Infants’ Responses to Frustrating Situations: Continuity and Change in Reactivity and Regulation

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BRAUNGART-RIEKER, JULIA M., and STIFTER, CYNTHIA A. Infants’ Responses to Frustrating Situations: Continuity and Change in Reactivity and Regulation. CHILD DEVELOPMENT, 1996, 67, 1767–1779. We examined continuity, stability, and change in behaviors reflecting infant reactivity and regulation. Healthy infants were observed in laboratory situations designed to elicit frustration when they were 5 (N = 87) and 10 months of age (N = 82). Behaviors indicative of reactivity included objective ratings of average intensity cry, peak intensity cry, and latency to cry. In addition, durations of orienting, avoidant, and nonnegative communicative behaviors were assessed as measures of regulation at each age. Results showed that several behaviors changed in level over time. In addition, Confirmatory Factor Analysis revealed both structural continuity and discontinuity: Behaviors were organized into 2 similar factors at 5 and 10 months (Reactivity and Regulation), but the relation between reactivity and regulation became increasingly independent over time, such that reactivity and regulation were negatively correlated at 5 months but not at 10 months. Finally, model-fitting revealed cross-dimension but not within-dimension stability (5-month reactivity predicted 10-month regulation).

Infants vary widely in their affective and behavioral responses to stimuli. Such individuality in responses is believed partly to reflect temperament. Although temperament theorists and researchers diverge on which dimensions they use to assess individual differences in behavior as well as how these differences develop, they converge on at least three aspects of temperament: (1) temperament is objectively definable in individuals, (2) temperament has a constitutional basis, and (3) it is evident in infancy and shows some degree of stability (Bates, 1980; Bayley, 1969; Buss & Plomin, 1984; Carey & McDevitt, 1978; Goldsmith et al., 1987; Rothbart & Derryberry, 1981; Rowe & Plomin, 1977; Thomas & Chess, 1977). Rothbart and Derryberry (1981), for example, incorporate these aspects into their theory by proposing that infant temperament involves variations in reactivity and regulation. Reactivity refers to an individual’s somatic, endocrine, and autonomic reaction to stimuli in the environment, and regulation is defined as those processes that function to modulate such reactivity via attentional and behavioral mechanisms. Although studies of reactivity have demonstrated that there is some consistency across the first year of life (Riese, 1987; Worobey & Lewis, 1989), few studies have examined its relation to regulation and the development of these two constructs over time. In the present study, we sought to determine whether several components of reactivity and regulation exhibited individual stability, continuity, and/or change during the first year of life.

Reactivity and Regulation

Infants frequently experience frustrating events in their daily routines. For example, when infants are placed in a confined position, must wait for food, or are unable to obtain a desired toy, they often cry.

Previous empirical work on infant frustration has demonstrated that when infants

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[Child Development, 1996, 67, 1767–1779. © 1996 by the Society for Research in Child Development, Inc. All rights reserved. 0009-3920/96/6704-0023$01.00]
are unable to attain a goal or lose control of a situation, they show anger and frustration (Lewis, Alessandri, & Sullivan, 1990). For example, studies using paradigms in which infants’ pacifiers are withdrawn (e.g., Calkins & Fox, 1992), movements are restricted (e.g., Stifter & Fox, 1990), and toys are removed (e.g., Stifter & Grant, 1993), or placed behind a clear barrier (van Lieshout, 1975) have shown facial, vocal, and/or physiological responses identified as frustration or anger. Such crying, also referred to as distress or negative reactivity, is believed to reflect the infant’s current feeling state (Izard & Malatesta, 1987). Both generalized emotional negative reactivity in addition to discrete emotional expressions of anger have been reliably observed in infants during such situations (e.g., Stenberg, Campos, & Emde, 1983). Functionalists have suggested that the expression of emotions, such as anger or distress, is adaptive (Campos, Barrett, Lamb, Goldsmith, & Stenberg, 1983). By exhibiting such negativity, infants’ communication stimulates others to change their behavior and/or to motivate their own and others’ efforts to restore progress toward achieving the desired goal.

Although the ability to exhibit negative reactivity is universal, infants often differ in their styles of response. When assessing individual differences in reactivity, both temporal and intensive aspects can be observed (Bornstein & Lamb, 1992; Rothbart & Derryberry, 1981). For example, some infants show a long latency to respond, whereas others cry immediately; some infants express mild fussing while others sob loudly when upset. Indeed, Thompson’s (1990) empirical examination of reactivity demonstrated that components such as intensity and latency of emotional responses are similarly organized from 6 to 12 months. Measures of reactivity (e.g., vocal or facial intensity) have also been linked with physiological indices of arousal (Fox, 1989; Stifter & Fox, 1990), supporting the idea that reactivity has a neurological basis.

In addition to crying during frustrating situations, infants often exhibit other types of nondistress behaviors. For example, when upset, some infants may focus their attention away from the frustrating source and reengage their attention on another object. Others may point to the desired object and remain focused on their goal. Still others may suck their thumb or fingers. Such behaviors may reflect the infants’ attempts to regulate the situation and/or their feelings of negative arousal. As Frijda (1986) concisely summarized: “People not only have emotions, they also handle them” (p. 401). The modulation of heightened levels of negative (and positive) emotions is referred to as “regulation,” “emotion regulation,” or “affect regulation” (Cicchetti, Ganiban, & Barnett, 1991; Dodge, 1991; Kopp, 1989; Rothbart & Derryberry, 1981; Thompson, 1990). According to Tomkins (1962), modulation of arousal occurs because the reduction of negative affect is “rewarding,” which motivates future attempts to reduce negativity. The apparent adaptive function of such ability is to help maintain internal arousal within a manageable, performance-optimizing range (Kopp, 1992). Campos, Campos, and Barrett (1989) also suggest that regulation is part of the emotional system. In turn, emotions are those processes by which the environment establishes, maintains, or disrupts the relationship between the organism and others. In addition, factors regulating the neuroendocrine system may overlap with those influencing the affective system (Gunnar, Mangelsdorf, Larson, & Hertsgaard, 1989).

Rothbart and Derryberry (1981) propose three quantifiable behavioral responses believed to reflect regulation. First, self-comforting behaviors, such as thumb-sucking, may aid in reduction of distress. Empirical support for these behaviors has been found (Gianino & Tronick, 1988; Stifter & Braungart, 1995). Second, attentional strategies are believed to function as regulators of emotion. For example, infants may use gaze aversion to regulate increases in arousal (Field, 1981; Stern, 1974; Stifter & Moyer, 1991). Several studies have shown that the ability to shift and focus attention away from the negative stimulus was related to lower levels of distress (Rothbart, Posner, & Boylan, 1990). In contrast, inattentiveness has been related to subsequent negative mood and unadaptability (Ruff, 1990). Third, avoidance (as opposed to approach) behaviors, have been related to decreases in distress, especially during fear situations (McGuire & Turkewitz, 1979). A fourth set of behaviors that have been suggested by others to enhance emotion regulation (e.g., Kopp, 1989) are communicative behaviors such as gesturing, pointing, and directed nonnegative vocalizations, which appear at about 9 months of age (Bates, O’Connell, & Shore, 1987).
Development of the ability to regulate negative emotional arousal is believed to be multiply determined (Kopp, 1989) and include temperament (Rothbart & Derryberry, 1981), the caregiving environment (Ainsworth, Blehar, Waters, & Wall, 1978), and socialization processes (Malatesta-Magai, 1991). For example, some infants may be temperamentally predisposed to tolerate only very low levels of negative arousal, resulting in the need for increased regulation. Alternatively, Ainsworth et al. (1978) has asserted that a sensitive caregiving environment during infancy leads to infants' abilities to modulate distress. Further, parents may differ in the degree to which they encourage control of negative emotional displays (Lewis & Saarni, 1985; Malatesta-Magai, 1991). On the extreme end, poor regulation may have a medical or congenital basis. Infants who are older than 6 months who exhibit excessive fussiness, poor self-soothing, and intolerance to changes have been termed regulatory disordered infants (DeGangi, DePietro, Greenspan, & Porges, 1991). Such regulatory disordered infants appear to share many of the early symptoms displayed by children with learning and affective difficulties.

Although reactivity and regulation appear to be somewhat related (e.g., an infant who successfully can regulate her negative arousal will display lower levels of distress, whereas an infant who does not regulate will have higher amounts of crying), distress and regulation may also function somewhat independently (Fox, 1989; Posner & Rothbart, 1980; Rothbart & Derryberry, 1981). For example, some infants may have a high threshold for distress for feeling upset and thus require little regulation. In contrast, some infants may react intensely and attempt to regulate but cannot effectively reduce negativity. Moreover, developmental level may play a key role in the associations between reactivity and regulation. Young infants may not yet have the repertoire of behaviors necessary to effectively modulate all levels of distress, whereas toddlers and young children, whose language skills, for example, enable them to communicate their reasons for distress, may be better at controlling their emotions (Dunn & Brown, 1991).

Although more attention has been given recently to the description and explanation of regulation and its relation to reactivity, empirical evidence is sparse. Thus, one goal of this study was to examine whether infants' temporal and intensive patterns of crying as well as behaviors such as orienting, avoidance, and communicative responses during a frustrating situation are organized into separate dimensions reflecting individual differences in reactivity and regulation. Further, we were interested in developmental changes and continuities in such responses to frustrating events.

**Stability, Continuity, and Change**

The study of stability, continuity, and change is complex, yet it is of central interest to developmentalists. Numerous theoretical perspectives and empirical studies have been generated attempting to address such developmental issues (Baltes, Reese, & Nesselroade, 1977; Brim & Kagan, 1980; Connell & Furman, 1984; Emmerich, 1964; Flavell, 1971; Rutter, 1984; Werner, 1957, Wohlwill, 1973). For example, we may be interested in how much the level or amount of a behavior or attribute changes over time. To the extent that age groups show significantly different levels of a given characteristic, we conclude that quantitative or level change has occurred. However, quantitative change in a construct does not necessarily imply instability or discontinuity. **Stability** refers to consistency in individual's rank ordering across time on a given construct and is often indexed as a correlation or a regression coefficient. Thus, group means may change over time, but the rank ordering among individuals may be maintained. **Continuity** has been defined as the similarity in the structure or organization among variables over time, also known as **structural continuity**. To the extent that behaviors differ in their relation to each other, often indicated by changes in factor structures, we have observed discontinuity or qualitative change with age.

Although perspectives often diverge, there is a consensus that there are certain periods of the life span in which rapid changes and transitions occur—such as infancy. Depending on which domains are examined, some behaviors appear to be stable while others change. Qualitative changes are apparent when new behaviors and skills emerge during the first year of life, such as the onset of object permanence, fear, and communication skills. In addition, most studies examine homotypic stability and change, which focuses on one dimension over time, rather than on heterotypic stability, which examines the extent to which one variable at time 1 predicts a different variable at time 2. For example, it is possible that neurological characteristics that affect
reactivity at one age play a role in regulation at a later age.

Because the study of continuity and change is complex, we analyzed three types of developmental change in this study. First, we examined level changes, that is, to what degree do infant behaviors during a stressful situation increase, decrease, or remain the same on average over time? Second, are there structural similarities or differences between behaviors over time? In other words, do behaviors at each age reflect similar organizational constructs, such that the factor pattern is stable over time? In addition, to what extent do relations between factors within each age change over time? Finally, if there are comparable factors at each age, we address the issue of homotypic and heterotypic stability—is there evidence for predictability within or across constructs over time?

**Method**

**Sample**

Subjects were drawn from a longitudinal sample of 100 healthy, full-term infants recruited at birth. Subjects were predominantly white (two African-American, one Hispanic, one Asian-American) and from middle-class families. At 5 months of age (± 2 weeks), 87 (45 males) subjects were available for follow-up. At 10 months of age (± 2 weeks), 82 (40 males) infants were reassessed.

**Procedure**

Infants and mothers participated in several procedures in our laboratory when infants were 5 and 10 months of age: free play, positive reactivity task, mental development test, and an age-appropriate frustration task. Data for the present study are limited to those measures obtained during the frustrating situation. At 5 months of age, infants participated in an arm restraint task. By 5 months, infants have developed the ability to control their arms; therefore, arm restraint is an effective frustrator (Camras, Oster, Campos, Miyake, & Bradshaw, 1992). At 10 months of age, however, infants exhibit an intense preference for manipulating and exploring objects; thus toy removal serves as a potent frustrator (Longo, Harvey, Wilson, & Denf, 1982; van Lieshout, 1975). Thus, a toy-removal task was used to elicit frustration at 10 months. Procedures were recorded on videotape to permit future behavioral coding.

**Reactivity.**—Intensity of negative vocalizations was assessed as an index of reactivity and was scored every 10 sec on a scale of 0 (no negative vocalizations), 1 (mild whimper or fuss), 2 (intermittent fussing and/or one cry), 3 (continuous crying or sobbing), and 4 (shrieking, hysterical crying). Interrater reliabilities on the 10-sec epoch ratings resulted in a mean Cohen’s kappa of .70 at 5 months and .82 at 10 months.

Rothbart and Derryberry (1981) suggest that reactivity includes both temporal and intensive qualities. In other words, infants can vary on how quickly and intensely they respond to stimuli. Thus, based on epoch-by-epoch ratings, three measures of reactiv-

**Five-month arm restraint.**—Infants were placed in an infant seat situated at eye level and across from their mothers. Mothers were instructed to gently restrain their infants by holding their infants’ arms down to their sides. Mothers were also instructed to maintain a neutral facial expression and to refrain from verbally interacting with their infants. If mothers forgot to maintain a neutral facial expression or vocalized, the experimenter verbally reminded them to stay noninterative. After 2 min of arm restraint or 20 sec of intense infant crying (mean duration = 100 sec), mothers were cued to release their infants’ arms. After remaining noninteractive for 1 min, mothers were allowed to soothe their infant if necessary using any method they deemed appropriate.

**Ten-month toy-removal task.**—At 10 months of age, infants were placed in an infant high chair and mothers were seated toward the side but facing the infant. After mothers and infants played with an attractive Busy Box toy for 90 sec, mothers were cued to remove the toy from their infants’ hands and hold the toy out of reach but within the infant’s sight for 2 min or 20 sec of intense crying (mean duration = 111 sec). In addition, mothers were instructed to assume a neutral expression and remain noninteractive. Subsequently, mothers were instructed to return the toy to their infants but remain noninteractive for 1 min and then resume interacting with their infants.
ity were constructed: Average negative intensity across epochs, which represents infants' general affective display, peak intensity (i.e., infant's highest level of negative affect expressed during the procedure, signifying the infant's highest reactive state), and latency to the first negative vocalization (number of epochs prior to the first expression of negativity, which indicates the infants' speed of response). Other studies have used similar measures of negative affect (e.g., Frodi & Thompson, 1985; Thompson & Lamb, 1984).

Regulatory behaviors.—Regulatory behaviors were coded continuously from the videotapes using a laptop computer programed to calculate the duration of each behavior. Refer to Stifter and Braungart (1995) for a more detailed description of behaviors. In brief, behaviors included: Object orientation (e.g., focused attention on an object—other than the toy at 10 months), mother orientation (e.g., focused gaze on the mother's face), scanning (unfocused gaze, eyes roaming), avoidant behaviors (twisting, turning, attempting to get out of the seat), and communication (nonnegative vocalizations directed at the mother at 5 and 10 months, and gesturing at 10 months). Intrater reliabilities (as assessed by Cohen's kappa) for 5- and 10-month behaviors averaged .85 and .81, respectively.

To reduce the number of variables, certain regulatory behaviors were combined to reflect three modes of regulation. Based on Rothbart and Derryberry's (1981) concepts of regulation, behaviors used by the infant to modulate arousal can be grouped into three categories: Attentional, approach/withdrawal, and self-soothing behavior (e.g., thumb sucking). Because the 5-month procedure involved the restraint of arms, we excluded self-soothing behaviors from our analyses. However, we included intentional communication as an additional category of regulation, which has been believed to be important in regulation (Dunn & Brown, 1991; Kopp, 1989; Thompson, 1990). Thus, we created the following three categories of regulation: (1) Focused orientation behaviors, which included the sum of mother orientation and object orientation at each age; (2) avoidance, which included escape and unfocused scanning behavior at 5 and 10 months; and (3) communication, which was represented by nonnegative vocalizations at 5 months and by the sum of nonnegative vocalizations and gesturing at 10 months. Subsequently, durations of each of the three regulatory variables were divided by the total number of 10-sec intervals for each episode of the procedure. Scores reflect the average number of seconds per 10-sec epoch spent engaged in each behavior.

Results

Three major developmental issues were examined in the present study: level changes, structural continuity, and stability. In addition, gender differences were examined for each of the measures by means of a 2 (gender) × 2 (age) × 6 (behavior) MANOVA with gender as the between-subjects factor and age and behavior (average cry, peak cry, cry rate, orientation, avoidance, communication) as the within-subjects factors. All main and interaction effects involving gender were nonsignificant (ps ranged from .28 to .96). These results suggest that boys and girls do not differ in affective or behavioral patterns at 5 or 10 months. Subsequently, gender was excluded from further analyses.

Level Changes

The 2 (gender) × 2 (age) × 6 (behavior) MANOVA revealed a significant main effect for age, \(F(1, 80) = 36.17, p < .001\), demonstrating the presence of mean differences across age. ANOVAs were then calculated to determine which of the infant behaviors showed significant changes over time. Table 1 presents the means, standard deviations, and \(F\) tests for the six ANOVAs.

On average, infants showed lower levels of orienting and avoidance and greater levels of communication at 10 months than at 5 months. Ten-month-old infants also exhibited higher peak negative intensities in crying than 5-month-olds. There was no significant difference from 5 to 10 months for average negative intensities or latencies to initial negative vocalizations. Thus, there is evidence for change and continuity in levels of infant behaviors during a frustrating situation.

Structural Continuity/Discontinuity

Prior to the examination of continuity and change in factor patterns, which assumes normal distribution patterns among

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1 The 5-month measure of communication did not include gesturing because infants at 5 months do not use gestures to communicate (Lempers, 1979).
the variables, several of the variables required transformations due to skewness. Latency to negative affect at each age was transformed by calculating the log of the inverse (Afifi & Clark, 1984), which resulted in normal distribution patterns (M = .52, SD = .25 at 5 months; M = .35, SD = .20). As a result of the transformation, scores higher in magnitude represent faster rates of expressing the first cry, whereas lower scores indicate slower rates of cry onset. To avoid confusion in interpretation, we will hereafter refer to the latency variable as “cry rate.”

In addition, many of the infants at 5 months did not display communication, resulting in a skewed distribution. A log transformation was also performed (Afifi & Clark, 1984) on these data and resulted in an improved distribution (M = .23, SD = .38), albeit still skewed.

To examine structural changes and continuities among measures of infant reactivity and regulation, maximum-likelihood confirmatory factor analysis was performed using LISREL VII (Jöreskog & Sörbom, 1985). Confirmatory factor analysis (CFA) tests hypotheses that a certain subset of variables define a prespecified factor (Gorsuch, 1983). In addition, CFA provides estimates and tests of significance for factor loadings as well as intercorrelations among factors. To test the overall fit of the model, a chi-square analysis is performed. A significant chi-square indicates that the data differ significantly from the model—a poor fit, whereas a nonsignificant chi-square suggests a good fit between the model and the observed data (Jöreskog & Sörbom, 1985).

In the present study, four confirmatory factor analysis models were performed and compared. Our assumption was that the observed variables underlie two theoretically separate latent factors at each age: Peak intensity cry, mean intensity cry, and cry rate underlie one latent factor called “reactivity,” while orienting, avoidance, and communication represent another factor labeled “regulation.” We refer to this model as Model 1. Model 2 tested an alternative hypothesis that infant behaviors represent only one factor at each age. The third model (Model 3) tested whether 5-month data represent a one-factor solution and 10-month data follow a two-factor pattern. Finally, Model 4 tested the reverse of Model 3 (two-factor solution at 5 months and one-factor solution at 10 months).

Results indicate that for Model 1, the chi-square was nonsignificant, $\chi^2(14) = 17.00, p = .26$, indicating a reasonable fit. Conversely, Models 2 and 4 yielded significant chi-squares, $\chi^2(14) = 64.83, p < .001$, and $\chi^2(12) = 437.60, p < .001$, and Model 3 was not identifiable, indicating a poor fit. These results indicate that the data are best represented by a two-factor solution and that loadings are similar across age.

Table 2 presents factor loadings for the two-factor solution (Model 1) at 5 and 10 months. Because error variance for each of the observed variables may covary (Jöreskog & Sörbom, 1985), we permitted the model to allow for correlated error variance between mean intensity cry and regulatory variables at 5 and 10 months. In addition, Table 3 presents a summary of the model-fitting analyses.

Because there was empirical support for consistency in factor patterns across age, we also examined whether associations between factors were similar over time. CFA provided estimates of the intercorrelation among the reactivity and regulation factors.
TABLE 2
FACTOR LOADINGS FROM CONFIRMATORY FACTOR ANALYSIS OF 5 AND 10 MONTH INFANT BEHAVIORS

<table>
<thead>
<tr>
<th>Latent Factor I (&quot;Reactivity&quot;)</th>
<th>Latent Factor II (&quot;Regulation&quot;)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Observed Variables</strong></td>
<td><strong>.93</strong>*</td>
</tr>
<tr>
<td>5-month behaviors:</td>
<td></td>
</tr>
<tr>
<td>Peak negative intensity ......</td>
<td>.93***</td>
</tr>
<tr>
<td>Average negative intensity</td>
<td>.98***</td>
</tr>
<tr>
<td>Cry rate</td>
<td>.79***</td>
</tr>
<tr>
<td>Orient</td>
<td></td>
</tr>
<tr>
<td>Avoid</td>
<td>0</td>
</tr>
<tr>
<td>Communicate</td>
<td>0</td>
</tr>
<tr>
<td>10-month behaviors:</td>
<td></td>
</tr>
<tr>
<td>Peak cry intensity</td>
<td>.69***</td>
</tr>
<tr>
<td>Average cry intensity</td>
<td>.99***</td>
</tr>
<tr>
<td>Cry rate</td>
<td>.69***</td>
</tr>
<tr>
<td>Orient</td>
<td>0</td>
</tr>
<tr>
<td>Avoid</td>
<td>0</td>
</tr>
<tr>
<td>Communicate</td>
<td>0</td>
</tr>
</tbody>
</table>

**p < .01.
***p < .001.

at each of the ages in the phi matrix. Phi was estimated to be -.74 and .03 at 5 and 10 months, respectively. These results indicate that at 5 months, infants who exhibited greater levels of reactivity were more likely to display lower amounts of regulation. At 10 months, however, reactivity and regulation factors appear to be more independent. To test whether this structural change in factor intercorrelations from 5 to 10 months was significant, we compared the overall fit for Model 1 to the goodness of fit for model in which phi was constrained to be equal for 5- and 10-month data (Model 5). As Table 3 indicates, Model 5 was a poor fit, suggesting that the factor intercorrelations differed sig-

TABLE 3
SUMMARY OF CONFIRMATORY FACTOR ANALYSES MODEL-FITTING RESULTS

<table>
<thead>
<tr>
<th>Model Description</th>
<th>df</th>
<th>( \chi^2 )</th>
<th>p Value</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Models testing number of factors:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 1: Number of factors stable:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 factors at 5 and 10 months ............</td>
<td>14</td>
<td>17.00</td>
<td>&gt;.25</td>
<td>Good fit</td>
</tr>
<tr>
<td>Model 2: Number of factors stable:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 factor at 5 and 10 months ............</td>
<td>14</td>
<td>64.83</td>
<td>&lt;.001</td>
<td>Poor fit</td>
</tr>
<tr>
<td>Model 3: Number of factors change:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 factor at 5 months; 2 factors at 10 months .....................................</td>
<td>13</td>
<td>213.03</td>
<td>&lt;.001</td>
<td>Poor fit</td>
</tr>
<tr>
<td>Model 4: Number of factors change:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 factors at 5 months; 1 factor at 10 months .....................................</td>
<td>13</td>
<td>437.60</td>
<td>&lt;.001</td>
<td>Poor fit</td>
</tr>
<tr>
<td>Models testing relation between factors:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Model 5: Factor intercorrelation equivalent from 5 to 10 months ....</td>
<td>15</td>
<td>33.97</td>
<td>&lt;.001</td>
<td>Poor fit</td>
</tr>
<tr>
<td>Model 6: Factor intercorrelation changes:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>factors correlated at 5 months; factors uncorrelated at 10 months ..........................</td>
<td>15</td>
<td>17.05</td>
<td>&gt;.30</td>
<td>Good fit</td>
</tr>
<tr>
<td>Model 7: Factor intercorrelation changes:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>factors uncorrelated at 5 months; factors correlated at 10 months ..........................</td>
<td>Model unidentified</td>
<td>Poor fit</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
significantly from 5 to 10 months. In addition, a model that permitted phi to be estimated at 5 months but fixed to be zero at 10 months (Model 6) yielded a good fit. Finally, Model 7 tested the idea that the factors were fixed to be zero at 5 months and freely estimated at 10 months was unidentified, indicating a poor fit to the data. These analyses confirm that reactivity and regulation are related at 5 months but are independent factors at 10 months.

Given that infant behaviors are organized into similar factors at each age, albeit interrelated differently, we examined the stability and predictability of these latent factors. We tested two different models using LISREL VII. In Path Model 1, we examined whether there was within-construct stability, that is, reactivity at 5 months predicts reactivity at 10 months and regulation at 5 months predicts regulation at 10 months. We compared the results from this model to Path Model 2, which examined whether there was cross-construct stability (reactivity at 5 months predicts regulation at 10 months, and regulation at 5 months predicts reactivity at 10 months). Figure 1 presents the path model and coefficients for these two models. The overall fit for Path Model 1 was significant, $\chi^2(2) = 5.90, p < .05$, indicating a poor fit to the data, whereas Path Model 2 yielded a good fit, $\chi^2(2) = 1.47, p > .40$. Thus, it appears there is both stability across reactivity and regulation factors, but not within factors: Infants who exhibited greater levels of reactivity at 5 months showed lower levels of regulation at 10 months.

**Discussion**

Results from this study reveal that infant behaviors during frustrating situations show both continuity and change from 5 to 10 months. Observed behaviors were organized into similar constructs reflecting reactivity and regulation at both 5 and 10 months, indicating continuity in the structure of factors. However, the relation between reactivity and regulation changed from 5 to 10 months, in that the two factors became more independent over time. In addition, the average levels of the specific components within reactivity and regulation factors changed from 5 to 10 months. Finally, evidence emerged for longitudinal *heterotypic* but not homotypic stability across the reactivity and regulation dimensions: higher negative reactivity at 5 months was related to lower levels of regulation at 10 months; however, 5-month
regulation was not predictive of 10-month reactivity or regulation.

Findings from the present study demonstrate that behaviors such as peak and average intensity of negative vocalizations and cry onset during a frustrating situation reflect one factor (reactivity), while behaviors such as communicative attempts, visual orientation, and low avoidance underlie a second factor (regulation) at both ages. Models testing alternative patterns of organization, such as one-factor solutions at each age or a mix of one and two-factor solutions across both time points, yielded poor fits to the data. These findings support Rothbart and Derryberry's (1981) conceptual distinction between reactivity and regulation as well as Thompson's (1990) empirical examination of reactivity which demonstrated that components such as intensity and latency of emotional responses were similarly organized from 6 to 12 months. Thus, infants' specific behaviors during a frustrating situation appear to reflect two distinct dimensions—reactivity and regulation at both 5 and 10 months.

Although components of reactivity and regulation were similarly organized within each age, there was little stability within these dimensions across time. Indeed, there was greater evidence for cross-dimension stability: Infants who exhibited greater levels of reactivity at 5 months showed lower levels of regulation at 10 months, whereas those who expressed lower 5-month reactivity demonstrated a higher degree of 10-month regulation. It is possible that at 5 months, those low-reactive infants were regulating at a level not detected by our 5-month coding system (e.g., neurologically). By 10 months, however, certain regulatory behaviors, such as communicative gesturing, became observable. Such a developmental phenomenon resembles the principle of hierarchical organization in which higher level functioning has integrated preexisting lower level processes, which in turn provides for a more differentiated and flexible response pattern (Satinoff, 1982).

In addition, while the construct of reactivity remains the same (similar parameters), maintenance (stability) of individual differences over time may be constrained by differential growth rates. For example, infants may differ in their rates of maturation—at the neural, cognitive, or motoric levels, which may explain a lack of stability for reactivity and regulation (Rothbart & Derryberry, 1981; Thompson, 1990). Furthermore, different levels and types of experience and exposure to environmental influences (e.g., attachment formation) may affect the degree to which a child reacts negatively (Fish, Stifter, & Belsky, 1991). Indeed, few researchers have found stability of negative reactivity within the first year of life (Rothbart, 1986). Similarly, lack of stability of regulation may be due to the emergence of new skills and response specificity. For example, a 5-month-old infant who primarily uses orientation may substitute his or her emerging communicative vocalizations and gestures for the purpose of regulating at 10 months. It is also possible that the procedures used in the present study to elicit frustration encourage the use of different strategies, thus obscuring stability of individual differences in regulation.

Interestingly, reactivity and regulation also show discontinuity in that the relation between the two factors changed over time. At 5 months, reactivity and regulation were highly negatively correlated: A 5-month-old who exhibited high reactivity tended to show low regulation and vice versa. Conversely, reactivity and regulation were uncorrelated at 10 months, such that a distressed 10-month-old may or may not exhibit high levels of regulation. It is possible that at 5 months, reactivity and regulation reflect a similar underlying response system, but at 10 months of age, reactivity and regulation become more differentiated or independent. Perhaps regulation in younger infants involves an automatic response, which is dependent upon distress levels. By 10 months, however, cognitive and neurological advances have ensued which permit infants to have more control over their own behavior and emotions (Kopp, 1982; Rothbart & Derryberry, 1981; Thompson, 1990), as well as a better understanding of how to obtain their desired goal. According to several researchers (e.g., Diamond, 1990; Fox, 1994), maturation of the frontal lobe in 9–10-month-olds permits infants to better manage arousal and cope with emotionally arousing events. Indeed, we found 10-month-olds were more likely to rely on communicative behaviors than were 5-month-olds, suggesting a more sophisticated means of regulation. Alternatively, it may be that at 5 months of age, high levels of distress inhibit the infants' ability to recruit appropriate behaviors to effectively reduce arousal at 5 months. At 10 months, however, some highly distressed infants can recruit certain regulatory behav-

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iors, which may or may not prove successful in reducing negativity.

Furthermore, negative affect at later ages may be more voluntary and thus function as a means of communication strategy, rather than representing a more pure reactive state in the younger infant (Campos et al., 1989). However, it is interesting that components of 10-month negative reactivity did not load onto the 10-month regulation dimension, suggesting that the ability to use crying as a means of communication as regulation is still maturing. Thus, results in the present study demonstrate that self-regulation is an emerging ability whereas reactivity, which is present at birth, is modified with the development of regulation (Rothbart & Derryberry, 1981; Thompson, 1990).

In addition to endogenous characteristics playing a role in developmental change in reactivity and regulation, exogenous factors may be important as well. According to Kopp (1982), parents and other caregivers must assist the young infant in modulating the infant's arousal. Those infants who were highly reactive at 5 months may elicit more frequent interventions from their parents than infants who are less reactive. Over time, the highly reactive infant receives greater external regulation and relies on it for the reduction of arousal. Indeed, Hubbard and van IJzendoorn (1991) found in their naturalistic longitudinal study that more frequent delay of maternal response to infant crying was related to a reduction in the number of cry bouts expressed by infants during the first 6 months. In addition, parents may even avoid exposing their reactive infant to arousing situations, which then reduces the need for the infant to regulate. Such exogenous factors may help explain why reactivity and regulation show little within-construct stability, yet yield a significant and inverse relationship from 5-month reactivity to 10-month regulation.

The findings from the present study should be interpreted in light of several limitations. First, the sample included healthy, middle-class infants. Distress and regulation patterns may develop differently for infants under less optimal circumstances. Second, we have examined distress and regulation under conditions designed to elicit anger or frustration. Other negative emotions, such as fear and pain, may evoke different response styles in infants. Third, the two laboratory situations at each age might not be exactly equivalent. However, it is important to note that situations at each age evoked the same level of negative affect and the same type and organization of responses in infants. Fourth, because the 5-month procedure involved the restraint of infants' arms, we were unable to examine change and continuity of self-comforting behaviors, which would be important to examine. Fifth, the laboratory situations in which infants participated may not reflect their day-to-day experiences. However, arms are frequently restrained when infants have their clothes changed. Similarly, infants may be unable to obtain desired objects when interacting with siblings, waiting to be fed, or exploring a “child-proof” environment.

Thus, it would be important to examine congruence between responses during structured laboratory situations to those during naturally occurring events in future studies. Future studies should also examine subsequent developmental changes in reactivity and regulation as infants enter into early childhood—especially as language abilities begin to emerge. The extent to which endogenous factors, such as neural, genetic, and cognitive factors, versus exogenous factors such as parental and sibling treatment, environmental conditions, and peer experiences play a role in explaining developmental changes and continuity in reactivity and regulation should also be considered. Finally, future studies should examine differences in social and emotional outcomes for children who contrast in their reactivity and regulatory styles.

References
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