

# Caregiver Emotional Availability, Caregiver Soothing Behaviors, and Infant Pain During Immunization

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## Abstract

**Objective** To determine whether caregivers with more extreme emotional availability scores enact different levels of soothing behaviors and whether infants of these caregivers differ in their pain scores across the first year of life. **Methods** Cross-sectional analyses (analyses of variance and multivariate analyses of variance) were conducted with parent–infant dyads at 2, 4, 6, and 12 months of age who had extreme caregiver emotional availability scores. Pain scores were examined using a minimum clinically significant difference. **Results** Infants with lower pain scores had caregivers who were in the high emotional availability group. This effect was most pronounced during the regulatory period at 2 months, and clinically significant differences in pain scores were found during the regulatory period at 12 months. Physical comforting and/or rocking were characteristic of caregivers with high emotional availability. **Conclusion** This study suggests that caregiver emotional availability, in the extremes, do have clinically meaningful relationships with infant pain regulation.

**Key words:** infancy; pain; parenting; parents.

## Importance of Emotional Availability

The term “emotional availability” was first introduced in the context of mothers’ support of their infants’ initial independent explorations (Mahler, Pine, & Bergman, 1975), and has since been defined as “an individual’s emotional responsiveness and ‘attunement’ to another’s needs and goals” (Emde, 1980, p. 80). Because of its foundation in attachment theory, emotional availability shares similarities with Ainsworth’s concept of sensitivity, which involves accurately and contingently interpreting the cues and communications implicit in the infant’s behavior and responding accordingly (Ainsworth, Bell, & Stayton, 1974). In fact, emotional availability is thought to subsume and expand on Ainsworth’s concept of sensitivity, with an added emphasis both on the dyadic nature of the

parent–child relationship and on the emotional attunement of parent and infant (Bretherton, 2000). It is through this emotional responsiveness that infants develop an understanding of their emotional states and how to regulate from distressing events (Pillai Riddell & Chambers, 2007; Pillai Riddell & Racine, 2009).

Parental emotional availability, as well as the more traditional concept of sensitivity, is central to the development of self-regulation of emotions (Bretherton, 2000; Calkins, 1994; Conrath & Ablow, 2010). Self-regulation involves the acquiring of skills needed to modulate, inhibit, and enhance emotional experiences and expressions (Calkins & Hill, 2006). In infancy, dyads operate jointly to regulate negative emotionality (Crockenberg & Leerkes, 2004), allowing for the development of adaptive emotion regulation processes in

the infant (Conradt & Ablow, 2010). Throughout childhood, global measures of maternal sensitivity continue to be associated with better self-regulation of emotionality, which in turn allows for greater social competence and positive relations with others (Crockenberg & Leerkes, 2004; Leerkes, Blankson, & O'Brien, 2009).

### Parental Responsiveness in Distress Contexts

There is evidence that responsiveness to distress is especially influential in the development of regulation strategies. This is consistent with Bowlby's theory of instinctive behavior, which states that infant distress behaviors are intended to bring a caregiver close to reduce not only distress but also danger (Pillai Riddell & Chambers, 2007). Thus, responsiveness to distress signals should be of particular importance. Little and Carter (2005) found associations between dyadic emotional availability and infant distress regulation following an emotionally challenging condition. Conradt and Ablow (2010) found that maternal responsiveness during and after a period of distress predicts infant physiological and behavioral reactivity and regulation independently of responsiveness during a play episode. Responsiveness to infant distress also has long-term effects independent of responsiveness to nondistress, and is linked to socio-emotional outcomes in toddlerhood (Conradt & Ablow, 2010; Leerkes et al., 2009).

### Emotional Availability in the Pain Context

The study of infant pain provides an important context for examining parent–infant dyads in a distressing situation. For an infant, pain triggers not only negative affect but also the need for parental support in regulation (Din Osmun, Pillai Riddell, & Flora, 2014). Routine immunizations are the most frequent painful medical procedures in childhood (Taddio et al., 2009). Given their frequency, the study of these immunization appointments could provide valuable insight and aid in understanding developmental norms. The data for the current study is from the Opportunities to Understand Childhood Hurt (OUCH) cohort, a sample of parent–infant dyads who were followed at their 2-, 4-, 6-, and 12-month immunization appointments. Consistent with findings from other distress contexts, previous studies from the cohort have found higher caregiver emotional availability to be related to lower pain scores at the time of injection and across the appointment (Racine, Pillai Riddell, Flora, Garfield, & Greenberg, 2012), and to more rapid regulation of negative affect following the needle (Din Osmun et al., 2014). Although previous research has shown that emotional availability is statistically related to lower infant pain and more rapid regulation in the large sample, the magnitude of these relationships has

remained notably small (3–5% of the variance). Studies examining caregiver emotional availability and infant emotion regulation in high-risk samples (Little & Carter, 2005) have shown stronger relationships than our own work. However, our team has also shown how averaging over an entire sample obscures our understanding of true patterns (Pillai Riddell et al., 2013). This led us to pursue the hypothesis that perhaps by examining extremes of emotional availability, rather than simply averaging over the sample's diverse emotional availability scores, clinically significant differences may be found in lower risk samples.

### Caregiver Emotional Availability and Soothing Behaviors

Previous studies have also examined the soothing strategies used by caregivers during immunization appointments and their effectiveness in regulating infant distress. Previous research from the OUCH cohort has indicated that physical comforting, rocking, and verbal reassurance are the strategies used most often across age-groups, whereas offering food or offering a toy are used most infrequently (Lisi, Campbell, Pillai Riddell, Garfield, & Greenberg, 2013). In terms of effectiveness, pacifying and distraction are related to decreased distress at 2 and 6 months, respectively (Lisi et al., 2013). Verbal reassurance is related to increased distress at all ages (Lisi et al., 2013), perhaps through the communication of parental fear and anxiety (Racine et al., 2012). This is inconsistent with the findings of Jahromi, Putnam, and Stifter (2004) that holding/rocking and vocalizing were effective in reducing distress at all levels of infant reactivity; however, the authors did note that both strategies were only effective when used in tandem. Their findings also indicated that feeding and pacifying were effective at low or moderate levels, and that at the highest level of distress, touching and distracting lost their effectiveness (Jahromi et al., 2004).

Few studies have examined the variance in parental soothing strategies. There is some evidence that soothing techniques are affected by infant factors. Age-related trends were observed, such as an increased use of distraction at the 12-month appointment, and pacifying and physical comfort used most frequently at 2 and 4 months (Lisi et al., 2013). Distress level also plays a role, with higher reactivity predicting increased use of proximal soothing techniques at 4, 6, and 12 months (Campbell et al., 2013). Although it appears likely that parent factors contribute largely to the soothing strategies employed, there is little research on this subject. Racine et al. (2012) found a negative relationship between parent emotional availability and the use of verbal reassurance at 12 months, but not at any other age. To our knowledge, no other studies

have examined whether the use of soothing behaviors by parents is linked to caregiver emotional availability in a pain context.

### The Current Study

The overarching aim of the current study was to elucidate the role of caregiver emotional availability in the pain context by examining the extremes of emotional availability and by using a minimum clinically significant difference to identify differences. Understanding the extremes of emotional availability, particularly extremely low emotional availability, is important to pursue, given not only our previous work regarding fallacies of analyses based on average responses, but also long-standing recognition that significant challenges in parenting likely only occur when outside the range of “good enough” parenting (Winnicott, 1965).

The current study had two main goals: (1) to examine whether infants who have caregivers assessed to have either extreme high or extreme low emotional availability differ in their pain scores at 2, 4, 6, and 12 months, and (2) to examine whether caregivers who have either extreme high or extreme low emotional availability differ in their enacted soothing behaviors.

Based on previous findings from the cohort, we hypothesized that infants of caregivers with the highest emotional availability scores would have lower pain scores at the time of injection (Din, Pillai Riddell, & Gordner, 2009) and during their subsequent regulation (Racine et al., 2012). Further, based on our clinical understanding of the data, we hypothesized that these differences would have clinical significance, as determined by the 10% reduction in pain considered to be the minimal clinically important difference in child pain (Powell, Kelly, & Williams, 2001). We also hypothesized that high and low emotional availability caregivers would use different soothing strategies, potentially acting as a mechanism through which parental emotional availability impacts infant pain scores. Given infants' need for proximity during periods of distress (Pillai Riddell & Chambers, 2007), it was hypothesized that high-sensitivity caregivers would use proximal soothing behaviors, such as rocking and physical comfort, more frequently.

### Method

#### Participants

Participants in the current study were part of the OUCH longitudinal cohort. Caregiver–infant dyads were recruited from three pediatric clinics in Toronto at their 2-, 4-, or 6-month immunization appointments and followed at their subsequent immunizations over the first year of life. Infants were eligible if they were healthy, had not suffered any chronic illnesses, had never been admitted to a neonatal intensive care unit,

and had no suspected developmental delays. Caregivers were required to be able to read and speak English. All infants in the sample were considered healthy, and from middle-class, low-risk families. The total sample included 491 dyads at the 2-month appointment, 573 at the 4-month, 580 at the 6-month, and 526 at the 12-month appointment. As the design of the OUCH cohort recruited infants at their 2-, 4-, or 6-month immunization appointments, some of the same infants were present at each age-group. There were 65 caregiver–infant dyads who participated at 1 time point, 167 caregiver–infant dyads who participated at 2 time points, 266 caregiver–infant dyads with 3 time points, and 262 caregiver–infant dyads with all 4 time points.

Given that the data for the current study was taken from an ongoing longitudinal cohort, there is some overlap in variables used in this manuscript and other studies that have been published from the OUCH cohort. However, the research questions and hypotheses examined in the current study are unique to this manuscript. The data from the current cohort are longitudinal over an individual appointment (baseline epoch, needle epoch, 1-min epoch, etc.) and over the first year of life (2, 4, 6, and 12 months of age). Capturing this complexity in a consumable fashion has necessitated a carefully crafted analysis plan that examines the data from a cross-sectional and longitudinal perspective. The current study examines the relationships between caregiver extremes of sensitivity, infant pain behavior, and parental soothing strategies at 2, 4, 6, and 12 months of age, which is a unique analysis of this longitudinal cohort data.

The first goal of this article was to examine whether infants who have extreme high- and extreme low-sensitivity parents differ in their pain scores. By using the extremes of sensitivity, the present study aims to reveal the clinical significance of caregiver sensitivity that may have been obscured by analyzing the cohort as a whole. The inherent variability in measures that are not captured by full-sample analyses is a major challenge in infant pain research (Pillai Riddell et al., 2013). Owing to the size of the cohort, we are unprecedented in the area of infant pain for our ability to conduct important subgroup analyses such as this.

Further, although previous studies from our cohort have demonstrated the relationship between high parental sensitivity and a decreasing duration of infant distress across age (Din Osmun et al., 2014), and a concurrent relationship between sensitivity and pain behavior at 12 months (Pillai Riddell et al., 2011), no studies to date have used high- and low-sensitivity parents to examine differences in infant pain scores. It was crucial to determine this to fully understand the role of parental sensitivity in this context, given previous results suggesting small relationships.

The second goal of the current study was to examine parent soothing strategies as a potential mechanism by which sensitivity influences pain scores. This logically followed from our previous cohort studies, which have revealed age-related trends in the use of soothing strategies (Lisi et al., 2013), as well as differential impacts of specific soothing strategies such as rocking, physical comfort, and verbal reassurance on infant pain scores (Campbell et al., 2013; Lisi et al., 2013; Racine et al., 2012). Although sensitivity has been examined as a possible moderator in the relationship between verbal reassurance and infant pain-related distress in a previous study from our cohort (Racine et al., 2012), the current study examines the direct relationship between parent soothing behaviors (Measure of Adult and Infant Soothing and Distress [MAISD]) and parent emotional availability (Emotional Availability Scales [EAS]) as well as the differences in caregiver soothing behaviors based on extremes of high and low sensitivity.

### Procedure

Ethics approval was obtained from the affiliated university and tertiary-level hospital. Caregivers with infants receiving immunizations were given a flyer about the longitudinal study. A research assistant explained the study and obtained signed consent. Caregivers completed a demographic information form with the research assistant before entering the examination room. In the examination room, two video cameras were used to film a close-up of the infant's face and a wide shot of the caregiver–infant interaction. Filming occurred from the dyad's entry into the examination room until 5 min after the immunization. Demographic information was obtained at each immunization appointment, and filming was consistent. Caregivers were mailed a copy of each immunization video.

### Apparatus

Canon HD Video Camcorders (HV20) were used to capture a close-up video of infants' faces, which was subsequently used to code pain behaviors. A wide-lens video of the caregiver–infant interaction was also captured and was used to code parental soothing behaviors and sensitivity.

### Measures

#### Caregiver Emotional Availability

Caregiver emotional availability was coded using the fourth edition of the Infancy to Early Childhood version of the EAS. This scale includes four caregiver subscales: (1) sensitivity, which measures the contingency and appropriateness of responses; (2) structuring, which refers to the parent's guidance of infant activities, as well as the support of autonomy; (3) nonintrusiveness, which indicates the absence of interference

and overprotection; and (4) nonhostility, which measures the absence of impatience, anger, or concealed hostility (Biringen & Easterbrooks, 2012). The scale encompasses the traditional features of sensitivity, and provides a summary of the emotional quality of the caregiver–child relationship (Biringen, Derscheid, Vliegen, Closson, & Easterbrooks, 2014). It has been validated in a variety of contexts (Biringen et al., 2014), including a pain context (Din, Pillai Riddell, & Gordner, 2009; Pillai Riddell et al., 2011; Racine et al., 2012). Scores were based on the entire immunization appointment. Five reliable coders were trained by the scale developer following an intensive training. Interrater reliability was calculated for 18% of the data, and intraclass correlations ranged from .83 to .92.

#### Infant Pain-Related Distress

Infant pain-related distress was coded using the Neonatal Facial Coding System (NFCS), a well-validated assessment tool used to measure infants' facial responses to pain. It includes seven facial actions (brow bulge, eye squeeze, nasolabial furrow, open lips, vertical stretch mouth, horizontal stretch mouth, and taut tongue), which were coded as present (1) or absent (0) for every second of a 10-s period immediately preceding the first needle, immediately after the last needle, 1 min after the last needle, and 2 min after the last needle. Scores range from 0 to 1, indicating the proportion of time during which the facial actions were present. Higher scores indicate greater facial pain-related distress expression. Interrater reliability was coded for 20% of the data. Trained NFCS coders, blind to the study hypotheses, coded the data. Primary coders to the measure were trained with one of the original scale designers, and subsequent coders went through a stringent process to attain reliability with trained coders. Interrater reliability was calculated for every permutation of eight coders. Twenty percent of the data were coded for reliability. Percentage agreement scores for all seven pain facial actions ranged from 0.85 to 0.97.

#### Parent Soothing Behaviors

Parent soothing behaviors were coded using the MAISD (Cohen, Bernard, McClellan, & MacLaren, 2005). The MAISD is a reliable and valid behavioral observation scale developed for painful pediatric medical procedures. The scale consists of eight behaviors (distraction, offer pacifier, offer toy, offer food, nursing, physical comforting, rocking, and verbal reassurance), which were coded as present (1) or absent (0) for 5-s epochs 1 min before the needle, 1 min after the last needle, and 2 min after the last needle. Index scores ranging from 0 to 1 were created for each 1-min phase. Higher scores indicate a greater frequency



of behavior. For the purposes of this study, offer food, offer toy, nursing, and pacifying were excluded, as they were the least frequently used across ages (Lisi et al., 2013). Ten reliable coders underwent rigorous training with a reliable graduate student in the laboratory until they had achieved at least 80% reliability. Interrater reliability was calculated for 20% of data; intraclass correlations ranged from .67 to .92.

## Results

### Analysis Plan

The distribution of EAS scores at each of the 4 time points were examined to determine cutoff points for both high and low emotional availability that were both clinically and statistically relevant. Data for the full sample, and for the high emotional availability and low emotional availability groups, are presented in Table I. Groups were created using cutoffs of one standard deviation above and below the mean. This procedure was not done to suggest the existence of artificial groups, but rather to compare the data of families who were statistically in the extremes of the distribution of emotional availability. This division was especially meaningful clinically given the low variability of emotional availability in our low-risk sample, which could potentially obscure meaningful differences with mothers on the extreme ends. Given the correlation between maternal sensitivity and socioeconomic factors (Bornstein, Hendricks, Haynes, & Painter, 2007), and the strength of the relationships found in higher-risk samples (Little & Carter, 2005), examining the extremes of emotional availability is important to understand its true impact. Previous research has shown that caregiver emotional availability scores are one of the strongest predictors of future caregiver emotional availability (Pillai Riddell et al., 2011), as a high degree of consistency has been found. As such, similar caregivers would most likely have been categorized as high and low emotional availability caregivers across the different ages.

To examine clinically significant differences between mean pain scores, a minimum clinically significant difference was determined. Previous studies have shown that a minimum clinically significant difference in pain scores in children has been found to be

between 10% and 20% (Powell et al., 2001; Shah, Ipp, Sam, Einarson, & Taddio, 2004). One study conducted with 8–15-year-olds who provided self-report of pain on a visual analog scale determined that a minimum clinically significant difference was 10% on a visual analog scale (Powell et al., 2001). An infant pain study by Shah and colleagues reported that clinicians and researchers considered a 20% reduction in pain as the minimal clinically important difference (2004). Given the inability of infants to provide self-report on what level of improvement could truly make a difference in treatment strategy or in the affective component of pain, a minimum clinically significant difference of 10% was used to be sensitive to potential differences in pain scores. Given that the NFCS scores range between 0 and 1, a mean difference of  $\geq 0.1$  was considered a clinically significant difference.

### Emotional Availability and Pain

#### Analysis Plan

The first objective of this study was to examine whether infants who have caregivers assessed to have either extreme high or extreme low emotional availability differ in their pain scores at baseline, needle, 1 min after immunization, and 2 min after immunization. This research question was examined with four 2 (High or Low Emotional Availability)  $\times$  4 (Needle Time) Mixed Analyses of Variance (ANOVAs) at each age: 2, 4, 6, and 12 months. The assumption of sphericity was assessed using the Mauchly's test, and violations were addressed by using the Greenhouse-Geisser adjustment to degrees of freedom. Violations of normality are acknowledged here, but the robustness of ANOVA in addition to a large sample size justifies the use of the present analyses. For the purposes of these analyses, we were interested in the main effect of emotional availability and the interaction between emotional availability and needle time. As such, the main effect of needle time will not be interpreted. Additionally, simple effects were not interpreted if a significant interaction of needle time and emotional availability was not found.

#### Results

At 2 months, there was a significant interaction between emotional availability and needle time,  $F(2.66,$

**Table I.** Central Tendencies of EAS Scores in Total Sample and in High and Low EAS Parents

Time point	Total				High EAS parents				Low EAS parents			
	<i>n</i>	Mean	<i>SD</i>	Range	<i>n</i>	Mean	<i>SD</i>	Range	<i>n</i>	Mean	<i>SD</i>	Range
2 months	491	92.31	10.30	56.00–114.50	58	107.50	2.63	104.00–114.50	84	75.93	5.00	56.00–81.00
4 months	573	94.74	9.81	65.00–114.00	92	108.11	2.65	105.00–114.00	106	79.11	4.28	65.00–84.50
6 months	580	94.53	10.37	55.00–116.00	61	109.65	2.19	107.00–116.00	103	77.77	4.87	55.00–83.00
12 months	526	92.82	11.07	49.00–113.50	57	108.40	2.11	105.00–113.50	68	75.67	5.23	49.00–80.00

Note. EAS = Emotional Availability Scales.

582.21) = 4.50,  $p = .006$ ,  $\eta_p^2 = .02$ . Pairwise comparisons revealed that caregivers with extremely high emotional availability had infants with lower pain scores at 1 min after immunization ( $M = 0.09$ ,  $SE = 0.04$ ) and at 2 min after immunization ( $M = 0.08$ ,  $SE = 0.03$ ). At 4 months, there was no significant interaction between emotional availability and needle time; however, there was a main effect of emotional availability on pain scores,  $F(1, 279) = 10.29$ ,  $p = .001$ ,  $\eta_p^2 = .04$ . Caregivers with extremely high emotional availability had infants with lower pain scores ( $M = 0.31$ ,  $SD = 0.18$ ) compared with infants of caregivers with extremely low emotional availability ( $M = 0.36$ ,  $SD = 0.22$ ) across time points.

At 6 months, there was no interaction between emotional availability and needle time on infant pain scores; however, there was a main effect of emotional availability,  $F(1, 292) = 16.630$ ,  $p < .001$ ,  $\eta_p^2 = .05$ . Caregivers with extremely high emotional availability had infants with lower pain scores ( $M = 0.29$ ,  $SD = 0.18$ ) compared with infants of caregivers with extremely low emotional availability ( $M = 0.35$ ,  $SD = 0.21$ ) across time points. A similar pattern was seen at 12 months,  $F(1, 242) = 19.55$ ,  $p < .001$ ,  $\eta_p^2 = .08$ . Caregivers with extremely high emotional availability had infants with lower pain scores ( $M = 0.35$ ,  $SD = 0.19$ ) compared with those with extremely low emotional availability ( $M = 0.44$ ,  $SD = 0.32$ ) across time points.

To examine the clinically significant differences in pain scores, mean differences were examined by age and by time point for low and high emotional availability groups (See Table II). In terms of clinically significant differences, there were no clinically significant differences in pain scores between the low and high emotional availability groups at baseline or immediately following needle. There were however, clinically significant differences for the 12-month age-group at 1-min postneedle ( $M$  difference = 0.13) and at 2-min postneedle ( $M$  difference = 0.11).

### Emotional Availability and Soothing Behaviors Analysis Plan

The second objective of the current study was to examine whether caregivers who have either extremely high

or extremely low emotional availability differ in the soothing behaviors they enact at baseline, immediately following needle, 1 min after immunization, and 2 min after immunization. At each age (2, 4, 6, and 12 months), a multivariate analysis of variance (MANOVA) was run to examine each of the four soothing behaviors (distraction, physical comforting, rocking, and verbal reassurance), for a total of four MANOVAs. In the case of significant interaction, Univariate ANOVAs were used to determine which soothing behaviors were implicated, and pairwise comparisons were used to determine at which time points these differences in soothing behaviors occurred. To address violations of sphericity, the Wilks' Lambda correction to degrees of freedom was used.

### Results

At the 2-month immunization appointment, there was an interaction between emotional availability and needle time on soothing behaviors,  $F(12, 206) = 2.00$ ,  $p = .026$ ,  $\eta_p^2 = .10$ . Subsequent Univariate ANOVAs revealed that this interaction affected caregivers' use of rocking,  $F(2.66, 577.10) = 5.76$ ,  $p = .001$ ,  $\eta_p^2 = .03$ . Pairwise comparisons revealed that caregivers with extremely high emotional availability used more rocking to soothe their baby compared with caregivers with extremely low emotional availability immediately following the needle ( $M = 0.15$ ,  $SE = 0.04$ ), and during 1 min after immunization ( $M = 0.17$ ,  $SE = 0.05$ ).

At the 4-month immunization appointment, there was an interaction between emotional availability and needle time,  $F(12, 273) = 1.91$ ,  $p = .033$ ,  $\eta_p^2 = .08$ . Subsequent Univariate ANOVAs revealed that this interaction had a significant effect on rocking,  $F(2.80, 796.32) = 5.82$ ,  $p = .001$ ,  $\eta_p^2 = .02$ , and physical comfort,  $F(2.70, 765.88) = 2.92$ ,  $p = .039$ ,  $\eta_p^2 = .01$ . Pairwise comparisons revealed that caregivers with extremely high emotional availability used more rocking compared with caregivers with extremely low emotional availability immediately following the needle ( $M$  difference = 0.14,  $SE = 0.04$ ) and during 1 min after immunization ( $M$  difference = 0.09,  $SD = 0.04$ ). Furthermore, caregivers with extremely high emotional availability used more physical comfort immediately after the needle compared with caregivers with

**Table II.** Clinically Significant Differences in Mean Pain Scores Between High and Low Emotional Availability M (SD)

Time point	Baseline M (SD)		Needle M (SD)		1-min M (SD)		2-min M (SD)	
	Low EAS	High EAS	Low EAS	High EAS	Low EAS	High EAS	Low EAS	High EAS
2-month	.15 (.15)	.14 (.10)	.79 (.14)	.81 (.16)	.42 (.27)	.33 (.25)	.33 (.24)	.26 (.22)
4-month	.18 (.20)	.13 (.12)	.71 (.22)	.67 (.21)	.27 (.21)	.20 (.17)	.27 (.23)	.22 (.21)
6-month	.20 (.21)	.16 (.14)	.70 (.21)	.63 (.24)	.27 (.19)	.20 (.17)	.27 (.23)	.18 (.16)
12-month	.24 (.26)	.17 (.16)	.79 (.32)	.73 (.20)	.41 (.25)	.28 (.23) <sup>a</sup>	.33 (.46)	.22 (.17) <sup>a</sup>

Note. EAS = Emotional Availability Scales.

<sup>a</sup>Indicates a clinically significant difference of 10%.

extremely low emotional availability ( $M$  difference = 0.09,  $SE = 0.03$ ).

At the 6-month immunization appointment, there was no significant interaction between emotional availability and needle time, nor was there a main effect of emotional availability on soothing behaviors,  $F(4, 543) = 287.41$ ,  $p = .052$ ,  $\eta_p^2 = .02$ . Lastly, at the 12-month appointment, there was an interaction between emotional availability and needle time,  $F(12, 250) = 3.15$ ,  $p < .001$ ,  $\eta_p^2 = .13$ . Subsequent Univariate ANOVAs revealed that this interaction had an effect on rocking,  $F(2.67, 695.82) = 4.82$ ,  $p = .004$ ,  $\eta_p^2 = .02$ , physical comfort,  $F(2.82, 736.21) = 3.80$ ,  $p = .012$ ,  $\eta_p^2 = .01$ , and verbal reassurance,  $F(2.64, 687.66) = 3.11$ ,  $p = .032$ ,  $\eta_p^2 = .01$ . Pairwise comparisons revealed that caregivers with extremely high sensitivity used significantly less rocking at baseline compared with caregivers with extremely low sensitivity ( $M$  difference =  $-0.07$   $SD = 0.03$ ), used significantly more physical comfort immediately following the needle ( $M$  difference = 0.08,  $SD = 0.03$ ), and significantly less verbal reassurance 1 min after immunization ( $M$  difference =  $-0.07$ ,  $SD = 0.02$ ).

## Discussion

To our knowledge, this is the first study to systematically study the differences in high and low emotionally available parents on infant pain and parent soothing behaviors. This study builds on previous work from the OUCH cohort, which has shown small relationships between emotional availability and infant pain but has not contrasted the impact of being extremely emotionally unavailable or extremely emotionally available in the pain context. Given the value of integrating universal mental health screening into well-baby visits (Fiese, Poehlmann, Irwin, Gordon, & Curry-Bleggi, 2001; Freeman et al., 2005), the focus on examining extremes rather than the norm is of greater importance for potentially flagging dyads in challenge and understanding what optimal parenting in the immunization context looks like. Past research outside of the pain context has shown sensitivity interventions to be effective in changing parent sensitivity behavior and, to a lesser extent, infant outcomes (Bakermans-Kranenburg, van IJzendoorn, & Juffer, 2003). In the pain context, the provision of pain management education has led to improved long-term parental knowledge (Taddio et al., 2014), suggesting a potential for pain management intervention and improved infant mental health owing to greater focus on contingent soothing of infants. Based on the results of our now completed set of infant cohort analyses, particularly these observations of statistically significant optimal and nonoptimal parenting at 12 months, our team is currently validating an infant mental health behavioral screening tool (for infants between 12 and

24 months of age) designed to be filled out in the first 3 min after immunization.

In the current study, a pattern was seen in infant pain scores. Infants with lower pain scores had caregivers who were in the high emotional availability group. This finding is in line with previous research from the cohort (Din Osmun et al., 2014; Pillai Riddell et al., 2011; Racine et al., 2012). The role of caregiver emotional availability was most pronounced in pain scores during what we would define as the regulatory period (Pillai Riddell, Craig, Racine, & Campbell, 2013)—at 1 min and 2 min after immunization at 2 months of age. Clinically significant differences in pain scores between the groups were found in the regulatory phase at 12 months of age. However, when contrasting the discrete behaviors of caregivers with extremely low and extremely high scores, the most significant differences in behavior were seen immediately after the needle and in the first minute postneedle in terms of rocking or physical comforting behaviors. The following discusses this overall pattern in greater detail.

## Emotional Availability and Pain

Consistent with hypotheses, the significant main effect of emotional availability on pain scores indicates that, with little exception, infants of caregivers with higher emotional availability scores have lower pain scores across the appointment. At the 2-month age, pairwise comparisons revealed that this effect was only significant during the regulatory period, at 1- and 2-min after immunization. Similarly, analyses of clinically significant differences revealed that there were no clinically significant differences at baseline or immediately following the needle, but clinically significant differences were found 1 and 2 min following the needle at the 12 months of age. This is likely because behavioral infant distress is highest at the time of the needle; thus it is logical that in highest distress (when the infant is overwhelmed by sensory input from the needle and closes his/her eyes in response; Ahola Kohut, Pillai Riddell, Flora, & Oster, 2012), infants would be least impacted by parent behavior. However, the effect of caregiver emotional availability would increase as the initial sensory shock of the needle passes and is compared with its effect at regulation phases. Although it was hypothesized that sensitive caregiving leads to better infant regulation, it is also plausible that it is in fact easier to be sensitive and soothe an infant who expresses less distress. This is consistent with findings that high negative emotionality in infants predicts lower maternal sensitivity across time (Meritesacker, Bade, Haverkock, & Pauli-Pott, 2004; Therriault, Lemelin, Tarabulsky, & Provost, 2011).

## Emotional Availability and Soothing Behaviors

The second aim of this study was to explore whether discrete soothing behaviors differ in high and low

emotionally available parents during the immunization period. It was of great interest to see if we could identify key behaviors that may distinguish these groups. Findings indicate that high- and low-sensitivity parents did differ in their use of soothing strategies but that it was most notable in the first minute after the needle. Rocking and physical comforting immediately following and 1 min after the needle were most able to distinguish between the caregivers who were either high or low on emotional availability across the age span. This is consistent with classic attachment theory (Bowlby, 1982), which posits sensitive caregiving is about meeting the innate drive for infants to require proximity in times of distress.

Exceptions to this trend were found at the 6-month age, where there were no significant differences in soothing behaviors, and at the 12-month age, where higher emotional availability parents used more physical comforting immediately following the needle, but less rocking at baseline. One possible explanation for this latter finding is that an increase in rocking at baseline occurred in infants who were highly distressed before the needle. Caregivers may have started rocking infants who were already distressed or in anticipation of the distress. Further, the decrease in significance of proximal strategies with increased age may reflect an increased diversity of strategies used, with distal strategies like distraction or verbal reassurance playing a larger role in soothing older infants. Previous research from our laboratory shows an increased use of distraction at 12 months, and the predominance of physical comforting at 2 and 4 months (Lisi et al., 2013). Consistent with previous findings from our laboratory (Racine et al., 2012), higher emotional availability parents used less verbal reassurance 1 min following the needle at the 12-month age.

Given peak distress occurs in the first minute postneedle, these findings support that the most telling time to distinguish between caregiver emotional availability would be during this epoch. However, it is interesting to note that despite clearly robust relationships between pain and high/low emotional availability in the regulatory phases at 1- and 2-min postneedle, caregiver behaviors did not parallel these findings. This suggests that discrete physical soothing behaviors may not entirely explain the effect of high emotional availability on infant pain behavior.

### Limitations

The generalizability of the current study's findings is limited by the low-risk nature of the sample, which consisted for the most part of highly educated, two-parent families. The self-selection bias associated with parents who would agree to participate also poses a risk to generalizability. The inclusion of higher-risk participants in future studies might allow for a more in-depth

study of the impact of high and low sensitivity on infant pain responses and caregiver soothing behaviors. Additionally, one cannot preclude the possibility that videotaping may have impacted caregiver behavior.

### Conclusion

By using the extremes of emotional availability, and by examining clinically significant differences in pain scores, the current study expanded our understanding of parental emotional availability in the pain context. Confirming work in developmental psychology literature and making a novel contribution to the infant pain literature, it appears that the most influential impact of emotional availability on infant pain behaviors, across the first year of life, is during the regulatory phase. Moreover, examining how much caregivers physically comfort their infants during the first minute postneedle is strongly related to being deemed either high or low on emotional availability. The finding in the current study that increased use of proximal soothing strategies by high-sensitivity parents in the first minute postneedle is thus a novel finding. Infant mental health is a core developmental domain. Well-baby medical visits enable health care practitioners to have regular contact with families who may struggle in developing strong distress regulation skills in their child. By understanding infant and caregiver immunization behaviors, researchers can help find feasible methods to screen and support families who may need help in teaching crucial infant regulatory skills.

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