Brief Report: Maternal Emotional Availability and Infant Pain-related Distress

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Objectives The current study investigated the relationships between maternal emotional availability and infant pain expressions. Methods A group of 73 mother–infant dyads were recruited prior to their routine immunization appointment and were subsequently filmed. Results Analyses revealed that maternal non-intrusiveness was related to lower infant pain expressions both immediately and 1 min following needle. In addition, maternal sensitivity and overall emotional availability were related to lower infant pain expressions 1 min after needle. Conclusions These results suggest that intrusive caregiving behaviors can increase infant pain reactivity and hinder the regulation of pain-related distress. On the other hand, sensitive and emotionally available caregiving help infants to regulate their pain-related distress. The results support that infant pain expressions are related to the quality of maternal caregiving.

Key words immunizations; infant pain-related distress; maternal emotional availability; maternal interactive behaviors.

For years, it was assumed infants simply did not experience pain (Byers & Thornley, 2004). Recent research suggests that infants are not only capable of experiencing pain but may actually experience pain more intensely than adults (Fitzgerald, 2005). However, infants cannot communicate their pain verbally and are limited in their repertoire of pain management behaviors (Pillai Riddell & Chambers, 2007). Consequently, infants often rely on their primary caregivers to help them regulate their pain-related distress.

Research has revealed that maternal behaviors can have long-term effects of the neurobiological development of the infant’s stress regulation systems (Luecken & Lemry, 2004). Poor regulation of negative stress (such as negative stress-related to painful events), in turn, has been linked to pathological affect regulation and poor biopsychosocial health in later development (Davidson, Putnam & Larson, 2000; Repetti, Taylor & Seeman, 2002). Thus, one would hypothesize that maternal behaviors during painful events can have important repercussions for how distress is regulated throughout the infant’s life. For these reasons, it is crucial to gain a better understanding of the roles caregivers play in the infant’s ability to regulate their distress during painful procedures.

Few studies to date have investigated the relationships between caregiver behavior and infant distress reactivity and regulation within a painful context. Those studies that have examined these relationships have focused on specific maternal behaviors which are linked to the infant’s expression of pain (e.g. Cohen, Bernard, McClellan, & MacLaren, 2005). With infants, specific behavioral interventions such as visual, auditory, oral, and kinesthetic modalities used by parents have been found to decrease pain-related distress during immunizations as measured by behavioral and biochemical markers (e.g. Felt et al., 2000). As such, the majority of studies have either focused on frequency counts of specific maternal behaviors such as rocking, reassuring, and distracting (e.g. Jahromi, Putnam, & Stifter, 2004) or on the sequential relationships between caregiver and child behaviors (Cohen et al., 2005) as opposed to a clinical evaluation of the quality of caregiver behavior towards infants during acute painful procedures. Unfortunately, simple frequency counts of maternal and infant behaviors alone can lead to an incomplete analysis of the quality of caregiving because it does not take into account the quality of affect between mother and infant or the appropriateness of caregiver behaviors (Biringen, 2000). For these reasons, the current study was interested in...
exploring a more wholistic index of maternal caregiving behavior by using a clinical measure of the quality of the caregiver–infant interaction and its relationships to infant pain reactivity and regulation during routine immunizations. It was hypothesized that appropriate and sensitive maternal caregiving behaviors would be linked to lower infant pain expressions during immunizations.

**Methods**

**Procedure**

This study was reviewed and approved by the Human Participants Review Committee at the sponsoring university. The study consisted of two phases. During Phase One, healthy infants between the ages of 3–20 who were older than 36 weeks gestation at time of birth, and their English speaking mothers, were recruited from a pediatrician’s waiting room. Data collection took place at three different clinics within the same high-risk community of Toronto. If the mother was interested, a Research Assistant (RA) explained the study, obtained written consent, and scheduled a phone interview appointment. The RA then followed the mother and infant into the examination room where the immunization took place and filmed the entire appointment with two cameras, one focused on the infant’s face and the other on the mother–infant interaction. This included all mother–infant interaction pre- and post-meeting with the doctor, the weighing of the infant, and the immunization. Mother’s were not given any instructions regarding how to act or hold their infant in order to keep the observation as naturalistic as possible. During Phase Two, a phone interview was conducted within 2 weeks following the clinic visit to collect demographic information. Mothers received a $5 gift certificate from a local coffee franchise after the clinic appointment and a DVD copy of their clinic footage after the phone interview.

**Behavioral Coding Measures**

**Infant Pain**

The infant’s pain face was filmed during the immunization procedure and was coded using the Neonatal Facial Coding Scale (NFCS; Grunau and Craig, 1987). The NFCS has been validated for the measurement of infant pain in a variety of context, including immunizations (Grunau and Craig, 1987; Grunau, Johnston, & Craig, 1990). NFCS was scored by measuring the presence or absence of seven facial actions believed to be a part of the infant pain face: brow bulge, eye squeeze, naso-labial furrow, open lips, stretch mouth horizontal, stretch mouth vertical stretch, and taut tongue. These facial actions were coded during two separate time periods: (a) 10 s immediately following the last needle (representing pain distress reactivity) and (b) 10 s, 1 min following the last needle (representing pain distress regulation). Scores for each of the two 10 s periods (reactivity and regulation) were summed and percentage scores were then calculated. The percentage scores represent the proportion of epochs that pain facial behaviors were expressed over the total number of epochs coded, where higher percentage scores were indicative of greater pain. Inter-rater reliability coefficients between the coders (Cohen’s κ) were .85 or higher.

**Maternal Interactive Behavior**

Maternal interactive behavior was coded using the Infancy/Early Childhood Version of the Emotional Availability Scales (EAS; Biringen, Robinson, & Emde, 2000). A major strength of the EAS is that it is comprised of global or wholistic clinical rating scales of maternal behavior that must be contextualized by the infant’s reactions to those behaviors. This maternal rating scale requires clinical judgment to determine the actual quality of maternal behaviors rather than a simplistic frequency count of specific behaviors. The EAS has been well validated in a variety of distressing nonpain contexts (Biringen, 2000). To ensure validity, the measure was coded only after obtaining specialized training with the scale’s creator (Dr Zeynep Biringen) for the pain context. Moreover, to ensure ongoing validity and reliability in our use of the EAS, a PhD graduate in Dr Biringen’s lab was the reliability coder for our entire sample (20%). Maternal dimensions were reliable with a Pearson correlation of ≥ .80.

The EAS includes four individual maternal subscales (sensitivity, structuring, nonintrusiveness, and nonhostility), which can be combined to form a composite emotional availability score. Parental sensitivity included the mother’s ability to “read” an infant’s cues and display appropriate affect, while respecting the developmental interests and capabilities of the infant (e.g., the mother’s ability to read the infant’s subtle cues). Parental structuring referred to the parent’s ability to structure and stimulate the infant during the immunization (e.g., using toys to entertain or distract the infant). Parental nonintrusiveness referred to the parent’s ability to be available and avoid intrusive, direct, overstimulating, or overpowering behaviors (e.g., getting in infant’s face and intrusively kissing the infant). Finally, parental nonhostility represents the parent’s ability to refrain from antagonistic or impatient behaviors (e.g., expressing annoyance or sarcasm).

The EAS rating was based on the video footage obtained during the entire clinic visit. After reviewing the entire filmed interaction (M = 10.49 min; SD = 4.50 min),
a coder provided a rating on each of the Emotional Availability (EA) subscales (score ranges: 1–9 for sensitivity; 1–5 for structuring, nonintrusiveness, and nonhostility). These subscale scores were then summed to form a composite EA score on a scale from 4 to 24. On all scales, higher scores represented more positively valenced behaviors.

**Recruitment Rate and Participant Characteristics**

Of the 137 individuals who were approached and eligible to participate, 44 refused (34.6%) and 83 agreed (65.4%). Ten were excluded for various reasons (e.g., they had missing video footage), leaving 73 mother–infant dyads in the final sample. The average age of mother was 31.2 years (SD = 5.28), the majority were married (73.4%), and had a high school degree or higher (75.4%). The average age of infant was 9.04 months (SD = 4.38), and half the infants were male (50.0%). In terms of ethnicity, ~32.2% of the sample was of European decent, 18.9% were of African descent, 16.9% were from the West Indies/Caribbean, 11.8% were of Asian decent, 8.4% were of East Asian decent, and 6.8% were “other”.

**Results**

Data transformations on skewed data were performed before analyses took place. Moreover, preliminary analyses verified that variables did not differ across clinics.

In order to explore the relationships between maternal emotional availability and infant expressions, and because initial correlations revealed infant age was significantly related to infant pain scores, exploratory partial correlations were performed controlling for infant age (Table I). As hypothesized, maternal interactive behaviors were related to infant pain expressions. In specific, maternal sensitivity was significantly related to infant expression 1 min postneedle puncture \( r(70) = -0.25, \ p = 0.037 \). Maternal nonintrusiveness was significantly related to infant expressions of pain immediately following the needle \( r(70) = -0.31, \ p = 0.008 \), and 1 min postneedle \( r(70) = -0.31, \ p = 0.007 \). The total composite score for maternal emotional availability was significantly correlated with infant pain expressions 1 min postneedle \( r(70) = -0.27, \ p = 0.020 \). In addition, infant pain expression immediately following needle was significantly related to infant pain expression 1 min postneedle \( r(70) = 0.34, \ p = 0.03 \).

**Discussion**

The results of this study demonstrate that infant pain expressions are related to the quality of maternal caregiving during acute painful procedures such as immunizations. Maternal nonintrusiveness was linked to lower infant pain expressions both immediately and 1 min following the needle. In other words, intrusive maternal behaviors were related to higher infant pain expressions immediately following needle and poorer distress regulation 1 min following needle. These findings are in line with previous research, which suggests that infants experience intrusive caregiving behaviors as a stressor which can interfere with their ability to control interactions and may impede on emotion regulation (Ispa et al., 2004). Intrusive maternal behaviors in the current study included behaviors that interrupted the infant in distress (e.g., starting to dress the infant while infant was still upset or mother invasively kissing baby’s face repeatedly as the infant was crying), which may have further distressed the infant as his/her pain signals were not being acknowledged, nor were they being comforted. These findings suggest that intrusive maternal behaviors increase pain reactivity and slow pain distress regulation after an acute painful procedure by further distressing infants and not allowing them to regulate their emotions effectively.

In addition, maternal sensitivity and overall emotional availability were related to better pain–distress regulation 1 min following the needle. These findings support the idea that the more sensitive a mother is, the quicker her infant is able to regulate negative arousal effectively (Fish, Stifter, & Belsky, 1991; van den Boom & Hoeksma, 1994), and the sooner he or she is to quiet after a painful procedure such as an immunization (Axia & Bonichini, 2005).

**Table I. Partial Correlations between Maternal Emotional Availability and Infant Pain Expressions Immediately and 1 Min Following Needle Controlling for Infant Age (Excluding Inter-correlations among Emotional Availability Scales)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Infant pain expressions immediate post needle</td>
<td>76.26 (%)</td>
<td>25.06 (%)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>2. Infant pain expressions 1 min post needle</td>
<td>39.18 (%)</td>
<td>27.65 (%)</td>
<td>.34**</td>
<td>–</td>
</tr>
<tr>
<td>3. Maternal sensitivity</td>
<td>6.79</td>
<td>1.45</td>
<td>.09</td>
<td>–.25*</td>
</tr>
<tr>
<td>4. Maternal structuring</td>
<td>4.19</td>
<td>0.79</td>
<td>.09</td>
<td>–.14</td>
</tr>
<tr>
<td>5. Maternal nonintrusiveness</td>
<td>4.49</td>
<td>0.58</td>
<td>–.31**</td>
<td>–.31**</td>
</tr>
<tr>
<td>6. Maternal nonhostility</td>
<td>4.66</td>
<td>0.50</td>
<td>.02</td>
<td>.07</td>
</tr>
<tr>
<td>7. Total maternal emotional availability</td>
<td>20.25</td>
<td>2.69</td>
<td>.01</td>
<td>–.27*</td>
</tr>
</tbody>
</table>

Raw data represented in means (M) and standard deviations (SD) for ease of interpretation. Partial correlations between maternal emotional availability and infant pain expression immediately and 1 min after needle after controlling for infant age (M = 9.95 months, SD = 4.09 months). Sample size n = 73.

* <p < .05, ** < p < .01.
This study had several limitations of note. Although the authors attempted to collect data from a high-risk community, it is possible that the mothers who refused were those at the highest risk for disrupted caregiver–infant interactions, resulting in a low-risk sample and limiting the generalizability to high-risk dyads. Moreover, due to the high refusal rate, the inclusion criteria required a large infant age range. Finally, the relatively small sample size prevented the authors from controlling for demographic variables (e.g., maternal age, education, and cultural background) in analyses. As a result, future research needs to investigate these relationships in larger and higher psychosocial risk sample.

Using a global, clinical measure evaluating the quality of caregiving behaviors, the current study demonstrated that intrusive maternal behaviors are linked to increased infant pain reactivity and poorer distress regulation during routine immunizations. Additionally, it revealed that sensitive and emotionally available caregiving help infants to regulate their pain-related distress. As such, maternal interactive behaviors during immunizations appear to have important repercussions for how negative distress is regulated during infancy. In light of these findings, the immunization context can be seen as a unique opportunity to support caregivers in helping their infants to contain and regulate their pain-related distress.

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