive, playful, and affectionate (for meta-analysis, see Lovejoy et al., 2000). They are more likely to report feeling inadequate as a mother (Fleming, Fuble, Flett, & Shaul, 1988).

Within the group of mothers with PPD, two main interaction styles have been described in the literature: intrusive and withdrawn (for reviews, see Field, 2010; Field, Hernandez-Reif, & Diego, 2006). Mothers who behave intrusively are overstimulating and controlling with their infants, expressing angry facial and vocal expressions, and touching or gesturing quickly and forcefully (e.g., rough tickling, poking, tugging, abrupt actions). They report experiencing more angry/hostile feelings overall (Hart, Field, Jones, & Yando, 1999). When observed in a three-minute face-to-face interaction with their infants, 39% to 50% of mothers with PPD behaved intrusively most of that time (Diego, Field, & Hernandez-Reif, 2001; Field, Healy, Goldstein, & Guthertz, 1990; Jones, Field,

Hart, Lundy, & Davalos, 2001). Forty-one percent of depressed mothers report having thoughts of harming their infants (Jennings, Ross, Popper, & Elmore, 1999) and 31.7% endorse pathological anger and/or rejection (Loh & Vostanis, 2004). Mothers who are withdrawn, on the other hand, are understimulating and disengaged with their infants, expressing more flat affect and looking away or passively watching, as well as less vocalizing, and touching (Field et al., 1990; Jones et al., 2001). They endorse more anxious feelings overall (Hart et al., 1999). Based on single observations of interactions with their infants, nearly a third of mothers with PPD behaved predominantly withdrawn (Diego et al., 2001; Field et al., 1990; Jones et al., 2001). Thirty-two percent of depressed mothers report a lack of emotion response or postpartum anxiety with their infants (Loh & Vostanis, 2004). Infants appear to find both maternal intrusive and withdrawn behaviour aversive, responding with avoidance/disengagement, fussing, and few brief positive expressions (Cohn, Matias, Tronick, Connell, & Lyons-Ruth, 1986; Cohn & Tronick, 1989; Field et al., 1990).

However, when observed on a single occasion (as is typical in such research), mothers with PPD do not all behave in an intrusive or withdrawn manner with their infants. Seventeen to 38% cannot be classified as intrusive or withdrawn (Cohn & Tronick, 1989; Diego et al., 2001; Field et al., 1990; Jones et al., 2001). In fact, some do not appear to exhibit interactive difficulties at all. Field and colleagues (1990) found that 8% of mothers with high depressive symptoms behaved mostly positively and playfully with their infants, Cohn and Tronick (1989) noted 23% behaved positively, and Field, Diego, Hernandez-Reif, Schanberg, and Kuhn (2003) found 25% behaved well.

What then accounts for the differences observed in interactive behaviour across mothers with PPD? Like well individuals, those with depression vary in their experience of positive and negative emotions within and across days (Peeters et al., 2006). So, although depressed individuals are more likely to report feeling negatively overall (Peeters et al., 2006), at any given moment, they may feel positively or negatively to varying degrees. As assessments of interaction style of mothers with PPD are based on single observations of their infant interactions, it is possible that differences found in interactive style are not static or trait-like, but rather may vary depending on mothers' emotion state at the time they are observed. Thus, based on Dix et al.'s (2004) predictions, exploration of the emotions mothers with PPD endorse overall, and observation of their expressive and interactive behaviour, it may be the current experience of anger that is driving intrusive behaviour, anxiety or sadness that is inducing withdrawn behaviour, and positive emotion is leading to positive/playful behaviour. Indeed, Murray, Cooper, Creswell, Schofield, and Sack (2007) found that mothers with social phobia and those with generalized anxiety disorder were more disengaged in interactions with their 10-week-old infants than were non-anxiety disordered mothers, a pattern not unlike that observed in depressed withdrawn mothers. Nicol-Harper, Harvey, and Stein (2007) also found that mothers with high trait and state anxiety were less sensitive and less emotionally positive with their 10- to 14-month-old infants than were mothers with low levels of anxiety.

There are, however, several limitations in research that preclude firm conclusions about the relationship between maternal emotion states and interactive behaviour from being drawn. First, mothers' subjective emotion states are typically inferred from their

expressive behaviour rather than from self-reports. Although the activation of emotion states may increase the likelihood of certain behaviours, mothers can use their regulatory abilities to control their behaviour to some extent (Dix, 1991). It is therefore possible that one mother who presents an angry facial expression and another who smiles are both currently experiencing anger, the latter may just have better control over her behaviour. Thus, in order to evaluate the relationship between maternal emotion states and interactive behaviour, mothers should be asked to self-report their current emotions. Second, in the few studies in which mothers with PPD were asked to rate their emotions, they were typically asked to rate their feelings over time (e.g., over the past week), rather than in the moment. A mother who indicates she typically feels anxious may be more likely to feel anxious with her infant overall, but not necessarily at the time she is observed interacting. To determine if current emotion state is affecting behaviour, researchers would need to ascertain what the mother is experiencing immediately prior to interacting with her infant. Thirdly, given that the majority of the research on maternal emotions and interactive behaviour is restricted to mothers with PPD or other mental health problems, it remains unclear if maternal emotion state in and of itself affects behaviour rather than the combination of psychopathology and a negative emotion state. Studies with well mothers are needed to clarify the effect of normal transient variations in maternal emotion state on the interaction. Finally, conclusions about the relationship between maternal emotion state and interactive behaviour cannot be drawn based on current methodologies that involve only single observations of mothers' interactions. Even if researchers found that mothers' current experience of sadness was associated with withdrawn behaviour with their infants, it would not be clear if the behaviour

observed were trait-like or would change if the mother felt differently at another time. Thus, to discern if emotion state indeed affects behaviour, researchers would need to evaluate if within-subject variability in self-reported emotion state in well mothers over time was associated with corollary changes in interactive behaviour with infants.

Review of the literature indicate only five studies that come close to meeting the aforementioned criteria, however, they were conducted with non-pathological mothers and their toddlers, not infants. In the first, Martin, Clements, and Crnic (2002) explored the relationship between mothers' self-reported emotion state and their sensitive behaviour with their 2-year-olds during a waiting task in a laboratory setting. After interacting, mothers were asked to rate the emotions they experienced during the interaction. Mothers were divided into three categories based on their self-reported negative emotion. They found that mothers who were moderately-high negative were significantly less sensitive with their children than were not negative or slightly negative mothers in the wait task.

Weis and Lovejoy (2002) observed mothers interact with their 2- to 5-year-old children in a laboratory during free play and during a stressful condition (i.e., mothers asked to complete anagrams while ensuring their children did not play with attractive toys). Immediately afterward, they asked mothers to rate their mood state "over the last 15 minutes." In both conditions, they found that maternal negative mood state was negatively associated with mothers' ratings of their supportive parenting, and positive mood state was positively associated. Of note, they also found that mood state was a stronger predictor of maternal interactive behaviour than trait affect. However, in the free play laboratory task, the effects of positive and negative mood states and trait affects on

supportive parenting were not statistically significant when parenting was determined by direct observation in lieu of self-report. In the stressful task, on the other hand, mood states were associated with observer ratings of supportive parenting.

In the third study, Dix et al. (2004) explored the relationship between mothers' emotional experience and motivation during interactions with their 14- to 27-month old children. They videotaped mothers interacting with their children during three stressful conditions in a laboratory setting (i.e., mother asked to prevent child from playing with certain attractive toys while completing questionnaires, playing with child, and during clean-up). Mothers then reviewed their videotaped interactions and rated their moment-by-moment emotions. Dix et al. found that the more joy mothers reported during the interaction, the more supportive behaviour was observed. Anxiety/worry was associated with passive watching behaviour, sadness with detached behaviour, and anger with more detached and restrictive behaviour and less supportiveness. Thus, even in well mothers, emotion states elicited what appeared to be sensitive, withdrawn, or intrusive behaviour. When emotion states were aggregated into positive and negative categories, they found that positive emotion was negatively associated with unsupportive parenting, whereas negative emotion was positively associated. Neither grouping was significantly associated with supportive parenting.

Finally, Lorber and O'Leary (2005) and Lorber and Slep (2005) explored the relationship between mothers' emotion states and their responses to their toddlers' misbehaviour during challenging laboratory situations (i.e., child not to play with attractive objects in room during while cleaning up, and then while playing independently while mother spoke on the phone or completed a questionnaire). After interacting,

mothers watched the videotape of themselves interacting and rated their experienced emotions on a scale from negative to positive. The more intense the mothers' emotions were, the angrier or more irritated (Lorber & O'Leary, 2005) or more hostile and power-assertive (Lorber & Slep, 2005) were their responses to their toddlers' misbehaviour.

In all, these investigations suggest that mothers' emotion states are associated with how they behave with their toddlers. However, as all of the studies involved retrospective reports of maternal emotion state during the interaction, it is unclear if maternal emotion *predicted* interactive behaviour, co-occurred, or was predicted by factors in the interaction. Also, in all cases, interactions were observed in a laboratory setting, and all but one study focused on only stressful or challenging situations rather than on naturalistic unstructured situations. Thus, it is unclear if the findings from these studies' generalize to typically occurring interactions. Interestingly, the only study to explore interactions during free play found that mothers' emotions were related to *perceptions* of their supportive parenting, but not with observer-rated parenting. However, emotions and affective expressions are arguably more salient in interactions between mothers and their pre-verbal infants than with their toddlers, thus relationships between emotions and parenting behaviour may be more apparent. Finally, only one investigation focused on sensitivity, whereas the rest explored relationships with other facets of parenting behaviour. More research is also needed to verify if the above findings extend to mothers' behaviour with their infants, and to account for the variability in interactive behaviour across time. These are primary objectives of the present dissertation research.

1.3.4 Fatigue as a Regulatory Difficulty Disrupting Maternal Emotions and Ability to Behave Sensitively.

Dix (1991) proposed that parents' current emotions incline them to behave in a particular manner, and their ability to understand these emotions and control them governs how they will actually behave with their children (i.e., regulation processes). According to this theory, any interference in parents' ability to regulate themselves would be expected to increase the likelihood of them behaving insensitively with their children when feeling a negative emotion.

Fatigue – the sense of extreme exhaustion and reduced bodily resources for mental and physical activity (Parks, Lenz, Milligan, & Han, 1999; Piper, 1989; Rubin, 1984) – has been found to disrupt the ability to concentrate, plan, make decisions, and execute behaviour (Frijda, 1986; Hockey, Maule, Clough, & Bdzola, 2000; Torres-Harding & Jason, 2005; van der Linden, Frese, & Meijman, 2003; van der Linden, Frese, & Sonnetag, 2003). This state may therefore interfere with parents' regulation processes. This is of concern given that fatigue is one of the most frequently reported complaints for mothers in the postpartum period (Gjerdinger, Froberg, Chaloner, & McGovern, 1993; Righetti-Veltema et al., 2002) compared to women outside of the postpartum period (for a review, see Hunter, Rychnovsky, & Yount, 2009). In their study of 426 first-time mothers in the U.S., Gjerdinger et al. (1993) found that fatigue was the third most common concern (after respiratory illness and sexual difficulties) in mothers at 3 and 6 months postpartum. Mothers have been found to describe their experience in this period as "foggy and tremendously sleep-deprived" (p.118, Kennedy, Gardiner, Gay, & Lee, 2007). They largely attributed their lack of sleep to the need to adjust to their infants'

feeding and sleep patterns (Hunter et al., 2009). By decreasing the personal resources parents have to ensure their goals are met (Dix, 1991), fatigue may also induce negative emotion (Runquist, 2007). Indeed, a mother may feel unable to manage her crying infant when she is in an extreme state of exhaustion, leaving her feeling hopeless and lacking confidence as a mother, resulting in sadness.

Researchers have found that fatigue disrupts executive functioning (e.g., van der Linden, Frese, & Meijman, 2003) and is very common in the postpartum period (e.g., Gjerdinger et al., 1993). Several authors have suggested that fatigue may interfere with mothers' ability to appropriately interact and care for their infants (Bozoky & Corwin, 2002; Jomeen & Martin, 2007; Kienhuis, Rogers, Matthews, Giallo, & Treyvaud, 2010; McQueen & Mander, 2003; Parks et al., 1999; Troy, 2003). However, there appear to be only five studies evaluating the association between fatigue, emotions, and parenting behaviour of infants and young children. In a grounded theory investigation of 15 mothers with postpartum fatigue, Runquist (2007) found that mothers reported more difficulty concentrating or paying attention due to cognitive slowing or rambling thoughts. Fatigue exacerbated their irritable, frustrated, and worried feelings, and these emotions in turn worsened their fatigue. Once frustrated, mothers reported being easily disturbed and impatient with others. Similarly, in a qualitative study of 20 mothers, Kennedy et al. (2007) found that mothers noted that their sleep deprivation made them irritable and impatient with their partners. By impeding concentration and attention, and increasing the experience of negative emotions with others, it is possible that fatigue may impair mothers' ability to function and respond sensitively to their infants, however, this was not explored in these investigations. Supporting this hypothesis, Troy (1999) found

that fatigued women were half as likely as non-fatigued women to report a return to full functional status, including household, social, employment and self-care activities, and assumption of infant care responsibilities. No direct measure of parenting was collected in these three studies.

In a self-report investigation of the effects of fatigue on the parenting of well mothers, those with multiple sclerosis (MS), and those with rheumatoid arthritis (RA), White, White, and Fox (2009) found that fatigue predicted mothers' report of poorer monitoring (i.e., Likert response to the question "there are times I don't have the energy to pay attention to where my child is") of their 12- to 45-month-old children. Fatigue did not predict self-reported laxness (i.e., mothers' follow-through on discipline), however, discipline may be much less relevant when applied to the parenting of young infants as compared to older children. After controlling for sleep, depression, and number of children in the home, there was a trend for fatigue predicting greater reports of over-reactivity (i.e., discipline marked by irritation or anger with the child) in well mothers and those with MS. Fatigue may therefore increase mothers' angry feelings and behaviour, and interfere with their attention to their young children. In the only study exploring the relationship between fatigue in well mothers and an indicator of parenting skill with their infants, Parks, Lenz, and Jenkins (1992) found that mothers who indicated that they had been fatigued or tired in the previous month and had low social support, had less stimulating home environments for their infants (an indirect indicator of parenting skill) than did non-fatigued mothers with low social support. Although these findings suggest fatigue may interfere with parenting of infants in certain circumstances, there was no measure of the extent or chronicity of fatigue or the effect of current fatigue on any direct

measure of parenting behaviour. In sum, the five studies reviewed provide preliminary support for the contention that that mothers' experience of fatigue may lead to problems attending and concentrating, negative emotions, impatience with others, and parenting difficulties. However, to truly support this claim, more research is needed to directly explore the effect of mothers' current feelings of fatigue on their observable interactive behaviour with their infants.

Fatigue has also been found to be a very frequent concomitant of PPD (Dennis & Ross, 2005; Kammerer, et al., 2009) and other postpartum psychopathology (Fisher, Feekery, and Rowe-Murray, 2002). Fatigue and loss of energy is one of the factors most strongly distinguishing women with PPD from those without (Dennis & Ross, 2005; Kammerer et al., 2009). In a qualitative study of 30 mothers with self-reported PPD, Ugarriza (2002) found that several indicated that sleep deprivation was a contributing factor to their depression. Similarly, maternal fatigue at 4 months postpartum, significantly predicted depressive symptomatology at 8 weeks postpartum. Indeed, individuals undergoing sleep deprivation report less vigour and greater feelings of fatigue and depression than when not sleep-deprived (Scott, McNaughton, & Polman, 2006). Mothers with PPD reported that daytime sleepiness affected their ability to care for their infants (Huang, Carter, & Guo, 2004). Together, these findings offer preliminary evidence that postpartum fatigue may contribute to feelings of sadness, depressive symptomatology, and parenting difficulties observed in mothers with PPD.

As there is a high prevalence of fatigue in the postpartum period and the little research published in the area suggests it contributes to negative emotions and parenting difficulties, more research is needed to investigate the extent of this association in

mothers with infants. A significant relationship between the current experience of fatigue and maternal emotions and sensitive behaviour may support the development of interventions designed to decrease or manage exhaustion as a means of improving the mother-infant relationship. The association between mothers' self-reported current fatigue, emotion state, and sensitive behaviour with their infants was explored in the present dissertation.

1.3.5 Effect of Mother-Infant Interaction on Maternal Enjoyment.

Repeated sensitive maternal behaviour across time is theoretically important in facilitating healthy infant attachment and development. A large body of research supports a significant positive relationship between early sensitivity and positive infant outcomes. Thus far, the focus of this review has been on maternal state predictors of sensitive behaviour in the moment. However, in order to develop recommendations and interventions to help mothers interact optimally over time, it is not sufficient merely to understand what determines maternal sensitivity in any single interaction, but rather, upon behaving sensitively, what increases the likelihood that mothers will continue to do so in future interactions. In other words, what makes sensitive behaviour reinforcing or motivating for mothers?

Theoretically, it is maternal enjoyment in interactions that motivates proximity and continued interactions. Indeed, when behaviour is immediately followed by the experience of positive emotion, people tend to perceive that behaviour more positively and be more motivated to perform it in the future (e.g., Custers & Aarts, 2005; Zellner, Rozin, Aron, & Kulish, 1983). Therefore, to predict which mothers will be more likely to

engage sensitively with their infants repeatedly over time, it may be fruitful to evaluate how they feel after engaging in such behaviour with their infants. Indeed, when given the opportunity to avoid contact with their infants, mothers with PPD who behaved insensitively and expressed anger during interactions spent a considerable amount of time out of the room their infant was in during naturalistic observation (Cohn & Tronick, 1989). Perhaps due to associating interactions with their infants with the experience of negative emotion, these mothers avoided engaging when possible.

Dix (1991) proposed that perceived goal advancement or obstruction is critically important in determining what emotions parents experience in interactions with their children. A successful mother-infant interaction is thought to be one in which the mother is effective at maintaining her infants' enjoyment and engagement. Mothers help achieve this end by accurately interpreting and responding appropriately and contingently to their infants' cues. According to Dix (1991), it is this combination of empathic goals and parenting skill that increases the likelihood that parents will have mutually enjoyable interactions, as both partners are working together toward achieving the same end, and people experience positive emotion when they believe their goals are being advanced. Indeed, there is evidence that attainment of a behavioural goal activates the experience of positive emotion (e.g., Moors & De Houwer, 2001). Mothers' increase in positive emotion following the interaction suggests that they should be more likely to approach and interact sensitively with their infants in the future. Parents who, in the moment, do not have empathically oriented goals (e.g., parents who want their infant to behave appropriately in front of guests), will likely work at cross-purposes with their infants, and will therefore be less likely to have their goals met and more likely to experience

increased negative emotion. Finding the interaction with their infants unpleasant, these mothers will be less likely to engage with their infants in the future.

Although mothers who behave sensitively are more likely to elicit positive affect, engagement and communication in their infants, this is not always the case. Infants are also active participants in interactions (e.g., Bornstein & Tamis-LeMonda, 2001; Cohn & Tronick, 1988), and may be generally or occasionally easier or more difficult to engage with appropriately. There is a moderate (r = .49; Murray et al., 1996) – but not large – association between maternal sensitivity and infant active engagement, suggesting that sensitivity is an important but not unique determinant of infant behaviour in the moment. To illustrate, a mother's attempts to interact sensitively may be largely ineffective at yielding positive, active engagement in an infant who is overtired or ill. However, were the infant healthy and well-rested, the mother's attempts would be more likely to be met by smiles, attention, and vocalizations. There appear to be no studies investigating the effect of infant states on mothers' sensitive or insensitive interactive behaviour.

By virtue of their physiology or past interactive experiences, some infants may be more challenging interactive partners. For example, newborns of mothers with PPD have been found to have EEG patterns, and dopamine, norepinephrine, cortisol, and serotonin levels similar to their mothers, as well as less optimal performance than infants of non-depressed mothers on several scales of the Brazelton Neonatal Behavioural Assessment Scale (e.g., poorer orientation, motor skills, and depression scores; Field et al., 2001; Field et al., 2003). Compared to infants of non-depressed mothers, it is possible that these infants' different biochemical, emotional, and behavioural profiles may make it more challenging for their mothers to respond appropriately to elicit active engagement,

perhaps leaving these mothers discouraged and less likely to engage sensitively in future interactions. Indeed, mothers with PPD who behaved sensitively with their infants at age 3 months had neonates who had better Brazelton scores, less indeterminate sleep, and less relative right frontal EEG activation than did the neonates of intrusive and withdrawn mothers with PPD. These more regulated neonates may have been easier and thus more reinforcing for their mothers to effectively engage sensitively with them (Field et al., 2003). However, it is unclear the extent to which the relatively lower anger scores and less extreme intrusive and withdrawn behaviour styles of the good interaction mothers with PPD accounted for their more sensitive behaviour when compared with the poor interaction mothers with PPD. Field et al. (1988) observed that the 3- to 6-month-old infants of depressed mothers demonstrated similar interactive behaviour problems when interacting with their mothers as with female strangers (e.g., less physical activity, fewer vocalizations, more negative facial expressions and more fussiness than infants of non-depressed mothers). The female strangers were blind to the classification of the mother-infant dyads. Interestingly, although the female strangers did not demonstrate the same degree of interactive difficulties with the depression-group infants as did the depressed mothers, they did behave significantly worse with these infants than they did with the non-depressed group infants (e.g., less physical activity, fewer vocalizations, and less contingent responsivity). Although maternal depression may contribute to more extreme problems interacting, infants' behaviour does seem to exert an effect, making it more difficult for their mothers to behave sensitively with them.

In the present dissertation, the postulate that mothers would feel better after behaving sensitively with their infants if, and only if, their infants responded favourably (i.e., with

positive and active engagement) was evaluated. These findings will help to clarify the processes that contribute to mothers being motivated to repeat their sensitive behaviour in the future.

1.4 Methodology For Evaluating The Mother-Infant Interaction

Observational evaluations are considered paramount in the objective assessment of mother-infant interactions (see Gardner, 2000; Fowles & Horowitz, 2006). Such assessments may be less subject to systematic bias than parent-report measures (e.g., see Eddy, Dishion, & Stoolmiller, 1998; French & Sutton, 2011). Indeed, there is evidence that people are more likely to report socially desirable behaviour in questionnaires, than to engage in such behaviour when directly observed (e.g., Stanton, Clemens, Aziz, & Rahman, 1987; Manun'Ebo, Cousens, Haggerty, Kalengaie, Ashworth, & Kirkwood, 1997; Strina, Cairncross, Barreto, Larrea, & Prado, 2003). Observational assessments are also valuable assets in the planning of interventions to improve mother-infant interactions (see Fowles & Horowtiz, 2006; Munson & Odom, 1996). It is therefore not surprising that this type of assessment has proliferated in research studies evaluating the interaction (e.g., Cohn & Tronick, 1987; Field, et al., 1985; Lundy, 2003; Tomlinson et al., 2005), as compared to self-report and interview measures.

Although there are no accepted or best-practice guidelines for the duration, frequency, and setting of observational assessments of mothers and infants (Munson & Odom, 1996), typically, the mother is instructed to feed or to sit and play face-to-face with her infant as she normally would on one occasion for three to twenty minutes in a laboratory or home setting (for reviews, see Fowles & Horowitz, 2006; Horowitz,

Logsdon, & Anderson, 2005; Munson & Odom, 1996). A researcher is usually present during these interactions, in order to directly code the dyad's behaviours or, more typically, to videotape them for later coding.

This usual methodology employed for conducting observational evaluations in mother-infant research may interfere with the ecological and external validity of such assessments. To begin with, as previously discussed, data accrued from assessments based on single observations may not be indicative of mothers' and infants' usual interactions (e.g., Lindhiem et al., 2010). It is also possible that dyads may behave differently in novel environments such as a laboratory (see Gardner, 1997, 2000). Indeed, there is evidence of moderate to no consistency in mothers' behaviour with their children across home and laboratory settings, depending on the behaviour observed (Belsky, 1980; Crockenberg & Litman, 1990; Pauli-Pott, 2008; Webster-Stratton, 1985). For example, Crockenberg and Litman (1990) observed 95 mothers interacting with their 2-year-old children behind a one-way mirror during a clean-up task in a laboratory, and then directly observed (i.e., observer present in the setting to document and rate behaviours) and audiotaped the dyads during dinner in their homes within a month of the initial observation. A medium correlation was found across settings for maternal controlling behaviour (r = .32 for negative control and r = .34 for control), but not for responsive behaviour (i.e., allowing the child to lead conversations; r = .03, NS) or for guidance (r = .17, NS). Thus, in constructs related to sensitivity (i.e., responsiveness and guidance), mothers differed more widely in their behaviour across settings. Similarly, Belsky (1980) directly observed six mothers and their 12-month-old infants interacting twice in their homes, during which time they were asked to go about their daily routines while a

researcher observed, six were observed twice during free play in a laboratory environment behind a one-way mirror, and 12 once in each environment. Mothers were found to behave differently across settings (i.e., mothers were two to four times more active and responsive during laboratory observations than home observations), and were more consistent in their behaviour in the same environment than across settings. Belsky concluded that, "cross-contextual generalizations, especially from the lab to the field, are unwarranted unless across-setting consistency can be empirically documented" (p. 37).

However, an important confound in these and in most other investigations documenting any across-setting differences in maternal behaviour, is that these investigations often employ different kinds of tasks and levels of observation conspicuousness (e.g., one-way mirror, observer present in room, or audiotape alone) in each setting (for discussion, see Aspland & Gardner, 2003; Gardner, 2000). Thus, it is possible that these factors account for or contribute to observed differences in mothers' behaviour across settings. In one of the few studies comparing behaviour during the same activity in multiple settings, Pauli-Pott (2008) had 101 mothers engage in free play with their 4-month-old infants in both the home and laboratory environment. She found a small (r = .22) correlation between same-day ratings of maternal reactivity/sensitivity across settings. Thus, even when activity remained constant, the relationship between ratings of maternal behaviour across settings remained small. Of note, how observations were conducted (e.g., one-way mirror, observer present) in each setting was not specified. In another investigation employing the same task across settings, Webster-Stratton (1985) observed 40 mothers interacting with their 3- to 8-year-old children with disruptive behaviour problems at home and in a clinic playroom. At home, dyads were directly

observed in an unstructured condition (i.e., "do what you would normally do"). At the clinic, dyads were videotaped behind a one-way mirror while engaging in an unstructured condition, and two structured conditions (i.e., one child-directed and one parent-directed). Moderate to no significant correlations (r = .13 to .46) were found between mothers' critical, commanding, and positive behaviour between the unstructured and structured laboratory conditions, and no significant relationship was found between their behaviour in the parent-directed structured laboratory condition and the unstructured home condition. However, medium to large correlations (r = .37 to .70) were found between their behaviour in the unstructured laboratory and home conditions. Thus, in contrast with Pauli-Pott (2008), Webster-Stratton (1985) found that maternal behaviour appeared to be more affected by the type of activity than by the setting of observation. However, it is possible that mother-child dyads with psychopathology or at different stages of development may demonstrate different patterns of reactivity.

In his reviews of observational methods for assessing parent-child interactions, Gardner (1997, 2000) concluded that parent-child interactions might be affected by the type of activity or by the location of the observation. In order to enhance generalizability of findings from such research, he recommends observational assessments be conducted in a naturalistic home environment. Similarly, Eddy et al. (1998) recommend using Bronfenbrenner's (1989) ecological model as a guide, asserting it is important that "researchers measure behaviour in the natural environment, and select environments that developmental research indicates are relevant to the target problem and age of the child" (p. 66). As discussed above, for infants, repeated and ongoing face-to-face interactions with their primary caregivers (typically their mothers) are of particular developmental

significance (e.g., Bornstein & Tamis-LeMonda, 2001). Evidently, these interactions occur primarily in the home environment, and not in a clinic or laboratory setting. An important additional argument for conducting observations in participants' homes is that rural and working families may be effectively excluded from participating in studies requiring them to travel a great distance or to take time off work to be observed in a university or hospital laboratory setting. This may limit the generalizability of findings to these populations.

In addition to concerns about the validity of single assessments in unnatural settings, and on the nature of the task imposed on participants, there is evidence that families may change their behaviour when they are aware of being observed, such as by engaging with the observers (Harvey, Olórtegui, Leontsini, & Winch, 2009) or by interacting differently with their children (Baum, Forehand & Zegiob, 1979; Jacob, Tennenbaum, Seilhamer, Bargiel, & Sharon, 1994; Morawska & Sanders, 2007; Zegiob, Arnold, & Forehand, 1975; Zegiob & Forehand, 1978). In Baum et al.'s (1979) review of 17 studies on observer reactivity in adult-child interactions, they found that the majority documented greater adult positive and neutral behaviours with children when they were aware they were being observed. Of note, negative behaviours appeared less subject to reactivity effects. In a more recent investigation, Jacob et al. (1994) had 87 non-distressed or distressed families manually activate a tape-recorder during dinnertime in their homes over the course of a week. During another week, tape-recorders were *automatically* activated at dinnertime, however, the specific timing of activation was not known to the families. Order of conditions was counterbalanced. They found that mothers with alcoholic husbands and those in non-distressed families behaved more positively with

their children when they activated the tape-recorder themselves than when it was automatically activated. However, mothers with depressed husbands showed the reverse pattern. In all, these findings suggest that mothers' behaviour with their children can be affected by their awareness of being observed, the type of behaviour being observed, and by their personal or family characteristics (e.g., psychopathology).

As people's behaviour can be affected by their awareness of participating in a psychological study and by the measurement process itself (Gardner, 1997; French & Sutton, 2010, 2011), and observing families without their awareness may be very challenging (or completely unethical), it has been recommended that measurement be as unobtrusive as is reasonably possible (e.g., French & Sutton, 2011). However, despite this ubiquitous recommendation, it was possible to locate only one published investigation comparing observational ratings of varying conspicuousness, where participants were aware of being observed. In this study, Johnson and Bolstad (1975) audiotaped the interactions of 12 families over six consecutive days, half of the time with an observer present and half without (in the latter case, the participants activated the tape-recorder). They found no significant differences between audiotape ratings with or without an observer present of parent negative behaviours and commands. However, power was quite low given the small sample size and no descriptive values were presented. Correlations were presented between observer-present and observer-absent ratings, which were .51 for parent negative behaviours and .48 for commands. These correlations were quite high, but should be interpreted with caution given that Pearson correlations may be inflated by the failure to account for the lack of independence in data due to repeated observations.

In summary, external or ecological validity of observational assessments of parent-child interactions may be affected by a multitude of factors, including the frequency of observations, the setting, the activity engaged in by the dyads, the behaviour being observed, the awareness of being observed, the conspicuousness or obtrusiveness of observation, and the characteristics of the dyads. It is difficult to discern the true size of reactivity effects, if any, given the few studies published in the area and the possibility of publication bias toward significant findings (French & Sutton, 2010). However, until there is compelling evidence that behavioural data gleaned from observing mother-infant interactions on a single occasion, in an artificial setting, during a structured task, and by conspicuous or obtrusive means (e.g., direct observation), are generalizable to those occurring in typical daily life, it behooves researchers to conduct repeated observational assessments in as natural and inconspicuous a manner as is reasonably possible. Although a few investigations have assessed parent-child interactions repeatedly and unobtrusively through automatically- or parent-activated tape recordings of families' verbal communications in their homes (e.g., Jacob et al., 1994; Johnson & Bolstad, 1975), this methodology has yet to be adapted to the observational assessment of mother-infant interactions. Videotape may be better suited to assessing the latter, as such early interactions are largely non-verbal. In order to help optimize the external or ecological validity of mother-infant interaction assessment, a goal of this dissertation was to develop an original methodology to videotape mother-infant interactions repeatedly and over time in families' homes, without a researcher present.

1.5 Research Objectives and Hypotheses

The primary objective of this dissertation was to explore what accounts for the variability in maternal sensitive behaviour with their infants over time. In so doing, this dissertation had three underlying goals. As the assessment of mother-infant interactions has typically only represented a brief snapshot of behaviour, often in an unnatural setting and with a researcher present in the room, the first goal of this dissertation was to develop and employ a more ecologically valid, unobtrusive and naturalistic methodology to measure interactions over time in families' homes. In so doing, user-friendly recording materials and instructions were developed and delivered to participating mothers to enable them to videotape their interactions with their infants themselves in their homes, without an observer present. To this researcher's knowledge, this is the first time such a methodology has been employed in the assessment of mother-infant interactions. Therefore, the feasibility of and participant satisfaction with this novel observational methodology was explored in a feasibility study.

The second goal was to evaluate the effect of mothers' emotion states and perception of bodily states on their ensuing interactive behaviour with their infants. Based on a review of the literature and previous studies, and Dix's (1991) affective model of parenting, it was hypothesized that maternal negative emotion state would predict less sensitive behaviour with infants than would a positive maternal emotion state. It was predicted that fatigue would moderate these effects by interfering with mothers' ability to regulate their emotions and behaviour. Specifically, negative emotion state would negatively predict maternal sensitivity when mothers were very fatigued, but this relationship would be weakened when mothers were minimally fatigued. In the case of

maternal positive emotion state and maternal sensitive behaviour, low fatigue would be associated with a stronger positive relationship than would high fatigue.

The final goal of the present dissertation was to explore what makes maternal sensitivity reinforcing to mothers, and thus more likely to be repeated in future interactions. It was hypothesized that infants' positive and active engagement would largely determine whether or not mothers felt better after interacting sensitively with their infants, thereby mediating this relationship.

CHAPTER 2: METHODS

2.1 Methods Overview

This chapter presents the methods for the feasibility study and the main study of this dissertation. The purpose of the feasibility study was to determine whether the novel observational methodology was well-tolerated and what adjustments should be made to it based on the quality of the data collected, as well as the mothers' feedback. Ethics approval from the IWK Research Ethics Board was obtained for both the feasibility study and the main study.

2.2 Feasibility Study Methods

2.2.1 Participants.

Participants were recruited from October 2008 to February 2009, from an advertisement placed on a local free online classified site for Halifax, Nova Scotia (http://halifax.kijiji.ca/), as well as from posters at local daycare and community centres, and throughout the IWK Health Centre. Only biological mothers of infants aged 13 to 30 weeks, or those who were primary caregivers of their infant since birth, were included. In order to allow for coding of mothers' utterances, only mothers who reported they interacted with their infants in English were eligible to participate. Finally, if other young children lived in the home, mothers must have been able to ensure that another adult would supervise these children while she and her baby participated in the study. Exclusion criteria for infants included factors found to markedly effect the mother-infant

interaction, including infant prematurity and serious physical illness (Barnard, Bee, & Hammond, 1984; Minde, Whitelaw, Brown, & Fitzhardinge, 1983; Salerni, Suttora, & D'Odorico, 2007). Mothers were offered the Bumbo Baby Sitter® (for details, see below) as compensation for their time.

Twelve participants were assessed for eligibility for the feasibility study. Two did not meet inclusion criteria (i.e., one participant's infant was older than 30 weeks and another participant's infant was born prematurely) and one declined to participate.

Participants included nine mothers aged 25 to 35 years (M = 29.89, SD = 4.01) and their 18- to 28-week-old infants (four male, five female; M = 23 weeks, SD = 3.99). Mothers did not report their racial or ethnic background. Based on review of the videotaped interactions, all nine mother-infant pairs appeared Caucasian. Six mothers had one other child living in the home, and three had two or three additional children. Table 2.1 presents participant characteristics. Although participants' marital and visible minority status were largely representative of those found in Nova Scotia families at the time, participants' educational attainment and household incomes were higher (Statistics Canada, 2007).

Table 2.1

Feasibility study participant characteristics

Characteristic	*n*
Infant sex	
Female	5
Male	4

Characteristic	*n*
Infant feeding since birth	
Mainly breast-fed	5
Mainly formula-fed	3
Breast- and formula-fed	1
Marital Status	
Legally married or common law	8
Single	1
Current employment	
On parental leave	6
Not employed	3
Household income (before taxes)	
$10,000-$19,999	1
$20,000-$29,999	1
$30,000-$39,999	1
$40,000-$59,999	1
$60,000-$79,999	1
$80,000 or more	4
Education	
High school certificate or equivalent	2
Trade school or college certificate	2
University certificate, diploma or degree	5

Characteristic	*n*
Maternal past or current psychiatric condition	
Depression	1
None	8

According to maternal reports, three infants suffered from a past or current medical condition. One male infant had some allergies, colic, and reflux. Another male infant had cleft-lip reconstructive surgery at age 2 months, 3 months before participation in the study; his mother reported that he was developing within normal limits. Infants with cleft lip and palate tend to have disturbed early interactions with their mothers, however, a couple of months after corrective surgery, their interactions have been found to no longer significantly differ from those of typical mother-infant pairs (Murray et al., 2008). Finally, one female infant was born with Turner Syndrome, a chromosomal disorder solely afflicting females, marked by distinct physical characteristics (e.g., short stature, webbed neck, broad chest, and low-set ears), gonadal dysfunction, and often associated with deficits in visual-spatial processing, nonverbal memory, and attention. There is no previous research documenting differences between the interactions of mothers and infants with Turner Syndrome from those of typical dyads. In order to determine if the latter two dyads' interaction ratings differed markedly from those of the other seven feasibility study participants, their mean maternal sensitivity and infant engagement scores were compared. Both dyads' mean sensitivity (M_{cleft} = 3.60, SD_{cleft} = .43; M_{Turner} = 4.33, SD_{Turner} = .38) and infant engagement scores (M_{cleft} = 2.67, SD_{cleft} = .85; M_{Turner} = 3.52, SD_{Turner} = .74) were within one standard deviation of the mean sensitivity (M =

4.03, *SD* = .53) and infant engagement scores (*M* = 2.94, *SD* = .79) of the other seven participating dyads. Therefore, as there were no present or past empirical reasons to suggest mothers' interactions with infants with previous (several months prior) cleft-lip reconstructive surgery or Turner Syndrome would markedly differ from interactions with typical infants, these pairs were included in analyses.

Four of the nine participants enrolled in the study (44.4%) discontinued their participation early. Three mothers discontinued due to infant illness, two of whom had infants aged 18 weeks (discontinued after 5 and 6 recordings), and one of whom had an infant aged 28 weeks (discontinued after 10 recordings). The fourth mother, who had an infant aged 26 weeks, discontinued after completing 10 recordings due to the illness of another child in the home. Mothers who discontinued early were more likely to have two or more other children in the home (*n* = 2). No other significant demographics differences were noted.

2.2.2 Procedure.

Interested mothers contacted the primary investigator over the telephone. The investigator began by briefly explaining the study and assessing if inclusion criteria were met. If so, study information and consent were reviewed in detail. The investigator and mothers then had a discussion to ensure that the mothers were fully informed about the study as demonstrated by their recall of the study information. These conversations were recorded and kept confidential on Dr. Patrick McGrath's secure servers at the Centre for Research in Family Health at the IWK Health Centre.

Upon consenting to participate, mothers were asked basic demographic questions. The primary investigator then had the study instructions and recording materials delivered to the mothers' homes.

Mothers were provided with a study procedure outline (see Table 2.2). They were first asked to set up the recording materials, using a colour-coded set-up instruction sheet. They were then asked to do the following every morning (some point between 06:00 and 12:00) and afternoon (between 12:00 and 18:00) for seven days (total 14 administrations): complete 15-item Profile of Mood States (POMS-15; Cranford et al., 2006; 2 minutes), videotape themselves interaction with their infants (5 minutes), and then complete the POMS-15 once again (2 minutes). To interact with their infants, mothers were instructed to "play as you normally would" with their infants for 5 minutes, without toys.

Following the first, second, seventh, and last administration, mothers were called to discuss issues pertaining to the validity of the emotion and video play data collected, sources of disruption to data collection, their satisfaction and burden as participants, and their suggestions for the future. Questions were open-ended, proceeding from general (e.g., "What has it been like being in this study so far?") to more specific (e.g., "How did playing with your baby in front of the camera make you feel?"). At the end of each interview, the investigator summarized what she thought the participants had said and had participants check it for accuracy. Interviews were recorded for later transcription and coding using content analysis. Following the last administration, the primary investigator scheduled a time to retrieve the study materials and completed POMS-15 forms.

Table 2.2

Summary of Study Procedure from the Perspective of the Participant

Day 1	Days 2 & 3	Day 4	Days 5 & 6	Day 7
Morning (06:00 – 12:00)				
Set up equipment				
POMS-15	POMS-15	POMS-15	POMS-15	POMS-15
Videotape interaction	Videotape interaction	Videotape interaction	Videotape interaction	Videotape interaction
POMS-15	POMS-15	POMS-15	POMS-15	POMS-15
Interview		Interview		
Afternoon (12:00 – 18:00)				
POMS-15	POMS-15	POMS-15	POMS-15	POMS-15
Videotape interaction	Videotape interaction	Videotape interaction	Videotape interaction	Videotape interaction
POMS-15	POMS-15	POMS-15	POMS-15	POMS-15
Interview				Interview

2.2.3 Measures.

2.2.3.1 Telephone Recording Equipment. Participant consent and interviews with the primary investigator were recorded and stored using Nice Call Focus III, a full-

featured, compact recording solution with excellent voice quality. A research assistant blind to the objectives of the investigation transcribed the interviews.

2.2.3.2 Maternal Interview Coding. The participant interview format and questions were developed based on the content analysis procedures outlined by Graneheim and Lundman (2004), Holloway (2005), Krippendorff (2004) and Sandelowski (2000). The focus of the present quantitative content analysis was on describing the frequency with which participants discussed various key issues pertaining to the study's methodology.

The primary investigator read the transcripts several times in order to become familiar with the data. All participant statements pertaining to their experience participating in the study were transcribed into a single text, and sorted into meaning units (i.e., collection of words/statements having the same core meaning). These meaning units were summarized and used to create themes, categories, and codes. These were documented and defined in a coding manual (see Appendix A). The codebook outlined four themes: 1) Issues pertaining to the validity of the emotion state and videotaped interaction data collected (Threats to Validity); 2) Sources of disruption to data collection (Data Collection Disruptions); 3) Mothers' satisfaction and burden as participants (Satisfaction vs. Burden); and 4) Their suggestions for the future (Suggestions for the Future). The coding structure was hierarchical, such that within these four themes, 12 categories were identified, comprising 41 codes in all. Any code repeated by a participant more than once across the four interviews, was counted as a single occurrence. For each participant, each code was rated as either endorsed or not endorsed.

The primary investigator coded all of the transcribed participant interviews. In order to evaluate interrater reliability, the investigator trained a research assistant to analyse the

interviews using the coding manual. The research assistant then independently reviewed and coded five randomly selected participants' interviews (55.56% of the participants) using the coding manual.

Interrater reliability was evaluated with Cohen's Kappa. Separate individual values of the observed proportion of positive agreement (p_{pos}) and of negative agreement (p_{neg}) were also reported, as recommended by Cicchetti and Feinstein (1990). Interrater reliability for the overall scale was substantial (Landis & Koch, 1977; Viera & Garrett, 2005) with Cohen's Kappa .79 ($p < .001$), $p_{pos} = .85$, $p_{neg} = .94$ (see contingency table below, Table 2.3). Regarding the themes, almost perfect agreement was established for Data Collection Disruptions (Kappa = .91, $p < .001$, $p_{pos} = 1.00$, $p_{neg} = 1.00$), Validity (Kappa = .85, $p < .001$, $p_{pos} = .85$, $p_{neg} = .94$), and Suggestions for the Future (Kappa = .84, $p < .001$, $p_{pos} = .86$, $p_{neg} = .98$), and substantial agreement for Satisfaction vs. Burden (Kappa = .71, $p < .001$, $p_{pos} = .86$, $p_{neg} = .92$). Category reliabilities between raters ranged from moderate to almost perfect agreement. Code reliabilities between raters ranged from slight to perfect agreement. Specifically, slight agreement was found for Experience with Recording Equipment: Set-Up Easy (Kappa = .17, $p < .001$, $p_{pos} = .50$, $p_{neg} = .67$); fair agreement was found for Mother's Feelings About Being Observed: Did Not Notice Being Recorded (Kappa = .29, $p < .001$, $p_{pos} = .67$, $p_{neg} = .50$); there was moderate agreement for Experience with Mood Questionnaire: Quick, Baby Seat: Enjoyed No Squirming Mentioned, Baby Seat: Enjoyed But Some Squirming, Baby Reactivity to Recording Materials: Baby Distracted, Play Recordings Typical of Mother-Infant Play: Yes, and Play Recordings Typical of Mother-Infant Play: No (Kappa = .55, $p < .001$; p_{pos} = .67 to .86, p_{neg} = .67 to .86); and Overall Experience Participating: Enjoyed Having

One-On-One Scheduled Play had substantial agreement (Kappa = .62, $p < .001$; p_{pos} = .80, p_{neg} = .80). Perfect agreement was established for the remaining 32 codes. Disagreements were resolved through discussion and consensus.

Table 2.3

Contingency Table Comparing Raters' Scores Across Codes for the Overall Scale For Five Randomly Selected Participants

	Research Assistant		
	Endorsed	Not Endorsed	Total
Primary Investigator			
Endorsed	52	9	61
Not Endorsed	9	135	144
Total	61	144	206

2.2.3.3 Maternal Emotion and Fatigue States. Mothers' emotion and fatigue states were assessed with an abbreviated 15-item self-report scale, adapted by Cranford and colleagues (2006) from the Profile of Mood States (POMS; McNair, Lorr, & Droppleman, 1992). The POMS-15 was designed to assess three negative emotion states (i.e., depression, anxiety, and anger), one positive emotion state (i.e., vigour), and fatigue. Cranford et al. (2006) chose the POMS-15 items based on high factor loadings and the extent to which they were reflective of each state. Depression emotion items are "sad", "hopeless", and "discouraged". Anxiety emotion items include "on edge," "uneasy," and

"anxious." The three angry items are "angry," "annoyed," and "resentful." Vigour is a positive emotion state, with items including "lively," "cheerful," and "vigorous." Finally, the items assessing fatigue are "worn out," "fatigued," and "exhausted." These states are rated on a scale ranging from *not at all* (0) to *extremely* (4). Scores for each are calculated by averaging the ratings of the relevant items. Cranford et al. (2006) found the POMS-15 scales demonstrated good reliability at detecting within-person change in current emotion state (Reliability of change = R_C = .81-.88).

As it was hypothesized that negative emotion states would be related to less sensitive maternal behaviour, and given past research documenting high correlations between the depression, anxiety, and anger scales on the POMS and abbreviated POMS (e.g., Bourgeois, LeUnes, & Meyers, 2010; McNair & Heuchert, 2005; Norcross, Guadagnoli, & Prochaska, 1984; Yeun & Shin-Park, 2006), these scales were combined and averaged to yield a negative emotion scale. Negative emotion, vigour (i.e., positive emotion), and fatigue were the focus of the present dissertation.

2.2.3.4 Mother-Infant Interaction Recording Materials.

The following materials were supplied to participants to complete the recordings: a checklist summarizing the study procedure from the participants' perspective, a colour-coded equipment set-up instruction sheet, recording equipment, a colour-coded canvas floor mat with the placement of materials indicated, an infant seat, and a timer.

In order to facilitate assembly, recording equipment was divided into two pieces. The first consisted of a three-legged camcorder-stand base (Matthews Studio Equipment 20'' Turtle Base C-Stand), attached to a MSE Stand Adapter 1 1/8-5/8'') permitting the top of the stand to connect to the base. The second recording equipment piece consisted of the

top of the camcorder stand (Manfrotto F900 Baby Double Header 5/8 Arm), with two camcorders (Victor Company of Japan Ltd. Everio camcorders with 80 gigabyte hard drives) attached to it by two camera adapters (Avenger ¼" to 5/8"). The camcorders were pre-set at specific angles in order to ensure an adequate view of each mother and infants' faces, arms, and torsos in the videos would be obtained. The camcorders' power and record buttons were marked with coloured tape. The camcorders were plugged into a power bar taped to the top bar of the camcorder stand.

Mothers were also sent a 168 cm x 122 cm canvas mat marked with coloured tape to help illustrate where recording equipment was to be placed and the mother and infant seated. A Bumbo Baby Sitter® was used to secure the infant in a seated-position for the interaction. See Figure 2.1 for illustration of mother-infant videotaped interaction set-up Mothers were also provided with a timer to keep track of the duration of their videotaped interactions.

2.2.3.5 Mother-Infant Interaction Assessment. Mother-infant play video-recordings were rated using the Global Rating Scales of Mother-Infant Interaction (GRS; Murray et al., 1996). The GRS was developed to assess differences in the infant interactions of depressed and non-depressed mothers, although it has been used to assess other high-risk and clinical populations (e.g., Riordan, Appleby, & Faragher, 1999). It has been used extensively in cross-cultural samples (e.g., Tomlinson et al., 2005) and been found to be sensitive to changes following treatment of depressed mothers and their infants (Onozawa, Glover, Adams, Modi, & Kumar, 2001).

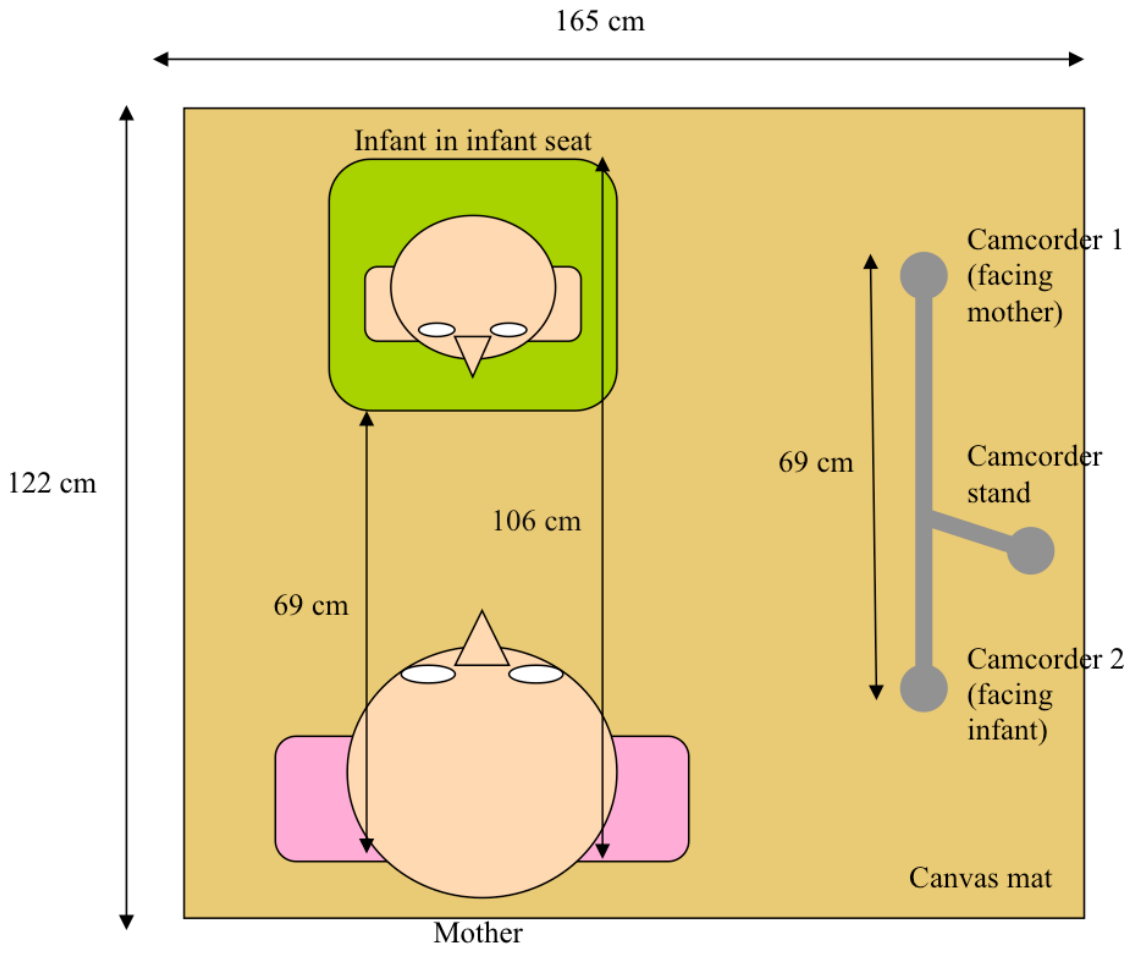

Figure 2.1. Illustration of mother-infant videotaped interaction set-up. Equipment is not drawn to scale.

Coding using the GRS involves observation of the mother and infant in a 3- to 5-minute free play videotaped interaction. Thirteen maternal behaviour scales, seven infant behaviour scales, and five interaction scales are rated. Scales are combined to create six dimensions. For the purposes of this dissertation, the focus was on the maternal sensitivity and infant engagement dimensions. Maternal sensitivity refers to the mother's expressions of positive regard towards her infant, her attempts to follow her infants' lead, and her acknowledgement, validation, and appropriate and contingent responsiveness to her infants' behaviour. It is rated on a scale from 1 (*poor)* to 5 (*good*), and consists of the

average of five scales (i.e., warm/positive, accepting, responsive, non-demanding, and sensitive). Infant engagement indicates the infants' positivity, communicative behaviour, and active engagement with his/her mother (i.e., average of attentive, active communication, and positive vocalizations scales), and is rated from 1 (*poor*) to 5 (g*ood*).

As recommended by McGraw and Wong (1996) and Shrout and Fleiss (1979), interrater reliability was calculated using two-way mixed consistency intraclass correlation coefficients (ICC). In order to learn the GRS coding system, the primary investigator completed a 3-day training workshop led by Dr. Lynne Murray, the primary author of the GRS. The investigator then coded 10 training videos provided by Dr. Murray, and achieved an interrater reliability with Dr. Murray of $ICC = .73$, $p = .03$ for the maternal sensitivity scale, and $ICC = .86$, $p = .002$ for the infant engagement scale. The primary investigator then trained a research assistant to code videotaped interactions using the GRS. Using the same 10 training videos, the research assistant achieved an interrater reliability with the primary investigator of $ICC = .84$, $p = .001$ for the maternal sensitivity dimension, and $ICC = .81$, $p = .001$ for the infant engagement dimension.

The research assistant coded all of the feasibility study mother-infant interactions. The primary investigator independently coded three of the participants' interaction videos (19 interactions), and established an interrater reliability of $ICC = .93$, $p < .001$ for the maternal sensitivity dimension, and $ICC = .82$, $p < .001$ for the infant engagement dimension.

2.2.4 Data Analysis Plan

The effectiveness of the emotion and play data collection was evaluated as follows. In order to determine if the videotaped interactions met the minimum duration criteria of 180 seconds to be codeable using the GRS (Murray et al., 1996), the primary investigator began by syncing the corresponding mother and infant videos to one video image, to have a view of both interaction partners, using Adobe Premiere software. The duration of each synced mother-infant play video was documented, from the beginning of the interaction until the timer rang. Instances where the mother or infant's facial expressions, arm, and trunk movements were not visible in the videos, where the content of mother's speech was not discernable, and where the interaction was interrupted by an outside person or event were omitted. The number of videos per participant that were over 180 seconds (i.e., were codeable) were tabulated.

2.3 Feasibility Study Brief Results

2.3.1. Quality of Data Collected.

In order to evaluate the quality of the data collected, this research explored the proportion of videotaped interactions that were codeable using the GRS (Murray et al., 1996), participants' feedback about threats to the validity of the POMS-15 and videotaped interaction data, and sources of disruption to data collection.

2.3.1.1. Codeable Videotaped Interaction Data. Mothers were asked to videotape 14 play episodes with their infants. Including the 4 participants who discontinued their participation early, mothers together completed 85 recordings (*M* recordings per mother =

9.44). In total, 14 (16.4%) of these play episode videos were uncodeable for the following reasons: 1) Six of the mother-infant play videos for one participant contained footage of the infant, but not of the mother (i.e., only one of the camcorders was set to record); 2) One participant recorded four videos playing with her infant not seated in the Bumbo Baby Sitter® (each of which was under 180 sec), and during another recording, play was cut-off after 148 seconds due to her infant spitting up; 3) One participant recorded a play video with repeated and prolonged interruptions by her other child, and another video in which her infant was inconsolably crying throughout; and 4) One participant recorded an interaction with footage of the infant, but not the mother (i.e., only one of the camcorders was set to record). All of the remaining play episode videos (n = 71, M recordings per mother = 7.89) had a sufficient duration (i.e., over 180 seconds), sound quality, and view of the mother and infant for coding to proceed unimpeded. For characteristics of the mother-infant interaction videos, please see Table 2.4.

Table 2.4

Mother-Infant Interaction Videos

Video order	Total number recorded	Number codeable
1	9	9 (100%)
2	8	7 (87.5%)
3	8	7 (87.5%)
4	8	6 (75%)
5	8	6 (75%)

Video order	Total number recorded	Number codeable
6	7	5 (71.4%)
7	7	5 (71.4%)
8	7	5 (71.4%)
9	6	5 (71.4%)
10	5	4 (83.3%)
11	3	3 (100%)
12	3	3 (100%)
13	3	3 (100%)
14	3	3 (100%)
Total	85	71 (83.5%)

2.3.1.2 Threats to Validity of POMS-15 and Videotaped Interaction Data.

Participants reported several issues potentially affecting the study's validity. These pertained to the POMS-15 questionnaires, infants' reactivity to the recording materials and procedure, mothers' feelings about being videotaped, and whether the mother-infant recordings were indicative of the pair's typical play.

2.3.1.2.1 POMS-15 Validity. With respect to the POMS-15 overall validity in this sample, one mother indicated she noticed her emotion ratings became increasingly positive over the course of her participation. She was unsure whether her ratings reflected a true increase in positive emotion or increased insight and accuracy over time. Also, whereas one mother noted some discomfort endorsing negative emotions on the POMS-15 ("I think that it's hard to admit that you're feeling anxious, or sad […] and I think

there are a few times that I did write that, but again it's hard to say you're feeling like that"), two indicated they experienced no such discomfort. Another mother indicated that she felt many of the POMS-15 items were irrelevant to her typical experience, such as "anxiety". Finally, two mothers indicated that some of the POMS-15 items were somewhat unclear; one mother asked for clarification regarding the meaning of "vigorous" and the other noted that she would have liked "tired" to be included on the scale in lieu of "exhausted", as the latter failed to adequately capture her state.

2.3.1.2.2 Infant Reactivity. Most mothers (n = 7) felt that the study materials or other objects in the room distracted their infants during their recorded face-to-face interactions. Sources of distraction included the following: recording equipment set-up (n = 2), the shininess of the camcorder stand (n = 2), the camcorder light (n = 1), the coloured-tape on the mat (n = 1), the Bumbo Baby Sitter ® (n = 1), or by other lights and toys in the room (n = 3). Two mothers indicated that the Bumbo Baby Sitter ® enabled their infants to play with their toes, serving as a distraction from the interaction. One mother noted that, as per her infant's usual reaction to cameras and camcorders, her infant was distracted by the camcorders. Finally, one mother indicated that her infant became fussy due to wanting to be picked up during play, but the interaction recording instructions precluded this.

2.3.1.2.3 Mothers' Feelings About Being Videotaped. In response to the question, "How did playing with your baby in front of the camera make you feel?" one mother indicated that she enjoyed the experience, and another three mothers noted that they were unaffected by being recorded (e.g., "to be honest I didn't even really notice it;" "I really just kind of put it out of my head that the cameras were even on. I didn't really pay too

much attention to it and just carried on with what I was supposed to do."). The remaining five mothers indicated that they initially experienced some performance anxiety while completing the videotaped recordings. For example, after completing the first recording, one mother explained, "I was nervous. Today when I pressed record and stuff I could feel my heart just kind of racing. I don't know why I was nervous playing with my daughter… Yeah [it was from being observed], because it was being recorded and I knew people were going to watch it." All five mothers noted a marked decrease in their anxiety over the course of their participation, however, the time it took for this to occur varied considerably between participants, ranging from partway through the first recording to the sixth or seventh recording.

2.3.1.2.4 Typicality of Mother-Infant Interaction Recordings. All participating mothers were asked, "Do you feel that the video accurately captured how you normally play with your baby?" Although two indicated it did, the remaining seven felt the play episodes were atypical. From most endorsed to least, the following were the reasons mothers gave for the play recordings being different from their usual play: lack of toys (n = 6), the magnitude of the distance between mother and infant (e.g., not in arms, less touch possible) (n = 6), the long duration of these play episodes (n = 5), being seated face-to-face (e.g., instead of lying on the floor) (n = 3), less movement and physical play (n = 2), and being one-on-one in lieu of incorporating other children in play (n = 1).

2.3.1.3 Disruptions to Data Collection.

2.3.1.3.1 Interruptions and Reasons. Participants reported several sources of disruption to their participation. Due to illness, one mother skipped two days of

recordings. Another mother indicated she forgot to complete one of the POMS-15 questionnaires after a recording.

Although three mothers indicated they were never interrupted during the one-on-one recordings, the remaining six reported experiencing one to three interruptions. When interrupted during the recordings, this was predominantly by other children in the home or the phone ringing. Other sources of interruption included the door, outside noise, and a pet.

Two mothers indicated they experienced delays in completing the scheduled recordings. One noted she forgot to complete one of the morning recordings in time and that on another occasion her infant was too distressed to complete the scheduled recording. The other mother had to delay one of the scheduled recordings due to a power outage, and had to cut one of the recordings short because her infant was too distressed to continue.

2.3.2 Participant Satisfaction and Burden.

2.3.2.1 Overall Experience. Overall, participants reported a positive experience participating in the study ($n = 9$), with minimal burden. Five further indicated that they particularly enjoyed having the one-on-one scheduled playtime with their infants. One mother explained, "I think it was nice actually doing the study that you segregate a specific time to be one-on-one with [infant name] and that's not something you typically consciously do during the day, so it is nice to have that interaction that is planned. It was nice for me because I had it to look forward to."

2.3.2.2 Duration and Timing. Five participants did not comment about the study's duration and scheduling. The four who did indicated the following: one noted the study's duration was not a problem, two noted it was difficult to find time to complete the recordings when they were otherwise busy (i.e., during weekends and near winter holidays), and one noted it was difficult to find two times daily when the infant's state permitted recordings to be completed (i.e., infant not asleep or too fussy).

2.3.2.3 Experience with POMS-15. All mothers found the POMS-15 questionnaires easy to complete. Five mothers indicated the POMS-15 was quick to fill-out, although one felt it took too long.

2.3.2.4 Experience with Equipment. With respect to the study equipment, all nine participants noted that they found the recording equipment easy to set-up and to operate, despite four finding it looked intimidating initially. Two noted that they even enjoyed setting-up the equipment, stating, "It made me feel like I actually knew something technical." One mother felt somewhat stressed when first setting up the equipment because her infant became "fussy because [mother] wasn't paying attention to her." The two mothers living in mobile homes reported that the recording equipment was too large to leave assembled throughout the week of their participation, therefore making it inconvenient, cumbersome, and time-consuming to assemble and disassemble it each time. Four mothers reported problems with the timer not functioning properly (especially ringing before the five minutes were up) and two noted minor problems with the camcorders (indicating "please insert memory card").

2.3.2.5 Infant Seat. All mothers reported their infants mostly enjoyed being seated in the Bumbo Baby Sitter ®. Five indicated their infants squirmed occasionally while in the seat.

2.3.3 Participants' Suggestions for Future.

Six mothers made suggestions for how this study should be conducted in the future. Two indicated that it would help them to stay organized if the forms (POMS-15 and Study Schedule Outline) were dated or colour-coded. Other suggestions included not having other children in the home during recordings, telling mothers in advance that the equipment is easier to operate than it looks, being seated more closely together during play, assessing different types of play, using web-cams instead of camcorders, and including a tray with the Bumbo Baby Sitter® to help secure the infant in place.

2.4 Feasibility Study Brief Discussion

The purpose of the feasibility investigation was to determine what changes should be made to the main study's methodology in order to optimize the quality of the data collected and mothers' satisfaction with their participation. In so doing, the present researcher calculated the proportion of videotaped mother-infant interactions that were codeable using the GRS (Murray et al., 1996) and interviewed the nine participating mothers regarding sources of disruption to data collection, their satisfaction and burden as participants, and their suggestions for the future. Overall, participants reported a positive experience participating in the study, with minimal burden noted. Based on these

findings, minor changes were made to the measures and procedure in the main study. Modifications are detailed below.

2.4.1 Modifications to the Maternal Emotion and Fatigue State Scale.

Given that mothers predominantly found the POMS-15 (Cranford et al., 2006) quick and easy to complete (see 2.3.2.3), it continued to be used as is in the main study. Also, in order to preserve the validity of the POMS-15 as developed, the wording of the emotion items were not changed despite some mothers suggesting this. However, some modifications were made to the POMS-15 instructions in light of one participant's comment that she was somewhat uncomfortable reporting negative emotions (see 2.3.1.2.1). Based on the research literature on social desirability (for review, see Morsbach & Prinz, 2006), the following changes were made to the POMS-15 instructions in the main study to make participants feel more comfortable endorsing potentially socially-undesirable emotions, should they occur:

1. Participants' perceptions of the study's legitimacy and importance help to reduce their reluctance to report potentially socially undesirable behaviour. Therefore, the importance of receiving accurate emotion data was emphasized to participants, the study's affiliation with the IWK Health Centre was highlighted, and IWK logos were used on all forms;
2. It was reiterated to participants that all of their responses would be kept confidential; and

3. It was explained that experiencing each of the emotion states is normal (i.e., "Because of events, thoughts, and hormones, everyone feels happy, anxious, depressed, angry, or fatigued sometimes").

As it was unclear why one mother's emotion ratings became more positive over the course of her participation, the administration of the POMS-15 in the main study was not modified in light of this information.

2.4.2 Changes to Mother-Infant Interaction Recording Materials.

Participants reported that they found the recording equipment easy to set up and operate (see 2.3.2.4) and that their infants largely enjoyed being seated in the Bumbo Baby Sitter ® (2.3.2.5). Therefore, the overall set-up was left largely unchanged for the main study. Minor modifications were made based on mothers' feedback about the large size of the equipment, malfunctions with the timer, and infants' reactivity to the study materials.

1. As two mothers indicated the equipment was too large to leave set up in their homes (see 2.3.2.4), in the main study, the decision was made to minimize the overall size of the equipment by using a smaller camcorder stand and by utilizing a smaller mat (47 cm shorter in length).
2. Timers were replaced in the main study, as the ones used in the feasibility study did not function consistently (see 2.3.2.4).
3. Several mothers indicated that they believed the study materials distracted their infants during videotaped interactions (see 2.3.1.2.2). In order to minimize

infants' reactivity to the study materials in the main study, the following small changes were made:

a) Used a new camcorder stand in a matte colour and camcorders that did not have a light in the front. The chrome-coloured camcorder stand used in the feasibility study was painted in a matte colour, and the camcorders' lights were obstructed using opaque tape.

b) To decrease sources of distraction in infants' visual field during interactions (e.g., the coloured tape on the mat, the infants' own toes, and other objects in the room), mothers were instructed to sit closer to their infants. This was accomplished by placing the coloured tape indicating where the mother and infant should be seated on the canvas mat 11 cm closer together then was previously indicated. This modification was also made to help address mothers' concern that the recorded interactions were atypical due to a relative lack of physical proximity with infants (see 2.3.1.2.4) and was in line with mothers' suggestions for how the study should be conducted in the future (see 2.3.3).

2.4.3 Changes to Procedure.

The decision to have mothers videotape interactions with their infants in their homes and without a researcher present was made in an attempt to optimize the ecological validity of this research and to minimize mothers' feelings of social or performance anxiety. It was encouraging that most mothers reported that they enjoyed having the one-on-one scheduled playtime with their infants as part of the study's procedure (see

2.3.2.1). However, several felt the interaction recordings were different from their usual play (see 2.3.1.2.4) for reasons such as the long duration of the recordings, being seated face-to-face, not involving other children in the interaction, and not including toys. As these specifications are required in order to code using the GRS (Murray et al., 1996), as well as in a number of other mother-infant interaction observational coding systems (e.g., see Fowles & Horowitz, 2006), they were not modified in the main study. Furthermore, one-on-one face-to-face interactions between mothers and infants are typical during infant ages 2 to 6 months (e.g., Bateson, 1971), and at this stage, infants have typically not yet developed joint attention and are therefore unable to interact with people and objects simultaneously (e.g., see Moore, 2006). As the focus of this dissertation was on exploring mother-infant interactions and not infant-object interactions, the decision was made to continue requesting mothers interact with their infants without toys.

Additionally, despite attempts to design the procedure so as to minimize mothers' performance anxiety during interactions, some mothers indicated that they felt anxious merely due to being videotaped (see 2.3.1.2.3). However, all noted that this performance anxiety decreased over the course of their participation. Future research could explore whether mothers are less anxious videotaping interactions in their own homes than being videotaped by a researcher in a laboratory or at home.

Based on mothers' feedback about the study's duration and scheduling, sources of disruption to data collection, and suggestions for the future, as well as the present review of the reasons several interaction recordings were uncodeable using the GRS (Murray et al., 1996), the following changes were made to the study's procedure:

1. Although most participants did not comment about the study's duration and scheduling, three indicated some difficulties finding time to complete the recordings due to being otherwise busy or to the infants' state (see 2.3.1.3.1). Therefore, in the main study, the study duration was reduced from 14 recordings over approximately seven days to 10 recordings over approximately five days. In the feasibility study, it was after 10 recordings (about eight of which were codeable) that the majority of mothers stopped completing additional recordings.
2. In order to minimize sources of disruption to data collection, in the main study three telephone check-in calls with mothers were scheduled over the course of their participation. In these calls, the researcher briefly checked in regarding mothers' experience participating in the study, inquired as to whether they had been able to complete all of the recordings and POMS-15 (Cranford et al., 2006) forms, and answered any questions they may have had. The researcher asked those mothers who indicated that they were unable to complete a recording or POMS-15 (e.g., due to illness, infant fussiness, or power outage) to make up the missed recording/POMS-15 at a later time. If mothers reported any difficulties with operating the camcorders, these were addressed as needed.
3. To minimize mothers forgetting to complete recordings or POMS-15 forms (see 2.3.1.3.1) and in keeping with their suggestions, in the main study mothers were provided with a Study Schedule Checklist listing each study component organized by date and time and colour-coded.
4. Fourteen interaction videotapes were uncodeable due to mothers not closely following the study instructions or to interruptions (see 2.3.1.1). In order to

address these concerns, in the main study the study instructions were clarified by developing a Study Instructions sheet including illustrations as well as bolded and coloured text to emphasize important points. Additional instructions included that other children in the home should be supervised by an adult in another room, noise should be minimized (e.g., by turning off phone ringers), the infant should be seated in the Bumbo Baby Sitter ® during the interaction, and both camcorders should be set to record.

5. Based on mothers' suggestions for how the study should be implemented in the future (see 2.3.3), upon delivering the study equipment to mothers' homes in the main study, the researcher advised them that most mothers have found the equipment easier to set up and to operate than it initially appears.

Although mothers' feedback was taken into consideration, it was not possible to implement several of their suggestions in the main study (see 2.3.3). As it would change the nature of the topic under investigation, the decision was made not to assess different types of play, although this would be an interesting question to explore in future investigations. In order to ensure that mothers could participate in the study even without reliable Internet connections, camcorders continued to be used in lieu of web-cams. Finally, a tray was not included with the Bumbo Baby Sitter ® as it may have obstructed mothers' physical access to their infant during play.

2.5 Main Study Methods

Considering that most of the main variables of interest did not significantly differ between the feasibility and main study (see 3.11), and that there were only small modifications made to the methodology between the studies, the decision was made to combine data together in analyses. Study membership was statistically accounted for in analyses involving those variables found to significantly differ between the studies.

2.5.1 Participants.

The effect of the study design (i.e., repeated observations per participant) on power estimation depended in a complicated way on a number of unknown and estimated factors, including the true dependence present between the predictors and outcome variables, the variability within a participant relative to the variability between participants, the correlation between consecutive observations from the same participant compared to those more separated in time (i.e., serial correlation or serial dependency; Fox, 2002; Gueorguieva & Krystal, 2004; Littell et al., 2006; Schwatrz & Stone, 1998; West & Hepworth, 1991), the amount of missing data (e.g., due to drop-out, uncodeable interactions, and equipment malfunction), and the residual variance. These quantities require a lot of data to estimate precisely. Therefore, a simpler model was used to estimate sample size. Specifically, a two-sided test of the relationship between a single continuous dependent and an independent variable (i.e., test of significance of a regression coefficient of the relationship between pre-interaction maternal negative emotion state and ensuing sensitivity) with independent observations was used. In this

case, a sample size of 54 independent observations would be required in order to detect a medium effect size of 0.15, at an alpha of 0.05 with 80% power. This estimate assumed no missing data, independence of observations within and across participants, and no serial correlation in the data. In reality, these assumptions would be violated in the present analyses. Given the number of unknowns, a statistical consultant recommended a sample size of at least 25 participants with eight observations per participant (i.e., 200 observations total). To be more conservative, the decision was made to inflate this estimate to 50 participants with 10 observations per participant, assuming based on the feasibility data that this would yield at least eight codeable interactions per participant (i.e., 400 observations total).

Participants included those recruited from the feasibility study (period from October 2008 to February 2009) and the main study (July 2009 to January 2010). Recruitment, inclusion and exclusion criteria, and compensation for participation were unchanged (see section 2.2.1).

In total, 63 mothers were assessed for eligibility. Six did not meet inclusion criteria and seven declined to participate. The remaining 50 consented to participate. No data were recorded from one participant, as she reported being unable to keep her other children supervised while she attempted to complete the first videotaped interaction with her infant, and therefore discontinued her participation. Of the remaining 49 participants from whom data were collected, 20 discontinued their participation early, four due to infant illness, two due to being busy, one due to illness of another child in the home, and 13 for unspecified reasons. None withdrew their consent. The data collected from these 49 participants, including those who discontinued early, was included in analyses.

In total, participants included 49 20- to 43-year-old mothers (M = 29.90 years, SD = 5.41) and their 15- to 28-week-old infants (24 male, 25 female; M = 22.53 weeks, SD = 3.77). When queried about their ethnic, cultural, or religious identity, two mothers noted they were Catholic, one reported Christian, one Jehovah's Witness, one Mi'kmaq, one Australian, and one Scottish, African, and Jewish; the remaining 42 responded "none." In order to obtain some (albeit imprecise) estimate of participants' race or ethnicity, the primary investigator conducted a visual inspection of the videotaped interactions. Based on this inspection, 46 mother-infant pairs appeared Caucasian, two pairs appeared Caucasian or First Nations, and one Caucasian mother had an infant who appeared to be of African decent. Please see Table 2.5 for participant characteristics. Although participants' marital and visible minority status were largely representative of those found in Nova Scotia families at the time, participants' educational attainment and household incomes were higher (Statistics Canada, 2007).

Table 2.5

Participant Characteristics

Characteristic	*n*	%
Infant sex		
Female	25	51
Male	24	49
Infant feeding since birth		
Mainly breast-fed	31	63
Mainly formula-fed	13	27

Characteristic	*n*	%
Breast- and formula-fed	5	10
Marital Status		
Legally married or common law	41	84
Single, divorced or separated	7	14
Unspecified	1	2
Current employment		
Currently employed and working	4	8
On parental leave from employment	36	73
Not employed	9	18
Household income (before taxes)		
$10,000-$19,999	5	10
$20,000-$29,999	4	8
$30,000-$39,999	3	6
$40,000-$59,999	6	12
$60,000-$79,999	8	16
$80,000 or more	21	43
Don’t know	2	4
Education		
No certificate, diploma or degree	2	4
High school certificate or equivalent	14	29
Trade school or college certificate	13	27
University certificate, diploma or degree	20	41

Characteristic	*n*	%
Maternal past or current psychiatric condition		
Depression and/or anxiety	9	18
None	40	82
Other children living in the home		
None	23	47
1	17	35
2 to 3	9	18

2.5.2 Measures.

2.5.2.1 Maternal Emotion and Fatigue States. As in the feasibility study (see 2.2.2.3), maternal negative emotion, vigour, and fatigue were assessed using a 15-item self-report scale, the POMS-15 (Cranford et al., 2006). Based on mothers' feedback in the feasibility study, POMS-15 instructions were modified (see 2.3.3).

Six participants failed to answer one item on one or more of their POMS-15 forms. In total, 11 items were unanswered on 11 POMS-15 forms, including one negative emotion item, two vigour items, and four fatigue items. In these cases, the scales were calculated using the average of the answered items for each participant.

2.5.2.2 Mother-Infant Interaction Recording Materials. As in the feasibility study, mothers were delivered instructions and equipment to complete the videotaped interactions with their infants (see 2.2.2.4). In order to minimize the chance of participants forgetting to complete recordings and other study components (see section

2.4.3), mothers were sent a colour-coded Study Schedule Checklist. They were also delivered the recording equipment and a colour-coded canvas floor mat with the placement of materials indicated. The recording equipment consisted of: 1) A new set of smaller equipment, consisting of the three-legged camcorder-stand base (Matthews Studio Equipment 20'' Turtle Base C-Stand attached to a MSE Stand Adapter 1 1/8-5/8''), and the top of the camcorder stand (Manfrotto F900 Baby Double Header 5/8 Arm) with two camcorders (Sony DCR-HC52 Handycam camcorders) attached to it by two camera adapters (Avenger ¼" to 5/8"). In order to decrease the likelihood of infants being distracted by the equipment (see 2.4.3), the camcorder-stand base and the top of the camcorder stand were both a matte-coloured grey, and the light in the front of the camcorders was obstructed with opaque tape; 2) The distance was shortened between the mother and infant by 11 cm as indicated on the canvas mat; and 3) The 165 cm x 122 cm mat was replaced with a smaller one, 118 cm x 122 cm. The timer used in the feasibility study was replaced with one that was easier to operate. Equipment was transported in an IM 2950 Storm Case manufactured by Hardigg Industries. As in the feasibility study, mothers were provided with a Bumbo Baby Sitter® to seat the infant in during recorded interactions. Please see Figure 2.2 for an illustration of the modified mother-infant interaction set-up.

Mothers were provided with a Study Instructions sheet illustrating the steps for setting up the recording equipment.

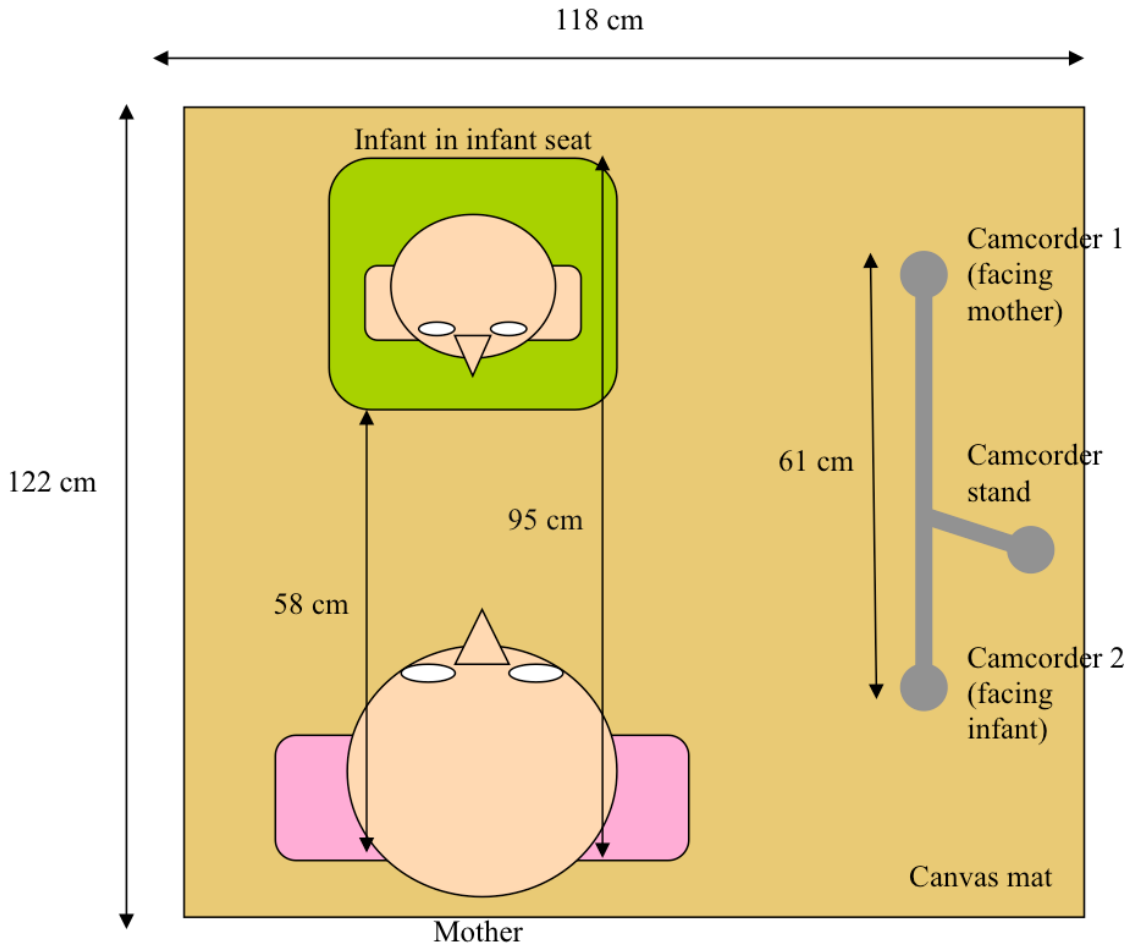

Figure 2.2. Illustration of revised mother-infant videotaped interaction set-up. Equipment is not drawn to scale.

2.4.2.3 Mother-Infant Interaction Assessment. As in the feasibility investigation (see section 2.2.2.5), the videotaped mother-infant interactions were coded using the GRS (Murray et al., 1996). Maternal sensitivity and infant engagement were rated on a scale from 1 to 5. The research assistant coded all of the mother-infant interaction videos. The primary investigator independently coded 13 randomly selected participants' videos (107 interactions). At the time of coding, both coders were unaware of mothers' self-reported emotion and fatigue states. Including the three randomly selected feasibility study participants' 19 interaction videos, interrater reliability was $ICC = .89$, $p < .001$ for the

maternal sensitivity dimension, and $ICC = .92$, $p < .001$ for the infant engagement dimension.

2.5.3 Procedure

The procedure for the main study remained largely unchanged from that of the feasibility study (see section 2.2.3). Upon consenting to participate, mothers were asked a few basic demographic questions. The research assistant then had the study materials delivered to their homes.

The study instructions were outlined on a Study Schedule Checklist and a Study Instructions sheet provided to mothers. Upon setting up the recording equipment, they were instructed to do the following every morning (between 06:00 and 12:00) and afternoon (between 12:00 and 18:00) for 5 days (total 10 administrations): they were to complete the POMS-15, videotape play with their infants, and then complete the POMS-15 once again. The research assistant called mothers three times during the 5 days to ask about their experience being in the study and to answer any questions they may have had. Following the last administration, the research assistant scheduled a time with the mothers to retrieve the study equipment and completed POMS-15 forms. The Bumbo Baby Sitter® was given to each family for their continued use.

2.5.4 Data Analysis Plan

Preliminary and descriptive analyses were conducted using the Predictive Analytics Software for Windows (PASW version 20.0). SAS version 9.2 was used to compute the mixed effects models.

2.5.4.1 Preliminary Analyses.

2.5.4.1.1 Comparing Feasibility Study and Main Study Data. To determine if participants' scores on the main variables of interest significantly differed according to study membership (i.e., feasibility or main study), a series of mixed effects *t*-tests were conducted. In so doing, one hierarchical regression analysis was fit for each main variable, with study membership as the predictor variable. To account for nesting of data within participants, subjects were entered as a covariate in the first step of each regression equation. Study membership was statistically accounted for in subsequent main analyses involving those variables found to significantly differ between the feasibility and main study.

2.5.4.1.2 Missing Data. Missing data were described. Using a series of Pearson correlations, the primary investigator also explored the relationship between the proportion of data missing per participant and various demographic characteristics, including mothers' ages, household income, and number of other children in the home.

2.5.4.1.3 Descriptive Statistics and Assumptions Testing. Descriptive statistics were presented for the main variables of interest addressed in each objective. Measures of dispersion were also inspected to evaluate for normality. Variables that departed markedly from normality were dichotomized or trichotomized for subsequent analyses.

Hypotheses in the present dissertation were tested using mixed effects models (see below for description). The main underlying assumptions for these models are that within-participant errors and the random effects across participants are independent and normally distributed with a mean of zero (Luke, 2004). These assumptions were assessed

for each model by inspecting the residual plots (Luke, 2004). The plots and influence diagnostics were also examined for the presence of outliers (Littell, Milliken, Stroup, Wolfinger, & Schabenberger, 2006; Luke, 2004). Influence diagnostics indicate the change in the model estimates were each participant removed individually from the analysis (Littell et al., 2006; Verbeke & Molenberghs, 2000).

2.5.4.2 Main Analyses: Mixed Effects Modelling. To analyze the associations between predictors (including hypothesized mediator and moderator variables) and outcome variables, while explicitly accounting for the repeated-measures study design (i.e., Level-1 units of repeated observations nested within Level-2 units of participants; Raudenbush & Bryk, 2002), a series of linear mixed effect models were run (Albright & Marinova, 2010; Luke, 2004; Schwartz & Stone, 1998). Specifically, random coefficients models (i.e., multilevel models) were used, which accounted for between-person (i.e., baseline; intercept) differences in the predictor variables as well as the within-person (i.e., rate of change over time; slope) differences by permitting the intercepts and slopes of the predictor variables to vary across participants (Gueorguieva & Krystal, 2004; Littell et al., 2006; Luke, 2004; Schwartz & Stone, 1998). This was accomplished by setting the intercepts and slopes (i.e., regression lines) of the predictor variables as both random and fixed effects. Treating the effects as random enabled each participant to have their own regression lines, which were assumed to randomly deviate around an overall population regression line (Littell et al., 2006). Once these individual differences in the effect of the predictor on the outcome variable were accounted for, this enabled estimation of the fixed effect intercepts and slopes, which refer to the overall estimated mean intercepts and

slopes (Littell et al., 2006; Schwartz & Stone, 2007) that were of primary interest. In order to be able to meaningfully interpret the intercepts, each Level-1 predictor variable was centered about the sample mean (Luke, 2004; Raudenbush & Bryk, 2002), save for dichotomous or trichotomous variables. This linear transformation changes the interpretation of the intercept from the value of the outcome when the predictor is zero, to the value of the outcome when the predictor is equal to the grand mean.

In repeated-measures designs, consecutive observations of the same participant tend to be more highly correlated than those that are more separated in time (i.e., serial autocorrelation or serial dependency; Fox, 2002; Gueorguieva & Krystal, 2004; Littell et al., 2006; Schwatrz & Stone, 1998; West & Hepworth, 1991). The models accounted for this possibility by including a first order autoregressive variance term as a random effect (Littell, Pendergast, & Natarajan, 2000; West & Hepworth, 1991). The parameters of the models were estimated using restricted maximum likelihood (REML; Longford, 1993; Schwartz & Stone, 1998) in the MIXED procedure of SAS Version 9.2. The statistical significance of all parameters were assessed by a Wald test, where the parameter estimate is divided by its standard error (Luke, 2004; Singer & Willett, 2003; West, Welch, & Galecki, 2007) and compared to a *t*-distribution with degrees of freedom estimated by the containment method (West et al., 2007).

In order to account for potential confounders, models statistically accounted for any between-person demographic variables found to significantly predict the main outcome variables in this sample.

In describing the results of the mixed effects models, the term "prediction" was used to describe the relationships found between the predictor variable(s) and the outcome

variable (e.g., maternal pre-interaction emotion significantly *predicted* ensuing sensitivity). The decision was made to use this term in lieu of "relation" as the temporal ordering of variables implied directionality of associations (i.e., If A then B, then it is more plausible that A affected B than the reverse), more so than had the variables been collected simultaneously (i.e., If A and B, then it is just as plausible that A affected B as the reverse). As the design of this dissertation research was correlational, prediction was merely used to denote temporal ordering or direction of the relationship between variables, and *not* that one variable caused the other.

2.5.4.2.1 Testing Hypotheses. The second objective of the present investigation was to evaluate whether fatigue moderated the effect of negative emotion state and vigour on maternal sensitivity. To begin with, the predictor and moderator variables were grand-mean centred (except in the case of dichotomous or trichotomous variables). To assess the association between negative emotion and maternal sensitivity without the moderator, the primary investigator first conducted the analysis with the negative emotion intercept and slope as fixed and random effects. Moderation was then evaluated by setting the intercepts and slopes of negative emotion, fatigue, and the interaction of the two as fixed and random effects in the model. Statistical significance of the fixed effects interaction term was interpreted as evidence of moderation. These same two analyses were re-run with vigour as the predictor in lieu of negative emotion, to assess the relationship between vigour and maternal sensitivity and to determine if fatigue moderated this effect.

In order to evaluate the third objective, namely whether infant engagement accounted for (i.e., mediated) the relationship between maternal sensitivity and change in negative emotion or vigour post-interaction (i.e., the difference between post-interaction and pre-

interaction emotion states), the predictor variables were grand-mean centered. The mixed modeling approach was then applied to Baron and Kenny's (1986; Kenny, 2012) four steps for establishing if a variable functions as a mediator. First, the primary investigator evaluated if maternal sensitivity predicted the change in negative emotion. A non-zero coefficient for this total effect was interpreted as evidence that there was a relationship between the predictor and outcome variable that may be mediated. However, there are cases in which mediation is present and this relationship is not statistically significant, such as when the analysis is underpowered or when the mediation is inconsistent (i.e., the indirect effect has a different sign than the direct effect; Kenny, 2012; MacKinnon, Fairchild, & Fritz, 2007). Importantly, a relationship between the predictor and outcome is implied if non-zero coefficients are found in the second and third steps (Kenny, 2012). Secondly, the association between the predictor (maternal sensitivity) and the mediator (infant engagement) was explored. It was then evaluated if infant engagement was associated with the change in negative emotion, after accounting for maternal sensitivity. Statistical significance (non-zero coefficients) of the aforementioned second and third steps testing the indirect effect is required to establish partial mediation. Finally, in the fourth step, the effect of maternal sensitivity on the change in negative emotion, accounting for infant engagement, was examined. A non-significant (zero coefficient) relationship for this direct effect would indicate that infant engagement completely mediated the relationship. See Figure 2.3 for illustration of a mediated model.

To evaluate if infant engagement mediated the effect of maternal sensitivity on positive emotion, these four steps were repeated using change in vigour in lieu of negative emotion.

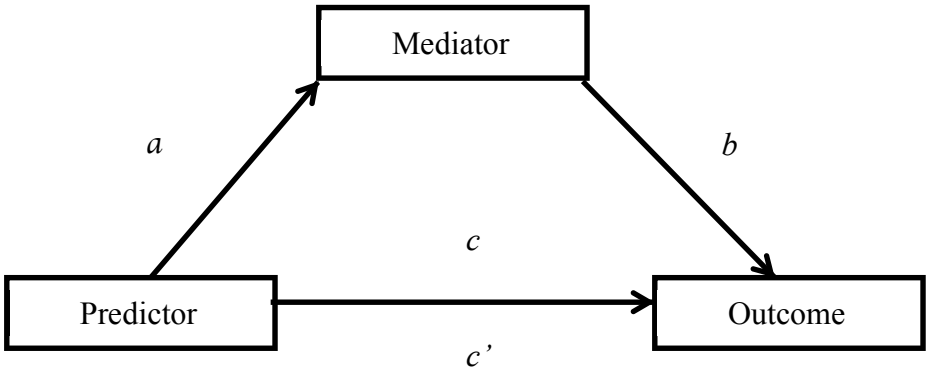

Figure 2.3. Mediated model, adapted from Kenny (2012). *a* = effect of the predictor on the mediator; *b* = effect of the mediator on the outcome, accounting for the predictor; *c'* = the direct effect of the predictor on the outcome, accounting for the mediator; and *c* = the total effect of the predictor on the outcome.

CHAPTER 3: RESULTS

3.1 Preliminary Analyses

3.1.1 Comparing Feasibility Study and Main Study Data.

Given that there were only minor methodological changes made between the feasibility study and the main study, participants' scores on the main variables of interest were compared to determine whether to combine their data together in analyses. See Table 3.1 for participants' mean scores on the main variables. After accounting for the clustering of data within participants, pre-interaction vigour ($b = .519$, $t = 2.35$, $p = .02$) and change in vigour ($b = .737$, $t = 3.30$, $p = .001$) both significantly differed between the feasibility and the main study. Therefore, study membership was included as a covariate in the main analyses involving these variables. None of the other main variables of interest were found to significantly differ between the feasibility and main study. Therefore, all subsequent analyses were conducted for the sample as a whole ($N = 49$ mother-infant dyads).

Table 3.1

Feasibility and Main Study Scores on Main Variables

Variable	Feasibility ($N = 9$)		Main ($N = 40$)	
	M (*SD*)	Range	*M* (*SD*)	Range
PI negative emotion	.18 (.30)	0.00 – 1.67	.16 (.28)	0.00 – 2.11
PI vigour	1.37 (.85)	0.00 – 4.00	1.19 (.74)	0.00 – 3.33

Variable	Feasibility (N = 9)		Main (N = 40)	
	M (SD)	Range	M (SD)	Range
PI fatigue	1.15 (.68)	0.00 – 3.00	.86 (.75)	0.00 – 4.00
Vigour change	.19 (.49)	-1.00 – 1.67	.27 (.61)	-1.33 – 3.00
Negative emotion change	-.07 (.18)	-.78 – .56	-.74 (.23)	-1.56 – .56
Maternal sensitivity	4.04 (.53)	2.60 – 5.00	4.08 (.55)	2.20 – 5.00
Infant engagement	3.02 (.82)	1.67 – 4.67	2.56 (.85)	1.00 – 5.00

Note. PI = pre-interaction.

Had the 49 participants completed all occurrences, there would have been 526 pre-interaction POMS-15 (Cranford et al., 2006), videotaped interaction GRS scores (Murray et al., 1996), and post-interaction POMS-15. Twenty participants discontinued their participation early, accounting for 61 missing occurrences. During their participation, a further two mothers failed to complete two pre-interaction POMS-15, two did not record 12 interactions, and eight failed to complete 18 post-interaction POMS-15. Twenty-three participants recorded 48 interactions that were uncodeable using the GRS. Videos were uncodeable for the following reasons: 1) Participant forgetting to press record on one of the camcorders, leaving only one member of the dyad visible (17 interactions of nine participants); 2) Mother's or infant's facial expressions not visible due to camcorder being misaligned or zoomed (15 interactions of six participants); 3) Interaction under three minutes in duration (nine interactions of six participants); 4) Infant removed from the Bumbo Baby Sitter ® during the interaction (two interactions of two participants); 5) Infant too distressed to interact (two interactions of two participants); 6) Interaction

interrupted by another child in the home (one interaction of one participant); 7) Camcorder malfunction (one interaction of one participant); and 8) Infant sucking pacifier during interaction (one interaction of one participant). The remaining 405 videotaped codeable interactions were included in analyses.

Six participants failed to answer a single item on one or more of their POMS-15 forms. In total, four items were unanswered on the pre-interaction POMS-15 and seven on the post-interaction POMS-15. Unanswered items included one negative emotion item, two vigour items, and four fatigue items. In these cases, the scales were calculated using the average of the answered items. In total, 463 pre-interaction and 447 post-interaction POMS-15 were included in analyses. Please see Figure 3.1 for data flow chart illustrating missing data and data included in analyses.

Including those participants who discontinued their participation early, on average, each participant completed 84.44% (SD = 20.83) of the total number of possible pre-interaction POMS-15, codeable GRS interactions, and post-interaction POMS-15. Due to violations of assumptions of normality, Spearman rank order correlations and independent samples Mann-Whitney U tests were computed between participant characteristics and the amount of data completed. The higher participating mothers' level of education attained and of household income, the more data they completed overall (respectively, r_s = .44, p = .001, and r_s = .36, p = .01). There was no significant relationship between the amount of data completed and mothers' age, infants' age, and the number of children living in the home (respectively, r_s = .21, p = .15; r_s = .05, p = .75; and r_s = -.19, p = .18). There was also no significant difference in the amount of data completed between participants with male infants (M = 81.76%, SD = 23.37) and those

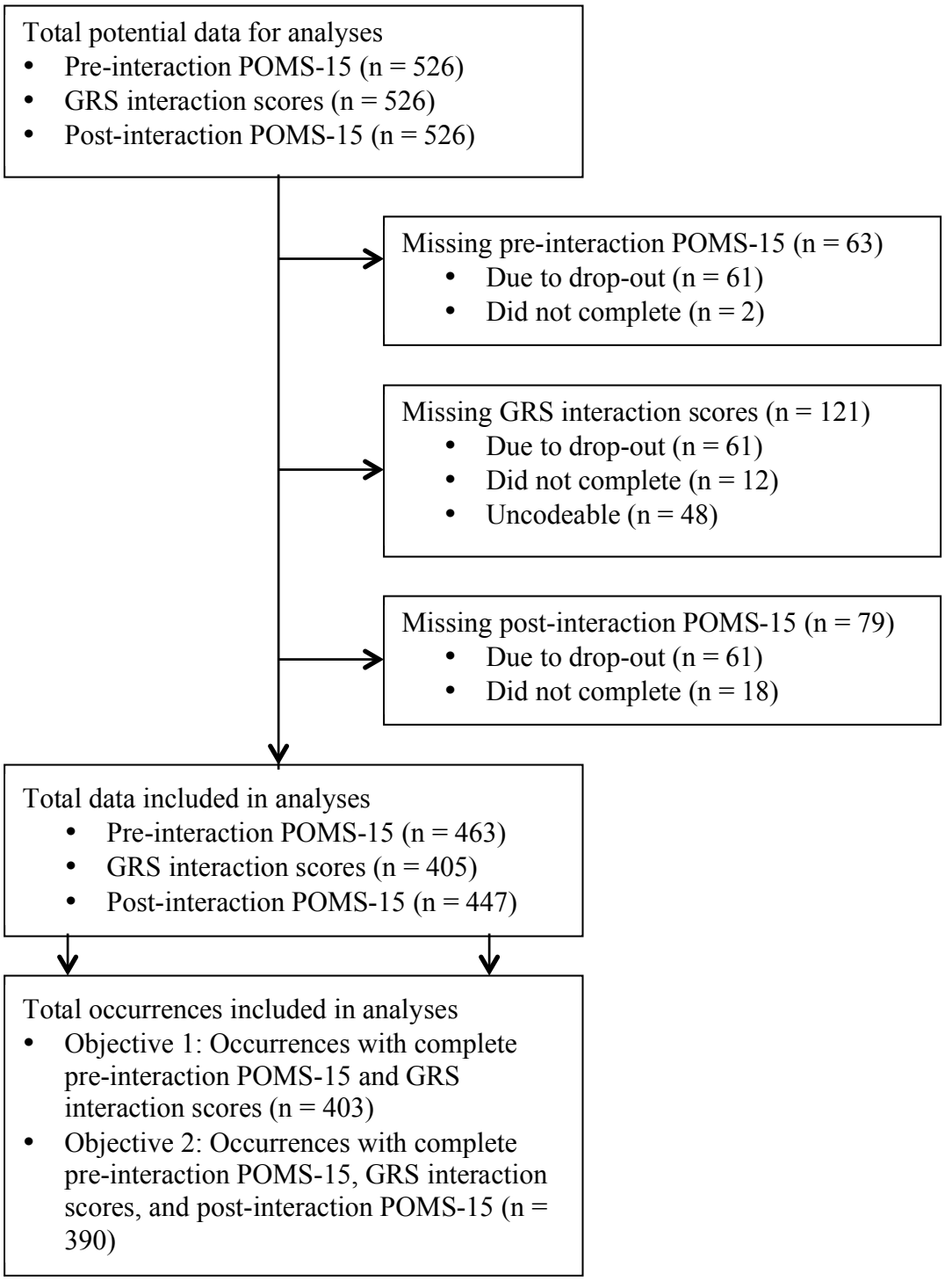

Figure 3.1. Data flow chart.

with female infants (M = 85.40%, SD = 19.59), p = .34. Thus, data from participants with a higher level of education and household income may be disproportionately represented in analyses.

Importantly, unlike traditional methods of repeated-measures analysis, mixed effects models do not exclude participants with incomplete or missing data from analyses (i.e., use all available data to make estimates; Schwartz & Stone, 1998). Instead, only those *occurrences* with incomplete or missing data are excluded. For example, in an analysis of the relationship between pre-interaction emotion state and maternal sensitivity, a given participant who completed 10 pre-interaction POMS-15 and nine videotaped interactions would have the nine occurrences with complete data included in analysis. The models also account for the variability in the outcome due to differences within and between participants. Thus, even though participants with more data have the potential to unduly influence models, having accounted for the within- and between-subject effect of each participant on the outcome mitigated some of this influence. Furthermore, inspecting the influence statistics provided an indication of the extent to which any one participant influenced the fixed effects estimates (see below).

Of note, although household income and maternal education were found to be statistically significant predictors of the pattern of missing data, these or other demographic variables were only included as covariates in subsequent analyses if they also significantly predicted the outcome variables. The reasons for this were as follows: 1) If the level of education and household income were not related to the outcome variables, then they could neither act as confounders, nor enhancers of effects; 2) As discussed above, by accounting for within- and between-subject effects of each

participant on the outcome in mixed models and by not excluding participants with missing data, this helped to mitigate the influence of these participants on results; and 3) For these reasons, it is believed that inclusion of these variables in models would have unnecessarily consumed degrees of freedom, minimizing power to detect effects.

3.1.3 Descriptive Statistics and Assumptions Testing of Second Objective Analyses: Do Pre-Interaction States Predict Maternal Sensitivity?

The second objective of this dissertation was to evaluate if maternal fatigue functioned as a moderator of the relationship between negative or positive emotion and maternal sensitivity. Analyses to address this objective included the pre-interaction POMS-15 variables of negative emotion, vigour, and fatigue, as well as GRS maternal sensitivity. The 49 participants had a total of 403 occurrences in which they had corresponding pre-interaction POMS-15 and GRS scores. Please see Table 3.2 for descriptive statistics of the variables addressed in this second objective.

On average, participants rated themselves as being *a little* vigorous and fatigued prior to interactions (respectively, $M = 1.21$, $SD = .76$; and $M = .93$, $SD = .75$). Participants' sensitivity in interactions was rated as 4.07 ($SD = .54$) on the 1 to 5 scale. Forty-two percent of the total variance in ratings of sensitivity was due to individual differences between mothers in their average sensitivity ($ICC = .42$). The remaining 58% of the variance was due to fluctuations in sensitivity within mothers; it is this within-person variance that the primary investigator attempted to account for in analyses.

Distributions for the second objective variables approximated normality (see Figures 3.2A through 3.2C), with low skew and kurtosis values (see Table 3.2). However, the

distribution of pre-interaction negative emotion was highly skewed and peaked, with 98.23% of the negative emotion measures having a value less than or equal to 1 (*not at all* to *a bit*) on the 0 to 4 scale (see Figure 3.2D). Thus, pre-interaction negative emotion departed markedly from normality and there was insufficient variance to model it as a continuous variable. As it is possible that mothers experiencing more intense negative emotion reported experiencing only *a little* due to perceiving this as more socially acceptable, the decision was made to dichotomize pre-interaction negative emotion into values of 0 or *no* negative emotion (54.3% of measures) and values above 0 or *some* negative emotion (45.7% of measures) and to use this dichotomized negative emotion variable as the predictor in mixed effects models to test the relevant second objective hypotheses. It is also possible that mothers in the sample endorsed fatigue when they were in actuality experiencing negative emotion, perhaps due to social desirability concerns or to a conflation of the two states during the postpartum period. Therefore, although not an explicit objective of this investigation, an exploratory mixed effects model was fit, in which the effect of pre-interaction fatigue on maternal sensitivity was explored.

Inspection of the residual plots for the analyses addressing the second objective revealed that the residuals were centered at zero, approximately normally distributed, and independent. Examination of the influence statistics for each analysis indicated that deletion of any given participant would have changed the estimated maternal sensitivity outcome value (i.e., fixed effects estimates; overall estimated mean intercepts and slopes) by no more than .02 on the 1 to 5 sensitivity scale. Thus, removal of any participant would not have clinically significantly affected the results.

Table 3.2

Descriptive Statistics for Pre-Interaction State Variables and Maternal Sensitivity (n = 403)

Variable	*M* (*SD*)	Range	Skew (*SE*)	Kurtosis (*SE*)
PI negative emotion	.16 (.28)	0.00 – 2.11	3.11 (.12)	13.42 (.24)
PI vigour	1.21 (.76)	0.00 – 3.33	.59 (.12)	-.11 (.24)
PI fatigue	.93 (.75)	0.00 – 4.00	.89 (.12)	.86 (.24)
Maternal sensitivity	4.07 (.54)	2.20 – 5.00	-.63 (.12)	.21 (.24)

Note. n = number of occurrences across participants included in analyses; and PI = pre-interaction.

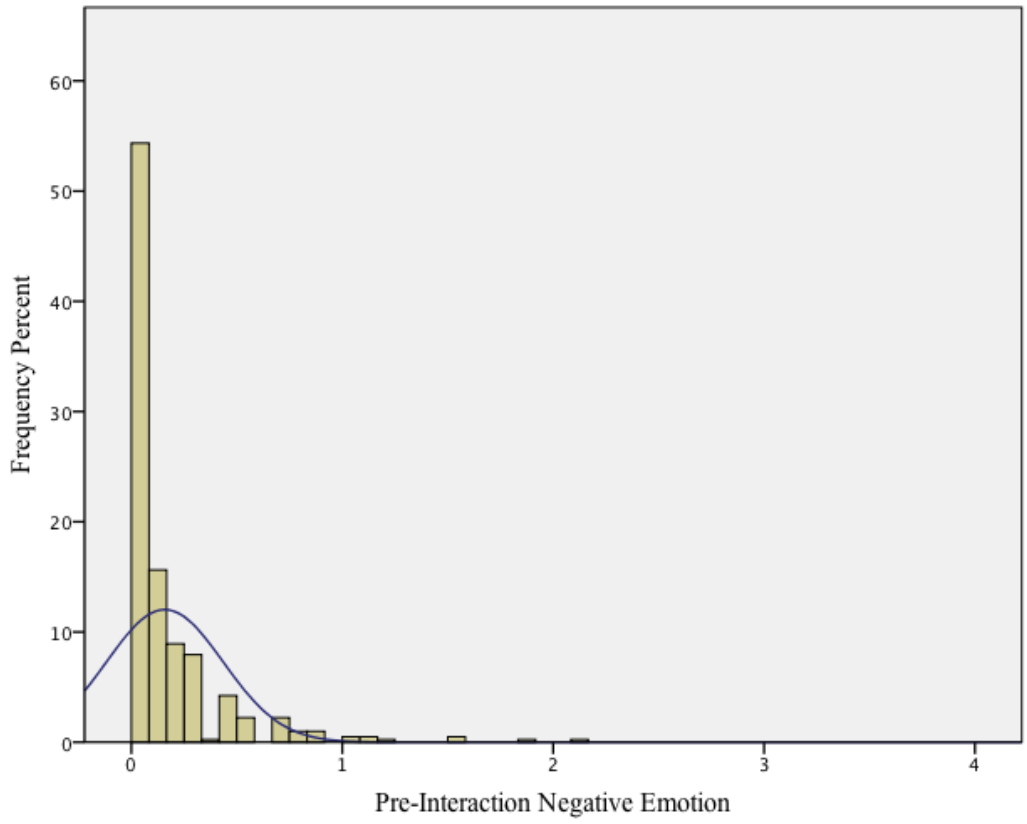

Figure 3.2A. Frequency distribution of pre-interaction POMS-15 negative emotion scores, on a scale from 0 (*not at all*) to 4 (*extremely*).

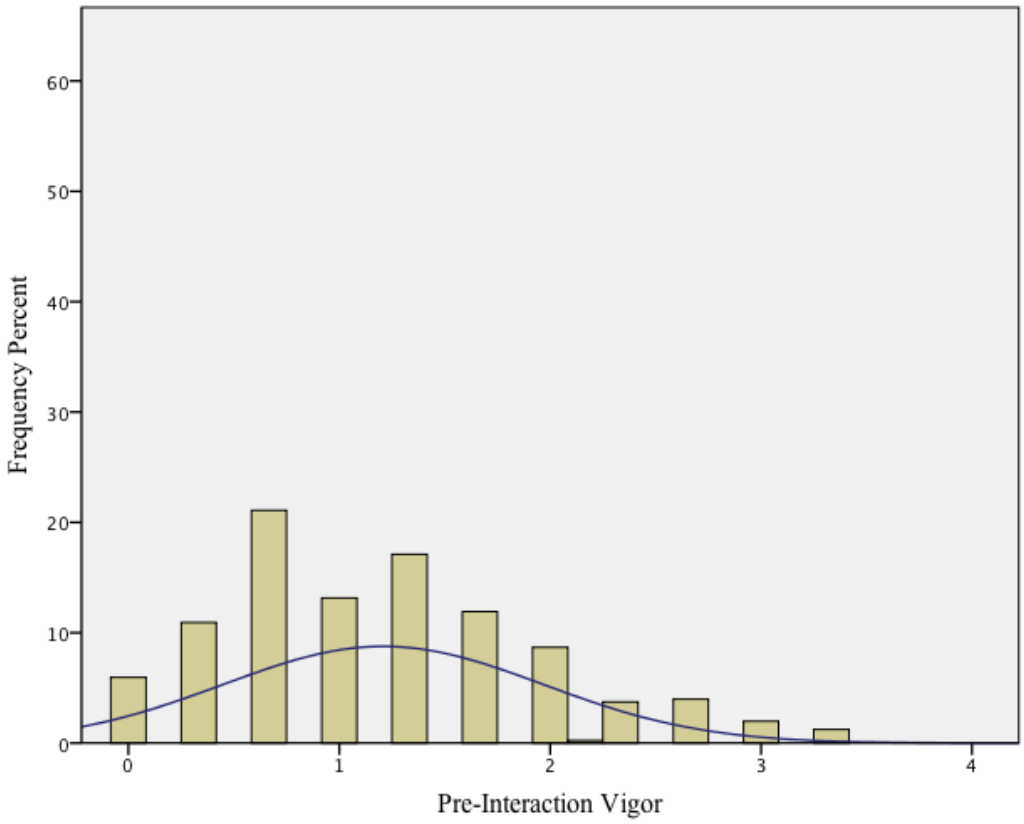

Figure 3.2B. Frequency distribution of pre-interaction POMS-15 vigour scores, on a scale from 0 (*not at all*) to 4 (*extremely*).

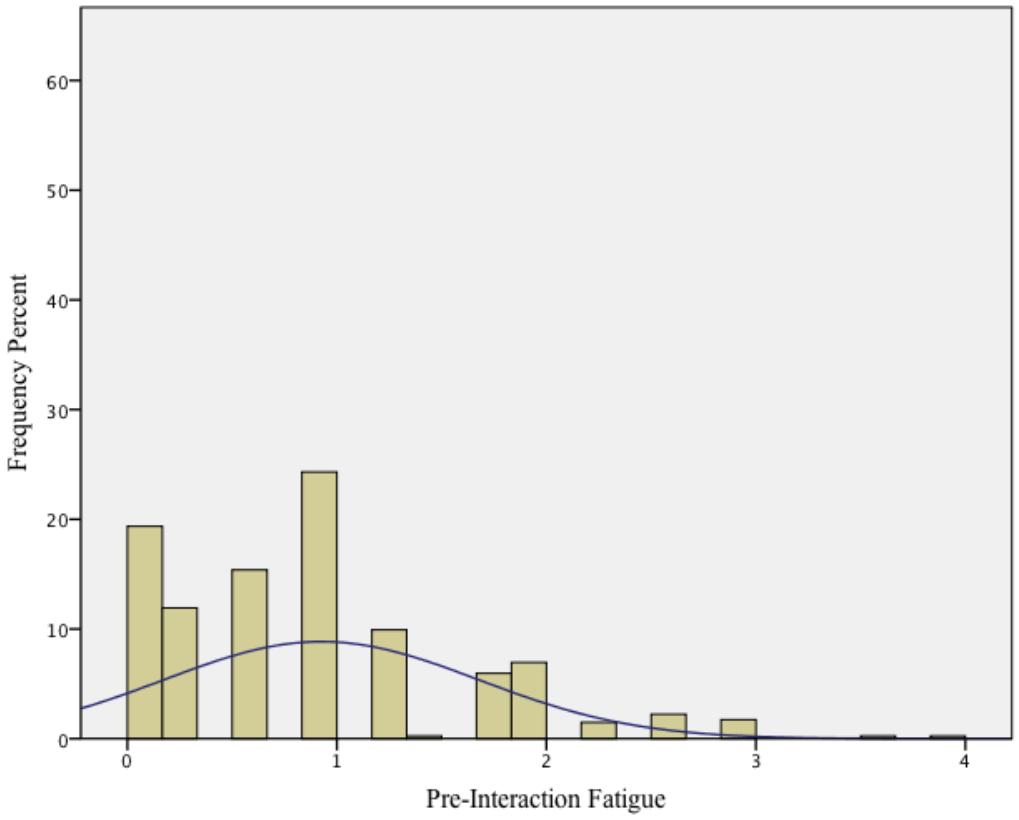

Figure 3.2C. Frequency distribution of pre-interaction POMS-15 fatigue scores, on a scale from 0 (*not at all*) to 4 (*extremely*).

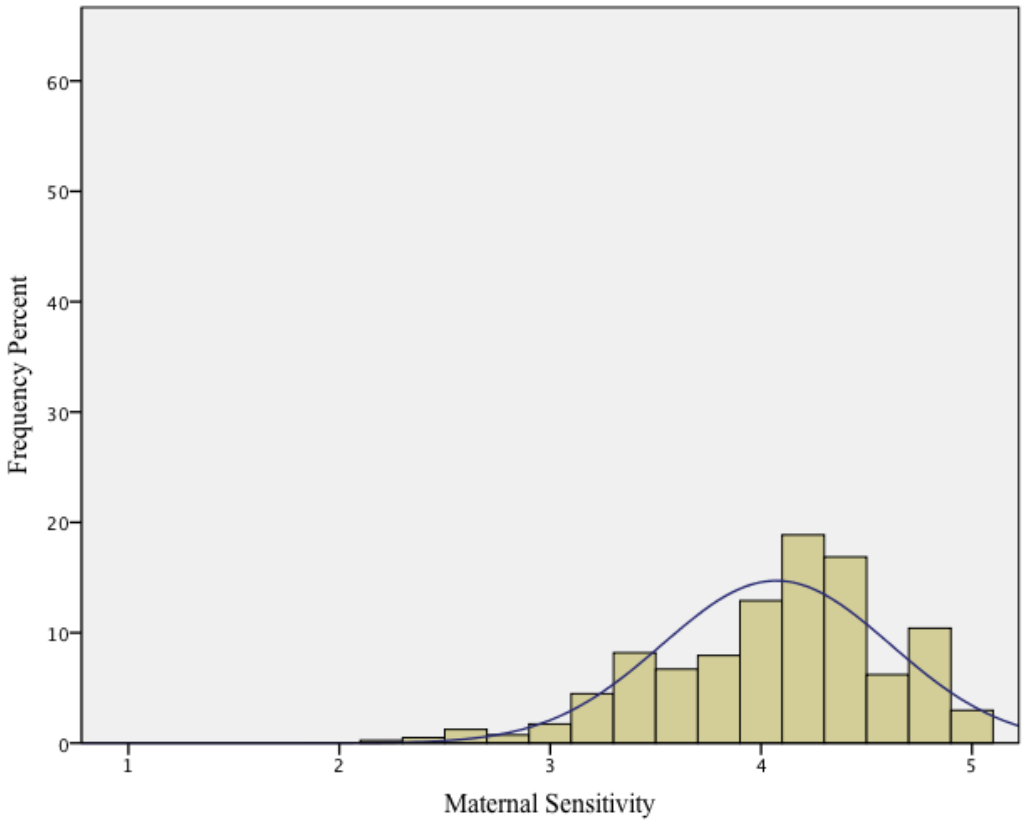

Figure 3.2D. Frequency distribution of GRS maternal sensitivity scores, on a scale from 1 (*poor*) to 5 (*good*).

3.1.4 Descriptive Statistics and Assumptions Testing of Third Objective Analyses: Do Sensitivity and Infant Engagement Predict Change in Emotion States?

The third objective of this dissertation was to determine if infant engagement mediated the effect of maternal sensitivity on change in negative and positive emotion. The variables included in analyses addressing this objective were GRS infant engagement, GRS maternal sensitivity, and the change in POMS-15 negative emotion and vigour from pre- to post-interaction. The 49 participants had a total of 390 occurrences in which they had corresponding GRS and POMS-15 difference scores. Descriptive statistics for these variables are presented in Table 3.3.

On the 1 to 5 point GRS scales, the infant engagement mean was 2.66 (*SD* = .86) and the maternal sensitivity mean was 4.08 (*SD* = .55). On average, participants indicated feeling slightly less negative after interactions with their infants (i.e., negative emotion change *M* = -.07, *SD* = .22) and slightly more vigorous (i.e., vigour change *M* = .26, *SD* = .60).

Thirty-two percent of the variance in vigour change and 42% of the variance in negative emotion change were attributable to differences between mothers in their average negative emotion change and vigour change (*ICC* = .32 and .42). The remaining 68% and 58% of the respective variances were due to fluctuations in negative emotion change and vigour change within mothers; it is these within-person variances that the primary investigator attempted to account for in analyses.

All variables were approximately normally distributed with low skew and kurtosis values, except for negative emotion change, which had a negative skew and a high kurtosis. See Figures 3.3A through 3.3D for distributions. Therefore, negative emotion change was trichotimized into three values: decrease in negative emotion (i.e., 31.80% of occurrences, 0% of which had no negative emotion pre-interaction), no change in negative emotion (i.e., 59.20% of occurrences, 81.82% of which had no negative emotion pre-interaction), and increase in negative emotion (i.e., 9.00% of occurrences; 57.14% of which had no negative emotion pre-interaction). This trichotomized negative emotion change variable was used in the pertinent third objective linear mixed effects models.

For analyses with trichotimized negative emotion change as the outcome variable, residuals appeared to be centered at zero and independent. However, due to the trichotomization of the variable, residuals only marginally approximated normality.

Violation of this assumption does not bias the fixed effects estimates, but may affect the confidence intervals and statistical significance tests (Raudenbush & Bryk, 2002); therefore these should be interpreted with caution. For the other analyses addressed in the third objective, inspection of residual plots indicated that assumptions were not violated for the present data. Inspection of influence statistics for the third objective analyses, including those with trichotomized negative emotion change as an outcome variable, indicated that no one participant had a clinically significant influence on the results. Specifically, removal of any given participant's data would have changed the fixed effects estimates by no more than .03 on the -1 to 1 negative emotion change scale or on the -4 to 4 vigour change scale.

Table 3.3

Descriptive Statistics for Interaction and Post-Interaction Variables (n = 390)

Variable	*M* (*SD*)	Range	Skew (*SE*)	Kurtosis (*SE*)
Infant engagement	2.66 (.86)	1.00 – 5.00	.58 (.12)	-.42 (.25)
Maternal sensitivity	4.08 (.55)	2.20 – 5.00	-.63 (.12)	.21 (.25)
Negative emotion change	-.07 (.22)	-1.56 – .56	-3.19 (.12)	16.08 (.25)
Vigour change	.26 (.60)	-1.33 – 3.00	1.11 (.12)	2.67 (.25)

Note. n = number of occurrences across participants included in analyses.

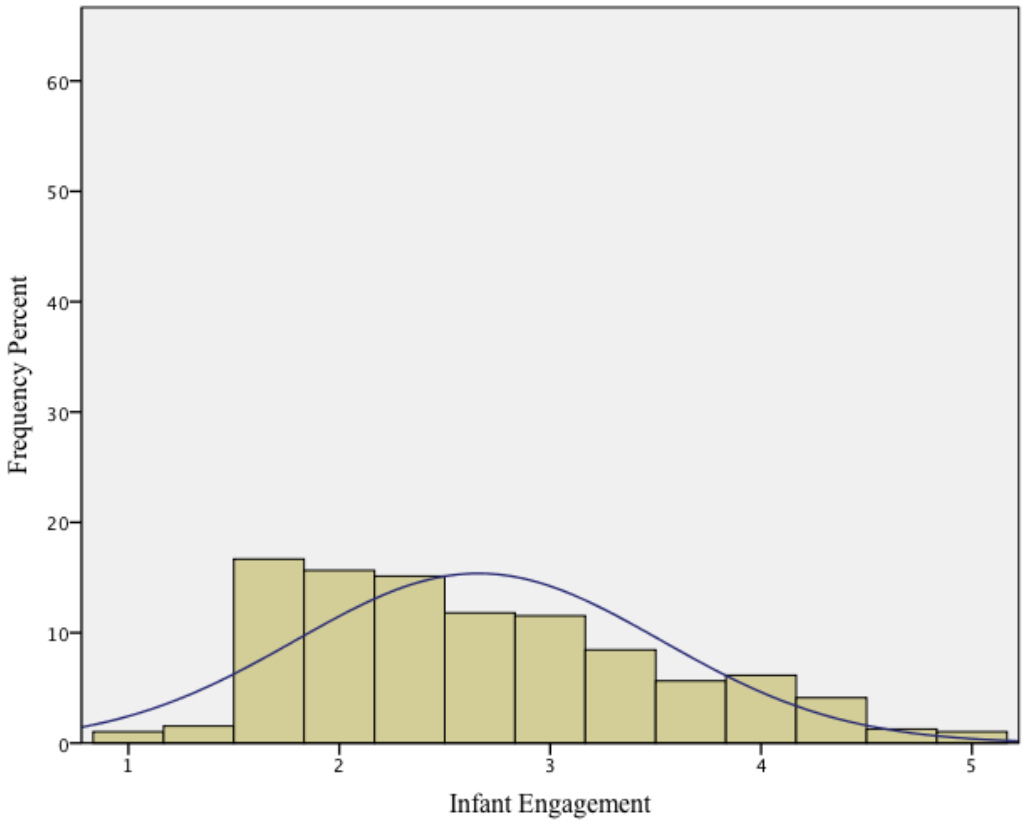

Figure 3.3A. Frequency distribution of GRS infant engagement scores, on a scale from 1 (*poor*) to 5 (*good*).

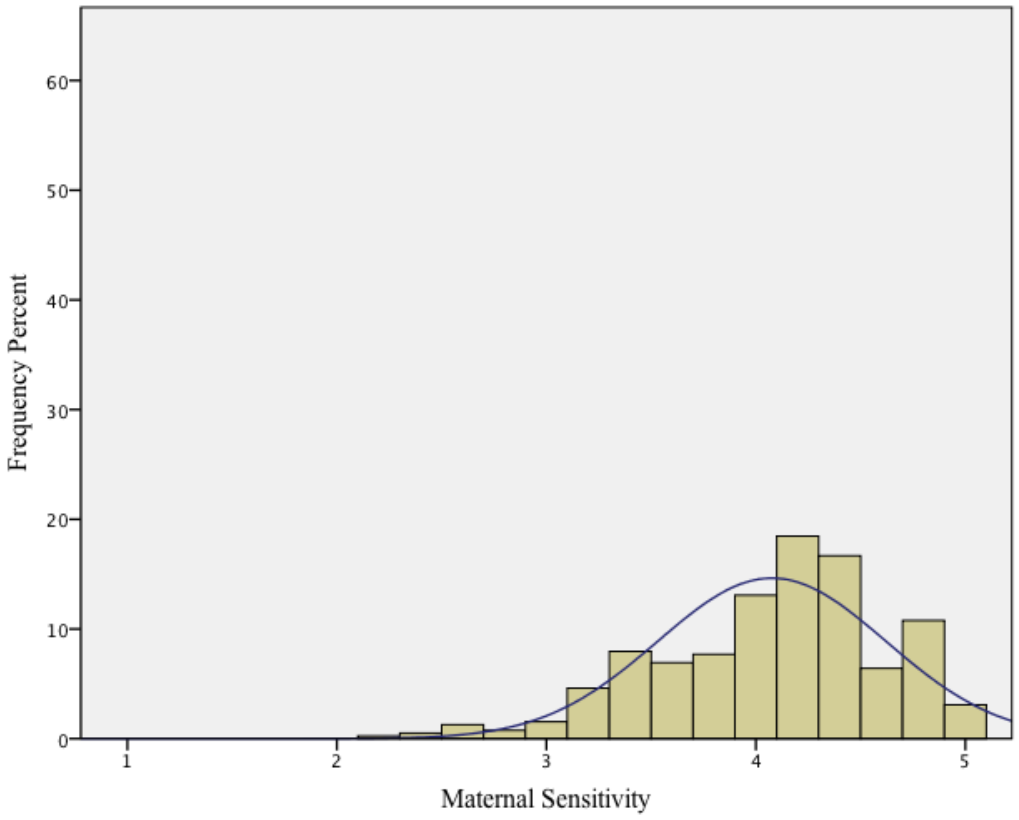

Figure 3.3B. Frequency distribution of GRS maternal sensitivity scores, on a scale from 1 (*poor*) to 5 (*good*).

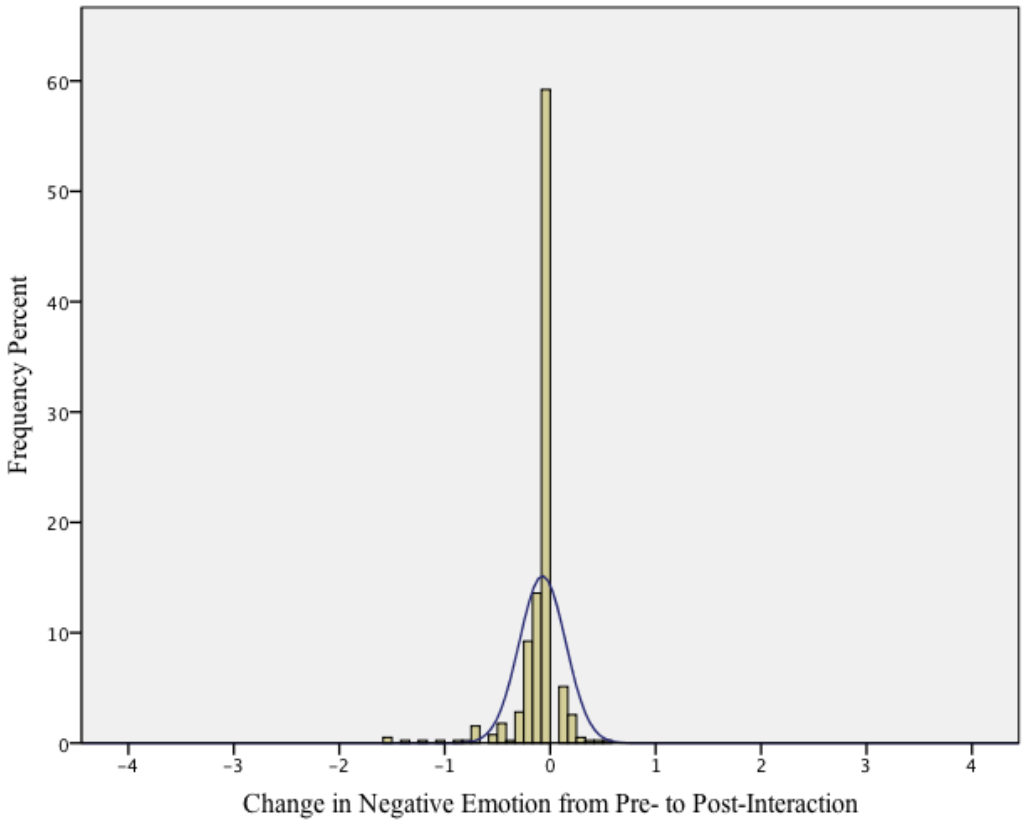

Figure 3.3C. Frequency distribution of POMS-15 negative emotion change scores, on a scale from -4 to 4.

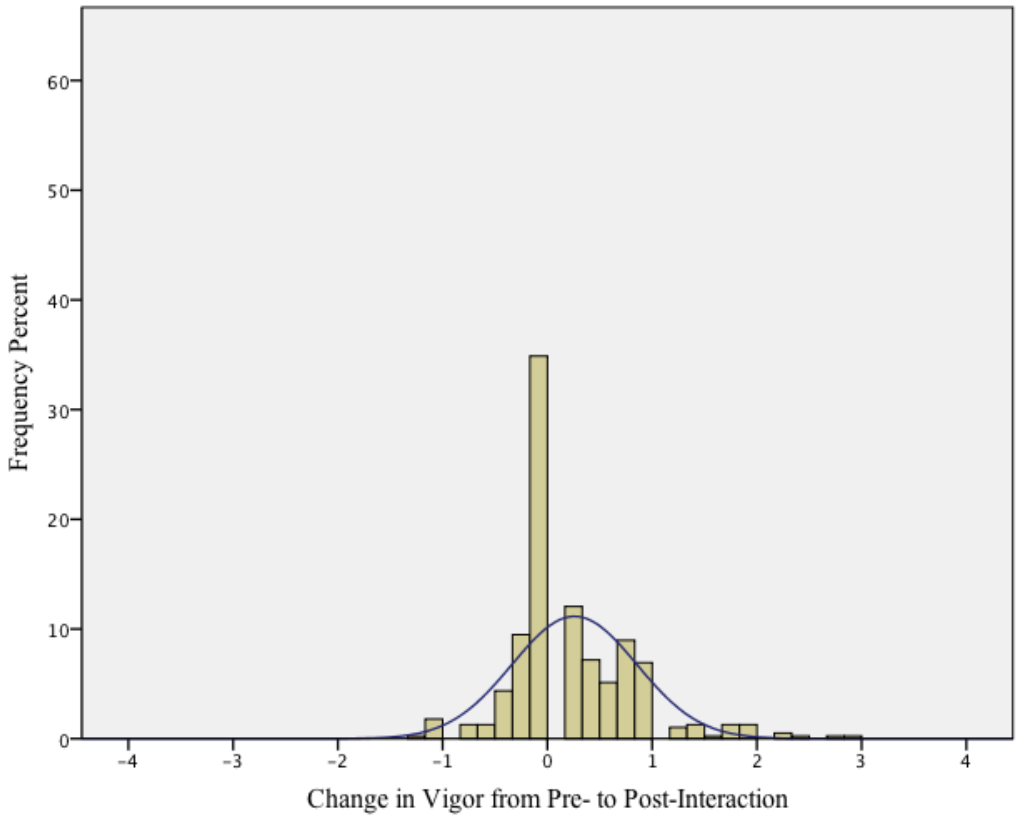

Figure 3.3D. Frequency distribution of POMS-15 vigour change scores, on a scale from -4 to 4.

3.2 Main Analyses

3.2.1 Second Objective: Do Pre-Interaction States Predict Maternal Sensitivity?

Five mixed effects models were fit separately testing the effects of infant sex, household income, maternal education, and maternal age on maternal sensitivity. Of these potential confounders, none were statistically significant predictors of maternal sensitivity.

3.2.1.1 Does Fatigue Moderate the Relationship Between Pre-Interaction Negative Emotion and Maternal Sensitivity? It was hypothesized that maternal negative emotion would negatively predict maternal sensitivity. Results indicate that when mothers reported experiencing some negative emotion before interacting with their infants, they

were rated as -.10 less sensitive than when they reported no negative emotion, 95% CI [-.21, .01], $p = .07$. This trend was in the predicted direction, but was not statistically significant. Contrary to expectations, pre-interaction fatigue did not significantly moderate this effect, $b = .08$, 95% CI [-.12, .27], $p = .43$. Thus, in all, support was not found for hypotheses that pre-interaction negative emotion would predict sensitivity, or that fatigue would moderate this effect.

3.2.1.2 Does Fatigue Moderate the Relationship Between Pre-Interaction Vigour and Maternal Sensitivity? It was hypothesized that vigour would positively predict maternal sensitivity, and that fatigue would moderate this effect. Overall, when participants had an average pre-interaction vigour score and study membership was accounted for, their sensitivity was rated as 4.06, 95% CI [3.95, 4.18], $p < .0001$. For each one-point increase in vigour above the grand mean, sensitivity increased by .02, 95% CI [-.04, .09]. Although the effect was in the direction predicted, it was not statistically significant, $p = .47$. Thus, pre-interaction vigour did not significantly predict maternal sensitivity. Also, support was not found support for the prediction that pre-interaction fatigue would moderate the relationship between vigour and maternal sensitivity, $b = .08$, 95% CI [.00, .17], $p = .06$.

3.2.1.3 Exploratory Analysis: Does Fatigue Predict Maternal Sensitivity? Results indicated a non-significant negative relationship between pre-interaction fatigue and maternal sensitivity. Occasions in which mothers' fatigue was at the grand mean were associated with a maternal sensitivity rating of 4.07, 95% CI [3.95, 4.18], $p < .0001$. For each one-point increase in fatigue, maternal sensitivity decreased by $b = -.04$, 95% CI [-

.12, .03], $p = .26$. This effect was not statistically significant, suggesting that fatigue did not significantly predict maternal sensitivity.

3.2.2 Third Objective: Do Sensitivity and Infant Engagement Predict Change in Emotion States?

Five mixed effects models were fit separately testing the effects of infant sex, household income, maternal education, and maternal age on change in negative emotion, as well as five models testing the effects on change in vigour. Of these potential confounders, none were found to be statistically significant, and therefore none were included as covariates in subsequent analyses.

3.2.2.1 Does Infant Engagement Mediate the Relationship Between Maternal Sensitivity and Change in Negative Emotion?

It was hypothesized that infant engagement would function as a mediator of the relationship between maternal sensitivity and change in negative emotion. In order to test this hypothesis, the mixed modeling approach was applied to Baron and Kenny's (1986; Kenny, 2012) four steps for establishing mediation. Of note, confidence intervals and statistical significance tests for analyses in which change in negative emotion was the outcome variable may be inaccurate due to the lack of normality of residuals; however, fixed effects estimates should not be affected (Raudenbush & Bryk, 2002).

Step 1: Does Maternal Sensitivity Predict Change in Negative Emotion? In this analysis, change in maternal negative emotion was trichotomized into three values: -1 for a decrease in negative emotion, 0 for no change in negative emotion, and 1 for an increase in negative emotion. Overall, an average rating of maternal sensitivity was

associated with a decrease in negative emotion from pre- to post-interaction, b = -.23, 95% CI [-.32, -.14], p < .0001. However, maternal sensitivity did not significantly predict change in negative emotion, b = -.04, 95% CI [-.16, .08], p = .52. Lack of normality of residuals for change in negative emotion would not have affected the size or magnitude of this total effect (*c*), but may have biased this statistical significance test. It is also possible that this effect was not statistically significant due to the power of the test for this path being considerably lower than for paths *a* and *b* (for discussion, see Kenny, 2012).

As it was not possible to rely on the results of the statistical significance testing for this path, inspection was undertaken of the magnitude of the effect to determine if it was practically significant. The value of -.04 indicates that for each one unit increase in sensitivity, negative emotion decreased by 2% on the -1 to 1 scale. This effect appears so small as to be practically insignificant, suggesting that there was no meaningful relationship to be mediated. However, it is possible that this total effect was small due to the presence of inconsistent mediation or a suppression effect. In this case, the mediated effect (*ab*) would have an opposite sign to the direct effect (*c'*) (Kenny, 2012; MacKinnon, Krull, & Lockwood, 2000; MacKinnon et al., 2007; Tzelgov & Henik, 1991). Inconsistent mediation could be demonstrated in the data if sensitivity predicted an increase in infant engagement (*a*), infant engagement (after accounting for sensitivity) predicted an increase in negative emotion (*b*), and sensitivity predicted a decrease in negative emotion (after accounting for infant engagement; direct effect *c'*). This would account for the small total effect (*c*), because the indirect effect (*ab*) cancelled out much of the direct effect (*c'*). Thus, although the total effect appeared too small to support

consistent mediation (i.e., where the mediated and direct effects have the same sign; e.g., MacKinnon et al., 2000), mediation could still be demonstrated if there was evidence that infant engagement acted as a suppressor variable (i.e., steps 2 and 3 significant and opposite in sign to step 4).

Step 2: Does Maternal Sensitivity Predict Infant Engagement? Average maternal sensitivity was associated with an infant engagement rating of 2.65, 95% CI [2.49, 2.80] $p < .0001$. Each one-point increase in maternal sensitivity was associated with a statistically significant .58 increase in infant engagement, 95% CI [.42, .74], $p < .0001$. Thus, behaving sensitively predicted more engagement in infants.

Step 3: Does Infant Engagement Predict Change in Negative Emotion, After Accounting for Maternal Sensitivity? When the effect of maternal sensitivity was accounted for, there was a trend toward statistical significance in the hypothesized direction, with infant engagement negatively predicting change in negative emotion, $b = -.08$, 95% CI [-.17, .00], $p = .05$. As discussed above, the results of statistical significance testing where negative emotion change is the outcome variable may be biased. However, the magnitude of this effect (b) may be considered small, as it indicates that for each one point increase in infant engagement (after accounting for sensitivity), negative emotion decreased by 4% on the -1 to 1 scale.

Step 4: Does Maternal Sensitivity Predict Change in Negative Emotion, After Accounting for Infant Engagement? Accounting for the effect of infant engagement, maternal sensitivity did not significantly predict change in negative emotion, $b = .01$, 95% CI [-.12, .14], $p = .91$. This zero-order relationship indicates that there was no direct relationship (c') between sensitivity and change in negative emotion for infant

engagement to have suppressed. Therefore, support was not found for inconsistent mediation or a suppression effect.

As evidence was not found for inconsistent mediation or a suppression effect, there is no evidence that such an effect accounted for the trivial total effect of sensitivity on change in negative emotion (*c*) found in Step 1.

Summary. In all, results of Step 1 of the mediation analysis indicate that there was no meaningful total effect of sensitivity on change in negative emotion to mediate. It was, however, possible that the size of the total effect appeared trivial due to infant engagement acting as a suppressor variable, and thus largely cancelling out the opposing direct effect of sensitivity on change in negative emotion; results of Steps 2 to 4 did not provide support for such inconsistent mediation.

3.2.2.2 Does Infant Engagement Mediate the Relationship Between Maternal Sensitivity and Change in Vigour?

It was hypothesized that infant engagement would act as a mediator of the relationship between maternal sensitivity and change in vigour. To test this hypothesis, the mixed modeling approach was applied to Baron and Kenny's (1986; Kenny, 2012) four steps for establishing mediation.

Step 1: Does Maternal Sensitivity Predict Change in Vigour? An average maternal sensitivity rating was associated with a change in vigour of .27, 95% CI [.14, .40], $p <$ .0001. For each one-point increase in maternal sensitivity ratings above the mean, change in vigour significantly increased by .22, 95% CI [.10, .34], $p = .0005$. In other words, the

more sensitive mothers were at a given time, the better they felt after interacting. These findings indicate that there is a significant relationship that may be mediated.

Step 2: Does Maternal Sensitivity Predict Infant Engagement? Maternal sensitivity predicted significantly more engagement in infants (see Step 2 above).

Step 3: Does Infant Engagement Predict Change in Vigour, After Accounting for Maternal Sensitivity? Upon accounting for the effect of maternal sensitivity, infant engagement was associated with a non-significant increase in vigour from pre- to post-interaction, $b = .06$, 95% CI [-.03, .14], $p = .19$. Results indicated that infant engagement did not significantly mediate the relationship between maternal sensitivity and change in vigour. Therefore, support was not found for the hypothesis and it was unwarranted to proceed to test for the presence of complete mediation in Step 4.

3.2.4 Summary of Main Findings.

In all, results indicate little support for hypotheses. Although several of the effect sizes were in the direction predicted, they were very small and were not statistically significant. Pre-interaction emotion states did not predict how sensitively mothers behaved, and fatigue did not significantly moderate these effects. The present dissertation also explored whether mothers' and infants' behaviour in interactions affected how mothers' felt afterward. The more sensitively mothers behaved, the more engaged their infants were and the more vigorous mothers felt thereafter. Sensitivity was not significantly associated with mothers' ensuing negative feelings. Contrary to predictions, infant engagement did not mediate the effects of maternal sensitivity on change in negative or positive emotion.

CHAPTER 4: DISCUSSION

4.1 Discussion Overview

A critical element in child development is the quality of the early interactions between adults and infants, and especially between mothers and their infants. Mothers largely drive these interactions because of their greater relative control over their own behaviour. Poor quality maternal-infant interactions are often characterized by a predominance of maternal negative affective expressions, as well as maternal psychopathology involving significant negative mood. Although how mothers feel in the moment is theoretically important in determining the quality of these interactions, research in the area has largely focused on more stable trait-like or psychopathological measures of maternal emotions. Given the importance of repeated and affectively positive mother-infant interactions in predicting healthy child development, this research sought to explore those in-the-moment factors predicting and maintaining such behaviour. Previous research and Dix's (1991) affective model of parenting were used to inform predictions.

As the assessment of mother-infant interactions has typically only represented a brief snapshot of behaviour, often in an unnatural setting and/or with a researcher present in the room, the first objective of this dissertation was to develop a novel, more ecologically valid, unobtrusive, and naturalistic methodology to measure interactions and emotions over time in families' homes. In so doing, the primary investigator delivered equipment, forms, and instructions to participants' homes and had them videotape several interactions with their infants. As this is the first time such a methodology has been

employed, feasibility was evaluated in a feasibility study. By and large, the procedure was acceptable to participants and yielded useable data. Some minor modifications were made to the main study methodology based on findings.

The second objective was to explore the moderating effect of mothers' fatigue on the relationship between their emotion states and ensuing interactive behaviour. Contrary to predictions, neither negative nor positive emotion significantly predicted sensitivity. Results also failed to support the hypothesis that fatigue would moderate these effects.

The final objective was to evaluate if infant engagement during interactions accounted for the relationship between maternal sensitivity and improvement or deterioration in maternal feelings following the interaction. Change in maternal emotion from pre- to post-interaction was interpreted as an indicator of whether or not behaving sensitively in the interaction was reinforcing to mothers, and thus likely to be repeated in the future. Results indicated that the more sensitively mothers behaved, the more engaged their infants were, and the more positive emotion they experienced. However, contrary to expectations, infant engagement did not mediate the effect of sensitivity on ensuing negative or positive emotion.

In the following sections, findings for each of objective are interpreted. In so doing, findings are related to the current literature and *post hoc* and alternative explanations are offered for those supported and unsupported hypotheses. Strengths, limitations, and directions for future research are presented, followed by concluding remarks.

4.2 Integration of Findings with Research Literature

4.2.1 First Objective: Methodology to Evaluate the Mother-Infant Interaction.

In order to minimize the obtrusiveness and travel burden for participants, and to maximize the ecological validity of the investigation, the primary investigator developed a novel methodology to assess mother-infant interactions over time by having mothers record their interactions with their infants in their homes, without a researcher present. In the preliminary study, the feasibility of this methodology was assessed by interviewing participating mothers and evaluating the videotaped interaction data obtained. Assessment was undertaken of the codeability of the videotapes, validity of the data, disruptions to data collection, participant satisfaction and burden, and suggestions for the future. In the following section, the focus will be on discussing the results pertaining to mothers videotaping their interactions themselves, as this was the novel aspect of the present methodology. Specifically, the following is addressed: this methodology's acceptability to participants, its effectiveness in yielding useable data, and its validity.

4.2.1.1 Acceptability. Encouragingly, all of the mothers in the feasibility study reported a positive experience participating. In keeping with findings from this dissertation that mothers' emotion state on average improved following interactions, mothers in the feasibility study mostly reported enjoying the one-on-one scheduled playtime this study procedure afforded, and found the recording equipment easy to operate. Although two indicated they liked setting up the equipment, one reported feeling stressed as her baby became fussy. Two mothers further reported that the equipment was too large to leave set up in their homes and four indicated problems operating the timers –

both are issues addressed in the main study by decreasing the size of the equipment and replacing the timers.

With respect to mothers' impressions of their infants' enjoyment of the procedure, all mothers noted that their infants mostly enjoyed being seated in the Bumbo Baby Sitter ®. One mother reported her baby became fussy when she set up the recording equipment and another that her infant became fussy during the interaction due to wanting to be picked up. Thus, only twice did mothers perceive their infants becoming fussy due to the procedure. Overall, the procedure appears to have been well-tolerated by mothers and infants.

In the only other study the primary investigator is aware of that investigated participants' impressions of the acceptability of observational parenting assessments, Rhule, McMahon, and Vando (2009) found that mothers reported laboratory-based child-directed play and clean-up tasks with their 3- to 6-year-old children were more acceptable than were parent-directed play or compliance tasks. Of note, mothers indicated that all of the tasks were at least moderately acceptable. Thus, even in a laboratory context with an experimenter watching behind a one-way mirror, mothers interpreted observational parenting assessment procedures as reasonable to complete with their children, particularly when they believed those procedures were more representative of their typical interactions. It is possible though that Rhule et al.'s (2009) participants, as well as the present feasibility study participants, did not find the procedure enjoyable, but merely said they did in order to be pleasing to the experimenters (i.e., social desirability). However, this does not appear to be a significant driving factor in the present case as several participants were comfortable independently reporting other concerns with the

study, such as not feeling the videos accurately captured how they normally played with their infants or that the recording equipment was too large.

Of note, acceptability in Rhule et al.'s (2009) study was assessed by summing up participants' responses on a rating scale inquiring about each procedure's acceptability, likeability, fairness, cruelty, and riskiness. In the present feasibility study, questions regarding acceptability were posed by an experimenter and were open-ended, such as, "What has it been like being in this study?" and "How did you find setting up the recording equipment?" Thus, acceptability appears to have been operationalized and assessed quite differently in the two studies, potentially affecting participants' responses. Therefore, although all participants indicated finding the present methodology acceptable overall, it cannot be gauged at this time if they would have found it *more* acceptable than Rhule et al.'s (2009) methodology.

Another way to gauge the acceptability of the procedure to participants is the attrition or missing data rate. Overall (i.e., across the feasibility study and main study), 14% of potential interaction data were lost due to dropout or to participants' failure to record interactions. However, by decreasing the number of repeated measures from 14 in the feasibility study to 10 in the main study, this led to a decrease from 33% missing to 8%. Due to increased travel and time burdens, it is likely that the attrition rate would have been significantly higher had participants been asked to come to the laboratory twice daily for several consecutive days instead of completing observations in their homes. It is less clear though how the attrition rate would have been affected by having an experimenter visit participants' homes to complete the recordings in lieu of participants completing the recordings themselves: participants may have either found such visits

intrusive/invasive or convenient. Thus, how dropout and missing data rates are affected by such methodological differences remains to be investigated. However, from a pragmatic point of view, having experimenters repeatedly visit participants' homes would dramatically increase the cost and time commitments for the researchers, and potentially lead to excluding participants living more than a short distance from the laboratory.

4.2.1.2 Useable Data. Besides acceptability to participants, to be practical for use in research, it is imperative that the procedure be effective in yielding useable data. Some videotaped interactions were uncodeable due to participants not closely following instructions and due to interruptions. By simplifying instructions and adding visual aids, the proportion of videos collected that were uncodeable decreased from 16% in the feasibility study to 9% in the main study (11% were uncodeable across the two studies). Although some degree of data loss may be inherent in having participants record their own interactions, it is encouraging that the loss was small and that it was possible to decrease this loss through greater clarity of instructions. Furthermore, 2/3 of the uncodeable videotapes were due to participants forgetting to press record on one of the two camcorders or to a camcorder being misaligned or zoomed. Were the study equipment modified to enable participants to press one button to record in lieu of two, and to encase the camcorders so they could not be manipulated, this could potentially have further minimized the quantity of uncodeable data from an overall total of 11% of videos collected to 4%. All that said, by and large, most of the data were codeable, suggesting that having participants videotape themselves in their homes was a feasible means of yielding useable data.

4.2.1.3 Validity. As one of the goals in having participants record their interactions themselves in their homes was to optimize the study's ecological validity, the following section will focus on whether this investigation was successful in achieving this end. In so doing, participants' reactions to being observed and mothers' beliefs about the representativeness of their videotaped interactions will be addressed.

Of concern, 5 of the 9 participating mothers in the feasibility study indicated experiencing some performance anxiety while being videotaped. However, all indicated this decreased over the course of their participation. Inspection of their self-reported emotion state ratings pre-interaction suggests that any anxiety they may have experienced was minimal, given that the highest negative emotion rating was between *a little* and *moderate*, and most endorsed none at all. Furthermore, although mothers may have initially reacted emotionally (and potentially behaviourally) to being videotaped, this problem is not unique to the present methodology, but rather may be inherent in observational studies. It remains to be investigated whether the procedure resulted in less anxiety about being observed than the typical procedure of having a researcher present and/or to being in a laboratory.

With respect to infants' reactivity to the study procedure, most mothers in the feasibility study indicated that their infants were distracted at some point due to the recording equipment or to other objects in the room. Some noted that the baby seat enabled their infants to play with their own toes, which also served as a distraction. As discussed above, one mother also reported that her infant became fussy while she set up the recording equipment, and another that her infant was distressed due to not being picked up during an interaction. In keeping with participants' comments, several aspects

of the recording equipment in the main study (e.g., obstructing the camcorder light and changing the finish of the camcorder stand from shiny to matte) were changed. It was not possible to control what objects were present in participants' homes, and, even if it were possible, doing so might have reduced the ecological validity of this investigation. In the main study, mothers and infants were asked to sit closer together to increase the ease of physical contact, but no changes were made regarding the baby seats, setting up the recording equipment, or holding infants during play. Although the objects of their attention may have differed in this investigation (i.e., the baby seat and their toes), it is typical for infants to actively explore their environments and their bodies. In fact, "engaged with the environment" is even part of the standard coding in the Global Rating Scales (Murray et al., 1996). However, unlike in the present study procedure, mothers are usually able to pick up their infants in typical interactions, should they so desire. Although many mother-infant observational assessments require infants to be seated face-to-face with their mothers for the duration (for reviews, see Fowles & Horowitz, 2006; Horowitz et al., 2005; Munson & Odom, 1996), it is unclear the effect being seated has on the external validity of the interaction.

In response to the question, "Do you feel that the video accurately captured how you normally play with your baby?", only two participants responded that it did. The remaining seven explained that it was atypical due to the lack of toys, the magnitude of the distance between them and their infants, the long duration of the play episodes, being seated face-to-face in lieu of lying on the floor, less movement and physical play possible, and not incorporating other children in play. As mentioned above, the physical distance was decreased between mothers and their infants during play episodes in the

main study. However, the decision was made not to modify the procedure further in response to these concerns, as doing so would have affected the ability to code the videotapes (i.e., more difficult to obtain a clear video image of both partners and would have violated coding requirements for the Global Rating Scales, Murray et al., 1996) and would have changed the nature of the present investigation (i.e., had toys or other children been incorporated). In this respect, the physical context of the videotaped interactions raises concerns about the study's ecological and external validity.

In addition to exploring the acceptability of four observational parenting assessments, Rhule et al. (2009) are the only researchers the primary investigator is aware of to investigate participants' impressions of these assessments' representativeness. All of the assessments were administered in a laboratory setting, with an experimenter videotaping and watching the interaction behind a one-way observation mirror. Rhule et al. found that mothers reported all of the tasks were at least *somewhat* typical, and that the child-directed play and clean-up tasks were more representative than the parent-directed play or structured compliance tasks. Although most participating mothers indicated the procedure was atypical, unlike Rhule et al., mothers were not asked to rate the extent to which it was. Thus, it is unclear from the present findings whether participants perceived the videotaped interactions to be only slightly atypical, or largely atypical. It can be speculated that participants would have viewed the present home-based, observer-absent assessment procedure as more representative than those laboratory-based, observer-proximate ones evaluated by Rhule et al., but further research is needed to verify this.

However, the paramount concern is not whether the set up of the videotaped interactions resembles that of typical interactions *per se*, but rather whether the procedure was natural enough for participants to behave as they typically would (for discussion on ecological validity, see Schmuckler, 2001). Unfortunately, this question cannot be truly addressed based on mothers' responses to question about representativeness, as it appears as though they focused on physical or contextual differences of the study procedure rather than on the effect these may have had on their interactive behaviour. Although there are several studies comparing ratings of parents' and children's interactive behaviours at home and in a laboratory (e.g., Belsky, 1980; Crockenberg & Litman, 1990; O'Brien, Johnson, & Anderson-Goetz, 1989; Pauli-Pott, 2008; Webster-Stratton, 1985) – with correlations across contexts varying widely – there appear to be none which compare participants' feelings about being recorded in either environment. There are, however, two studies contrasting the behaviour of families being audiotaped in their homes with and without an observer present (Bernal, Gibson, William, & Pesses, 1971; Johnson & Bolstad, 1975). Interestingly, relatively high consistency was found between ratings of maternal behaviour with their children across the two procedures (for discussion, see Gardner, 2000). However, these findings are based on a sample size of one family for Bernal et al. (1971) and 12 families for Johnson and Bolstad (1975). The mother of the family in Bernal et al. (1971) may also have been particularly motivated to behave as she normally would when directly observed, as she was actively seeking recommendations to improve her interactions with her children. Mother-infant reactivity to being videotaped at home, with or without a researcher present, has yet to be investigated (Gardner, 2000).

4.2.1.4 Summary and Conclusion. In the present dissertation research, mothers recorded themselves interacting with their infants in their homes, without an observer present. Interview and behavioural data suggest this procedure was largely acceptable to participants. The procedure also yielded a high rate of codeable videotaped interactions. This rate may be improved in future investigations by further increasing the clarity of study instructions and implementing small changes to the recording equipment. Of concern, participants raised some issues pertaining to the validity of the videotaped interactions, as some reacted emotionally to recording themselves, some infants reacted behaviourally to the set-up and procedure, and most mothers indicated they did not feel the video accurately captured how they normally played with their infants. Although some changes were made to the methodology in keeping with the mothers' concerns, the decision was made to leave the procedure largely unchanged for pragmatic and conceptual reasons. Having mothers videotape their interactions in their homes seems more ecologically (and potentially externally) valid than having an observer present, but this is merely conjecture and has yet to be investigated empirically. Pragmatically though, by minimizing travel costs and time for researchers and participants, the present procedure is well-suited to conducting repeated-measures investigations of the mother-infant relationship.

4.2.2 Second Objective: Pre-Interaction States Predict Maternal Sensitivity.

The second objective of the present dissertation was to evaluate whether state factors predict the extent to which mothers behave sensitively with their infants at a given time. In preliminary analyses, results indicated that maternal negative emotion pre-interactions

approached statistical significance in negatively predicting ensuing sensitivity, and positive emotion was associated with a non-significant increase in sensitivity. Although these findings were in the directions predicted, effects were small and not statistically significant, therefore they do not lend support for claims from Dix's affective model of parenting (1991; Dix et al., 2004) that parents' negative emotions tend to interfere with their motivation and ability to behave supportively with their children and that positive emotions are likely to promote increased supportiveness.

On first review, the non-significance of findings appear to run counter to those in studies of pathological negative emotion and parenting, and of positive and negative emotion states and concurrent parenting of young children. In their meta-analysis of observational studies of maternal depression and parenting, Lovejoy et al. (2000) found a small but significant negative association between depression and positive maternal behaviour (i.e., pleasant and enthusiastic). Of note, effects were stronger for studies involving economically disadvantaged mothers than non-disadvantaged mothers, for whom effects were not significant. Investigations involving non-pathological samples have documented significant relationships between mothers' negative or positive emotion states during interactions and their sensitive behaviour (Martin et al., 2002), supportive behaviour (Weis & Lovejoy, 2002), unsupportive behaviour (Dix et al., 2004), harsh discipline (Lorber & Slep, 2005), and angry or irritated behaviour (Lorber & O'Leary, 2005) with their toddlers in *stressful* or *challenging* laboratory situations (e.g., mothers asked to complete anagrams while ensuring their children did not play with attractive toys). However, when Weis and Lovejoy (2002) explored the relationship between

maternal emotion states and supportive parenting with toddlers in a *free-play* laboratory task, no significant associations were found.

Together, these findings suggest the possibility that maternal emotion states only exert a significant effect on parenting when mothers' resources are otherwise taxed, be this overall by the stressors associated with economic disadvantage, or in the moment by having to juggle multiple demands and a potentially resistant child in a challenging laboratory situation. These overall and current stressors may impinge on mothers' regulatory processes (i.e., ability to understand and control their emotions and their expression), which are what Dix (1991) proposed affect the relationship between parents' emotions and behaviour. In other words, by taxing their overall emotional, cognitive, or attentional resources, these stressors may make it more difficult for mothers to dedicate their resources to understanding, attending to, and controlling their current emotions.

Therefore, in the present study, it is possible that maternal emotion states did not significantly predict sensitive behaviour because participating mothers were not otherwise strained by economic hardships (i.e., on average, participating mothers had high household incomes) or by the current situation (i.e., free-play interaction in their homes without a researcher present); they may have been sufficiently stress-free to be able to regulate their emotions and behaviour without marked interference from their current emotion states. Thus, even though emotions and emotional expressions appear to play a particularly important role in early mother-infant interactions (e.g., Tronick, 2007), the present results illustrate that low-risk mothers' positive and negative emotion states *alone* do not significantly predict their ensuing sensitive behaviour with their infants in free-play interactions at home.

However, an alternative explanation is that negative emotion states *do* predict sensitivity in typical low-stress mother-infant interactions, but this was not found in the present investigation due to having lumped maternal anxiety, sadness, and anger together into one variable, negative emotion. Emotion states were grouped together because they are all thought to adversely affect sensitivity (e.g., Dix et al., 2004), and they often co-occur (e.g., McMahon et al., 2001; McNair & Heuchert, 2005). However, individually, each may be associated with different goals, motivations, and behaviours (e.g., Andersen & Guerrero, 1998; Frijda et al., 1989). For example, sadness is generally associated with the motivation to withdraw (e.g., Andersen & Guerrera, 1998) and with concurrent detached and resistant behaviour with toddlers (Dix et al., 2004), whereas anger is associated with antagonism (Frijda et al., 1989) and with more controlling and less supportive behaviour with toddlers (Dix et al., 2004). In fact, Dix et al. (2004) found that positive emotion (i.e., sum of scores of joy, relief, and interest) and negative emotion (i.e., sum of scores of anger, worry, sadness, and guilt) did not significantly predict high synchrony (i.e., behaviour supportive of children's goals), a construct similar to sensitivity. However, when these emotion states were examined individually, they found that joy was positively associated with high synchrony, and interest and anger were negatively associated. Thus, it is possible that mothers' individual emotion states affect sensitivity differently, and combining them masked effects. Unfortunately, in the present investigation, individual negative emotion states could not be examined separately due to low occurrence, and the only positive emotion state assessed was vigour. Of note though, Dix et al. (2004) found associations between individual emotion states and high synchrony in the context of mothers' interactions with their toddlers in stressful

laboratory interactions, whereas the present research involved interactions between mothers and infants in a low-stress home environment.

Finally, it is also possible that effects were masked in this study due to a failure to account for the effect of mothers' goals. Dix (1991) theorized that the combination of parents' emotion states and interactive goals (in conjunction with their regulatory abilities) determined their parenting behaviour. Supporting this, Dix et al. (2004) found that mothers' behaviour with their toddlers differed somewhat depending on whether their current emotion state was associated with the interactive goal to promote their children's interests (i.e., child-oriented) or their own (i.e., parent-oriented). To illustrate, on one occasion, a mother may experience anxiety because she is worried her infant is falling ill (i.e., child-oriented concern), so she pays close attention to his cues and is appropriately responsive; whereas at another time, this mother feels anxious because she has a job interview later in the day (i.e., parent-oriented concern), so she is not sufficiently focused on her infant in the interaction, mentally rehearsing for her upcoming interview.

Although in this study support was not found for Dix's (1991) proposal that emotion states predict parenting behaviour, an additional component of Dix's theory is that parents' regulation processes affect the nature of any such relationships. In other words, when properly functioning, regulation processes purportedly modulate emotions and their expression, in keeping with parents' concerns (Dix, 1991, 2000). By interfering with mothers' ability to concentrate, make decisions, and execute behaviour (e.g., Hockey et al., 2000; Jugovac & Cavallero, 2012), the present investigation proposed that fatigue would interfere with mothers' regulation processes, making it more difficult for them to

regulate their emotions appropriately in order to behave sensitively with their infants. Support was not found for this hypothesis; fatigue did not significantly moderate the effect of mothers' positive and negative emotion states on their subsequent sensitive behaviour with infants. Thus, it appears as though fatigue did not sufficiently impinge on mothers' regulatory processes to affect the relationship between their emotions and behaviour.

It is therefore possible that fatigue is not as disruptive or deregulating of mothers' emotions and sensitivity as proposed. This may be because, by this stage, mothers have already learned how to cope with this ubiquitous phenomenon and are effectively able to shield their infants from any potentially adverse effects. It is also possible that fatigue negatively affects mothers' *perceptions* of their emotions and parenting (e.g., Kennedy et al., 2007; White et al., 2009), but not their actual behaviour.

Alternatively, fatigue may selectively affect the relationship between high-intensity negative emotions and sensitivity, and not the relationship between positive emotions or low-intensity negative emotions and sensitivity. To elucidate, Dix (1991) proposed that parents' regulatory processes help them to match their emotions and behaviour to the parenting task at hand. Given the overall importance of positive emotion in sensitive mother-infant interactions (e.g., Ainsworth et al., 1978; Blehar et al., 1977), and the theorized pro-social effects of positive emotion in general (e.g., Andersen & Guerrero, 1998; Oatley & Johnson-Laird, 1987; Scherer & Wallbott, 1994), strong regulatory abilities may not be needed for happier mothers to behave sensitively; positive emotion may already be sufficiently well-matched to the task of playing with an infant. Thus, even if fatigue indeed impinges on mothers' regulatory abilities, these abilities are not needed

to successfully regulate the relationship between positive emotions and sensitivity, which is why significant moderation effects were not found. In the case of negative emotions, participating mothers reported little to none. At such low levels, negative emotion may not markedly interfere with sensitivity, regardless of the strength of mothers' regulation processes. It remains to be explored whether in situations where mothers are experiencing more intense negative emotions, fatigue affects the relationship between such emotion states and sensitivity.

Another possibility is that the moderating effect of fatigue depends on the specific negative emotion state or maternal goal experienced. For example, for a mother experiencing anger at her infant for interfering with her plans, the experience of fatigue may be positive, as she may lack the bodily resources to behave as intrusively as she otherwise would have. On the other hand, a sad mother may be motivated to withdraw or passively watch her infant, which would only be exacerbated by fatigue. Therefore, by combining negative emotion states together in analyses and not exploring maternal goals, the effect of fatigue may have been masked. In the present investigation, mothers mostly denied experiencing any negative emotion, making it unfeasible to explore this proposal further and to analyze the moderating effect of fatigue on the relationship between negative emotion and sensitivity separately. Also, mothers' goals in interactions were not assessed, and thus could not be evaluated further.

In all, support was not found for hypotheses that maternal positive and negative emotion states affect sensitivity, and that fatigue moderates these effects. Thus, the results imply that mothers' typical day-to-day fluctuations in positive and negative emotions and fatigue do *not* account for past research findings that maternal sensitivity varies

somewhat across observations (Ainsworth et al., 1978; Lindhiem et al., 2010; Pauli-Pott, 2008). These fluctuations may instead be attributable to other factors, such as maternal cognitions, environmental or situational stressors, specific emotion states, and measurement error. Nevertheless, given that only 42% of the total variance in sensitivity ratings across occurrences was due to individual trait-like differences in average sensitivity, the present findings lead to further questioning of the validity of the typical research methodology of basing maternal sensitivity assessments on single observations.

4.2.3 Third Objective: Sensitivity and Infant Engagement Predict Change in Emotion States.

Engaging in repeated sensitive mother-infant interactions over time facilitates infants' healthy development. The present investigation therefore evaluated what factors determine whether mothers find behaving sensitively reinforcing, and thus makes them more likely to repeat this behaviour in future interactions. It was proposed that the extent to which mothers would be successful at promoting their infants' positive and active engagement in an interaction would determine whether mothers felt better or worse after behaving sensitively. In essence, it was hypothesized that infant engagement would mediate the effect of maternal sensitivity on the change in positive and negative emotion states following interactions.

Preliminary analyses indicated that, the more sensitively mothers behaved, the more engaged their infants were with them in the interaction. These findings are in line with past research (e.g., Blehar et al., 1977; Murray et a., 1996). However, causality and directionality of effects remains unclear. In the course of free-play, face-to-face

interactions between mothers and infants, there is evidence that mothers respond to their infants' expressions (e.g., positive infant expressions predicted maternal affirmations, Murray et al., 1996), and that infants respond to their mothers' expressions (e.g., maternal positive expression preceded infants' positive expressions, Cohn & Tronick, 1987). Field et al. (1988) found that infants of depressed mothers demonstrated similar interactive difficulties when playing with their mothers as when playing with female strangers (who were naïve to infant group classification). Of note, although female strangers did not demonstrate the same degree of interactive difficulties with the depression-group infants as did the depressed mothers, they did behave significantly worse with these infants than they did with the non-depressed group infants (e.g., less contingently responsive). These findings suggest that in some cases, infants may be more difficult to effectively engage with than others, perhaps by virtue of their relative interactive behaviour problems. Results of meta-analyses of studies employing the Still Face Paradigm have also demonstrated that when mothers are instructed to present a neutral expression and remain unresponsive, their infants respond with decreased positive affective behaviour and gazing than in the context of a normal interaction (Mesman, van IJzendoorn, & Bakermans-Kranenburg, 2009). In this context, directionality of effects has only been demonstrated from mothers to infants, as it is evidently not feasible to experimentally control infants' behaviour to observe how their mothers respond. It therefore remains unclear in this study whether maternal sensitivity led infants to be more actively engaged or vice versa (or whether there was a third confounding variable contributed to both partners' behaviours). However, given prior evidence of bidirectional effects (e.g., Cohn & Tronick, 1987; Field et al., 1988), it is plausible that mothers behaved more sensitively

when their infant's state was amenable, and infants in turn responded with more active engagement when their mothers behaved more sensitively.

Results also indicated that, at an average level of sensitivity, mothers reported feeling better (i.e., more positively and less negatively) after interacting with their infants. Increases in sensitivity were associated with further improvements in positive emotion, but not with further decreases in negative emotion. Thus, the more sensitively mothers behaved, the happier they felt, but this did not affect how negatively they felt. To the knowledge of the primary investigator, this dissertation is the first empirical study to explore and document that mothers feel better after interacting with their infants, and that behaving sensitively predicts an ensuing improvement in positive emotion. The present findings suggest that mothers experience such behaviour as positively reinforcing (though not negatively reinforcing), which may partly explain why the majority of non-pathological mothers behave sensitively (e.g., Trevarthen & Aitken, 2001) and most mothers interact repeatedly with their infants over time (e.g., Wille, 1995).

The question remains, why did behaving sensitively predict how good mothers felt after interacting, but not how negatively they felt? Given that mothers in the study endorsed little to no negative emotion prior to and following interactions, it is possible that there was insufficient variability for sensitivity to account for it. In other words, mothers may indeed feel less negatively the more sensitively they behave, but only if they feel markedly negative to begin with. This remains to be explored in a sample of mothers who report higher ratings of negative emotions.

Alternatively, the relationship between parenting and emotion may be specific to the type of parenting being investigated. In their meta-analysis of observational studies of

maternal depression and parenting, Lovejoy et al. (2000) found that effects of depression were stronger on negative (i.e., hostile, coercive, or negative affective behaviour) or disengaged maternal behaviour (i.e., neutral affect and withdrawn behaviour) (respectively, r = .20 and .14), than on positive maternal behaviour (*r* = .08). Similarly, Rueger, Katz, Rissr, and Lovejoy (2011) found evidence of specificity of effects in their meta-analysis on parental affect and parenting behaviours, with positive affect more strongly associated with supportive parenting (*r* = .20) than with harsh, negative parenting (*r* = .07), and negative affect more closely related to harsh-negative parenting (*r* = .19) than with supportive parenting (*r* = .13). These meta-analyses suggest that feeling negative is largely specific to parenting negatively, and feeling positive is largely specific to parenting positively. Although the present investigation did not explore the effect of negative parenting (e.g., intrusive and withdrawn behaviour) on ensuing emotions, findings suggest that sensitivity (i.e., a form of positive or supportive parenting) is specific in its effect on ensuing positive emotion rather than on negative emotion. The present study is the first to investigate and demonstrate that in free-play interactions among low-risk mothers and their infants, how good or bad mothers feel when entering an interaction does not significantly affect how sensitively they will behave, but how sensitively they behave affects how much positive emotion they will experience. In other words, behaving sensitively is experienced as enjoyable to mothers, but positive emotion when entering an interaction is not necessary to engage sensitively.

It was also hypothesized that infant engagement would account for the effects of maternal sensitivity on change in positive and negative emotion. However, as sensitivity did not predict how negatively mothers felt after interacting, there was no effect for infant

engagement to account for; in other words, infant engagement could not mediate the effect of sensitivity on change in negative emotion, as there was no effect to mediate. On the other hand, there was a significant effect of sensitivity on change in positive emotion, but contrary to predictions, infant engagement did not mediate this effect. Thus, mothers felt better the more sensitively they behaved, but this was not determined by their infants' engagement in the interaction.

Infant engagement was proposed to function as a mediator because it was presumed that mothers' goals for behaving sensitively would be to promote their infants' enjoyment and engagement. Therefore, based on Dix's affective model of parenting (1991; Dix et al., 2004), it was anticipated that mothers who have this empathic or child-centered goal would experience an improvement in mood from behaving sensitively, but only if they met their goal, namely that their infants become positively and actively engaged in the interaction. However, it is possible that mothers' empathic goal was merely to behave in keeping with their infants' needs, and thus they felt better the more sensitively they behaved, regardless of how their infants responded; their goal was to behave sensitively, so they felt better when they did so. "Because children's thoughts, feelings, and points of view are highly accessible when empathic goals are active, parents at these times make more benign attributions for children's behaviour" (Applegate, Burleson, & Delia, 1992, p. 33). If their infants responded with minimal engagement, rather than feel worse that they *failed* to engage their infants, they felt good that they did the best they could and attributed their infants' behaviour to not sleeping well, being hungry, having gas, or just not being *in the mood.* Thus, mothers felt better when they behaved sensitively, but did not take it personally if their infants remained unengaged.

Another possibility is that mothers had differing goals for behaving sensitively, and that the failure to assess and account for this obfuscated any effects of infant engagement. Some mothers may have behaved sensitively with the goal of *looking good* for the experimenters, others may have done so to prevent their infants from fussing, whereas others may have done so to get their infants positively and actively engaged in the interaction. As sensitivity is associated with less infant fussiness (e.g., Bell & Ainsworth, 1972) and increased infant engagement, all of these mothers may have had their goals advanced and thus overall felt better the more sensitively they behaved, but only the latter group would have felt better depending on their infants' degree of active engagement.

4.3 Limitations and Considerations

Several limitations and considerations should be noted. Below, a discussion is presented of those concerns believed to be most salient to the present investigation.

4.3.1 Interpretation of Null Findings.

In all, results indicate little support for hypotheses. Although mothers, on average, felt better after interacting, and maternal sensitivity predicted infant engagement and an ensuing increase in positive emotion, none of the remaining analyses reached statistical significance. In his discussion of negative results, Kazdin (2003) proposes several alternative interpretations for "no-difference" findings, such as those obtained for the primary hypotheses in the present investigation. Two of these interpretations may be particularly pertinent in this case and will be considered in turn below.

First, non-significant findings may accurately reflect null or very small (i.e., effectively null) relationships in the population. Thus, the study's findings may correctly indicate that mothers' emotion states and fatigue prior to interacting do not individually or jointly affect their ensuing sensitive behaviour with their infants during free play in their homes, and that the relationship between sensitivity and how mothers feel thereafter does not depend on infants' active engagement. Kazdin (2003) explains that such null results may be considered informative and interpretable if the study is well-conceptualized and methodologically sound. With respect to conceptualization, the present investigation's primary hypotheses were formulated based on a thorough review of the literature on the characteristics of and relationships between mothers' and infants' behaviours in early dyadic interactions, the impact of maternal (pathological and typical) emotions and fatigue on parenting, and basic research and theory on emotions and reinforcement. Hypotheses were also informed by Dix's (1991) affective model of parenting, which is widely cited in research on parent-child interactions and may be particularly applicable in the present case due to it being unique in accounting for the within-subject variability in parenting across occurrences. However, it is possible that effects were obfuscated due to not having accounted for potential shifts in mother-infant interactions occurring between infant ages 15 to 28 weeks (i.e., when infants are shifting from dyadic to triadic modes of communication), as would be predicted by the Dynamic Systems Perspective (Fogel, 2011). For example, face-to-face interactions without toys may be more relevant for 15-week-olds with their mothers than for 28-week-olds and their mothers (see Fogel et al., 2006), and the extent (and therefore the role) of infant engagement in interactions may shift across this developmental period. Further, as

mothers and infants get to know each other better over this period, their behaviour with each other may become more predictable and their relationship increasingly secure, and therefore less subject to fluctuations based on each other's current state.

Regarding methodological adequacy, the present investigation employed an observational methodology, which is considered paramount in the objective assessment of mother-infant interactions. Efforts were made to enhance the external validity of such assessments by having mothers repeatedly record their interactions over time in their homes, without a researcher present. Coding of interactions was conducted using a well-validated measure with good interrater reliability, which has been used extensively in cross-cultural samples. Emotion states were assessed with a brief self-report scale found to demonstrate good validity and reliability in detecting within-person change in current emotion state. Assuming adequate conceptualization and methodology, the present investigation's null findings are interpreted as likely accurate, with possible reasons and explanations discussed in sections 4.2 and 4.3 above.

However, it is possible that one aspect of the procedure obfuscated effects, potentially invalidating the accuracy of the null effects found. Specifically, having mothers self-report their emotions pre-interaction may have caused them to reflect on their emotions more so than they typically would have, prompting them to exercise more control over their ensuing interactive behaviour. For example, in a typical day, a mother may feel angry and act automatically and without reflection on this emotion with her infant, thus behaving more intrusively. However, when asked to pause and rate her emotions first, she may have had the time to think, "I guess I *am* angry. I should be *extra* careful not to act on my anger with my baby." Indeed, among other things, Dix (1991)

proposed that the relationship between emotions and parenting behaviour is influenced by parents' understanding of their emotions and their expression. Raag et al. (1997) found that dysphoric mothers who were given a depression scale to complete *before* interacting face-to-face with their 4-month-old infants behaved more positively than did those given the same scale *after* interacting. Thus, despite having been overall adequately conceptualized and having several methodological strengths, by not accounting for potential developmental shifts in interactions between mothers and infants aged 15 to 28 weeks and by encouraging reflection, it is possible that the present procedure affected the size and direction of findings. This should be investigated in future research to determine if the null effects found are indeed valid.

The other relevant possible interpretation for non-significant findings advanced by Kazdin (2003) is that effects are actually present but were not detected due to insufficient statistical power. Prior to conducting the main study, sample size was determined by calculating the number of participants that would have been required to detect a medium effect of interest using a simple regression analysis, with no nesting in the data. This number was then multiplied several-fold, as a gross means of accounting for the lack of independence in the data. As mixed effects models are a relatively new form of analysis, more precise means of calculating sample size have not been widely disseminated. Despite extensive readings in the area and consultation with several statistics experts at the time, a more sophisticated means of estimating sample size for this model was not identified.

Upon conclusion of the investigation and through consultation with several more statisticians and quantitative psychologists, it was possible to identify what appeared to

be a more suitable way to estimate sample size for the main analysis of interest, i.e., whether fatigue moderated the effect of pre-interaction emotion (negative or positive) on maternal sensitivity. Through consultation with Drs. William F. Chaplin and Jonathan A. Shaffer, the decision was made to apply a method for calculating sample size for clustered randomized control trials (see Hemming, Girling, Sitch, Marsh, & Lilford, 2011) to the present single group repeated-measures design. Were this method to calculate sample size have been used *pre hoc* using the feasibility study data and with the planned cluster size of eight observations per participant, approximately 257 nested observations would have been needed to detect a small effect of the interaction of fatigue and emotion on sensitivity. Using this same method *post hoc*, with the average obtained cluster size of 8.2 observations per participant, 294 nested observations would have been required to detect a small effect (see Appendix B for calculations). The present investigation had 402 nested observations, suggesting the study was adequately powered to detect a small moderation effect.

With a larger sample, it is possible that several of the effects found in this dissertation might have reached statistical significance. However, in addition to statistical significance, important considerations in interpreting results in a given investigation are the magnitude of effect sizes, the width of confidence intervals, and substantive significance (Gliner, Leech, & Morgan, 2002; Kline, 2004). Effect sizes obtained were evidently much smaller than anticipated, and, in fact, were arguably too small to be considered interesting or important. For example, one of the findings was that, compared to experiencing no negative emotion prior to interacting, experiencing some predicted marginally lower sensitivity by -0.10 (95% CI [-.21, .01]) on a 1 to 5 scale from *poor* to

good. Although this finding is in the direction predicted, even if it were statistically significant, the effect would be far too small to justify making recommendations as to when mothers ought, or ought not, interact with their infants. Furthermore, confidence intervals of the present investigation's non-significant findings were narrow and did not include any potentially substantive effect sizes.

It is nonetheless reassuring that, at least with respect to the relationship between emotion states and sensitivity, the present study's effect sizes (although not statistically significant) are not hugely disparate in size and direction from previous investigations exploring similar relationships involving older infants and toddlers. For example, in their meta-analysis, Rueger et al. (2011) found effect sizes of $r = .11$ for the relationship between self-reported positive affect and observationally assessed supportive parenting with 1- to 3-year-old children, and $r = .09$ for negative affect and supportive parenting. Effect sizes were a bit larger when emotions and parenting were both assessed by self-report, which Rueger et al. (2011) attributed to shared method variance. Dix et al. (2004) had mothers rate their emotion states during interaction retrospectively, and found similar relationships between emotions and supportive behaviour with toddlers as those found in the present study with in-the-moment emotion ratings and sensitive behaviour with infants.

Thus, although it is possible that the non-significance of the present findings is attributable to an aspect of the procedure, it is plausible that findings are accurately null given this investigation's otherwise good conceptualization, other methodological strengths, and adequate power. As reciprocal emotional expressions, touch and behaviours are the primary mode of communication between mothers and infants in early

interactions (e.g., Demos, 1986), the primary investigator had proposed that maternal emotion states would play a significant role, more so than at other stages of development. However, it is also reasonable to assume that typical variability in emotion states and fatigue is not a significant determinant of parents' behaviour with their infants, particularly in parents not suffering from a significant stressor or major psychopathology. The effects of emotion state, fatigue, and infant engagement may only be salient when mothers' resources are markedly taxed, or when other factors, such as parental cognitions, are accounted for.

4.3.2 Associations Not Causation.

This investigation did not employ any experimental manipulations (e.g., no random assignment or mood induction procedures), but rather assessed and observed associations between mothers' naturally occurring emotion states and their interactive behaviour. Therefore, any significant relationships found were merely associations, and do not imply a causal relationship.

By examining maternal emotions before and after their interactive behaviour rather than concurrently, the present model implied directionality of effects (i.e., that maternal emotions pre-interaction predicted subsequent interactive behaviour, and that interactive behaviour predicted change in maternal emotions) more so than models in which variables were assessed simultaneously (e.g., relating ratings between scales on a single questionnaire). However, as with other correlational models, it is also possible that an unassessed confounding variable accounted for any significant relationships observed.

4.3.3 Infrequent and Low Ratings of Negative Emotion.

Although the main objective was to evaluate the relationship between maternal positive and negative emotion states and sensitivity, over 98% of the participating mothers reported experiencing *not at all* or *a little* negative emotion prior to interactions, and none endorsed more than a moderate level. These low levels of negative emotion states are consistent with those found by Cranford et al. (2006) in adults from couples (half of whom were graduate students) across 28 or 35 days when using the POMS-15. Although it is possible that the present findings are accurate and mothers do not experience much negative emotion in the postpartum period, this seems unlikely given other research findings with larger samples demonstrating that the period is characterized by a heightened risk of emotional psychopathology (e.g., Cox et al., 1993). This begs the question: why did participating mothers not report more frequent or intense negative emotions? Several possibilities are considered, including social desirability concerns, conflating negative emotion with fatigue, choosing not to complete the procedure when they felt negative, and our sampling period having not been sufficiently long.

4.3.3.1 Socially Desirable Responding. Participants may have been reticent to endorse negative emotion, perhaps due to unrealistic concerns that the researchers would judge them unfavourably as mothers. Indeed, one mother in the feasibility investigation indicated that she was uncomfortable endorsing negative emotion. Although steps were taken to minimize social desirability concerns in the main study, mothers' discomfort may have persisted nonetheless. In a sample of women with relatively high socioeconomic status (SES), Dipietro, Costigan, and Sipsma (2008) found that the tendency to respond in a socially desirable manner prenatally had a small negative

association with stress and with emotional distress prenatally and at 24 months postpartum, but not at 6 weeks postpartum (social desirability was not re-evaluated postnatally). However, the authors noted that, at most, this response inclination accounted for 4.8% of the variance in emotional distress ratings and controlling for it did not significantly affect their results. It is therefore possible that even if social desirability concerns affected the present participants' willingness to endorse negative emotion, this effect may have been negligible. Indeed, closer inspection of the data revealed that nearly all mothers endorsed some negative emotion at some point during their participation. This helps to mitigate concerns that most mothers did not endorse negative emotion due to social desirability concerns and that only a few particularly negative mothers drove effects. However, although mothers may have felt comfortable reporting mild negative emotion at times, they may still have denied or minimized experiences of intense negativity. As participants' propensity toward socially desirable responding was not assessed in the present study, it was not possible to ascertain the extent of its effect, if any.

4.3.3.2 Conflating Negative Emotion with Fatigue. The presented investigation did, however, explore if pre-interaction fatigue negatively predicted sensitivity, as would be expected if mothers had reported feeling fatigued when they actually felt negatively (due to perceiving fatigue as more socially acceptable or to conflating the two states). The effect was not significant, suggesting that mothers probably did not report fatigue in lieu of negative emotion. However, it may be that mothers endorsed fatigue when they were fatigued *or* felt negatively, so the effect on sensitivity may not have been straightforward.

4.3.3.3 Discretion Regarding Timing of Participation. Finally, mothers may have experienced more frequent or intense negative emotion than their ratings would suggest, but simply chose not to complete the rating scales or interactions at those times. Were mothers to have come to the laboratory at a scheduled time or had a researcher visit them to complete the procedure, they would have had less in-the-moment discretion regarding when to complete the procedure, whether they felt upset or not. However, in the present studies, mothers were asked to complete the rating scales and interactions daily, at some point between 6AM and 12PM and then again between 12PM and 6PM, leaving them with considerably more choice as to the timing of their participation. Some even skipped completing certain morning or afternoon recordings altogether or completed them at a later date (e.g., extended their participation over 6 days instead of 5). Thus, mothers could easily have chosen to restrict the timing of their participation to those times when they did not feel upset. The flexibility afforded to them in the timing of their participation may therefore be one reason there were highly positively-skewed negative-emotion ratings in the present study.

Although it is frustrating that the methodology may have precluded examination of the effects of more intense negative emotion, this may actually have *enhanced* the external validity of this study. To illustrate, when experiencing intense negative emotions, mothers may avoid playing with their infants due to disinterest or to believing their feelings will adversely affect their interactive behaviour. At these times, mothers may instead choose to engage in routine tasks, letting their infants engage in solitary play, or encouraging other available people to interact with or care for their infants. If this is indeed the case, then investigating the effect of intense negative emotions on interactions

with infants would be of more theoretical than practical interest in non-pathological mothers. It is more reflective of daily life for mothers to have control over the timing of play with their infants, thus participants' ratings of infrequent and low maternal negative emotion prior to interactions with infants may in fact be more indicative of reality, therefore increasing the external validity and generalizability of the present findings.

4.3.3.4 Insufficient Study Duration. Whereas positive emotion and fatigue tend to follow daily (Murray, Allen, & Trinder, 2002; Watson, Wiese, Vaidya, & Tellegen, 1999) and weekly cycles (Cranford et al., 2006), cycles in negative emotion are not as apparent (Cranford et al., 2006; Murray et al., 2002; Watson et al. 1999). Instead of following a consistent pattern, negative emotion is viewed as reactive in nature, mobilizing the body in the event of stress or threat (Watson et al., 1999). For example, negative emotions have been found to rise steadily in the days leading up to an exam and then fall sharply after the exam's completion (Cranford et al., 2006). Thus, although the sampling period of five to seven days in the present research was sufficient to capture variability in positive emotion and fatigue, it may have been too brief or inopportunely timed to capture acute-stress related variability in negative emotion, such as to illness, marital relationship dissolution, or property damage.

4.3.4 External Validity Concerns.

Although aspects of the methodology (e.g., participating in their homes without a researcher present, discretion regarding timing of participation) may potentially bode well for the external validity of the present findings, other aspects may not, and thus warrant consideration. Of note, participants were not randomly selected, they had higher

educational attainment and household incomes than typical Nova Scotians, and they were mostly Caucasian. Among the other reasons listed above, their relatively higher socio-economic status (SES) may partly explain why low and infrequent ratings of negative emotions were found (e.g., mothers with lower SES have been found to have a higher risk of depression; Smith-McKeever, Rowe, Gao, 2012). There is also evidence that high maternal education is associated with indicators of positive or attuned child interactions (e.g., Ruttle, Serbin, Stack, Schwartzman, & Shirtcliff, 2011), various child outcomes (e.g., Côté et al., 2007; Gutman & Feinstein, 2010; Serbin et al., 1998), and moderates the effect of parenting on child development (e.g., Gutman & Feinstein, 2010). Greater maternal education may be associated with increased knowledge about child development and about what constitutes desirable (e.g., sensitive) parenting behaviour. Thus, state and infant engagement effects may not have been apparent in the present dissertation due to participating mothers' knowledge that behaving sensitively is desirable, that acting on their fatigue or negative emotion is undesirable, and that infants' behaviour or engagement may be multiply determined. The fact that mothers responded to advertisements to participate in research suggests that they may also have been highly motivated and that mothers who were having problems may not have responded.

As in most other single investigations of phenomena, caution should be exercised in generalizing findings to the broader population prior to conducting replications with larger and more varied samples.

Furthermore, as discussed in section 4.2.3.3 above, some concerns were raised about the validity or representativeness of the videotaped interactions, most notably that mothers in the feasibility study reported that their recorded interactions were atypical due

to contextual and physical factors (e.g., being seated, not using toys). Although the present procedure was arguably more ecologically valid than those typically used in mother-infant research due to it occurring in participants' homes without a researcher present, mothers' and infants' behavioural reactivity to the procedure and the extent to which their recorded behaviour generalizes to their naturally occurring behaviour warrants further investigation.

4.4 Strengths

The present dissertation research has several noteworthy strengths. First, in contrast to the single measurement assessments of maternal interactive behaviour that have dominated the research literature, repeated observations of mother-infant interactions were conducted. This approach is consistent with the theoretical importance of mothers' continued sensitive interactive behaviour over time in predicting healthy infant development. It also acknowledges and permits exploration of the variability in sensitive behaviour across time, which is another strength of this investigation. The present study is one of the only investigations to attempt to empirically explain the variability in maternal sensitivity across days and occurrences.

In so doing, the present investigation involved the development of an innovative solution to the problem of discerning how to efficiently and unobtrusively conduct repeated observations of mother-infant interactions: the primary investigator developed a methodology to permit mothers to videotape their interactions in their homes themselves. Compared to the traditional method of having a researcher present to observe or record interactions, often in a laboratory setting, the present method may arguably be less costly,

less time-intensive, and more ecologically and externally valid. However, further research is needed to verify this claim. By eliminating travel requirements for mothers and affording more flexibility in the timing of their participation, this methodology may also permit greater inclusion of rural and working families in such research. Importantly, the investigator collaborated with participants by actively seeking out their feedback on the procedure. Encouragingly, the present methodology was acceptable and yielded useable data with little data loss.

Another notable strength of this dissertation was the focus on typical emotion states, including positive ones, in lieu of negative emotion traits or psychopathology (Rueger et al., 2011). A large body of research has demonstrated that postpartum depression predicts maternal insensitive behaviour, but it is unclear if this effect is attributable to mothers' negative feelings when interacting, to the combination of negative feelings and psychopathology, or to some other aspect of psychopathology. Adopting a state perspective to the evaluation of emotion, enabled exploration of the unique effect of mothers' in-the-moment feelings on their interactive behaviour, despite these effects being non-significant in the present case. Assessing mothers' emotion states also afforded the opportunity to explore what factors make behaving sensitively in a given interaction reinforcing to mothers (i.e., making mothers feel better after interacting). In so doing, this appears to be the first investigation to empirically demonstrate that mothers generally feel better after interacting with their infants and the more sensitively they behave.

Finally, although fatigue is one of the most common complaints in the postpartum period and has been proposed to contribute to negative emotions and parenting difficulties, the present investigation is one of the only ones to actually explore its effect

on mothers' observable interactive behaviour with their infants. On the basis of this research, it may be possible to offer some reassurance to typical or high-functioning mothers that this common experience – when transient – does not appear to have a significant direct effect on sensitive behaviour in free-play interactions.

4.5 Directions for Future Research

Several avenues for future research can be gleaned from the present findings. These pertain to the value of conducting repeated observations of parenting, investigating methodological issues, and exploring the interactions between maternal emotion states and behaviour with their infants. These will be discussed further, in addition to suggestions regarding conducting replications with other populations.

First, as in previous investigations (e.g., Lindhiem et al., 2010), results indicated that maternal sensitive behaviour varied across interactions. This evidence adds support for the argument that researchers should consider basing sensitivity assessments on repeated observations, as any one observation may not be indicative of mothers' typical behaviours.

Second, based on evaluation of the data collected and of mothers' feedback about their participation, several suggestions for future investigations using this methodology are advanced to further minimize the quantity of uncodeable videotaped interaction data (see section 4.2.1.2). It is also recommended to conduct further research on the representativeness of assessments using this methodology, by evaluating participant responses to *both* open-ended interviews and on rating scales (such as that used by Rhule et al., 2009; see section 4.2.1.3) and by evaluating the convergent validity of results to

those from typical naturalistic mother-infant interactions and more traditional single-observation researcher-present or laboratory assessments.

Although the present methodology was developed in an attempt to increase the ecological validity and acceptability to participants of observational mother-infant assessment over the traditional researcher-present laboratory-based procedures, it is possible to further innovate in this regard, particularly in light of modern developments in technology (e.g., through the use of miniature camcorders clipped to mothers' and infants' clothing). Of note, naturalistic assessment methodologies may be more appropriate to advancing our understanding of typical mother-infant interactions. Other research questions may warrant different assessment procedures and methods (Gardner, 2000), such as using more structured controlled tasks in a laboratory to explore mothers' and infants' behaviours in response to stress and novelty.

Third, the present findings also illustrate that the relationship between mothers' feelings and their sensitive behaviour depends on the emotion state being explored. This adds support for, at minimum, applying bivariate models of emotion (i.e., where positive and negative emotions have unique effects) over univariate models (i.e., where the two types of emotion are inversely correlated; for review, see Reich, Zautra, & Davis, 2003) to the investigation of affect and parenting. Indeed, our findings coupled with those from previous investigations (e.g., Dix et al., 2004; Rueger et al., 2011), suggest that it cannot be assumed that the relationship between parenting and positive emotion is merely the reverse of that with negative emotion, or that all negative emotions have the same influence; each may exert unique effects and interact with different factors to affect aspects of parenting behaviour. This should be further explored. In so doing, the use of

multiple converging emotion assessment measures (e.g., POMS-15, Cranford et al., 2006; Positive and Negative Affect Schedule, Watson et al., 1988; Maximally Discriminative Affect Coding System, Izard, 1979) and other measures of sensitivity and parenting behaviour (e.g., Global Rating Scales, Murray et al., 1996; Emotional Availability Scales, Biringen, Robinson, & Emde, 1988, 1993; Parent Child Early Relational Assessment Scale, Clark, 1985) is recommended in order to parse out and account for some of the disparate ways emotions and parenting are conceptualized and assessed in research.

Finally, participants in this investigation were a convenience sample of mothers (and their infants) with a relatively higher SES and level of educational attainment than is typical in Nova Scotia. The majority appeared Caucasian, but it was not otherwise possible to decipher their racial, ethnic, or cultural backgrounds, as most did not report it. Although statistical analyses largely accounted for individual differences in the effect of the predictors on the outcome variables across participants, it remains possible that findings were idiosyncratic to the present sample. In order to determine if results generalize to the wider population and to other racial, ethnic, cultural, or SES groups, replications of the present investigation should be conducted with larger more varied samples of mother-infant dyads (e.g., lower SES and different racial or ethnic backgrounds). Such research is particularly important, as the nature and structure of parent-child interactions may differ across cultures (e.g., see Field & Pawlby, 1980; McShane & Hastings, 2004) and thus the relationship between emotion states and sensitivity may be different, and predict different outcomes. For example, there is evidence that Italian mothers behave more sensitively and engage in more touch/holding and more positive social/affective behaviour with their infants than do U.S. mothers

(Bornstein et al., 2008; Hsu & Lavelli, 2005). Chuang and Su (2009) found that mainland Chinese parents of 1-year-olds were more likely to value authoritarian parenting beliefs than were Chinese Canadian parents, whereas Chinese Canadian parents were more likely to endorse authoritative beliefs.

Further investigating the factors affecting maternal sensitivity in typical populations may also prove valuable in better understanding the processes that may go awry in pathological dyads. For example, results indicated that pre-interaction emotion and fatigue states did not individually or jointly predict ensuing sensitivity. As discussed above, it is conceivable that these effects may be significant in mothers with psychopathology or with low SES, perhaps due to their greater regulatory difficulties. We also found that mothers generally felt better after interacting with their infants, particularly the more sensitively they behaved. A failure to experience a mood boost following infant interactions (perhaps related to the experience of more general anhedonia) may explain why some mothers suffering from psychopathology behave insensitively or avoid their infants, whereas others do not.

Although the majority of research on parenting of infants (including the present investigation) has involved the exploration of mothers' roles, the role of other caregivers should also be investigated, such as that of fathers. This may be particularly pertinent in other cultures, such as First Nations or First Peoples, where it is not uncommon for infants to be raised in separate homes by other family members (McShane & Hastings, 2004). It remains to be investigated if the research on mother-infant interactions generalizes to these different family constellations.

4.6 Concluding Remarks

Early caregiver (typically mother)-infant interactions marked by sensitivity to infants' cues, form a critical foundation for infants' healthy emotional, cognitive, and social development. The primary objective of this dissertation research was to explore those in-the-moment factors predicting and maintaining such positive maternal interactive behaviour. Given the highly affective nature of early mother-infant interactions, and previous research demonstrating that maternal pathological negative emotions interfere with parenting, the focus was largely on the interplay between mothers' emotions and their sensitive behaviours. Unlike the bulk of research exploring parenting of infants, the focus was on accounting for the *variability* in maternal behaviour across situations and times (rather than assuming stability) in a normative sample of mother-infant dyads, rather than a pathological or at-risk one.

In all, findings indicated that it was feasible to modify the traditional method of conducting observations of parenting in research, by having participants videotape their interactions in their homes themselves, without an observer present. Methodological changes are proposed to further minimize data loss and to enhance the representativeness of observed interactions. Results also indicated significant variability in mothers' sensitivity across interactions, adding support for basing assessments of sensitivity on multiple observations. No statistically significant direct or joint effects were found for emotion and fatigue on ensuing sensitivity. Thus, how mothers felt when entering interactions did not significantly affect how sensitively they then behaved with their infants. It remains to be explored whether mothers' feelings exert an effect when their resources are otherwise markedly taxed, such as in high-stress situations or among

economically-disadvantaged mothers, or when their specific goals are taken into account. Finally, results indicated that the more sensitively mothers behaved, the more actively engaged their infants were in the interaction, and the better mothers felt thereafter. Sensitivity did not predict how negatively mothers then felt. Contrary to predictions, infant engagement did not account for any of these relationships.

In all, results suggest that in free-play interactions, mothers can behave sensitively with their infants irrespective of how they feel when entering interactions. These findings may offer some solace to typical mothers that, regardless of how emotional or fatigued they may feel in-the-moment, these states do not appear to interfere with how sensitively they engage in free play with their infants. The present investigation is also the first to investigate and find that mothers feel better after interacting with their infants, and feel more positively the more sensitively they behave. Thus, one possible mechanism determining why mothers continue to behave sensitively in subsequent interactions is that they experience positive (though not negative) reinforcement for such behaviour, regardless of whether their infants respond with active engagement. It is possible that other factors not investigated in the present research also exert an influence, such as maternal cognitions, stress, and specific emotion states. Several possible explanations for and interpretations of these findings are outlined, attention is drawn to strengths and limitations, and suggestions are made for future research.

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APPENDIX A: CODING MANUAL FOR PARTICIPANT INTERVIEWS

Goal: To find out how can we improve this study in the future

Coding:

- Give precedence to later statements/interviews. So, if a mother says something, then contradicts herself or clarifies the statement later in the interview or in a subsequent interview, go with the latter.
- Counts refer to the number of participants endorsing each code. If a participant endorsed the same code several times, code it as one occurrence.
- Under counts, indicate the number of participants endorsing each code, as well as which participants endorsed it, e.g., 3 (P1, P3, P6)
- Sometimes mothers directly answer the questions, sometimes they don't. So, pay attention to the content (what mom is actually saying) and context (the question posed) of mothers' speech when coding.
- A given sentence of maternal speech could have parts that go under different categories (e.g., "A little difficult getting [baby] to stop staring at the camera light, but other than that [participation has been] pretty good." – in this case the beginning of the sentence would go under *Baby reactivity to recording materials/procedure* whereas the end would go under *impressions of study overall*).
- The same participant can endorse more than one code in a given category (e.g., can find the overall experience being in the study "good" *and* "enjoyed having one-on-one scheduled play")

Themes:

Satisfaction vs. Burden
Validity
Data collection disruptions
Suggestions for future

Categories	Codes	Counts (specify which participants)
Overall experience participating	Good	
	Enjoyed having one-on-one scheduled play	
Duration/Timing	A) No problem B) Tough	
Experience with mood questionnaire	Easy/straightforward (including "ok")	
	A) Quick B) Too long C) No comment	

Experience with recording equipment	Set-up easy Easier than it looked (initially intimidating)	
	Enjoyed set-up	
	Too long to set-up (baby distressed so mom stressed)	
	Equipment size too large to leave assembled (e.g., inconvenient, cumbersome, time-consuming)	
	Camcorder problems	
	Timer problems	
Baby seat	A) Infant enjoyed – no squirming mentioned B) Infant enjoyed but some squirming	
Mood questionnaire validity	Irrelevant items (e.g., anxiety)	
	Unclear items (e.g., vigorous, tired vs. fatigued/exhausted)	
	Mood more positive over time due to increased "insight"	
	A) Comfortable endorsing negative moods B) Discomfort endorsing negative moods	
Baby reactivity to recording materials/procedure	Baby distracted by… Recording equipment set-up Shininess of stand Camcorder light Camcorders inherently interfere with baby desire to play Coloured tape on mat Bumbo seat Bumbo facilitates baby playing with his/her toes Other objects in the room	
	Baby fussy b/c wanted to be picked up during play	
Mother's feelings about being observed/videotaped	Enjoyed Self-conscious/anxious at first… Decreased during 1st recording (after 1-2min) Decreased by 2nd recording Decreased by 2nd-3rd recording Decreased by 4th recording Decreased by 6th-7th recording	
	Didn't notice being recorded (i.e., tuned it out, ignored)	
Play recordings typical of mother-infant play	Yes	
	No, because…	

	Duration too long (i.e., not used to playing this way so long, in structured time frame, without interruption) No toys Distance (i.e., not in arms, less touch) Seated face-to-face Less physical activity (i.e., less moving around, less physical play) One-on-one	
Interruptions	A) None, B) 1-3 interruptions By other children in home By pet(s) By phone ring By door By outside noise	
Reasons for delays, missing data, and discontinuations	Forgot (including "lost track of time")	
	Baby fussy (caused delays or shortened recordings)	
	Illness… Baby Mother Sibling	
	Power outage	
Suggestions for future	Easier if only one child in house	
	Tell moms equipment easier than it looks	
	Bumbo tray to secure baby in place	
	Web-cams instead of camcorders	
	Dating/colour-coding forms	
	Sitting closer together during play	
	Different types of play	

APPENDIX B: CALCULATION OF ESTIMATED SAMPLE SIZE

Through consultation with Drs. William F. Chaplin and Jonathan A. Shaffer, the decision was made to apply a method for calculating sample size for clustered randomized control trials (see Hemming, Girling, Sitch, Marsh, & Lilford, 2011) to the present single group repeated-measures design. The primary investigator began by using G*Power 3, a freeware power calculator, to determine the number of observations required to detect a small effect of interest ($R^2 = .01$, $f^2 = .011$), with 80% power, an alpha of .05, and three predictors (i.e., pre-interaction negative or positive emotion, pre-interaction fatigue, and the interaction of the two). In this case, 73 participants *without* nested data would have been needed. This total number of participants was then multiplied by a variance inflation factor (VIF), to determine the number of nested observations needed to detect a small effect. The formula for the VIF is $(1+(m-1)\rho)$, where m is the average number of maternal sensitivity ratings per participant and ρ is the intra-class correlation coefficient (ICC) indicating the how strongly the observations within individuals are related to each other for the outcome variable (i.e., the ICC found for sensitivity is .42). Were this method to calculate sample size have been used *pre hoc*, the feasibility study ICC for sensitivity of .34 and the planned cluster size of 8 repeated observations would have been used to determine the VIF. In this case, the VIF would have been 3.38. Multiplying the total number of participants determined by G*Power 3 (i.e., 73) by the VIF (i.e., 3.38), the result indicated that were there a small effect for the interaction of fatigue and emotion on sensitivity, approximately 257 nested observations would have been needed to detect it. The present investigation had 402 nested

observations, suggesting the study should have been adequately powered to detect a small effect.

Of note, it requires considerable data to accurately estimate the ICC for the outcome variable. Thus, using this same method *post hoc*, the VIF would have been determined using the full study ICC for sensitivity of .42 and the actual average cluster size per participant of 8.2. In this case, the VIF would have been 4.024, which when multiplied by 73, would have yielded a sample size estimate of 294 nested observations to detect a small effect. Based on the present investigation's actual data, this number again suggests the study was adequately powered to detect a small moderation effect.