

Delivery Pain and the Development of Mother–Infant Interaction

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This study examined delivery pain as a possible risk factor for the development of mother–infant interaction. Eighty-one mothers completed the Pain Catastrophizing Scale, the State–Trait Anxiety Inventory, and the Edinburgh Postnatal Depression Scale. A retrospective evaluation of labor pain was performed using the Visual Analog Scale at 2 days postpartum. Six weeks after birth the mothers were visited at home, completed measures of anxiety and depression, and were observed during a free play session with the infant. The mother’s tendency to catastrophize pain predicted lower levels of mother–infant reciprocity at 6 weeks, controlling for maternal age, education, parity, epidural analgesia, pain perception, anxiety, and depression. Trait anxiety was related to lower maternal sensitivity. The mother’s tendency to catastrophize pain was discussed in relation to the personality trait of exaggerated emotional perception of pain and its potential interference with the formation of the mother–infant relationship.

The newborn’s optimal development depends on accessible and consistently sensitive mothering that provides regular contact, security, and age-appropriate stimulation (Bowlby, 1971; Brazelton & Cramer, 1990). Factors that may impede on the mother’s capacity to provide attuned parenting pose a risk to the infant’s emo-

tional, social, and cognitive growth (Barnett, Schaafsma, Guzman, & Parker, 1991; Downey & Coyne, 1990; Fenton, Bhat, Davies, & West, 1989; Field, 1994; Ponirakis, Susman, & Stifter, 1998; Weinberg & Tronick, 1998). The quality of the mother–infant relationship is one of the main predictors of the infant’s well-being and development (Bee et al., 1982; Cohen & Parmelee, 1983; Lyons-Ruth, Alpen, & Repacoli, 1993; Murry & Hornbaker, 1997). Although mother and child both contribute to the interaction in a bidirectional manner, the mother’s emotional state is a central determinant in the development of a sensitive dyadic relationship (Cohn & Tronick, 1989). In this study we examine the mother’s tendency toward exaggerated emotional perception of pain as a predictor of the developing mother–infant relationship in the immediate postpartum period.

One of the important contexts for the development of mothering is the experience of childbirth. The birth experience integrates physiological components related to pregnancy, delivery, and the duration of the confinement, as well as emotional and social components associated with the changes in the family structure and the formation of the maternal role (Bobak & Jensen, 2000). The experience of childbirth is accompanied by significant pain, which has been described as one of the most intensive experiences of acute pain (Melzack, Kinck, Dobkin, Lebrum, & Taenzer, 1984; Melzack, Taenzer, Feldman, & Kinck, 1981). Studies have shown that traumatic deliveries, such as Cesarean sections or instrument deliveries (vacuum and forceps), delay the formation of the mother–infant bond in the immediate postpartum period, possibly as a result of prolonged maternal preoccupation with the experience of delivery, which interferes with her investment in the infant and the emerging relationship (DiMatteo et al., 1996; Kochanevich-Wallace, McCluskey-Fawcett, Meck, & Simons, 1988; Rowe-Murray & Fischer, 2001). However, most research on the effects of childbirth on the mother–infant relationship has focused on the short-term effects of pain on initial bonding (Cohen & Woods, 1983; Gathwala & Narayanan, 1991; Tulman, 1986) with far less attention to the effects of delivery pain perception on the development of mothering.

Pain is a complex phenomenon that includes physiological, cognitive, cultural, social, and emotional components (Fields, 1999). Among the emotional components that have a significant impact on the perception of pain is the tendency to catastrophize pain (Sullivan, Bishop, & Pivic, 1995). In the past two decades, pain catastrophizing has been studied as an exaggerated negative orientation to aversive stimuli that involves rumination about painful sensations, magnification of the threat value of the painful stimulus, and perceived inability to control pain (Rosenstiel & Keefe, 1983; Sullivan et al., 1995; Sullivan & Neish, 1998, 1999; Sullivan, Stanish, Waite, Sullivan, & Tripp, 1998). Sullivan et al. (2001) provided a broader perspective on pain catastrophizing and described it as related to both the experience and the anticipation of pain. Because pain catastrophizing is often related to the individual’s preoccupation with the perception and experience of pain, it is likely to interfere with the formation of the mother–infant relationship in its earliest stages.

There are several pathways through which pain catastrophizing may impact the development of the mother–infant relationship. Fields (1999) distinguished between two types of pain that contribute to the experience of pain intensity and have different, yet related brain pathways. The first type, which is termed *algoty*, refers to the sensory experience. The second type, which has been termed *unpleasantness*, refers to the emotional reaction to pain and the meaning attributed to the painful experience. It is the latter type that has more relevance in this context. In this study we measured both the cognitive-emotional component of unpleasantness (catastrophizing) and the sensory response to pain (algoty, measured by pain intensity) in relation to the mother's pain during childbirth.

Several studies have addressed the relations between the mother's pain perception and the experience of childbirth (e.g., Price, Harkins, & Baker, 1987). It was found that during labor, women who were focused on their own pain reported higher pain levels as compared to those who focused on the coming baby. The pain intensity scores of labor pain assessed with the Visual Analog Scale (VAS; Price, McGrath, Rafii, & Buckingham, 1983) methodology among mothers who focused on the infant were 50% lower than those of the mothers who focused on their own pain. These studies support the view that focusing on the infant reduces the unpleasantness of labor pain by giving a positive meaning to the pain and preparing the mother to accept the maternal role. In addition, pain tolerance was found to decrease in women suffering from fear of labor (Saisto, Kaaja, Ylikorkala, & Halmesmaki, 2001). Because the fear of labor is similar to the fear of pain, it is important to note that the fear of pain and pain catastrophizing are highly correlated (Sullivan, Thorn, Rodgers, & Ward, 2004). Thus, decreased tolerance to pain and lower threshold to painful experiences may be associated with lower thresholds to emotional or stressful situations or higher frustration level in the caregiving role. Thus, not surprisingly, among the known correlates of pain catastrophizing in adults are trait anxiety and depression (Sullivan et al., 1995; Sullivan et al., 2001).

Because levels of maternal depression and anxiety tend to increase in the immediate postpartum period (Burt & Stein, 2002; Nissen, Gustavsson, Widstrom, & Uvnas-Moberg, 1998), the combination of high maternal pain catastrophizing with elevated anxiety and depressive symptoms is likely to have a negative impact on the mother–infant dyad. Increased maternal anxiety and depression in the immediate postbirth period are associated with lower levels of maternal sensitivity to the infant's cues, difficulties with physical closeness, or withdrawal from social interactions (Dumas & LaFreniere, 1993; Feldman, Greenbaum, Mayes, & Erlich, 1997; Nagata, Nagai, Sobajima, Ando, & Honjo, 2003). Weinberg and Tronick (1998) pointed to the negative effects of maternal depression on the mother–infant dyad and stated that “in each communicative modality, e.g., face, voice, or touch—the social and affective behaviors of depressed mothers differs significantly from that of their non-depressive counterparts in quantity, quality, and timing” (p. 1298). Some depressed mothers are withdrawn and flat, whereas others tend to be intrusive and angry, yet both styles are associated with a lack of contingent respon-

siveness to the infant's signals, lower levels of mother–infant synchrony, and reduced infant social involvement (Cohn, Campbell, Matias, & Hopkins, 1990; Downey & Coyne, 1990; Feldman, 2003; Field, 1998; Field, Healy, Goldstein, & Guthertz, 1990; Weinberg & Tronick, 1998). Children of depressed mothers lag behind their peers in cognitive, social, and emotional development, pointing to the long-term effects of early maternal depression and emphasizing the need for early detection (Goodman & Gotlieb, 1999). Anxious mothers similarly tend to be less sensitive and more intrusive during mother–infant interaction across the first year (Feldman et al., 1997). Interactions between anxious mothers and their infants are characterized by reduced maternal responsiveness, continuous intrusion on the child's natural flow of activity, and restricted infant exploratory play (Biringen, 1990; Nover, Shore, Timberlake, & Greenspan, 1984). Infants of anxious mothers tend to exhibit higher behavioral inhibition (Manassis, Bradley, & Goldberg, 1995; Rosenbaum et al., 1988; Sichel, Cohen, Dimmock, & Rosenbaum, 1993), higher proneness to anxiety disorders in later childhood (Biederman, Rosenbaum, & Hirshfeld, 1990), higher salivary cortisol, and more disturbed sleep as compared to infants of nonanxious mothers (Gathwala & Narayanan, 1991; Johnson, Chilcoat, & Breslau, 2000; Warren et al., 2003), emphasizing the need for early detection of maternal anxiety and its correlates.

Recent reports point to the specific role of obsessive thinking in the case of postpartum depression, more so than in other depressed states (Wisner, Parry, & Piontek, 2002). Such obsessive thinking may coincide with the tendency to ruminate, which is an essential part of pain catastrophizing. In addition, mothers who exhibited higher pain catastrophizing scored lower on their social ability and were less able to resume social relationships with the nuclear and extended family and close circle of friends in the early postpartum period (Ferber, Granot, & Zimmer, 2005). These findings indicate that pain catastrophizing may serve to index the mother's interpersonal insensitivity, which is also common in postpartum depression (Chaudron, 2003), and suggest that depression and pain catastrophizing may share some attributes such as a heightened focus on self and a decreased capacity to become preoccupied with the infant and the parenting process.

The similarities between the behavioral and cognitive processes associated with postpartum depression and anxiety and those related to pain catastrophizing may be explained by a theoretical model outlining the relations among these three conditions in the immediate postbirth period. We suggest that pain catastrophizing taps the cognitive component of pain perception, which precedes the emotional component and mediates the mother's anxious or depressive response to the painful situation (Granot & Ferber, *in press*). In the context of the immediate postpartum period, pain catastrophizing reflects the cognitive appraisal of the labor process that mediates the mother's emotional state (i.e., depression and anxiety) and, in turn, results in less adaptive responses to becoming a parent, such as helplessness, social withdrawal, and incompetence in coping with the overwhelming

needs of infant care. The cognitive component, indexed by the mother's tendency for pain catastrophizing, may later lead to postpartum depression or anxiety and may interfere with the mother's ability to read and respond to the infant's cues. This view implies that pain catastrophizing represents the degree of maternal involvement with herself versus her involvement with the infant and possibly reflects the mother's cognitive evaluation of the complex painful-joyful birth process, as shaped by her emotional dispositions. This cognitive component colors the sensory perception of labor pain and shapes the mother's level of emotional distress during the postpartum period. Thus, the previously mentioned cognitive component of pain (i.e., catastrophizing) responds to emotional predispositions, then affects consequences of emotional response to the birthing process, and is interrelated to cognitive perceptions of the infant in the immediate postpartum period. Because little research has examined the relations between pain catastrophization and aspects of the mother-infant relationship, it may be of interest to explore the specific aspects of the dyadic relationship that are sensitive to the mother's tendency to catastrophize pain. Understanding the links between pain catastrophization during delivery and the development of mother-infant interaction may also provide a useful tool for detecting mothers and infants at risk.

In light of this information, the goal of this study was to examine whether the experience of pain during labor has a long-term effect on the development of the mother-infant relationship. It was hypothesized that greater perceived labor pain intensity and higher pain catastrophizing would predict less optimal mother-infant interactions at 6 weeks of age.

Three components of the mother's interactive style were examined: maternal sensitivity, maternal intrusiveness, and dyadic reciprocity. Each of these components of the maternal style are known to have long-term effects on the development of children's social, emotional, cognitive, and self-regulatory capacities. Maternal sensitivity addresses the mother's provision of a sensitive and adaptive interactive context, expression of warmth and positive affect, consistency of interactive style, and engagement in species-specific interactive behavior such as imitation and elaboration of the infant's interactive signals. Maternal sensitivity has been associated with lower levels of maternal anxiety and depression (Feldman et al., 1997; Feldman, Keren, Gross-Rozval, & Tyano, 2004) and was found to predict children's social and cognitive development (Stams, Juffer, & van Ijzendoorn, 2002) and infant attachment security (Isabella, 1993). The links between sensitive mothering and better child outcomes have been found across cultures (Posada et al., 2002) and are related to the mother's personality as well as to her internal representations of the infant and the maternal role (Pederson, Gleason, Moran, & Bento, 1998). Maternal intrusiveness, which refers to the disruption in the mother's ability to provide attentive and matched interactions, has been associated with higher anxiety and lower social support (Feldman et al., 1997), pointing to a potential link between intrusiveness and pain catastrophizing. Maternal intrusiveness in early

childhood has been associated with lower academic achievements at school (Pomerantz & Eaton, 2001). Mother–infant reciprocity and synchrony is the central component of early interactions that is compromised by maternal depression (Feldman, 2003; Feldman & Eidelman, 2004; Pelaez-Nogueras, Field, Hossain, & Pickens, 1996). Dyadic reciprocity or synchrony during the first months of life has been shown to predict infant cognitive, linguistic, social-emotional, and self-regulatory skills (Feldman & Eidelman, 2004; Feldman & Greenbaum, 1997; Feldman, Greenbaum, & Yirmiya, 1999; Lester, Hoffman, & Brazelton, 1985). These findings underscore the centrality of early affective matching for the infant’s optimal growth and development.

We hypothesized that pain catastrophizing, anxiety, and depression in the immediate postbirth period would be related to the development of more optimal mother–infant relationships. Specifically, it was expected that lower pain catastrophizing, anxiety, and depression would predict higher maternal sensitivity, lower maternal intrusiveness, and higher dyadic reciprocity in the second month of life above and beyond the mother’s demographic factors, the use of analgesics during labor, and the mother’s appraisal of the sensory experience of pain.

METHOD

Participants

Participants were 81 middle-class married Israeli women who had given birth via vaginal delivery (without aid of forceps or vacuum). Mean maternal age was 29.43 years ($SD = 4.87$, range = 21–42). Twenty-nine (35.8%) mothers gave birth to their first child, and the others were multiparae. Fifteen (18.52%) mothers completed elementary school, 26 (32.1%) completed high school, and 40 (49.38) had a college degree. The infants were all healthy, their birth weight was within the normal range (above the 10th percentile; 2,800–4,200 g), and their gestational age was between 38 and 42 weeks. The Institutional Review Board for Human Experimentation in the medical centers participating in the study approved the protocol, and all mothers provided written informed consent.

Inclusion criteria. Healthy mothers with singleton pregnancies and documented prenatal care who were admitted at term (38–42 weeks gestation) to the hospital’s delivery room with early uterine contractions and entering Stage 1 of an anticipated spontaneous vaginal delivery were considered for inclusion in the study.

Exclusion criteria. Mothers who showed signs of fetal distress during labor or required cesarean section were excluded from the study. There were no instances of exclusion due to fetal distress. Information from 10 of the assigned

mothers was taken out of the study due to the need to perform a cesarean section. The remaining 81 mothers were included in the statistical analysis.

Procedure

On admission to the delivery room, mothers gave their consent to participate in the study. Two days after the birth (Time 1), mothers completed the Pain Catastrophizing Scale (PCS; Sullivan et al., 1995), and a retrospective evaluation of labor pain was performed in the mother's room in the obstetrics department using the VAS. Mothers also completed the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970) and the Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden, & Sagovsky, 1987). At 6 weeks after birth (Time 2), mothers were visited at home, were given and completed the STAI and the EPDS, and were videotaped in a free play session with their infants.

For the observation, mother-infant dyads were videotaped in a play situation during the day (10 a.m.–7 p.m.) at a time the mother felt the infant was neither tired nor hungry, and both mother and child were ready for play. The infant was placed in an infant seat on the floor facing the mother. The mother was seated on a rug facing the infant in a position that allowed eye contact and face-to-face interaction. The distance between the infant and the mother was approximately 45 cm, and the angle between their seating positions was 45°. In accordance with previous research (e.g., Feldman, 2000; Feldman et al., 1997), each mother was encouraged to relate to her infant, play with the infant, and try maintaining eye contact as she typically does. Filming lasted 10 min, preceded by a 5-min period of warm-up and preparations. The camera focused on the infant and the upper half of the mother's body, including her hands. The filming angle allowed observation of at least 75% of their faces.

Measures

The PCS (Sullivan et al., 1995) was used to assess catastrophizing level. The PCS is a self-report questionnaire comprised of 13 items combined into three composites: (a) processes of focusing on or distraction from the pain (rumination), (b) a tendency to exaggerate the negative consequences of the pain (magnification), and (c) the extent of the helplessness experienced during the pain. A higher score shows a higher tendency for catastrophizing pain. The PCS yields three separate scores for rumination, magnification, and helplessness, as well as a total score. In this study we used both the total score and the separate scores. The Hebrew version was achieved using back-and-forth translation on a different participant pool with acceptable-to-high internal consistency. The Hebrew version was then assessed for each PCS factor and for the total score on 80 healthy participants (rumination, $\alpha = .926$; helplessness, $\alpha = .921$; and magnification, $\alpha = .654$). The only item that

showed low reliability was Number 7 in the magnification factor ($\alpha = .242$). Therefore, this item was deleted from the scale. The total alpha score for the Hebrew version of the entire scale was .863 (Granot & Ferber, in press).

The VAS has been widely used in the measurement of pain perception and pain intensity (for reviews and meta-analyses, see Block et al., 2003; Choi, Bhandari, Scott, & Douketis, 2003; Coll, Ameen, & Mead, 2004; Crawford & Thomson, 2003). In this procedure, the examiner shows the mothers a 10-cm ruler and asks her to point to the exact level that fits the intensity of pain she experienced during labor. The ruler has two anchors of 0 (*no pain at all*) and 10 (*the worst imaginable pain*; Price et al., 1983).

Trait anxiety was measured with the Hebrew version of the STAI (Spielberger et al., 1970), which was validated on an Israeli sample by Teichman and Malineck (1978). This scale includes 20 items that assess current states of anxiety and 20 items focusing on individually stable anxiety proneness. Higher scores show a higher tendency for anxiety. The STAI has been validated in numerous studies (de Anda et al., 2000; Mataix-Cols, Fullana, Alonso, Mechon, & Vallejo, 2004; Munafo & Stevenson, 2001). The trait subscale was used in this study.

Maternal depression was measured with the Hebrew version of the EPDS (Cox et al., 1987; Glasser & Barell, 1999). This questionnaire measures symptoms of postpartum depression using 10 items rated on a 4-point scale. A higher score indicates higher levels of depression. The EPDS has been widely used (Samuelsen et al., 2001) in the study of postpartum depression.

Coding

Interactions were coded offline with the Coding Interactive Behavior (CIB) manual (Feldman, 1998). Two coders, who were blind to the mother's self-reported information, conducted coding. Coding followed a training stage on 10 healthy mother–infant dyads until interrater reliability reached 98% of agreement on each item. Interrater reliability was computed on 15 interactions and averaged 93% (intraclass $r = .92$, range = .87–.98).

The CIB is a global rating system of parent–child interaction, with different versions for newborns, infants, and toddlers. The CIB includes 42 codes (not all are used for newborn and infant): 21 for parents, 16 for infants, and 5 for dyads, each rated on a 5-point scale ranging from 1 (*low*) to 5 (*high*). Codes were averaged into three composites, in line with previous research. The CIB has been validated in studies of healthy and at-risk dyads and has shown sensitivity to infant age and cultural setting, to parent gender and interacting adults, to biological and emotional risk conditions, and to improvement following intervention (Feldman, 2000; Feldman et al., 1997; Feldman et al., 2004; Feldman & Klein, 2003; Feldman, Masalha, & Nadam, 2001; Feldman, Weller, Sirota, & Eidelman, 2003). Composites, codes, and internal consistency were as follows:

1. *Maternal Sensitivity* included 10 items: acknowledgment of the infant's interactive signals, imitation of infant social communication, elaboration of the child's vocalizations and movements, warm and positive affect, consistent visual regard, affectionate tone of voice, fluency of the interaction, consistency of style, resourcefulness in dealing with the infant's negative states, and appropriate range of affect ($\alpha = .92$).

2. *Maternal Intrusiveness* was based on 3 items: gaze break, overriding the infant's activity or focus of attention, and breaking the continuity of the interaction ($\alpha = .78$).

3. *Dyadic Reciprocity* was based on 3 items: reciprocity (engagement in give-and-take interaction cycles), adaptation and regulation (mother's adjustment of stimulation in accordance with the infant's moment-by-moment interactive signals), and harmony (extent to which interactions are smooth, free-flowing, and harmonious; $\alpha = .89$).

RESULTS

Descriptive statistics for the pain measures, maternal anxiety, and depression on the second day postpartum (Time 1) and at 6 weeks postpartum (Time 2) appear in Table 1.

As shown in Table 1, although depression and anxiety decreased over time, $t(1, 80) = 5.006, p < .0001$, and $t(1, 80) = 3.654, p < .0001$, respectively, both depression and trait anxiety were moderately stable over time ($r = .474, p < .0001$, and $r = .530, p < .0001$, respectively). Scores of mother-infant interaction were in accordance with previous research on full-term dyads (e.g., Feldman, 2000; Feldman et

TABLE 1
Descriptive Statistics for Study Variables at the Newborn Period
and at 6 Weeks Postpartum

<i>Measures</i>	<i>M</i>	<i>SD</i>	<i>Range</i>
2nd day postpartum			
Visual Analog Scale	6.17	2.95	0-10
Pain Catastrophizing Scale	20.80	12.72	1-47
Trait anxiety	33.02	10.38	20-61
Depression	17.16	5.98	9-32
6 weeks postpartum			
Trait anxiety	29.32	7.87	20-60
Depression	13.40	4.75	10-30
Maternal sensitivity	3.89	0.66	2.4-5
Dyadic reciprocity	3.26	1.02	1-5
Maternal intrusiveness	1.46	0.53	1-4.25

al., 1997). No differences were found in the PCS or in maternal anxiety and depression between mothers of firstborn and later-born infants.

Prior to computing the regression models, intercorrelations between the predicting variables were examined and are reported in Table 2.

One can see from Table 2 that parity was positively correlated with maternal age and negatively correlated with the use of analgesia. Higher use of analgesia was associated with higher pain intensity. Higher trait anxiety was associated with lower maternal education. Anxiety and depression were interrelated. Higher pain catastrophizing was associated with older age, lower education, decreased use of analgesia, higher pain intensity, and higher depression.

Finally, three hierarchical multiple regression models were computed, predicting the three mother–infant interaction constructs: maternal sensitivity, maternal intrusiveness, and dyadic reciprocity. Variables were entered in a theoretically guided order. Maternal age, education, and parity (firstborn or later-born) were entered to partial the effects of demographic conditions on the mother's interactive behavior. This was followed by entering the use of analgesia during labor and pain perception, as measured by the VAS, to account for the sensory experience of pain. The mean scores of anxiety and depression at birth and at 6 weeks were then entered to examine the contribution of maternal emotional well-being to the mother's interactive style. The mean score of the two assessments was chosen as it represents the continuous component in the mother's trait anxiety and depression. Pain catastrophization was entered in the last step to examine the unique contribution of the unpleasantness component of pain above and beyond all other factors in the model. Results of the regression models for sensitivity and reciprocity are presented in Table 3. The model predicting maternal intrusiveness was not significant. Similar regression models were computed using the 6-week measures of anxiety and depression rather than an average score of depression and anxiety over the two measurement times. These regressions revealed the same pattern of results: Sensitivity was predicted by education ($\beta = 0.385, p < .0001$) and trait anxiety ($\beta = -0.335, p = .003$); dyadic reciprocity was predicted by education ($\beta = 0.440, p < .0001$) and PCS ($\beta = -0.354, p = .005$).

As Table 3 shows, maternal age and education were significantly related to both maternal sensitivity and dyadic reciprocity, with older, more educated mothers providing more optimal parenting. Pain catastrophization predicted dyadic reciprocity above and beyond all other factors in the model. In the model predicting maternal sensitivity, maternal trait anxiety had a unique contribution to the prediction of sensitivity, above and beyond demographic factors and pain perception, but pain catastrophization did not explain a unique variance in sensitivity. The model predicting maternal intrusiveness was not significant, although the mother's PCS scores were related to maternal intrusiveness (see Table 4).

Finally, following the significant relations between the mothers' total PCS scores and dyadic reciprocity, we tested whether each of the three PCS factors (ru-

TABLE 2
Intercorrelations Between Predicting Variables

	Maternal Age	Maternal Education	Parity	Analgesia	VAS	Trait Anxiety	Depression	PCS
Maternal age	—							
Maternal education	.205	—						
Parity	.391***	-.189	—					
Analgesia	.007	.096	-.284*	—				
VAS	-.011	-.220	.163	.328***	—			
Trait anxiety	-.074	-.229***	.689	-.158	.068	—		
Depression	.148	-.215	.084	-.042	.088	.457***	—	
PCS	.302***	-.437***	.060	-.222*	.383***	.114	.357***	—

Note. VAS = Visual Analog Scale; PCS = Pain Catastrophizing Scale.

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

TABLE 3
 Prediction of Dyadic Reciprocity and Maternal Sensitivity by Pain
 Catastrophizing and Trait Anxiety

Predictors	Dyadic Reciprocity ^a			Maternal Sensitivity ^b		
	β	ΔR^2	ΔF	β	ΔR^2	ΔF
Maternal age	.241	.058	4.831*	.238	.057	4.761*
Maternal education	.440	.188	18.890***	.388	.143	13.993**
Parity	-.02	<.0001	0.025	.160	.020	1.929
Analgesia	.134	.016	1.642	-.004	<.0001	0.001
Visual Analog Scale	.016	<.0001	0.021	.121	.011	1.054
Trait anxiety	-.12	.013	1.316	-.255	.056	5.818**
Depression	-.17	.021	2.122	.055	.002	0.209
Pain Catastrophizing Scale	-.35	.066	7.281***	-.117	.007	0.757

^a R^2 total = .36, $F(1, 71) = 4.993$, $p = .002$. ^b R^2 total = .275, $F(1, 71) = 3.37$, $p < .0001$.

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

TABLE 4
 Prediction of Maternal Intrusiveness

Predictors	Maternal Intrusiveness ^a		
	β	ΔR^2	ΔF
Maternal age	-.005	<.001	0.002
Maternal education	-.097	.009	0.711
Parity	-.023	<.001	0.032
Analgesia	.193	.340	2.676
Visual Analog Scale	.228	.038	3.122
Trait anxiety	.061	.003	0.265
Depression	.106	.008	0.618
Pain Catastrophizing Scale	.331	.060	5.072*

^a R^2 total = .152, $F(1, 71) = 1.614$, $p = .136$.

* $p < .05$.

mination, helplessness, and magnification) was significantly related to dyadic reciprocity above and beyond the demographic and pain variables. In each regression, predictors were entered in the same order as previously described (maternal age, education, parity, analgesia, VAS, mean trait anxiety, and depression), and in the last step we entered one of the PCS subscales: rumination, magnification, or helplessness. All three models were demonstrated to be significant. In each model, the PCS subscale explained a unique portion of variance in dyadic reciprocity above and beyond all other factors in the model: rumination, $\beta = -0.361$, $R^2 = .38$, $F(1, 72) = 5.528$, $p < .0001$; helplessness, $\beta = -0.260$, $R^2 = .338$, $F(1, 72) = 4.598$, $p <$

.0001; and magnification, $\beta = -0.206$, $R^2 = .333$, $F(1, 72) = 4.487$, $p < .0001$. These data indicate that the three aspects of pain catastrophization—the increase in ruminations, the feeling of helplessness, and the tendency to magnify pain—are each independently related to lower levels of mother–infant reciprocity.

DISCUSSION

Results of this study indicate that labor pain catastrophizing in the second day postpartum predicts lower levels of mother–infant reciprocity at 6 weeks. These findings suggest that the mother's tendency to catastrophize pain during labor may serve as an early marker of mother–infant relationship difficulties in the neonatal period. The contribution of pain catastrophization to the prediction of mother–infant reciprocity was significant above and beyond the mother's depression and anxiety in the postpartum period, the mother's sociodemographic variables, or the mother's pain-related factors such as the use of analgesia during labor and the recollection of pain intensity. Thus, it appears that labor pain catastrophizing may have an effect that persists beyond the conclusion of delivery and the confinement period.

The construct of pain catastrophization consists of three components: rumination, helplessness, and magnification of pain. Rumination is a positive response during the postpartum stage when the focus is the infant and not the pain. According to Winnicott's (1956) account, the mother's mental state during the postpartum period is characterized by an obsessive-like rumination termed *primary maternal preoccupation*, which include thoughts of the baby, compulsive checking of the infant, ritualistic behaviors during feeding and caregiving, and an exclusive mental focus on the child. In support of this view, Feldman, Weller, Leckman, Kuint, and Eidelman (1999) found decreased mental preoccupation among mothers of very sick premature infants and reduced preoccupations among depressed mothers. On the other hand, mothers who reported high rumination with labor pain may turn the natural tendency for mental preoccupation away from the infant and toward their own experience, a tendency that may result in lower focus on the infant and the emerging relationship. In line with Fields's (1999) perspective and our theoretical conceptualization outlined earlier, it seems that women who tended to catastrophize pain magnified the unpleasantness of their own labor experience and were thus more preoccupied with themselves. These mothers were less mentally available to initiate the bonding process with the newborn and employ the cognitive-emotional transformations required to turn the unpleasant part of labor pain into a growing involvement with the coming infant.

Each of the three PCS factors was found to predict mother–infant reciprocity above and beyond demographic, emotional, and pain-related factors. It is thus possible that a mother who feels helpless about her own pain will be less competent

during interactions with the infant when she needs to focus on the infant's cues and provide a regulatory framework for the nonverbal interaction in its earliest stages. Helpless individuals tend to assume a withdrawn posture and decrease their initiations for social interaction, a tendency that is likely to result in lower levels of interpersonal reciprocity (Stern, 1995). It is also possible that a mother who magnifies pain—the third factor of the catastrophizing tendency—may be overwhelmed by her infant's needs and by the demands of the maternal role, a state that may compromise her ability to adapt to the infant's signals and attend to her own mental processes as the primary coregulator (Als, 1999). In addition, the mother's willingness to focus on the child and her ability to mobilize her sense of agency in dealing with the temporary pain of childbirth are important emotional-cognitive attributions in preparing for the maternal role and in establishing the relationship with the infant during the first postpartum period. Further research is required to address the mother's tendency for magnification, helplessness, and rumination in unpleasant events other than labor and to examine their association with the mother-child relationship. It is possible that pain catastrophizing is an umbrella construct that includes a set of tendencies that compromise the individual's resourcefulness to deal with the immense burden of raising an infant.

Our data show that trait anxiety and catastrophizing were each related to a different aspect of the mother-infant interaction. As both trait anxiety and catastrophizing belong to the unpleasantness component of pain (Fields, 1999), it is possible that trait anxiety corresponds to the emotional component and catastrophizing to the cognitive appraisal part (Granot & Ferber, *in press*). The negative correlation between trait anxiety and maternal sensitivity possibly relates to the fact that high emotional distress interferes with the development of sensitive mothering (Weinberg & Tronick, 1998). Catastrophizing, on the other hand, may be related to reciprocity given that accurate cognitive appraisals of the situation are required to receive the cues from the infant, interpret them, and respond in a timely manner. It is possible that the model predicting maternal intrusiveness was not significant because the sample consisted of healthy and relatively educated women and the general level of intrusiveness in this sample was relatively low.

Pain catastrophizing was associated with a more reciprocal mother-infant relationship, yet the mother's report on the VAS measure, which index pain intensity, was not predictive of dyadic reciprocity. The VAS measure reflects the sensory perception of pain intensity, which is different from the unpleasantness component of pain catastrophizing. The findings therefore suggest that the cognitive and emotional components of the painful experience may be more central to the development of the mother-infant relationship than the purely sensory assessment of the degree of physical pain. Our data show that higher PCS scores were associated with less analgesia use, whereas higher VAS scores were correlated with more analgesia. It is thus possible that although the PCS and the VAS scores were positively correlated in many previous reports of painful experiences other than labor (Sullivan et al., 1995; Sullivan et al., 2001), during labor the management of the

unpleasantness—emotional aspect of pain is not necessarily linked to analgesia, whereas the use of analgesia directly impacts the experience of the sensory component of pain. This proposition points to the need to include psychological measures during labor to enhance the mother's strategies for coping with pain to decrease the unpleasantness component. Interestingly, one mother who scored zero on the VAS measure of pain intensity had a relatively high score on the PCS, pointing to the complex interrelations between the sensory and the cognitive-emotional components of pain in extreme cases, particularly during labor.

Mothers giving birth for the first time did not differ from those giving birth to later-born infants on pain catastrophizing and labor pain intensity. This may suggest that pain catastrophizing is a trait that may be relatively stable over time and life experiences, and its relevance to the development of mother–infant interaction may go beyond the experience of actual or past labor pain. Maternal education was found to be a significant predictor of maternal sensitivity and reciprocity, a finding that is consistent with previous research on the development of mother–infant interaction (Bee et al., 1982; NICHD Early Child Care Research Network, 1999). Maternal education was also negatively correlated with pain catastrophization, and the data suggest that the combination of low education and high catastrophizing tendency may be a risk factor for the development of a synchronous and reciprocal mother–infant relationship. Pain as shown in the PCS measures was positively correlated with maternal age. This finding may be related to the healthier physique of younger women who may not react to the delivery as a threat and may have more physical and mental resources to cope with labor pain. Education provides one of the cognitive avenues for coping with painful situations, and thus, higher education was negatively correlated with pain measures. Such findings are in accordance with previous studies on the relations of higher education and better coping (Bédard, Reid, McGrath, & Chambers, 1997; Drossman, Leserman, Li, Hu, & Toomey, 2000).

Considering the significance of early synchrony and reciprocity to the development of infants' cognitive, social, and self-regulatory skills, the early detection of dyads at risk for the development of reciprocity is of theoretical and clinical importance. Implications of this study for the treatment of mothers at risk may include the application of cognitive behavior therapy methods to reframe the cognitive appraisal of labor pain as a threat at admission and decrease the level of rumination after the conclusion of pain. Similarly, relaxation methods to reduce stress responses during contractions may be helpful (Field et al., 1992), as may brief psychotherapeutic interventions during hospital confinement to sensitively review with the mother the labor experience and facilitate the transition from focusing on the self to involvement in the maternal role.

Among the limitations of the study is the absence of longitudinal measures beyond the first 6 weeks after birth. In addition, neurobehavioral and cognitive development as well as the collection of physiological measures from mother and child were beyond the scope of this study. Although we used the VAS mea-

sure as an account of delivery difficulty, recording of delivery length may have added important information. Future research should examine other aspects of labor pain and their effects on the mother, the child, and their relationship. It is of interest to know whether mothers low or high on pain catastrophization differ on a range of neuroendocrine measures during labor. Finally, it is important to examine whether the birth experience has an effect on infant development in the cognitive or social-emotional domains. As mothers who experience high pain catastrophization may be at a higher risk in terms of their preparedness to face the hardships involved in motherhood, attention to these mothers during the postpartum period may facilitate higher maternal attunement to the developmental and relational needs of their infants.

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