THE RELATIONSHIP BETWEEN CAREGIVER EMOTIONAL AVAILABILITY, CAREGIVER SOOTHING BEHAVIOURS, AND INFANT ATTACHMENT STYLE IN AN ACUTE PAIN CONTEXT: A LONGITUDINAL ANALYSIS

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ABSTRACT

Through this study, the relationships between caregiver behaviours seen in immunization appointments (i.e. emotional availability, proximal soothing, distraction, verbal reassurance, and pacifying) across the first year of an infant's life and subsequent infant attachment were examined. Three research aims were addressed: (1) to describe caregiver behaviour trajectories during routine immunizations *across* the infant's first year of life; (2) to relate these caregiver behaviour trajectories to subsequent infant attachment during the second year of life, and (3) to relate caregiver behaviour trajectories *within* each immunization appointment, at a given infant age, to subsequent infant attachment during the second year of life. A subsample of 130 caregiver-infant dyads was recruited from an ongoing longitudinal study. Dyads were videotaped during infants' 2-, 4-, 6-, and 12-month immunization appointments and subsequently invited to participate in an assessment of attachment when infants were between 12 and 18 months of age at the local children's hospital. Overall, caregivers remained fairly consistent in terms of their emotional availability and use of specific soothing behaviours during immunization appointments across the first year of life. Although caregiver emotional availability was not related to infant attachment, certain discrete caregiver soothing behaviours were. Higher frequencies of caregiver proximal soothing at 12 months were related to infants' organized attachment, whereas steeper decreases in proximal soothing across the first year were associated with disorganized infant attachment. In addition, when caregivers engaged in proximal soothing for longer after their 12-month olds' immunization(s), these infants were more likely to be secure or organized in their attachment. In addition, an accelerating U-shaped verbal reassurance trajectory was related to subsequent organized infant attachment, whereas caregivers of infants with disorganized attachment were characterized by a verbal reassurance trajectory that started out low, increased over time, and then decelerated (i.e., the increase slowed) by 12 months of age. Also, when caregivers engaged in verbal reassurance for longer after their 2 month olds' immunization(s), these infants were more likely to be organized in their attachment. Clinical implications and suggestions for future research are discussed.

DEDICATION

> Don't limit yourself. Many people limit themselves to what they think they can do. You can go as far as your mind lets you. What you believe, remember, you can achieve.
> Mary Kay Ash

This study is dedicated to my family, especially my parents, my husband Michael, and our son Eamon. You have inspired me, supported me, and most of all believed in me every step of the way.

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OVERVIEW OF DISSERTATION

Attachment theory posits that individual differences in infant attachment relationships are the result of the cumulative product of the infant's experience in interacting with the caregiver across the first year of life (Ainsworth, 1979; Bowlby 1969/1982). A large body of research has explored caregivers' 'sensitivity' toward their infants as a key determinant of infant attachment. However, meta-analytic studies have suggested that this relationship only accounts for a relatively small proportion of the variance in infant attachment (DeWolff & van Ijzendoorn, 1997). Therefore, efforts are needed to further elucidate the specific caregiver factors that contribute to infant attachment relationships beyond a global measure of caregiver sensitivity. This dissertation helps address this issue by examining the relationships between caregiver emotional availability (i.e., a global clinical judgement of caregiver's behaviours: sensitivity, structuring, lack of hostility, and lack of intrusiveness), as well as specific caregiver soothing behaviours seen in a high distress context (i.e. proximal soothing, distraction, verbal reassurance, and pacifying during routine immunization) across the first year of life, and subsequent infant attachment during the early part of the second year of life.

A subsample of 130 caregiver-infant dyads was recruited from a larger ongoing longitudinal observational cohort study (The OUCH Cohort) at their 12-month immunization. Prior to recruitment, dyads were videotaped during their 2-, 4-, 6-, and 12-month immunization appointments at their local pediatrician. Caregiver behaviour variables were coded from the obtained immunization footage in two ways. First, they were coded on their emotional availability (EA; Biringen, 2008) to their infant over the entire immunization appointment. Second, caregivers were coded using a measure (MAISD; Cohen, Bernard, McClellan, & MacLaren, 2005) that tracked the frequency of specific soothing behaviours (e.g., proximal soothing, distraction, verbal reassurance, pacifying) for each minute after the final immunization (for 3 minutes total). After the 12-month immunization, a subsample of caregivers and infants was invited to participate in an assessment of attachment between 12 and 18 months of age.

There were three research aims: (1) to describe, for the first time in the literature, caregiver behaviour trajectories (i.e., EA and MAISD) during routine immunizations *across* the first year of an infant's life, (2) to relate these caregiver behaviour trajectories to subsequent infant attachment during the second year of life, and (3) to relate caregiver behaviour trajectories *within* each immunization appointment, at a given infant age (i.e., 2, 4, 6, and 12 months), to subsequent infant attachment during the second year of life. Several specific research questions (to be introduced later) subsuming these three aims were also examined. Latent growth modeling (LGM) was used to examine the entire longitudinal sample (N = 760) and LGM including logistic regression analyses were used to answer research questions pertaining to only those dyads who participated in the attachment portion of the study (N = 130).

Using attachment theory (Bowlby, 1969/1982) as a guide, it was hypothesized that caregiver emotional availability and soothing behaviours at 12 months (i.e., the intercept factor in the LGM analyses) and the change in these behaviours over the first year of life (i.e., the slope factor in the LGM analyses) would be associated with infant attachment. These behaviours were compared across three different attachment classification types (4-way [avoidant vs. secure vs. resistant vs. disorganized]; 2-way [secure versus insecure]; 2-way [organized versus disorganized]) whenever possible. Generally speaking, higher caregiver emotional availability and more frequent proximal soothing behaviours were hypothesized to be associated with secure or organized infant attachment; whereas more distal soothing behaviours (i.e., distraction, verbal reassurance, pacifying) were hypothesized to be associated with insecure or disorganized infant attachment.

To facilitate comprehension of the analyses, the entirety of the statistical analyses and findings for this dissertation are summarized in non-technical language in Appendix A. The findings only partially supported the hypotheses. Overall, caregivers remained fairly consistent in terms of their emotional availability over the course of the first year of life. Mean trajectories of the four specific caregiver soothing behaviours (i.e. proximal soothing, distraction, verbal reassurance, and pacifying) varied to different degrees over the course of the first year, with some decreasing (i.e., proximal soothing and pacifying), one increasing (i.e., distraction), and one remaining fairly stable (i.e., verbal reassurance) over time.

Caregivers of infants with organized attachment styles (compared to those with disorganized attachment) used more proximal soothing behaviours during the 12-month time point and continued using these behaviours for longer during this specific immunization appointment (i.e., during the 3rd minute after the needle). Caregivers of infants with organized attachment also continued to use verbal reassurance for longer during their infants' 2-month immunization appointment. Lastly, these caregivers tended to have a U-shaped trajectory of verbal reassurance use, whereby verbal reassurance decreased initially (i.e., from 2 to 6 months of age) and then increased and accelerated over the later half of first year of life (i.e., from 6 to 12 months of age). In contrast, caregivers of infants with disorganized attachment (compared to those with organized attachment styles) were characterized by a steeper decline in the amount of proximal soothing used over the first year of life. Caregivers of infants with disorganized attachment were also characterized by low levels of verbal reassurance at the beginning of the first year (i.e., 2 months) that increased over time and then decelerated (i.e., the increase slowed) by the end of the first year (i.e., 12 months). Finally, caregivers of securely attached infants also continued using proximal soothing for longer during their 12-month olds' immunization appointment relative to caregivers of insecurely attached infants.

These novel results extend previous research and provide empirical support for the ecological validity of studying infant attachment in a pediatric pain context. The ways in which caregivers soothe their infants when undergoing an acutely painful medical procedure is related to subsequent infant attachment. Therefore, the pediatric "well-baby" visit may provide an ideal opportunity to identify and potentially moderate caregiver-infant dyads at risk of developing attachment difficulties.

Introduction

Seminal attachment theorists and researchers, Bowlby (1969/1982) and Ainsworth (1979), set the foundation for how we understand an infant's unique connection to a primary caregiver and the ways in which this connection can be disrupted. Over the course of the first year of life, infants pass through several stages on their way to developing an attachment relationship with a primary caregiver. Infants are born with no real preference for a particular caregiver (Pre-Attachment Phase: birth to 2 months), but over time a preference for a primary caregiver begins emerging (Attachment in the Making Phase: 2 to 6 months) and is solidified (Clear Cut Attachment Phase: 6 months to 1- to 2-years old) when an infant's preference for one particular caregiver is clear by the infant actively seeking out and maintaining proximity to this caregiver (Bowlby, 1969/1982). By better understanding how caregiver behaviours shape infant attachment patterns, early interventions for at-risk dyads can be tailored to provide better long-term outcomes for young children. This dissertation aims to discern caregiver behaviour patterns during immunizations over the first year of life and then relate these patterns to infant attachment. To set a context for the current project, a review of the basics of attachment theory follows.

Attachment Theory Basics

Bowlby's theoretical framework. Caregivers play a variety of roles in an infant's life, such as teacher and playmate, but it is the unique role caregivers play in responding to their infants' cues, particularly those signaling distress, that characterizes the attachment relationship (Goldberg, Grusec, & Jenkins, 1999). Bowlby's attachment theory draws on theory and research from several fields including evolutionary and behavioural psychology, ethology, and biology to illustrate the importance of this unique relationship between caregiver and infant and its impact on emotional and psychological well-being across development. Bowlby's attachment theory places importance on the infant-caregiver relationship and the unique role of the mother as the primary caregiver. Although the majority of primary caregivers are mothers, this study will use the term "caregiver" to recognize the variety of caregivers who may also play primary roles in an infant's upbringing (e.g., father).

Infants are greatly dependant on their caregivers for survival and protection. Bowlby postulated that all infants are born with instinctive behaviours that are controlled by behavioural control systems. Behavioural control systems are mechanisms within humans that organize an individual's responses within a given environment (Bowlby 1969/1982). These behavioural responses can be activated by either internal or external cues. The two most relevant control systems for the purposes of this study are the attachment control system and the caregiver control system. According to attachment theory, during distressing events, infants are innately driven through the attachment control system to enact behaviours (e.g. crying) that will elicit proximity to and distress-reducing actions from the caregiver (Marvin & Britner, 1999). A complementary behavioural control system in the caregiver, the caregiver behavioural control system, is activated by the infant's distress behaviours and generally drives a caregiver to achieve proximity and soothe an infant in a way that will regulate the infant's attachment behavioural control system (i.e., reduce the infant's distress and therefore reduce the infant's drive to achieve proximity to the caregiver). Therefore, caregivers function as external regulators of infant emotion and distress and provide an infant with a sense of security when threatened.

Over the course of the first year of the infant's life, the cumulative interactions and experiences between caregiver and infant shape how the infant perceives his or her caregiver as well as how the infant perceives his or her own ability to solicit care from this caregiver when distressed. These "working models" of the 'self' and 'other' form the basis of attachment patterns and emotion regulation across the lifespan (Bowlby, 1969/1982). As children develop and become more independent from caregivers, they begin to internalize these working models and learn to self-regulate (Calkins, 1994; Dodge, 1989). An important component of Bowlby's theory is the age at which attachment behaviours emerge. In order to determine whether attachment behaviours have emerged, there must be evidence that the infant recognizes the caregiver and is capable of enacting purposeful behaviours that increase the likelihood of sensitive and appropriate behavioural responses from this caregiver (Bowlby, 1969/1982). In addition to the stages of attachment described by Bowlby (1969/1982) (i.e., Pre-Attachment, Attachment in the Making, Clear Cut Attachment phases), Ainsworth, Blehar, Waters, and Wall (1978) showed that infants between 8 and 9 months of age begin to show stranger anxiety, that most infants display some attachment behaviours as early as 6 months, and that by 9 months these behaviours are exhibited more regularly and with more intensity, corroborating Bowlby's theory that attachment to the caregiver becomes stronger and more consolidated over the first year of life. Ainsworth et al. (1978) posited that attachment in the infant is not considered stable and cannot be reliably measured until 12 months of age.

Ainsworth's approach to the measurement of attachment - the Strange Situation Procedure. Based on Bowlby's work, Ainsworth and colleagues developed the Strange Situation Procedure (SSP; Ainsworth & Wittig, 1969; Ainsworth et. al., 1978), a laboratory based procedure designed to examine the quality of an infant's attachment relationship by gradually inducing stress through separations from the caregiver. The SSP is the gold-standard approach to measuring attachment in infants 12 to 18 months of age and has been validated by over three decades of research. The SSP is meant to represent situations that caregivers and infants are likely to experience in their day-to-day interactions (i.e., brief separations that last no more than 3 minutes). At the beginning of the SSP, the caregiver and infant are introduced to a novel room where the infant is free to explore age-appropriate toys and his or her surroundings. The SSP consists of eight brief episodes during which a research assistant (RA) who acts as a "stranger" (the caregiver and infant have not met the RA previously), the caregiver, and the infant undergo a series of interactions, separations, and reunions that activate attachment behaviours by placing cumulative stress on the infant's attachment system (See Appendix B).

The *Scoring System for Interactive Behaviours* (SSIB) was developed by Ainsworth and colleagues (1978) to assess caregiver-infant attachment within the SSP using four scales to code infant behaviour:

(1) *Proximity- and Contact-Seeking*: The intensity and persistence of the infant's efforts to gain (or to regain) proximity to or contact with the caregiver.

(2) *Contact-Maintaining*: The degree of activity and persistence in the infant's efforts to maintain contact with the caregiver once he or she has gained it.

(3) *Resistant*: The intensity and frequency or duration of resistant behaviour (e.g., angry distress, temper tantrums involving kicking, pushing the caregiver away, rejecting toys) evoked by the caregiver's initiations for contact, proximity, or play interactions.

(4) *Avoidant:* The intensity, persistence, duration, and promptness of the infant's avoidance of proximity and interaction with the caregiver even across a distance (e.g., averting gaze, turning the head or body away, hiding the face, ignoring the caregiver).

Each of these scales is scored from 1 to 7, where "1" is indicative of little or no behaviour and "7" is indicative of a strong expression of the behaviour. Based on the infant's behaviour in the SSP across the four scales, particularly when the infant is reunited with the caregiver following two brief separations (episodes 5 and 8), the infant is classified into one of three "organized" attachment classifications: secure (referred to as the "B" group), avoidant (referred to as the "A" group), or resistant (referred to as the "C" group).

Infants classified as secure (B) typically exhibit moderate levels of Proximity- and Contact-Seeking and Contact-Maintaining behaviours during the reunions as well as scores that substantially decrease or remain low from episode 5 to 8 on the Resistant and Avoidant scales. Secure infants may or may not be distressed during the SSP separation episodes, but demonstrate clear positive greetings with their caregivers upon reunion (e.g., visually acknowledging the caregiver, smiling at the caregiver, or physically approaching the caregiver) and are able to regulate distress effectively by using caregivers for support (e.g., actively seeking physical contact with caregivers).

Infants classified as avoidant (A) typically have low to moderate scores on the Proximity- and Contact-Seeking, Contact-Maintaining, and Resistant scales during reunions and have consistently high scores or increasing scores from episode 5 to 8 on the Avoidant scale. Avoidant infants tend to ignore caregivers upon reunion and often exhibit minimal behavioural distress throughout the SSP. Avoidant infants spend much of their time in the SSP exhibiting “low quality play” (Spangler & Grossmann, 1993), rarely using the caregiver as a secure base. Although avoidant infants exhibit minimal distress during the reunion episodes and seemingly take a short time to regulate if they do become distressed, they have been shown to be equally or more physiologically stressed than secure infants (Hill-Soderlund et al., 2008; Spangler & Grossmann, 1993), suggesting a mismatch between external behavioural displays of distress and internal stress states in avoidant infants.

Infants classified as resistant (C) score high on Proximity- and Contact-Seeking and Contact-Maintaining scales, have scores that substantially increase or remain high from episode 5 to 8 on the Resistant scale, and score low on the Avoidant scale. Resistant infants typically become highly distressed during the separation episodes of the SSP. During reunion episodes, resistant infants often appear ambivalent towards their caregiver, exhibiting a mixture of signalling caregivers for proximity or comfort (e.g., clambering up and clinging strongly to caregivers) while also actively resisting contact and interaction with caregivers by exhibiting angry, rejecting behaviour towards the caregiver (e.g., back arching and temper tantrums). These infants have difficulty regulating distress and require more time to soothe than either secure or avoidant infants, despite the caregiver being nearby and perhaps attempting to provide comfort.

In addition to secure, avoidant, and resistant categorizations pioneered by Ainsworth, a new category emerged upon further examination of SSP data. The disorganized classification was not originally part of the SSP assessment tool. Subsequent to the development of the SSP, Main and Solomon (1990) observed infant behaviours in the SSP that were difficult to classify as secure, avoidant, or resistant. These behaviours constituted a fourth attachment classification referred to as “disorganized” when coding the SSP. The *Indices of Disorganization and Disorientation* (Main & Solomon, 1990; see Appendix C) is used to code disorganized behaviours. The episodes in which the infant and caregiver are together (i.e., episodes 1, 2, 3, 5, and 8) are coded for disorganized behaviours on a 1 to 9 point scale with “1” signifying unsubstantiated disorganized behaviours and “9” signifying extreme disorganized behaviours. A total D score is assigned based on the number and intensity of disorganized behaviours observed and a cut-off score of 5 is used to determine a D classification. Infants with a D score of 5 may or may not be classified as disorganized (the coder must make a clinical judgment) whereas infants with a D score above 5 are automatically classified as disorganized (D).

An infant who is classified as D may display contradictory patterns of organized attachment behaviours (e.g., crying loudly for the caregiver while simultaneously moving away from the caregiver). Attempts are first made to classify infants into one of the organized classifications (i.e., A, B, or C), however, once disorganized behaviours have been coded, infants are ultimately classified into one of the four classifications (i.e., A, B, C, or D; Solomon & George, 2008).

Based on a large scale meta-analysis, the typical distribution of attachment classifications in the general North American population (i.e., non-clinical samples) is approximately 15% avoidant, 62% secure, 9% resistant, and 15% disorganized (van IJzendoorn, Schuengel, & Bakermans-Kranenburg, 1999). These figures are similar to what Ainsworth and colleagues' (1978) and Main and Solomon (1990) had described based on their original sample distributions. The SSP has also been shown to be ecologically valid in that attachment classifications as measured by the SSP are predictive of infant-caregiver interactions observed in the home setting (Ainsworth et al., 1978; Vaughn & Waters, 1990; Solomon & George, 2008). Attachment has also been shown to be a fairly stable construct over time. A meta-analysis by Fraley (2002) demonstrated that correlations between attachment measured using the SSP at 12 months and attachment measured between 13 and 20 months were between .40 and 1.00 for low risk samples. Moreover, longer term stability in attachment has also been shown by Sroufe, Egeland, Carlson, and Collins's (2005) 30-year longitudinal study, which provided evidence of predictable developmental pathways based on initial infant attachment classifications in the areas of self reliance, emotion regulation, and social competence. These pathways spanned from infancy through to adolescence and even early adulthood. For example, children with avoidant or resistant infant attachment classification histories were consistently shown, at both preschool ages and school ages, to be rated as 'dramatically' more reliant on teachers relative to children with secure infant attachment histories. In addition, children with secure infant attachment histories were consistently shown to be rated as being more self-confident, higher on self-esteem, and better able to regulate their emotions at preschool and school ages relative to those children with avoidant and resistant infant attachment histories. Lastly, disorganized attachment in infancy was found to be a strong predictor of later disturbance. For example, a correlation of .40 was found between the degree of disorganization in infancy and the number and severity of psychiatric symptoms at age 17, based on diagnostic interviews.

There are several ways to group the attachment classifications derived from the SSP. These groupings allow researchers to compare attachment styles that differ in terms of their risk for difficulties in emotional well-being. The four-level A/B/C/D comparison examines differences between the secure (B), avoidant (A), resistant (C), and disorganized (D) groups separately. The secure attachment group is the lowest risk group and is commonly used as the comparison group in the A/B/C/D comparison. These comparisons allow researchers to examine the specific interaction styles that differentiate each of these classifications. However, these comparisons are not always possible, especially given that the size of the overall sample would have to be quite large to have frequencies in each attachment classification which are adequate for more complex statistical analyses. The two-level secure/insecure comparison allows for the examination of a low risk group (i.e., secure group [B]) relative to a higher risk group (made up of all avoidant [A], resistant [C], and disorganized [D] infants). Finally, the two-level organized/disorganized comparison allows for comparisons between the highest risk group (i.e., disorganized [D]) relative to the lower risk "organized" groups (avoidant [A], secure [B], and resistant [C]). Whenever possible, all three types of attachment groupings will be used (A/B/C/D; B versus A/C/D; D versus A/B/C).

Research on Caregiver Sensitivity as a Predictor of Infant Attachment

Although infant attachment is measured based on behaviours exhibited by the infant in relation to the caregiver, it is how the caregiver responds to the infant's cues over the first year of life that is theorized to be of particular importance in shaping these infant behaviours and ultimately infant attachment style. Ainsworth (1979) was the first to put forth evidence for the relationship between distinct infant attachment patterns and caregiver sensitivity over the first year of life. The theory states that sensitive caregivers will be aware of their infant's cues, will interpret them correctly, and will respond promptly, appropriately, and consistently. These caregivers are also emotionally expressive and are accepting of infants' negative and positive affect (Ainsworth et al., 1978). It follows that the secure infant is theorized to develop a working model of the caregiver as a reliable figure whom he or she can depend on to provide quick and effective soothing and relief during times of distress (Lyons-Ruth, Connell, Zoll, & Stahl, 1987; Pederson, Moran, Sitko, Campbell, & Ghesquire, 1990; Smith & Pederson, 1988; Cassidy, 1994).

As previously mentioned, there are three types of insecure infants: avoidant, resistant, and disorganized. Caregivers of avoidant infants are characterized as rejecting of infants' attachment needs. These caregivers are more intrusive, excessively stimulating, and controlling in their interaction style (Belsky, Rovine, Taylor, 1984; Isabella, Belsky, von Eye, 1989; Isabella & Belsky, 1991; Smith & Pederson, 1988; Vondra, Shaw, Kevinides, 1995). They are slow to respond to infants' distress signals, exhibit a restricted range of emotional expressivity, and are uncomfortable with close body contact, particularly when their infants are distressed (Ainsworth et al., 1978). The avoidant infant is therefore likely to develop a working model of the caregiver as unwilling or unable to provide feelings of safety during times of distress and a working model of the self as unable to effectively solicit support from the caregiver when distressed. Thus, these infants tend to minimize behavioural expressions during distress despite evidence of physiological distress (Hill-Soderlund et al., 2008; Spangler & Grossmann, 1993).

Caregivers of infants with resistant attachment styles are characterized as inconsistent in their responsiveness to infants' attachment needs. These caregivers are sensitive at times and insensitive at other times, inappropriate in their use of soothing strategies, as well as insufficient when they do respond to their infant's cues (Belsky et al., 1984; Isabella et al., 1989; Isabella & Belsky, 1991; Smith & Pederson, 1988; Vondra et al., 1995). They are also often inept in physical comfort (e.g., preferring to use a more distal strategy such as distraction), but are typically less rejecting than caregivers of avoidant infants (Ainsworth et al., 1978). The resistant infant is theorized to develop a working model of the caregiver as inconsistent in her or his ability to provide feelings of safety under conditions of stress and a working model of the self as inconsistent in the infant's own ability to solicit comfort from the caregiver when distressed. Thus, these infants typically have difficulty regulating distress and often signal with higher levels of distress in an attempt to elicit a response from their inconsistently responsive caregivers.

A 30-year longitudinal study by Sroufe and colleagues (2005) found similar results to these previous studies regarding secure, avoidant, and resistant caregiver-infant dyads, but also added that disorganized attachment was predicted by caregiver intrusiveness and maltreatment, frightening behaviours, and emotional unavailability. Caregivers of disorganized infants behave atypically, acting in dissociated, disoriented, frightened, or frightening ways towards the infant (Lyons-Ruth, Bronfman, & Parsons, 1999; Madigan et al., 2006; Out et al., 2009). As a result of atypical, often unpredictable parenting behaviours, these caregivers are themselves a source of stress to the infant. Subsequently, infants have no clear way to organize their feelings of distress, simultaneously wanting to be close and to distance themselves from caregivers when distressed. It follows that these infants do not establish clear expectations regarding the caregiver or themselves and in turn have no effective ways of regulating distress (Beebe et al., 2012). Thus, these infants, depending on their underlying organized attachment style, may or may not exhibit high levels of distress. However, if they are distressed, they have difficulty regulating this distress and are not be able to use the caregiver effectively to decrease their distress. The disorganized attachment category is overrepresented in high-risk, clinical groups, including those in which infants have been the victims of maltreatment (van IJzendoorn et al., 1999).

Given the strong link between caregiver interaction style and infant attachment, it is logical that attachment researchers would focus on caregiver sensitivity as the main predictor of infant attachment. However, empirical evidence for this relationship has been inconsistent, which may be due to differences in definitions of sensitivity, methodological differences in the measures used to assess this construct, as well as the context in which sensitivity is studied (i.e., non-distressing play paradigms vs. distressing contexts) (Isabella, 1993). An extensive meta-analysis (De Wolff & van Ijzendoorn, 1997) found an average correlation of $r = .24$ across 21 studies which used the SSP to examine the link between caregiver sensitivity and infant attachment. Atkinson and colleagues (2000) also found a small overall effect of $r = .27$ for the link between sensitivity and attachment security. Higher effect sizes ($r = .60$) have been found using the Maternal Behavior Q-Sort (MBQS), a measure of caregiver sensitivity that focuses on attachment-related interactive behaviours in situations where a caregiver's "attention is divided between the demands of their infant and the tasks posed by the researchers" (Pederson & Moran, 1995, p.115; Pederson & Moran, 1996). This measure is based on observations during a 2-hour home visit and consists of 90 descriptions of maternal interactive behaviour items that are sorted based on comparisons of a prototypically sensitive mother and the mother being observed. Despite the improved strength of the relationship using this measure, measures of maternal sensitivity have tended to focus on a global score that represents an overall clinical impression of the mother's sensitivity. However, research is limited regarding the discrete soothing behaviours that subsume these global constructs of caregiver sensitivity.

Examining discrete caregiver soothing behaviours is also important given that each attachment classification consists of subgroups of caregiver-infant interaction patterns which, although different, lead to the same attachment classification. For example, caregivers and infants of a securely attached dyad may seem quite different within an SSP. One secure dyad may show an infant becoming very distressed when the caregiver leaves the room, but settling quickly when the caregiver returns and clinging closely to the caregiver during the rest of the SSP. The caregiver in this SSP would likely engage in lots of physical comfort. In contrast, another secure dyad may have an infant who is not distressed when the caregiver leaves, but is happy when she or he returns and interacts from a distance, showing toys and smiling at or looking at the caregiver throughout the remainder of the SSP. Caregivers of these infants may show positive affect towards the infant but do not necessarily engage in proximal soothing. Both of these hypothetical dyads are secure but are very different in terms of the specific behaviours they each exhibit.

To explore more finely-grained nuances of the relationship between caregiver sensitivity and infant attachment, recent research has focused on understanding the relationship in different contexts. McElwain and Booth-LaForce (2006) examined caregiver-infant dyads at 6 and 15 months of age to determine if maternal sensitivity to distress and non-distress in the infant were predictive of infant attachment at 15 months as per the SSP. The researchers found that greater maternal sensitivity to distress (but not non-distress) at 6 months was associated with increased chances of being classified as secure at 15 months of age. Leerkes (2011) also found that maternal sensitivity to distressing (but not non-distressing) tasks at 6 months predicted infant attachment security at 16 months. Research also suggests that maternal sensitivity in distressing versus non-distressing contexts constitutes two subtypes of sensitivity with unique origins and effects on subsequent child well-being (Leerkes, Weaver, & O'Brien, 2012). Sroufe and Waters (1977) have also asserted that behaviours related to infant attachment are more strongly predicted within a context of distress and Pederson and Moran (1995) posited that high-demand circumstances reveal more meaningful differences in caregiver sensitivity. Therefore, it follows that the pediatric health care setting, where infants undergo repeated painful or distressing procedures and experiences over the course of their life, would be a useful and ecologically valid setting to study infant attachment and its related constructs.

The Pediatric Pain Context: An Optimal Setting in Which to Study the Influence of Caregiver Behaviours on Infant Attachment

Routine contact with caregiver-infant dyads throughout infancy. As mentioned previously, multiple studies point to the importance of infant secure attachment to long-term well-being. As such, the importance of identifying and providing early intervention for dyads at risk for difficulties in attachment is of critical importance (Zeanah & Zeanah, 2009). Zeanah and Gleason (2009) argue that by integrating infant mental health into primary pediatric health care, early intervention has the potential to benefit a large number of caregivers and their infants.

Pain is a particularly relevant context in which to examine attachment theory. Bowlby himself (1988) noted "a child's attachment behaviour is activated especially by pain, fatigue and anything frightening, and also by the mother being or appearing inaccessible" (p. 3). In Canada, the majority of caregivers and infants are seen regularly over the first year of life by health care practitioners during scheduled "well baby" visits at 2, 4, 6, and 12 months of age, which include routine immunization (National Advisory Committee on Immunization, 2014). These appointments provide multiple opportunities for caregiver-infant dyads to be screened for potential disruptions in interaction and to be offered appropriate intervention should problems continue. Not only do these visits provide regular interactions between health care professionals and caregiver-infant dyads, but the immunization itself provides a roughly standardized procedure which would allow health care providers to more objectively discern adaptive from maladaptive patterns of interactions early on in an infant's life.

Immunization as a paradigm for understanding distress regulation and caregiver support of that regulation. Attachment categorizations can be thought to be integral not only to the development of relationships to close others but also as foundational to the development of negative affect regulation. Immunization pain as an emotion regulation paradigm has recently been established in the pediatric pain literature (Blount, Devine, Cheng, Simon, & Hayutin, 2008; Din, Pillai Riddell, & Gordner, 2009; Pillai Riddell, Stevens, Cohen, Flora, & Greenberg, 2007; Cohen et al., 2005; Horton &

Pillai Riddell, 2010). The limited ability of an infant to communicate and moderate pain places great importance on caregivers for accurately assessing and managing infant pain-related distress (Pillai Riddell & Racine, 2009; Pillai Riddell & Craig, 2007; Pillai Riddell & Chambers, 2007). A recent theoretical model describes this dyadic interaction and places primary importance on the caregiver in supporting an infant's regulation from acute pain.

The Development of Infant Acute Pain Responding Model (DIAPR model; Pillai Riddell, Racine, Craig, & Campbell, 2013; Pillai Riddell, 2011) provides a comprehensive biopsychosocial conceptualization of infant acute pain responding over the first year of life (see Figure 1). Based on longitudinal research with the OUCH Cohort (e.g. Din Osmun, Pillai Riddell, & Flora, 2014; Lisi, Campbell, Pillai Riddell, Greenberg, & Garfield, 2013; Pillai Riddell, 2013; Stevens et al., 2013; Hillgrove-Stuart, Pillai Riddell, Horton, & Greenberg, 2013; Campbell, Pillai Riddell, Greenberg, & Garfield, 2013; Pillai Riddell et al., 2013; Racine, Pillai Riddell, Flora, Garfield, & Greenberg, 2012), this model is unique in that it highlights the specific infant-related developmental and temporal factors that have been shown to impact the ways in which infants respond to acutely painful stimuli such as immunizations.

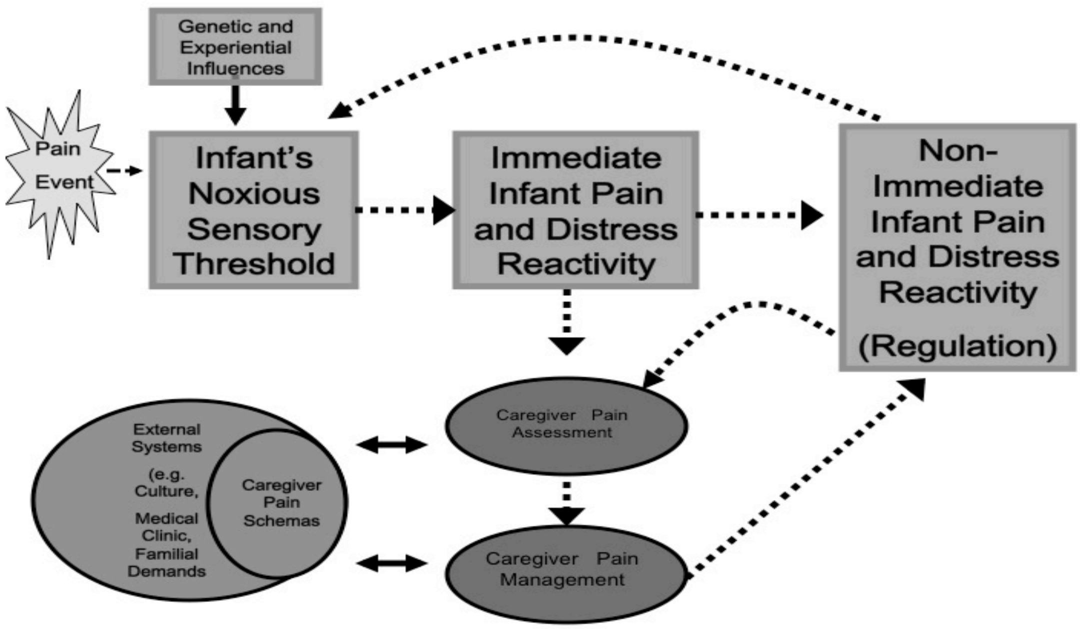

Figure 1. The Development of Infant Acute Pain Responding Model (The DIAPR Model).

The DIAPR model includes intrinsic factors related to the caregiver and infant (e.g., infant temperament or caregiver beliefs) and extrinsic factors (e.g., culture) that are theorized to impact infant pain through feedback loops that shape pain responding over time. This model takes into account the infant's developmental stage and posits that more extrinsic processes involving the caregiver exert more of an influence on pain-related distress reactivity and regulation as an infant ages. For example, by 12 months of age, interactions with the caregiver (e.g., the caregiver infant attachment relationship) have been shown to have a greater influence on the infant pain response than at 2 or 4 months of age. Thus, based on the DIAPR model, it is crucial to examine the interaction between infant and caregiver, both cross-sectionally and longitudinally.

Thus, to set up a foundation for this study, the section above reviewed why the immunization paradigm is potentially an ideal setting for predicting the crucial developmental construct of attachment. Moreover, due to the developmental progression of caregiver factors, this study will examine caregiver factors (i.e., a clinical judgement of overall caregiver emotional availability and specific soothing behaviours) at four separate ages in the year leading up to the attachment assessment. As we are conceptualizing attachment as a distress regulation paradigm, the literature review below first examines previous work on caregiver sensitivity and soothing behaviours within acutely painful medical procedures predicting infant distress regulation. Next will be a review of the literature linking caregiver sensitivity and soothing behaviours within acutely painful medical procedures to formal measures of attachment (i.e. outside the medical context).

Research on Caregiver Sensitivity, Emotional Availability, and Soothing Behaviours as Predictors of Infant Pain Related Distress

Caregiver sensitivity and emotional availability and infant pain related distress. Studies examining global measures of caregiver sensitivity are limited in the pediatric pain literature. Sweet, McGrath, and Symons (1999) found that infants of sensitive mothers expressed more pain-related distress reactivity (i.e., the immediate response to pain) than infants of less sensitive mothers. This finding supports the hypothesis that infants of sensitive mothers are more comfortable openly expressing distress in the presence of caregivers who consistently respond to these signals. Sweet et al. (1999) found that maternal sensitivity accounted for 35% of the variance of pain behaviours exhibited by 18-month olds undergoing immunization.

In contrast to the work of Sweet et al., research from our lab with a high-risk sample found that caregiver emotional availability predicted infant pain-related distress such that infants of more emotionally available caregivers exhibited less pain immediately post-needle and 1 minute post-needle than infants of less sensitive mothers (Din et al., 2009). Moreover, also using data from the OUCH Cohort, Din Osmun et al. (2014) found that higher levels of caregiver emotional availability averaged over the 2-, 4-, and 6-month immunization appointments were related to larger decreases in the duration of infant pain-related negative affect during this period. The authors note that emotionally available caregiving may help infants regulate distress from pain and that less sensitive caregiving (i.e., intrusive behaviours) may exacerbate infant distress following immunization. Additional research with the OUCH Cohort suggests that the influence of caregiver emotional availability on the infant pain response grows stronger over the first year of life, with greater sensitivity associated with an attenuated pain response during the 12-month immunization appointment but not during previous immunizations at 2, 4, and 6 months of age (Pillai Riddell et al., 2011). Pillai Riddell and colleagues (2011) also found that the greatest predictor of later caregiver emotional availability was previous caregiver emotional availability, not infant pain behaviours, suggesting that caregivers remain fairly consistent in their emotional availability across the infants first year of life, regardless of the infant's reactions.

Differences in these studies may be related to how caregiver sensitivity is measured. Measures of caregiver sensitivity and caregiver emotional availability both provide a global clinical judgment of caregiver responsiveness and the overall sensitivity of the caregiver-infant interaction. However, caregiver emotional availability uniquely focuses on caregivers' displayed affect with respect to the infant and context, and also encompasses constructs of structuring (i.e., the caregiver's ability to structure and create a "holding environment" that leads the infant in a positive way), non-intrusiveness (i.e., the caregiver's ability to be available and avoid intrusive, overstimulating, or overpowering behaviours), and non-hostility (i.e., the caregiver's ability to refrain from antagonistic or impatient behaviours) that are lacking in many measures of caregiver sensitivity.

Given the equivocal nature of the findings from studies investigating associations between caregiver sensitivity and infant pain, more work is needed. By examining how patterns of caregiver emotional availability within a pain context are related to the established construct of infant attachment, links may be made with respect to caregiver behaviours and the broader domain of child development.

Specific caregiver soothing behaviours and infant pain related distress. Within the pediatric pain literature, discrete soothing behaviours are most often examined to determine their effectiveness in managing infant pain-related distress. These caregiver behaviours are often broken into categories of proximal and distal behaviours. Proximal behaviours are those that bring the infant closer to the caregiver, such as touching, stroking, rocking, and kissing, whereas distal behaviours are those that do not involve bringing the infant close, such as distraction, verbal reassurance, or pacifying. Overall, research has shown that proximal soothing behaviours are associated with less pain reactivity and better soothing in infants undergoing immunizations (Jahromi, Putnam, & Stifter, 2004; Campos, 1994; Jahromi & Stifter, 2007; Pederson 1975). Additional caregiver behaviours that have been shown to be associated with lower levels of infant pain-related distress include non-procedural talk (Piira, Champion, Bustos, Donnelly, & Lui, 2007) and displays of positive affect (Gonzalez, Routh, & Armstrong, 1993). In contrast, more distal techniques such as distraction have shown equivocal evidence of effectiveness in younger infants (Cohen, 2002; Hillgrove-Stuart et al., 2013; Cramer-Berness & Friedman, 2005) with increasing efficacy as the child ages and can actively (physically or cognitively) engage in the distraction (Powers, 1999; DeMore & Cohen, 2005). Verbal reassurance, however, has been consistently shown to lead to increases in infant pain expression (Sweet & McGrath, 1998; Blount et al., 2008; Cohen, Manimala, & Blount, 2000; Racine et al., 2012; Lisi et al., 2013), regardless of age. In addition to verbal reassurance, caregiver apologizing, and empathizing (Blount et al., 2008; Cohen et al., 2000) as well as criticizing (Manne et al., 1992; Dahlquist, Power, & Carlson, 1995) have also been associated with increased pain-related distress in infants undergoing painful procedures. Pacifying or non-nutritive sucking, although effective for preterm and neonate (< 1 month of age) infants' pain reactivity and regulation, has not been examined thoroughly with older infants. Curtis, Jou, Ali, Vandermeer, and Klassen (2007) examined pacifying in infants aged 0 to 6 months and found that pacifying reduced pain during a venipuncture procedure, but only among infants 0 to 3 months of age.

Lisi et al. (2013) used the OUCH Cohort data to examine the naturally occurring caregiver behaviours within immunization appointments across the first year of life and their relation to infant pain-related distress regulation. These authors found that at 2 months of age, pacifying use prior to the needle was associated with lower distress immediately following the procedure. Distraction was also associated with lower distress levels for 6-month olds and verbal reassurance was consistently associated with increased levels of distress at all four ages (2, 4, 6, and 12 months of age).

Another study using the OUCH Cohort examined caregiver proximal soothing and its relationship to infant pain reactivity and regulation (Campbell et al., 2013). Once pre-needle distress was controlled, caregiver proximal soothing had little relationship with infant pain reactivity or regulation across the first year of life, albeit these relationships were statistically significant. The authors concluded that earlier infant pain is a stronger predictor of subsequent infant pain than is caregiver proximal soothing.

Given the mixed findings with respect to caregiver soothing behaviours and their impact on infant pain-related distress during the first year of life, an important area of inquiry is to examine relationships between caregiver behaviours and measures that occur later in infancy, such as attachment during the second year of life. Although specific caregiver soothing behaviours (e.g. physical comfort, distraction, verbal reassurance, pacifying) have been examined in relation to infant pain management within an immunization context, they have not been examined in relation to infant attachment. Hence, this dissertation examines the link between specific soothing behaviours during immunization to an established approach to the measurement of infant attachment (i.e. the SSP).

Research on Infant Attachment and the Pediatric Pain Context

To date, five studies have examined infant attachment within a pediatric pain context. These studies examine a variety of infant and caregiver factors with a focus on different outcomes of interest. Two of the studies do not involve caregiver behaviours and focus on infant distress, temperament, and attachment, whereas the other studies do incorporate caregiver behaviours and their relationship to infant attachment. These five studies are discussed below based on these distinctions, with emphasis on the three studies that incorporated caregiver behaviour.

Literature on infant behaviour and infant attachment in the pediatric pain context. Wolff and colleagues (2011) examined the impact of infant attachment and temperament on infant distress in 14 month olds ($N = 246$) during a venipuncture procedure. Mothers rated infant temperament at 6 months of age using the fear, distress to limitations, recovery from distress, and sadness scales of the Infant Behavior Questionnaire – Revised (IBQ-R; Gartstein & Rothbart, 2003). When infants were 14 months of age on average, they took part in the SSP and a venipuncture procedure. Infants who had both disorganized attachment and fearful temperament had more distress during venipuncture. The authors suggest that when different risk factors are present simultaneously, infant distress is heightened. A limitation of this study was that the SSP took place within the same appointment as the venipuncture, potentially confounding these two procedures. In addition, this study did not examine caregiver behaviours, thus, making it difficult to determine how parents of temperamentally fearful and disorganized infants acted when their infants were distressed due to a painful procedure.

A more recent study based on the OUCH cohort data by Horton et al. (under review) focused on understanding the relationships between infant attachment and temperamental fear with infant pain-related distress during infants' 12-month immunization appointment. This study also examined additional infant behaviours within the immunization appointment and their relation to attachment. Higher temperamental fear in the infant did not predict higher infant pain reactivity. However, temperament did moderate the effect of infant attachment on pain regulation. More specifically, high temperamental fear predicted slower regulation in avoidant infants but faster regulation in secure infants, whereas low temperamental fear predicted faster regulation for avoidant and disorganized infants and slower regulation for secure infants. The authors suggest that under conditions of high threat, such as an immunization, avoidant infants may not be able to sustain their distress-suppressing strategies that they often use during times of mild to moderate threat. In addition, infants' efforts to snuggle into their caregivers following the 12-month immunizations predicted secure infant attachment (Horton, 2013). This study highlights the importance of the biopsychosocial context in which the infant develops when examining infant emotion regulation to pain. However, it lacks the crucial aspect of caregiver soothing behaviours and how these specific behaviours may contribute to this relationship. The results from the current study expand on these findings by providing evidence related to caregiver factors to better explain the entire picture of the development of infant emotional regulation and attachment within a pain context over the first year of life.

Caregiver behaviours and infant attachment in the pediatric pain context. A longitudinal study by Gunnar, Brodersen, Nachmias, Buss, and Rigatuso (1996) examined 83 infants at their 2-, 4-, 6-, and 15-month immunization appointments where their cortisol, behavioural distress, and caregiver behaviours were measured, and then conducted a SSP at 18 months of age to measure infant attachment. In addition, caregiver report of children's social fearfulness at the 15- and 18-month time points was also included to classify children as high-, average-, or low-fearful. Maternal responsiveness was measured using definitions and scales from Ainsworth et al. (1978). Results indicated that infants with higher cortisol responses to both the immunizations and the SSP were more likely to have insecure attachment and high temperamental fear. The authors postulated that secure attachment acts as a buffer against the deleterious effects of high temperamental fear on the physiological stress response across naturalistic (i.e., immunization) and laboratory (i.e., the SSP) contexts. When maternal responsiveness scores were combined for 2, 4, and 6 month olds, greater maternal responsiveness and lower infant cortisol baselines were related to later secure attachment. These findings are in line with attachment theory and lend further support to the idea that the 'well-baby' visit could provide a useful context for detecting dyads at risk for the development of insecure or disorganized attachment relationships. Limitations of this study included potentially missing important affective qualities in the dyadic interactions by using responsiveness as the sole measure of sensitivity. In addition, by collapsing data across the first 6 months of life, important developmental differences in caregiver and infant interactions as well as infant emotion regulation may have been hidden. This study also did not examine discrete caregiver soothing behaviours that have been shown to reduce pain related distress.

Favez and Berger (2011) created the Paediatric Attachment Style Indicator (PASI), a qualitative measure that illustrates infant and caregiver behaviours in the context of immunization which are hypothesized to be associated with attachment status. Through vignettes based on attachment theory and infant behaviours in the SSP, the PASI depicts caregiver and infant behaviour before, during, and after immunization according to prototypical secure, avoidant, and resistant patterns of distress regulation. In addition, the authors also examined maternal behaviours and how they related to the infant attachment classifications determined by the PASI. Prior to the needle, mothers of infants with resistant attachment styles tended to make more distress-promoting comments than did mothers of infants with avoidant or secure attachment styles. Mothers of infants with secure attachment styles were also more likely to provide a warning to their toddler prior to the appointment than mothers of infants with avoidant attachment. The authors suggest that given these results, the pediatric acute pain context is valid for use in studying infant attachment. Limitations of this study include a small sample size ($N = 41$), as well as a lack of description of disorganized behaviours during immunization, limiting the clinical utility of the measure for this high-risk group. Lastly, by only examining maternal verbal behaviours as predictors of infant attachment, several other physical caregiver behaviours that have been found to be helpful in reducing infant pain-related distress were not examined with respect to infant attachment variables.

The final study to examine infant attachment and caregiver behaviours in a pain context was conducted by Pritchett, Minnis, Puckering, Rajendran, and Wilson (2013). The authors examined whether caregiver behaviours exhibited during immunization in preschool aged children could be used to predict attachment. The researchers examined immunization video data for 18 preschoolers (*M* age of 4.12 years) and coded both the general quality of the parent-child interactions as well as specific pain-promoting (i.e., empathy, apologies, mild criticism) or pain-reducing behaviours (i.e., non procedural talk, humour, and commands to engage in coping strategies). Following the immunization, at a later date, the child's attachment patterns were assessed using the Manchester Child Attachment Story Task (MCAST; Green, Stanley, Smith, & Goldwyn, 2000). Researchers did not find a relationship between the quality of caregiver-child interactions as hypothesized; however, their sample size was small. These researchers did find that caregivers of secure children exhibited more pain-reducing behaviours (e.g., coping strategies and nonprocedural talk) than caregivers of insecure children, again suggesting that immunization is a valid context in which to study and assess attachment and that caregiver discrete soothing behaviours may be related to attachment in similar ways as they are to infant distress. However, additional research is needed with infant populations to confirm the utility of the pediatric visit for assessing attachment in infancy and elucidating which discrete caregiver soothing behaviours are related to different attachment classifications with a larger and longitudinal population.

In sum, the results from the current literature establish that acute pain is a useful paradigm in which to study attachment and there is a need to examine both overall caregiver emotional availability and specific caregiver soothing behaviours in a longitudinal pain context. By examining these caregiver behaviours (i.e., for parsimony within the dissertation, EA will be referred to as a behaviour despite it being a global score comprised on multiple caregiver behaviours), a better understanding of which interaction styles and specific soothing behaviours should be promoted or discouraged can be gained. By examining which patterns of caregiver behaviours are related to infant attachment in a pain context, these analyses may provide important insight into the types of behaviours front-line health care professionals (e.g. nurses and pediatricians) could look for and in turn may provide a unique opportunity for intervention at an early age.

Objectives of the Current Study and Hypotheses

The current longitudinal study has three general research aims: (1) to describe caregiver behaviour trajectories during routine immunizations *across* the first year of life (i.e. from 2 to 4 to 6 to 12 months); (2) to relate these caregiver trajectories to subsequent infant attachment during the second year of life; and (3) to relate caregiver behaviour trajectories *within* each immunization appointment, at a given infant age, to subsequent infant attachment during the second year of life. Five behaviours were examined: emotional availability, proximal soothing, distraction, verbal reassurance, and pacifying.

Mean trajectories for each caregiver behaviour were plotted. Then, LGM was used to generate intercept (i.e., representing the mean score of a particular caregiver behaviour at 12 months *or* 3 minutes after-needle, depending on whether the *across* or *within* analyses) and slope (i.e., the change in a particular caregiver behaviour from 2 to 12 months *or* from 1 to 3 minutes after-needle, depending on whether the *across* or *within* analyses) factors for each caregiver behaviour that were then used to examine the relationships between caregiver behaviour trajectories and infant attachment. In order to achieve these general research aims, the following specific research questions were posed.

Research Aim 1: Description of Caregiver Behaviour Trajectories During Routine Immunizations *Across* the First Year of Life.

1a) What is the mean trajectory of caregiver emotional availability across the first year of life (i.e., from 2 to 4 to 6 to 12 months)?

1b) What is the mean trajectory of caregiver proximal soothing across the first year of life?

1c) What is the mean trajectory of caregiver distraction across the first year of life?

1d) What is the mean trajectory of caregiver verbal reassurance across the first year of life?

1e) What is the mean trajectory of caregiver pacifying across the first year of life?

Mean trajectories represent the pattern of average caregiver behaviour scores across each appointment (i.e., 2, 4, 6, and 12 months). It was hypothesized that mean caregiver emotional availability will remain fairly stable across the course of the first year. In addition, the mean proximal soothing trajectory was hypothesized to decrease across the first year as caregivers begin to engage in more distal or cognitive strategies to soothe their infants as they age. The caregiver distraction mean trajectory was hypothesized to increase across the first year as infants become more competent in engaging in cognitive strategies to soothe distress. It was also hypothesized that the mean caregiver verbal reassurance and pacifying trajectories would decrease across the first year, again as infants and caregivers begin to engage in different, more cognitive strategies to soothe distress.

Research Aim 2: Relating Caregiver Behaviour Trajectories *Across* the First Year of Life to Subsequent Infant Attachment During the Second Year of Life.

(2a) Did caregiver emotional availability trajectories (intercept [i.e., caregiver emotional availability at 12 months] and slope [i.e., change from 2 to 12 months] factors) relate to infant attachment?

(2b) Did caregiver proximal soothing trajectories relate to infant attachment?

(2c) Did caregiver distraction trajectories relate to infant attachment?

(2d) Did caregiver verbal reassurance trajectories relate to infant attachment?

(2e) Did caregiver pacifying trajectories relate to infant attachment?

It was hypothesized that caregiver emotional availability and proximal soothing at 12 months (i.e., intercept factor) would be related to infant attachment such that higher emotional availability and proximal soothing would be associated with secure or organized infant attachment. It was also hypothesized that any change in these scores over the course of the year would also be related to infant attachment such that an increase (i.e., positive slope) would be associated with secure or organized attachment, whereas a decrease (i.e., negative slope) would be associated with insecure or disorganized infant attachment classifications. It was also hypothesized that high levels of distraction at 12 months would be associated with secure or organized infant attachment. Changes in distraction over the first year were also hypothesized to be associated with infant attachment in that caregivers whose distraction behaviours increase would be associated with secure or organized infant attachment, whereas caregivers whose behaviours decrease would be more likely to have infants with insecure or disorganized attachment.

Given previous research regarding the paradoxical relationship with verbal reassurance, higher levels of verbal reassurance were hypothesized to be associated with insecure or disorganized infant attachment classifications at 12 months. Any changes in the amount of verbal reassurance across the first year was also expected to be related to infant attachment. Caregivers whose verbal reassurance behaviours increase were expected to be associated with insecure or disorganized attachment, whereas caregivers whose verbal reassurance behaviours decrease were expected to be more strongly associated with secure or organized infant attachment.

Lastly, it was hypothesized that frequent pacifying at 12 months would be associated with insecure or disorganized infant attachment. It was also hypothesized that change in pacifying behaviour over the first year of life would be associated with infant attachment such that decreases would be associated with secure or organized infant attachment and increases would be related to insecure or disorganized infant attachment.

Research Aim 3: Relating Caregiver Behaviour Trajectories *Within* Each Immunization Appointment, at a Given Infant Age, to Subsequent Infant Attachment During the Second Year of Life.

(3a) Did caregiver <u>proximal soothing</u> within-appointment trajectories (intercept [i.e., proximal soothing at 3 minutes after-needle] and slope [i.e., change from 1 to 3 minutes] factors) relate to infant attachment?

(3b) Did caregiver <u>distraction</u> within-appointment trajectories relate to infant attachment?

(3c) Did caregiver <u>verbal reassurance</u> within-appointment trajectories relate to infant attachment?

3d) Did caregiver <u>pacifying</u> within-appointment trajectories relate to infant attachment?

It was hypothesized that higher levels of proximal soothing at 3 minutes after the needle (i.e., intercept factor) would be associated with secure or organized infant attachment at all ages, but especially at the 12-month visit when attachment is theorized to be more solidified. It was also hypothesized that caregivers who engage in decreasing levels of proximal soothing within the immunization appointment would be more likely to have infants with insecure or disorganized attachment.

It was hypothesized that caregivers that use more distraction at 3 minutes after the needle would be more likely to have infants that were secure or organized in their attachment, but only at the 12-month time point when infants are more cognitively able to attend to distraction techniques. Caregivers who engage in increasing levels of distraction within the 12-month immunization appointment were hypothesized to be more likely to have infants with secure or organized attachment.

Higher levels of verbal reassurance at 3 minutes after the needle were hypothesized to be associated with insecure or disorganized infant attachment. Increasing levels of verbal reassurance within the immunization appointment, at any age, was hypothesized to be associated with insecure or disorganized infant attachment.

Higher levels of pacifying at 3 minutes after the needle were expected to be associated with secure or organized infant attachment, especially in younger infants (i.e., 2 and 4 months). Higher levels of pacifying at 6- and 12-month appointments, however, were expected to be associated with insecure or disorganized infant attachment. If there were changes in this behaviour within the immunization appointment, decreases in pacifying at 6 and 12 months would be more likely associated with secure or organized infant attachment.

Method

Participants

The current study used existing data from a larger longitudinal study that included 760 caregiver-infant dyads that were observed at 2, 4, 6, and 12 months of age. Participants were initially recruited for this larger study from three pediatric clinics in the Greater Toronto Area at either the 2-, 4-, or 6-month well-baby immunization visit and observed at each subsequent visit until their 12-month immunization appointment. Of these 760 dyads, 256 were observed four times (2, 4, 6, and 12 months of age), 263 were observed three times (2, 6, and 12 months or 4, 6, and 12 months, or 2, 4, and 6 months), 175 were observed twice (all two time point permutations were possible), and 66 were observed once (2, 4, or 6 months). In order to control for factors that have been shown to impact infants' behavioural pain responses, only healthy infants born greater than 36 weeks gestation, who had no suspected developmental delays or neurological impairments, and were without prolonged medical or foster care were included in this larger study. In addition, caregivers had to be fluent in English.

Caregivers' self-identified heritage culture was diverse (35.9% European, 12.6% Asian, 11.2% Canadian/American, 7.5% Jewish, 5.8% Mixed Canadian, 5.1% South Asian, 5% African/Middle Eastern, 3.8% South/Latin American, and 13.1% Other). The majority of caregivers were married (83.9%) and in dual-income families (89.7%), and were on average 33.5 years old (*SD* = 5.0) at the time of recruitment. Approximately half (50.1%) of the infants were male, born between 37 and 44 weeks gestation (caregiver-reported), and approximately half (54.6%) were first- or only-born children. Across all four ages, mothers most frequently (55.6%) attended the infant's immunization appointment, followed by both caregivers together (33.1%). When both parents attended the immunization, mothers were the primary providers of soothing behaviours (65% to 73% of the time). Fathers were the providers of soothing behaviours 15% to 23% of the time, and soothing behaviours were shared between caregivers 6% to 15% of the time. When additional caregivers (beyond the biological parents) were present, nannies provided soothing behaviour 16% of the time and grandparents between 4% and 9% of the time. When the infant was not the only-born child, at least one other sibling was present during the appointment 17% of the time.

As a follow-up to this larger longitudinal study, caregiver-infant dyads were recruited at their 12-month well-baby immunization visit and invited to take part in the SSP at a local children's hospital when infants were between 12 and 18 months of age (see Figure 2 for an illustration of the recruitment process). Of the 286 caregivers approached at the 12-month appointment, 175 (62%) agreed to participate in the study. However, some caregivers were unable to bring their infants to the hospital prior to 18 months of age (the upper age limit for the SSP). Thus, the final sample consisted of 130 caregiver-infant dyads. Reasons for refusal included being too busy, living too far from the hospital, and not being interested. Sixty-four dyads were recruited from a pediatrician's office in midtown Toronto, 64 dyads were recruited from a pediatrician's office in downtown Toronto, and two dyads were recruited from a pediatrician's office in northwest Toronto. Demographic characteristics were compared between the families that agreed to participate in the follow-up study versus the whole sample, and no notable differences were discerned. In addition, the number of infants classified as secure/insecure, χ^2 (1, *N* = 128) = 1.13, *p* = .38, and organized/disorganized, χ^2 (1, *N* = 128) = 0.05, *p* = .99, did not differ between the two pediatricians' offices from which 98.5% of participants were recruited. The third pediatric office was not included in these comparisons because only two dyads were recruited from this site; the two infants from this third site were both coded as secure (B) in the SSP. Therefore, samples were collapsed across pediatric clinics in subsequent analyses.

Infants in this follow-up study were the biological children of the caregivers taking part in the study with the exception of one adopted infant. In order to maintain consistency in caregivers across appointments, the caregiver who brought his or her infant to the 12-month immunization appointment was also invited to take part in the SSP. If more than one caregiver accompanied the infant to the 12-month appointment, the primary caregiver was invited to take part in the SSP. "Primary caregiver" was defined as the caregiver who spent the most amount of time with the infant or who was primarily responsible for his or her child's care and caretaking decisions. The final sample of 130 dyads included 72 (55%) male and 58 (45%) female infants and 116 (89%) mothers and 14 (11%) fathers. At the time of the SSP appointment, infants were an average age of 13.74 months (range = 12.06 – 20.70, *SD* = 1.35) and the average age of caregivers was 34.70 years (range = 22.59 – 58.08, *SD* = 5.05). The majority of caregivers were married or in common-law relationships (94%) and educated at or above the university level (76%).

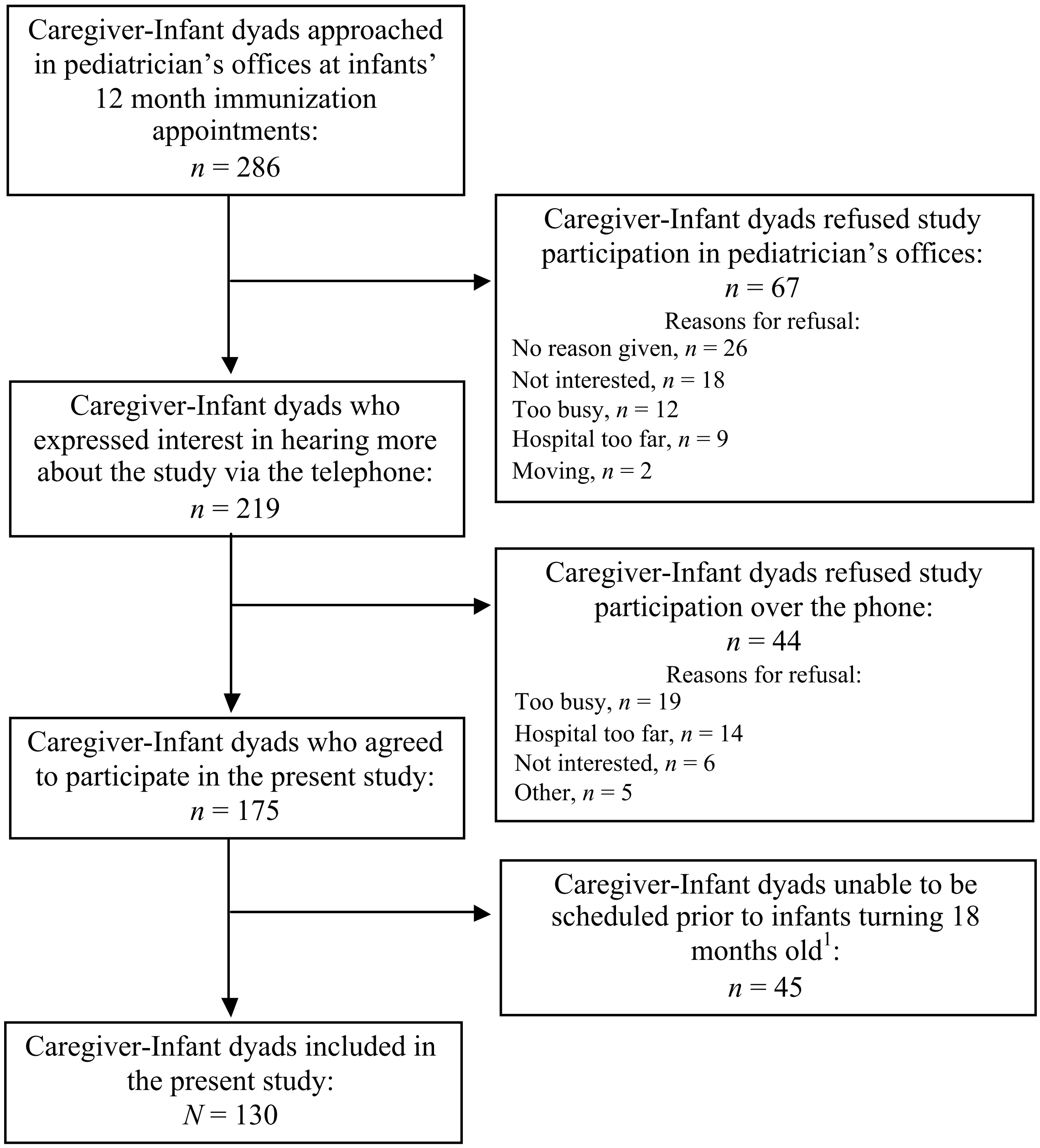

Figure 2. Recruitment flow chart for the present study.
[1] One infant was 20.7-months old at the time of the SSP; the SSP for this case was deemed valid by an expert SSP coder and retained in the final dataset.

The current sample was culturally diverse, with the majority of caregivers identifying as European or Canadian/North American (59%) with the second largest group of caregivers identifying as Asian (11%). A summary of demographic information for the current follow-up study (*N* = 130) is presented in Table 1.

Procedure

Two- to 12-month immunization visits were filmed to record caregiver and infant behaviours. Caregiver-infant dyads were seen by the pediatrician in a private clinic room. A research assistant (RA) videotaped caregiver-infant interactions for up to three minutes pre-needle and up to five minutes after-needle. Caregiver-infant dyads were observed naturalistically, with no interference from the RA during the immunization period. At the end of the 12-month appointment, the RA approached the caregiver to ask if he or she might be interested in participating in a follow-up study at the Hospital for Sick Children examining caregiver-infant interactions. For those subjects who participated in the follow-up study (*N* = 130), infants across all four immunization appointments typically received two needles in one visit (2 months: 97%, 4 months: 96%, 6 months: 71%, 12 months: 74%). The types of immunizations typically given during these four appointments were Pediacel, Prevnar, or MMR (12-month appointment only). Caregivers were informed that they would receive $10 to cover the cost of travel and parking, an infant “onesie”, a framed commemorative photo of the infant, and a DVD copy of their visit to the hospital. The procedure for the current follow-up study received separate ethics approval obtained through both the York University Ethics Review Board as well as the Hospital for Sick Children Institutional Review Board (Appendix D).

Table 1

Demographic Characteristics of the Follow Up Study Sample

Demographic Variable	Description	*N*	%
Caregiver education	Graduate degree or professional	47	36.2
	training	52	40.0
	University graduate	6	4.6
	Partial University (at least 1 year)	21	16.2
	Trade school or community college	3	2.3
	High school graduate	1	0.8
	Some High School (minimum 10th Grade)		
Marital status	Married	109	83.8
	Common Law	13	10.0
	Single/Never Married	5	3.8
	Divorced/Separated	1	0.8
	Engaged	1	0.8
	Other	1	0.8
Self-Reported Heritage Culture	European	57	43.8
	Canadian/North American	20	15.4
	Asian	14	10.8
	Central American/Caribbean	8	6.2
	South Asian	8	6.2
	South American	7	5.4
	African/Middle Eastern	7	5.4
	East Asian	5	3.8
	Other	4	3.1

Note. $N = 130$.

Caregivers who expressed interest in participating in the follow-up study provided the RA with their contact information. A second RA contacted the caregiver via telephone to provide more details about the study and, if interested, to book an appointment. When scheduling the SSP appointment, caregivers were consulted as to what time of day the infant would be in an alert state and were encouraged to provide the infant with a snack prior to the visit to avoid confounds such as sleepiness or hunger. Once an appointment was booked, caregivers were sent a confirmation email that included directions to the hospital and pictures of compensation items (Appendix E). Caregivers were also telephoned a day or two prior to their appointment for a friendly reminder.

Immunization appointments took place between June 2009 and April 2012 and appointments at the hospital took place between September 2009 and April 2012. The average amount of time between the 12-month immunization visits and the hospital appointments was 42.88 days (*SD* = 38.48). When the caregiver and infant arrived at the hospital, a trained RA explained the purpose, potential benefits, and harms of the study as well as the confidential and voluntary nature of the study using two consent forms: Consent to Participate and Consent to Videotape (Appendix F). Caregivers were also provided copies of the consent forms that included contact information for the RAs and the principal investigator.

After providing consent, the caregiver was provided with a brief oral description of the SSP. A paper copy of the instructions was provided during the SSP so that the caregiver could refer to them as needed. As per SSP protocol, the caregivers were instructed to bring a bag (purse or diaper bag) to leave on their chair during the separations as well as to not bring in a pacifier or bottle, which could provide comfort to the infant and confound the SSP observations. Following the SSP, caregivers were asked to complete a questionnaire related to infant temperament (IBQ-R) that was not used in the current study. The visit to the hospital took approximately one hour.

Apparatus

Pediatrician visit at 2, 4, 6, and 12 months. Two Canon HV20 High Definition Camcorders were used to record caregiver and infant behaviour. One camera was hand-held by an RA to record a close-up image of both the infant's and the caregiver's facial expressions. The second camera was mounted on a tripod and fitted with a wide angle lens to record caregiver-infant interactions from a distance.

Laboratory visit between 12 and 18 months. Two wall-mounted rotating video cameras were used to record infant and caregiver behaviour during the SSP. The experimental room included a one-way mirror so that the researcher could unobtrusively observe the participants (caregiver, infant, and an RA who acted as the stranger) from an adjacent control room. Two chairs were arranged (one for the caregiver and one for the stranger) in the experimental room. A small table displaying magazines and caregivers' SSP instructions was placed between the two chairs. A number of age-appropriate toys were spread out on the floor in the middle of the room. The toys included three blocks, a pop-up toy, a puppet, two dolls, a toy truck, a toy stethoscope, two books, a stacking ring toy, a toy telephone, and a rattle. The same toys were used across SSPs and sterilized after each visit.

Measures

A timeline of when measures were coded during the 2- to 12-month immunization appointments is in Figure 3. A global measure of caregiver emotional availability (EA) was coded during the entire immunization appointment, which typically lasted around 11-12 minutes. For the current analysis, caregiver soothing behaviours (MAISD) were coded in 5-second intervals as present or not present across the entire 1, 2, and 3 minutes after the last needle.

Demographic information sheet. At their 2-month immunization appointment, parents completed a short demographic questionnaire that asked for basic background information such as their age, heritage culture, as well as infant sex. Some questions were asked at each subsequent visit (4, 6, 12 months), including medical conditions since the last time they participated in the study, as well as whether they had administered pharmacological analgesics to their infants (i.e., topical anesthetics such as Eutectic Mixture of Local Anesthetics [EMLA] cream or over-the-counter acetaminophens such as Tylenol or Tempra) prior to the immunization appointment.

Caregiver behaviours during the 2- to 12-month immunization visits. Two major coding systems were used to code caregiver behaviours. The epochs of which each system was based is shown in Figure 3.

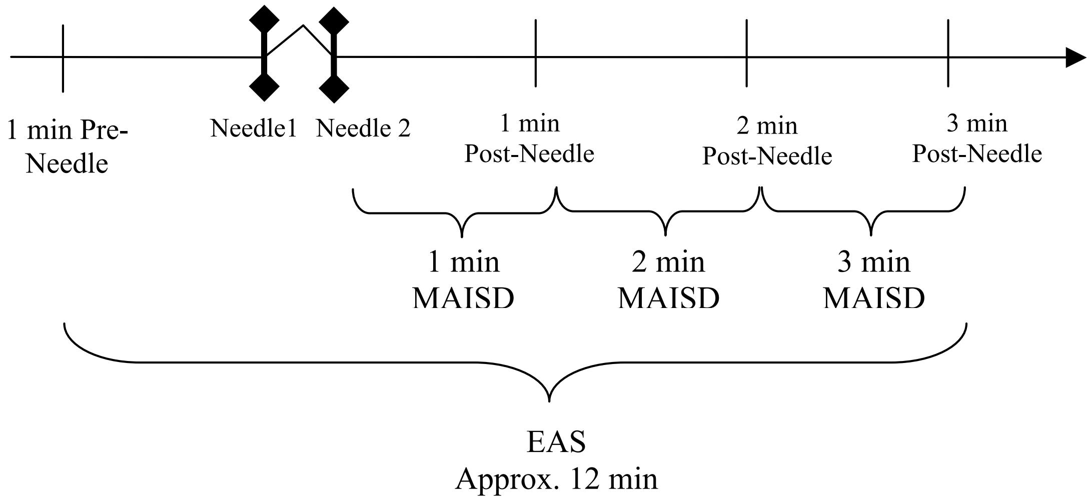

Figure 3. Timeline representing the measures coded during the 2-, 4-, 6-, and 12-month "well-baby" visits. EAS = Caregiver emotional availability; MAISD = Caregiver discrete soothing behaviours (i.e., proximal soothing, distraction, verbal reassurance and pacifying).

Emotional Availability Scales (EAS). Caregiver sensitivity was coded using the Infancy/Early Childhood version of the Emotional Availability Scales (EAS 4th Ed.; Biringen, 2008). A major strength of the EAS over other measures of caregiver sensitivity is that, it consists of global clinical rating scales of caregiver behaviour that must be contextualized by the infant's reactions to those behaviours. The EAS has been well-validated in a variety of distressing non-pain contexts (Biringen, 2000) as well as in a pain context (Din et al., 2009). To ensure validity, coders of this measure obtained specialized training with the scale's creator for the pain context. The EAS includes four individual caregiver subscales (sensitivity, structuring, non-intrusiveness, and non-hostility), which are combined to form a composite emotional availability score. The total score is a clinical judgment based on detailed objective parameters to determine the quality of the caregiver behaviours. For a parent to have a high emotional availability score, she or he would have to consistently enact behaviours (regardless of what those specific behaviours are) that sensitively and effectively address the infant's pain-related distress.

Caregiver sensitivity included the caregiver's ability to interpret and respond to the infant's cues while displaying appropriate affect and respecting the developmental level of the infant (e.g., sensitively and contingently responding to the infant's pain cues). Caregiver structuring referred to the caregiver's ability to structure the environment in a manner that leads the infant in a positive direction (e.g., effectively using toys to distract the baby from the pain once the infant's distress is sufficiently regulated). Caregiver non-intrusiveness referred to the caregiver's ability to be available and avoid intrusive, over-stimulating, or overpowering behaviours (e.g., getting in the infant's face and intrusively kissing the infant while the infant is highly distressed). Finally, caregiver non-hostility referred to the caregiver's ability to refrain from antagonistic or impatient behaviours (e.g., expressing frustration about the infant's pain-related crying).

The EAS rating was based on video footage from the time the caregiver and infant entered the clinic room until they left. After viewing the entire filmed interaction, a coder provided a rating on each of the emotional availability subscales (potential scores range from 7 to 29). These subscales were subsequently summed to form a composite emotional availability score that potentially ranges from 28 to 116. On all scales, higher scores represented more optimal interactions. When more than one caregiver accompanied the infant for the immunization appointment, the caregiver who did the majority of the caregiving was coded. When both caregivers provided equal care during the clinic visit, both caregivers were coded and the average was calculated. Four coders coded the videotaped immunization appointments for this study and were blind to study hypotheses. Inter-rater reliability was calculated among coders. Intraclass correlations for the caregiver EAS composite score ranged from .88 to .93. In addition, 5% of the total sample was quadruple-coded by all coders to prevent coder drift, and the intraclass correlations for the caregiver EAS composite score was .93.

Measure of Adult and Infant Soothing and Distress (MAISD). Caregiver discrete soothing behaviours during the immunization appointment were coded using the Measure of Adult and Infant Soothing and Distress (MAISD; Appendix G; Cohen et al., 2005). The MAISD is a reliable and valid behavioural observation scale that was originally developed to evaluate the behaviours of infants, caregivers, and nurses during painful pediatric medical procedures. Each of the eight caregiver behaviours (Distraction, Offer Toy, Offer Pacifier, Offer Food [bottle or solid food], Nursing [breastfeeding], Physical Comfort, Rocking, and Verbal Reassurance) was coded as present (1) or absent (0) for 5-second epochs for four 1-minute periods: one minute before the first needle (Pre-Needle), one minute after the last needle (1-minute After-Needle), two minutes after the last needle (2-minutes After-Needle), and three minutes after the last needle (3-minutes After-Needle). For each of the eight behaviours, scores ranging from 0 to 100 were calculated for all four 1-minute phases. These scores represent the percent of time a behaviour was present during that minute. Higher scores reflect a greater frequency of the behaviour.

Ten trained MAISD coders, blind to the study hypotheses, coded the data. Primary coders had training with the scale designer until adequate reliability was attained. Subsequent coders went through a stringent process to attain adequate reliability with trained coders. 20% of all data were coded for reliability. Inter-rater reliability on all eight caregiver behaviours was calculated between coders. The intraclass correlations for the entire ($N = 760$) sample ranged from .80 to .96 for the analyzed variables (i.e., those that occurred more than 5% of the time). Regardless of age, three of the eight caregiver soothing behaviours (Offer Food, Offer Toy, and Nursing) occurred extremely infrequently (less than 5% of the time). Accordingly, data for these behaviours were not included in this study. For Research Aims 1 and 2, a combined index score for the two minutes after-needle for each MAISD caregiver behaviour at each age was calculated and used in the analyses. For Research Aim 3, each MAISD caregiver behaviour, at each age, was examined at each minute post-needle (i.e., 1, 2, and 3 minutes) separately.

Caregiver-infant attachment. As reviewed in the introduction, the Strange Situation Procedure (SSP; Ainsworth et al., 1978) is considered a gold-standard approach to measuring infant-caregiver attachment, and is a controlled laboratory procedure designed to elucidate the quality of an infant's attachment relationship by inducing stress through separation from the caregiver. This relationship is assessed over eight episodes involving infant, caregiver, and an RA who acts as a "stranger" (see Appendix B). The *Scoring System for Interactive Behaviors* (SSIB; Ainsworth et al., 1978) is used to code episodes 5 and 8 of the SSP (when infants are reunited with their caregivers after brief separations) to determine an infant's organized attachment classification (A, B, or C). Efforts are first made to classify an infant according to one of the organized attachment styles. The *Indices of Disorganization and Disorientation* (Main & Solomon, 1990; Appendix C) is then used to code disorganized behaviours during the episodes in which the infant and caregiver are together.

For the current study, two researchers were trained in administering and coding the SSP. Adequate reliability for both coders was achieved on the organized A, B, and C classifications. For the current study, an experienced and reliable SSP coder from an internationally renowned attachment laboratory coded the entire sample for A, B, C, and D classifications (S. Bento; University of Western Ontario). Approximately 70% of the tapes were double-coded by the first two researchers for training purposes and to assess ongoing reliability. Tapes on which there were major disagreements were reviewed by a third highly experienced SSP coder. Intraclass correlations between coders ranged from .71 to 1.00 (see Table 2).

Table 2

Intraclass Correlation Coefficients for Strange Situation Procedure Reliability

		Attachment Classification Comparison		
Coders	*N*	A/B/C/D	Secure (B)/Insecure (A, C and D)	Organized (A, B and C)/Disorganized (D)
PC and C1	68	.75	.71	.79
PC and C2	24	.80	.84	.84
C1 and C2	7	.93	.75	1.00

Note. PC = Primary Coder, C1 = Coder 1, C2 = Coder 2.

As noted above, attachment was operationalized in three ways: (1) the four-level A/B/C/D comparison (using secure as the reference group); (2) the two-level secure/insecure comparison (secure [B] vs. insecure [A, C, and D groups combined]); and (3) two-level organized/disorganized comparison (organized [A, B, and C groups combined] vs. disorganized [D]). These contrasts allowed for examinations of low- versus high-risk groups (i.e., secure vs. insecure and organized vs. disorganized) as well as examinations of attachment groups separately. Of the 130 cases, 31 (24%) were classified as avoidant (A), 68 (52%) were classified as secure (B), 8 (6%) were classified as resistant (C), and 23 (18%) were classified as disorganized (D). These proportions are consistent with non-clinical samples (van IJzendoorn et al., 1999; Main & Soloman, 1990).

Results

A four-page non-technical summary of the entire Results section is presented in Appendix A to support interpretation of the 63 latent growth models and 42 logistic regressions contained within the dissertation. Analyses are presented in order of the three research aims described previously. Each section begins with an overview of the analysis plan for that research aim, a description of preliminary descriptive results, and finally, a description of their respective primary results.

Research Aim 1: Description of Caregiver Behaviour Trajectories During Routine Immunizations *Across* the First Year of Life

Analysis overview. Initially, descriptive statistics were calculated including means and standard deviations for variables of interest. In order to address this aim, each caregiver behaviour (i.e. emotional availability, proximal soothing, distraction, verbal reassurance, and pacifying) was first individually described by plotting its mean trajectory across the first year of life (i.e., based on means at 2, 4, 6, and 12 months).

In order to move beyond simple descriptive statistics and provide a plausible representation of the development of these caregiver behaviours over the first year of life within the larger population, five unconditional latent growth models (LGM) were specified. These models provided key descriptive information (i.e. intercept and slope factors) about the mean trajectory and interindividual variability around the mean for each caregiver behaviour. The models were specified so that the intercept factor represented the mean caregiver behaviour score at 12 months and the slope factor represented the change in the caregiver behaviour over time. The mean values for each of the caregiver behaviours (see Table 3) across the four time points indicated that the overall growth trajectories were not linear, with the exception of caregiver pacifying. Therefore, quadratic growth models were specified for caregiver EA, distraction, and verbal reassurance variables, and a freed-loading model in which the 4- and 6-month factor loadings were freely estimated (rather than constrained to reflect linear growth) was specified for the caregiver proximal soothing variable. A linear growth model was estimated for caregiver pacifying. Figure 4 provides an example of a basic, fixed-loading, unconditional model.

LGMs were estimated using Mplus version 6.1 (Muthén & Muthén, 2010). Full-information maximum likelihood estimation with the Yuan–Bentler model χ^2 statistic (Yuan & Bentler, 2000) and robust standard errors were used to account for potential non-normality in the presence of missing data.

Table 3

Descriptive Statistics of Variables Central to Research Aim 1

Continuous Variables	*N*	Minimum	Maximum	*M*	*SD*
Caregiver EA 2 months+	497	56	114	92.3	10.3
Caregiver EA 4 months+	591	65	114.5	94.7	9.7
Caregiver EA 6 months+	602	55	116	94.6	10.3
Caregiver EA 12 months+	547	55	113.5	92.8	11
Proximal soothing 2 months+	498	0	100	36.9	23.4
Proximal soothing 4 months+	594	0	100	34.6	22.3
Proximal soothing 6 months+	601	0	90	26.1	19.9
Proximal soothing 12 months+	538	0	98	26	19.9
Distraction 2 months+	499	0	100	1.8	7.8
Distraction 4 months+	594	0	100	4.7	12.3
Distraction 6 months+	601	0	100	5.9	13.6
Distraction 12 months+	538	0	71	6.8	12
Verbal Reassurance 2 months+	499	0	100	16.2	17.9
Verbal Reassurance 4 months+	592	0	100	12.6	16
Verbal Reassurance 6 months+	599	0	100	12.6	14.8
Verbal Reassurance 12 months+	535	0	100	15.7	16.7
Pacifying 2 months+	497	0	96	5.2	14.3
Pacifying 4 months+	594	0	79	3.3	9.6
Pacifying 6 months+	601	0	87	2.5	7.8
Pacifying 12 months+	538	0	33	1.2	3.8
Categorical Variables	**Percentage of Sample (%)**				
Distraction 2 months (Yes) +	13.2				
Distraction 4 months (Yes) +	28.6				
Distraction 6 months (Yes) +	33.1				
Distraction 12 months (Yes) +	42.0				
Pacifying 2 months (Yes) +	19.5				
Pacifying 4 months (Yes) +	13.6				
Pacifying 6 months (Yes) +	11.3				
Pacifying 12 months (Yes) +	7.8				
Sex+					
Male	50.1				
Female	49.9				
#Needles 2 months+					
1	6.2				
2	92.4				
3 or more	1.4				
#Needles 4 months+					
1	6.6				

2	91.7
3 or more	1.7
#Needles 6 months+	
1	12.8
2	83.5
3 or more	3.7
#Needles 12 months+	
1	14.2
2	81.2
3 or more	4.6
A/B/C/D^	
A (avoidant)	23.8
B (secure)	52.3
C (resistant)	6.2
D (disorganized)	17.7
Secure/Insecure^	
Secure (B)	52.3
Insecure (A, C and D)	47.7
Organized/Disorganized^	
Organized (A, B and C)	82.3
Disorganized (D)	17.7

Note. EA = Emotional Avilability; +*N* = 760 for longitudinal study, ^*N* = 130 for the current follow-up study.

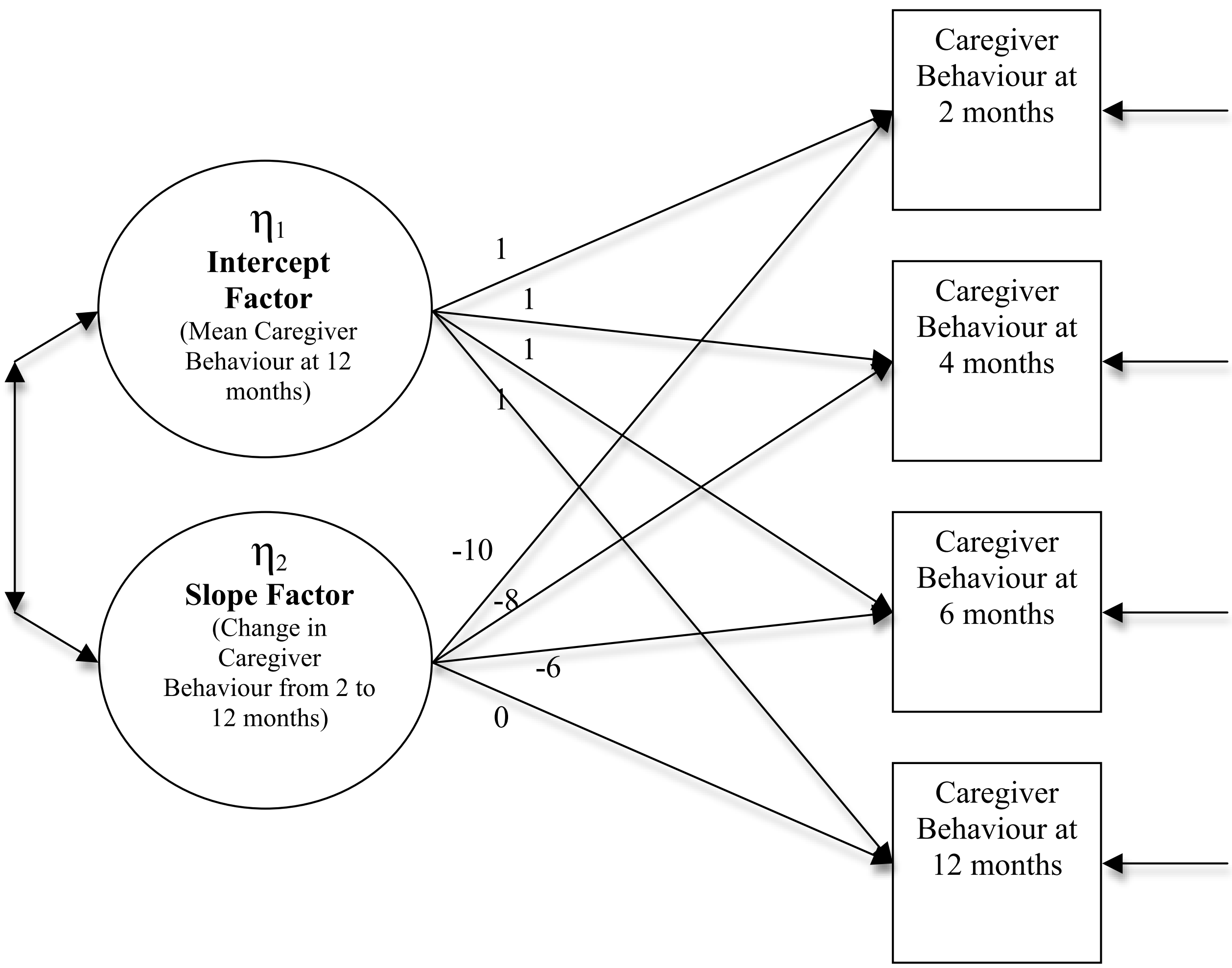

Figure 4. Unconditional latent growth model

Preliminary results. Descriptive statistics of variables central to the first research aim and its specific research questions are presented above in Table 3. Correlations and covariances for the variables in each of the five models are presented below.

Results for (1a): Caregiver emotional availability trajectory. A line graph of the mean caregiver EA trajectory showed high and stable caregiver EA scores across the first year of life (see Figure 5). Mean scores ranged from 92.75 to 94.70, with higher scores indicating more optimal emotional availability and 116 being the maximum possible score.

A quadratic LGM was estimated to move beyond simple descriptive statistics and provide a plausible representation of the development of caregiver emotional availability over the first year of life within the larger population. The initial model estimation produced an improper solution such that the quadratic factor had a negative residual variance estimate, suggesting that there was minimal individual variability in the amount of curvature in the trajectory of caregiver emotional availability from 2 to 12 months. Therefore, the residual variance for the quadratic factor was constrained to 0.00 to obtain a properly estimated model. The correlations and covariances among the variables in this model are presented in Table 4. Unstandardized parameter estimates for this model are presented in Table 5.

The quadratic model fit the data well, with root mean square error of approximation (RMSEA) = .01 (90% CI: .00 - .06), comparative fit (CFI) and Tucker-Lewis indices (TLI) = .99, and the standardized root mean square residual (SRMR) = .08 (Hu & Bentler, 1999).

The mean of the caregiver EA intercept factor (i.e., mean total EAS score at 12 months) was 92.5. There was also significant variance around the mean intercept ($p < .001$), indicating that there are significant individual differences in the levels of caregiver EA scores at the 12-month immunization appointment.

The means of both the linear slope factor and the quadratic factor were negative and significant ($p < .001$), indicating that caregiver EA scores are decreasing at the end of the first year of life (12 months) and the rate of decrease is accelerating over time. To aid interpretation of this non-linear slope, the model was also specified so that the intercept factor represented the mean caregiver EA score at 2 months. With this model specification, the mean linear slope factor was positive and the quadratic factor was negative, indicating that caregiver EA scores are increasing at 2 months and the rate of increase is slowing over time. A significant variance around the linear slope ($p = .04$) at 12 months indicated significant individual differences in the linear change in caregiver EA scores at 12 months. Therefore, some caregivers increase their level of emotional availability, while others decrease or remain stable over the first year of their infant's life.

In addition, there was a significant positive relationship between the intercept and linear slope factors, indicating that higher caregiver EA scores at the 12-month immunization appointment were associated with larger amounts of change in caregiver EA scores (i.e. larger increases in EA scores and smaller decreases in EA scores) across the first year of life, *residual* $r = .54$, $p < .001$. Because the quadratic factor variance was constrained to 0.00, the relationships between the quadratic factor and the intercept and linear slope factors could not be calculated.

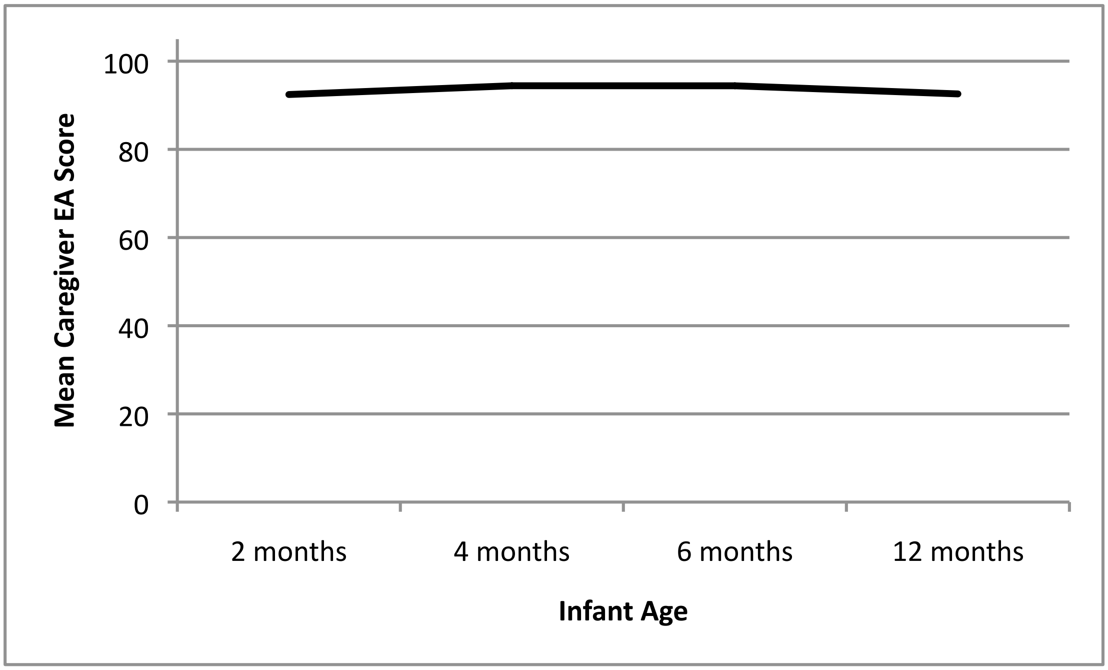

Figure 5. Mean caregiver EA trajectory

Table 4

Correlations and Covariances Among Variables for Caregiver EA

Variable	1	2	3	4
1. Caregiver EA 2 months	105.02	.520**	.545**	.397**
2. Caregiver EA 4 months	52.04	94.72	.518**	.406**
3. Caregiver EA 6 months	61.88	51.00	105.26	.523**
4. Caregiver EA 12 months	42.92	38.97	61.70	121.55

Note. Correlations are above the diagonal in the shaded region. Covariances are below the diagonal. EA = Emotional availability.
** $p < .01$. * $p < .05$.

Table 5

Model Estimates for Caregiver EA

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
	M			
Caregiver EA intercept factor	92.55	.46	201.12	<.001
Caregiver EA linear slope factor	-.88	.15	-5.88	<.001
Caregiver EA quadratic factor	-.09	.02	-5.77	<.001
	Variance			
Caregiver EA intercept factor	74.67	11.59	6.44	<.001
Caregiver EA linear slope factor	.38	.19	2.06	.04
Caregiver EA quadratic factor	0.00	0.00		

Note. S.E. = estimated standard error; EA = Emotional availability.

Results for (1b): Caregiver <u>proximal soothing</u> trajectory. A line graph of mean caregiver proximal soothing frequencies indicated that caregiver proximal soothing use was moderate (occurring approximately 30 to 40% of the time measured) from 2 to 4 months of age then dropped by approximately 10% and remained lower from 6 to 12 months of age (see Figure 6).

A freed-loading LGM was estimated to provide a plausible representation of the development of caregiver proximal soothing over the first year of life within the larger population. The model was specified such that the 4- and 6-month loadings on the caregiver proximal soothing non-linear slope factor were freely estimated, while the 2-month loading was fixed to -1.0 and the 12-month loading was fixed to 0. The correlations and covariances among the variables in this model are presented in Table 6. Unstandardized parameter estimates for this model are presented in Table 7. This freed-loading model fit the data well with RMSEA = .05 (90% CI: .01, .09), CFI = .96, TFI = .93, and SRMR = .03.

Results indicated that the caregiver proximal soothing non-linear slope factor loadings changed from $\lambda = -1.00$ to $\lambda = -.77$ to $\lambda = -.01$ to $\lambda = 0.00$ from 2 to 4 to 6 to 12 months, which reflected a large change in caregiver proximal soothing from 4 to 6 months compared to the amount of change occurring from 2 to 4 months or 6 to 12 months (with linear growth, the factor loading at 4 months would have been -.80 and at 6 months would have been -.60 to represent the amount of change that was equivalent to two months' worth of linear change).

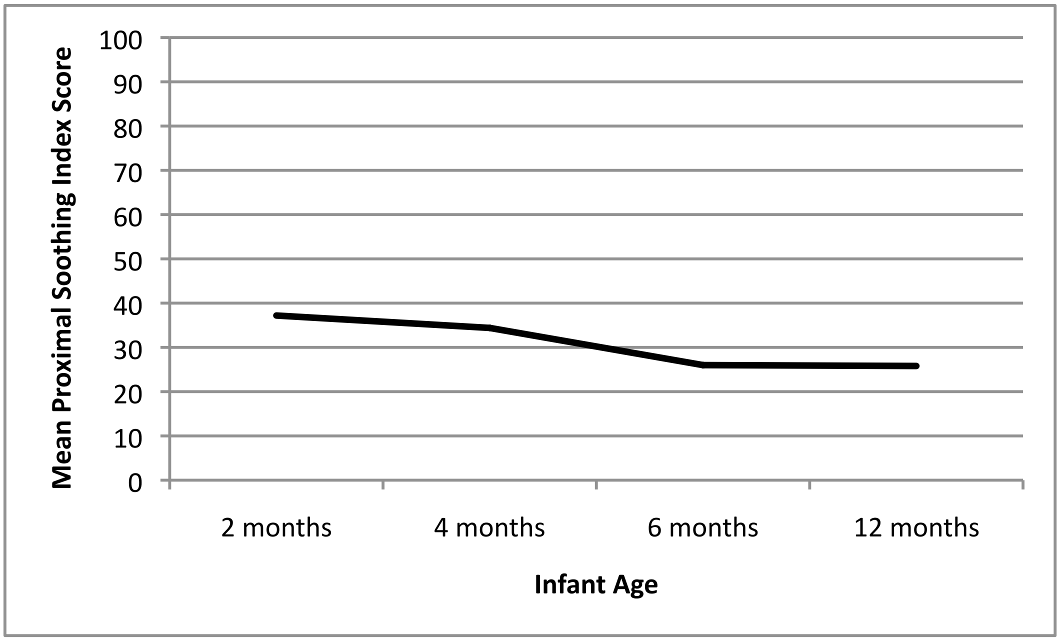

Figure 6. Mean caregiver proximal soothing trajectory

Table 6

Correlations and Covariances Among Variables for Caregiver Proximal Soothing

Variable	1	2	3	4
1. Proximal soothing 2 months	.055	.323**	.268**	.144**
2. Proximal soothing 4 months	.017	.050	.277**	.343**
3. Proximal soothing 6 months	.013	.012	.040	.253**
4. Proximal soothing 12 months	.006	.015	.010	.040

Note. Correlations are above the diagonal in the shaded region. Covariances are below the diagonal.
** $p < .01$. * $p < .05$.

Table 7

Model Estimates for Caregiver Proximal Soothing

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
	M			
Proximal soothing intercept factor	.26	.01	29.98	<.001
Proximal soothing non-linear slope factor	-.11	.01	-.8.79	<.001
	Variance			
Proximal soothing intercept factor	.01	.002	5.91	<.001
Proximal soothing non-linear slope factor	.01	.01	1.02	.31

Note. S.E. = estimated standard error.

The mean of the intercept factor is 25.8%, indicating the predicted frequency of caregiver proximal soothing use during the 12-month immunization appointment. There was also significant variance around the mean intercept ($p < .001$), indicating that there are significant individual differences in the frequency of caregiver proximal soothing at the 12-month immunization appointment.

The mean of the non-linear slope factor was negative and significant ($p < .001$), indicating that caregiver proximal soothing frequencies decrease across the first year of life. The variance around the non-linear slope factor was not significant, indicating that there were not significant individual differences in the amount of change in caregiver proximal soothing frequencies across the first year of life. In addition, there was no significant relationship between the intercept factor and non-linear slope factor, *residual r* = -.19, $p = .63$.

Results for (1c): Caregiver <u>distraction</u> trajectory. A line graph of mean caregiver distraction frequencies indicated that distraction use was low (< 10%) and increased with age by approximately 5% from 2 to 12 months (see Figure 7). A preponderance of caregivers did not engage in any (i.e., 0% vs. non-zero%) distraction and therefore frequencies were also examined as a dichotomous variable (i.e., 0 vs. non-zero) using a bar graph. These frequencies also revealed that distraction use increased from 2 to 12 months such that the percentage of caregivers engaging in *any* level of distraction increased from 13% to 42% across the first year (see Figure 8).

A quadratic LGM was estimated to provide a plausible representation of the development of caregiver distraction across the first year of life within the larger population. The initial model estimation produced an improper solution such that the quadratic factor had a negative residual variance estimate, suggesting that there was minimal individual variability in the amount of curvature in the trajectory of caregiver distraction from 2 to 12 months. Therefore, the residual variance for the quadratic factor was constrained to 0.00 to obtain a proper estimated model. The correlations and covariances among the variables in this model are presented in Table 8. Unstandardized parameter estimates for this model are presented in Table 9. The quadratic model fit the data moderately well, with RMSEA = .05 (90% CI: .01, .08), CFI = .87, TFI = .81, and SRMR = .06.

The mean of the intercept factor was 7%, representing the predicted frequency of caregiver distraction during the 12-month immunization appointment. There was also significant variance around the mean intercept ($p = .01$), indicating that there are significant individual differences in the frequency of caregiver distraction use at the 12-month immunization appointment.

The mean of the linear slope factor was not significant ($b = -.004$, $p = .08$), but the mean of the quadratic factor was ($b = -.001$, $p < .001$), indicating a downturn or deceleration in the caregiver distraction trajectory. To aid interpretation of the non-linear mean trajectory, this model was also specified so that the intercept factor represented the mean distraction frequency at 2 months. Both the mean linear slope and quadratic factors of this model were significant ($b = .014$, $p < .001$; $b = -.001$, $p < .001$, respectively), indicating that caregiver distraction frequencies are increasing at 2 months and the rate of increase is slowing over time. The variance around the linear slope at 12 months was not significant ($p = .21$), indicating that there are no significant individual differences in the linear change in caregiver distraction frequencies at 12 months.

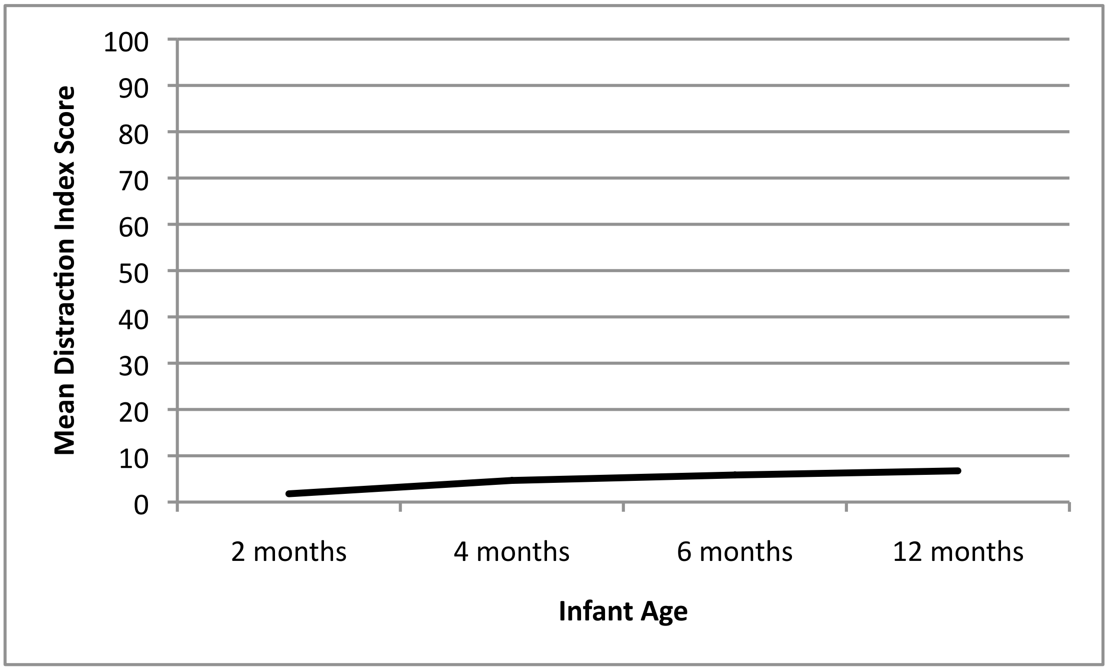

Figure 7. Mean caregiver distraction trajectory

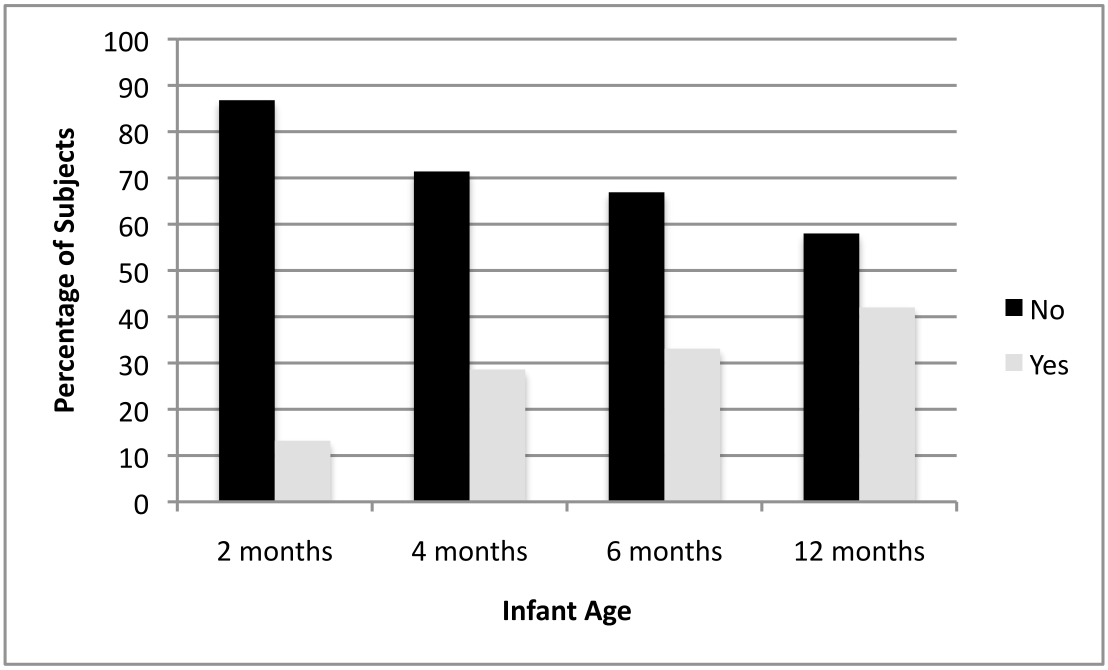

Figure 8. Caregiver distraction dichotomous frequencies

Table 8

Correlations and Covariances Among Variables for Caregiver Distraction

Variable	1	2	3	4
1. Distraction 2 months	.006	.230**	.314**	.060
2. Distraction 4 months	.002	.015	.328**	.108*
3. Distraction 6 months	.003	.005	.018	.278**
4. Distraction 12 months	.000	.001	.004	.014

Note. Correlations are depicted above the diagonal in the shaded region. Covariances are depicted below the diagonal.
** $p < .01$. * $p < .05$.

Table 9

Model Estimates for Caregiver Distraction

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
	M			
Distraction intercept factor	.07	.01	12.85	<.001
Distraction linear slope factor	-.004	.002	-1.77	.08
Distraction quadratic factor	-.001	0.00	-4.08	<.001
	Variance			
Distraction intercept factor	.01	.003	2.79	.01
Distraction linear slope factor	0.00	0.00	1.25	.21
Distraction quadratic factor	0.00	0.00		

Note. S.E. = estimated standard error.

Lastly, there was a significant relationship between the intercept factor and the linear slope factor, such that higher frequencies of caregiver distraction at the 12-month time point was associated with greater increases in distraction use by caregivers at 12 months, *residual* $r = .82$, $p < .001$. Because the quadratic factor variance was constrained to 0.00, the relationships between the quadratic factor and the intercept and linear slope factors could not be calculated.

Results for (1d): Caregiver verbal reassurance trajectory. A line graph of mean caregiver verbal reassurance frequencies indicated that verbal reassurance use was relatively low (< 20%) and remained fairly stable across the first year of life (see Figure 9).

A quadratic LGM was estimated to provide a plausible representation of the development of caregiver verbal reassurance across the first year of life within the larger population. The initial model estimation produced an improper solution such that the quadratic factor had a negative residual variance estimate, suggesting that there was minimal individual variability in the amount of curvature in the trajectory of caregiver verbal reassurance from 2 to 12 months. Therefore, the residual variance for the quadratic factor was constrained to 0.00 to obtain a proper estimated model. The correlations and covariances among the variables in this model are presented in Table 10. Unstandardized parameter estimates for this model are presented in Table 11. The quadratic model fit the data well, with RMSEA = .02 (90% CI: 0.00, .06), CFI = .99, TFI = .99, and SRMR = .03.

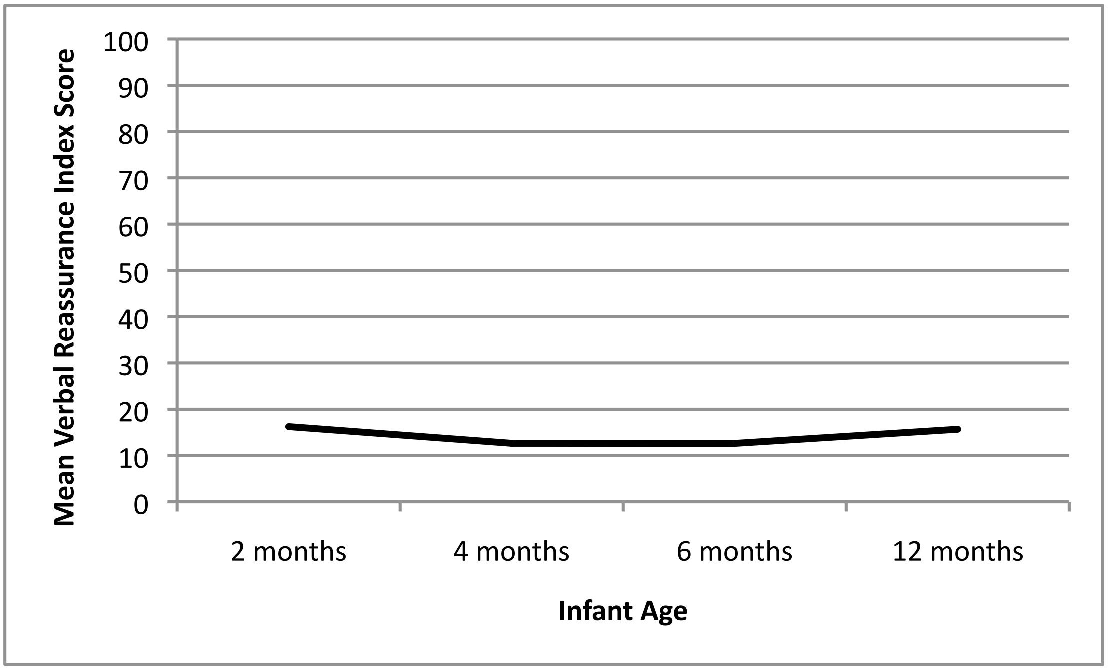

Figure 9. Mean caregiver verbal reassurance trajectory

Table 10

Correlations and Covariances Among Variables for Caregiver Verbal Reassurance

Variable	1	2	3	4
1. Verbal Reassurance 2 months	.032	.444**	.375**	.248**
2. Verbal Reassurance 4 months	.013	.025	.378**	.314**
3. Verbal Reassurance 6 months	.010	.009	.022	.281**
4. Verbal Reassurance 12 months	.007	.009	.007	.028

Note. Correlations are above the diagonal in the shaded region. Covariances are below the diagonal.
** $p < .01$. * $p < .05$.

Table 11

Model Estimates for Caregiver Verbal Reassurance

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
	M			
Verbal reassurance intercept factor	.16	.01	22.06	<.001
Verbal reassurance linear slope factor	.01	.003	5.42	<.001
Verbal reassurance quadratic factor	.001	0.00	5.42	<.001
	Variance			
Verbal reassurance intercept factor	.01	.004	2.25	.025
Verbal reassurance linear slope factor	0.00	0.00	1.06	.29
Verbal reassurance quadratic factor	0.00	0.00		

Note. S.E. = estimated standard error.

The mean of the intercept factor was 15.5%, representing the predicted frequency of caregiver verbal reassurance during the 12-month immunization appointment. There was also significant variance around the mean intercept (p = .025), indicating that there are significant individual differences in the frequency of caregiver verbal reassurance use at the 12-month immunization appointment.

The means of both the linear slope factor and the quadratic factor were significant (b = .01, p < .001; b = .001, p < .001), indicating that caregiver verbal reassurance frequencies are increasing at the end of the first year of life (12 months) and this rate of increase is accelerating. To aid interpretation of this non-linear trajectory, the model was also specified so that the intercept factor represented the mean verbal reassurance frequency at 2 months. Both the mean linear slope and quadratic factors of this model were significant (b = -.02 , p < .001 ; b = .001, p < .001 , respectively), indicating that caregiver verbal reassurance frequencies are decreasing at 2 months and this rate of decrease is slowing over time. The variance around the linear slope at 12 months was not significant (p = .29), indicating that there were not significant individual differences in the linear change in caregiver verbal reassurance frequencies at 12 months.

In addition, there was no significant relationship between the intercept factor and linear slope factor, *residual* r = .12, p = .84. Because the quadratic factor variance was constrained to 0.00, the relationships between the quadratic factor and the intercept and linear slope factors could not be calculated.

Results for (1e): Caregiver pacifying trajectory. A line graph of mean caregiver pacifying frequencies indicated that mean pacifying use was low (≤ 5%) and decreased across the first year of life by approximately 4 % (see Figure 10). A preponderance of caregivers did not engage in any (i.e., 0% frequency) pacifying and therefore frequencies were also examined as a dichotomous variable (0% vs. non-zero %) using a bar graph. These frequencies also indicated that pacifying use decreased from 2 to 12 months such that the percentage of caregivers engaging in *any* level of pacifying decreased from 20% to 8% (see Figure 11).

A linear LGM was estimated to provide a plausible representation of the development of caregiver pacifying over the first year of life within the larger population. The correlations and covariances among the variables in this model are presented in Table 12. Unstandardized parameter estimates for this model are presented in Table 13. The linear model fit the data moderately well, with RMSEA = .04 (90% CI: 0.01, .07), CFI = .79, TFI = .75, and SRMR = .06.

The mean of the intercept factor was 1.2%, representing the predicted caregiver pacifying frequency during the 12-month immunization appointment. There was no significant variance around the mean intercept, indicating that there are no significant individual differences in the frequency of caregiver pacifying at the 12-month immunization appointment.

The mean of the linear slope factor was significant ($b = -.003$, $p < .001$), indicating that caregiver pacifying frequencies decrease across the first year of life. The variance around the mean linear slope was significant ($p = .035$), indicating that there are significant individual differences in the change in caregiver pacifying frequencies across the first year of life. In addition, there was no significant relationship between the intercept factor and linear slope factor, *residual* $r = .27$, $p = .49$.

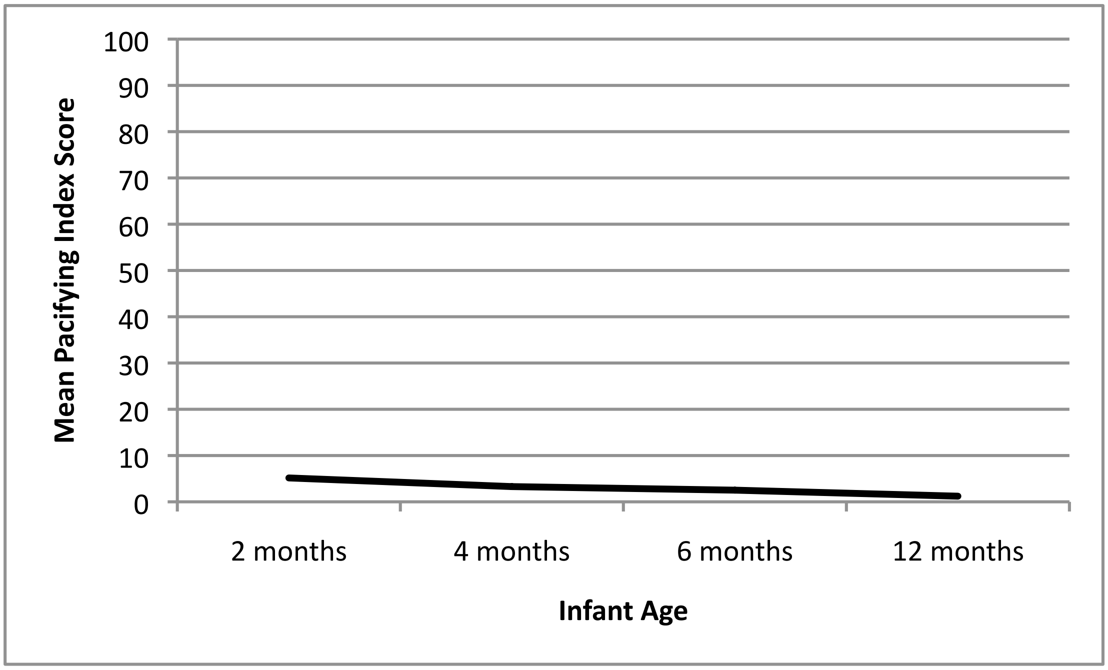

Figure 10. Mean caregiver pacifying trajectory

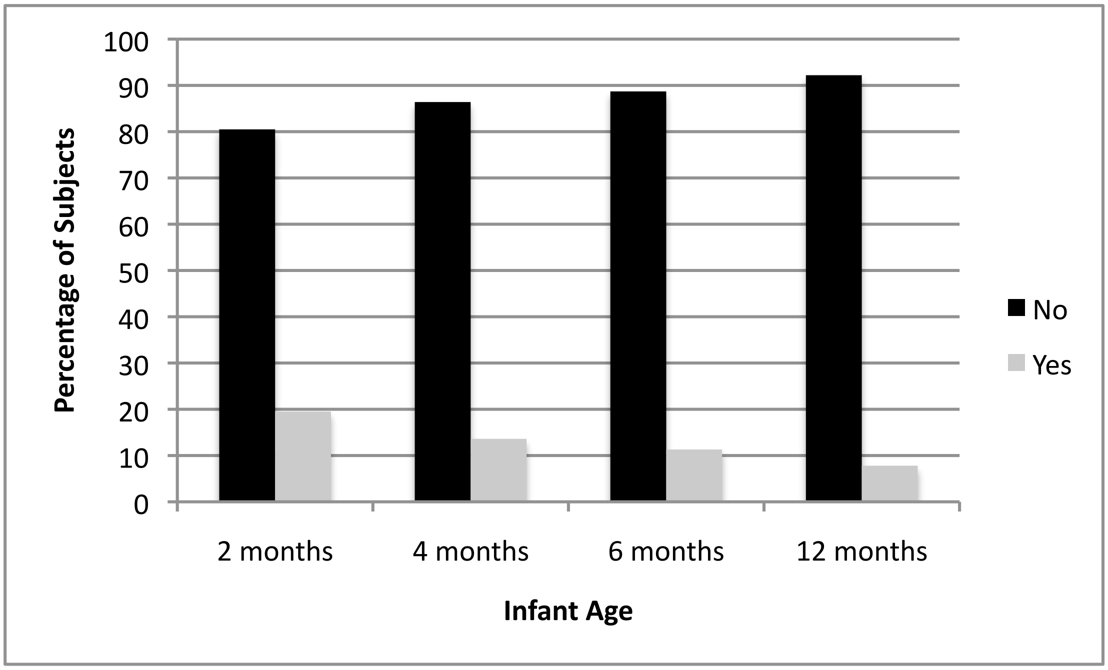

Figure 11. Caregiver pacifying dichotomous frequencies

Table 12

Correlations and Covariances Among Variables for Caregiver Pacifying

Variable	1	2	3	4
1. Pacifying 2 months	.020	.321**	.147**	.136*
2. Pacifying 4 months	.004	.009	.236**	.041
3. Pacifying 6 months	.002	.002	.006	.197**
4. Pacifying 12 months	.001	.00	.001	.001

Note. Correlations are above the diagonal in the shaded region. Covariances are below the diagonal.
** $p < .01$. * $p < .05$.

Table 13

Model Estimates for Caregiver Pacifying

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
	M			
Pacifying intercept factor	.012	.002	7.19	<.001
Pacifying linear slope factor	-.003	0.00	-6.71	<.001
	Variance			
Pacifying intercept factor	.001	.001	.99	.33
Pacifying linear slope factor	0.00	0.00	2.12	.035

Note. S.E. = estimated standard error.

Research Aim 2: Relating Caregiver Behaviour Trajectories *Across* the First Year of Life to Subsequent Infant Attachment During the Second Year of Life.

Analysis overview. Initial descriptive statistics were calculated for those with attachment data (N = 130) overall and by attachment classification. Next, the five unconditional LGMs from Research Aim 1 were expanded to include attachment classification variables. Due to the complexity of these models and the relatively small sample size, with unequal *n*s in each attachment group, models using the A/B/C/D attachment classification could not be estimated properly. Therefore, only Secure/Insecure (S/I) and Organized/Disorganized (O/D) attachment comparisons were examined for the following analyses. Similarly, models with attachment as the dependant variable and caregiver trajectory factors as predictor variables also could not be estimated. Therefore, the models estimated provide descriptive information about the group differences between caregiver behaviours across age and attachment, but are not directly predictive of attachment status. The same sequence of analyses was repeated ten times, once for each of the five caregiver behaviours crossed with the two attachment classification groupings (S/I and O/D). As in Research Aim 1, the models were specified so that the intercept factor represented the mean caregiver behaviour score at 12 months and the slope factor represented the change in the caregiver behaviour from 2 to 12 months.

Preliminary results. Descriptive statistics of variables central to the second research aim and its specific research questions are presented in Table 14. Table 15 presents descriptive statistics for caregiver behaviours for each attachment classification.

Table 14

Descriptive Statistics of Caregiver Behaviours for Subjects with Attachment Data

Caregiver Variables	*N*	Possible Range	Min.	Max.	*M*	*SD*
Caregiver EA 2 months	96	16-116	64	112	94.08	9.19
Caregiver EA 4 months	110	16-116	66	114	95.71	9.54
Caregiver EA 6 months	116	16-116	76	112	97.10	9.04
Caregiver EA 12 months	129	16-116	67	113	93.81	9.54
Proximal soothing 2 months	96	0-100	0	97	37.53	24.21
Proximal soothing 4 months	110	0-100	0	98	35.10	22.68
Proximal soothing 6 months	116	0-100	0	88	25.83	20.80
Proximal soothing 12 months	122	0-100	0	98	26.53	20.42
Distraction 2 months	96	0-100	0	43	2.32	7.49
Distraction 4 months	110	0-100	0	38	2.78	6.93
Distraction 6 months	116	0-100	0	50	4.75	8.87
Distraction 12 months	122	0-100	0	50	5.40	10.50
Verbal reassurance 2 months	96	0-100	0	58	14.41	13.24
Verbal reassurance 4 months	108	0-100	0	63	10.95	13.87
Verbal reassurance 6 months	115	0-100	0	50	10.48	11.58
Verbal reassurance 12 months	121	0-100	0	67	15.07	15.84
Pacifying 2 months	96	0-100	0	96	3.56	12.63
Pacifying 4 months	110	0-100	0	55	3.55	9.70

Pacifying 6 months	116	0-100	0	45	2.61	7.38
Pacifying 12 months	122	0-100	0	30	1.73	4.34

Categorical Variables	Percentage of Sample (%)
Sex	
Male	56.15
Female	44.62
#Needles 2 months	
1	0.00
2	96.88
3 or more	3.12
#Needles 4 months	
1	1.82
2	93.64
3 or more	4.54
#Needles 6 months	
1	13.91
2	80
3 or more	6.09
#Needles 12 months	
1	11.63
2	82.95
3 or more	5.43

Note. EA = Emotional Availability.

Table 15

Descriptive Statistics for Caregiver Behaviours by Attachment Classification

	Attachment Variables											
	S (Secure)			I (Insecure)			O (Organized)			D (Disorganized)		
Caregiver Variables	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*
EA 2 months	49	93.5	10.2	47	94.8	8.1	78	94.3	9.1	18	93.1	9.7
EA 4 months	57	96.4	9.4	53	95.0	9.8	91	95.9	9.1	19	94.8	11.5
EA 6 months	59	97.2	8.8	57	97.0	9.4	95	97.8	8.8	21	93.9	9.7
EA 12 months	67	94.3	10.0	62	93.4	9.0	106	93.9	9.5	23	93.6	9.9
Proximal 2 months	49	37.4	25.5	47	37.6	23.1	78	36.1	23.6	18	43.8	26.3
Proximal 4 months	57	35.6	24.8	53	34.6	20.4	91	34.7	23.6	19	37.0	17.9
Proximal 6 months	59	27.6	23.0	57	24.0	18.3	95	26.7	21.1	21	21.9	19.5
Proximal 12 months	64	28.5	22.7	58	24.4	17.5	100	28.1	21.2	22	19.5	14.5
Dist. 2 months	49	1.4	3.3	47	3.7	10.0	78	1.3	5.5	18	6.7	12.3
Dist. 4 months	57	3.0	6.0	53	2.6	7.9	91	2.4	5.6	19	4.6	11.3
Dist. 6 months	59	4.0	8.6	57	5.5	9.1	95	4.4	8.7	21	6.1	9.5
Dist. 12 months	64	5.2	10.6	58	12.6	10.5	100	4.5	9.4	22	9.6	14.2
VR 2 months	49	16.2	14.3	47	12.6	11.8	78	15.8	13.8	18	8.4	8.1
VR 4 months	56	12.0	15.2	52	9.9	12.4	89	11.7	14.7	19	7.7	8.9
VR 6 months	58	9.0	9.6	57	12.0	13.2	94	9.6	10.5	21	14.6	15.1
VR 12 months	63	15.1	16.8	58	15.1	14.9	99	14.7	15.9	22	16.6	15.7
Pacifying 2 months	49	1.8	5.4	47	5.5	17.1	78	3.6	13.7	18	3.4	6.8
Pacifying 4 months	57	1.9	6.0	53	5.3	12.3	91	2.4	7.6	19	9.0	15.5
Pacifying 6 months	59	1.7	7.4	57	3.6	7.3	95	2.2	7.2	21	4.5	8.1
Pacifying 12 months	64	1.2	3.5	58	2.3	5.1	100	1.7	4.6	22	1.8	3.1

Note. EA = Caregiver Emotional Availability; Proximal = Proximal Soothing; Dist. = Distraction; VR = Verbal Reassurance.

Correlations and covariances for each variable in each of the 10 models are also presented below.

Results for (2a): Did caregiver emotional availability trajectories relate to infant attachment? The unconditional quadratic LGM (from Research Aim 1) was expanded to include infant attachment variables S/I and O/D (Models 1 and 2 respectively). As in Research Aim 1, the initial model estimations with S/I and O/D added produced improper solutions such that the quadratic factors had negative residual variance estimates. Therefore, the residual variance for the quadratic factor was again constrained to 0.00 to obtain proper estimated models. See Table 16 for correlations and covariances among the variables for Models 1 and 2, as well as Table 17 for unstandardized parameter estimates for these models.

The quadratic models with attachment variables S/I and O/D added fit the data moderately well, Model 1: RMSEA = .05 (90% CI: .00 - .14), CFI = .99, TLI = .97, and SRMR = .15; Model 2: RMSEA = 0.00 (90% CI: .00 - .11), CFI = 1.00, TLI = 1.01, and SRMR = .16.

The intercept factors, linear slope factors, and quadratic factors were not significantly related to infant attachment (see Table 17 for parameter estimates and *p* values).

Table 16

Correlations and Covariances Among Variables for Models 1 and 2

Variable	1	2	3	4	5	6
1. Caregiver EA 2 months	105.02	.520**	.545**	.397**	.070	-.049
2. Caregiver EA 4 months	52.04	94.72	.518**	.406**	-.071	-.045
3. Caregiver EA 6 months	61.88	51.00	105.26	.523**	-.009	-.166
4. Caregiver EA 12 months	42.92	38.97	61.68	121.55	-.047	-.010
5. S/I	.325	-.340	-.043	-.226	.251	.486**
6. O/D	-.178	-.162	0.580	-.037	.093	.147

Note. Correlations are depicted above the diagonal in the shaded region. Covariances are depicted below the diagonal. EA = Emotional Availability; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.
** $p < .01$. * $p < .05$.

Table 17

Estimates for Caregiver EA Models (Models 1 and 2)

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
	S/I			
Caregiver EA intercept factor	-.77	1.66	-.46	.64
Caregiver EA linear slope factor	.19	.64	.30	.77
Caregiver EA quadratic factor	.04	.06	.55	.58
	Residual variance (S/I model)			
Caregiver EA intercept factor	28.43	20.18	1.41	.16
Caregiver EA linear slope factor	.08	.28	.28	.78
Caregiver EA quadratic factor	0.00	0.00		
	O/D			
Caregiver EA intercept factor	-.33	2.17	-.15	.88
Caregiver EA linear slope factor	.90	.81	1.11	.27
Caregiver EA quadratic factor	.08	.09	.93	.35
	Residual variance (O/D model)			
Caregiver EA intercept factor	28.34	19.97	1.42	.16
Caregiver EA linear slope factor	.07	.28	.24	.81
Caregiver EA quadratic factor	0.00	0.00		

Note. S.E. = estimated standard error.; EA = Emotional availability; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.

Results for (2b): Did caregiver proximal soothing trajectories relate to infant attachment? The unconditional freed-loading proximal soothing LGM (from Research Aim 1) was expanded to include infant attachment variables S/I and O/D (Model 3 and 4 respectively). See Table 18 for correlations and covariances among the variables in Models 3 and 4, as well as Table 19 for unstandardized parameter estimates for these models. Models 3 and 4 both fit the data well, with RMSEA = 0.00 (90% CI: .00 - .09), CFI = 1.00, TLI = 1.12, and SRMR = .04 for both models.

For Model 3, there were no significant relationships between the intercept and non-linear slope factors and infant S/I attachment, $b = -.038$, $p = .21$; $b = -.036$, $p = .43$ respectively. In Model 4, there was a significant relationship between proximal soothing at 12 months (i.e., intercept factor) as well as the change in proximal soothing across the first year of life (i.e., non-linear slope factor) and infant O/D attachment, such that higher frequencies of caregiver proximal soothing were associated with organized infant attachment ($b = -.072$, $p = .029$) and a decrease in proximal soothing was associated with disorganized infant attachment ($b = -.137$, $p = .025$). Examination of mean caregiver proximal soothing frequencies across the first year of life by O/D attachment classifications show a steeper negative slope for caregivers of disorganized infants (see Figure 12).

Table 18

Correlations and Covariances Among Variables for Models 3 and 4

Variable	1	2	3	4	5	6
1. Proximal soothing 2 months	.055	.323**	.268**	.144**	.004	.126
2. Proximal soothing 4 months	.017	.050	.277**	.343**	-.022	.038
3. Proximal soothing 6 months	.013	.012	.040	.253**	-.086	-.089
4. Proximal soothing12 months	.006	.015	.010	.040	-.102	-.162
5. S/I	.001	-.003	-.009	-.010	.251	.486**
6. O/D	.012	.003	-.007	-.013	.093	.147

Note. Correlations are depicted above the diagonal in the shaded region. Covariances are depicted below the diagonal. S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.
** $p < .01$. * $p < .05$.

Table 19

Estimates for Caregiver Proximal Soothing Models (Model 3 and 4)

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
S/I				
Proximal soothing intercept factor	-.04	.03	-1.25	.21
Proximal soothing non-linear slope factor	-.04	.05	-.80	.43
Residual variance (S/I model)				
Proximal intercept factor	.014	.003	4.089	<.001
Proximal soothing non-linear slope factor	.013	.012	1.084	.278
O/D				
Proximal soothing intercept factor	-.07	.03	-2.18	.029
Proximal soothing non-linear slope factor	-.14	.06	-2.24	.025
Residual variance (O/D model)				
Proximal intercept factor	.014	.004	3.842	<.001
Proximal soothing non-linear slope factor	.011	.011	.928	.353

Note. S.E. = estimated standard error; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.

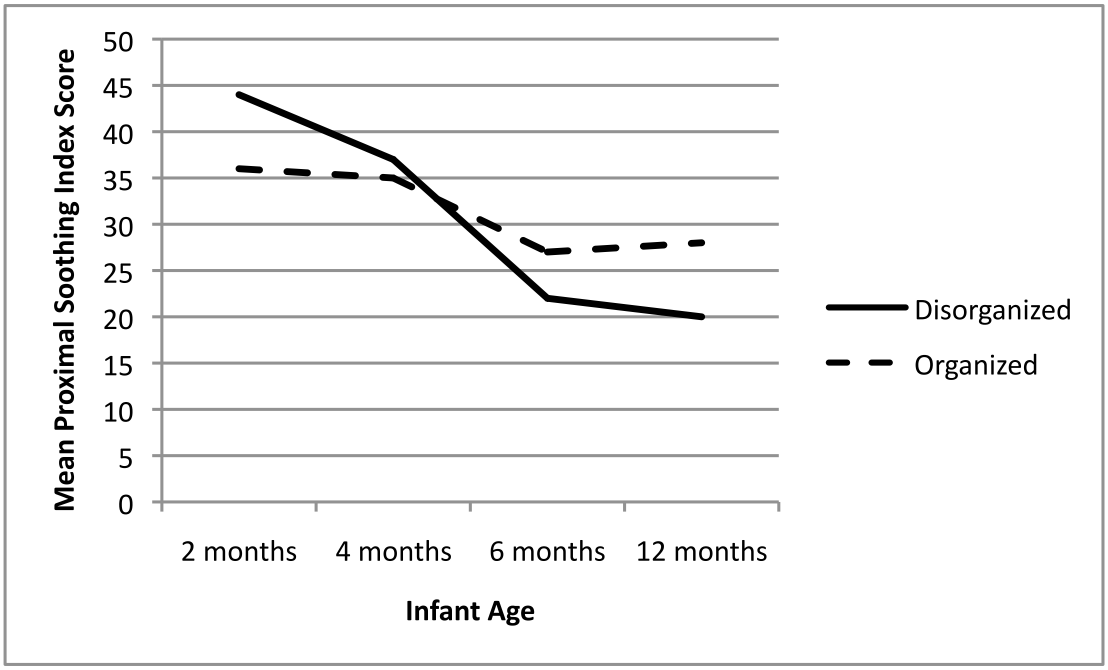

Figure 12. Mean proximal soothing trajectories for organized/disorganized infant attachment classifications

Results for (2c): Did caregiver distraction trajectories relate to infant attachment? The unconditional quadratic distraction LGM (from Research Aim 1) was expanded to include infant attachment variables S/I and O/D (Model 5 and 6 respectively). The initial model estimations with infant attachment variables S/I and O/D added produced improper solutions such that for Model 5 both the quadratic factor and linear slope factor had negative residual variance estimates and for Model 6 only the quadratic factor had a negative residual variance estimate. This result suggests that there was minimal individual variability in the change in caregiver distraction from 2 to 12 months. Therefore, for Model 5 the residual variances for the quadratic and linear slope factors, and for Model 6 the residual variances for the quadratic factor only, were constrained to 0.00 to obtain proper estimated models. See Table 20 for correlations and covariances among the variables for Models 5 and 6, as well as Table 21 for unstandardized parameter estimates for these models.

Models 5 and 6 fit the data well, Model 5: RMSEA = .00 (90% CI: .00 - .09), CFI = 1.00, TLI = 2.44, and SRMR = .06; Model 6: RMSEA = .00 (90% CI: .00 - .08), CFI = 1.00, TLI = 2.03, and SRMR = .04.

For both Models 5 and 6, the intercept factors, linear slope factors, and quadratic factors were not significantly related to infant attachment (see table 21 for parameter estimates and *p* values).

Table 20

Correlations and Covariances Among Variables for Model 5 and 6

Variable	1	2	3	4	5	6
1. Distraction 2 months	.006	.230**	.314**	.060	.176	.284**
2. Distraction 4 months	.002	.015	.328**	.108*	-.025	.123
3. Distraction 6 months	.003	.005	.018	.278**	.086	.074
4. Distraction 12 months	.000	.001	.004	.014	.017	.186*
5. S/I	.007	-.001	.004	.001	.251	.486**
6. O/D	.008	.003	.003	.008	.093	.147

Note. Correlations are depicted above the diagonal in the shaded region. Covariances are depicted below the diagonal. S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.
** $p < .01$. * $p < .05$.

Table 21

Estimates for Caregiver Distraction Models (Models 5 and 6)

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
	S/I			
Distraction intercept factor	.01	.02	.26	.80
Distraction linear slope factor	.003	.008	.41	.67
Distraction quadratic factor	0.00	.001	.60	.55
	Residual variance (S/I model)			
Distraction intercept factor	.001	0.00	1.96	.051
Distraction linear slope factor	0.00	0.00		
Distraction quadratic factor	0.00	0.00		
	O/D			
Distraction intercept factor	.05	.03	1.64	.10
Distraction linear slope factor	.02	.01	1.21	.23
Distraction quadratic factor	.002	.001	1.17	.24
	Residual variance (O/D model)			
Distraction intercept factor	.002	.003	.82	.42
Distraction linear slope factor	0.00	0.00	.38	.71
Distraction quadratic factor	0.00	0.00		

Note. S.E. = estimated standard error; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.

Results for (2d): Did caregiver <u>verbal reassurance</u> trajectories relate to infant attachment? The unconditional quadratic verbal reassurance model (from Research Aim 1) was expanded to include infant attachment variables S/I and O/D (Model 7 and 8 respectively). The initial model estimations with infant attachment variables S/I and O/D added produced improper solutions such that both the quadratic factors and linear slope factors had negative residual variance estimates, suggesting that there was minimal individual variability in the change in caregiver verbal reassurance from 2 to 12 months. Therefore, the residual variances for the quadratic and linear slope factors were constrained to 0.00 to obtain proper estimated models. See Table 22 for correlations and covariances among the variables for Models 7 and 8, as well as Table 23 for unstandardized parameter estimates for these models.

Models 7 and 8 did not fit the data well, <u>Model 7</u>: RMSEA = .10 (90% CI: .04 - .17), CFI = .83, TLI = .75, and SRMR = .09; <u>Model 8</u>: RMSEA = .09 (90% CI: .02 - .16), CFI = .87, TLI = .81, and SRMR = .09, despite that, the unconditional verbal reassurance model did fit the data well, RMSEA = .02 (90% CI: 0.00, .06) , CFI = .99, TFI = .99, and a SRMR = .03.

The Model 7 intercept, linear slope, and quadratic factors were not significantly related to infant attachment (see Table 23 for parameter estimates and p values). In Model 8, the intercept and linear slope factors were not significantly related to infant attachment (b = .02, p = .56; b = -.023, p = .12, respectively), but the quadratic factor was significantly related to infant attachment (b = -.003, p = .02) such that organized infant attachment was associated with a U-shaped trajectory of verbal reassurance use over the course of the first year of life (i.e., starting around 16% then decreasing to around 10% at

6 months, then increasing to approximately 15% at the end of the first year). In contrast, disorganized infant attachment was characterized by low levels (around 8%) of caregiver verbal reassurance at the beginning of the first year that increased over time, followed by a deceleration (i.e., the increase slowed) by the end of the first year (ending at around 17%; see Figure 13).

Results for (2e): Did caregiver pacifying trajectories relate to infant attachment? The unconditional linear pacifying LGM (from Research Aim 1) was expanded to include infant attachment variables S/I and O/D (Models 9 and 10 respectively). See Table 24 for correlations and covariances among the variables in Models 9 and 10, as well as Table 25 for unstandardized parameter estimates for these models.

Models 9 and 10 fit the data well and moderately well, respectively, Model 9: RMSEA = 0.00 (90% CI: 0.00 - .10), CFI = 1.00, TLI = 1.06, and SRMR = .07; Model 10: RMSEA = 0.06 (90% CI: 0.00 - .14), CFI = .83, TLI = .76, and SRMR = .08.

For both models, the intercept and linear slope factors were not significantly related to infant attachment (see Tables 25 for parameter estimates and *p* values).

Table 22

Correlations and Covariances Among Variables for Model 7 and 8

Variable	1	2	3	4	5	6
1. Verbal reassurance 2 months	.032	.444**	.375**	.248**	-.138	-.217*
2. Verbal reassurance 4 months	.013	.025	.378**	.314**	-.075	-.109
3. Verbal reassurance 6 months	.010	.009	.022	.281**	.134	.170
4. Verbal reassurance 12 months	.007	.009	.007	.028	-.001	.047
5. S/I	-.009	-.005	.008	.000	.251	.486**
6. O/D	-.011	-.006	.008	.003	.093	.147

Note. Correlations are depicted above the diagonal in the shaded region. Covariances are depicted below the diagonal. S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.
** $p < .01$. * $p < .05$.

Table 23

Estimates for Caregiver Verbal Reassurance Models (Models 7 and 8)

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
	S/I			
Verbal reassurance intercept factor	.001	.03	.03	.97
Verbal reassurance linear slope factor	-.01	.01	-1.16	.25
Verbal reassurance quadratic factor	-.002	.001	-1.55	.12
	Residual variance (S/I model)			
Verbal reassurance intercept factor	.007	0.02	3.57	.051
Verbal reassurance linear slope factor	0.00	0.00		
Verbal reassurance quadratic factor	0.00	0.00		
	O/D			
Verbal reassurance intercept factor	.02	.04	.59	.56
Verbal reassurance linear slope factor	-.02	.02	-1.57	.12
Verbal reassurance quadratic factor	-.003	.001	-2.32	.02
	Residual variance (O/D model)			
Verbal reassurance intercept factor	.007	.002	3.61	.42
Verbal reassurance linear slope factor	0.00	0.00		
Verbal reassurance quadratic factor	0.00	0.00		

Note. S.E. = estimated standard error; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.

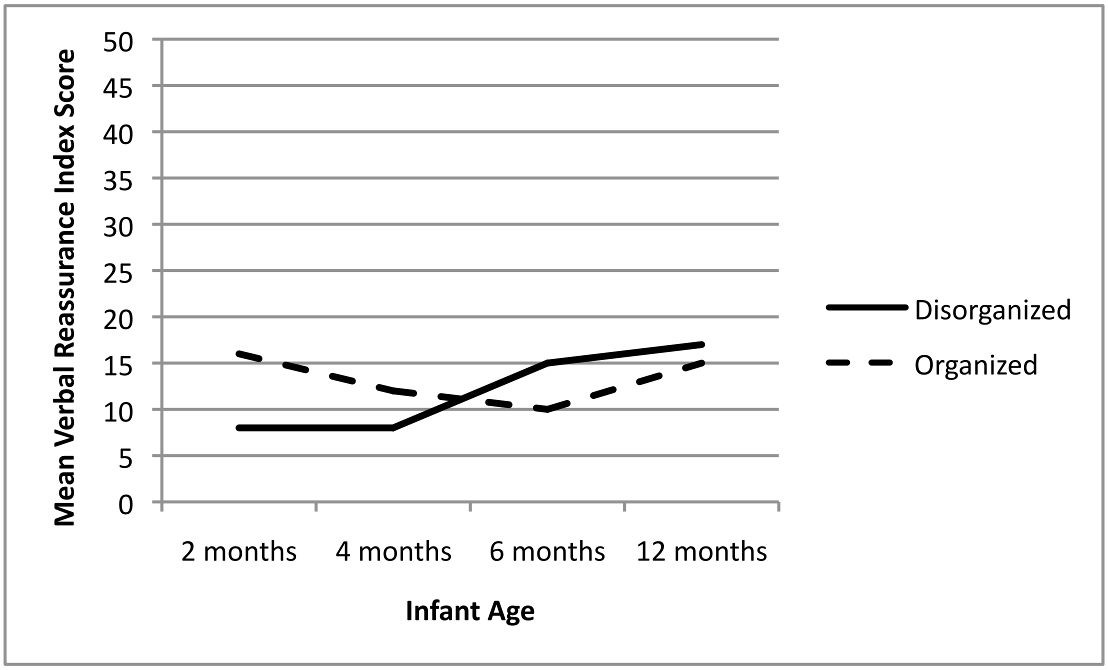

Figure 13. Mean verbal reassurance trajectories for organized/disorganized infant attachment classifications

Table 24

Correlations and Covariances Among Variables for Models 9 and 10

Variable	1	2	3	4	5	6
1. Pacifying 2 months	.020	.321**	.147**	.136*	.147	-.005
2. Pacifying 4 months	.004	.009	.236**	.041	.178	.255**
3. Pacifying 6 months	.002	.002	.006	.197**	.127	.122
4. Pacifying 12 months	.001	.000	.001	.001	.128	.010
5. S/I	.009	.009	.005	.003	.251	.486**
6. O/D	.000	.009	.003	.000	.093	.147

Note. Correlations are depicted above the diagonal in the shaded region. Covariances are depicted below the diagonal. S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.
** $p < .01$. * $p < .05$.

Table 25

Estimates for Caregiver Pacifying Models (Models 9 and 10)

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
	S/I			
Pacifying intercept factor	.01	.01	1.36	.17
Pacifying linear slope factor	-.002	.002	-1.22	.22
	Residual variance (S/I model)			
Pacifying intercept factor	.001	.01	.68	.50
Pacifying linear slope factor	0.00	0.00	1.3	.17
	O/D			
Pacifying intercept factor	.002	.01	.23	.82
Pacifying linear slope factor	-.004	.002	-1.90	.06
	Residual variance (O/D model)			
Pacifying intercept factor	.001	.001	.71	.48
Pacifying linear slope factor	0.00	0.00	1.41	.16

Note. S.E. = estimated standard error; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.

Research Aim 3: Relating Caregiver Behaviour Trajectories *Within* Each Immunization Appointment, at a Given Infant Age, to Subsequent Infant Attachment During the Second Year of Life

Analysis overview. Initial descriptive statistics were calculated for both the overall attachment sample ($N = 130$) and by attachment classification. Next, 16 unconditional LGMs were estimated, one for each of the four caregiver behaviours crossed with four immunization appointments (2, 4, 6, 12 months), to determine means of intercept and slope factors as well as the variance around these means. These unconditional models are only described briefly because describing within appointment trajectories in detail across the first year of life has already been examined using the OUCH Cohort data in previous studies (Lisi et al., 2013; Pillai Riddell et al., 2013). Instead, the focus is on the subsequent 32 conditional LGMs that were specified, one for each of the four caregiver behaviours crossed with four immunization appointments and two attachment classification groupings (S/I and O/D). Caregiver emotional availability was not included in these models because the EAS is scored based on the entire dyadic interaction and is not broken down into epochs within an appointment.

The models were specified so that the intercept factor represented the mean caregiver variable score at 3 minutes after-needle and the slope factor represented the change in the caregiver variable from 1 to 2 to 3 minutes after-needle. These intercept and slope factors were then used to predict infant attachment via logistic regressions within the LGMs. Figure 14 provides a general illustration of the models estimated for Research Aim 3. Due to the complexity of these models and the relatively small sample size, with unequal *n*s in each attachment group, models using the A/B/C/D attachment classification could not converge to a proper solution. Therefore, only S/I and O/D attachment comparisons were examined for the following analyses. Similarly, models were first attempted with attachment classification as the dependant variable (as shown in Figure 14), but if a model did not converge properly then a descriptive model was estimated with the LGM factors linearly regressed on attachment (as in Research Aim 2). LGMs were again estimated using Mplus version 6.1 (Muthén & Muthén, 2010). Full-information maximum likelihood estimation with the Yuan–Bentler model χ^2 statistic (Yuan & Bentler, 2000) and robust standard errors were used to account for potential non-normality in the presence of missing data.

Preliminary results. Descriptive statistics of variables central to the third research aim are presented in Tables 26 and 27. The correlations and covariances for the variables in each of the 32 models are also presented below.

Results (3a): Did caregiver proximal soothing within-appointment trajectories relate to infant attachment? First, four within-appointment unconditional proximal soothing models (one for each of the immunization appointments) were estimated. These models all fit the data well, all RMSEA = 0.00, all CFI = 1.00, all TLI ≥ 1.00, and all SRMR ≤ .01. For caregiver proximal soothing at the 2-month time point, linear LGMs were estimated. Initially, these model estimations produced improper solutions such that proximal soothing at 3 minutes after the needle (the intercept factor) had a negative residual variance estimate, suggesting that there was minimal individual variability in proximal soothing at 3 minutes after the needle at the 2-month immunization appointment. Therefore, this parameter was constrained to 0.00 to obtain proper estimated models. For caregiver proximal soothing at the 4-, 6- and 12-month time points, freed-loading models were estimated (the slope factor loading for caregiver proximal soothing at 2 minutes after the needle was freely estimated while the 1-minute loading was fixed equal to -1.0 and the 3-minute loading was fixed to 0.0). The initial 12-month model estimations produced improper solutions such that proximal soothing at 1 minute after the needle had a negative residual variance estimate, suggesting that there was minimal individual variability in proximal soothing at 1 minute after the needle at the 12-month immunization appointment. Therefore, this parameter was constrained to 0.00 to obtain proper estimated models.

In the unconditional models, the means of intercept factors at 2 months (21%), 4 months (16%), 6 months (12%), and 12 months (12%) represented the predicted caregiver proximal soothing frequencies at 3 minutes after the needle. The variances around each of the mean intercepts were significant ($p < .001$), indicating that there were significant individual differences in the frequency of caregiver proximal soothing within each immunization appointment at 3 minutes after the needle. The means of the slope factors were all significant ($p < .001$), indicating that caregiver proximal soothing frequencies at each immunization appointment decreased by 10% (at 2 months), 29% (at 4 months), and 22% (at 6 and 12 months) from 1 to 3 minutes after the needle(s). The variances around the mean slopes were also significant ($p < .001$), indicating that there were significant individual differences in the amount of change in caregiver proximal soothing frequencies within each immunization appointment, after the needle.

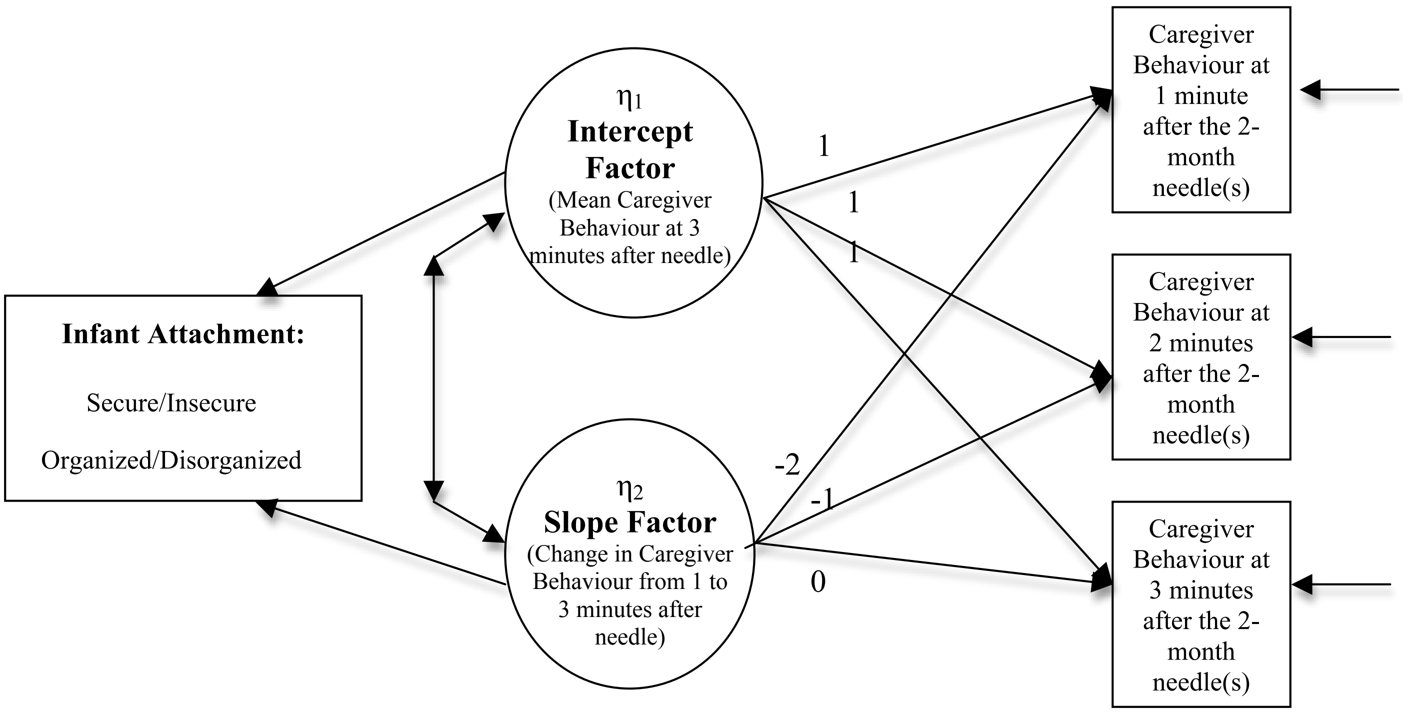

Figure 14. General path diagram for predicting infant attachment from caregiver variables within the 2-month immunization appointment. Models within each additional time point (i.e., 4, 6, and 12 months) were also estimated.

Table 26

Descriptive Statistics of Caregiver Behaviours at Each Age at 1, 2, and 3 Minutes After the Needle for Subjects with Attachment Data

Caregiver Variables	*N*	Possible Range	Min.	Max.	*M*	*SD*
Proximal soothing 2 months 1min	96	0-100	0	100	41.32	25.82
Proximal soothing 2 months 2min	96	0-100	0	100	34.13	30.93
Proximal soothing 2 months 3min	92	0-100	0	100	23.73	26.38
Proximal soothing 4 months 1min	110	0-100	0	100	45.94	26.13
Proximal soothing 4 months 2min	110	0-100	0	100	24.31	25.84
Proximal soothing 4 months 3min	110	0-100	0	92	17.67	24.31
Proximal soothing 6 months 1min	116	0-100	0	100	34.66	24.99
Proximal soothing 6 months 2min	115	0-100	0	79	17.50	21.59
Proximal soothing 6 months 3min	112	0-100	0	71	10.16	17.47
Proximal soothing 12 months 1min	121	0-100	0	100	34.00	22.15
Proximal soothing 12 months 2min	120	0-100	0	96	20.03	23.32
Proximal soothing 12 months 3min	118	0-100	0	96	14.49	21.89
Distraction 2 months 1min	96	0-100	0	91	2.25	10.44
Distraction 2 months 2min	95	0-100	0	75	2.24	10.22
Distraction 2 months 3min	92	0-100	0	17	.53	2.39
Distraction 4 months 1min	110	0-100	0	67	2.11	8.41
Distraction 4 months 2min	110	0-100	0	42	3.41	8.11
Distraction 4 months 3min	110	0-100	0	25	1.66	5.52
Distraction 6 months 1min	116	0-100	0	67	4.35	10.41
Distraction 6 months 2min	115	0-100	0	83	5.36	13.42
Distraction 6 months 3min	112	0-100	0	75	4.46	12.42
Distraction 12 months 1min	122	0-100	0	100	6.12	15.69
Distraction 12 months 2min	120	0-100	0	67	5.16	11.18
Distraction 12 months 3min	119	0-100	0	100	5.21	12.95
Verbal reassurance 2 months 1min	96	0-100	0	67	16.28	16.88
Verbal reassurance 2 months 2min	95	0-100	0	58	12.60	13.79
Verbal reassurance 2 months 3min	92	0-100	0	100	11.77	19.50
Verbal reassurance 4 months 1min	108	0-100	0	80	12.37	16.08
Verbal reassurance 4 months 2min	108	0-100	0	67	9.74	15.61
Verbal reassurance 4 months 3min	108	0-100	0	75	7.81	13.81
Verbal reassurance 6 months 1min	115	0-100	0	70	14.02	15.87
Verbal reassurance 6 months 2min	114	0-100	0	50	6.95	11.04
Verbal reassurance 6 months 3min	111	0-100	0	58	6.90	10.89
Verbal reassurance 12 months 1min	121	0-100	0	100	18.28	20.29
Verbal reassurance 12 months 2min	119	0-100	0	83	12.32	17.46
Verbal reassurance 12 months 3min	118	0-100	0	100	10.09	17.35
Pacifying 2 months 1min	96	0-100	0	92	4.46	14.44
Pacifying 2 months 2min	95	0-100	0	100	2.54	11.92
Pacifying 2 months 3min	92	0-100	0	100	4.41	15.08
Pacifying 4 months 1min	110	0-100	0	60	3.95	10.85
Pacifying 4 months 2min	110	0-100	0	73	3.33	12.63
Pacifying 4 months 3min	110	0-100	0	25	1.45	4.68
Pacifying 6 months 1min	116	0-100	0	70	4.01	12.16
Pacifying 6 months 2min	115	0-100	0	27	1.38	4.89

Pacifying 6 months 3min	112	0-100	0	17	.69	2.85
Pacifying 12 months 1min	121	0-100	0	55	2.85	7.37
Pacifying 12 months 2min	120	0-100	0	17	.54	2.32
Pacifying 12 months 3min	118	0-100	0	17	.35	2.00

Table 27

Descriptive Statistics for Caregiver Behaviours at Each Age at 1, 2, 3 Minutes After the Needle by Attachment Classification

	Attachment Variables											
	S (Secure)			I (Insecure)			O (Organized)			D (Disorganized)		
Caregiver Variables	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*	*N*	*M*	*SD*
Proximal 2 months 1min	49	40.0	27.3	47	42.7	24.4	78	40.4	25.6	18	45.3	27.2
Proximal 2 months 2min	49	34.9	32.1	47	33.4	30.0	78	31.7	29.9	18	44.5	34.1
Proximal 2 months 3min	48	25.7	28.4	44	21.6	24.1	76	24.2	26.9	16	21.6	24.3
Proximal 4 months 1min	57	47.4	27.9	53	44.3	24.2	91	46.0	26.2	19	45.7	26.3
Proximal 4 months 2min	57	24.4	27.2	53	24.2	24.5	91	23.6	26.2	19	27.5	24.4
Proximal 4 months 3min	57	16.2	23.7	53	19.3	25.1	91	16.2	23.2	19	24.7	28.8
Proximal 6 months 1min	59	35.5	26.9	57	33.8	23.0	95	36.0	25.4	21	28.8	22.6
Proximal 6 months 2min	58	19.9	23.3	57	15.1	19.6	94	18.0	21.8	21	15.3	21.1
Proximal 6 months 3min	55	11.3	18.5	57	9.1	16.5	91	12.0	18.7	21	6.7	10.5
Proximal 12 months 1min	63	36.0	23.3	58	31.9	20.7	99	34.8	22.4	22	30.2	20.9
Proximal 12 months 2min	63	21.9	26.5	57	18.0	19.2	98	22.1	24.6	22	10.8	13.3
Proximal 12 months 3min	62	19.4	26.2	56	9.1	14.1	97	16.0	23.0	21	7.5	14.2
Dist. 2 months 1min	49	1.2	5.3	47	3.4	13.9	78	2.1	11.1	18	2.8	7.0
Dist. 2 months 2min	49	.8	3.9	46	4.2	14.0	78	0.5	3.1	17	11.2	21.6
Dist. 2 months 3min	48	.3	1.6	44	0.8	3.0	76	0.3	1.6	16	1.6	4.6
Dist. 4 months 1min	57	1.6	5.5	53	2.7	10.7	91	1.5	5.2	19	5.3	16.8
Dist. 4 months 2min	57	4.3	8.1	53	2.5	8.1	91	3.3	7.5	19	4.0	10.9
Dist. 4 months 3min	57	1.4	5.0	53	1.9	6.1	91	1.6	5.3	19	2.2	6.8

Dist. 6 months 1min	59	3.0	7.4	57	5.8	12.7	95	3.9	9.5	21	6.3	13.9
Dist. 6 months 2min	58	5.2	14.1	57	5.6	12.8	94	5.2	14.0	21	6.0	11.0
Dist. 6 months 3min	55	4.0	8.3	57	5.0	15.4	91	3.5	9.8	21	8.7	20.0
Dist. 12 months 1min	64	5.8	16.1	58	6.5	15.3	100	4.8	13.7	22	12.1	22.1
Dist. 12 months 2min	63	5.4	13.0	57	4.9	8.9	98	4.6	11.3	22	7.5	10.8
Dist. 12 months 3min	62	4.8	11.2	57	5.7	14.7	97	4.1	9.7	22	10.1	21.8
VR 2 months 1min	49	19.5	19.2	47	12.9	13.5	78	18.3	17.5	18	7.7	10.5
VR 2 months 2min	49	12.8	13.7	46	12.4	14.0	78	13.0	14.2	17	10.7	12.0
VR 2 months 3min	49	12.8	21.9	43	10.7	16.5	76	12.3	20.7	16	9.1	12.7
VR 4 months 1min	56	14.6	18.4	52	1.0	12.8	89	13.3	16.9	19	7.8	10.6
VR 4 months 2min	56	9.7	16.2	52	9.8	15.1	89	10.3	16.1	19	7.4	13.0
VR 4 months 3min	56	7.9	14.1	52	7.7	13.6	89	8.9	14.5	19	2.6	8.3
VR 6 months 1min	58	12.3	14.4	57	15.8	17.2	94	13.2	14.8	21	17.7	20.1
VR 6 months 2min	57	5.7	8.7	57	8.2	12.9	93	6.0	9.5	21	11.1	15.9
VR 6 months 3min	54	6.7	12.0	57	7.1	9.9	90	6.4	10.9	21	9.0	10.7
VR 12 months 1min	63	18.4	22.2	58	18.2	18.1	99	17.9	20.4	22	20.1	20.4
VR 12 months 2min	62	12.7	18.1	57	12.0	16.8	97	12.2	18.1	22	12.8	14.4
VR 12 months 3min	62	10.6	18.6	56	9.5	16.0	97	10.2	17.3	21	9.7	17.9
Pacifying 2 months 1min	49	2.7	8.8	47	6.3	18.6	78	4.7	15.7	18	3.4	7.0
Pacifying 2 months 2min	49	.8	3.1	46	4.4	16.7	78	2.6	12.8	17	2.5	7.1
Pacifying 2 months 3min	48	3.1	12.3	44	5.9	17.7	76	3.6	15.0	16	8.3	15.2
Pacifying 4 months 1min	57	3.1	9.8	53	4.9	11.9	91	3.0	9.0	19	8.4	16.8
Pacifying 4 months 2min	57	.7	4.0	53	6.1	17.4	91	1.8	8.6	19	10.5	23.0
Pacifying 4 months 3min	57	1.2	4.6	53	1.7	4.8	91	1.5	4.8	19	1.3	4.2

Pacifying 6 months 1min	59	2.4	10.6	57	5.6	13.5	95	3.8	11.8	21	5.1	13.8
Pacifying 6 months 2min	58	1.0	4.9	57	1.7	4.9	94	0.8	4.0	21	4.0	7.3
Pacifying 6 months 3min	55	.2	1.2	57	1.2	3.8	91	0.7	2.6	21	0.8	3.7
Pacifying 12 months 1min	63	1.9	5.4	58	3.9	9.0	99	2.7	7.7	22	3.5	5.7
Pacifying 12 months 2min	63	.5	2.5	57	0.6	2.1	98	0.7	2.5	22	0.0	0.0
Pacifying 12 months 3min	62	.1	1.0	56	0.6	2.7	97	0.2	1.1	21	1.2	4.0

Note. Proximal = Proximal Soothing; Dist. = Distraction; VR = Verbal Reassurance.

Next, eight conditional proximal soothing models (one for each of the four immunization appointments [2, 4, 6, and 12 months] crossed with two attachment classification groupings [S/I and O/D]) were estimated. All other model parameterizations and constraints used in the unconditional models described above were also used for these conditional LGMs. Initial conditional models for caregiver proximal soothing at the 2-month, 4-month (O/D model only), and 12-month time points did not converge when the attachment variables were added as outcome variables and subsequently descriptive models, with attachment as an explanatory variable rather than outcome, were estimated for these time points. All eight models fit the data well (see Table 28 for model fit statistics). See Tables 29 to 32 for correlations and covariances for proximal soothing models for each time point. Tables 33 to 36 present unstandardized parameter estimates for each of the eight models.

At the 2-month immunization appointment, there were no significant relationships between intercept and linear slope factors and infant attachment (see Tables 33 for parameter estimates and *p* values). Similarly, at the 4- and 6-month time points, the intercept and non-linear slope factors were also not related to infant attachment (see Tables 34 and 35 for parameter estimates and *p* values). However, at 12 months there were significant relationships between the intercept factors and infant attachment classifications (S/I and O/D) such that more caregiver proximal soothing at 3 minutes after the needle was significantly related to secure and organized infant attachment, $b = -.095$, $p = .016$; $b = -.098$, $p = .006$, respectively. Figures 15 and 16 show higher proximal soothing frequencies at 3 minutes after the needle, during the 12-month time point, for caregivers of infants with secure and organized attachment styles relative to caregivers of infants with insecure and disorganized attachment styles. Yet, there were no significant relationships between the non-linear slope factors and infant attachment at the 12-month time point, $b = -.06$, $p = .18$; $b = -.05$, $p = .31$.

Results for (3b): Did caregiver distraction within-appointment trajectories relate to infant attachment? First, four linear within-appointment unconditional distraction LGMs (one for each of the immunization appointments) were estimated. These models all fit the data well, all RMSEA ≤ .03, all CFI ≥ .98, all TLI ≥ .98, and all SRMR ≤ .06. Initial model estimations for caregiver distraction at the 2-month time point produced improper solutions such that caregiver distraction at 1 and 3 minutes after the needle had a negative residual variance estimate, suggesting that there is minimal individual variability in distraction at these time points after the 2-month immunization(s). Therefore, these parameters were constrained to 0.00 to obtain proper estimated models. For caregiver distraction at the 6- and 12-month time points, initial model estimations produced improper solutions such that caregiver distraction at 3 minutes after the needle had a negative residual variance estimate, suggesting that there is minimal individual variability in distraction at 3 minutes after the needle during these immunization appointments. Therefore, this parameter was constrained to 0.00 to obtain proper estimated models.

Table 28

Caregiver Proximal Soothing Model Fit Statistics

Model	RMSEA (90% CI)	CFI	TLI	SRMR
2 months S/I	0.00 (0.00 - .09)	1.00	1.09	.02
2 months O/D	.07 (0.00 - .20)	.97	.94	.04
4 months S/I	0.00 (0.00 - 0.00)	1.00	1.00	0.00
4 months O/D	0.00 (0.00 - .18)	1.00	1.09	.01
6 months S/I	0.00 (0.00 - 0.00)	1.00	1.00	0.00
6 months O/D	0.00 (0.00 - 0.00)	1.00	1.00	0.00
12 months S/I	.075 (0.00 - .21)	.99	.97	.02
12 months O/D	0.00 (0.00 - .16)	1.00	1.01	.01

Note. RMSEA = root mean square error of approximation; CI = confidence interval; CFI = comparative fit index; TLI = Tucker-Lewis index; SRMR = standardized root mean square residual; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.

Table 29

Correlations and Covariances Among Variables for Caregiver Proximal Soothing 2-Month Models

Variable	1	2	3	4	5
1. Proximal soothing 2 months 1min	.063	.476**	.213**	.053	.074
2. Proximal soothing 2 months 2min	.034	.085	.532**	-.024	.162
3. Proximal soothing 2 months 3min	.013	.039	.066	-.077	-.037
4. S/I	.007	-.004	-.010	.252	.484**
5. O/D	.007	.020	-.004	.093	.148

Note. Correlations are depicted above the diagonal in the shaded region. Covariances are depicted below the diagonal. S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.
** $p < .01$. * $p < .05$.

Table 30

Correlations and Covariances Among Variables for Caregiver Proximal Soothing 4-Month Models

Variable	1	2	3	4	5
1. Proximal soothing 4 months 1min	.068	.467**	.269**	-.058	-.004
2. Proximal soothing 4 months 2min	.031	.065	.538**	-.004	.057
3. Proximal soothing 4 months 3min	.016	.031	.051	.063	.133
4. S/I	-.008	.000	.008	.252	.484**
5. O/D	.000	.006	.012	.093	.148

Note. Correlations are depicted above the diagonal in the shaded region. Covariances are depicted below the diagonal. S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.
** $p < .01$. * $p < .05$.

Table 31

Correlations and Covariances Among Variables for Caregiver Proximal Soothing 6-Month Models

Variable	1	2	3	4	5
1. Proximal soothing 6 months 1min	.056	.478**	.293**	-.035	-.110
2. Proximal soothing 6 months 2min	.025	.048	.525**	-.111	-.049
3. Proximal soothing 6 months 3min	.013	.021	.036	-.062	-.095
4. S/I	-.004	-.012	-.005	.252	.484**
5. O/D	-.011	-.004	-.007	.093	.148

Note. Correlations are depicted above the diagonal in the shaded region. Covariances are depicted below the diagonal. S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.
** $p < .01$. * $p < .05$.

Table 32

Correlations and Covariances Among Variables for Caregiver Proximal Soothing 12-Month Models

Variable	1	2	3	4	5
1. Proximal soothing 12 months 1min	.057	.547**	.343**	-.092	-.081
2. Proximal soothing 12 months 2min	.028	.046	.605**	-.083	-.189*
3. Proximal soothing 12 months 3min	.015	.024	.034	-.236**	-.149
4. S/I	-.010	-.010	-.026	.252	.484**
5. O/D	-.007	-.017	-.013	.093	.148

Note. Correlations are depicted above the diagonal in the shaded region. Covariances are depicted below the diagonal. S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.
** $p < .01$. * $p < .05$.

Table 33

Estimates for Caregiver Proximal Soothing 2-Month Models

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
	S/I			
Proximal soothing intercept factor	-.04	.06	-.73	.47
Proximal soothing linear slope factor	-.03	.03	-1.07	.28
	Residual variance (S/I model)			
Proximal soothing intercept factor	.07	.01	6.82	<.001
Proximal soothing linear slope factor	.02	.004	4.33	<.001
	O/D			
Proximal soothing intercept factor	-.02	.07	-.35	.72
Proximal soothing linear slope factor	-.05	.05	-1.01	.31
	Residual variance (O/D model)			
Proximal soothing intercept factor	.07	.01	6.67	<.001
Proximal soothing linear slope factor	.02	.004	4.21	<.001

Note. S.E. = estimated standard error; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.

Table 34

Estimates for Caregiver Proximal Soothing 4-Month Models

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
	S/I			
Proximal soothing intercept factor	.29	1.11	.26	.79
Proximal soothing non-linear slope factor	.87	.91	.97	.33
	O/D			
Proximal soothing intercept factor	.08	.06	1.29	.20
Proximal soothing non-linear slope factor	.08	.08	1.01	.31
	Residual variance (O/D model)			
Proximal soothing intercept factor	.04	.01	3.56	<.001
Proximal soothing non-linear slope factor	.04	.03	1.56	.12

Note. S.E. = estimated standard error; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.

Table 35

Estimates for Caregiver Proximal Soothing 6-Month Models

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
	S/I			
Proximal soothing intercept factor	-1.38	1.52	-.90	.37
Proximal soothing non-linear slope factor	-.15	.96	-.15	.88
	O/D			
Proximal soothing intercept factor	-2.22	1.92	-1.16	.25
Proximal soothing non-linear slope factor	.93	1.10	.85	.40

Note. S.E. = estimated standard error; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.

Table 36

Estimates for Caregiver Proximal Soothing 12-Month Models

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
	S/I			
Proximal soothing intercept factor	-.10	.04	-2.42	.016
Proximal soothing non-linear slope factor	-.06	.04	-1.36	.18
	Residual variance (S/I model)			
Proximal soothing intercept factor	.04	.01	3.83	<.001
Proximal soothing non-linear slope factor	.04	.01	4.46	<.001
	O/D			
Proximal soothing intercept factor	-.10	.04	-2.75	.006
Proximal soothing non-linear slope factor	-.05	.05	-1.01	.31
	Residual variance (O/D model)			
Proximal soothing intercept factor	.04	.01	3.70	<.001
Proximal soothing non-linear slope factor	.03	.01	4.46	<.001

Note. S.E. = estimated standard error; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.

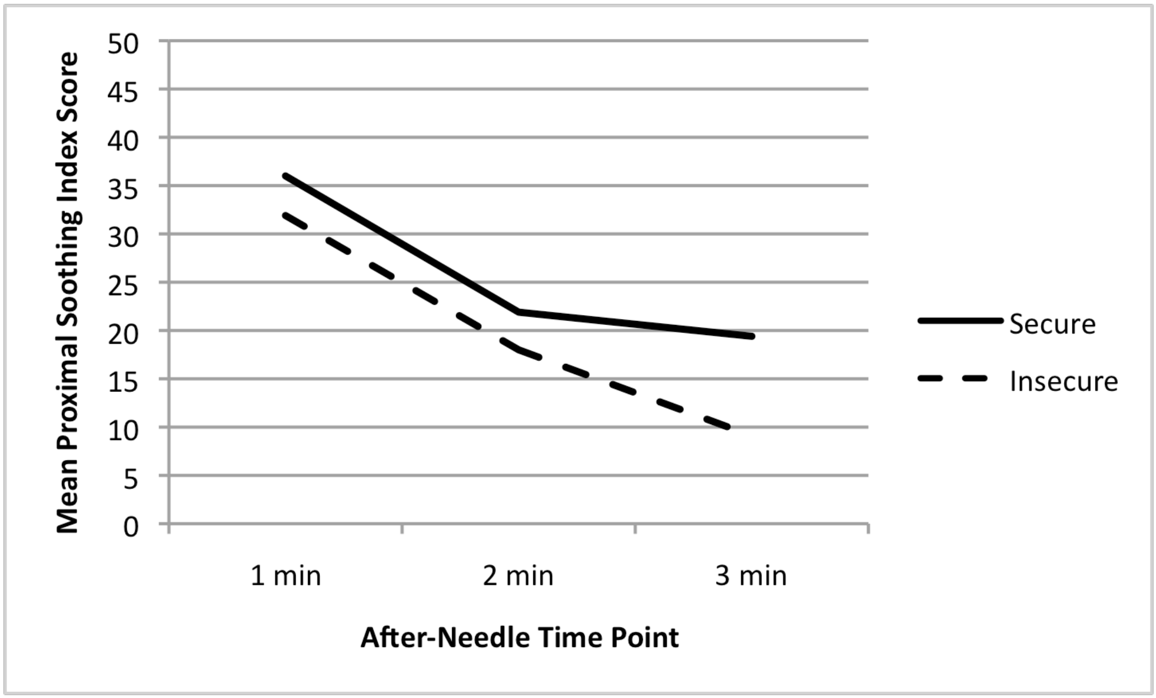

Figure 15. Caregiver proximal soothing trajectories within the 12-month immunization appointment by secure/insecure attachment classification.

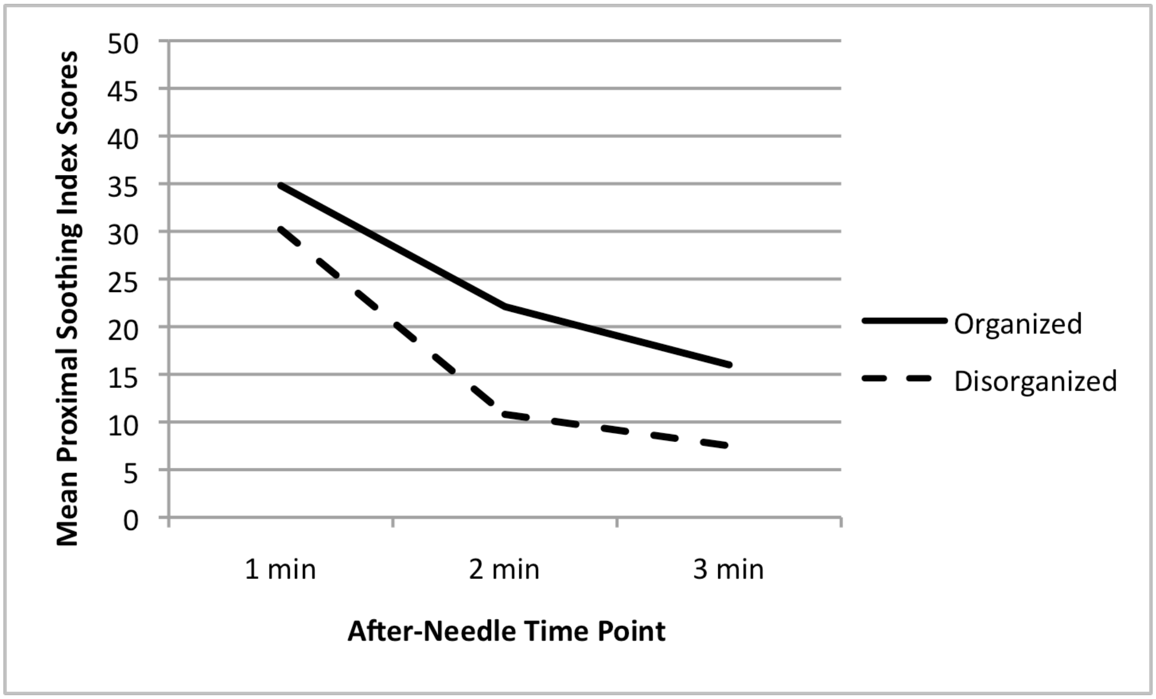

Figure 16. Caregiver proximal soothing trajectories within the 12-month immunization appointment by organized/disorganized attachment classification.

The means of the intercept factors at 2 months (1%), 4 months (4%), 6 months (4%), and 12 months (8%) represented the predicted caregiver distraction frequencies at 3 minutes after the needle. The variances around each of the mean intercepts were significant (2 months: $p = .03$, 4 months: $p = .01$, 6 and 12 months: $p < .001$), indicating that there are significant individual differences in the frequency of caregiver distraction within each immunization appointment at 3 minutes after the needle. The means of the slope factors at 2, 4, and 12 months were not significant ($p = .46, .29, .21$, respectively), suggesting that there is not a significant amount of change in caregiver distraction use after immunizations (from 1 to 3 minutes after the needle) at these infant ages. However, the mean of the slope factor at 6 months was significant ($p = .01$) indicating that caregiver distraction frequencies within the 6-month immunization appointment decrease by 1% from 1 to 3 minutes after the needle. The variances around the mean linear slopes were also significant (2 months: $p = .01$; 4 months: $p = .03$; 6 months: $p < .001$, 12 months: $p = .003$), indicating that there are significant individual differences in the amount of change in caregiver distraction frequencies within each immunization appointment, after the needle.

Next, eight linear conditional LGMs were estimated by adding attachment variables. All other model parameterizations and constraints used in the unconditional models described above were also used for these conditional LGMs. Initial models for caregiver distraction at the 2-, 6-, and 12-month time points did not converge when the attachment variables were added as an outcome variable, and subsequently descriptive models with attachment as an explanatory variable were estimated for these time points. Five of the eight models fit the data well (4-month S/I model, 6-month models, and 12-

month models); The other three models (2-month models and 4-month O/D model) had poor fit when the attachment variables were added as outcome variables (see Table 37 for model fit statistics). However, as previously mentioned, the unconditional models for the 2- and 4-month time points did fit the data well. See Tables 38 to 41 for correlations and covariances for distraction models for each infant age.

For all infant ages, there were no significant relationships between caregiver distraction intercept and linear slope factors and infant attachment (S/I or O/D; see Tables 42 to 45 for parameter estimates and *p* values)

Results for (3c): Did caregiver <u>verbal reassurance</u> within-appointment trajectories relate to infant attachment? First, four within-appointment unconditional verbal reassurance models (one for each of the immunization appointments) were estimated. These models all fit the data well, all RMSEA ≤ .08, all CFI ≥ .97, all TLI ≥ .92, and all SRMR ≤ .02. Linear LGMs were estimated for caregiver verbal reassurance at 2 and 12 months, whereas freed-loading models were estimated for the 4- and 6-month time points (with the 2-minute slope factor loading freed, the 1-minute loading fixed to -1.0, and the 3-minute loading fixed to 0.0). For caregiver verbal reassurance at the 6-month time point, initial model estimations produced improper solutions such that caregiver verbal reassurance at 1 minute after the needle had a negative residual variance estimate, suggesting that there is minimal individual variability in verbal reassurance at 1 minute after the needle during this immunization appointment. Therefore, this parameter was constrained to 0.00 to obtain proper estimated models.

Table 37

Caregiver Distraction Model Fit Statistics

Model	RMSEA (90% CI)	CFI	TLI	SRMR
2 months S/I	.18 (.10 - .18)	.62	.43	.18
2 months O/D	.21 (.13 - .30)	.54	.31	.20
4 months S/I	0.00 (0.00 - .14)	1.00	1.04	.09
4 months O/D	.06 (.10 - .21)	.77	.30	.05
6 months S/I	0.00 (0.00 - .15)	1.00	1.10	.08
6 months O/D	0.00 (0.00 - .15)	1.00	1.07	.08
12 months S/I	0.00 (0.00 - .10)	1.00	1.22	.04
12 months O/D	0.00 (0.00 - .14)	1.00	1.08	.05

Note. RMSEA = root mean square error of approximation; CI = confidence interval; CFI = comparative fit index; TLI = Tucker-Lewis index; SRMR = standardized root mean square residual; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.

Table 38

Correlations and Covariances Among Variables for Caregiver Distraction 2-Month Models

Variable	1	2	3	4	5
1. Distraction 2 months 1min	.007	.586**	.415**	.105	.024
2. Distraction 2 months 2min	.005	.009	.481**	.163	.404**
3. Distraction 2 months 3min	.003	.003	.005	.088	.199
4. S/I	.006	.008	.001	.252	.484**
5. O/D	.001	.016	.002	.093	.148

Note. Correlations are depicted above the diagonal in the shaded region. Covariances are depicted below the diagonal. S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.
** $p < .01$. * $p < .05$.

Table 39

Correlations and Covariances Among Variables for Caregiver Distraction 4-Month Models

Variable	1	2	3	4	5
1. Distraction 4 months 1min	.020	.538**	.318**	.064	.172
2. Distraction 4 months 2min	.010	.018	.425**	-.107	.030
3. Distraction 4 months 3min	.005	.007	.015	.042	.045
4. S/I	.003	-.004	.001	.252	.484**
5. O/D	.005	.001	.001	.093	.148

Note. Correlations are depicted above the diagonal in the shaded region. Covariances are depicted below the diagonal. S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.
** $p < .01$. * $p < .05$.

Table 40

Correlations and Covariances Among Variables for Caregiver Distraction 6-Month Models

Variable	1	2	3	4	5
1. Distraction 6 months 1min	.024	.510**	.316**	.138	.090
2. Distraction 6 months 2min	.013	.025	.493**	.015	.023
3. Distraction 6 months 3min	.006	.008	.015	.041	.165
4. S/I	.007	.001	.003	.252	.484**
5. O/D	.004	.001	.008	.093	.148

Note. Correlations are depicted above the diagonal in the shaded region. Covariances are depicted below the diagonal. S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.
** $p < .01$. * $p < .05$.

Table 41

Correlations and Covariances Among Variables for Caregiver Distraction 12-Month Models

Variable	1	2	3	4	5
1. Distraction 12 months 1min	.020	.310**	.261**	.020	.181*
2. Distraction 12 months 2min	.007	.026	.762**	-.024	.098
3. Distraction 12 months 3min	.006	.021	.029	.037	.182*
4. S/I	.002	-.001	.002	.252	.484**
5. O/D	.011	.004	.009	.093	.148

Note. Correlations are depicted above the diagonal in the shaded region. Covariances are depicted below the diagonal. S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.
** $p < .01$. * $p < .05$.

Table 42

Estimates for Caregiver Distraction 2-Month Models

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
S/I				
Distraction intercept factor	.004	.01	.83	.41
Distraction linear slope factor	-.01	.01	-.79	.43
Residual variance (S/I model)				
Distraction intercept factor	.001	0.00	1.83	<.001
Distraction linear slope factor	.003	.002	1.41	<.001
O/D				
Distraction intercept factor	.01	.01	1.11	.27
Distraction linear slope factor	.003	.01	.25	.81
Residual variance (O/D model)				
Distraction intercept factor	.001	0.00	1.94	.05
Distraction linear slope factor	.003	.002	1.40	.16

Note. S.E. = estimated standard error; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.

Table 43

Estimates for Caregiver Distraction 4-Month Models

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
	S/I			
Distraction intercept factor	-.42	6.02	-.07	.95
Distraction linear slope factor	-3.39	7.53	-.45	.65
	O/D			
Distraction intercept factor	4.14	8.04	.52	.61
Distraction linear slope factor	-11.26	9.41	-1.20	.23

Note. S.E. = estimated standard error; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.

Table 44

Estimates for Caregiver Distraction 6-Month Models

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
	S/I			
Distraction intercept factor	.01	.02	.47	.64
Distraction linear slope factor	-.01	.01	-.54	.59
	Residual variance (S/I model)			
Distraction intercept factor	.02	.01	2.63	.008
Distraction linear slope factor	.003	.001	2.30	.02
	O/D			
Distraction intercept factor	.05	.04	1.20	.23
Distraction linear slope factor	.02	.02	.81	.42
	Residual variance (O/D model)			
Distraction intercept factor	.02	.01	2.71	.01
Distraction linear slope factor	.003	.001	2.26	.02

Note. S.E. = estimated standard error; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.

Table 45

Estimates for Caregiver Distraction 12-Month Models

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
	S/I			
Distraction intercept factor	.01	.02	.44	.66
Distraction linear slope factor	.01	.01	1.06	.29
	Residual variance (S/I model)			
Distraction intercept factor	.02	.01	2.09	.04
Distraction linear slope factor	.002	.003	.83	.41
	O/D			
Distraction intercept factor	.06	.05	1.32	.19
Distraction linear slope factor	.02	.02	.84	.40
	Residual variance (O/D model)			
Distraction intercept factor	.02	.01	2.19	.03
Distraction linear slope factor	.002	.003	.85	.40

Note. S.E. = estimated standard error; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.

The means of the intercept factors at 2 months (12%), 4 months (8%), 6 months (8%), and 12 months (8%) represented the predicted caregiver verbal reassurance frequencies at 3 minutes after the needle. The variances around each of the mean intercepts were significant ($p < .001$), indicating that there are significant individual differences in the frequency of caregiver verbal reassurance within each immunization appointment at 3 minutes after the needle. The means of the slope factors were all significant ($p < .001$), indicating that caregiver verbal reassurance frequencies at each immunization appointment decreased by 3% (at 2 months), 7% (at 4 months), 8% (at 6 months), and 4% (at 12 months) from 1 to 3 minutes after the needle. The variances around the mean slopes were also significant ($p < .001$) for all but the 4-month time point ($p = .21$), indicating that there are significant individual differences in the amount of change in caregiver verbal reassurance frequencies within the 2-, 6-, and 12-month immunization appointments, after the needle.

Next, eight conditional LGMs were estimated for caregiver verbal reassurance by adding attachment variables. All other model parameterizations and constraints used in the unconditional models described above were also used for these conditional LGMs. Models for verbal reassurance at the 6-month time point would not converge when the attachment variables were included as an outcome variable, and subsequently descriptive models with attachment instead as an explanatory variable were estimated for this time point. All eight models fit the data well (see Table 46 for model fit statistics). See Tables 47 to 50 for correlations and covariances for verbal reassurance models for each infant age. See Tables 51 to 54 for unstandardized parameter estimates.

Table 46

Caregiver Verbal Reassurance Model Fit Statistics

Model	RMSEA (90% CI)	CFI	TLI	SRMR
2 months S/I	0.00 (0.00 - .12)	1.00	1.00	.01
2 months O/D	0.00 (0.00 - .12)	1.00	1.00	.01
4 months S/I	0.00 (0.00 - 0.00)	1.00	1.00	0.00
4 months O/D	0.00 (0.00 - 0.00)	1.00	1.00	0.00
6 months S/I	0.00 (0.00 - .16)	1.00	1.06	.02
6 months O/D	0.00 (0.00 - .16)	1.00	1.07	.02
12 months S/I	0.00 (.02 - .16)	.97	.92	.02
12 months O/D	0.00 (.02 - .16)	.97	.92	.02

Note. RMSEA = root mean square error of approximation; CI = confidence interval; CFI = comparative fit index; TLI = Tucker-Lewis index; SRMR = standardized root mean square residual; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.

Table 47

Correlations and Covariances Among Variables for Caregiver Verbal Reassurance 2-Month Models

Variable	1	2	3	4	5
1. Verbal reassurance 2 months 1min	.041	.539**	.415**	-.195	-.245*
2. Verbal reassurance 2 months 2min	.021	.040	.544**	-.016	-.064
3. Verbal reassurance 2 months 3min	.015	.020	.034	-.054	-.063
4. S/I	-.017	-.001	-.005	.252	.484**
5. O/D	-.016	-.003	-.005	.093	.148

Note. Correlations are depicted above the diagonal in the shaded region. Covariances are depicted below the diagonal. S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.
** $p < .01$. * $p < .05$.

Table 48

Correlations and Covariances Among Variables for Caregiver Verbal Reassurance 4-Month Models

Variable	1	2	3	4	5
1. Verbal reassurance 4 months 1min	.039	.499**	.432**	-.144	-.131
2. Verbal reassurance 4 months 2min	.017	.029	.499**	.004	-.071
3. Verbal reassurance 4 months 3min	.013	.013	.025	-.006	-.174
4. S/I	-.012	.000	.000	.252	.484**
5. O/D	-.008	-.004	-.009	.093	.148

Note. Correlations are depicted above the diagonal in the shaded region. Covariances are depicted below the diagonal. S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.
** $p < .01$. * $p < .05$.

Table 49

Correlations and Covariances Among Variables for Caregiver Verbal Reassurance 6-Month Models

Variable	1	2	3	4	5
1. Verbal reassurance 6 months 1min	.034	.500**	.385**	.111	.109
2. Verbal reassurance 6 months 2min	.013	.021	.532**	.112	.179
3. Verbal reassurance 6 months 3min	.010	.011	.022	.021	.091
4. S/I	.009	.006	.001	.252	.484**
5. O/D	.007	.008	.004	.093	.148

Note. Correlations are depicted above the diagonal in the shaded region. Covariances are depicted below the diagonal. S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.
$p < .01$. * $p < .05$.

Table 50

Correlations and Covariances Among Variables for Caregiver Verbal Reassurance 12-Month Models

Variable	1	2	3	4	5
1. Verbal reassurance 12 months 1min	.041	.488**	.309**	-.004	.043
2. Verbal reassurance 12 months 2min	.018	.034	.487**	-.021	.014
3. Verbal reassurance 12 months 3min	.010	.015	.028	-.031	-.011
4. S/I	.000	-.002	-.003	.252	.484**
5. O/D	.003	.001	-.001	.093	.148

Note. Correlations are depicted above the diagonal in the shaded region. Covariances are depicted below the diagonal. S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.
** $p < .01$. * $p < .05$.

Table 51

Estimates for Caregiver Verbal Reassurance 2-Month Models

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
	S/I			
Verbal reassurance intercept factor	-2.89	1.94	-1.49	.14
Verbal reassurance linear slope factor	7.95	5.48	1.45	.15
	O/D			
Verbal reassurance intercept factor	-6.71	3.40	-1.97	.049
Verbal reassurance linear slope factor	19.21	10.37	1.85	.06

Note. S.E. = estimated standard error; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.

Table 52

Estimates for Caregiver Verbal Reassurance 4-Month Models

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
	S/I			
Verbal reassurance intercept factor	.38	2.63	.14	.89
Verbal reassurance non-linear slope factor	6.90	7.03	.98	.33
	O/D			
Verbal reassurance intercept factor	-6.18	4.94	-1.25	.21
Verbal reassurance non-linear slope factor	1.04	5.41	.19	.85

Note. S.E. = estimated standard error; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.

Table 53

Estimates for Caregiver Verbal Reassurance 6-Month Models

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
	S/I			
Verbal reassurance intercept factor	.01	.02	.83	.41
Verbal reassurance non-linear slope factor	-.02	.03	-.76	.45
	Residual Variance (S/I model)			
Verbal reassurance intercept factor	.01	.001	4.02	<.001
Verbal reassurance non-linear slope factor	.02	.004	5.46	<.001
	O/D			
Verbal reassurance intercept factor	.04	.03	1.43	.15
Verbal reassurance non-linear slope factor	-.01	.04	-.17	.87
	Residual variance (O/D model)			
Verbal reassurance intercept factor	.01	.001	4.21	<.001
Verbal reassurance non-linear slope factor	.02	.004	5.29	<.001

Note. S.E. = estimated standard error; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.

Table 54

Estimates for Caregiver Verbal Reassurance 12-Month Models

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
	S/I			
Verbal reassurance intercept factor	-.42	1.58	-.26	.79
Verbal reassurance linear slope factor	-.29	3.54	-.08	.94
	O/D			
Verbal reassurance intercept factor	.44	1.81	.24	.81
Verbal reassurance linear slope factor	-2.23	4.91	-.45	.65

Note. S.E. = estimated standard error; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.

There were no significant relationships between the intercept and slope factors of verbal reassurance and infant attachment (S/I or O/D) at 4, 6, and 12 months (see Tables 52 to 54 above for parameter estimates and *p* values). At the 2-month time point, the verbal reassurance intercept factor significantly predicted infant attachment classification (O/D only), such that more verbal reassurance at 3 minutes after the needle predicted an increased likelihood for organized infant attachment relative to disorganized attachment ($b = -6.71$, $p = .049$). Figure 17 shows caregiver verbal reassurance trajectories within the 2-month immunization appointment by attachment grouping (O/D).

Results for (3d): Are caregiver <u>pacifying</u> within-appointment trajectories related to infant attachment? First, four within-appointment unconditional pacifying models (one for each of the immunization appointments) were estimated. Models for the 2-, 4-, and 6-month immunization appointments all fit the data well, all RMSEA ≤ .05, all CFI ≥ .99, all TLI ≥ .96, and all SRMR ≤ .02. A properly converged estimated model could not be obtained at all for the 12-month time point data. A linear LGM was estimated for caregiver pacifying at the 2- and 4-month time points, whereas a freed-loading model was estimated for the 6-month time point (with the 2-minute slope factor loading freed, the 1-minute loading fixed to -1.0, and the 3-minute loading fixed to 0.0). Initial model estimations for caregiver pacifying at the 4-month time point produced improper solutions such that caregiver pacifying at 3 minutes after the needle had a negative residual variance estimate, suggesting that there was minimal individual variability at 3 minutes after the needle at this immunization appointment. Therefore, this parameter was constrained to 0.00 to obtain proper estimated models.

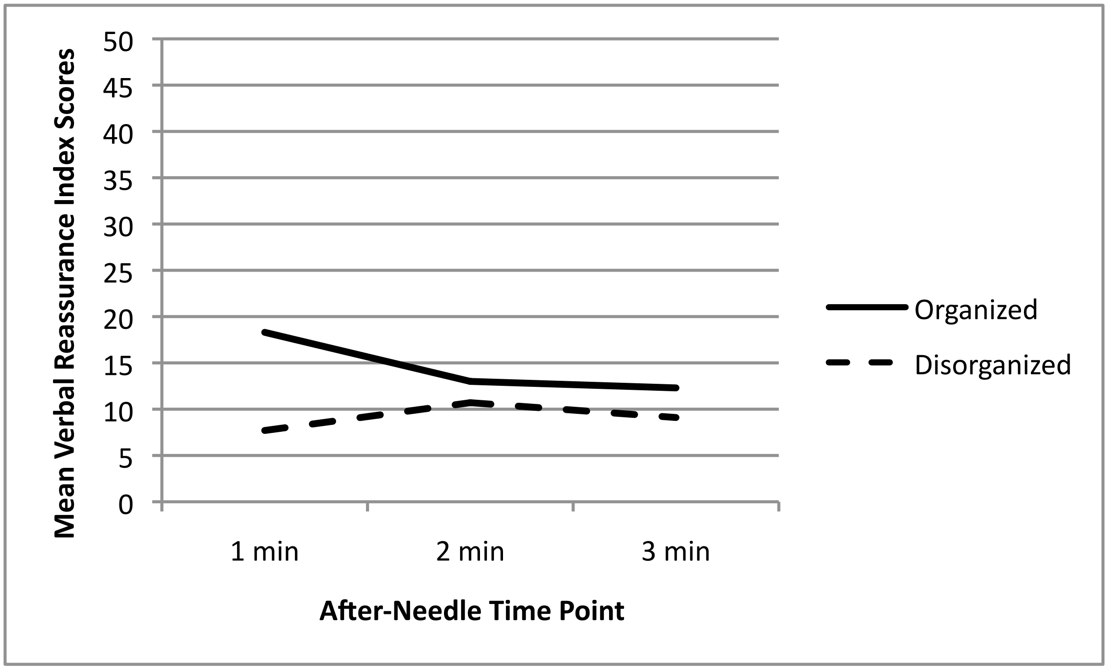

Figure 17. Caregiver verbal reassurance trajectories within the 2-month immunization appointment by organized/disorganized infant attachment classification.

For caregiver pacifying at the 6-month time point, initial model estimations produced improper solutions such that caregiver pacifying at 1 minute after the needle had a negative residual variance estimate, suggesting that there was minimal individual variability at 1 minute after the needle at this immunization appointment. Therefore, this parameter was constrained to 0.00 to obtain proper estimated models.

Means of the intercept factors at 2 months (4%), 4 months (2%), and 6 months (1%), represent the predicted caregiver pacifying frequencies at 3 minutes after the needle. The variances around the mean intercepts for the 2- and 4-month appointments were significant ($p < .001$), indicating that there are significant individual differences in the frequency of caregiver pacifying within these immunization appointments at 3 minutes after the needle.

The means of the slope factors were all significant ($p < .001$), indicating that caregiver pacifying frequencies at each immunization appointment decreased by 1% (at 2 and 4 months) and 2% (at 6 months) from 1 to 3 minutes after the needle. The variances around the mean slopes were also significant, indicating that there are significant individual differences in the amount of change in caregiver pacifying frequencies within the 2- ($p = .01$), 4- ($p < .001$), and 6-month ($p < .001$) immunization appointments, after the needle.

Next, six conditional LGMs were estimated for caregiver pacifying by adding attachment variables. All other model parameterizations and constraints used in the unconditional models described above were also used for these conditional LGMs. In addition, when attachment variables were added to the 4- and 6-month models as an outcome variable, the initial predictive models would not converge and therefore descriptive models with attachment as an explanatory variable were estimated for these two time points. Five of the six models fit the data well (see Table 55 for model fit statistics). The 6-month model with the O/D attachment variable added as an outcome variable did not fit the data well, however, as previously mentioned, the unconditional model for this time point did fit the data well. See Tables 56 to 58 for correlations and covariances for pacifying models for each time point.

There were no significant relationships between intercept and slope factors and infant attachment (S/I or O/D) in any of these models (see Tables 59 to 61 for parameter estimates and *p* values).

Table 55

Caregiver Pacifying Model Fit Statistics

Model	RMSEA (90% CI)	CFI	TLI	SRMR
2 months S/I	0.05 (0.00 - .14)	.99	.96	.02
2 months O/D	0.05 (0.00 - .14)	.99	.96	.02
4 months S/I	.09 (0.00 – 0.20)	.81	.62	.06
4 months O/D	.09 (0.00 – 0.18)	.89	.78	.05
6 months S/I	0.00 (0.00 - .15)	1.00	1.23	.02
6 months O/D	.11 (0.00 - .24)	.77	.30	.06

Note. RMSEA = root mean square error of approximation; CI = confidence interval; CFI = comparative fit index; TLI = Tucker-Lewis index; SRMR = standardized root mean square residual; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.

Table 56

Correlations and Covariances Among Variables for Caregiver Pacifying 2-Month Models

Variable	1	2	3	4	5
1. Pacifying 2 months 1min	.027	.650**	.410**	.122	-.034
2. Pacifying 2 months 2min	.015	.021	.587**	.148	-.003
3. Pacifying 2 months 3min	.009	.011	.019	.093	.119
4. S/I	.009	.009	.007	.252	.484**
5. O/D	-.002	.000	.007	.093	.148

Note. Correlations are depicted above the diagonal in the shaded region. Covariances are depicted below the diagonal. S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.
** $p < .01$. * $p < .05$.

Table 57

Correlations and Covariances Among Variables for Caregiver Pacifying 4-Month Models

Variable	1	2	3	4	5
1. Pacifying 4 months 1min	.015	.331**	.071	.087	.189*
2. Pacifying 4 months 2min	.005	.013	.352**	.214*	.262**
3. Pacifying 4 months 3min	.000	.002	.004	.060	-.013
4. S/I	.005	.014	.001	.252	.484**
5. O/D	.008	.013	.000	.093	.148

Note. Correlations are depicted above the diagonal in the shaded region. Covariances are depicted below the diagonal. S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.
** $p < .01$. * $p < .05$.

Table 58

Correlations and Covariances Among Variables for Caregiver Pacifying 6-Month Models

Variable	1	2	3	4	5
1. Pacifying 6 months 1min	.013	.406**	.037	.132	.044
2. Pacifying 6 months 2min	.003	.005	.246**	.072	.250**
3. Pacifying 6 months 3min	.000	.001	.007	.188*	.021
4. S/I	.008	.002	.003	.252	.484**
5. O/D	.002	.005	.000	.093	.148

Note. Correlations are depicted above the diagonal in the shaded region. Covariances are depicted below the diagonal. S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.
** $p < .01$. * $p < .05$.

Table 59

Estimates for Caregiver Pacifying 2-Month Models

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
	S/I			
Pacifying intercept factor	3.26	2.24	1.46	.15
Pacifying linear slope factor	-4.41	5.51	-.80	.42
	O/D			
Pacifying intercept factor	.94	1.98	.47	.64
Pacifying linear slope factor	8.52	8.40	1.01	.31

Note. S.E. = estimated standard error; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.

Table 60

Estimates for Caregiver Pacifying 4-Month Models

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
	S/I			
Pacifying intercept factor	.006	.01	.63	.53
Pacifying linear slope factor	-.01	.01	-.64	.52
	Residual variance (S/I model)			
Pacifying intercept factor	.002	.001	3.02	.003
Pacifying linear slope factor	.003	.001	2.50	.01
	O/D			
Pacifying intercept factor	-.002	.01	-.15	.88
Pacifying linear slope factor	-.03	.02	-1.40	.16
	Residual variance (O/D model)			
Pacifying intercept factor	.002	.001	3.04	.003
Pacifying linear slope factor	.003	.001	2.20	.03

Note. S.E. = estimated standard error; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.

Table 61

Estimates for Caregiver Pacifying 6-Month Models

Variable	Unstandardized estimate	S.E.	*Z*	Two-tailed *p*-value
S/I				
Pacifying intercept factor	.009	.01	1.85	.06
Pacifying non-linear slope factor	-.02	.02	-1.08	.28
Residual variance (S/I model)				
Pacifying intercept factor	0.00	0.00	.84	.40
Pacifying non-linear slope factor	.01	.005	2.39	.02
O/D				
Pacifying intercept factor	.007	.01	.87	.39
Pacifying non-linear slope factor	-.007	.03	-.21	.83
Residual variance (O/D model)				
Pacifying intercept factor	0.00	0.00	.85	.39
Pacifying non-linear slope factor	.01	.005	2.40	.02

Note. S.E. = estimated standard error; S/I = Secure vs. Insecure attachment classifications; O/D = Organized vs. Disorganized attachment classifications.

Discussion

The present study examined both caregiver emotional availability as well as discrete caregiver soothing behaviours during immunization appointments across the first year of an infant's life. These behaviour trajectories were then examined in relation to subsequent infant attachment during the second year of life. To our knowledge, this is the first study to examine these caregiver constructs together, in a pain context and longitudinally, in relation to infant attachment.

In order to achieve these objectives, three general research aims were examined: (1) to describe caregiver behaviour trajectories during routine immunizations *across* the first year of life; (2) to relate these caregiver behaviour trajectories to subsequent infant attachment during the second year of life; and (3) to relate caregiver behaviour trajectories *within* each immunization appointment, at a given infant age, to subsequent infant attachment during the second year of life.

Research Aim 1: Understanding the Development of Caregiver Emotional Availability and Specific Caregiver Soothing Behaviours During Routine Immunizations *Across* the First Year of Life

To address Research Aim 1, mean values were plotted and unconditional latent growth models (LGM) were estimated for each of the five caregiver behaviours. These models provided a detailed picture of caregiver behaviour trajectories, including an intercept factor (i.e., mean score for a given caregiver behaviour at a specific time point) as well as a slope factor (i.e., the changes in a given caregiver behaviour across the first year of life). Importantly, the LGMs also provided information about the individual variability around mean scores and factors. The use of LGM analysis allowed for the examination of the role of caregiver as an evolving and dynamic process. All available data from the longitudinal study at the 2-, 4-, 6- and 12-month time points ($N = 760$) was used in these models.

The development of caregiver <u>emotional availability</u> across the first year of life. Means for caregiver emotional availability were relatively high and stable across the first year of life in our low risk sample. The LGM analysis indicated that caregiver emotional availability increased slightly across the first year and the rate of increase slowed over time. However, there was significant variability in caregiver emotional availability at the 12-month immunization appointment. There was also significant variability in the amount of change in caregiver emotional availability across the first year of life.

Overall, these findings supported our hypotheses and are consistent with previous studies examining caregiver emotional availability in an immunization context (based on a smaller subsample of the OUCH Cohort data; Din et al., 2009; Din Osmun et al., 2014). Results from the above referenced studies indicated that caregiver emotional availability changed minimally, especially from 2 to 6 months of age, and also that caregiver emotional availability at 2 months predicted caregiver emotional availability at 12 months. These findings are also consistent with literature on the development of caregiver interactive behaviour, which demonstrates stability in caregiver interactive behaviours across the first year of life (Pauli-Pott & Mertesacker, 2009).

The development of caregiver <u>proximal soothing</u> across the first year of life. On average, caregivers engaged in moderate levels of proximal soothing overall and less proximal soothing as the infant aged. Although it was the most common strategy used by caregivers, none of the mean proximal soothing frequencies, at any age, was above 50%. The LGM analysis indicated that there was a significant decrease in caregiver proximal soothing from 4- to 6-month immunization appointments. In addition, there was also significant variability in the frequency of caregiver proximal soothing use at the 12-month immunization appointment. However, there were no significant variability in the amount of change in caregiver proximal soothing across the first year of life, suggesting that the mean change of this trajectory is representative of the entire sample (i.e., caregivers generally use less proximal soothing over time).

These findings supported our hypotheses and suggest that as infants age (and their cognitive abilities increase), caregivers are tending to rely less on proximal soothing techniques and likely turn to more distal strategies requiring cognitive competence, such as verbal interaction and distraction. The drop in caregiver proximal soothing use from 4 to 6 months may also be indicative of the development of infant negative affect across the first year of life. Studies outside of the pain context have shown that infants display a decrease in negative affect between 3 and 6 months of age (Malatesta & Haviland, 1982). Studies examining infant negative affect within a pain context have found that infants show a sharp decrease, both physiologically and behaviourally, in responsiveness to painful stimuli by 4 months of age (Ipp et al., 1990; Ramsey & Lewis, 1994). Ahola Kohut et al., (2012) examined infant facial expressions during immunization appointments across the first year of life and found that as infants age they display more 'distress regulation' facial expressions and display these regulatory facial expressions quicker after the immunization. There are several mechanisms through which this decrease in negative affect is believed to occur, including physical maturation in the brain, self-regulating capacities developing, as well as the socialization of emotion (Lilley, 1995; Lilley, Craig, & Grunau, 1997). Therefore, the drop in caregiver proximal soothing seen in the current study may be a result of the drop in infant pain-related distress across the first year. Caregivers may be responding to the infant's lower pain expression with less proximal soothing.

The development of caregiver <u>distraction</u> across the first year of life. Overall, the proportion of time that caregivers used distraction was low but increased slightly across the first year. The LGM analysis indicated that the caregiver distraction trajectory was characterized by an increase in distraction use across the first year of life and this rate of increase slowed over time. In addition, there were significant variability in the frequency of caregiver distraction use at the 12-month immunization appointment. These findings were in line with our hypotheses. Infants' cognitive abilities are developing with age, which allows them to be better able to attend to distractors and in turn encourages caregivers to engage in these behaviours more often and with more effectiveness (Power, 1999).

Caregivers in the current study did not naturally engage in distraction often and many did not engage in any distraction at all. Caregivers have many competing demands during an immunization appointment (i.e., responding to and asking questions to the doctor, responding to their infant who is distressed, needing to leave the examination room and get the infant ready to go in a timely manner). These demands may make it difficult for a caregiver to naturally engage in distraction behaviours for very long, especially with infants under 12 months of age who are not able to attend to distractors for extended periods of time.

The development of caregiver verbal reassurance across the first year of life. Caregiver verbal reassurance use was fairly low and stable across the first year of life. The LGM analysis indicated that caregiver verbal reassurance frequencies decreased slightly across the first year and this rate of decrease slowed over time. In addition, there was significant variability in the frequency of caregiver verbal reassurance use at the 12-month immunization appointment. These findings were contrary to our hypotheses that caregiver verbal reassurance would decrease consistently over time, as more cognitive strategies and other types of verbal communication are developing. These findings suggest that some caregivers, when placed in a setting where their infant exhibits high levels of distress, persistently engaged in verbal reassurance regardless of the infants' age. For these caregivers, this pattern occurs despite consistent findings that verbal reassurance is related to higher infant pain response during acutely painful procedures. Although it is widely reported in the pediatric pain literature, this relationship between caregiver verbal reassurance and infant pain is counterintuitive and therefore, caregivers often instinctively make reassuring comments to an infant who is distressed, regardless of the infants' age.

The development of caregiver pacifying across the first year of life. Caregiver pacifying was quite infrequent (mean frequencies ranging from approximately 1% to 5%) and its use decreased slightly across the first year of life. The LGM analysis indicated that there was significant variability in the amount of change in caregiver pacifying frequencies across the first year of life. The finding that, on average, there was a decrease in pacifying was in line with our hypotheses and is supported by research suggesting that younger infants may benefit more from non-nutritive sucking, as this is an age when the sucking reflex is highly soothing to infants (i.e., between 0 and 3 months of age; Curtis et al., 2007). It follows that caregivers may be more likely to use this form of soothing with younger infants. In addition, with age, infants learn to develop other soothing strategies as their cognitive capacities increase.

Summary of results from Research Aim 1. In summary, mean trajectories of caregiver behaviours provided a detailed picture of what caregivers naturalistically do to soothe and comfort their infants after an immunization over the first year of life. Trajectories for each caregiver behaviour across the first year of life indicated that, in general, caregiver behaviours remained fairly stable (i.e., caregiver EA and verbal reassurance), with only slight increases (i.e., distraction) or decreases (i.e., proximal soothing and pacifying) for some variables. However, it is important to note that some of these caregiver behaviour factors did have statistically significant individual differences at specific infant ages and in terms of the amounts of change across the first year of life, suggesting that there is variability in these trajectories.

These findings can be compared to research using the same sample of caregiver-infant dyads (the OUCH Cohort) examining infant variables during immunization appointments across the first year of life. Although caregivers appear to remain fairly consistent in the types of behaviours they use across their infants' first year, infants, on the other hand, show marked variability in pain regulation across the first year, especially across the latter half of the first year (i.e., 6 and 12 months of age). Pillai Riddell et al. (2013) examined trajectories from pain reactivity (immediately after-needle) to pain regulation (1 to 2 minutes after the needle) and found that infants differ substantially in terms of their patterns of pain responding over the 2 minutes after the needle. These authors concluded that using overall means to represent infant pain (at 1 and 2 minutes after the needle) would lead to clinically significant misrepresentations of infant variability. These findings, taken together with those of the current study, suggest that although infants go through tremendous changes in development and are constantly influenced by new experiences as well as the interaction between these experiences and genetic factors, such as temperament, adults are much more stable in terms of their behaviour in response to this variability. Pillai Riddell et al. (2011) found that not only is caregiver emotional availability fairly stable across the first year of life, but also that past caregiver emotional availability is a greater predictor of future caregiver emotional availably than is infant pain behaviour. Taken together, these findings suggest that targeting interventions for caregiver-infant dyads early on (e.g., at 2 months) may be most effective for bringing about lasting changes in caregiver behaviours and overall developmental improvement in infants and children.

Research Aim 2: Relating Caregiver Behaviour Trajectories *Across* the First Year of Life to Subsequent Infant Attachment During the Second Year of Life

In order to address the second research aim, the unconditional LGMs from the previous exploratory analyses in Research Aim 1 were expanded to include infant attachment variables. Although analyses were first attempted with infant attachment variables as outcome variables and caregiver trajectory factors as predictors, these models could not be properly estimated. In turn, the LGMs that were estimated could only provide descriptive information about attachment group differences with respect to caregiver behaviours across age.

Did caregiver <u>emotional availability</u> trajectories relate to infant attachment? Caregiver emotional availability (both at the 12-month immunization appointment and the change in caregiver EA across the first year of life) was not related to infant attachment in the current low-risk sample.

The lack of variability of this variable in the current sample made finding relationships with attachment difficult. The strong body of research linking caregiver sensitivity to attachment, particularly within distressing contexts such as pain, suggests that there is indeed a relationship between global measures of caregiver sensitivity such as this and infant attachment. Therefore, perhaps a more diverse sample, with more variability in emotional availability, would obtain this effect. It may also be that specific soothing behaviours are more indicative of attachment in an infant pain context or that differences in these global measures of caregiver sensitivity are better examined during slightly less stressful situations, where caregivers would be more likely to engage in those behaviours that are thought to be associated with insecure or disorganized attachment (e.g., hostility, intrusiveness).

In line with the current study's findings, Pritchett et al. (2013) also did not find a relationship between the quality of the caregiver-child relationship within a pain context and a measure of preschool attachment. However, their sample was very small and examined older children. Contrary to the current study's findings, Gunnar et al. (1996) found significant relationships between maternal responsiveness and low cortisol levels prior to immunization(s) and subsequent secure infant attachment. In addition, early caregiver emotional availability has been shown to be related to infant pain regulation (a concept theorized to be strongly linked to infant attachment) in the immunization context at 12 months in a previous study using a smaller subsample of the current data (Din Osmun et al., 2014). It is important to note that both of these studies examined caregiver behaviour by averaging scores across 2 to 6 months of age. This method was not used in the current study as one of the main aims of the study was to examine the development of these caregiver behaviours at each infant immunization appointment across the first year of life. Din et al. (2009) also included a sample of caregivers with much lower average SES, which could have added some additional variability to their measure of caregiver emotional availability.

The lack of findings with respect to caregiver emotional availability and infant attachment in the current study, given previous relationships between caregiver emotional availability and infant pain regulation, may also suggest that perhaps emotion regulation in the pain context is qualitatively different than emotion regulation outside of the pain context. The pain context may be so overwhelming (e.g., most infants still experience significant levels of distress at 2 minutes post-needle, especially under 12 months of age; Pillai Riddell et al., 2013) that it disrupts an infant's normal emotion regulatory system (that is typically seen in low threat contexts) and leads infants to behave in ways that may be inconsistent with those that would be expected given their attachment classification. Therefore, there may be different emotion regulation processes, one within the pain context when perceived threat is very high and another outside of the pain context when perceived threat is lower. This idea that context plays a key role in how both caregivers and infants behave is also in line with research examining maternal sensitivity in relation to infant attachment in distressing or non-distressing contexts. Research suggests that maternal sensitivity in distressing, but not non-distressing, contexts is a greater predictor of subsequent infant attachment (McElwain and Booth-LaForce, 2006; Leerkes, 2001). Leerkes, Weaver, and O'Brien, (2012) suggest that maternal sensitivity in distressing versus non-distressing contexts constitutes two subtypes of sensitivity with unique origins and effects on subsequent child well-being. If follows that just as there may be different subtypes of sensitivity depending on the context there may also be different subtypes or processes of emotion regulation depending on the context.

This idea is also supported by findings from Horton et al. (under review), who found that infant attachment was related to infant pain regulation only among infants with a certain level of temperamental fear. Specifically, infants with high temperamental fear was predictive of slower emotion regulation in avoidant infants but faster emotion regulation in secure infants, whereas low temperamental fear predicted faster regulation for avoidant and disorganized infants and slower regulation for secure infants. These findings suggest that under conditions of high threat, like an immunization, infants with avoidant attachment styles may not be able to sustain their typical distress-suppressing strategies used during times of low to moderate threat. In addition, infants with high temperamental fear and secure attachment styles may be able to use their caregivers to relieve distress more effectively as they feel more confident in their ability to solicit support from caregivers. Therefore, emotion regulation may not be a general construct that is consistent and predictable across all contexts. The context, as well as infant factors such as temperament and the attachment relationship likely all impact how one regulates emotions.

Did caregiver <u>proximal soothing</u> trajectories relate to infant attachment?

Caregiver proximal soothing at the 12-month immunization appointment was significantly related to infant attachment, such that higher levels of caregiver proximal soothing after the needle were associated with organized infant attachment. In addition, decreases in the amount of proximal soothing used over the first year were associated with disorganized infant attachment. Although the overall mean proximal soothing trajectory decreased across the first year of life, the mean trajectory of proximal soothing had a steeper negative slope for caregivers of infants with disorganized attachment styles relative to caregivers of infants with organized attachment styles. These findings were in line with our hypotheses.

There is a wealth of research suggesting that proximal soothing strategies are effective at reducing pain-related distress in infants (Jahromi, Putnam, & Stifter, 2004; Campos, 1994; Jahromi & Stifter, 2007; Pederson 1975; Schechter et al., 2007; Campbell et al., 2013). In addition, according to Bolwby (1969/1982), proximity to the caregiver is what the infant innately seeks when the attachment system is activated. Therefore, it follows that caregivers who engage in low levels of or sharp decreases in proximal soothing during a highly distressing context would negatively impact an infant's attachment with their caregiver. The finding that proximal soothing at 12 months was only related to organized/disorganized infant attachment (i.e., a more adaptive style relative to the most maladaptive style) suggests that this caregiver behaviour is foundational to the development of an organized or adaptive way of regulating one's emotions and relating to a primary caregiver. Caregivers that do not engage in the appropriate amount of proximal soothing, during a highly distressing context, are at highest risk of having an infant with disorganized attachment, the style that is most strongly associated with poor long-term outcomes.

Relationships between caregiver proximal soothing and infant secure/insecure attachment classifications were not found for these analyses. Possible explanations for this are that, infants' emotion regulation systems may become overwhelmed within the pain context, causing them to behave in uncharacteristic ways given their attachment style. For example, avoidant and disorganized infants from the current sample, at the 12-month time point, were not always able to minimize their distress under the high threat level of an immunization (as they would typically be expected to do based on prototypical behaviours of these infants seen in the less stressful context of the SSP or home observations). In addition, resistant infants were not significantly different from secure infants with respect to pain regulation when temperamental fear was controlled (Horton et al., under review). Based on attachment theory and how infants respond to caregivers in the SSP, resistant infants would be hypothesized to engage in high levels of distress as well as proximity seeking and resistant behaviours but have difficulty regulating this distress. Secure infants are hypothesized to also seek proximity when distressed but would have better regulatory skills and be able to use their caregiver more effectively to regulate distress. Horton and colleagues' (under review) findings suggest that secure and resistant infants may behave similarly in the immunization pain context and continue signalling distress (i.e., not regulating quickly) given the continued threat of the pain they are experiencing. Therefore, a small proportion of the infants in the current study's 'insecure' attachment group (resistant infants) may behave similarly to secure infants in the pain context. This in turn may have impacted caregiver behaviours such that even those caregivers who may not normally (i.e., based on what would be expected given prototypical behaviours in the SSP and home observations) engage in much proximal soothing (e.g., caregivers of resistant infants) engaged in higher levels given the high level of distress their infant was displaying.

Horton et al.'s (under review) findings also indicated that infants 'snuggling' behaviours after immunization(s) were related to infant attachment such that securely attached infants engaged in significantly more snuggling behaviours than avoidant or disorganized infants. These findings support the tenet that infants use attachment-driven behaviours to regulate pain related distress (Cassidy, 1994). This idea is also supported by research in non-pain contexts such as the SSP, where secure infants have been shown to use more approach strategies towards their caregiver when distressed while avoidant and disorganized infants use less of these behaviours when distressed. Favez and Berger's (2011) results, using their measure of attachment during immunization (PASI), also indicated that secure and resistant infants seek contact with caregivers while avoidant infants avoid this contact following the needle. In terms of the current study's results, infants with organized attachment classifications may be better at effectively using the caregiver to regulate distress (getting proximity when experiencing significant levels of distress) than infants with disorganized attachment styles who do not have any consistent strategies to implement in order to alleviate distress and are described as fearful of their caregiver, which may lead to these infants not effectively seeking contact even when they are highly distressed.

That these relationships were found only at the 12-month immunization appointment is also consistent with research suggesting that by 12 months, the infant's attachment relationship is solidified (Ainsworth et al., 1978). Although it is possible that infant attachment may also be predicted by characteristics present during an earlier age, the current study suggests that caregiver behaviours that are exhibited at the age when infant attachment is said to be reliably observed and measured (12 months of age) are more strongly related to infant attachment than are caregiver behaviours exhibited at earlier ages. The DIAPR model (Pillai Riddell et al., 2013) also posits that external factors such as caregiver behaviours exert a stronger influence on infant pain-related distress later in infancy and that intrinsic factors such as infant temperament play a larger role earlier in the infant's life. Studies specifically examining infant temperament in a pain context have supported this facet of the DIAPR model. Sweet et al. (1999) found a relationship between infants' temperamental difficultness and pain-related distress at 6 months of age but not at 18 months. In addition, Horton et al. (under review) did not find a direct link between infant temperamental fear and pain-related distress reactivity when examining the same 12 month old infants used in the current study, suggesting that intrinsic infant factors, such as temperament, may play less of a role in older infants and more external factors, such as caregiver behaviours or attachment relationships, are more influential in infant emotion regulation and reactivity at this age.

Taken together, caregiver behaviours, in particular proximal soothing, as well as infant temperament, and the caregiver-infant attachment relationship all appear to contribute to a dynamic process that warrants further investigation within the unique context of infant pain.

Did caregiver distraction trajectories relate to infant attachment? Neither caregiver use of distraction at the 12-month immunization appointment nor the change in distraction across the first year of life were related to infant attachment. These findings were contrary to our hypotheses.

Although distraction has been found by some researchers to be effective in reducing pain and promoting pain-related distress regulation (a concept linked to emotion regulation which is strongly linked to infant attachment) (Cohen, 2002; Lisi et al., 2013), others have not found this (Hillgrove-Stuart et al., 2013; Cramer-Berness & Friedman, 2005). Hillgrove-Stuart et al. (2013) found that distraction was not more effective, for infants ranging in age from 12 to 20 months, relative to no distraction when the caregiver was also engaged in proximal soothing behaviours. These findings provide further support to the current study findings that proximal soothing is a key soothing strategy over and above other strategies within the pain context. Pritchett et al. (2013) found that caregivers of secure children exhibited more pain reducing strategies, which were described as techniques used by caregivers to distract the child through things such as nonprocedural talk, humour directed to the child, and commands to engage in coping strategies. Although these 'distraction' strategies were found to be related to child attachment they are not the types of behaviours that are typically seen when caregivers are trying to distract an infant (12 month or less). The most common types of distraction techniques used by parents of infants in the OUCH Cohort include using a toy to divert the infants' attention, pointing to objects in the room or out of the window as well as singing to the infant. Parents of securely attached children in Pritchett et al.'s study were described as providing coping strategies to the child such as looking out of the window or hugging tightly to the caregiver. Therefore, their measure of pain reducing behaviours does not only include distraction but also includes proximal soothing behaviours that the current study has found support the development of organized attachment. Also, Pritchett and colleagues examined children aged 4 years on average. Given the increased cognitive capacity in these children relative to infants in the current study, distraction strategies used, especially verbal strategies, such as nonprocedural talk, would function differently in this older age group once language skills and comprehension are more developed.

In the current study, naturally occurring distraction behaviours in the immunization context were minimal and a large proportion of caregivers did not engage in any distraction after the immunization(s), which likely contributed to a lack of associations with attachment. Additionally, distraction may simply be a caregiver behaviour that does not impact infant attachment in this age group. However, despite the lack of significant relationships in the current study with respect to caregiver distraction and subsequent infant attachment, when examining the mean frequencies for caregiver distraction use, on average, caregivers of infants with disorganized attachment styles had the highest distraction frequencies at the 2-, 4- and 6-month immunization appointments and caregivers of both disorganized and insecure infants had the highest distraction frequencies at the 12-month immunization appointment. In conjunction with the equivocal findings regarding distraction use and infant pain-related distress regulation, these means may suggest that distraction in the pain context, when infants often experience high levels of distress, may not be an appropriate strategy until infants have more fully regulated. Given the inconsistent picture of the role distraction plays in infant emotional regulation and attachment, it may be worth examining distraction, in particular the timing of this strategy, at higher frequencies in relation to infant attachment classifications with a larger sample.

Did caregiver <u>verbal reassurance</u> trajectories relate to infant attachment? The quadratic change factor for caregiver verbal reassurance was significantly related to infant attachment, such that caregivers with a trajectory whereby verbal reassurance started high, then decreased, and finally increased again at the end of the first year were more strongly associated with organized infant attachment. Caregivers of infants classified as disorganized in their attachment were characterized by a trajectory that started with low frequencies of verbal reassurance that gradually increased as the year progressed, followed by a deceleration (or slowing of this increase) by the end of the first year.

Verbal reassurance has been consistently found to be associated with increased pain expression in infants and poor pain-related distress regulation (again, linked to emotion regulation and in turn infant attachment) (Sweet & McGrath, 1998; Blount, Devine, Cheng, Simons, & Hayutin, 2008; Cohen, Manimala, & Blount, 2000; Racine et al., 2012; Lisi et al., 2013), and was therefore hypothesized to also be associated with insecure or disorganized infant attachment. The current study's findings suggest that verbal reassurance, although detrimental to pain regulation in the immunization context, may not have the same negative impact on an infants' attachment relationship. When examining trajectories of verbal reassurance by organized/disorganized attachment classifications, the key difference appears to be at the beginning of the first year of life (2 months) when caregivers of organized infants engage in higher levels of verbal reassurance (16%) than caregivers of disorganized infants (8%). At this early age, when infants are expressing the highest levels of pain and have the poorest regulation abilities, caregivers who do not use verbal reassurance may be those that have the greatest difficulty relating to and understanding their infant's cues (i.e., caregivers of disorganized infants).

As aforementioned, Pritchett et al. (2013) found that caregiver verbal behaviours were related to preschool aged children's attachment style. Caregivers who engaged in more nonprocedural talk (i.e., anything not related to the painful procedure and excluding reassuring statements), a verbal behavior associated with lower pain responding (Chambers, Craig, & Bennett, 2002), were more likely to have securely attached preschoolers. Verbal behaviours, including reassurance, may have more of an impact on attachment as children age and become more verbal themselves and their ability to communicate and understand language increases.

Several studies, including one based on the OUCH Cohort by Racine et al. (2012), have shown that higher infant pain predicts higher caregiver verbal reassurance, which in turn predicts higher subsequent infant pain. Despite this pattern, caregiver behaviours in a pain context may not be related to infant pain regulation in the same way they are related to infant attachment. Verbal reassurance in the context of attachment theory may actually be viewed as a sensitive behaviour (depending on the specific context, how and when it is being said, etc…). Caregivers that are more in tune with their infants' emotional and physical states and able to be present (i.e., not afraid of their infant's distress or dissociating, as a caregiver of a disorganized infant might be) would naturally respond to a highly distressed infant with empathy and would want to reassure the infant that it will be okay even if they are not the most sensitive of caregivers typically (as is the case with caregivers of avoidant and resistant infants, who make up part of the organized attachment group). Caregivers that do not engage in these types of reassuring, empathizing verbal behaviours would likely be viewed as quite insensitive given the high levels of distress infants' typically display in an immunization pain context. Again, the finding that this caregiver behaviour distinguishes only the most maladaptive attachment classification relative to a less maladaptive attachment classification suggests that this behaviour may be an important indicator of problems within a caregiver-infant dyad.

Did caregiver pacifying trajectories relate to infant attachment? Neither caregiver use of pacifying at the 12-month immunization appointment nor the change in pacifying across the first year of life was related to infant attachment. This finding was contrary to our hypotheses.

There is limited research on non-nutritive sucking (i.e., pacifying) in non-neonates (i.e., >1 month) (Pillai Riddell et al., 2014). However, it is believed that one of the primary ways young infants' can self- soothe is through engaging in sucking (either through nursing or non-nutritive sucking), and sucking is thought to trigger the release of serotonin in the brain (Curtis et al., 2007). It follows that as infants develop additional cognitive and regulatory capacities, they begin learning new and additional ways of regulating their emotions beyond sucking. Curtis et al. (2007) found that pacifying was only effective in relieving infant pain when infants were 0 to 3 months of age. Pacifying in the current study was used very infrequently, especially at the 12-month immunization appointment, which likely contributed to a lack of associations with attachment. Additionally, pacifying may simply be a caregiver behaviour that does not impact infant attachment. Unlike other distal soothing strategies, pacifying may not interfere with caregiver behaviours that appear to be more critical to the development of infant attachment such as proximal soothing, as it can be used easily in conjunction with many other strategies.

Despite the lack of significant differences, the mean frequencies for caregiver pacifying were in the expected direction at some but not all ages. Caregivers of infants with insecure attachment styles had the highest pacifying frequencies at the 2- and 12-month immunization appointments and caregivers of disorganized infants had the highest pacifying frequencies at the 4- and 6-month immunization appointments. Therefore, it may be worth examining pacifying use at higher frequencies in relation to infant attachment classifications with a larger sample.

Summary of results from Research Aim 2. Caregiver emotional availability, a global measure of caregiver sensitivity as well as other relational constructs, was not related to infant attachment in the current study. However, there were significant relationships between some of the specific caregiver soothing behaviours and infant attachment. Infants classified as organized in their attachment were more likely to have caregivers that used higher frequencies of proximal soothing after their 12-month immunization(s). These caregivers were also characterized by a verbal reassurance trajectory that began with higher frequencies and then decreased slightly at the beginning of the first year but increased again as the year progressed. Infants classified as disorganized in their attachment were more likely to have caregivers who had a steeper decline in the frequency with which they engaged in proximal soothing across the first year of life. These caregivers were also characterized by a verbal reassurance trajectory with low initial frequencies that increased as the year progressed, followed by a deceleration (or slowing of this increase) by 12 months of age.

These findings highlight that proximity to one's caregiver during times of distress is a key factor in promoting an organized attachment relationship. In addition, moderate levels of verbal reassurance may not be detrimental to infant emotion regulation outside of the pain context (i.e. infant attachment) and may be a particularly important marker of future attachment that can be assessed early on in the first year of life. These findings, taken together, provide important insight into specific caregiver behaviours naturally occurring in the infant immunization pain context that are related to infant attachment. These findings also support the idea that the immunization pain context provides a valid paradigm by which to study factors that relate to infant attachment. Because these caregiver behaviours appear to distinguish the most at risk (disorganized) from those with lower risk (organized), these behaviours might be used to help identify those at the highest risk for subsequent mental health problems later in life.

Research Aim 3: Relating Caregiver Behaviour Trajectories *Within* an Immunization Appointment, at a Given Infant Age, to Subsequent Infant Attachment During the Second Year of Life

In order to provide more insight into the relationship between caregiver behaviours and infant attachment, LGMs were estimated to examine caregiver behaviour trajectories within each of the four immunization appointments and whether they were related to infant attachment.

Did caregiver <u>proximal soothing</u> within-appointment trajectories relate to infant attachment? Higher levels of caregiver proximal soothing during the 12-month appointment at the 3^{rd} minute after the needle were significantly related to secure and organized infant attachment styles. These findings are in line with our hypotheses and our findings from Research Aim 2 in that proximal soothing appears to be a key factor within the pain context that relates to subsequent infant attachment relationships. These findings suggest that caregivers who continue to keep their infant close until they have more fully regulated provide what an infant's attachment system is seeking, which in turn is related to the development of organized and, more importantly, secure attachment relationships.

An additional explanation is that secure infants are better able to solicit support from caregivers and use them effectively to regulate distress in a pain context. For example, Horton et al. (under review) demonstrated that infant 'snuggling' behaviour, within the post-immunization context, was related to secure infant attachment in the current sample. Horton (2013) also indicated that caregivers of securely attached infants held their infants longer after the needle relative to caregivers of infants with other attachment styles. Taken together, these findings suggest that, within an acute pediatric pain context at 12 months of age, future secure infant attachment is reflective of caregivers that hold and sooth their infants proximally for as long as is needed for the infant to regulate and infants who actively seek out this proximity and are effective at maintaining it for as long as is needed. This type of caregiver-infant relational profile outside of the pain context has consistently been linked to secure attachment (Ainsworth et al., 1978).

These findings also suggest that the timing of caregiver soothing behaviours is important for infant attachment development. As previously mentioned, infant pain has been shown to continue past the immediate insult of the needle for at least 2 minutes post-needle (Pillai Riddell et al., 2013). Therefore, it follows that the most sensitive caregiver would continue soothing in a way that brings the infant close, until the infant's distress has decreased enough to engage in other behaviours. Caregivers of secure infants may be more adept at reading their infant's distress cues and judging when their infant is ready to switch from being proximally soothed to some other more distal activity (i.e., distraction or dressing to leave the examination room). Trajectories of proximal soothing by attachment category showed that although both secure and insecure infants have similar levels and amounts of change from 1 to 2 minutes after-needle, caregivers of insecure infants continue to use consistently less proximal soothing from 2 to 3 minutes after the needle, whereas caregivers of secure infants only decrease minimally from 2 to 3 minutes after the needle. These trajectories may also be indicative of securely attached infants signalling more distress than insecurely attached infants during the 3rd minute after the needle, which is reciprocated by more proximal soothing on behalf of the sensitive caregiver. It is important to note that caregivers of disorganized infants showed a significant drop in proximal soothing use after the initial 1 minute after-needle time point. These caregivers appear to provide proximal soothing for the shortest amount of time after the needle and engage in the lowest levels of proximal soothing at 2 and 3 minutes after the needle.

Securely attached infants are described as being able to freely express emotions in the presence of a supportive caregiver. Given that immunization pain can last far beyond the actual insult to the skin (Pillai Riddell et al., 2007), it follows that secure infants would continue to signal if pain is felt, whereas insecure infants, in particular avoidant and disorganized infants would be more likely to suppress their feelings of distress or not be as effective at using the caregiver to relieve the distress they are experiencing. This, in conjunction with a caregiver that does not effectively respond to their infant's distress cues, would likely lead to caregivers not continuing to engage in proximal behaviours beyond the 1st or 2nd minute after the needle.

Did caregiver distraction within-appointment trajectories relate to infant attachment? There were no significant relationships between distraction at 3 minutes after the needle within any age nor was the change in distraction within an appointment related to infant attachment. These findings are consistent with findings regarding caregiver distraction from Research Aim 2.

Contrary to our hypotheses, distraction use was not related to secure or organized infant attachment in older infants. Distraction does not appear to be an important construct in the development of infant attachment despite some findings in the pain literature that it is effective in reducing pain-related distress in older infants and children especially. Again, the fact that caregivers in the current sample only engaged in low levels of distraction also made it difficult to find relationships with infant attachment variables.

In addition to the lack of relationships with infant attachment, the mean frequencies for caregiver distraction use within immunization appointments were not in the expected direction. Caregivers of infants with disorganized attachment styles had the highest distraction frequencies, on average, across the entire post-needle period at 6- and 12-month immunization appointments. Distraction frequencies for these caregivers were also highest at 1 minute after the needle at the 4-month appointment and 2 minutes after the needle at the 2-month appointment. Therefore, the timing of distraction use, both across and within procedures, may be worth examining in relation to infant attachment classifications with higher frequencies of distraction use and a larger sample.

Did caregiver verbal reassurance within-appointment trajectories relate to infant attachment? At the 2-month immunization appointment, higher levels of caregiver verbal reassurance at 3 minutes after the needle significantly predicted organized infant attachment. This finding is consistent with findings regarding caregiver verbal reassurance from Research Aim 2.

This result is important to contextualize given the fact that, as previously mentioned, research in the pain context generally discourages the use of verbal reassurance because it has consistently been linked to higher pain expression (Sweet & McGrath, 1998; Blount et al., 2008; Cohen, Manimala, & Blount, 2000; Racine et al., 2012; Lisi et al., 2013). As discussed in Research Aim 2 verbal reassurance findings, verbal reassurance may not have the same negative effects on emotion regulation outside of the pain context (i.e., infant attachment) as it does on emotion regulation within the pain context (i.e., pain-related distress regulation). This finding suggests that caregiver verbal reassurance at 2 months of age (at the 3 minute epoch) represents a caregiver who responds with an appropriate amount of concern and responsiveness given the context. These caregivers that engage in verbal reassurance later during the immunization (i.e. after the initial reactivity period) may be those who respond most appropriately given their infants' high levels of distress during their very first immunization experience. This pattern may also suggest that early in the first year (as opposed to later), caregivers of infants with disorganized attachment, in a high-distress context (their infants' first immunization, where infants typically exhibit high levels of pain and poor pain-related distress regulation) may lack the strategies to cope with the stressful situation and the infant's expression of distress may actually be a source of fear for the caregiver, making them less able to empathize with their infant and the distress the infant is experiencing. This type of parent profile has consistently been linked to disorganized infant attachment (Lyons-Ruth, Bronfman, & Parsons, 1999; Madigan et al., 2006; Out et al., 2009).

This finding taken together with the finding in Research Aim 2 suggests that very low levels or a lack of caregiver verbal reassurance during an infants 2-month immunization appointment, where the highest levels of infant distress are typically seen, is associated with later disorganized infant attachment. Verbal reassurance at immunization appointments after the 2-month appointment does not appear to relate to subsequent infant attachment, although given its robust link to increased infant pain expression, high levels of verbal reassurance should still be avoided after 2-months of age.

Did caregiver <u>pacifying</u> within-appointment trajectories relate to infant attachment? There were no significant relationships between pacifying at 3 minutes after the needle at any age nor were changes in pacifying within an appointment related to infant attachment. These findings were in line with the results from Research Aim 2, but contrary to our hypotheses.

Pacifying was used very infrequently in the current study, making it difficult to make any firm conclusions regarding its relationship to infant attachment. However, it is possible that the timing of pacifying use within the immunization appointment may not be an important factor in the development of infant attachment.

However, despite the lack of significant relationships, the mean frequencies for caregiver pacifying use were again in the expected direction, but at certain ages only. Caregivers of infants with disorganized and insecure attachment styles had the highest average level of "offering pacifier" frequencies across the entire post-needle period at the 2- and 4-month immunization appointments. These caregivers also had the highest pacifying frequencies at 2 minutes after the 6-month immunization appointment. Therefore, the timing of pacifying use, both across and within procedures, may be worth examining in relation to infant attachment classifications with higher frequencies of pacifying and a larger sample.

Summary of results from Research Aim 3. Partially in line with findings from Research Aim 2, infants classified as secure or organized in their attachment were more likely to have caregivers who continued engaging in proximal soothing for longer after their 12-month immunization(s) (i.e., at the 3rd minute after the needle). Caregivers who persist in maintaining proximity to their infant beyond the initial distress reactivity are those that are more likely to have fostered secure or organized attachment relationships in their infants. It is important to note this was the only caregiver behaviour pattern related to infant secure attachment, the attachment style associated with the best long term outcomes. Caregiver verbal reassurance use for longer after the 2-month immunization(s) (i.e., at the 3rd minute after the needle) also predicted organized infant attachment. These caregivers may be responding appropriately given the context of their infants' first immunization experience where many infants experience significant pain responses and have little self regulatory abilities. Taken together, these findings support the idea that timing of caregiver soothing behaviours is important.

Clinical Implications of the Dissertation and Future Directions

Results from Research Aims 1, 2, and 3 provide novel contributions to the field of pediatric psychology and infant mental health. The current results also provide support for the immunization context as a valid context within which to study infant attachment, a construct strongly related to mental health outcomes. Results from the current longitudinal study have implications for clinical interventions for infants undergoing immunizations as well as those that are at risk of developing attachment-related difficulties.

Building on research on attachment theory that has found caregiver sensitivity to infant cues to be important in the development of secure infant attachment (Ruth-Lyons, Connell, Zoll, & Stahl, 1987, Pederson et al., 1990, Smith & Pederson, 1988; Cassidy, 1994), the current study's findings related to caregiver proximal soothing are of primary clinical importance. Proximal soothing, comprised of physical comfort (i.e., hugging, kissing, rubbing, patting) and rocking, was a key factor related to infant organized and secure attachment at 12 months of age. By validating these key caregiver behaviours in the immunization context, it provides the basis from which to inform and teach caregivers, particularly those that are at risk of attachment difficulties, to use these simple techniques. This finding is also consistent with research from the pediatric pain literature indicating that proximal soothing is effective for reducing immunization pain-related distress (Jahromi, Putnam, & Stifter, 2004; Campos, 1994; Jahromi & Stifter, 2007; Pederson 1975; Schechter et al., 2007). It follows that providing parents with these simple tools can impact not only their infants' pain experiences but also their emotion regulation and in turn their attachment relationship. Identifying simple caregiver behaviours that can be observed repeatedly across the infant's first year of life could also form the foundation for the development of a screening tool that primary health care providers could use to assess dyads and identify those that may need extra support.

Verbal reassurance is another caregiver soothing behaviour that may be easily observed and provides insight into how a caregiver-infant dyad is functioning. When an infant is young (e.g., 2 months), higher verbal reassurance may be reflective of a caregiver who is able to cope with the infants' distress and reacts accordingly, whereas lower levels or a lack of verbal reassurance at this young age may be reflective of a caregiver that is unable to cope with their infants' distress and may even be fearful of this distress. Verbal reassurance use after the needle at 4, 6, and 12 months of age was not found to be related to infant attachment, therefore verbal reassurance at these ages does not appear to be an important factor in the development of infant attachment.

It is also important to note that, besides verbal reassurance use during the 3rd minute after the 2-month immunization(s) predicting organized infant attachment, there were no significant relationships between caregiver soothing behaviours and infant attachment at the 2-, 4-, or 6-month time points. These findings are in line with research outlining the development of attachment across the first year of life. Bowlby (1969/1982) and Ainsworth et al. (1979) described attachment as a dynamic construct that passes through many stages until a more solidified attachment relationship with a primary caregiver is developed by 1 year of age.

By finding discrete caregiver soothing behaviours which promote or hinder the development of secure and organized attachment relationships, health care workers who have repeated exposure to caregiver-infant dyads could provide easy and quick tips to caregivers for better soothing their distressed infant. These tips would not only provide immediate results in terms of decreasing their infant's pain-related distress, but would also have long-lasting implications in terms of the infant's attachment and mental health outcomes. Additional research should look at the longer-term outcomes that these caregiver trajectories have on constructs related to overall well-being. Future studies using the OUCH Cohort will follow up these caregiver-infants dyads in preschool to examine any links between these findings and childhood outcomes such as intelligence, sleep disturbances, emotional and behavioural concerns, and so on.

Limitations

Given the novel approach to linking attachment and immunization, a decision was made not to apply a Type I error correction to the error rates used in the study. Given the number of analyses in the current study, it is nearly certain that Type I errors have occurred. However, this study provides novel data to demonstrate the need to further examine the relationship between attachment and caregiver behaviours on a larger scale during immunization.

There are several other limitations of the current study to highlight. The inclusion criteria required that caregivers be fluent in English in order for them to understand and complete two consent forms and a temperament questionnaire (not used in the current analyses), thus limiting the generalizability of the results. In addition, the caregivers in this study were also highly educated (76% had a university or graduate education). The results may not generalize to less-educated caregivers and more high-risk populations.

Although the overall sample size ($N = 130$) was adequate, when broken down into the four attachment classifications (A/B/C/D), the small groups with unequal *n*s made examining the differences between these distinct groups difficult. Future studies with lager sample sizes should examine these relationships with all four attachment classifications to understand the key differences that are hypothesized to exist.

Conclusion

The findings from the current study support the notion that specific caregiver soothing behaviours during immunization are related to infant attachment. By comparing caregiver behaviours in a naturalistic context to caregiver-infant interactions in a laboratory based setting, this project bridges the gap between the pediatric pain and infant mental health literatures. The link between these literatures sets the foundation for identifying caregiver-infant dyads at risk for problems in attachment as well as primary care interventions with the goal of improving the attachment relationship and related outcomes. However, additional research is needed to elucidate the link between caregiver behaviour trajectories and infant well-being later in childhood.

Attachment theory highlights the importance of proximity as a central tenant. Bowlby (1969/1982) posited that during distressing events, infants are innately driven to achieve and maintain proximity to their caregiver. The findings from the current study support this view in that caregiver proximal soothing was related to infant attachment both across the first year of life and within an immunization appointment at 12-months of age, once the attachment relationship has become more stable. The findings suggested that more proximal soothing at 12 months was associated with organized infant attachment and that proximal soothing for longer after the 12-month immunization(s) (i.e., at 3 minutes after the needle) was associated with both secure and organized infant attachment. In addition, at 2 months, caregiver verbal reassurance use for longer after the needle predicted organized infant attachment. These caregivers were also characterized by a U-shaped trajectory of verbal reassurance over the first year of life. In contrast, caregivers with steep decreases in proximal soothing across the first year were more likely to have infants who were disorganized in their attachment relationship. These caregivers were also characterized by low levels of verbal reassurance at 2 months that increased over time and then decelerated (i.e., the increase slowed) by the end of the first year of life.

The current findings are also consistent with research from the pediatric pain literature. Proximal soothing has generally been shown to promote decreases in infant pain-related distress, whereas verbal reassurance consistently predicts increases in infant pain-related distress. Despite the multitude of studies in the area of pediatric pain management, results from our large-scale naturalistic study showed that caregivers, in general, engage in soothing behaviours relatively infrequently during immunization appointments across the first year of life (on average less than 50% of the time). Given that these soothing behaviours are specific, easily observed, and teachable, it follows that health care providers (e.g., pediatricians, nurses) could promote the appropriate soothing behaviours early on (e.g., at 2 months) and continue to reinforce these behaviours across the crucial first year of life. Research has begun to draw attention to the great potential for 'in the moment' teaching during routine pediatric visits, with a focus on changing caregiver behaviour which ultimately impacts positive change in infant well-being and mental health (Ranger & Campbell-Yeo, 2008; Zeanah & Gleason, 2009).

The findings from the current study provide insight into the types of 'in the moment' teaching that could be offered to caregivers. The current study suggests that a hierarchical approach to soothing is optimal for promoting positive infant attachment relationships and a less painful experience for infants during immunizations. For example, caregivers should first be encouraged to engage in proximal soothing as long as their infant is distressed and then, once infant distress has regulated sufficiently, other strategies such as distraction can be attempted. In addition, verbal reassurance should not be discouraged at 2 months of age. Advice can be imparted in many different ways, such as making observations out loud about what is good as well as what could be changed about the interaction (e.g., "It seems like your baby is really comforted by being close to you", and "now that your baby is calmer, why don't you try distracting her with this toy"). Brief tip sheets as well as brief video clips available on pediatricans' websites may also be effective ways to communicate key pieces of information.

By improving caregiver infant interactions early on, a ripple effect could occur whereby caregivers will continue to use these basic tips in subsequent distressing contexts both in and outside of the immunization appointment. Improving these caregiver infant interactions over the first year of life is also likely to impact attachment security and infant emotion regulation abilities, all of which provide the foundation from which a person learns to effectively cope with distress throughout his or her life. Early intervention could therefore not only have a more immediate impact on infant pain and the development of a secure attachment relationship over the first year of life, but may also impact a child's well-being and long term outcomes over the lifespan.

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Appendix A

Summary of Analyses and Results

Research Aim 1: To describe the average trajectories of caregiver behaviours (i.e., emotional availability, proximal soothing, distraction, verbal reassurance and pacifying) during routine immunizations *across* the first year of life

Analysis: Five latent growth models (LGM) were used to describe the pattern of change in each of the 5 caregiver behaviours across the first year of life.

Five research questions (one for each caregiver behaviour) subsume this aim.

1a) What is the mean trajectory of caregiver emotional availability across the first year of life (i.e. from 2 to 4 to 6 to 12 months)?

Results: Mean emotional availability scores were high and relatively stable over the first year of life. The mean trajectory indicated that caregiver emotional availability increased slightly at the beginning of the first year and the rate of increase slowed over time.

1b) What is the mean trajectory of caregiver proximal soothing across the first year of life?

Results: Mean proximal soothing frequencies were moderate (used 30-40% of the post-needle period). The mean trajectory indicated that caregiver proximal soothing decreased across the first year of life, especially from 4 to 6 months of age.

1c) What is the mean trajectory of caregiver distraction across the first year of life?

Results: Mean distraction frequencies were low (used < 10% of the post-needle period). The mean trajectory indicated that caregiver distraction increased at the beginning of the first year and the rate of increase slowed over time.

1d) What is the mean trajectory of caregiver verbal reassurance across the first year of life?

Results: Mean verbal reassurance frequencies were relatively low (used < 20% of the post-needle period). The mean trajectory indicated that caregiver verbal reassurance frequencies decreased over the first year and the rate of decrease slowed over time.

1e) What is the mean trajectory of caregiver pacifying across the first year of life?

Results: Mean pacifying frequencies were low (used ≤ 5% of the post-needle period). The mean trajectory indicated that pacifying decreased slightly across the first year of life.

Research Aim 2: To relate caregiver behaviour trajectories *across* the first year of life to subsequent infant attachment during the second year of life

Having first described the mean trajectories across the first year of life, the second goal of the current study was to link these mean caregiver behaviour trajectories to infant attachment. This allowed us to examine whether the pattern of change in these behaviours over the first year of life was related to attachment. This was accomplished by using a statistical technique (i.e., latent growth modeling) that provided key descriptive information (i.e., intercept and slope factors of the average trajectory), as well as the variability around the mean for each caregiver behaviour. The intercept factor was set to represent the mean caregiver behaviour score at 12 months and the slope factor represented the change in the caregiver behaviour over time (i.e., 2 to 12 months of age). These trajectory factors (i.e., intercept and slope) were then used to examine the relationship between these trajectories and infant attachment. Of note, the 4-way attachment categorization (A/B/C/D) could not be examined because of our relatively small sample size with un-equal *n*s.

Analyses: 10 LGMs, including logistic regressions (5 caregiver behaviours X 2 attachment classification groupings [secure/insecure; organized/disorganized]).

(2a) Did caregiver emotional availability trajectories relate to infant attachment?

Results: Caregiver EA trajectory factors were not related to infant attachment.

(2b) Did caregiver proximal soothing trajectories relate to infant attachment?

Results: Proximal soothing at the 12-month immunization appointment (i.e., intercept factor) was related to infant attachment such that higher levels of caregiver proximal soothing were associated with organized infant attachment. In addition, a steeper decrease in proximal soothing over the first year of life (i.e., slope factor) was related to disorganized infant attachment.

(2c) Did caregiver distraction trajectories relate to infant attachment?

Results: Distraction trajectory factors were not related to infant attachment.

(2d) Did caregiver verbal reassurance trajectories relate to infant attachment?

Results: Quadratic change in verbal reassurance over the first year of life was related to infant attachment such that organized infant attachment was associated with a U-shaped trajectory of caregiver verbal reassurance use (i.e., starting around 16% then decreasing to around 10% at 6 months, then increasing to approximately 15% at the end of the first year). In contrast, disorganized infant attachment was associated with low levels (around 8%) of caregiver verbal reassurance at the beginning of the first year that increased over time and then decelerated (i.e., the increase slowed) by the end of the first year (ending at around 17%).

(2e) Did caregiver pacifying trajectories relate to infant attachment?

Results: Pacifying trajectory factors were not related to infant attachment.

<u>Research Aim 3</u>: To relate caregiver behaviour trajectories *within* each immunization appointment, at a given infant age, to subsequent infant attachment during the second year of life

Having examined the relationship between infant attachment and the trajectories for caregiver behaviours *across* the first year, the analysis then turned to examining trajectories of caregiver behaviours *within* the immunization appointment (i.e., average frequency of each behaviour for the 1^{st} , 2^{nd} , and 3^{rd} minute after the needle). In essence, the within appointment trajectories describe how the frequency of each caregiver behaviour changed over the appointment (rather than over the year). Caregiver emotional availability was not included in these analyses as EA is based on one score for the entire immunization appointment. Latent growth modeling was again used to generate an intercept factor (i.e., mean caregiver behaviour score at 3 minutes after the needle) and a slope factor (i.e., change in caregiver behaviour from 1 to 3 minutes after the needle), as well as variability around the mean for each of the four caregiver variable trajectories at each of the four immunization appointments (2, 4, 6, and 12 months). The trajectory factors (i.e., intercept and slope) were then used to examine the relationship between these trajectories and infant attachment. As in Research Aim 2, the 4-way attachment categorization could not be examined because of our relatively small sample size with un-equal *n*s.

<u>Analysis:</u> 16 unconditional LGMs (4 caregiver behaviours X 4 immunization appointments [2, 4, 6, 12 months] were estimated to describe the average within-appointment trajectories; followed by 32 conditional LGMs (i.e., including logistic regressions; 4 caregiver behaviours X 4 immunization appointments [2, 4, 6, 12 months] X 2 attachment classification groupings [S/I; O/D]).

(3a) Did caregiver <u>proximal soothing</u> within-appointment trajectories relate to infant attachment?

Results: Proximal soothing at the 12-month immunization appointment, during the 3^{rd} minute after the needle (intercept factor), was related to infant attachment such that higher levels of proximal soothing were associated with secure and organized infant attachment.

(3b) Did caregiver <u>distraction</u> within-appointment trajectories relate to infant attachment?

Results: Distraction trajectory factors were not related to infant attachment at any age.

(3c) Did caregiver <u>verbal reassurance</u> within-appointment trajectories relate to infant attachment?

Results: Verbal reassurance at the 2-month immunization appointment, during the 3^{rd} minute after needle (intercept factor), was related to infant attachment such that higher levels of verbal reassurance were associated with organized infant attachment.

(3d) Did caregiver pacifying within-appointment trajectories relate to infant attachment?

Results: Pacifying trajectory factors were not related to infant attachment at any age.

Appendix B

Strange Situation Procedure Episodes (adapted from Ainsworth et al., 1978)

Episode #	Duration	Description
1	30 seconds	The caregiver and infant are introduced to a novel room by the researcher who instructs the caregiver to carry the baby into the room, engage them with the toys and sit in a chair where he or she is free to peruse a magazine.
2	3 minutes	Begins when the caregiver places the infant on the floor in front of the toys, facing the one-way mirror. The infant is subsequently left to explore the toys and/or room while the caregiver refrains from initiating interaction with the baby from his or her chair unless the baby initiates interaction, in which case, the caregiver is instructed to respond in a way he or she deems appropriate. If the infant has not settled into exploring the toys or the room after two minutes' time, the observer may knock on the one-way mirror as a cue to the caregiver to attempt to engage the infant in play/exploration for one minute (timed by the observer)
3	3 minutes	A stranger enters the room and takes a seat in the second chair where she remains silent for a minute. During the second minute, the stranger engages the caregiver in conversation and provides further instructions. During the third minute of the episode, the stranger approaches the infant and engages him or her in play. A knock from the observer at the end of the third minute cues the caregiver to unobtrusively leave the room.
4	3 minutes or less	During the first separation episode, the stranger interacts with the infant, taking his or her cues from the infant. If the infant becomes markedly distressed and is not able to resume play or exploration, the observer may wish to terminate the episode prior to 3 minutes by sending the caregiver back into the room.
5	3 minutes or more	The first reunion episode begins when the caregiver returns to the room, pausing at the door in order to allow the baby to great her spontaneously. Following the greeting between caregiver and infant, the stranger surreptitiously leaves the room. The observer may wish to prolong the episode if the baby takes a long time to become re-involved in play or exploration. Caregiver then leaves baby alone in the room, saying "bye bye" upon her departure.
6	3 minutes or less	The baby is left alone in the room during the second separation episode which the observer may wish to cut short by sending the stranger into the room if the baby is markedly distressed prior to the end of the 3 minutes.
7	3 minutes or less	The second separation from caregiver continues during this episode when the stranger enters the room and interacts with the baby, following his or her cues. Again, the observer may wish to cut the episode short by sending the caregiver into the room if the baby is markedly distressed prior to the end of the 3 minutes.
8	3 minutes	During the second reunion episode, the caregiver returns to the room and pauses at the door to allow baby to greet her spontaneously. After the caregiver and infant have greeted each other, the stranger leaves unobtrusively.

Appendix C

Indices of Disorganization and Disorientation (Main & Solomon, 1990)

I. Sequential display of contradictory behaviour patterns

II. Simultaneous display of contradictory behaviour patterns

III. Undirected, misdirected, incomplete, and interrupted movements and expressions

IV. Stereotypies, asymmetrical movements, mistimed movements, and anomalous postures

V. Freezing, stilling, and slowed movements and expressions

VI. Direct indices of apprehension regarding the caregiver

VII. Direct indices of disorganization or disorientation

For detailed descriptions, see Main & Solomon, 1990.

Reference: Main, M. & Solomon, J. (1990). Procedures for identifying infants as disorganized/disoriented during the Ainsworth Strange Situation. In Mark T. Greenberg, Dante Cicchetti, & E. Mark Cummings (Eds.), *Attachment in the Preschool Years: Theory, Research and Intervention* (pp. 121-160). Chicago: The University of Chicago Press.

Appendix D
Ethics Approval from York University and The Hospital for Sick Children

YORK
UNIVERSITÉ
UNIVERSITY

RENEWAL

Certificate #:	**2009 - 216**
3rd Renewal Approved:	**08/20/12**
2nd Renewal Approved:	**08/04/11**
Renewal Approved:	**08/3/10**
Approval Period:	**08/20/12-08/20/13**

OFFICE OF RESEARCH ETHICS (ORE)
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Memo

To: Dr. Rebecca Pillai Riddell, Faculty of Health
rpr@yorku.ca

From: Alison M. Collins-Mrakas, Sr. Manager and Policy Advisor, Research Ethics
(on behalf of Duff Waring, Chair, Human Participants Review Committee)

Date: **Monday August 20th, 2012**

Re: Ethics Approval

Synergizing Infant Health and Infant Mental Health: Applying Attachment Theory to the Context of Infant Pain

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With respect to your research project titled, "Synergizing Infant Health and Infant Mental Health: Applying Attachment Theory to the Context of Infant Pain", the committee notes that, as there are no substantive changes to either the methodology employed or the risks to participants in the research project or any other aspect of the project, a renewal of approval re the above project is granted.

Should you have any questions, please feel free to contact me at: 416-736-5914 or via email at: acollins@yorku.ca.

Yours sincerely,

Alison M. Collins-Mrakas M.Sc., LLM
Sr. Manager and Policy Advisor,
Office of Research Ethics

SickKids

THE HOSPITAL FOR
SICK CHILDREN

RESEARCH ETHICS BOARD

August 12, 2011

Dr. Rebecca Pillai Riddell
Psychiatry
The Hospital for Sick Children

Dear Dr. Pillai Riddell:

Your study "Synergizing Infant Health and Infant Mental Health: Applying Attachment Theory to the Context of Infant Pain"

REB File No.: 1000013477

On behalf of the REB, I am writing to confirm that the above noted study was re-approved by the REB for one year ending in August 2012. The REB approved continuing review at level 1B. As necessary, the Clinical Research Office will be contacting you to arrange follow-up.

Please note that, in accordance with the Personal Health Information Protection Act of Ontario, you are responsible for adhering to all conditions and restrictions imposed by the REB governing the use, security, disclosure, return and disposal of the research subjects' personal health information. You are also responsible for reporting immediately any privacy breaches to the REB Chair and to Janice Campbell, the Sick Kids privacy officer.

Yours truly,

Richard Sugarman

Richard Sugarman
Chair, Research Ethics Board

Co-Investigator(s): Rachel Horton, Jessica Hillgrove

555 University Ave
Toronto, Ontario
Canada M5G 1X8

www.sickkids.ca

Appendix E

Information Package for Participating Parents

Directions to Sick Kids

The Hospital for Sick Children (SickKids) is located at 555 University Avenue (Corner of University and Gerrard).

How to get to SickKids by TTC - subway:
Exit at Queen's Park subway station and walk south two blocks on University Avenue. For bus and subway information, call the 24-hour ttc line at (416) 393-4636 or visit their Web site: www.ttc.ca

How to get to SickKids by car:
If driving from a **northern direction**, take the Don Valley Parkway south (downtown). Exit at Bloor Street and make a left on to Castle Frank Road then a right onto Bloor Street. Follow Bloor (travelling west) to Bay Street (Bay Street is one intersection west of Yonge). Travel south on Bay and make a right on to Elm Street. Parking and the hospital can be found one block west, on your right side.

If driving from a **southern direction**, exit the Gardiner Expressway at the York Street/Bay Street exit. Take the York Street ramp. Go straight on York Street. Turn left onto University Avenue. Travel north on University Avenue up to Elm Street. Make a right on Elm. The hospital's underground parking can be found one block east, on your left side.

If driving from the **east or west**, take the 401 to the Don Valley Parkway south (downtown). Follow the directions from above, driving from a northern direction.

Where to go at Sick Kids…

ON SATURDAY AND SUNDAYS, PLEASE USE THE ELIZABETH STREET ENTRANCE

Once at the Hospital, take the Black Wing Elevators (in front of the Shoppers Drug Mart and closest to the University Avenue entrance) to the 4th Floor.

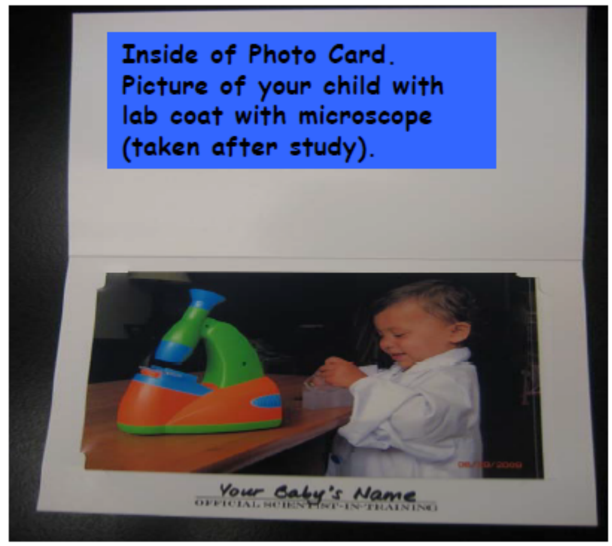
A research assistant will be waiting for you at the Black Wing elevators on the 4th Floor. We will be taking you to the Psychiatry Research Wing.

If you get lost, call the OUCH lab and leave a message as to where you are (and a contact number if you have your cell), we'll be checking messages- 416 736-2100 X20177

Map of main floor at Sick Kids

THE FUN STUFF…

the post-study souvenirs for you and your baby



Appendix F
Research Consent Form and Video Consent Form

YORK UNIVERSITÉ UNIVERSITY redefine THE POSSIBLE.

SickKids® THE HOSPITAL FOR SICK CHILDREN
Research Ethics Board

Date: September 20th, 2008
Version Code: 1

Research Consent Form

Title of Research Project:
Synergizing Infant Health and Infant Mental Health: Applying Attachment Theory to the Context of Infant Pain

Investigator(s):
Principal Investigator:

Dr. Rebecca Pillai Riddell, PhD, CPsych
(416) 736-2100, ext. 33204 (York University)
(416) 813-6854 (Sick Kids)

Co-Investigators:

Rachel Horton, MA, Clinical Developmental Psychology
Doctoral Student, York University
Supervisor: Dr. R. Pillai Riddell
Clinical Research Assistant, The Hospital for Sick Children
(416) 736-2100, ext. 20177 (York University)

Jessica Hillgrove, Clinical Developmental Psychology
Doctoral Student, York University
Supervisor: Dr. R. Pillai Riddell
Clinical Research Assistant, The Hospital for Sick Children
(416) 736-2100, ext. 20177 (York University)

Purpose of the Research:
We are doing this study to understand ways that we can help infants when they are having pain. Specifically, we are interested in finding out if the ways in which caregivers and their infants interact impacts how infants experience and express pain.

Description of the Research:
We are interested in looking at parents and infants when infants are between 12 and 18 months of age. We will be videotaping your infant's immunization visit today and would like to invite you to a laboratory visit at the Hospital for Sick Children in the next two week that will involve everyday interactions between yourself, your infant and a research assistant. This visit will take no longer than 45 minutes and you will

receive a small token of our appreciation as well as compensation for travel to and from the hospital.

1) We will use information from your participation in our earlier study at Dr. Greenberg's/Dr. Garfield's clinic.
2) You will receive reminders via phone, mail or email regarding your upcoming hospital visit appointment.
3) You and your infant will be videotaped during the laboratory visit. You will be asked to fill out a separate consent form regarding videotaping.

Potential Harms:

We know of no harm that taking part in this study could cause you or your baby.

Potential Discomforts or Inconvenience:

The only potential inconvenience with participating in this study is that you and your child will be taking time out of your day to travel to the Hospital for Sick Children. TTC travel costs (to and from the Hospital) or parking costs (at the Hospital) will be provided to minimize your inconvenience.

Potential Benefits:

To individual subjects:

You and your child will not benefit directly from participation in this study. If you are interested in our findings, please let the research assistant know by filling out the attached sheet and he/she will arrange to send a summary of the results to you after the study is completed. Specific findings pertaining to you and your child will not be available.

To society:

We hope that the results of this study will help us to understand pain in infants so that we can determine ways to manage it better.

Confidentiality:

We will respect your privacy. No information about who you are or who your child is will be given to anyone or be published without your permission, unless required by law. For example, the law could make us give information about you if a child has been abused, if you have an illness that could spread to others, if you or someone else talks about suicide (killing themselves), or if the court orders us to give them the study papers.

Sick Kids Clinical Research Monitors, employees of the funder or sponsor [Canadian Institutes of Health Research], or the regulator of the study may see your health record to check on the study. By signing this consent form, you agree to let these people look at your records. We will give you a copy of the consent form for your records.

The data produced from this study will be stored in a secure, locked location. Only members of the research team (and maybe those individuals described above) will have access to the data. This could include external research team members. Following completion of the research study the data will be kept as long as required then destroyed as required by Sick Kids policy. Published study results will not reveal your identity.

Reimbursement:
In addition to TTC or parking costs, after completing the study we will also provide you with a certificate of participation and a small token of appreciation (infant t-shirt) in recognition of your time and effort. If after beginning the study, you want to stop taking part, we will still pay you for your TTC or parking expenses.

Participation:
It is your choice to take part in this study with your infant. You can stop at any time. The care you get at Sick Kids or by your pediatrician will not be affected in any way by whether you take part in this study or withdraw from this study. Nor will your refusal/withdrawal jeopardize current or future relationships with the researchers at any of the institutions involved with this study (e.g. York University).

New information that we get while we are doing this study may affect your decision to take part in this study. If this happens, we will tell you about this new information. And we will ask you again if you still want to be in the study.

During this study we may create new tests or other things that may be worth some money. Although we may make money from these findings, we cannot give you [or your child] any of this money now or in the future because you [or your child] took part in this study.

If you or your child becomes ill or are harmed because of study participation, we will treat you or your child for free. Your signing this consent form does not interfere with your legal rights in any way. The staff of the study, any people who gave money for the study, or the hospital/pediatrician's office are still responsible, legally and professionally, for what they do.

Sponsorship:
The sponsor of this research is the Canadian Institutes of Health Research. The discretionary funding has been allocated to Dr. R. Pillai Riddell as a result of New Investigator Award.

Conflict of Interest:
None of the research team members have any conflicts of interest to declare.

Consent :
By signing this form, I agree that:
1) You have explained this study to me. You have answered all my questions.

2) You have explained the possible harms and benefits (if any) of this study.
3) I know what I could do instead of having my child take part in this study. I understand that I have the right to refuse to let my child take part in the study. I also have the right to take my child out of the study at any time. My decision about my child taking part in the study will not affect my child's health care at Sick Kids or by my child's pediatrician.
4) I am free now, and in the future, to ask questions about the study.
5) I have been told that my child's medical records will be kept private except as described to me.
6) I understand that no information about my child will be given to anyone or be published without first asking my permission.
7) I agree, or consent, that my child ______________________ may take part in this study.

*(Baby's **first** and **last** name)*

Printed Name of Parent/Legal Guardian signature & date	Parent/Legal Guardian's
Printed Name of person who explained consent	Signature of Person who explained consent & date

If you have any questions about this study, please call Dr. Rebecca Pillai Riddell at 416-736-2100, extension 33204 or 416-813-6854 (Sick Kids). If you have any questions about your rights as a participant a study or injuries during a study, please contact Ms. Alison Collins-Mrakas, Manager, Research Ethics, 309 York Lanes, York University [telephone (416)736-5914 or e-mail acollins@yorku.ca] or Ms. Margo Farren, Research Ethics Manager, Hospital for Sick Children, Room 5255 Black Wing, Sick Kids [telephone (416 813-5718 or email margo.farren@sickkids.ca].

CONTACT INFORMATION:

I consent for researchers to contact me via mail, email or phone regarding:

Check which statements applies:

☐ No further contact aside from contact directly related to participation in this study.
☐ Further contact for results of this study.
☐ Further contact for results of this study and opportunities for participation in new future studies.

Mailing address:
Email address:
Phone number:

Please print clearly

YORK U UNIVERSITÉ UNIVERSITY

SickKids THE HOSPITAL FOR SICK CHILDREN

Research Ethics Board

Date: September 20th, 2008
Version Code: 1

Videos, Photographs, & Sound Recordings Consent Form

Title of Research Project: Synergizing Infant Health and Infant Mental Health: Applying Attachment Theory to the Context of Infant Pain

Investigator(s):

Principal Investigator:

Dr. Rebecca Pillai Riddell, PhD, CPsych
(416) 736-2100, ext. 33204 (York University)
(416) 813-6854 (Sick Kids)

Co-Investigators:

Rachel Horton, MA, Clinical Developmental Psychology
Doctoral Student, York University
Supervisor: Dr. R. Pillai Riddell
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Jessica Hillgrove, Clinical Developmental Psychology
Doctoral Student, York University
Supervisor: Dr. R. Pillai Riddell
Clinical Research Assistant, The Hospital for Sick Children
(416) 736-2100, ext. 20177 (York University)

Confidentiality:

The pictures or tapes produced from this study will be stored in a secure, locked location. Only members of the research team (and maybe the SickKids monitor) will have access to them. Following completion of the study the tapes/pictures will be kept for 7 years post-publication. They will then be destroyed according to this same policy.

Consent*:*

By signing this form,

1) I agree for my child and I to be taped during this study. These tapes/photographs will be used to provide information regarding how caregivers can help infants in pain.
2) I understand that I have the right to refuse to take part in this study. I also have the right to withdraw from this part of the study at any time e.g. before or even after the tapes or photographs
are made. My decision will not affect my health care at SickKids or by my child's pediatrician.

3) I am free now, and in the future, to ask questions about the taping/picture taking.
4) I have been told that my medical records will be kept private. You will give no one information about me, unless the law requires disclosure.
5) I understand that no information about me (including these tapes/pictures) will be given to anyone or be published without first asking my permission.
6) I have read and understood both pages of this consent form. I agree, or consent, to having my picture taken/being taped as part of the study.

Questions about the Videotaping? If you have questions about the research in general or about your role in the study, please feel free to contact Dr. Rebecca Pillai Riddell either by telephone at (416) 736-2100, extension 33204 or at (416) 813-6854 or by e-mail (rpr@yorku.ca). This research has been reviewed by the Human Participants Review Committee in accordance with York's Senate Policy on Research Ethics (York University) and the HSC's Research Ethics Board. This study conforms to the standards of the Canadian Tri-Council Research Ethics guidelines. If you have any questions about this process or about your rights as a participant in the study, please contact Ms. Alison Collins-Mrakas, Manager, Research Ethics, 277 York Lanes, York University [telephone (416)736-5914 or e-mail acollins@yorku.ca] or Ms. Margo Farren, Research Ethics Manager, Hospital for Sick Children, Room 5255 Black Wing, Sick Kids [telephone (416 813-5718 or email margo.farren@sickkids.ca].

I agree to be videotaped along with my child in this study entitled "Synergizing Infant Health and Infant Mental Health: Applying Attachment Theory to the Context of Infant Pain". I have also received a copy of this consent form for my own records.

In addition, I agree or consent for this tape(s)/photograph(s) to be used for:

1. Other studies on the same topic **o**
2. Teaching and demonstration at York University/SickKids. **o**
3. Teaching and demonstration at meetings outside York /SickKids. **o**
4. Not to be used for anything else. **o**

In agreeing to the use of the tape(s)/photograph(s) for other purposes, I have been offered a chance to view/hear the tape(s)/photograph(s). I also have the right to withdraw my permission for other uses of the tape(s)/photograph(s) at any time.

____

Printed Name of Participant *Participant's signature & date*

____

Printed Name of person who explained consent *Signature & date*

____

Printed Witness' name (i.e. when Participant does not *Witness' signature & date*

Appendix G:
MAISD parent and infant behaviour descriptions

MAISD Coding Manual

Adult Category	*Definition and Examples*
Distraction	Behaviors intended to distract the infant. This may include the use of props (e.g., holding up toys, pointing to posters on the wall) or not (e.g., making funny faces, clapping). This is still coded even if the child does not appear to be distracted by the behavior.
Offer Toy	If the adult simply hands (or attempts to hand) the child a toy-like object in an effort to comfort or distract him/her. If the parent uses the toy to interact with the child, code Distraction and not Offer Toy. Often an adult may hand the child a toy so that the child will soothe him/herself.
Offer Pacifier	If the parent either hands the infant the pacifier or puts the pacifier in the infant's mouth. This is still coded if the infant does not accept the pacifier.
Offer Food	Feeding can include handing the child a bottle, cracker, other food, or nurses. Code even if the child rejects the food/nursing.
Physical Comfort	Any physical (i.e., nonverbal) behavior conducted in an attempt to comfort the child. This may include: rubbing, massaging, or patting the child (may be on the head, back, or other body part), kissing the child, or a comforting hug. If the adult is simply holding the child so that the procedure may be performed, do not code hug. This has to be an obvious and blatant squeeze.
Rocking	If the parent remains in the chair and begins to sway, rock, or bounce the child. When the adult stands up and rocks, sways, or bounces, or when the adult moves around the room while holding the child.
Verbal Reassurance	Reassuring comments (e.g., "it is okay" "we are almost done" "it's alright, baby" "I'm sorry").

Infant Category	*Definition and Examples*
Engage in Distraction	Watches distraction (e.g., toys, posters on the wall, television, funny faces, clapping) or interacts with parent on non-procedural event (e.g., playing with toy, playing peek-a-boo).
Play with Object Alone	Manipulating, moving, or playing with a toy or object of interest (e.g., stuffed animal, sock, keys, bottle, piece of plastic, necklace). However, he/she must play by his/herself otherwise code as Engage in Distraction. This may be interpreted as self-soothing rather than relying on adult-soothing, even if adult gives child the object.
Suck	Any sucking behavior (on pacifier or while nursing). If the pacifier is in the infant's mouth at all, even if you can not see sucking action, code this. This includes sucking on the fingers, hands, blanket, etc.
Consume Food	Drinking from a bottle or eating solids (e.g., crackers, baby food).
Smiling/Cooing	Smiling, cooing or laughing.
Cry	Sobbing or full-lunged cry, whining (which expresses distress or dislike), or silent cry (i.e., baby appears to be crying but you don't hear anything).
Scream	High-pitched yell.
Flail	Complex, agitated body movements. If child is being restrained, look for body tension and squirming. If the child is simply wiggling around, do not code this as flail. Flail is a distress behavior.
Distress Composite	**This behavior is a combination of cry, scream, and flail. It is not coded separately. To record this behavior, place a check in each interval in which any of cry, scream, flail occurs. Place only one check in each interval (i.e., if cry and flail happen in the same interval, place only one check).**