



Published in final edited form as:

Infant Behav Dev. 2013 February ; 36(1): 139–146. doi:10.1016/j.infbeh.2012.11.004.

The Development of Negative Reactivity in Irritable Newborns as a Function of Attachment

Laura J. Sherman,

Department of Psychology, University of Maryland

Brandi Stupica,

Department of Psychology, University of Maryland

Matthew J. Dykas,

Department of Psychology, State University of New York at Oswego

Fatima Ramos-Marcuse, and

Department of Family and Community Health, University of Maryland School of Nursing

Jude Cassidy

Department of Psychology, University of Maryland

Abstract

This longitudinal study builds on existing research exploring the developmental course of infants' negative reactivity to frustration in a sample of 84 irritable infants. We investigated whether infants' negative reactivity to frustration differed during the first year as a function of infant attachment classification. Various elements of the designs of previous studies investigating negative reactivity and attachment preclude the strong conclusion that negative reactivity develops differently as a function of attachment. Thus, we utilized the same observational assessment of infant negative reactivity, conducted without parental involvement, at 5 and 12 months. One proposition, based in attachment theory (Bowlby, 1969/1982; Cassidy, 1994), is that relative to secure infants, insecure-avoidant infants come to minimize their negative emotional reactions, whereas insecure-ambivalent infants come to maximize their negative emotional reactions. As expected, we found that at 5 months, attachment groups did not differ in reactivity, but at 12 months, insecure-avoidant infants were the least reactive, followed by secure infants, and insecure-ambivalent infants were the most reactive. Results are discussed in terms of conceptualizing the development of emotion regulation and their implications for future research.

Keywords

attachment; reactivity; emotion regulation; affect; irritability; temperament

© 2012 Elsevier Inc. All rights reserved.

Correspondence concerning this article should be addressed to Laura J. Sherman, Department of Psychology, University of Maryland, College Park, MD 20742. jernigan@umd.edu.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Preliminary results were presented at the 2010 International Conference on Infant Studies, Baltimore, MD.

1. Introduction

Newborn infant irritability is often aversive and stressful to new parents. Compared to parents with non-irritable newborns, for example, parents of irritable newborns have reported higher levels of parenting stress and have displayed lower levels of parental sensitivity (van den Boom & Hoeksma, 1994). Such negative parental responses to newborn infant irritability may be at least one reason why irritable newborns, compared to their non-irritable counterparts, continue to be more negatively emotional and show less positive social behavior during the first year of life (e.g., Bates, Maslin, & Frankel, 1985; Keefe, Kotzer, Froese-Fretz, Curtin, 1996; Matheny, Riese, & Wilson, 1985; van den Boom & Hoeksma, 1994). This trajectory of negative emotionality is concerning because heightened negative emotionality has been associated with poor social competence and subsequent psychopathology (see Cole & Hall, 2008; Degnan, Calkins, Keane, & Hill-Soderlund, 2008; Kopp, 1989; Rothbart & Derryberry, 1981; Rothbart & Posner, 2006). In particular, heightened reactivity to frustrating events in infancy has been associated with noncompliance (Stifter, Spinrad, & Braungart-Rieker, 1999), aggressive behavior (Crockenberg, Leerkes, & Jo, 2008), and poor emotion regulation (Calkins, Dedmon, Gill, Lomax, & Johnson, 2002). As such, attempts to better understand the development of negative reactivity in irritable newborns is paramount. One important influence on children's emotional development is the quality of the caregiving environment (Calkins & Hill, 2007; Shonkoff & Phillips, 2000). In this longitudinal study, we asked whether infant-mother attachment is related to the way in which negative reactivity develops in irritable newborns.

On the basis of attachment theory (Bowlby, 1969/1982, 1973, 1980, 1988; see Cassidy & Shaver, 2008, for reviews), Cassidy (1994) proposed a model of emotion regulation characterized by minimizing and maximizing of emotion. According to this model, infants develop patterns of attachment – and corresponding strategies for emotion expression and regulation – based, in part, on their caregivers' typical responses to the infants' attachment-related needs (e.g., needs for comfort while distressed). Securely attached infants, who have had a history of sensitive responsiveness from their caregivers, are thought to learn implicitly that expressing negative affect is an effective means of signaling their caregivers for help and that their signaling will be met with sensitive responsiveness. On the other hand, insecure-avoidant infants, who have had a history of their signals being ignored or rejected, are thought to learn implicitly to minimize emotional reactions in order to avoid the probable experience of parental rejection and the resulting psychological pain associated with this rejection (see also Ainsworth, Blehar, Waters, & Wall, 1978; Main, 1981). Lastly, insecure-ambivalent infants, who have likely had a history of inconsistent responsiveness, are thought to implicitly learn to heighten emotional reactions in order to ensure a response from an inconsistent caregiver (see also Cassidy & Berlin, 1994). More precisely, these infants may maximize their emotional reactions because such behavior increases the likelihood that their inconsistent caregivers will respond to them. Thus, over time during the first year, infants likely come to understand how their attachment figures respond to their negative emotions and develop corresponding attachment-related strategies for their expressions of negative emotion. As such, attachment-related individual differences in infants' emotional reactions should be readily observable only once their attachment pattern has formed.

Surprisingly little research has addressed the theory that infants come to minimize or maximize their negative emotions based on attachment quality. To date, indirect support for these propositions has come from two studies: in one study, avoidant infants were more likely to be classified as less reactive than ambivalent infants (Braungart & Stifter, 1991), and in the other study, the group of ambivalent infants were rated as the most negatively

reactive of the three attachment groups (Moran & Pederson, 1998). Although much additional work has investigated the relation between infant attachment and negative reactivity (see Vaughn, Bost, & van IJzendoorn, 2008, for a review of attachment and temperament), the design and analyses used in these studies do not address patterns of minimizing and maximizing (i.e., these studies were designed to address other aspects of the relation between infant attachment and negative reactivity, such as whether security vs. insecurity is linked to negative reactivity, as opposed to whether insecure-avoidance is linked to minimizing and insecure-ambivalence is linked to maximizing negative reactivity). Thus, although the studies reviewed below make important contributions to the field, they cannot be used to answer the question of whether infants minimize and maximize their negative emotions as a function of their attachment patterns.

Several studies have examined individual differences in negative reactivity between secure and insecure infants or have used a continuous rating of attachment security; in both cases, attachment security was negatively associated with negative reactivity (e.g., Belsky, Fish, & Isabella, 1991; Ipsa, Fine, & Thornburg, 2002; Vaughn et al., 1992). Neither of these approaches, however, can speak to how infants with avoidant attachment differ from those with ambivalent attachment patterns. Moreover, in some of these studies negative reactivity was assessed using a parent report (e.g., Ipsa et al., 2002; Moran & Pederson, 1998); because parent reports have the potential for bias (Gartstein & Marmion, 2008; Leerkes & Crockenberg, 2003), the results may not reflect infants' actual level of reactivity.

Furthermore, in many of the studies of attachment and negative reactivity, infant reactivity was assessed only in the first half of the first year (e.g., Calkins & Fox, 1992; Marshall & Fox, 2005). The timing of the assessment of temperament is crucial when testing the claims of the minimizing and maximizing propositions because, as noted above, if the propositions are correct, negative reactivity and attachment will be linked only later in the first year when attachment patterns are fully formed. And, in fact, the studies that have examined the link between 6-month reactivity and attachment have not found them to be associated (e.g., Calkins & Fox, 1992). Further, when studies investigating the relations between negative reactivity and attachment use only a single assessment of reactivity (e.g., Braungart & Stifter, 1991; Calkins & Fox, 1992; Marshall & Fox, 2005), they do not provide information about how negative reactivity develops during the first year.

Other studies may have confounded the assessments of reactivity and attachment by assessing infants' reactivity using procedures that also involve the attachment figure (e.g., concurrently from the Strange Situation, Braungart & Stifter, 1991, or from parent-infant interactions, Belsky et al., 1991). This methodological approach has limits for evaluating whether infants minimize and maximize their emotions as a function of attachment because many of the behaviors that classify the infant's attachment pattern were also used to evaluate the infants' level of reactivity. Finally, the one study that did examine infants' response to frustration at two time points during the first year in relation to attachment used different measures across time, making it difficult to evaluate whether observed differences in infant behavior resulted from task demands rather than an actual developmental difference in the underlying construct (see Kochanska, 2001, who reported an increase in secure infants' anger in response to frustration between 9 to 14 months). In sum, the existing literature from community samples examining reactivity and attachment is unable to speak directly to the proposition that infants minimize and maximize their negative emotion as a function of their attachment quality.

Given that irritable infants have been identified as at-risk for poorer emotional development (e.g., Bates et al., 1985; Keefe et al., 1996; Matheny et al., 1985; van den Boom & Hoeksma, 1994), it is particularly important to establish whether attachment quality can

explain the development of negative reactivity in these at-risk infants. No study has yet examined this possibility. It may be that irritable newborns are biologically predisposed to react more negatively to their environment, which raises the possibility that infants' attachment quality will have little or no effect on their reactions to frustration. Alternatively, attachment quality may indeed relate to the development of negative reactivity for irritable infants as it is theorized to do for non-irritable infants. Moreover, by selecting a sample of irritable infants, we are able to more rigorously test the claims set forth by Cassidy (1994) on the minimizing and maximizing of emotion because the sample would be more homogenous in terms of their negative reactivity than a community-based sample. As such, if attachment relates to individual differences in negative reactivity for these infants, it would present strong evidence that attachment is an important predictor in the development of negative reactivity.

In the present study, we explored whether infant-mother attachment quality was linked to the development of irritable newborns' negative reactivity to frustration over the first year. To address the methodological concerns of prior studies, the present study employed the arm restraint procedure conducted by an experimenter, rather than the mother, at two time points to assess infant reactions without the confounding influence of the parent-infant relationship or problems associated with using different measures to assess a single construct over time. We expected that attachment-related differences in infant reactivity would not be evident at age 5 months because this time period is considered to precede the formation of attachment bonds. That is, because infants have not yet formed an attachment to their caregivers, attachment quality should not contribute to infant behavior at this time (Bowlby, 1969/1982). At 12 months, however, we predicted that attachment-related differences would emerge in infant reactivity, such that avoidant infants would be the least reactive, followed by secure infants, and ambivalent infants would be the most reactive.

2. Method

2.1. Participants

Participants were 84 irritable infants (45% female) and their economically stressed mothers (i.e., 99% of participants reported annual household incomes below \$50,000) enrolled in the control group of a randomized controlled study (see XXXXX, for full study and demographic details). Irritable infants were selected by screening infants ($N = 1103$) in the first month of life using two Neonatal Behavioral Assessment Scale (NBAS; Brazelton & Nugent, 1995) tests. Infants who scored in the top 20% of all infants screened were enrolled in the longitudinal study ($N = 220$). Mean irritability composite scores (peak of excitement, rapidity of buildup, and irritability; see Kaye, 1978) for the first and second NBAS administrations were 6.51 ($SD = .92$, $range = 4 - 9$) and 5.19 ($SD = 0.92$, $range = 1 - 9$). Of the 220 enrolled infants, 84 were assigned to the control group and completed the first year of the study. Infants' mean birth weight was 3362.14 grams ($SD = 418.78$). Infants' race/ethnicity was identified as 48% Black or African American, 18% White or Caucasian, 18% more than one race/ethnicity, 14% Hispanic, 1% Asian, and 1% American Indian/Alaskan. Mothers' mean age was 24.32 years ($SD = 5.16$).

2.2. Measures

2.2.1. Infant negative reactivity—We used an arm restraint task (e.g., Provost & Gouin-Decarie, 1979; Stifter & Fox, 1990) to elicit infant frustration. This task has been used successfully with infants aged 2 – 12 months (e.g., Bennett, Bendersky, & Lewis, 2005; Camras, Oster, Campos, Miyake, & Bradshaw, 1992; Moscardino & Axia, 2006). We videotaped infants' reactions to a 2-minute arm restraint and subsequent 1-minute recovery period. Mothers placed their infants in a car seat on the floor and sat quietly in the room

during the task. An experimenter, positioned behind the infant, gently held the infants' arms down (maximum 2 minutes). The task ended early if infants cried continuously for more than 30 seconds. Based on Braungart-Rieker and Stifter (1996), we coded infants' negative reactivity (i.e., facial expressions and distress vocalizations) in 5-second segments on a 4-point scale from 0 (*no negative reactivity or negative facial affect*) to 3 (*high intensity negative reactivity*). Segment ratings were then averaged. Inter-rater reliability was high at both time points (ICCs = .99; assessed from 47% and 38% of cases at 5 and 12 months, respectively).

2.2.2. Infant attachment—We assessed infant-mother attachment with the Strange Situation Procedure (Ainsworth et al., 1978). This 20-minute laboratory procedure assesses infant attachment quality with two brief separations from and reunions with a parent. Five trained, reliable coders classified infants into attachment groups. Classifications are based principally on infants' behavior during the two reunions. *Securely attached* infants demonstrate strong proximity-seeking and/or contact-maintaining behaviors on reunion, whereas *insecure-avoidant* infants actively avoid proximity and interaction on reunion with the parent, and *insecure-ambivalent* infants show angry resistant behaviors on reunion (Ainsworth et al., 1978). Infants classified as *insecure-disorganized/unclassifiable* appear to lack a coherent attachment strategy with their parents (Main & Solomon, 1986). These infants are also assigned an underlying classification as secure, avoidant, or ambivalent. Because of the theoretical basis of the study, infants who were considered as disorganized/unclassifiable were assigned to their underlying group classification; it is the strategies evident in these underlying classifications that are thought to drive infants' emotion regulation strategies (Cassidy, 1994). A randomly selected 34% ($n = 58$) were coded independently by two coders; coder agreement was 79% ($\kappa = 0.69, p < .001$).

2.3. Procedure

We conducted the laboratory arm restraint task when infants were 5 and 12 months old. After the 5-month visit, dyads were randomly assigned to the intervention or control group, and received three home visits between 6.5 and 9 months (see XXXXX, for details about the intervention protocol). At the 12-month visit, infants first participated in the Strange Situation, and approximately 20 minutes later (after a variety of laboratory tasks with their mothers) in the arm restraint task. In order to minimize potential carry-over effects from the Strange Situation, we did not start the arm restraint task if infants were distressed (i.e., had negative reactivity scores ≥ 2 at the start of the task). If an infant was distressed at the start of the arm restraint task, we delayed the start of the task; if an infant remained distressed, he or she was excluded from the procedure. This exclusion criterion resulted in the loss of 7 infants at the 5-month visit and 7 infants at the 12-month visit (note: none of the excluded infants was the same across time). Infants who were too upset to participate in the task could not be distinguished on the basis of their attachment classification (5-month: 2 were later classified as avoidant, 4 as secure, and 1 as ambivalent; 12-month: 2 were classified as avoidant, 3 as secure, and 2 as ambivalent). The majority of remaining infants showed no signs of negative reactivity at the start of the task (83.1% at 5 months, $M = .16, SD = .36, Median = 0$; and 87.0% at 12 months, $M = .13, SD = .34, Median = 0$).

3. Results

3.1. Preliminary Analyses

3.1.1. Missing data—Of the 84 infants for whom attachment classifications were available, infant negative reactivity scores were available for only 77 infants at the 5 assessment and 77 infants at the 12 month assessment, resulting in 70 infants with both 5 month and 12 month negative reactivity assessments. Thus, 77 infants were used for

analyses of the 5 month assessment, 77 infants were used for analyses of the 12 month assessment, and for comparisons of the 5 and 12 month assessments, 70 infants were available for analyses. Data were missing completely at random (MCAR) as indicated by Little's MCAR test ($\chi^2 [23] = 21.86, p = .529$). Given the small amount of missing data at each time point (8.3% at 5 months and 8.3% at 12 months) and that data were MCAR, we chose to use pairwise deletion to handle cases with missing data (Graham, 2009).

3.1.2. Descriptive statistics—Of the 15 infants who received a classification of disorganized or unclassifiable in the Strange Situation, 5 had an underlying secure classification, 5 avoidant, and 5 ambivalent resulting in 47 secure (55.95%), 19 insecure-avoidant (22.62%), and 18 insecure-ambivalent (21.43%). There was ample variation in mean reactivity scores for both the 5-month ($M = 1.13, SD = 0.81, range = 0 - 2.60$) and 12-month ($M = 1.30, SD = 0.89, range = 0 - 2.94$) assessments and the means were not significantly different at 5 and 12 months ($t [69] = -1.44, p = .155$) indicating that the task was equally frustrating for both 5- and 12- month-old infants. Infant negative reactivity at 5 and 12 months was correlated ($r = .31, p = .009$).

3.2. Principal Analyses

We conducted a generalized estimating equations (GEE) analysis with negative reactivity to frustration as a repeated measure outcome to obtain the estimated marginal (EM) means necessary to examine group differences at 5 and 12 months and changes over time within groups. We chose this analytical approach as opposed to a traditional analysis of variance (ANOVA) approach, because GEE analysis has increased power for repeated measures data, is robust to traditional assumptions of ANOVA, and provides less biased estimates when missing data are present (Hardin & Hilbe, 2003). We included the main effect of time (5 vs. 12 months) and attachment classification (Avoidant vs. Secure vs. Ambivalent) and the two-way interaction between Time and Attachment (Time \times Attachment).

To determine whether infant negative reactivity differed at 5 months as a function of later attachment, we examined the following planned comparisons within the 5 month time period: avoidant infants vs. secure infants, avoidant infants vs. ambivalent infants, and secure infants vs. ambivalent infants. We expected that avoidant, secure, and ambivalent infants' negative reactivity would not differ at 5 months. To determine whether infant negative reactivity differed at 12 months as a function of attachment, we examined the following planned comparisons within the 12 month time period: Avoidant infants vs. secure infants, avoidant infants vs. ambivalent infants, and secure infants vs. ambivalent infants. We expected that avoidant infants would have the lowest levels of negative reactivity at 12 months followed by secure infants, and ambivalent infants would have the highest levels of negative reactivity; given our a priori hypotheses, we use one-tailed tests of significance to test these comparisons within the 12-month time point between attachment groups. In addition, we were interested in exploring changes in negative reactivity between 5 and 12 months within each attachment group. Because we did not have specific hypotheses regarding changes between 5 and 12 months within each attachment group, we examined comparisons of negative reactivity at 5 and 12 months within each attachment group using two-tailed tests of significance.

The EM means for each attachment group at each time point are presented in Figure 1. As expected, attachment groups did not differ in their negative reactivity at 5 months. Specifically, at 5 months, avoidant infants' negative reactivity did not differ from that of secure infants (5 month avoidant vs. 5 month secure $M_{\text{difference}} = -.26, SE = .24, p = .263, d = 0.32$) or ambivalent infants (5 month avoidant vs. 5 month ambivalent $M_{\text{difference}} = -.34, SE = .27, p = .207, d = 0.43$), and the reactivity of secure infants did not differ from that of

ambivalent infants (5 month secure vs. 5 month ambivalent $M_{\text{difference}} = -.07$, $SE = .21$, $p = .732$, $d = 0.10$).

At 12 months, however, differences in infant negative reactivity emerged as expected such that avoidant infants had significantly lower levels of negative reactivity than both secure infants (12 month avoidant vs. 12 month secure $M_{\text{difference}} = -.40$, $SE = .22$, $p = .034$ [one-tailed], $d = 0.51$) and ambivalent infants (12 month avoidant vs. 12 month secure $M_{\text{difference}} = -.94$, $SE = .29$, $p = .001$ [one-tailed], $d = 1.14$ and secure infants had significantly lower levels of negative reactivity than ambivalent infants (12 month secure vs. 12 month ambivalent $M_{\text{difference}} = -.54$, $SE = .26$, $p = .018$ [one-tailed], $d = 0.63$). Thus, at 12 months, avoidant infants were the least reactive to frustration, followed by secure infants; insecure-ambivalent infants were the most reactive to frustration (see Figure 1).

We further explored attachment group differences in negative reactivity to frustration by examining changes for each attachment group between 5 and 12 months. Negative reactivity to frustration did not change between 5 and 12 months for either avoidant infants (5 month avoidant vs. 12 month avoidant $M_{\text{difference}} = .03$, $SE = .21$, $p = .883$, $d = 0.03$) or secure infants (5 month secure vs. 12 month secure $M_{\text{difference}} = -.10$, $SE = .15$, $p = .498$, $d = 0.11$). Ambivalent infants' negative reactivity to frustration, however, increased between 5 and 12 months (5 month ambivalent vs. 12 month ambivalent $M_{\text{difference}} = .57$, $SE = .26$, $p = .030$, $d = 0.60$).

4. Discussion

The present study is the first to explore whether infant attachment quality relates to the development of infants' negative reactivity in a sample of irritable newborns. We chose to explore this question in a sample of irritable newborns because these infants have been identified as being at-risk for poor emotion regulation. We asked whether the developing attachment relationship would be associated with a shift in the course of negative emotionality in our sample of irritable infants.

Our results support the notion that attachment quality is related to the ways in which infants regulate their emotions (Cassidy, 1994). As predicted, attachment groups did not differ in their levels of negative reactivity at age 5 months. At 12 months of age, however, once the infant has formed his or her primary attachment relationship, we saw predictable differences in the levels of infants' negative reactivity. The fact that insecure-avoidant infants had the lowest negative reactivity at 12 months supports the notion that these infants minimize their negative emotions perhaps to avoid the likely experience of rejection that they have come to expect from their attachment figure. In addition, the finding that insecure-ambivalent infants displayed the highest negative reactivity supports the notion that these infants maximize negative emotions, presumably to ensure a response from an inconsistent caregiver. Secure infants displayed levels of negative reactivity that were in between those of insecure-avoidant and insecure-ambivalent infants. This pattern of findings is not surprising given that secure infants are thought to have learned that the expression of negative emotion is an effective means for communicating their distress to their consistently responsive attachment figure. As such, secure infants are free to express negative emotionality without the risk of losing proximity to their caregiver as is thought to be the case with avoidant infants. In addition, secure infants simply have to express negative emotionality to have their caregiver respond, unlike ambivalent infants who have to heighten their negative emotional expressions in order to increase the likelihood that their attachment figure will be available and responsive.

If the observed differences in negative reactivity at 12 months could be accounted for by stable temperamental characteristics, we would have expected to see differences at 5 months as well. We did not, however, see any difference in negative reactivity at 5 months, despite ample variability in the 5 month assessment to detect individual differences. Given these results, we believe that these data support the claim that attachment contributes to infants' negative reactivity even in irritable newborns. Future studies could include more time points to track exactly when differences emerge. For example, are the differences observed only at 12 months when attachment patterns are reliably assessed or are the differences observed earlier in development?

Previous research identified a normative trend for infants' negative reactivity to increase during the first year (e.g., Bennett et al., 2005; Porter, Jones, Evans, & Robinson, 2009; Stifter & Spinrad, 2002). The developmental trend of increasing negative reactivity to frustration may result from infants being more frustrated by restraint as they become more mobile. An alternative explanation for this trend is that infants may become more upset from 5 to 12 months because stranger anxiety develops around 8 months (e.g., Spitz, 1950), and infants may be responding to their fear of the experimenter rather than the frustration of being restrained. Whatever the cause of the increased negativity, in this study we did not find support for this general developmental trend. It is possible that this normative trend did not emerge because the sample was selected for its heightened irritability. Nonetheless, we found predictable change in infants' negative reactivity as a function of attachment quality: Insecure-ambivalent infants were the only group to increase in their negative reactivity from 5 to 12 months. This result is consistent with the concept of maximizing emotions from an attachment theory perspective (see Cassidy, 1994). These results may also suggest that this normative trend in increased negative reactivity across the first year of life may not be true for all infants – particularly for insecure-avoidant infants who may learn over the course of the first year that expressions of negative emotion are often rejected by their caregiver.

Although our sample contained only infants identified as the most irritable newborns (top 20%) of all infants we screened, the results are likely to generalize to all infants for several reasons. First, the results are consistent with previous investigations from community samples that examined the association between infant attachment quality and negative reactivity. Second, choosing a sample of irritable infants could have limited our ability to find individual differences based on attachment quality because these infants could have been biologically predisposed to heightened levels of negative reactivity. The sample represents a more restricted range of negative emotionality than a community sample, yet we still found moderate to large sized effects in the differences among attachment groups. In addition, previous studies could not address the question of how attachment quality relates to changes in negative reactivity because of the different methodology and procedures used (described above). In this study, we used the same observational assessment of negative reactivity across a six month period, without parental involvement, to address our question. Thus, our methodology allows for a more rigorous test of the predictions from attachment theory.

Our findings are unable to speak to whether infants' actual experiences with their caregivers influence their emotional reactions. Our claim that our findings support the idea that infants minimize or maximize their negative emotional expressions according to their experiences with their caregivers rests on the assumption that infant attachment quality is a reasonably accurate reflection of the infant's probable caregiving experiences. There is evidence to justify this view (e.g., Ainsworth et al., 1978; Bakermans-Kranenburg, van IJzendoorn, & Juffer, 2003; Bokhorst, Bakermans-Kranenburg, Fearon, van IJzendoorn, Fonagy, & Schuengel, 2003; Weinfield, Sroufe, & Egeland, 2000), however, future research should assess caregivers' responses to infants' emotional expressions to determine whether this is

the mechanism for the changes in infant reactivity that we found. In particular, research that assesses caregivers' sensitivity, rejection, and availability in response to infants' emotional expressions is needed to address whether insensitive and rejecting caregiving leads to the pattern of restricted negative reactivity to frustration observed in this study for insecure-avoidant infants, and whether insensitive and inconsistent responsiveness leads to the pattern of heightened negative reactivity to frustration observed in this study for insecure-ambivalent infants.

Moreover, we cannot determine the direction of effects from these data; that is, it may be that children whose negative reactivity to frustration either increases more or less than average during the first year are more difficult to parent during the later part of the first year and thus, develop insecure attachments. This possibility is underscored by findings that parents of negatively reactive infants, compared to parents of less reactive infants, report more parenting stress, and are less sensitive and more intrusive while interacting with their infants (e.g., Calkins, Hungerford, & Dedmon, 2004; Spinrad & Stifter, 2002). Monitoring parent behavior and infant negative reactivity throughout the first year will shed light on these possibilities. Multiple assessments would also be particularly useful because the Strange Situation could have some carry-over effects; we minimized this possibility by providing ample time for each infant to return to baseline after the Strange Situation and excluding any infants who were observably upset at the start of the arm restraint procedure. Our interpretation that the observed differences in negative reactivity are not solely due to potential carryover effects is supported by previous research indicating that attachment-related differences in children's distress reactions represent stable individual differences and not carryover effects from the Strange Situation (e.g., Gilliom, Shaw, Beck, Schonberg, & Lukon, 2002; Kochanska, Philibert, & Barry, 2009; Volling, 2001). Nevertheless, because of possible carry-over effects, future research should assess attachment and reactivity during different sessions. Finally, infants' negative reactivity to frustration is only one aspect of emotional development. Considerable research indicates that parenting may shape other aspects of emotional development, including infants' reactivity to novelty (e.g., Crockenberg & Leerkes, 2004; Kochanska, 1998); future research should investigate how attachment quality relates to changes in other domains of emotional development (see for example, Kochanska, 2001).

Acknowledgments

This research was funded by Grant R01 MH58907 awarded to Jude Cassidy and Janet W. Johnson Summer Fellowships awarded to Laura J. Sherman and Brandi Stupica. The funding sources had no involvement in the study design, data collection, analyses or interpretation of the data, writing the report, or decision to submit the paper for publication.

References

- Ainsworth, MDS.; Blehar, MC.; Waters, E.; Wall, S. Patterns of attachment: A psychological study of the strange situation. Hillsdale, NJ: Erlbaum; 1978.
- Bakermans-Kranenburg M, van IJzendoorn M, Juffer F. Less is more: Meta-analyses of sensitivity and attachment interventions in early childhood. *Psychological Bulletin*. 2003; 129:195–215. [PubMed: 12696839]
- Bates JE, Maslin CA, Frankel KA. Attachment security, mother–child interaction, and temperament as predictors of behavior–problem ratings at age three years. *Monographs Of The Society For Research In Child Development*. 1985; 50(1–2):167–193. [PubMed: 4069127]
- Belsky J, Fish M, Isabella R. Continuity and discontinuity in infant negative and positive emotionality: Family antecedents and attachment consequences. *Developmental Psychology*. 1991; 27:421–431.
- Bennett D, Bendersky M, Lewis M. Does the organization of emotional expression change over time? Facial expressivity from 4 to 12 months. *Infancy*. 2005; 8:167–187. [PubMed: 16906232]

- Bokhorst CL, Bakermans-Kranenburg MJ, Fearon R, van IJzendoorn MH, Fonagy P, Schuengel C. The importance of shared environment in mother-infant attachment security: A behavioral genetic study. *Child Development*. 2003; 74:1769–1782. [PubMed: 14669895]
- Bowlby, J. *Attachment and loss: Vol. 1. Attachment*. New York: Basic Books; 1969/1982.
- Bowlby, J. *Attachment and loss: Vol. 2. Separation*. New York, NY: Basic Books; 1973.
- Bowlby, J. *Attachment and loss: Vol. 3. Loss*. New York, NY: Basic Books; 1980.
- Bowlby, J. *A secure base: Parent-child attachment and healthy human development*. New York, NY: Basic Books; 1988.
- Braungart JM, Stifter CA. Regulation of negative reactivity during the strange situation: Temperament and attachment in 12-month-old infants. *Infant Behavior & Development*. 1991; 14:349–364.
- Braungart-Rieker J, Stifter C. Infants' responses to frustrating situations: Continuity and change in reactivity and regulation. *Child Development*. 1996; 67:1767–1779. [PubMed: 8890506]
- Brazelton, TB.; Nugent, JK. *The Neonatal Behavioral Assessment Scale*. London: McKeith; 1995.
- Calkins SD, Dedmon SE, Gill KL, Lomax LE, Johnson LM. Frustration in infancy: Implications for emotion regulation, physiological processes, and temperament. *Infancy*. 2002; 3:175–197.
- Calkins S, Fox N. The relations among infant temperament, security of attachment, and behavioral inhibition at twenty-four months. *Child Development*. 1992; 63:1456–1472. [PubMed: 1446562]
- Calkins, SD.; Hill, A. Caregiver influences on emerging emotion regulation: Biological and environmental transactions in early development. In: Gross, JJ.; Gross, JJ., editors. *Handbook of emotion regulation*. New York, NY: Guilford; 2007. p. 229-248.
- Calkins S, Hungerford A, Dedmon S. Mothers' interactions with temperamentally frustrated infants. *Infant Mental Health Journal*. 2004; 25:219–239.
- Camras LA, Oster H, Campos JJ, Miyake K, Bradshaw D. Japanese and American infants' responses to arm restraint. *Developmental Psychology*. 1992; 28:578–583.
- Cassidy J. Emotion regulation: Influences of attachment relationships. *Monographs of the Society for Research in Child Development*. 1994; 59:228–283. [PubMed: 7984163]
- Cassidy J, Berlin LJ. The insecure/ambivalent pattern of attachment: Theory and research. *Child Development*. 1994; 65:971–981. [PubMed: 7956474]
- Cassidy, J.; Shaver, PR., editors. *Handbook of attachment*. 2nd ed. New York, NY: Guilford Press; 2008.
- Cole, PM.; Hall, SE. Emotion dysregulation as a risk factor for psychopathology. In: Beauchaine, TP.; Hinshaw, SP., editors. *Child and adolescent psychopathology*. Hoboken, NJ: John Wiley & Sons; 2008. p. 265-300.
- Crockenberg SC, Leerkes EM, J6 P. Predicting aggressive behavior in the third year from infant reactivity and regulation as moderated by maternal behavior. *Development And Psychopathology*. 2008; 20:37–54. [PubMed: 18211727]
- Degnan KA, Calkins SD, Keane SP, Hill-Soderlund AL. Profiles of disruptive behavior across early childhood: Contributions of frustration reactivity, physiological regulation, and maternal behavior. *Child Development*. 2008; 79:1357–1376. [PubMed: 18826530]
- Gartstein MA, Marmion J. Fear and positive affectivity in infancy: Convergence/discrepancy between parent-report and laboratory-based indicators. *Infant Behavior & Development*. 2008; 31:227–238. [PubMed: 18082892]
- Gilliom M, Shaw DS, Beck JE, Schonberg MA, Lukon JL. Anger regulation in disadvantaged preschool boys: Strategies, antecedents, and the development of self-control. *Developmental Psychology*. 2002; 38:222–235. [PubMed: 11881758]
- Graham JW. Missing data analysis: Making it work in the real world. *Annual Review of Psychology*. 2009; 60:549–576.
- Hardin, JW.; Hilbe, JM. *Generalized estimating equations*. Boca Raton, FL: Chapman and Hall/CRC Press; 2003.
- Ispa J, Fine M, Thornburg K. Maternal personality as a moderator of relations between difficult infant temperament and attachment security in low-income families. *Infant Mental Health Journal*. 2002; 23:130–144.

- Kaye K. Discriminating among normal infants by multivariate analysis of Brazelton scores: Lumping and smoothing. *Monographs of the Society for Research in Child Development*. 1978; 43(5-6, Serial No. 177):60–80. [PubMed: 752805]
- Keefe M, Kotzer A, Froese-Fretz A, Curtin M. A longitudinal comparison of irritable and nonirritable infants. *Nursing Research*. 1996; 45:4–9. [PubMed: 8570421]
- Kochanska G. Mother–child relationship, child fearfulness, and emerging attachment: A short-term longitudinal study. *Developmental Psychology*. 1998; 34:480–490. [PubMed: 9597358]
- Kochanska G. Emotional development in children with different attachment histories: The first three years. *Child Development*. 2001; 72:474–490. [PubMed: 11333079]
- Kochanska G, Philibert RA, Barry RA. Interplay of genes and early mother-child relationship in the development of self-regulation from toddler to preschool age. *Journal Of Child Psychology And Psychiatry*. 2009; 50:1331–1338. [PubMed: 19207629]
- Kopp C. Regulation of distress and negative emotions: A developmental view. *Developmental Psychology*. 1989; 25:343–354.
- Leerkes EM, Crockenberg SC. The impact of maternal characteristics and sensitivity on the concordance between maternal reports and laboratory observations of infant negative emotionality. *Infancy*. 2003; 4:517–539.
- Main, M. Avoidance in the service of attachment: A working paper. In: Immelman, K.; Barlow, G.; Main, M.; Petrinoitch, L., editors. *Behavioral development: The Bielefeld interdisciplinary project*. New York, NY: Cambridge University Press; 1981. p. 651-693.
- Main, M.; Solomon, J. Discovery of an insecure-disorganized/disoriented attachment pattern. In: Brazelton, T.; Yogman, MW.; Brazelton, T.; Yogman, MW., editors. *Affective development in infancy*. Westport, CT: Ablex Publishing; 1986. p. 95-124.
- Marshall P, Fox N. Relations between behavioral reactivity at 4 months and attachment classification at 14 months in a selected sample. *Infant Behavior & Development*. 2005; 28:492–502.
- Matheny AP, Riese ML, Wilson RS. Rudiments of infant temperament: Newborn to 9 months. *Developmental Psychology*. 1985; 21:486–494.
- Moran G, Pederson D. Proneness to distress and ambivalent relationships. *Infant Behavior & Development*. 1998; 21:493–503.
- Moscardino U, Axia G. Infants' responses to arm restraint at 2 and 6 months: A longitudinal study. *Infant Behavior & Development*. 2006; 29:59–69. [PubMed: 17138262]
- Porter C, Jones B, Evans C, Robinson C. A comparative study of arm-restraint methodology: Differential effects of mother and stranger restrainers on infants' distress reactivity at 6 and 9 months of age. *Infancy*. 2009; 14:306–324.
- Provost M, Gouin-Décarie T. Heart rate reactivity of 9- and 12-months old infants showing specific emotions in natural setting. *International Journal of Behavioral Development*. 1979; 2(2):109–120.
- Rothbart, MK.; Derryberry, D. Development of individual differences in temperament. In: Lamb, ME.; Brown, AL., editors. *Advances in developmental psychology*. Vol. Vol. I. Hillsdale, NJ: Erlbaum; 1981. p. 37-86.
- Rothbart, MK.; Posner, MI. Temperament, attention, and developmental psychopathology. In: Cicchetti, D.; Cohen, DJ.; Cicchetti, D.; Cohen, DJ., editors. *Developmental psychopathology*, Vol 2: *Developmental neuroscience*. 2nd ed. Hoboken, NJ: John Wiley & Sons Inc; 2006. p. 465-501.
- Shonkoff, J.; Phillips, D. *From neurons to neighborhoods: The science of early childhood development*. Washington, DC: National Academy Press; 2000.
- Spinrad T, Stifter C. Maternal sensitivity and infant emotional reactivity: Concurrent and longitudinal relations. *Marriage & Family Review*. 2002; 34:243–263.
- Spitz RA. Anxiety in infancy: A study of its manifestations in the first year of life. *International Journal of Psychoanalysis*. 1950; 31:138–142.
- Stifter CA, Fox NA. Infant reactivity: Physiological correlates of newborn and 5-month temperament. *Developmental Psychology*. 1990; 26:582–588.
- Stifter C, Spinrad T. The effect of excessive crying on the development of emotion regulation. *Infancy*. 2002; 3:133–152.

- Stifter CA, Spinrad TL, Braungart-Rieker JM. Toward a developmental model of child compliance: The role of emotion regulation in infancy. *Child Development*. 1999; 70:21–32. [PubMed: 10191513]
- van den Boom D, Hoeksma JB. The effect of infant irritability on mother–infant interaction: A growth-curve analysis. *Developmental Psychology*. 1994; 30:581–590.
- Vaughn, BE.; Bost, KK.; van IJzendoorn, MH. Attachment and temperament: Additive and interactive influences on behavior, affect, and cognition during infancy and childhood. In: Cassidy, J.; Shaver, PR., editors. *Handbook of attachment: Theory, research, and clinical applications*. 2nd ed. New York, NY: Guilford Press; 2008. p. 192-216.
- Vaughn B, Stevenson-Hinde J, Waters E, Kotsaftis A, Lefever G, Shouldice A, et al. Attachment security and temperament in infancy and early childhood: Some conceptual clarifications. *Developmental Psychology*. 1992; 28:463–473.
- Volling BL. Early attachment relationships as predictors of preschool children's emotion regulation with a distressed sibling. *Early Education And Development*. 2001; 12:185–207.
- Weinfield N, Sroufe LA, Egeland B. Attachment from infancy to early adulthood in a high-risk sample: Continuity, discontinuity, and their correlates. *Child Development*. 2000; 71:695–702. [PubMed: 10953936]

Highlights

- We examine infant negative reactivity and attachment in irritable newborns.
- We tested whether infants minimize or maximize emotion based on attachment quality.
- Reactivity at 5 and 12 months were consistent with theory and our hypotheses.
- At 5 months, attachment groups did not differ in their negative reactivity.
- At 12 months, avoidant infants had the least reactivity and ambivalent the most.

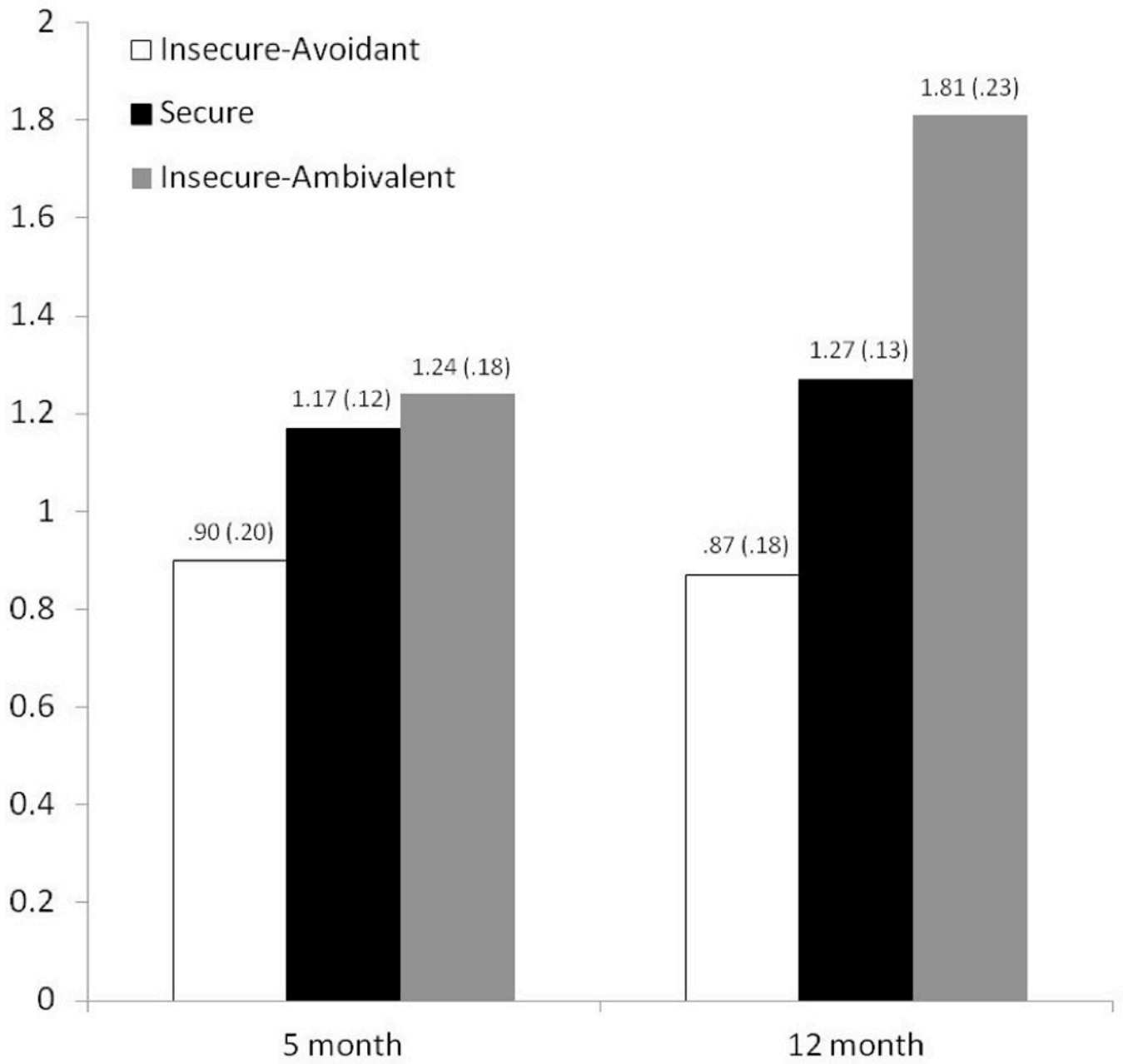


Figure 1. Mean levels of negative reactivity (with standard errors presented in parentheses) at 5 and 12 months as a function of attachment.