Toward a Developmental Model of Child Compliance: The Role of Emotion Regulation in Infancy

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Toward a Developmental Model of Child Compliance: The Role of Emotion Regulation in Infancy

Cynthia A. Stifter, Tracy L. Spinrad, and Julia M. Braungart-Rieker

The present study examined the relation between early emotion regulation and later compliance. When infants were 5, 10, and 18 months of age, they participated in a frustration task. The degree to which they reacted negatively to the stimuli and the behaviors they used to regulate that response were coded. Baseline heart rate also was recorded and a measure of cardiac vagal tone ($V_{NA}$) was derived. Several tasks (electrode placement, toy clean-up, and test situation) were administered to elicit compliance/noncompliance when the participants were 30 months of age. Results revealed that infants who demonstrated low levels of regulatory behavior were more likely to be noncompliant as toddlers. Several interaction effects suggested that the prediction to later noncompliance was also dependent upon the infants' level of reactivity. Cardiac vagal tone also was related to compliance but in a contradictory fashion. High $V_{NA}$ was related to noncompliance to toy clean-up, whereas low $V_{NA}$ was related to noncompliance to electrode placement. The data provide support for a developmental model of compliance that includes the ability to regulate emotional arousal.

INTRODUCTION

The ability of young children to comply with environmental demands is an important developmental task. Children are often asked to wait for food, stop an engaging activity, or refrain from touching an interesting object. Research on noncompliance has demonstrated that this ability develops and changes with age (Kopp, 1982; Kuczynski, Kochanska, Radke-Yarrow, & Gurnius-Brown, 1987). Similarly, the ability to comply is related to developmental level (Kaler & Kopp, 1990; Olson, Bates, & Bayles, 1990). For example, toddlers who scored higher on a language test were more likely to comply with their mother's request to put toys away than infants with poorer language ability (Vaughn, Kopp, & Krakow, 1984).

Individual differences in compliance/noncompliance are often attributed to characteristics in the child's environment, the most widely researched characteristic being maternal control strategies. Although there is some evidence that immediate, short, and firm reprimands are effective in eliciting compliance (Pfiffner & O'Leary, 1989), most studies have found that mothers who use warmth, support, and guidance are more likely to get their toddlers to comply, whereas mothers' strategies of power assertion and physical punishment are more likely to elicit noncompliant behaviors (Crockenberg & Litman, 1990; Power & Chapieski, 1986). Such studies suggest that noncompliance is the direct result of poor-quality caregiving techniques. However, this inference is seriously limited, in that it views children as passive recipients of caregiver influence, rather than as active agents of their own behavior.

Whereas some theorists propose that child characteristics also influence children's ability to regulate behavior in response to a request (Kochanska, 1993; Kopp, 1989), little research has examined this part of the equation. Aside from the findings that developmental level contributes to greater, more organized compliant behavior, the contribution of individual differences in child behavior (i.e., temperament) to the development of compliance has been virtually neglected (Kochanska, 1993). Child temperament's influence on compliance may be direct or indirect through its impact on parental behavior. A child who is emotionally reactive, for example, may not have the skills to self-regulate his or her arousal for the purposes of compliance or may be resistant to attempts to socialize compliant behavior. To date, the only studies to examine child characteristics used maternal reports of difficultness and produced conflicting findings (Himmelfarb, Hock, & Wenar, 1984; Olson et al., 1990). In a more recent study, toddlers with greater negative reactivity, as reported by mothers, were found to be less compliant, but the relation was mediated by mothers' control behavior (Braungart-Rieker, Garwood, & Stifter, 1997). While this study emphasizes the role of temperament in understanding noncompliance, all behaviors were measured concurrently, so the direction of effects is unknown. The predictive relation between temperament and compliance, therefore, remains to be identified.

Because a request to comply involves behavioral
control and may elicit an emotional response, Rothbart and Derryberry's (1981) theory of temperament is very conducive to researching the temperamental correlates of compliance. They define temperament as constitutionally based individual differences in reactivity and self-regulation in which reactivity refers to "the arousability of affect, motor activity and related responses," and regulation refers to processes such as attention, approach/avoidance, and self-soothing that function to modulate reactivity (Rothbart & Derryberry, 1981). Reactivity can take on several different forms. For instance, when assessing infant temperament, Rothbart and Derryberry (1981) distinguish positive from negative reactivity, and they further differentiate negative reactivity into anger (distress to limitations) and fear (distress to novelty). This distinction is consistent with discrete and functional theories of emotion (Barrett & Campos, 1987; Izard & Malatesta, 1987). In addition, the characteristic expression of the two negative emotions may lead to different social outcomes. For example, although individual differences in anger expressivity measured in infancy were positively related to later aggression, fear was negatively associated with this outcome (Rothbart, Ahadi, & Hershey, 1994).

Rothbart and Derryberry (1981) were less specific about the regulatory behaviors used to modulate the various types of emotional responses. Orienting behaviors, for example, may function to regulate both positive and negative reactivity by keeping the child focused on a pleasing stimulus or by withdrawing attention away from a novel or aversive stimulus (Rothbart, 1989). Recent evidence, however, suggests that infants use different regulatory behaviors depending on the emotion elicited (Buss & Goldsmith, 1998). Infants who showed fear were more likely to use withdrawal behaviors, whereas infants who responded with anger used distraction, among other behaviors, to regulate their reactions (Buss & Goldsmith, 1998; Stifter & Braungart, 1995).

The importance of temperament to the development of behavioral control has received recent attention by Kochanska (1993, 1995), who has eloquently proposed and demonstrated that temperament, specifically fear and effortful control, contributes significantly to the internalization of standards for conduct. Because compliance to parental demands is the "first step" in the process of internalization and because the modulation of frustration is considered a component of compliance (Kochanska, 1993), we propose that compliance is preceded by development of the ability to regulate emotional responses during infancy, especially those in response to frustration.

Opportunities to learn emotion and/or behavioral control in infancy may be directly linked to the experience of frustration. Infants are often confronted with frustrating events in their daily lives. Indeed, parents may allow or even provide such experiences for the purposes of learning tolerance or emotional control (Demos, 1986). Thus, situations such as waiting for food, being dressed, and sitting in a car seat provide important opportunities for acquiring emotion regulation skills. Being frustrated may afford a chance to practice regulation using behaviors the infant already possesses (e.g., orienting away from the stimulus). Moreover, by learning to regulate their emotional arousal, infants may adopt strategies that will contribute to their ability to control behavior, such as using distraction to delay gratification (Vaughn, Kopp, Krakow, Johnson, & Schwartz, 1986).

Conversely, the inability to regulate emotion in infancy also may have implications for development. Children who are easily frustrated but cannot modulate their emotions may respond with more noncompliance to parental demands and thus be at risk for behavior problems (Forehand, 1977). Specifically, the inability to tolerate frustration may be related to defiance, a form of noncompliance that is characterized by high degrees of negativity (Crockenberg & Litman, 1990). Because high levels of both anger and defiance typify oppositional defiant disorder (Lahey & Loeber, 1994), the identification of the early precursors of compliant/noncompliant behavior is worthwhile effort. The primary goal of this study, therefore, was to examine the role of emotion regulation in the development of compliance. Reactions to frustrating tasks and the behaviors used to regulate those reactions were investigated at three time points in infancy. Compliance to requests from an experimenter and from the child's mother was measured when participants were 30 months of age. Whereas previous studies linking temperament to later behavioral control have used maternal reports, the present study relied exclusively on observations of behavior at every time of measurement.

The ability to respond emotionally and to regulate that response also has been linked to physiological processes. Recent evidence suggests that the parasympathetic branch, as measured by vagal control of the heart, may underlie individual differences in behavior (Porges, Dossard-Roosevelt, & Maiti, 1994). Several studies have been conducted that support the view that cardiac vagal tone reflects individual differences in reactivity and regulation in infancy (Kagan, 1994; Richards & Cameron, 1989; Stifter & Fox, 1990; Stifter, Fox, & Porges, 1989). Studies of infant reactivity have demonstrated that high cardiac vagal tone is related to approach emotions such as anger and joy.
(Stifter et al., 1989), whereas low cardiac vagal tone is related to withdrawal emotions such as fear and wariness (Kagan, Reznick, & Snidman, 1987). There is also a group of studies that link vagal tone to regulatory processes (Fabes, Eisenberg, & Eisenbud, 1993; Fox, 1989; Richards, 1987; Stifter & Jain, 1996; Stifter et al., 1989; Suess, Porges, & Plude, 1994). For example, high levels of cardiac vagal tone have been found to be related to attentional processes (e.g., Richards, 1987), which are used in the regulation of emotion. Moreover, cardiac vagal tone has been positively linked to social processes that involve the regulation of one’s own arousal, as in stranger sociability (Fox, 1989) and sympathy (Fabes et al., 1993).

Together, data on the physiological correlates of temperament suggest that the parasympathetic nervous system may underlie individual differences in both reactivity and regulation (Porges, Doussard-Roosevelt, & Maiti, 1994). Indeed, a recent study examining the interaction between these two constructs demonstrated that infants who exhibited greater negative reactivity to frustration but also exhibited more regulatory behaviors had higher baseline levels of cardiac vagal tone across infancy (Stifter & Jain, 1996). Because it is proposed that emotion regulation, particularly in response to frustration, may be important to the development of compliance and that cardiac vagal tone may underlie the ability to regulate emotional arousal, the second goal of the present study was to investigate whether infant cardiac vagal tone was predictive of toddler noncompliance.

**METHODS**

**Participants**

One hundred families were recruited through a local community hospital. Study participants were healthy, term infants from predominantly White, middle-class families (two African American, one Asian American, and one Hispanic). Of the 100 original participants, 90 (46 male, 44 female) returned at 5 months; 84 (41 male, 43 female) were available for the visit at 10 months; 74 (37 male, 37 female) were tested at 18 months of age; and 60 (30 male, 30 female) returned for the follow-up visit at 30 months. All infants were tested within 3 weeks of their 5-, 10-, 18-, and 30-month birthdays.¹

¹To determine whether those who were unavailable for the 30-month visit differed in any way from those who participated in the 30-month follow-up, a series of t-tests was run on the predictor variables central to the study (VNA, reactivity, regulation). No significant differences were found.

**Procedures**

**Procedures/Measures at 5, 10, and 18 Months**

At 5, 10, and 18 months of age, infants participated in laboratory visits during which heart rate and behavioral reactivity and regulation were assessed. Details of these procedures can be found in Stifter and Braungart (1995) and Stifter and Jain (1996). In brief, infants were frustrated at each age through use of age-appropriate tasks—arm restraint at 5 months and toy removal at 10 and 18 months.² Negative vocalizations were coded every 10 s according to a 5-point scale ranging from 0 (no negative vocalization) to 4 (shrieking, hysterical crying) and averaged across each procedure. Behaviors hypothesized to regulate emotional arousal were coded continuously and included orientation (to mother, toy, other objects), avoidance (escape and scanning behaviors), communicative behaviors (non-negative vocalizations and gestures—10 and 18 months only), and self-comforting.

A proportion score was computed by dividing the total duration of each behavior by the total duration of the procedure. Baseline heart rate was recorded at the start of each visit (see below).

**Procedures at 30 Months**

At the 30-month visit, toddlers participated in several tasks to elicit compliance. These tasks included electrode placement, a toy clean-up, and a mental development test. Toddlers also participated in a delay task, but because the demands of this task differed from the others (a “don’t” task rather than a “do” task—see Kochanska & Askan, 1995), it was not included in the present analysis. Heart rate was recorded after the electrode placement; recording began when the toddler was judged to be in a positive or neutral state.

**Electrode placement.** To assess the degree to which toddlers were compliant to an experimenter’s request, we examined their behavior during the placement of electrocardiogram (ECG) electrodes. With the mother seated approximately 2.5 m away, a research assistant engaged the child in toy play. Soon after, the experimenter approached the child, holding colorful stickers and three electrodes. The experimenter offered the toddler a sticker and demonstrated to the child how the electrodes were similar to the stickers. While the experimenter explained to the child what

²Whereas the procedures for eliciting frustration were different at each age, previous analysis showed that they elicit the same patterns of reactivity as measured by negative facial expressions (Spinrad & Stifter, 1997).
was being done, each electrode was placed on the child’s chest, and the child was asked to sit in a high chair for the ECG recording.

**Clean-up.** The mother and child were left in the laboratory to play with several age-appropriate toys left on the floor of the room. At the end of 4 min of play, the experimenter cued the mother to begin directing her child to pick up the toys and place them in a basket. Mothers were told to act as they would at home. The toy clean-up lasted 60 s or until all the toys were put in the basket.

Test of mental development. The McCarthy Scales of Children’s Abilities (McCarthy, 1972) were administered by the experimenter while the child sat on the mother’s lap, facing the tester. The experimenter attempted to engage the child in a variety of tasks (e.g., blocks, puzzles, verbal questions) to which the child was expected to respond appropriately.

**Measures at 30 Months**

**Compliance/noncompliance.** Behaviors representing four types of noncompliance occurring during the electrode placement, toy pick-up, and the block task of the McCarthy test were coded from the videotapes. Behaviors were similar to those used by other researchers (Crockenberg & Litman, 1990; Kochanska & Askan, 1995). **Defiance** was rated when the child did not follow directions and responded with an angry or whiny tone of voice and/or displayed aggressive behaviors (e.g., kicking or throwing toys). **Passive noncompliance** was scored when a toddler simply ignored adult commands while maintaining nonangry or non-distressed affect, as when the child continued to play with the toys ignoring his/her mother’s requests for compliance. **Self-assertion** was rated when the toddler verbally refused to comply while maintaining a neutral, non-angry tone of voice (e.g., a child might say, “I’ll clean this up later, okay, Mom?”). **Avoidance** was coded if the child actively moved away or hid so as to avoid having to comply. Behaviors such as the child burying his or her head in the mother’s lap during electrode placement or running away from the mother during toy pick-up would be coded as avoidance. Time sampling was used to rate the presence/absence and/or degree (mild = 1; intense = 2) every 10 s. A zero (0) was given when the child complied immediately with a request. Because scoring the intensity of ignoring behavior was not appropriate, passive noncompliance was scored as present (2) or absent (0).

Scores for each noncompliant behavior were averaged across the 10-s epochs. Thus, children received four scores per situation. Cohen’s $\kappa$s were computed on 15% of the participants and yielded inter-rater reliabilities of .80 for Defiance, .69 for Passive noncompliance, .84 for Assertiveness, and .75 for Avoidance.

**Maternal behavior.** Because compliance to the toy clean-up task may have been the outcome of maternal control or persuasion, two scales were created to assess the degree to which mothers encouraged or discouraged compliance. Mother’s influence on getting a noncompliant child to become compliant was rated on a 4-point scale of 0 (child was compliant), 1 (mild or brief attempts to encourage the child), 2 (mother attempts were more intense or longer), and 3 (persistent and intense attempts to influence compliance). Mother’s “negative” influence also was coded on a similar 4-point scale, with the focus on the degree to which mothers encouraged noncompliance. For example, during the toy pick-up the child might say “no” in response to a request to pick up the toys, and the mother may reply by saying “yes” to each refusal, resulting in the escalation of the child’s negative affect. Because negative escalation occurred in only two cases, this measure was dropped from further analyses. Inter-rater reliability for maternal behavior was .94 by Cohen’s $\kappa$.

**Cardiac Activity Recording and Quantification**

At each age, 5 to 10 min of baseline ECG was obtained from each participant. Electrodes were placed in a triangular pattern on the participant’s chest. The ECG was collected off-line with a Grass (West Warwick, RI) pre-amplifier (model P15) and Vetter (Rebersburg, PA) FM cassette instrumentation recorder. To quantify the data, the ECG pulses were passed through an A/D converter programmed to display the raw ECG signal. The waveform was viewed and a threshold set to trigger at each R-spike. The resulting square wave impulses produced by the trigger were timed in milliseconds and organized into a heart period data file. An analytic method developed by Porges (1985) was then applied to these data and the $V_{NA}$ statistic, an estimate of cardiac vagal tone, computed. This method detects the heart period data to remove influences of nonstationarity, and uses time series extracts the components of heart period within the respiratory frequency band for young children (.24 to 1.04 Hz). The natural logarithm of this variance produces the $V_{NA}$ statistic. $V_{NA}$ was calculated on sequential 30-s epochs of the baseline recordings.

In cases of excessive movement that disrupts the ECG signal, the MXEDIT software program (Delta Biometrics, Bethesda, MD) was used. This program can exhibit the heart period data in graphic and numerical
form, allowing for the visual identification of artifact. In cases where these periods of data were identified, they were edited according to the absolute values within the range of the artifactual data. In cases of significant movement artifact (more than one correction per minute), the data were deleted and new trials created and averaged, or the data were coded as missing.

Data Reduction

Compliance/noncompliance. While the major focus of our study was the contribution of infant characteristics to later compliance/noncompliance, we recognized that maternal behavior would likely influence the degree to which a child complied. Therefore, residual scores were created for the four types of noncompliance exhibited during the clean-up task, partialing out the effect of mother behavior.

The noncompliance variables were then composited into four variables reflecting the type of noncompliance exhibited across the three situations as well as three variables representing procedural noncompliance. Passive noncompliance, self-assertion, avoidance, and defiance variables were created by averaging the incidence of each across the three procedures. Three additional variables, electrode noncompliance, clean-up noncompliance, and test noncompliance, were created by summing the four types of noncompliance within each procedure. Intercorrelations among the noncompliance types and procedural noncompliance revealed only avoidance and defiance to be significantly related (Table 1).

RESULTS

Preliminary Analyses

The means and standard deviations for the noncompliance data can be found in Table 2. A repeated measures analysis of variance was conducted to determine differences in the degree to which the noncompliance types were exhibited. Results revealed that avoidance was least likely to be used across the compliance tasks, all ps < .02, and passive noncompliance was exhibited more frequently than defiance. A test of differences in procedural noncompliance showed toddlers to be most noncompliant when asked to put toys away and the least noncompliant during a test of mental ability, all ps < .05. Finally, all analyses were performed with sex as a grouping variable. No significant main or interaction effects were found. Thus, the following analyses were performed with the data collapsed across sex.

Reactivity/Regulation and Noncompliance

Our primary goal was to examine whether varying levels of reactivity and regulation during infancy predicted noncompliance at 30 months. Using multiple linear regression, our strategy was to estimate a taxonomy of nested models in which we initially examined the effects of each variable separately and then simultaneously. In the last model, we included the interaction between reactivity and regulation. Analyses were performed with infant reactivity and regulation within each age as the predictor variable and each of the noncompliance types and the procedural noncompliances as the outcomes. The reactivity and regulation variables at each age were centered (the sample mean was subtracted from each individual's score) before creating the interaction term and performing the analyses.

5 Months. When 5-month reactivity and regulation were regressed on avoidance, a main effect was revealed for regulation, t(56) = -2.23, p < .02. Infants who exhibited low levels of regulatory behaviors at 5 months were more likely to use avoidance in re-

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Intercorrelations among the Noncompliance Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Avoidance</td>
</tr>
<tr>
<td>Avoidance</td>
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</tr>
<tr>
<td>Passive</td>
<td>1.00</td>
</tr>
<tr>
<td>Defiance</td>
<td>1.00</td>
</tr>
<tr>
<td>Electrode</td>
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<tr>
<td>Clean-up</td>
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</tr>
</tbody>
</table>

*p < .05; **p < .01.
Table 3 Effects of 5-Month-Old Infant Reactivity, Regulation, and Reactivity*Regulation on Toddler Noncompliance

<table>
<thead>
<tr>
<th>Variables</th>
<th>β</th>
<th>Standard Error</th>
<th>R²</th>
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<tr>
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<tr>
<td>Reactivity</td>
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<td>.044*</td>
<td></td>
</tr>
<tr>
<td>Regulation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passive noncompliance</td>
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<td>.017</td>
<td>.08</td>
</tr>
<tr>
<td>Reactivity</td>
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<td>.063</td>
<td></td>
</tr>
<tr>
<td>Regulation</td>
<td>-.098</td>
<td>.047*</td>
<td></td>
</tr>
<tr>
<td>React*Reg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Defiance</td>
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<td>.018</td>
<td>.12</td>
</tr>
<tr>
<td>Reactivity</td>
<td>-.127</td>
<td>.064*</td>
<td></td>
</tr>
<tr>
<td>Regulation</td>
<td>-.089</td>
<td>.051*</td>
<td></td>
</tr>
<tr>
<td>React*Reg</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrode placement</td>
<td>-.02</td>
<td>.019</td>
<td>.15</td>
</tr>
<tr>
<td>Reactivity</td>
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<td>.073*</td>
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<tr>
<td>Regulation</td>
<td>-.054</td>
<td>.054</td>
<td></td>
</tr>
<tr>
<td>React*Reg</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

+ p < .10; * p < .05.

Response to requests (Table 3). A main effect for regulation was also revealed for defiance, \( t(56) = -1.97, p < .05 \). As with avoidance, infants who were low on regulation exhibited high levels of defiance at 30 months. Finally, low levels of regulation at 5 months predicted noncompliance to the electrode procedure, \( t(54) = -2.19, p < .03 \).

When 5-month infant reactivity, regulation, and the interaction between the two were regressed on passive noncompliance, a significant interaction effect was found, \( t(55) = -2.06, p < .05 \). To further examine this interaction, the relation between passive noncompliance and reactivity at 5 months was plotted at three levels of regulation by using the .25, .50, and .75 percentiles of the sample distribution for regulation at 5 months (low = -.249; medium = -.035; high = .208). Figure 1 shows that 5-month-old infants who were low in reactivity but high in regulation were most likely to use passive noncompliance as toddlers. A near-significant interaction effect also was revealed for defiance, \( t(55) = -1.76, p < .08 \). Because we proposed that defiance may result from the lack of regulatory skill development, we examined this effect further by plotting the interaction. As can be seen in Figure 2, our hypothesis was confirmed. Infants who were high in reactivity at 5 months but did not exhibit any regulatory behaviors were more defiant as toddlers. Alternatively, infants who responded with high levels of reactivity but also had regulatory skills were the least defiant at 30 months.

10 Months. When we regressed 10-month reactivity and regulation on the noncompliance types and the procedural noncompliances only, two significant main effects emerged (Table 4). A main effect for regulation was revealed for passive noncompliance, \( t(54) = -2.26, p < .03 \), when controlling for reactivity and the interaction between reactivity and regulation. Infants who exhibited low levels of regulation at 10 months were more likely to use passive noncompliance at 30 months. Similarly, when we regressed reactivity, regulation, and their interaction on noncompliance to the clean-up task, a significant main effect for regulation emerged, \( t(53) = -3.26, p < .002 \). Toddlers who did not comply with their mothers' request to put the toys away exhibited low levels of regulation at 10 months of age.

18 Months. Multiple regression analyses of the 18-month reactivity and regulation data uncovered two significant interaction effects (Table 5). A significant

Figure 1 Graphic display of the relation between 5-month reactivity and passive noncompliance for three levels of regulation.
interaction effect was found for passive noncompliance, $t(52) = 3.38, p < .01$. Using the .25, .50, and .75 percentiles of the sample distribution for 18-month regulation (low = -.148; medium = .021; high = .109), the relation between 18-month reactivity and 30-month passive noncompliance was plotted. As can be seen in Figure 3, 18-month-olds who exhibited low levels of both reactivity and regulation were most likely to ignore requests to comply. A similar finding was revealed for noncompliance to the mental abilities test. A significant interaction effect, $t(50) = 2.23, p < .03$, suggests that infants who showed low levels of reactivity and regulation at 18 months were most noncompliant during a testing procedure (Figure 4).

Cardiac Activity and Noncompliance

We used multiple regression analyses to examine the independent contribution of cardiac vagal tone—measured at 5, 10, and 18 months—to toddler noncompliance. Thus, the correlation between 5-month $V_{NA}$ and noncompliance was first tested; then the contribution of 10-month $V_{NA}$ controlling for 5-month $V_{NA}$ was tested. Finally, the independent contribution of 18-month $V_{NA}$ was tested by controlling for 5- and 10-month $V_{NA}$ in the regression equation. In addition, separate regressions were computed, with the mean level of $V_{NA}$ across infancy as the predictor variable.

None of the regression models examining cardiac vagal tone at each age was significant. Only trends were detected for 5- and 10-month $V_{NA}$ and noncompliance to electrode placement ($r = -.26$ and $r = -.26$, respectively). Simple regressions using mean cardiac vagal tone, however, were significant for noncompliance during clean-up, $F(1, 32) = 4.07, p < .05$, and electrode placement noncompliance, $F(1, 33) = 7.68, p < .01$. Interestingly, the correlations were in opposing directions. Infants with high $V_{NA}$ were

![Figure 2](image-url)  
**Figure 2** Graphic display of the relation between 5-month reactivity and defiance for three levels of regulation.

<table>
<thead>
<tr>
<th>Table 4</th>
<th>Effects of 10-Month-Old Infant Reactivity, Regulation, and Reactivity*Regulation on Toddler Noncompliance</th>
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</thead>
<tbody>
<tr>
<td>Variable</td>
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<td>Reactivity</td>
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<td>React*Reg</td>
<td>.218</td>
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<tr>
<td>Clean-up</td>
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<td>Reactivity</td>
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<td>Regulation</td>
<td>-.256</td>
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<tr>
<td>React*Reg</td>
<td>.090</td>
</tr>
</tbody>
</table>

* $p < .10$; ** $p < .05$; *** $p < .01$.

<table>
<thead>
<tr>
<th>Table 5</th>
<th>Effects of 18-Month-Old Infant Reactivity, Regulation, and Reactivity*Regulation on Toddler Noncompliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
<td>$\beta$</td>
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<tr>
<td>Passive noncompliance</td>
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<td>Reactivity</td>
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<td>Regulation</td>
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<td>React*Reg</td>
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<tr>
<td>Test noncompliance</td>
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<td>Reactivity</td>
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<td>Regulation</td>
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<tr>
<td>React*Reg</td>
<td>.177</td>
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* $p < .05$.  
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more likely to be noncompliant during the clean-up procedure, $r = .39$, whereas low $V_{NA}$ was associated with noncompliance during electrode placement, $r = -.44$.

**DISCUSSION**

Compliance is a complex social behavior involving nearly all domains of development—cognitive, motor, social, and affective (Kochanska, 1993; Kopp, 1982), but little is known about its early precursors. In the present study, we examined the affective antecedents of compliance/noncompliance; we proposed that the ability to regulate emotional arousal would be related to compliance, and thus, conversely, the inability to regulate would be predictive of later noncompliance. Our results confirmed this hypothesis. Infants who were unable to regulate their frustration were more noncompliant as toddlers. Specifically, infants who exhibited low levels of regulation were more likely to use avoidance or defiance in response to requests to comply. In addition, low levels of regulation were predictive of greater noncompliance during both the electrode placement task and the clean-up procedure. Together, these data further support the view that early regulatory ability may set the stage for developing behavioral control (Kopp, 1989). That is, the behaviors that are recruited by the infant to regulate emotional arousal may translate into strategies needed for controlling behavior, as in response to a request to comply, and that those who do not develop such abil-
ities may have difficulty adhering to such requests. Another explanation is that a request to inhibit behavior in toddlerhood itself elicits emotional arousal, particularly frustration, and that our findings represent continuity in ability to regulate emotion.

Several interaction effects found at 5 months and 18 months suggest that reactivity level may be an important factor in predicting noncompliance from early regulation. At 5 months of age, infants who were low in reactivity but high in regulation were more likely to use passive noncompliance. That is, when asked to perform a task, these children ignored the request. It is not possible from these data to determine whether infants who were low in reactivity and high in regulation were either successfully regulating their response to frustration or were simply not distressed by the stimulus, and the regulatory behaviors they exhibited (self-comforting, orientation, etc.) were in response to being bored. Thus, any interpretation of the mechanism by which high regulation translates into passive noncompliance would be purely speculative. However, 10-month-olds who exhibited low levels of regulation and 18-month-olds who were low in both reactivity and regulation exhibited high levels of passive noncompliance. These findings suggest that a delay in the development of regulatory skills by 10 months may inhibit toddlers' ability to comply with requests. This may be particularly true for those infants who are low in reactivity. These data also support the hypothesis that experiencing frustration in infancy may be integral to the development of regulatory skills. Infants who are not easily frustrated may not experience levels of emotional arousal that require regulation and consequently may not develop, refine, or have the opportunity to practice the skills needed to control behavior. Likewise, the parents of infants with low reactivity would have fewer opportunities to intervene and support the development of regulation. It is notable that the form of noncompliance that these infants chose as toddlers was of the passive type. Ignoring the request to comply may reflect the child's low reactivity as the other forms of noncompliance, particularly avoidance and defiance, indicate some emotional arousal or reactivity.

Whereas we have proposed that the experience of frustration may be important to the development of regulatory skills, we also hypothesized that those infants who are highly reactive to frustration and do not develop behaviors to modulate this response may develop a specific form of noncompliance. This hypothesis was supported by a near-significant interaction effect at 5 months. Infants who exhibited high levels of reactivity but low levels of regulation displayed more defiance, a form of noncompliance that is accompanied by negative affect (Crockenberg & Litman, 1990). Moreover, infants who were highly reactive to frustration at 5 months but who also exhibited high levels of regulation were the least defiant. This finding indicates that emotional reactivity and regulation may be relatively stable across the first two years of life. That is, toddlers who were highly reactive to frustration as infants may have gotten angry when asked to stop what they were doing. And, because these toddlers had not developed in infancy the regulatory skills to deal with anger, they responded with defiance to a request to comply. Indeed, our data suggest that the ability to deal with frustration as early as 5 months of age is essential to dealing with frustration throughout the first few years of life.

Why should the ability or inability to modulate emotional responses to frustration be related to low or high levels of noncompliance, specifically defiance? The link may be through the type and functional significance of the emotion that frustration elicits. Anger is the typical emotional response to frustration and has been reliably identified in infants during frustrating tasks (Stenberg, Campos, & Emde, 1983; Stifter & Fox, 1990). Anger results from the interruption of an ongoing activity or the blocking of a goal and functions to mobilize energy to overcome obstacles (Barrett & Campos, 1987; Izard, 1977). Thus, anger may be elicited in an infant if he or she is prevented from getting food, moving his or her arms, or retrieving a favored toy. Compliance, which is defined as responding appropriately to parent requests, often involves deferring one's goal for another's. If we accept that asking a child to put away the toys would constitute interrupting an ongoing activity (playing with the toys), then anger may be a consequence. Successful compliance, therefore, would require the ability to regulate this emotional response, whereas defiance would be the result of the inability to do so.

This interpretation of the relation between early regulation and later compliance/noncompliance is not meant to imply that the goal of the child who has been asked to, for example, put the toys away cannot change from enjoying playing with the toys to maintaining the relation by complying. Indeed, several studies have shown that the mother–child relationship has important consequences for the development of compliance, implying that a positive relation will influence a child's eagerness to accept maternal goals as a way of maintaining the relation (Kochanska & Askan, 1995; Londerville & Main, 1981). Our findings, however, indicate that if an infant does not develop behaviors hypothesized to regulate emotional arousal, he or she may have difficulty complying with external demands as a toddler.
Noncompliance also was predicted from infant cardiac vagal tone. Whereas individual measures of cardiac vagal tone were not related to later noncompliance, mean level $V_{NA}$ across the three ages was significantly predictive of toddler behavior. Infants with low $V_{NA}$ were most noncompliant when asked to have electrodes placed on their chests. On the other hand, noncompliance during toy clean-up was exhibited most often by infants with high levels of cardiac vagal tone during infancy. At first glance, these findings appear quite contradictory, but they may be explained by the nature of the task and the person making the request. First, the demand characteristics of electrode placement and toy clean-up are very different and thus may have elicited different reactions. For example, lifting up one’s shirt to have a relatively unfamiliar person place “stickers” on one’s chest may have been emotionally arousing for some children because of the novelty of the situation. Even though the mother was present and the experimenter had carefully explained and demonstrated the task, fearfulness or heightened anxiety may have resulted, each a behavioral response that has been consistently linked to low cardiac vagal tone (e.g., Kagan, 1994). Consequently, the toddlers in the present study with low $V_{NA}$ may have refused to comply because they were distressed by the task. Interestingly, when we examined the types of noncompliance displayed during this procedure, we found that the overall association between noncompliance and cardiac vagal tone was driven primarily by self-assertion, $r = - .41$, $p < .01$, a more competent form of noncompliance that reflects the child’s growing autonomy (Crockenberg & Litman, 1990). However, self-assertion was also the type of noncompliance exhibited by toddlers who had high cardiac vagal tone during infancy, but only during the toy clean-up task, $r = .36$, $p < .03$. Thus, who is making the request, rather than the nature of the task, may explain these divergent findings.

Kochanska (1997) found that fearful children whose mothers used more gentle discipline were more likely to internalize rules and standards of conduct. Because low cardiac vagal tone is believed to underlie temperamental fearfulness, toddlers with low $V_{NA}$ may be more likely to comply to a familiar request by a familiar person, one with whom the child wishes to maintain a relation (Kochanska & Askan, 1995), as in the clean-up task. An unfamiliar request (electrode placement) by an unfamiliar person, however, may have emotionally overwhelmed the toddler with low vagal tone into noncompliance, albeit a more sophisticated, acceptable type. High cardiac vagal tone has been linked to approach behaviors. Specifically, infants with high $V_{NA}$ were more interested and responsive to strangers than infants with low vagal tone (Fox, 1989; Stifter et al., 1989). A request by a stranger, therefore, might be construed by the high-$V_{NA}$ toddler as an opportunity to socialize. On the other hand, when mothers asked them to clean up the toys, toddlers with high $V_{NA}$ were more noncompliant, although they used self-assertion predominantly. Perhaps saying “no” in a firm way was used by the high-vagal-tone toddler as a means of controlling his or her emotion. That is, toddlers with high $V_{NA}$ may have disliked having to end a pleasurable activity but used self-assertion to regulate as well as communicate this feeling. Findings from an earlier study support this interpretation. Stifter and Jain (1996) found that infants with high cardiac vagal tone not only were highly reactive to frustration but also showed high levels of regulation. Since negative emotions were not measured during the compliance task, however, this interpretation should be treated with caution. Future researchers might consider coding facial expressions of emotion to assess the toddlers’ reactions to requests to comply.

The fact that mean level of infant cardiac vagal tone—not the individual measures—was related to later noncompliance is intriguing. It may be that the maintenance of high levels of $V_{NA}$ across infancy, a period of rapid growth characterized by several developmental transitions, is a marker of more positive biobehavioral organization. Thus, mean $V_{NA}$ would be more predictive of outcomes requiring the regulation of physiology and behavior. The relation between cardiac vagal tone and compliance, however, appears to be moderated by the conditions under which the child is asked to comply.

Frustration, which is a daily experience for many infants, likely provides them with the opportunity to practice behaviors that regulate their emotional arousal. Likewise, complying with social demands may at times be frustrating for the developing child and require emotion-regulatory skills. The results of the present study demonstrate that infants who develop regulatory skills in response to frustration may be more able to control their behavior for the purposes of compliance than infants who do not have those skills. In addition, infants who do not develop methods for modulating their negative reactivity may be more likely to use defiance in response to social demands. While the results of the present study provide important information about the contribution of child characteristics to the development of compliance/noncompliance, there is still a significant proportion of the variance to be explained. It has been proposed that parents are central to the development of emo-
tion regulation (Kopp, 1989), and it is likely that their attempts to regulate their infants’ emotional arousal are influenced by the level of reactivity as well as the regulatory skills their infants have developed. Future research on the links between early emotion regulation and later compliance/noncompliance should take a multivariate approach by examining parental influences as well as child characteristics.

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