Individual Differences in the Contribution of Maternal Soothing to Infant Distress Reduction

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This study investigates individual differences in the contribution of specific maternal regulatory behaviors to the mother–infant dyad’s regulation of infant distress response. Additionally, we examined the stability of infants’ stress responses and the stability of specific maternal soothing behaviors. The sample included 128 mother–infant dyads that were observed during an inoculation at 2 and 6 months. The average intensity of infant cry response showed modest stability across age only before controlling for the infant’s general state of irritability, and the duration of crying was not stable. Of the 8 specific maternal regulatory behaviors studied, affection, touching, and vocalizing showed the strongest stability across infant age. Finally, an index of the contingency between maternal soothing and infant cry reduction at 2 months predicted shorter cry duration but not cry intensity at 6 months. The results of this study indicate that infants whose mothers showed a greater contribution to reducing their distress at 2 months showed a shorter duration of crying 4 months later. This suggests a possible longitudinal influence of maternal regulation on infants’ distress responses.

Infants display varied responses to negative stimuli, even those as aversive as pain. Differences exist in a number of infants’ response dimensions, including the intensity of reaction to stimuli as well as the duration of recovery from distress. One rea-
son for this difference may be the ways in which parents soothe their infants. The process of early infant regulation is a dyadic one, whereby the infant and caregiver both contribute to the infant’s ability to overcome heightened negative arousal (Kopp, 1989; Thompson, 1994; Tronick & Weinberg, 1997). Understanding the systematic variation of infants’ and mothers’ behaviors in the context of infant pain reactivity and the contribution of specific maternal soothing behaviors to infants’ distress reduction is significant because unrelieved distress in early infancy may have serious long-term influences on infants’ well-being (Anand & McGrath, 1993; Craig, Gilbert-MacLeod, & Lilley, 2000; Porter, Grunau, & Anand, 1999). This study examined the stability of infants’ reactions to an inoculation, the stability of mothers’ use of specific soothing behaviors in this context, and the contribution of maternal soothing to the dyad’s success at reducing infants’ distress.

Research concerning developmental changes in maternal soothing in response to infant pain reactivity suggests some discontinuity, such that mothers change their use of behaviors to reflect infants’ developmental maturation. Although overall soothing declines with infant age (Lewis & Ramsay, 1999), research on mothers’ use of specific strategies suggests a decrease in the use of some behaviors (e.g., affection, touching, and vocal soothing) and an increase in the use of others (e.g., distraction and vocalizations; Craig, McMahon, Morison, & Zaskow, 1984; Jahromi, Putnam, & Stifter, 2004). Interestingly, there is also evidence of cultural differences in the development of maternal soothing such that Italian mothers engage in more soothing behavior with their older infants than their younger infants (Axia & Weisner, 2002).

With respect to individual variability in maternal soothing, Lewis and Ramsay (1999) found that overall maternal soothing in response to infant pain distress was stable between 2 and 4 months and 4 and 6 months. That is, those mothers who used more soothing early on also tended to use more soothing as their infants increased in age. Furthermore, maternal soothing in the inoculation setting was found to be related to soothing behavior to everyday distress such as a diaper changing or feeding, suggesting some consistency in infants’ experience of external soothing in the first year. In contrast to these findings, however, Axia and Weisner’s (2002) study of Italian mothers did not reveal stability in maternal behaviors from 5 to 12 months of age. It may be that mothers are consistent in their use of some, but not all, soothing strategies across early infancy. In this study we explore this issue by examining individual differences in mothers’ use of specific soothing behaviors from 2 to 6 months of age.

Infants’ responses to painful stimuli have been well studied, and such research indicates that the intensity and duration of cry responses (both physiological and behavioral) tend to decrease across age (Axia & Weisner, 2002; Craig et al., 1984; Jahromi et al., 2004; Lewis & Ramsay, 1995; Ramsay & Lewis, 1994). Studies of the individual stability of these responses have demonstrated mixed findings, however. With respect to initial cry reaction or cry intensity, Worobey and Lewis
1989) found a relation between infants’ reaction to a heel stick at 2 days and an inoculation at 2 months. Likewise, Lewis and Ramsay (1995) found cross-age stability in infants’ initial reaction to an inoculation at 2 and 6 months. Finally, Axia and Bonichini (1998) found expressions of pain and distress following an inoculation to be stable between 3 and 5 months, and between 5 and 11 months of age. With respect to cry duration, or quieting, a number of studies have revealed a lack of stability in this cry parameter (Lewis & Ramsay, 1995; Worobey & Lewis, 1989). In contrast to the aforementioned findings, however, Gunnar, Brodersen, Krueger, and Rigatuso (1996) reported stability in time to calm (i.e., duration) between 6 and 15 months, but no stability in the intensity of behavioral distress to inoculation between 2 and 15 months. The mixed findings concerning stability of infant reactivity and regulation across time may be due, in part, to the emergence of self-regulation during the first year of the infant’s life (Kopp, 1982; Rothbart, Ziaie, & O’Boyle, 1992). This proposition would be consistent with findings that duration of crying is unstable early in the first year, but stable toward the end of the first year. Further exploration of cry parameters across early infancy would help clarify this issue.

What is the longitudinal effect of maternal soothing on the development of infants’ stress response? Axia and Weisner (2002) discussed the current state of the field by highlighting three positions concerning this issue. One position is that maternal regulation reduces infant distress, as evidenced by findings of concurrent relations between maternal soothing strategies and reductions in infant cry responses (e.g., Gormally et al., 2001; Gray, Watt, & Blass, 2000; Jahromi et al., 2004; Sweet, McGrath, & Symons, 1999). Another position is that maternal regulation has no effect on infant crying, as is suggested by Lewis and Ramsay’s (1999) finding that overall soothing, both concurrently and longitudinally, did not relate to infant emotional responses nor to levels of the stress hormone cortisol. Finally, there is the contention that maternal regulation may increase infants’ cry responses, as is suggested by Axia and Weisner’s (2002) finding that more maternal soothing in an Italian sample at 5 months predicted longer time to quiet at 12 months. Together, these studies indicate an inconsistent set of findings concerning the effect of maternal soothing on infant crying, both concurrently and longitudinally. In this study, we explore this issue utilizing an analytic approach that indexes the degree to which mothers’ soothing strategies were contingently related to reductions in infant distress. This approach enables us to explore associations between infant cry parameters and soothing that was specifically tied to reductions in infant crying, rather than simply correlating cry parameters and soothing, as is the approach utilized in much of the previous research. Thus, assuming some mothers had a greater effect on the dyad’s ability to reduce the infant’s distress than others, we aimed to examine whether those mothers whose behaviors were more contingently related to infants’ distress reduction had infants who demonstrated significant reductions in distress over time. Although our study measures only mothers’ regulatory be-
haviors while the infant is distressed, the process of distress regulation is considered to be a dyadic and mutual one such that both the infant and mother may contribute to reductions in infant crying over time (Tronick & Weinberg, 1997).

There are both advantages and disadvantages to observing infants’ and mothers’ behaviors in the inoculation setting. This naturalistic context involves a salient stimulus to which nearly all infants respond, thus allowing for consistency in the context’s ability to pull for both infant and maternal behaviors. Disadvantages of studying reactivity and soothing behaviors in this setting are that pain reactivity may differ conceptually from other forms of everyday negative reactivity, thus infants’ and mothers’ behaviors may not generalize to other environments. There is some evidence, however, of cross-contextual continuity in negative responses. Specifically, Schechter, Bernstein, Beck, Hart, and Scherzer (1991) found an association between preschoolers’ level of distress to immunization (e.g., resistance, muscular rigidity, crying, and screaming) and the child’s likelihood to be rated as having a “difficult” temperament, suggesting that children’s pain responses may be reflective of everyday negativity and temperament. Furthermore, Izard, Hembree, and Huebner (1987), who suggested that pain responses share characteristics of emotions, found that infants show both pain response and anger in response to inoculation. Finally, findings about the inoculation setting itself indicate that infants express varying levels of distress after receiving a shot and that mothers use different behaviors in response to different levels of infant reactivity (Jahromi et al., 2004). One might speculate that lower levels of reactivity in this setting may reflect both infant and maternal behaviors that one would observe in everyday settings.

The behaviors in which mothers engage to soothe their distressed infants are thought to have both immediate and long-term effects on infants’ self-regulation (Kopp, 1989; Thompson, 1994). Given the importance of the mother’s contribution to the dyad’s regulation of infant distress, this study aimed to examine individual differences in maternal soothing behaviors across infant age, and to assess whether mothers’ contributions to infants’ distress regulation was predictive of infant stress response 4 months later. Toward that end, infants’ intensity and duration of crying to an inoculation at 2 and 6 months of age as well as maternal soothing behaviors were examined. We hypothesized that maternal regulatory behaviors would be stable across early infancy and that infants of mothers who demonstrated a greater contribution to their soothing at 2 months of age would show more regulated stress responses 4 months later.

METHOD

Participants

As part of a longitudinal study of healthy, term infants, 128 participants (65 female, 63 male) were observed with their mothers during an inoculation when the
infants were 2 months of age ($M = 2.1$, range = 1.5–3.5) and 6 months of age ($M = 6.4$ months, range = 5.0–8.8 months). Dyads were dropped from the original longitudinal data set if they had incomplete data at one or both time points, either due to dropping from our study or because their physician’s office would not allow videotaping. Thus, of the original 150 dyads, 4 were dropped for missing both 2- and 6-month inoculation data, 5 for missing only 2-month data, and 13 for missing only 6-month data. Families were predominantly White (4 African American, 4 Asian, and 1 Hispanic), and were recruited from a local community hospital. Eighty-four percent of the mothers were married, and 96% were living with the infant’s father. At the time of recruitment, mothers had a mean age of 29.7 years (range =16–43 years) and an average of 15.7 years of education (range = 10–26 years).

Procedures

Infants and their mothers were observed during a routine inoculation visit at a total of 15 different pediatric offices. The infant’s state of general irritability was assessed while the infant and mother were in the waiting area and up to 1 min prior to the inoculation. The inoculation consisted of between one and four injections. After receiving the shot, the infant was given to the mother, who was free to soothe the baby using any method she deemed appropriate. Although consistent procedures were used across the physician’s offices, the physician’s office and the number of injections were noted by the experimenter and examined with respect to the outcome variables.

Measures

Infants and their mothers were videotaped for at least 1 min prior to the administration of the shot, and until the infant was calm for a period of 20 consecutive sec following the inoculation. The videotapes were subsequently coded independently for infant and maternal variables. Coding of infant reactivity and maternal soothing behaviors began once the last needle was retracted, and continued for a period of up to 4 min after the start of the inoculation. Infant reactivity and maternal behaviors were coded in 5-sec intervals, for a maximum of 48 intervals.

**Infant variables.** The infant’s state of general irritability prior to the inoculation (i.e., his or her baseline state prior to receiving a shot) was measured according to a 9-point Likert-type scale adapted from the Irritability item of the Brazelton Neonatal Behavioral Assessment Scale (Brazelton, 1973). The scale ranged from 1 (no irritability) to 9 (irritable to all degrees of stimulation). This scale, which has been set so that the midpoint (i.e., irritability to aversive or nonaversive stimuli but
with consoling returns to lower states) is the norm, provides reliable information about young infants’ responses and is valid for the study of infants from divergent populations (Brazelton, 1973). The mean general irritability scores were 5.81 (SD = 1.47) at 2 months and 5.34 (SD = 1.57) at 6 months.

Infant negative reactivity was coded every 5 sec according to the following 4-point scale, representing an increasing intensity of negative affect: 0 (no audible vocalization), 1 (fussing, whining, or whimpering, but not crying), 2 (low-intensity crying that may have occurred at a rapid frequency, but without shrieking cries), 3 (very intense, loud, piercing crying, usually with a quavering out-of-control quality, and typically with a red face, squinted eyes, and an open mouth). If more than one level of intensity of crying was observed during a 5-sec interval, the dominant intensity level during that interval was coded. Scores were averaged across the number of intervals observed to produce the measure of overall cry intensity. The measure of overall cry duration reflected the total number of intervals during which the infant was coded as distressed. See Table 1 for the means and standard deviations of the cry variables.

Ten percent of all infant reactivity observations were coded by two independent coders. Training occurred until coders achieved a Cohen’s kappa > .75. The mean interrater reliability across the 2- and 6-month observations of infant reactivity was Cohen’s kappa = .92.

### TABLE 1
Means, Standard Deviations, and Ranges for Infant and Maternal Variables

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aOverall cry intensity was measured on a scale ranging from 0 to 3. bOverall cry duration reflects proportion of total possible intervals. cMaternal behaviors reflect the proportion of time that the mother engaged in a specific behavior. dYule’s Q values may range from – 1.00 to 1.00.
**Maternal variables.** The presence or absence of the following eight maternal soothing behaviors was coded in 5-sec intervals: affection (e.g., kissing or hugging), touching (e.g., patting or stroking), holding or rocking (i.e., picking up the infant with or without any movement), vocalizing (e.g., talking, singing, “shushing,” or making unrecognizable noises), care taking (e.g., dressing, changing a diaper, or wiping the infant’s nose), distracting (i.e., overtly attempting to direct the infant’s attention away from discomfort of the shot), presenting face (i.e., overtly attempting to look into the infant’s face), and feeding or pacifying (i.e., giving the infant a bottle or pacifier, or breastfeeding). An unlimited number of maternal variables could be coded as present during each interval, as the behaviors were not mutually exclusive. The variables represent the proportion of time that the mother engaged in the given behavior (i.e., the total number of intervals in which the specific maternal behavior was present, divided by the total number of intervals during which the infant cried). See Table 1 for the means and standard deviations.

Ten percent of all maternal behavior observations were coded by two independent coders after an acceptable agreement (Cohen’s kappa > .75) was achieved in training. As behaviors were not mutually exclusive, kappas were derived from separate $2 \times 2$ contingency tables for each behavior. Coders achieved the following Cohen’s kappa for each of the soothing behaviors: .83 (affection), .78 (touching), .93 (holding or rocking), .85 (vocalizing), .89 (care taking), .80 (distracting), .90 (presenting face), and .98 (feeding or pacifying).

### RESULTS

Prior to conducting the primary analyses, we examined whether differences existed in infant cry variables or maternal behavior variables as a function of infant sex and birth order using one-way analyses of variance (ANOVA). These tests revealed that infants’ and mothers’ behaviors did not significantly differ between boys and girls. With respect to birth order, the analyses revealed that at 2 months, first-born infants ($n = 61$) cried for a significantly longer duration ($M = 30.57, SD = 12.63$) than those who were not first-born ($M = 25.63, SD = 11.93$), $t(126) = 2.28, p < .05$, Cohen’s $d = .40$. Compared to mothers of non-first-borns, mothers of first-born infants engaged in more care-taking behavior at 2 months, $t(126) = 2.02, p < .05$, and more vocalizing, $t(125) = 2.53, p < .05$, and distracting at 6 months, $t(125) = 2.62, p < .05$. Thus, we accounted for birth order in the study’s primary analyses concerning infant and maternal behaviors.

Additionally, we tested the relations among possible covariates (i.e., general irritability, number of shots, and doctor’s office) and infant cry variables. At both 2 and 6 months, infants’ general irritability was related to concurrent measures of overall cry intensity and duration, ($r$s ranged from .30–.60, all $ps < .01$), thus we controlled for general irritability in all analyses involving cry variables. Concur-
rent relations between cry intensity and cry duration were assessed using zero-order correlations. Results revealed that after controlling for general irritability, these parameters of infant distress were related at 2 months, $r(124) = .25, p < .01$, and at 6 months, $r(122) = .41, p < .001$. As expected, infants who cried more intensely in response to the inoculation also cried for longer periods of time.

Infants received an average of $2.6 (SD = .87)$ shots at the 2-month visit and $2.4$ shots ($SD = .65$) at 6 months. The number of shots at 6 months was related to the concurrent measure of overall cry intensity, $r(127) = .22, p < .05$, thus this variable was included as a covariate in all analyses of infant crying. Finally, there were no significant differences among the physician’s offices with respect to any of the study variables.

### Stability of Individual Differences in Infant Stress Responses

Zero-order correlations were conducted to assess the stability of overall cry intensity and overall cry duration. These analyses revealed that overall cry intensity showed modest stability, $r(128) = .18, p < .05$, but only before controlling for general irritability. Overall cry duration was not stable across age ($p = .49$), and general irritability showed only marginal stability across age, $r(124) = .19, p = .05$. Separate correlation analyses were next conducted for infants who were first-born and those that were not. These analyses did not reveal a different pattern of results from those conducted on the entire sample.

### Stability of Individual Differences in Specific Maternal Soothing Behaviors

Zero-order correlations were conducted to assess the stability of specific maternal behaviors. These analyses revealed that among the eight soothing behaviors measured, three showed good stability across age: affection, $r(126) = .33, p < .001$; touching, $r(128) = .31, p < .001$; and vocalizing, $r(128) = .35, p < .001$. Two maternal behaviors showed only modest stability: care taking, $r(128) = .19, p < .05$; and feeding or pacifying, $r(126) = .18, p < .05$.

Separate analyses for the first-born and non-first-born infants indicated a different pattern of results for the two groups. Specifically, non-first-time mothers showed stability in only their touching behaviors, whereas mothers of first-borns were stable in their use of affection, touching, holding and rocking, and vocalizing.

### Relation Between Effective Maternal Soothing and Infant Stress Responses

In line with the goal of this investigation to examine the predictive association between early effective maternal soothing and infant stress response 4 months later,
we used contingency analyses to create an index of each mother’s overall contribution to infant distress reduction at 2 and 6 months of age. Contingency analyses are considered a superior method to conducting correlations between infant and mother variables as such a method loses information about individual moments of distress reduction and relates two variables that are confounded to begin with. The results of the correlational analyses between infant crying and maternal soothing behaviors can be found in Jahromi et al. (2004).

Because a mother could have contributed to her infant’s distress regulation by using a number of different behaviors, we created an overall measure of this contribution across all behaviors for each mother–infant dyad. A composite Yule’s Q value was calculated by summing the $2 \times 2$ contingency tables for all behaviors. Yule’s Q is a transformation of the odds ratio that reflects the odds that a given contingency will occur, controlling for the base rate of behaviors. This value varies from $-1$ to $+1$ and serves as an index of the strength of the contingency between two variables (Bakeman, 2000; Bakeman, McArthur, & Quera, 1996; van Egeren, Barratt, & Roach, 2001). Thus, in the context of our study, a Yule’s Q value closest to $+1$ indicates that the mother’s soothing behaviors were strongly associated with decreases in infants’ cry levels, 0 indicates that the behaviors had no effect on infants’ crying, and a value closest to $-1$ indicates that the behaviors were strongly associated with an absence of a decrease or an increase in infants’ crying. For each contingency, rows reflected the presence or absence of a particular maternal behavior in a given interval and columns reflected the presence or absence of a decrease in infant reactivity in each next interval (Lag 1). Decreases could be for any level of reactivity (e.g., from Level 3 to Level 2). To create the composite Yule’s Q value for each dyad (across all behaviors), cell components of the tables for individual behaviors were summed. For example, each dyad had a $2 \times 2$ Yule’s Q contingency table for affection behaviors, with columns reflecting decrease or no decrease in infant reactivity and rows reflecting the presence or absence of maternal affection. Thus, the top left cell of each of these tables consisted of the number of times affection behaviors were contingently associated with infant soothing, and this was the case for the contingency table of all eight maternal behaviors. To create the top left cell for the composite Yule’s Q contingency table, this cell was summed across all behaviors. Next, the values in the top right cell (i.e., number of times a maternal behavior was followed by no infant soothing) were summed across all eight behaviors to create the top right cell of the dyad’s composite Yule’s Q table, and this process was repeated for all four cells of the composite table. See Table 1 for means and standard deviations of the composite Yule’s Q variable at 2 and 6 months. The composite Yule’s Q value at 2 months was not significantly related to that at 6 months ($p < .88$), and was not significantly related to any of the infant cry variables at 2 months. There was not a significant difference in the 2- or 6-month Yule’s Q variables by infant sex or infant birth order.
To test whether the contribution of 2-month maternal soothing on concurrent infant crying was predictive of 6-month infant cry duration, the 2-month Yule’s Q value was entered into a regression equation after accounting for the variance due to 2-month overall cry duration, mean general irritability (average of 2-month and 6-month general irritability), and number of shots. This test revealed that 2-month maternal contribution was a significant predictor of 6-month overall cry duration, $F(4, 125) = 2.73, p < .05, R^2 = .08; \beta = -.17, t(125) = -1.97, p = .05$, although the explained variance was relatively low. To test the prediction of 6-month overall cry intensity by 2-month maternal soothing contribution, the 2-month Yule’s Q value was entered into a regression equation after accounting for the variance due to 2-month overall cry intensity, mean general irritability, and number of shots at 6 months. This test revealed that 2-month Yule’s Q was not a significant predictor of 6-month overall cry intensity ($p = .32$). Thus, the index of mothers’ contribution in reducing infants crying at 2 months significantly predicted infants’ duration of crying at 6 months but not the intensity of their response.

Finally, we created categories based on mothers’ composite Yule’s Q values to explore the effect of consistently contingent versus less contingent maternal regulation on later infant cry responses. Mothers whose composite Yule’s Q value at 2 months fell 1 SD above the mean and higher were categorized as high contributors ($n = 26$) and those whose composite Yule’s Q value fell 1 SD below the mean or lower were categorized as low contributors ($n = 22$). Chi-square analyses were conducted to test for associations between Yule’s Q categories and both infant sex and infant birth order. No significant associations were found. One-way ANOVAs were conducted to test for significant differences in 6-month infant cry parameters based on maternal soothing contribution categories. The 6-month cry variables (cry duration and intensity) were first residualized to control for the effect of the respective 2-month cry variable, the concurrent measure of general irritability, and number of shots on each. There was a significant difference between mothers in the two soothing contribution categories in terms of their infants’ 6-month cry duration, $F(1, 47) = 4.97, p < .05$, Cohen’s $d = .65$. Infants whose mothers’ behaviors were classified as highly contingent with reductions in their distress at 2 months cried for a significantly shorter duration of time at 6 months ($M_{residualized z score} = -.37, SD = .89$) than those whose mothers were classified as less effective soothers at 2 months ($M_{residualized z score} = .26, SD = .95$). There was not a significant difference in 6-month infant cry intensity based on 2-month maternal effectiveness categories, nor was there a difference in either 6-month infant cry parameter based on 6-month maternal effectiveness category.

**DISCUSSION**

This study is an extension of previous work on infant reactivity, maternal soothing, and the contribution of maternal soothing behaviors to infant distress behaviors in
early infancy. Our findings revealed that early maternal soothing behaviors predicted later infant distress. Specifically, those infants whose mothers’ behaviors were more contingently related to reductions in their distress cried for a shorter duration in response to an inoculation 4 months later. The effect, however, was a modest one. Interestingly, the early contribution of maternal soothing did not predict later infant cry intensity. Similar results were obtained when we examined mothers who fell at the extremes of the continuum of contingent soothing. Mothers who were categorized as high contributors at 2 months had infants who cried less at 6 months of age but no effect was found for cry intensity. This finding not only supports the theory that early regulatory experience with a caregiver may influence emotional development over time (Kopp, 1989; Thompson, 1994), but also suggests that this effect may be specific to certain parameters of crying, in particular duration. It may be that at 6 months, both maternal and self-regulatory processes affected infants’ ability to quickly self-soothe or be soothed by the mother, but had less of an effect on the intensity of their reaction to felt pain. Such an interpretation would suggest that the intensity of pain response may be a more stable temperamental characteristic (Rothbart & Derryberry, 1981). Although our findings concerning the stability of intensity of crying were somewhat mixed, they provide modest support for the previous literature indicating stability in the intensity of infants’ and children’s pain response (e.g., Axia & Bonichini, 1998; Izard et al., 1987; Schechter et al., 1991; Worobey & Lewis, 1989).

That infant cry duration was not stable from 2 to 6 months is also consistent with much of the previous research (Lewis & Ramsay, 1995; Worobey & Lewis, 1989). One might hypothesize that the lack of stability in cry duration could be due to the maturation process that takes place early in the first year of the infant’s life whereby infants begin to produce alternative methods of communicating (e.g., cooing and smiling; Wolff, 1987) and engage in self-regulatory behaviors (e.g., self-stimulation, self-soothing, and redirecting of visual attention; Kopp, 1982; Rothbart et al., 1992). If such behaviors worked in tandem with the soothing brought on by the mother to quicken the infant’s recovery from inoculation, then those infants with greater self-regulatory maturation may have been more effective in regulating their distress to the inoculation at 6 months. The fact that first-born infants cried for a longer duration than non-first-borns at 2 months of age also points to a possible connection between mothers’ behaviors and infants’ distress reduction, such that mothers with more experience may be better able to soothe their infants. Experience soothing, however, may come quickly as first-borns’ cry durations were not different from the cry durations of later born children at 6 months of age.

This study extends previous work by exploring individual differences in specific maternal soothing behaviors. Previous research suggests that on average mothers increase their use of vocalizing and distraction behaviors as infants increase in age (Jahromi et al., 2004). These behaviors require more work on the infants’ part and thus may reflect their burgeoning self-regulation. Distraction re-
quires them to shift attention, and vocalization may activate memory of the mother and her responsiveness. With maturation, infants become capable of responding to a greater number of soothing strategies and this may influence the duration of time it takes them to be soothed. Our investigation of individual differences in the use of specific maternal behaviors revealed that affection, touching, and vocalizing showed the strongest stability, whereas care taking and feeding or pacifying were modestly stable across time. Interestingly, distraction was among those maternal strategies not found to be stable across time. In line with the theory that infants’ attentional self-regulatory strategies emerge by about 6 months (Rothbart et al., 1992), this finding likely reflects the mothers’ recognition that their infants may or may not respond to distraction as a means for soothing. In other words, with increasing maturation and consolidation of individual differences in attention shifting ability, mothers of infants who are able to be distracted used more of this strategy over time, whereas mothers of infants who did not exhibit (as of yet) this skill used less (or the same amount of) distraction over time. Thus, although our findings are relatively consistent with those of Lewis and Ramsay (1999), who found that overall maternal soothing was stable between 2 and 4 months and 4 and 6 months, our results suggest that accounting for specific soothing behaviors clarifies whether mothers adjust their use of individual behaviors to match their infants’ developing skills. It should be noted that our results are specific to the inoculation setting, a context that is potent and somewhat consistent. Whether specific maternal behaviors are stable across varying, less aversive contexts is an important question for future research.

Future work should also explore the antecedents of individual differences in maternal soothing behaviors. Thompson (1997) proposed that a variety of diverse factors, such as parental schemas and situational stressors, may influence parents’ sensitivity and responsiveness to their infants. Likewise, Axia and Weisner’s (2002) findings emphasized the importance of cultural variables in shaping parents’ soothing repertoires. Research concerning this issue may help to explain indirect effects on infants’ external soothing environment. Finally, as previous research has found individual variability in infants’ use of self-regulatory strategies within the first year of life to regulate negativity (e.g., Braungart-Rieker & Stifter, 1996; Fish, Stifter, & Belsky, 1991; Riese, 1987), an important direction for future research is to examine whether those infants whose mothers contribute to a greater extent in their early soothing display an increased ability to self-regulate as they develop.

This study has a number of limitations. First, as previously noted, the findings are specific to the inoculation setting, and may not reflect the individual stability of infants’ and mothers’ behaviors, or the effectiveness of maternal strategies, in other contexts. The inoculation setting itself is not a controlled context, thus infants experienced different physician’s offices and a variable number of shots. Although we controlled for these variables, they nevertheless represent a limitation of the setting. Also, our sample was homogeneous, and predominantly White. As Axia
and Weisner’s (2002) study of Italian mothers indicated, maternal soothing behavior may be directly influenced by cultural and societal expectations concerning infant development. Thus, the findings in this study may not generalize to other cultures. Also, as the process of infant regulation is a dyadic one, it is difficult to disentangle the mother’s and infant’s individual contributions to distress regulation. Thus, any changes in infant crying should be considered to be a function of both members of the dyad. Finally, our results may only represent infants’ and mothers’ behaviors during the studied infant ages. The period between 2 and 6 months is an important one for infants’ emotional development, and many researchers study mother–infant behaviors at these ages. However, different findings may have resulted if we incorporated a greater span of time between measurements, or followed up on longitudinal effects of effective soothing on infant responses 1 year later.

In sum, this study found that infants of mothers whose soothing behavior was more contingently related to their distress at 2 months showed a shorter duration of crying 4 months later, and that the effect was strongest for mothers who fell at the extremes of the continuum of effective soothing. This finding may explain the lack of stability in the duration of infant crying that was found in this study and in previous research. The intensity of infants’ stress responses and many of the specific maternal behaviors studied, however, showed stability over time. This study extends the previous research on the longitudinal effect of maternal soothing behaviors.

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