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The Effect of Excessive Crying on the Development of Emotion Regulation

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The goal of this study was to examine the effect of excessive crying in early infancy on the development of emotion self-regulation. Cry diaries were used to categorize excessive criers and typical criers at 6 weeks of age. At 5 and 10 months of age, infants and mothers participated in procedures to elicit infant reactivity and regulation during a frustration task and maternal sensitivity and intrusiveness during a free-play session. Last, maternal ratings of temperament were obtained. Results revealed excessive criers to show higher levels of negative reactivity than typical criers. Excessive criers also demonstrated lower regulation, but this finding was only significant for male infants. Boys in the excessive criers group exhibited the lowest level of emotion self-regulation. Maternal behavior and ratings of temperament at 5 and 10 months failed to distinguish the 2 cry groups. The findings suggest that excessive crying may influence the developmental trajectory of the ability of boys to self-regulate emotion. The hypothesized processes involved in this outcome are discussed.

Since Thomas and Chess (Thomas, Chess, & Birch, 1968) focused the developmental spotlight on individual differences in behavioral style and its moderating effect on environments, the study of infant and child temperament has flourished. Subsequently, several theoretical approaches to the study of child temperament have emerged, as have a number of assessment tools (Rothbart & Bates, 1998).

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Despite the diversity of perspectives and measures, the general consensus among temperament researchers is that temperament is a psychobiological construct that is relatively stable over time (Goldsmith et al., 1987). Whereas it is accepted that developmental changes may alter the expression of temperament, stability is expected to be maintained under most circumstances. Thus, even though we might expect the frequency with which an infant cries to an aversive stimulus to decrease, temperamental stability would presume that the child will remain high in crying relative to other infants. Stability also may be found for processes that underlie temperament behaviors, whereas observed behaviors across time might be different. Behavioral inhibition in a young infant is expressed with high negative affect and motor activity (Calkins, Fox, & Marshall, 1996; Kagan, 1994) but manifests itself later in withdrawal, low vocalizations, and high compliance. The underlying process is hypothesized to be heightened excitability in the brain region known as the amygdala (Kagan, 1994).

As theorists have noted, stability of temperament is relative. Indeed, in studies of infant and child temperament using parent ratings, the stability coefficients are quite modest, around .30 (Slabach, Morrow, & Wachs, 1991). The stability of observed temperament is examined less often, and when reported is lower than parent-reported temperament (Rothbart, 1986). This level of instability is expected, as temperament also is proposed to be modifiable. There is some disagreement, however, as to whether it is the expression of temperament that changes while the underlying nature remains the same or that both change (Goldsmith et al., 1987). Nevertheless, there is growing empirical evidence that several factors have an important impact on the longitudinal course of temperament.

One proposed source of change in temperament over time is the emergence of regulative systems that function to modulate reactivity (Rothbart, 1989). According to Rothbart, temperament is expressed as individual differences in reactivity and regulation. The ability to shift attention or disengage from orienting, for example, is considered a dimension of temperament (Rothbart & Bates, 1998). The development of this ability in the later part of the first year of life may explain changes in crying behavior that are observed during the same period. Mangelsdorf and colleagues (Mangelsdorf, Shapiro, & Marzoff, 1995) showed that the infants' use of distraction during a mildly stressful event increased from 6 to 12 months. Moreover, when examining the effectiveness of regulatory strategies in the first year of life, Stifter and Braungart (1995) found reorienting to be effective in regulating anger reactivity at 10 months but not at 5 months of age. Similarly, Diener and colleagues (Diener, Mangelsdorf, McHale, & Frosch, this issue) found social referencing to reduce distress during a competing demands task at 12 months of age. Thus, the emergence and consolidation of one temperament factor can influence the expression of another.

In the emotion domain, the modulation, maintenance, and enhancement of emotion is defined as emotion regulation (Thompson, 1994). Whereas temperament

research would suggest that infants may vary on the degree to which they develop and utilize certain behaviors to modulate temperamental reactivity, the development of the ability to regulate emotions depends largely on the input of the caregiver (Kopp, 1989). Initially, parents and caregivers reduce infant negative reactivity through soothing techniques. By relieving distress, caregivers create a context in which the infants associate their behaviors and the caregiver's actions with their accompanying changes in feeling state (Gianino & Tronick, 1988; Kopp, 1989). To illustrate, a crying infant generally elicits caregiving responses aimed at reducing the distress. Once levels of reactivity are reduced, the caregiver may then introduce new behaviors that encourage self-soothing, such as non-nutritive sucking or distraction. If successful, the infant then learns that these behaviors can reduce negative arousal. As the infant matures, the role of the parent in regulating infant emotions may change to one of support and scaffolding of the infant's existing skills. Maternal positive guidance, for example, was contemporaneously related to self-distraction in toddlers (Calkins & Johnson, 1998). However, when the infant is highly distressed, the parent may continue to be directly involved in the reduction of negative affect.

The proposal that parenting is central to the development of regulatory skills is supported by studies that have demonstrated that parenting behavior either mediates or moderates changes in temperamental reactivity (Eisenberg, Cumberland, & Spinrad, 1998). For example, warm, responsive, and sensitive mothering has been shown to be related to decreases in irritability over time (Bell & Ainsworth, 1972; Fish, Belsky, & Stifter, 1991; van den Boom, 1994). Interestingly, insensitive parenting resulted in lack of predictability from negative reactivity to behavioral inhibition (Park et al., 1997), suggesting that the relationship between parenting and temperament outcomes is conditional on the type of temperament. Expected relations between temperament and outcome also may be mediated or moderated by parent behavior (see Kochanska, 1993). In one study, negative temperament was hypothesized to predict noncompliance (Braungart-Rieker, Garwood, & Stifter, 1997). The findings revealed that this relationship was mediated by maternal behavior, specifically overcontrolling behavior. Similarly, fearful temperament was found to interact with gentle discipline to facilitate the development of conscience (Kochanska, 1995).

Recently it has been proposed that the development of emotion regulatory strategies is dependent on the degree of reactivity (Kopp, 1989; Stifter, Spinrad, & Braungart-Rieker, 1999); that is, infants must experience and communicate negative reactivity to learn that certain behaviors can be used to self-regulate. But at the extreme level, distress may actually inhibit the infant's recruitment and effective utilization of regulatory behaviors (Kopp, 1989; Stifter & Braungart, 1995). Stifter and Braungart (1995), for example, showed that reorienting was most effective at low levels of reactivity. Furthermore, high levels of reactivity may limt the opportunities for parents to introduce new strategies or support existing

strategies. This may explain why highly reactive infants exhibited more stable behaviors than less reactive infants (Worobey & Lewis, 1989).

One opportunistic method for testing the effect of reactivity on the emergence of emotion regulation would be to examine the developmental outcomes of infants who exhibit extreme levels of reactivity or excessive crying in early infancy. Developmentally, young infants are expected to increase in their crying, demonstrating a cry peak (averaging about 2 hr per day) at about 6 to 8 weeks (Barr, 1990). With the advent of increased alertness, social smiling, and nonnegative vocalizations, crying decreases to less than 1 hr per day by 3 months of age. However, approximately 10% of infants will cry more than the expected 2 hr per day and will be difficult to console. These infants are said to have infant colic (Barr, 1990). Recent attempts to understand this behavioral syndrome suggest that colic is a transitory condition that may be related to the infants' ability to regulate or be regulated (Barr & Gunnar, 2000; Stifter & Braungart, 1992). In addition, although organic causes for excessive crying during this period have been identified, such as cow's milk allergies, the number is projected to represent only 5% of colic cases (Gormally & Barr, 1997). Regardless of the cause of excessive crying, intense, inconsolable distress has the potential to affect emotion regulation development. To date, empirical studies that have examined the developmental consequences of infant colic are mixed and, more important, have not directly addressed this hypothesis. In one study, infants with colic were found to look "typical" in their responses to aversive stimuli after the colic was resolved (Stifter & Braungart, 1992). On the other hand, investigations on the outcomes of colic suggest that excessive crying in early infancy represents the extreme on a temperamental continuum (Carey, 1972; Jacobson & Melvin, 1995; Lehtonen, Korhonen, & Korvenranta, 1994) or is the result of continued insensitive, overstimulating parenting (Papoušek & von Hofacker, 1995). Interestingly, in one study infants with "persistent crying" were found to show stability in negative reactivity immediately after the colic resolved, but no differences were observed several months later (St. James Roberts, Conroy, & Wilsher, 1998b).

In this study, we examined the temperament outcomes of infants with excessive crying measured at 6 weeks of age. Drawing from the literature on emotion regulation, temperament, and infant colic, we hypothesized that infants who cried excessively, frequently, and inconsolably in early infancy will have limited experience with effective soothing, potentially interfering with the development of their ability to self-regulate their emotional responses. Infants were identified as excessive criers at 6 weeks of age using a 4-day, 24-hr cry diary. The standard definition of colic provided by Wessel (Wessel, Cobb, Jackson, Harris, & Detwiler, 1954) and used predominantly in studies of colic uses the criteria of excessive crying and fussing behavior. Excessive criers were identified using an adaptation of this criteria from the diary data. Outcome data were drawn from laboratory procedures conducted at 5 and 10 months of age. To investigate whether

the development of regulatory strategies in excessive criers may have been due to differences in parent behavior, maternal sensitivity and intrusiveness was assessed during a free-play procedure. Finally, some studies have shown boys to be more negatively reactive than girls (Moss, 1967; Phillips, King, & DuBois, 1978; Weinberg et al., 1999), whereas others have indicated the reverse (Mayes & Carter, 1990). Therefore, gender differences were examined in this study.

METHOD

Participants

Participants were 116 families (65 male infants). Families were recruited through a local community hospital and university medical center. Leaflets asking for volunteers to participate in a study of infant development were distributed to all new parents. Once the study was explained and consent given for participation, a 2-week home visit was scheduled. Infants recruited into the study were of normal gestational age and birthweight and did not suffer from any prenatal or perinatal complications.[1] Characteristics of the study participants (reported by group) can be found in Table 1.

Procedures and Measures

Infants and parents were seen three times throughout the infant's first year of life. An initial home visit was scheduled for 2 weeks. A 4-day, 24-hr cry diary was completed by parents when infants were 6 weeks of age. Follow-up laboratory visits were scheduled for when the infant was 5 and 10 months of age. During these visits several procedures for eliciting positive and negative reactivity were administered.

Cry diaries. Parents completed a 4-day, 24-hr diary when infants were 6 weeks of age. The ruler-like diary has been used extensively in research on infant colic and gives a reliable portrait of the infants' cry behavior (Barr, Kramer, Boisjoly, McVey-White, & Pless, 1988; St. James Roberts, Hurry, & Bowyer, 1993). Parents were given crayons, matched to five different infant states (awake

[1]Initially, 157 families were recruited into the study. Of the 41 who are not included in this study, 17 failed to complete the diary, 8 were unable to participate in the 5-month visit, and 16 dropped from the study due to relocation outside the area. Comparisons of these 41 infants on the demographic, grouping, and dependent variables revealed that of the families who did not complete the study mothers and fathers were slightly younger and their infants of slightly older gestational age than the families in this study. However, these differences were not viewed as having a significant impact on the outcome. Importantly, no differences in the dependent measures were found.

TABLE 1
Characteristics of the Study Sample

	Typical Criers (n = 102)			*Excessive Criers (n = 14)*		
	M	*SD*	*Range*	*M*	*SD*	*Range*
Mothers						
Age (years)	30.94	4.9	18–40	30.00	4.5	23–37
Education (years)	15.59	2.6	10–21	16.29	2.5	12–21
Years married	6.07	3.3	0–14	4.36	2.1	1–8
Fathers						
Age	32.72	5.5	19–55	31.43	5.5	21–40
Education	15.76	2.8	36–42	17.43	2.4	12–21
Infants						
Gestational age (weeks)	39.50	1.4	36–42	39.19	1.4	37–41
Gender (% male)	54			64		
Ethnicity (% White)	98			100		
Parity (% firstborn)	36			50		

Note. Only father education was significantly different for the cry groups.

and content, sleeping, feeding, fussing, and crying) and were instructed to record them in 5-min intervals. To insure compliance, a research assistant called parents 2 days into the diary to answer any parental questions or concerns. On receipt, the cry diaries were entered into a computer program. Four variables were derived from these data, which were averaged across the 4-day recording period: number of fuss bouts per day, total fussing per day (in minutes), number of cry bouts per day, and total crying per day (in minutes).

5- and 10-month laboratory visits. To elicit frustration, an arm restraint procedure was administered at both the 5 and 10 month visits. During this procedure, infants were placed in an infant seat or high chair while mothers were escorted out of the room. A research assistant, standing behind the infants, gently held down the infants' arms from behind for a period of 2 min, after which the infants' arms were released. If the infants became extremely distressed for a minimum of 10 sec, the research assistant released the infants' arms. One min after arm release, mothers were instructed to soothe their infants in a step-wise manner. First, mothers were instructed to soothe their infants from a distance (of about 10 ft) for 30 sec. Next, mothers were told they could approach their infants and touch them for 30 sec. Finally, mothers could then pick up their infants and soothe them in any way necessary.

Infant emotional reactivity was coded from the videotapes on a second-by-second basis. Behavioral categories were exclusive and exhaustive. Negative reactivity was coded on a 3-point scale (0 = *neutral*, 1 = *mild to moderate*

reactivity, 2 = *high negative reactivity*). Facial and vocal expressions were used to define when and to what degree the infant expressed negative reactivity. For example, variations in eye closure, furrowing of the brows, mouth openings, and cry sounds were used to determine the intensity of negative reactivity. Negative reactivity codes were averaged within each of the five episodes: arm hold, arm release, distal soothe, proximal soothe, and pickup. Coders were trained to at least .75 reliability. Cohen's kappa computed on 10% of the sample (after training) yielded reliabilities of .80 for the 5-month data and .83 for the 10-month data.

Behaviors hypothesized and demonstrated to reduce negative arousal (Buss & Goldsmith, 1998; Stifter & Braungart, 1995) were coded from the videotapes. Specifically, reorienting, self-comforting, avoidance, looks to the experimenter, and non-negative vocalizations were coded during the most intense portion of the arm restraint procedure—restraint and release. Behaviors were coded continuously on a computer. Two passes of the videotaped arm restraint procedure were necessary so that behaviors that co-occurred could be noted. Because the time during restraint and release varied by subject, the proportion of time spent using a particular strategy was calculated by dividing the total amount a regulatory behavior was exhibited by the total time of the restraint or release episode. The mean proportions (standard deviations) of each regulatory behavior and the percentage of infants who exhibited the behaviors during arm restraint and arm release can be seen in Table 2. Coders were trained to .75 reliability. Interrater reliabilities for the regulatory behaviors coded after training resulted in average Cohen's kappas of .75 for the 5-month coding and .83 for the 10-month coding.

TABLE 2
Mean Proportions for Each of the Coded Regulatory Behaviors and the Percentage of Infants Exhibiting That Behavior at 5 and 10 Months of Age During Arm Restraint and Arm Release

	Arm Restraint			*Arm Release*		
Regulatory Behaviors	*M*	*SD*	*%*	*M*	*SD*	*%*
5 Months						
Reorient	.14	.14	92	.13	.17	63
Non-negative vocalizations	.04	.09	34	.03	.07	21
Self-comfort	.01	.05	15	.06	.15	37
Looks to examiner	.01	.04	9	.01	.05	8
Avoidance	.17	.15	94	.03	.06	40
10 Months						
Reorient	.09	.10	76	.05	.08	57
Non-negative vocalizations	.01	.03	44	.00	.02	6
Self-comfort	.01	.02	22	.15	.20	68
Looks to examiner	.02	.03	17	.04	.08	40
Avoidance	.32	.27	90	.04	.08	48

Note. $N = 116$.

A regulation composite score was created based on previous literature (Buss & Goldsmith, 1998; Stifter & Braungart, 1995), demonstrating their effectiveness and the statistical relationship between the variables and negative reactivity. Whereas self-comforting, reorientation, looks to the examiner, and vocalizations were negatively related to reactivity (all *r*s > –.19) avoidance behaviors were found to be positively related to negative reactivity, $r = .24$ (5 m), $r = .26$ (10 m). Due to the low occurrence of three of the four variables (see Table 2), we created a score that represented the proportion of time any one of the regulatory behaviors (other than avoidance) was present. Thus, if two regulatory behaviors were used concurrently, regulation was only counted once. Avoidance was examined separately in the analyses.

Maternal behavior during free play. Mothers and infants participated in a free-play session at 5 months (10 min) and at 10 months (15 min). Mothers and infants were presented with a basket of toys and instructed to play as they normally would at home. The mother–infant interaction during the free play was videotaped and coded for maternal sensitivity and intrusiveness. Maternal sensitivity scores were based on contingent, infant-centered interactions (Fish, Stifter, & Belsky, 1991). A high score reflected baby-centered, synchronous interaction that had an appropriate level of response and stimulation. Maternal intrusiveness reflected overcontrolling behaviors and ignoring signals. High scores on intrusiveness were given for overly stimulating behavior, ill-timed responses, and inappropriate demands on the infant. Both sensitivity and instrusiveness were coded every 15 sec using a 4-point scale (0 = *no evidence* to 3 = *high level*). Coders were trained to at least .75 reliability. Interrater reliability was assessed using Cohen's kappa on 10% of the sample (after training) and was .69 and .86 for 5-month sensitivity and intrusiveness, and .68 and .76 for 10-month sensitivity and intrusiveness. All disagreements were resolved through conference.

Infant temperament questionnaires. An infant temperament questionnaire was completed by mothers when infants were 5 and 10 months of age. The Infant Behavior Questionnaire (IBQ; Rothbart, 1981), is a 99-item instrument that assesses the frequency with which certain behaviors occurred during the last 2 weeks. Dimensions of activity level, duration of orientation, distress to limitations, distress to novelty, smiling/laughter, and soothability are derived from the questionnaire. The IBQ has demonstrated satisfactory reliability and validity (Goldsmith & Rothbart, 1991).

Creation of cry groups. To examine whether excessive criers differ in the development of their regulatory skills, we created two groups of infants based on their cry behavior taken from the 6-week diaries. Selection of excessive criers was based on a study by St. James Roberts, Conroy, and Wilsher (1995). Using the

TABLE 3
Means, Standard Deviations, *F* Tests, and Effect Sizes for Typical Criers and Excessive Criers on Cry Behavior at 6 Weeks

	Typical Criers (n = 102)		*Excessive Criers (n = 14)*			
	M	*SD*	*M*	*SD*	*F test (1,112)*	η^2
Fuss frequency[a]	6.77	3.7	11.16	5.7	11.63*	.09
Cry frequency	2.67	2.2	7.02	4.5	27.25*	.20
Fuss duration[b]	78.96	39.1	158.39	57.4	41.85*	.27
Cry duration	24.79	20.3	88.93	44.2	82.09*	.59

[a]Values are for average frequency of bouts per day. [b]Values are for average bout duration (min) per day.
*$p < .001$.

data reported by St. James Roberts et al. for the average crying/fussing for persistent (excessive) criers, we categorized infants into two groups. *Excessive criers* were those infants who were reported to cry and fuss (distress) in excess of 221 min per day. Twelve infants met criteria for excessive crying and fussing. In addition, we included 2 infants who narrowly missed the total duration criteria for distress but scored above the average for the number of minutes of crying per day (86 min). Our rationale was that excesses in crying, which is qualitatively different than fussing, would likely interfere with successful soothing. These 14 infants (9 boys) represent the 94th percentile in crying and the 92nd percentile in distress. In addition, their crying and distress was 1.5 *SD*s above the sample mean. The remaining infants comprised the *typical criers* group ($N = 102$, 56 boys). Comparisons of the means for excessive criers and typical criers show that excessive criers cried and fussed significantly longer and more frequently than typical criers. Indeed, as can be seen in seen in Table 3, the duration of their daily fuss bouts was above the mean for fussing (135 min) reported by St. James Roberts and colleagues (1995).

RESULTS

All longitudinal data analyses comparing the two cry groups were conducted using repeated measures analysis of variance (ANOVA) with cry group and sex as between-subject factor and age as the within-group factor.

Prior to conducting the following analyses, cry group differences on the demographic data were tested using one-way ANOVAs. Only one difference emerged between excessive criers and typical criers. Fathers of excessive criers were more educated than fathers of typical criers, $F(1, 115) = 4.47$, $p < .05$ (see Table 1).

Reactivity to Arm Restraint

Our first aim was to examine whether infants who cried excessively at 6 weeks continued to exhibit high levels of negative reactivity at 5 and 10 months of age. Before testing for differences in negative reactivity during the five episodes of the arm restraint task (arm hold, arm release, distal soothe, proximal soothe, and pickup) the intercorrelation of these variables was examined. As expected, infants were very stable in their level of crying across the five episodes at both 5 months (*r*s ranging from .50 to .89) and 10 months (*r*s ranging from .29 to .73). To simplify the following analyses, infant reactivity to the arm hold and arm release episodes were averaged to form the variable reactivity to restraint at each age. In addition, the three episodes during which the mother soothed the infant were combined to create a reactivity to mother soothe composite at each age. Cross-age correlations revealed modest stability between 5 and 10 months for reactivity to restraint, $r = .23$, $p < .01$, but less so for mother soothe, $r = .15$, $p < .10$. Interestingly, when the stability of the reactivity variables was investigated by group, only the typical criers showed significant cross-age stability for reactivity to arm restraint, $r = .27$, $p < .004$, whereas the correlations between 5- and 10-month reactivity for the excessive criers was negative, $r = -.18$, $p = .53$.

Repeated measures ANOVA with cry group and sex as the between-subject factors and age as the repeated factor was used to test for differences in reactivity to arm restraint and mother soothe. A significant group effect showed that overall excessive criers were more negatively reactive than typical criers during restraint, $F(1, 112) = 4.72$, $p < .05$, $\eta^2 = .04$, and mother soothe, $F(1, 111) = 3.96$, $p < .05$, $\eta^2 = .03$.[2] In addition, a main effect for age was found for negative reactivity during arm restraint, $F(1, 116) = 46.97$, $p < .001$, $\eta^2 = .29$. Infants increased in their reactivity to arm restraint from 5 to 10 months of age. No significant interactions with sex or age emerged. Table 4 reports the means and standard deviations. As reactivity during restraint and mother soothe were significantly related to each other at 5 months, $r = .59$, $p < .001$, and 10 months, $r = .57$, $p < .001$, they were averaged to form one reactivity score.

Regulatory Behaviors During Arm Restraint

As with negative reactivity, regulatory behavior exhibited during the arm hold and regulatory behavior exhibited during the arm release episodes were positively related at 5 months, $r = .44$, $p < .0001$, and 10 months, $r = .35$, $p < .0001$. Therefore, we summed the two regulatory composites before conducting further analyses (recall that regulation was not coded during mother soothe segments). Cross-age stability

[2]Data for 1 infant were not available for this analysis because the infant fell asleep after restraint.

TABLE 4
Means and Standard Deviations for the Negative Reactivity and Regulation Data by Cry Group

	Typical Criers				*Excessive Criers*			
	Girls (n = 47)		*Boys (n = 55)*		*Girls (n = 5)*		*Boys (n = 9)*	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Reactivity[a]								
5-month restraint	.67	.64	.65	.69	1.24	.80	1.04	.72
5-month mother soothe	.98	.54	.99	.53	1.51	.45	1.21	.80
10-month restraint	1.15	.60	1.24	.56	1.32	.69	1.36	.41
10-month mother soothe	.98	.46	1.06	.45	.98	.46	1.19	.50
Regulation								
5-month composite[b]	.18	.05	.23	.05	.28	.07	.13	.03
5-month avoidance	.23	.19	.19	.16	.14	.20	.15	.13
10-month composite	.21	.04	.16	.05	.22	.03	.13	.02
10-month avoidance	.32	.29	.38	.29	.40	.38	.39	.22

[a]Reactivity was coded on a 3-point scale: 0 (*none*), 1 (*mild–moderate*), 2 (*high*). [b]Reported means and standard deviations are for proportion of time exhibiting either reorient, self-comfort, looks to examiner, and vocalizations adjusted for negative reactivity.

was near significant for the regulation composite, $r = .17$, $p < .07$, but nonsignificant for avoidance.

Our primary hypothesis stated that infants who cried excessively at 6 weeks would be more negatively reactive later in infancy because their inconsolability would have limited the opportunities to develop regulatory skills. Although excessive criers were found to be more negatively reactive to mildly frustrating events at both 5 and 10 months, this finding does not address whether these differences were linked to emotion regulation strategies. Simple correlations suggest that those with higher negative reactivity would be lower in regulation, as the two variables were significantly related at both 5 months, $r = -.56$, $p < .001$, and 10 months, $r = -.39$, $p < .001$. The same relationship was found for each group conducted separately at each age, with *r*s ranging from –.37 to –.59, with one exception. For excessive criers at 5 months, reactivity was not significantly related to regulation, $r = -.17$.

To test whether excessive criers also differed from typical criers in the amount of regulation they exhibited at 5 and 10 months, we conducted a repeated measures ANOVA. Because of its significant association with the regulation composite measure, negative reactivity was used as the time varying covariate in the analyses. This procedure was accomplished in two steps. First, the dependent variable, regulation, was regressed on the covariate (reactivity) and the residuals for both ages were obtained. These residuals were then used in the repeated

measures ANOVA for unbalanced groups, with cry group and sex as the between-subject factors and age as the within-subjects factor.[3]

A main effect for sex emerged, $F(1, 112) = 3.80$, $p < .05$, $\eta^2 = .04$, however, this was subsumed under a significant Cry Group × Sex interaction, $F(1, 112) = 4.03$, $p < .04$, $\eta^2 = .04$. Overall, boys in the excessive crier group, $M = .13$ ($SD = .06$), showed less regulatory behavior than either the boys in the typical criers group, $M = .20$ ($SD = .11$) and girls in the excessive criers group, $M = .24$ ($SD = .13$). A near significant three-way interaction (Sex × Cry Group × Age) also was revealed, $F(1, 112) = 3.12$, $p < .08$, $\eta^2 = .03$. Significant follow-up simple effects performed on the least squared means further demonstrate that boys who cried excessively at 6 weeks exhibited fewer regulatory behaviors at 5 months of age than boys in the typical criers group, $t(62) = 2.33$, $p < .05$, $\eta^2 = .08$ (see Table 4). Although girls in the excessive group showed a much higher level of regulation at 5 months than did boys in the same group, this difference did not reach significance, $t(12) = 1.24$, $p < .25$. However, a near significant difference between girls and boys in the excessive crier group was found at 10 months of age, $t(12) = 2.00$, $p < .07$, $\eta^2 = .05$. In addition, typical crying girls exhibited more regulation at 10 months than excessive crying boys, $t(54) = 2.20$, $p < .05$, $\eta^2 = .08$. The only significant follow-up contrast for age was revealed for boys in the typical criers group. Boys in the typical criers group significantly decreased the use of regulation from 5 to 10 months, $t(62) = 2.06$, $p < .04$, $\eta^2 = .03$.

A separate repeated measures analysis was performed for avoidance behaviors with sex and cry group as the between-subject factors and age as the within-subjects factor. The only significant finding was for age, $F(1, 115) = 25.06$, $p < .001$, $\eta^2 = .18$. Infants exhibited more avoidance behaviors when they were 10 months of age than when they were 5 months of age. No other main or interaction effects were revealed.

Parent-Rated Temperament

To examine whether infants who were excessive criers were more reactive across a variety of situations rather than just in response to a specific stimulus, we examined differences between excessive and typical criers on parent ratings of temperament. Repeated measures ANOVA with sex and cry group as the between-subject factors were conducted on the six dimensions of mother-rated IBQ. No significant main or interaction effects were found.

[3]When the analysis was run without negative reactivity as the covariate, no significant main effects for sex, $F(1, 112) = 2.40$, $p = .12$, or cry group, $F(1, 112) = 1.90$, $p = .17$, were found. Nor was the Sex × Group interaction effect significant, $F(1,112) = 2.02$, $p = .16$. Interactions with age were also nonsignificant.

Maternal Sensitivity and Intrusiveness

An alternative explanation for the persistence of excessive crying beyond early infancy is that the mothers of excessive criers would be low on sensitivity and high on intrusiveness. Maternal behavior was entered into the above analysis on regulatory behavior as a time varying covariate. No interaction effects were found due to the lack of correlation with the dependent measure. To further examine whether maternal behavior differed as a function of cry group, a repeated measures ANOVA with sex and cry group as the grouping factors and maternal behavior as the dependent measure was conducted and found to be nonsignificant. The findings indicate that mothers of excessive criers and mothers of typical criers are very similar in their sensitivity at 5 months (excessive criers $M = 2.44$, typical criers $M = 2.43$) and intrusiveness (excessive criers $M = .19$, typical criers $M = .18$). Mothers were also similar in their 10 month sensitivity (excessive criers $M = 2.25$, typical criers $M = 2.22$) and intrusiveness (excessive criers $M = .16$, typical criers $M = .18$).

DISCUSSION

The goal of this study was to address the issue of whether early levels of negative reactivity affected the development of the ability to self-regulate emotions. Using infants who displayed excessive levels of crying at 6 weeks as representing the extreme in negative reactivity, our findings suggest that high levels of inconsolable crying in early infancy may have an influence on the developmental trajectory of the ability to self-regulate emotions, but for male infants only. Further, our findings provide evidence that the quality of maternal behavior appears to be unrelated to this effect in excessive criers.

Infants who cried excessively at 6 weeks of age were more negatively reactive in response to a mildly frustrating stimulus at 5 and 10 months than were infants who presented with typical crying. In addition, as expected, excessive criers showed lower levels of self-regulation of emotion, even when controlling for negative reactivity. This effect, however, was only present for boys. Boys in the excessive cry group exhibited significantly fewer regulatory behaviors than boys in the typical cry group at 5 months and girls in the excessive criers group.

By 10 months of age, a shift in negative reactivity and self-regulation was demonstrated. Contrary to the expectation that infants should improve in their ability to self-regulate emotion and thus exhibit lower levels of negative reactivity, infants in this study increased their negative reactivity to frustration and showed lowered levels of self-regulation. This finding is likely due to the potency of the arm restraint procedure for older infants (Camras, Oster, Campos, Miyake, & Bradshaw, 1992). The decrease in regulation from 5 to 10 months of age

observed in this study appears to be primarily a function of boys in the typical criers group, as they were the only group to demonstrate a significant decrease in self-regulation from 5 to 10 months. Excessively crying girls also showed a decrease in regulation, but the number of girls in this group ($n = 5$) limited their contribution to the overall mean. Moreover, they continued to posses the highest rate of self-regulation relative to all other criers. These findings were contrasted with their female counterparts who showed slight (nonsignificant) increases in self-regulation. Finally, excessively crying boys demonstrated no change from 5 to 10 months and continued to show the lowest level of self-regulation.

These differences in regulatory behaviors for the boys, particularly those in the excessive criers group, are supported by several studies on gender differences in infant regulation. Previous studies have found boys to show fewer self-regulatory behaviors, such as hand-to-mouth activity and attention skills (Calkins, Dedmon, Gill, Lomax, & Johnson, this issue; Feldman, Brody, & Miller, 1980; Weinberg, Tronick, Cohn, & Olson, 1999). For example, Calkins et al. (this issue) found male 6-month-olds to demonstrate poorer attention as well as an inability to regulate physiologically. Taken together, these data might be interpreted as reflecting male infants' proneness to distress. Several studies on sex differences in negative reactivity during early infancy have reported modest findings, with boys exhibiting more irritability (Moss, 1967; Phillips, King, & DuBois, 1978; Weinberg et al., 1999) than girls. These findings, however, are contrasted by those that showed female infants to be more negatively reactive than male infants (e.g., Mayes & Carter, 1990).

The findings in this study with regard to reactivity in infant boys are as mixed as the previous research. Of the excessive criers, 64% were boys, but by 5 and 10 months of age they did not exhibit greater negative reactivity than girls, nor were they perceived by their parents as being more negative. So, whereas male infants, particularly those in the excessive criers group, showed fewer regulatory skills in response to a frustrating stimuli, it does not appear to have been due to their concurrent level of reactivity.

The putative regulatory behaviors chosen in this study have been found in previous research to be effective in reducing negative reactivity, specifically anger reactivity (Buss & Goldsmith, 1998; Diener & Mangelsdorf, 1999; Stifter & Braungart, 1995). An examination of the relationship between level of reactivity and regulation in this study suggests that higher levels of reorienting, looks to examiner, self-comforting, and vocalizations were related to lower levels of negative reactivity. Regulatory effectiveness, however, was not tested in this study and as such may have contributed to the small effect sizes revealed here. Indeed, whereas the excessive crying girls were as negatively reactive as the excessive crying boys at 5 and 10 months, they exhibited more regulatory behaviors, greater than that of the typical criers. It could be that female excessive criers' regulation was not as effective as the typical criers. Future research on the relation

between early excessive crying and the development of emotion regulation would benefit from a microanalysis of the dynamics between reactivity and regulatory behaviors.

Avoidance behaviors, although hypothesized as regulatory, were positively related to negative reactivity and as such could be construed as reflective of the infants' level of distress. Theoretically, using avoidance behaviors such as struggling against the arms of the experimenter would be considered an adaptive strategy for removing the restraint and avoiding further frustration. However, in this context, there was no escaping the restraint even after the arms were released, resulting in increased negative reactivity. This may explain the higher level of negative reactivity found at 10 months because infants at that age are more mobile and thus may expect more freedom of movement. Likewise, the importance of movement for 10-month-olds may have obscured any differences between the two cry groups. Examining avoidance behavior in a context that allows infants to actively remove themselves from the stimulus should be considered in future studies of emotion regulation strategies in infancy.

One hypothesis regarding the continuity of excessive crying and reactivity is that the parenting context is unresponsive or insensitive to the needs of the child (Fish et al., 1991; Taubman, 1984; van den Boom, 1994). Although we did not measure maternal behavior at 6 weeks, maternal sensitivity and intrusiveness measured in the laboratory at 5 and 10 months failed to distinguish mothers of excessive criers from mothers of typical criers despite their reactivity and self-regulation differences. This finding is consistent with other studies that showed infants with colic to have sensitive mothers (Stifter & Braungart, 1992) and to develop secure attachments (Stifter & Bono, 1998). Another study that examined maternal behavior and excessive crying in early infancy found some differences between mothers of excessive criers and mothers of typical criers at 6 weeks, but those that emerged were considered to be confounded by the degree of crying (St. James Roberts, Conroy, & Wilsher, 1998a). As in this study, no differences were revealed for mothers at 5 months of age. Finally, and specific to gender differences, Weinberg and colleagues (1999) found that although male infants were more fussy than female infants, mother–son interactions were more synchronous than mother-daughter interactions. To date, research has provided scant evidence to suggest that mothers of infants who demonstrate early excessive crying are unresponsive or insensitive to their infants' needs.

Our results and the proposed process through which infants learn self-regulation of emotion (Kopp, 1989; Thompson, 1994) led us to speculate about this process for infants who cry excessively in early infancy. It has been suggested (Kopp, 1989; Stifter et al., 1999) that infants may require a certain level of reactivity to elicit responses from the environment. It is through these sensitive interactions from the caregiver that infants come to learn that certain actions are associated with the modulation of arousal. However, at the extreme level, particularly

for infants who are difficult to console (Barr & Gunnar, 2000; St. James Roberts et al., 1995), this associative learning may be constrained, resulting in diminished self-regulatory capacity. Whereas the intense crying of the infant will bring the caregiver in close contact, the infant who cries excessively in early infancy will be likely inconsolable. Consequently, the infant will not be soothed to the level that can be used by the parent to introduce new strategies. Furthermore, extremes in crying may prevent the infant from making the association between the caregiver's behavior and the infant's accompanying decrease in distress. Several studies have shown that infant crying may inhibit memory performance (Ohr, Fleckenstein, Fagen, Klein, & Pioli, 1990; Wachs, Morrow, & Slabach, 1990). Thus, whereas parental attempts to console may be appropriate and in some cases may lead to brief reductions in arousal, excessive criers may not be able to retain the correspondence between the caregiver's behavior and the experience of regulation. There are little data, however, to indicate why this outcome presents for boys only. Earlier work on the socialization of emotion expressions has shown that mothers display different contingent expressions toward their sons and daughters. Treating contingent responses as instrumental learning, Malatesta and colleagues found that mothers are more likely to ignore (Malatesta & Havilland, 1982) and show less contingency (Malatesta, Grigoryev, Lamb, Albin, & Culver, 1986) to the pain expressions of their sons. It may be that differences in parental socialization of emotion expression toward their sons and daughters contribute to differences in infants' emotion self-regulation strategies.

It is also unclear why boys in the excessive crying group would persist in their level of regulation. We had expected that once crying decreased to typical levels, usually at 3 or 4 months of age, the emergence of emotion self-regulatory skills for excessive criers would temporarily lag behind that of their typical crying counterparts, but that by 10 months of age excessive criers would exhibit comparative levels of regulation to the typical criers. However, by 10 months of age, despite increases in negative reactivity to arm restraint and decreases in self-regulation in all the 10-month-old infants, the excessive crying boys continued to show significantly lower levels of regulation. Perhaps it takes boys longer to establish patterns of effective self-regulation. As the effect for boys in the excessive criers group was modest at best, examining gender differences in the development of emotion self-regulation, particularly during the first 2 years, would be important toward clarifying these findings.

This study is the first to examine the regulatory outcome of infants who cry excessively in early infancy. Whereas the results point to a role of excessive crying in the development of self-regulatory skills, interpretation of the regulatory behaviors should be done with caution. Likewise, only one measure of negative reactivity was available at each age. What is not clear from the results is whether excessive criers are more sensitive to frustration at later ages or more reactive to all forms of mildly aversive stimuli. Mother ratings of temperament in this study did

not illuminate this issue, and so it remains for future research to determine the extent to which excessive criers are negatively reactive.

Change in temperamental reactivity, specifically negative reactivity, may fall under the principle of lawful discontinuity; that is, the behavioral expression of temperament can be expected to change and this instability is due to the emergence and consolidation of other behaviors (Hinde & Bateson, 1984). For example, when regulatory behaviors such as attentional strategies come online they produce changes in the expression of negative arousal. It is agreed among both emotion and temperament researchers (Rothbart & Bates, 1998; Thompson, 1994) that the emergence of these skills is dependent on the actions of the caregiver. However, the level of reactivity that the infant brings to the interaction may affect the success and timing of these behaviors. As the findings of this study are limited to the early part of infancy, where excessive crying is expected in about 10% to 15% of the population and is considered transitional, the results leave open the possibility of alternative or additional processes related to emotion regulation development. Nevertheless, our results provide one context under which infants develop regulatory strategies, shedding light on the potential effect of early distress on the emergence of this ability.

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