The Regulation of Negative Reactivity in Infancy:

Function and Development

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Running Head: Regulation in Infancy
Abstract

The purpose of the present study was to examine the function and effectiveness of certain behaviors to regulate negative arousal in 5- and 10- month-old infants. Infants and mothers participated in an arm restraint procedure at 5 months (N=87) and a toy removal task when the infants were 10 months of age (N=82). Negative reactivity was coded every 10 seconds on a 5-point scale. Regulatory behaviors - avoidance, orienting, self-comforting, and communicative behaviors (10 month only), were continuously coded and sectioned into corresponding 10 second epochs. The results showed that self-comforting behaviors were preferred at both 5 and 10 months of age. A comparison of changes in negative reactivity across every two consecutive 10 second epochs (decreasers vs. increasers vs. no change) revealed self-comforting behaviors to be exhibited most often during periods of decreasing negative arousal. Orienting behaviors also appeared to serve a regulatory function but in a more limited way. Finally, under these circumstances avoidance and communicative behaviors were exhibited most often during increasing rather than decreasing distress.
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One of the infant's most important developmental tasks is to learn to modulate or tolerate high levels of arousal (Demos, 1986). The processes that serve to modulate, redirect, or cope with heightened levels of arousal is termed regulation. Several theories on the development of self-regulation (Kopp, 1982; Rothbart & Derryberry, 1981) and, more specifically, emotion regulation (Kopp, 1989; Thompson, 1990) have recently been proposed. Central to these theories is the notion that biological maturation and sensitive caregiving interact to provide the infant the means with which to effectively regulate emotion. Indeed, caregiving is believed to be essential to the control of negative affect states in earliest infancy (Kopp, 1982). Thus, while newborns are endowed with certain reflexes (e.g. eye closing, head turning) that aid in the withdrawal from aversive or overstimulating events, there are times when the infants' level of arousal is such that it overwhelms their ability to self-regulate. It is at these times, according to Kopp (1989), that external intervention becomes necessary while simultaneously providing a potent opportunity for learning about means for reducing distress. The infant, however, is not without the ability to recruit his/her own means for the purposes of regulation.

As the infant's central nervous system develops, perceptual, motoric, and cognitive skills emerge which can be used to reduce or maintain arousal. For example, enhanced visual ability in the form of selective attention can be used by the infant to orient away from the source of negative arousal and toward more pleasing, less arousing stimuli. Rothbart and Derryberry (1981) suggest that the behaviors used by the infant to modulate arousal can be grouped into three categories - approach/withdrawal, attentional, and self-soothing or self-comforting.
behaviors. A fourth set of behaviors, often cited by other researchers, which emerges in later infancy would be that of intentional communicative behaviors (Kopp, 1989; Thompson, 1990). While there are a handful of studies which have examined the effectiveness of some of these behaviors (e.g., Campos, 1989; Field, 1981), in general, their functional significance continues to be hypothetical.

Perhaps the most fundamental and primitive of the regulatory behaviors is that of approach/withdrawal. Infants may regulate the degree of arousal by varying their approach to a novel stimulus or they may reduce their arousal by avoiding or withdrawing from the source of their distress. The evolutionary and adaptive significance of approach/withdrawal was first proposed by Schneirla (1957) who suggested that these behaviors underlie motivated behavior in all animals. His principle that approach behaviors are elicited in response to low intensity stimuli and withdrawal in response to high intensity stimuli, has been successfully applied to behaviors in early infancy (McGuire & Turkewitz, 1979). With development these processes are believed to provide the bases for higher-level functioning and more organized behaviors such as active seeking and avoidance. Recently, Fox and Davidson (1984) proposed that during early infancy, approach and withdrawal behaviors are localized within the left and right hemispheres, respectively. They suggest, however, that with maturation of the connection between the two hemispheres, situations that previously elicited approach behaviors now compete with withdrawal behaviors to produce such affective states as wariness.

Another method by which infants regulate their arousal is through self-comforting behaviors. The most commonly observed self-soothing behavior is thumb or finger sucking. Nonnutritive sucking has been studied at length and the consensus is that it functions to reduce distress (Field & Goldson, 1984; Gunnar, Fisch, & Malone, 1984; Wolff & Simon, 1967).
Bruner (1973) suggests that nonnutritive sucking acts as a "buffer" to visually-arousing events. Both Campos (1989) and Woodson (Woodson, Drinkwin, & Hamilton, 1985), used pacifiers during aversive tasks and the results revealed significant reduction in arousal as measured physiologically and motorically. Other rhythmic behaviors such as hand clasping and rocking may also serve to reduce tension or discharge energy (Gianino & Tronick, 1988; Rothbart, Ziaie & O'Boyle, 1992).

Attentional strategies are also believed to function as emotion regulators. In early infancy, attention is considered "obligatory" and stimulus bound. During social interactions, however, young infants may use gaze away behaviors to regulate arousal and process information (Field, 1981; Stern, 1971). By three months of age infants demonstrate the ability to selectively orient toward particular stimuli and sustain attention in the face of distraction (Bahrick, Walker, & Neisser, 1981; Richards, 1989). The function of these various strategies to modulate arousal may vary according to the stimulus and its significance to the infant. For example, distractibility may be useful for the infant who is distressed, affording him/her the opportunity to re-orient toward another, more pleasant stimulus. On the other hand, the infant who is easily distracted and thus cannot sustain attention, may miss opportunities for assimilating pleasurable stimuli. Several studies with both infants and adults have shown that the ability to shift attention was related to less distress (Rothbart, Posner, & Boylan, 1990) while others have shown that "inattentiveness" was predictive of later negative mood, withdrawal and unadaptability (Ruff, 1990). Perhaps, the ability to intersperse periods of attention with gaze aversions may be the most effective means of regulating arousal while remaining involved with the stimulus (Field, 1981; Stifter & Moyer, 1991). The regulatory function of gaze aversion was successfully demonstrated by Field (1981) who found infant heart rate prior to gaze aversion
increased while heart rate following gaze aversion decreased.

A fourth group of behaviors that may function to regulate arousal are those behaviors used to communicate the needs of the infant. Intentional communication emerges around 9 months of age (Bates, O'Connell, & Shore, 1987). The intentionality of behaviors such as vocalizations and gestures, according to Bates, is dependent upon developmental changes in the infant's ability to alter gaze between a desired object and another person, the infant's repeated attempts to communicate using other signals, and the use of gestures and vocalizations solely for the purposes of communication. Bretherton and colleagues (Bretherton, Fritz, Zahn-Waxler, & Ridgeway, 1986) suggest that these behaviors represent the infant's understanding that others possess their own feelings and intentions separate from their own. This understanding coupled with the ability to communicate with intent might be used as a means for regulating arousal. Rather than express their distress at a novel or frustrating event, infants may communicate their need for assistance. The control of emotions through the use of language has been supported by studies of 2- and 3-year-olds (Dunn & Brown, 1991). Prelinguistic attempts to communicate during times of distress, therefore, may be a precursor to the role of language in emotion regulation. To date, this hypothesis has not been tested.

While there are many studies which have examined the presence and effectiveness of certain individual behaviors in reducing arousal, few have compared the utility of these behaviors or studied the development of their effectiveness. In other words, since approach/withdrawal, attention, and self-comforting behaviors are available to young infants, do these behaviors differ in terms of the preference for their use, and do they differ in their ability to reduce negative arousal? In the present study we investigated regulatory behaviors at 5 and 10 months of age by observing whether behaviors hypothesized to modulate emotional arousal were
used during a stressful situation. Secondly, we were interested in whether the recruitment of these behaviors were successful in regulating negative affect. Since one of the primary functions of regulatory behaviors is to reduce arousal, the presence and effectiveness of regulatory behaviors was examined during periods of heightened negative affect. Secondly, because the affective responses of infants are dynamic, regulatory behaviors were examined in relation to brief changes in reactivity. Simply reporting correlations between the mean level of reactivity and the average number of times an infant, for example, exhibits thumb-sucking behavior, does not allow for the examination of the contribution of regulation to the level of response. It may be that high levels of reactivity were preceded or followed by high levels of thumb sucking but we have no way of knowing whether thumb sucking was successful in reducing negativity. Thus, the examination of regulatory behaviors exhibited within the context of change in reactivity will provide a more realistic picture of the use and effectiveness of these strategies. In the present study we assessed negative reactivity every 10 seconds and examined changes across two consecutive 10 second epochs. The ability of these behaviors to "regulate" was determined by looking at whether they occurred more often during periods of decreasing arousal.

Methods

 Subjects

Subjects were drawn from a longitudinal sample of 100 infants recruited during their postnatal stay at a community hospital in central Pennsylvania. Criteria for inclusion were that subjects be healthy, term (GA > 36 weeks), infants of appropriate birthweight and uncomplicated pregnancies and deliveries. Subjects were from predominantly white (2 African American, 1 Hispanic, 1 Asian American) middle class families. At 5 months of age 87 (45 males) subjects were available for follow-up (M = 20.8 weeks, SD = 1.4). At 10 months of age 82 (40 males)
infants were seen (M = 40.7 weeks, SD = 1.2).

Procedures

Infants were recruited and tested at birth and returned for laboratory follow-up at 5 and 10 months of age. Infants and mothers participated in several procedures which included free play, a positive reactivity task, a mental development test, and a negative reactivity task. Infant responses to the negative reactivity task were used in the present study. At five months of age infants participated in an arm restraint task and at 10 months a toy removal task was used to elicit negative reactivity.

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. After two minutes of arm restraint or 20 seconds of hard crying, mothers were cued to release their infants' arms but to continue their neutral, noninteractive posture for one minute. Mothers were then told that they could soothe their infant if necessary using any method they deemed appropriate. The entire procedure was videotaped for later coding. The mean length of arm restraint was 100 seconds (range: 40-120s) with 60% of the sample completing the entire two minutes of arm restraint.

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 in front of the infant. For 90 seconds mothers and infants played with an attractive Busy Box toy that consisted of several moving and noise-making parts. Upon a cue from the experimenter, mothers removed the toy from their infants and held it out of reach but within the infant's sight. Mothers were also instructed to assume a neutral expression and to refrain from interacting with their infants during this time. Toy
removal lasted for two minutes or 20 seconds of hard crying. Mothers were then cued to return the toy to their infants but remain noninteractive. After one minute mothers resumed interacting with their infants. The mean length of toy removal was 111 seconds (range: 60-120s) with 79% of the sample completing the entire two minute toy removal episode.

Behavioral Measures

Reactivity. Negative vocalizations elicited by the arm restraint and toy removal procedures were used as a measure of negative reactivity. The scale used to assess negative reactivity was designed to capture both the peak intensity and the rate at which the negative vocalizations were emitted - 0 (no negative vocalization), 1 (intermittent fussing), 2 (escalated fussing with at least one sob), 3 (steady crying), 4 (escalated crying with at least one shriek). Negative vocalizations were scored every 10 seconds. Initial reviews of the videotapes indicated 10 seconds to be a useful time frame with which to score the escalation of negative reactivity.

Reactivity was scored during the arm restraint and arm release episodes of the 5 month task and the toy removal and toy return episodes of the 10 month task. The mean negative reactivity scores for the two episodes of the 5 month task (arm restraint M = 1.83, SD = 1.22; arm release M = 2.13, SD = 1.51) and the toy removal episode of the 10 month task (M = 1.83, SD = .90) were very similar suggesting that while the two procedures were different, they elicited equal degrees of distress. However, a majority (80%) of the 10-month-olds exhibited little or no negative reactivity when the toy was returned (M reactivity = .73), therefore, the data from this episode were not analyzed. Interrater reliability, calculated on 10% of the sample, resulted in a mean Cohen's kappa of .70 at 5 months and .82 at 10 months.

Regulatory behaviors. Regulatory behaviors were coded continuously from the videotapes using a laptop computer programmed to calculate the presence and duration of each
behavior. Based on previous research (Braungart & Stifter, 1991; Giannino & Tronick, 1985), behaviors which reflect the infant's attentional strategies, avoidance, self-comforting, and communication attempts were selected for coding. At 5 months of age, object orientation, mother orientation, scanning, escape behaviors, nonnegative vocalizations and self-comforting behaviors were coded from the arm restraint and arm release episodes of the five month reactivity procedure. The same behaviors were coded from the 10 month toy removal procedure with two additions -- orientation toward the toy, and communicative gestures. A description of the behaviors and the episodes during which they were coded can be found in Table 1. The mean number of seconds per 10 second epoch that the behavior was exhibited was the variable used in the statistical analyses. Two coders overlapped on 10% of the sample. Interrater reliabilities for the 5 month behaviors averaged .85 by Cohen's kappa (range .79 - .91). At 10 months interrater reliabilities averaged .81 by Cohen's kappa (range .59 - .93).

Based on previous research, face validity, and preliminary analysis, four regulatory composites were created - avoidance, attentional strategies, self-comforting behaviors and communicative behaviors. Avoidance was represented by a composite of escape and scan behaviors. Both behaviors are believed to be more primitive methods of avoidance (Gianino & Tronick, 1988; McGuire & Turkewitz, 1979). Orientation toward objects and toward mother were combined to represent attentional strategies and will be referred to as orientation. Orientation toward the toy, coded from the 10 month procedure, was not included in this composite for two reasons. 1) The toy which was removed from the infant was the source of frustration. Since we conceptualized orienting as using attentional strategies to redirect the infant away from the source of frustration/distress, we did not include it in our composite. 2) Including toy orientation in our composite variable would prevent comparison with the 5 month
orientation variable. A composite representing communicative behaviors was created by combining gestures and vocalizations coded during the 10 month procedure. It was not necessary to create a composite measure of self-comforting.

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Insert Table 1 about here
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**Data Reduction and Analysis**

To determine whether the behaviors hypothesized to regulate negative reactivity succeeded in that function, change in negative reactivity across two consecutive 10 second epochs and the behaviors exhibited during that time were examined. This required several preliminary manipulations of the data.

First, the data were rewritten so that the negative reactivity score for every 10 second epoch together with its following 10 second epoch score (rather than subject) were the units of analysis. That is, two scores per condition (epoch) per subject were included as variables in the data set.

Negative reactivity change scores (ÄNR) were then created by subtracting the two consecutive negative reactivity scores from each other. For example, if negative reactivity during a 10 second epoch was given a 3 and negative reactivity during the following 10 second epoch was scored as 2 then ÄNR would be -1 indicating that the infant's negative reactivity decreased across this interval. Recall that the higher the score the greater the reactivity. Change scores were computed for every two consecutive 10 second epochs of the arm restraint and arm release episodes of the 5 month procedure, and the toy removal episode of the 10 month procedure.
From these data three groups were formed based on ANR; negative reactivity which increased across the epochs, a group representing no change in negative reactivity, and negative reactivity that decreased from one epoch to the next. These groups were then compared on the duration of regulatory behaviors exhibited during the 10 second interval in which a change in arousal was observed. During the 5 month arm restraint episode, 105 consecutive epochs were categorized as decreasing while 165 were increasing and 489 exhibited no change. During the 5 month arm release episode, 57 consecutive epochs were identified as decreasing, 52 as increasing in negative reactivity, and 322 were categorized as no change. The toy removal episode of the 10 month frustration procedure produced 140 negative reactivity epochs that decreased while 238 increased and 504 stayed the same.

Repeated measures analysis of variance with reactivity change group as the independent factor and regulatory behavior as the dependent factor was the data analytic strategy employed to test the hypothesis that certain behaviors regulate negative arousal. To correct the error term for the degree of autocorrelation created by pooling across epochs and individuals, we entered each individual (as designated by their ID number) and the epoch by group interaction into all the analyses. That is, ID and the within-subject, repeated factor (epoch) were controlled for in the analyses. This strategy differs from the standard mixed model repeated measures ANOVA only in that the design was incomplete. We used the Type III sums of squares hypothesis which is the most appropriate test for incomplete, unbalanced designs.

Results

All analyses were performed with sex as a grouping variable. No significant main or interaction effects were found. Thus, the following analyses were calculated with the data collapsed across this variable.
The Effectiveness of Regulatory Behaviors

Our first goal was to test whether the behaviors hypothesized as functioning to regulate negative affect were exhibited for significantly longer duration during periods of decreasing arousal. Each regulatory behavior was submitted to a repeated measures ANOVA with negative reactivity change group as the independent factor. Because the infants' initial level of reactivity at the start of each 10 second epoch may influence the effectiveness of the behaviors to reduce arousal, the level of the first negative reactivity score was also entered as a covariate (in addition to ID and epoch). For the arm restraint episode, significant differences for avoidance, F (2,640) = 5.21, p < .001, and orientation, F (2,640) = 4.55, p = .01, were found. Follow-up contrasts revealed that avoidance was exhibited significantly more during periods of increasing arousal than during periods of either no change, F (1,640) = 9.69, p < .001, or decreasing arousal, F (1,640) = 3.73, p < .05. On the other hand, orienting behaviors were more likely to be exhibited for longer durations during periods of decreasing arousal, F (1,640) = 5.07, p < .03, and no change, F (1,640) = 7.24, p < .01, than when negative arousal was on the increase. Table 2 presents the means and standard deviations for these data.

Differences in avoidance, orienting, or self-comforting behaviors were not found for the arm release episode (see Table 2).

At 10 months, self-comforting and communicative behaviors appear to have divergent effects on changes in negative reactivity. A significant difference in communicative behaviors, F (2,763) = 5.01, p < .01, was found. Follow-up tests showed that vocalizations and gestures were used significantly more during periods of increasing, F (1,763) = 6.66, p < .01, and unchanged negative arousal, F (1,763) = 5.55, p < .02, than when negative reactivity was decreasing. On the other hand, a near significant difference in self-comforting behaviors, F (2,763) = 2.11, p < .1,
indicated that more self-comforting behaviors are exhibited when negative reactivity reduced in intensity than when it increased, $F(1,763) = 2.96$, $p < .08$, or exhibited no change, $F(1,763) = 4.13$, $p < .04$, over a 20 second period. No differences were found for avoidance or orientation (see Table 2).

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Insert Table 2 here

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**Level of Negative Reactivity and Effectiveness**

While certain behaviors may function to reduce negative arousal, they may be differentially effective depending upon the infants' level of arousal when the behaviors were initiated. For example, we might ask if self-comforting behavior is more effective when the child is just fussing or when he/she is crying intensely. Several significant interaction effects found in the previous analyses also suggest this post hoc test. ANOVAs, therefore, were computed with regulatory behavior as the dependent variable and levels of negative reactivity (1-4) as the grouping variable to test this question. The analyses were performed only for negative reactivity that decreased across the consecutive 10 second epochs. During the arm restraint episode, both avoidance, $F(3,101) = 2.58$, $p < .05$, and orienting behaviors, $F(3,101) = 7.04$, $p < .001$, were exhibited at significantly different durations. Follow-up contrasts revealed that infants exhibited significantly less avoidance when they were mildly distressed (level 1) than when they were more intensely distressed (see Table 3). On the other hand, infants used less orienting behaviors when they were highly distressed (level 4) compared to all other levels of negative reactivity. Similar results were found for orienting behaviors during the arm release episode, $F(3,53) = 9.15$, $p < .0001$. Infants who began the 10 second epoch intensely distressed
used less orienting behaviors than when they either crying, or fussing. No differences were found for avoidance or self-comforting behaviors. At 10 months of age, no differences in avoidance, orienting, self-comforting and communicative behaviors for the four levels of negative reactivity. Table 3 presents the means and standard deviations for these data.

Comparison of Regulatory Behaviors

Finally, we were interested in whether certain behaviors were utilized more often than others during periods of high negative reactivity. To test for differences between the mean durations of the regulatory behaviors exhibited within the three different episodes, 5 month arm restraint, 5 month arm release, and 10 month toy removal, regulatory variables within each episode and age were contrasted. Repeated measures ANOVA with ID, epoch, and change group as the independent factors was then computed. The results showed that during the arm restraint procedure, infants exhibited significantly more avoidance than orientation behavior, F (1,643) = 183.23, p < .0001. During the arm release episode, however, self-comforting behaviors were displayed for significantly longer durations than both avoidance, F (1,335) = 22.01, p < .0001, and orientation, F (1,335) = 13.34, p < .001. At 10 months of age, during the toy removal task, self-comforting behavior continued to be predominantly exhibited. Self-comforting was exhibited significantly longer than avoidance, F (1,777) = 172.01, p < .0001, orientation, F (1,777) = 169.25, p < .0001, and communicative behaviors, F (1,777) = 124.15, p < .0001. Communicative behaviors were also displayed more often than avoidance, F (1,777) = 4.43, p < .05, but not when compared to orientation. The durations of avoidance and orientation...
behaviors were not significantly different from each other (see Figure 2).

Discussion

In the present study, behaviors hypothesized to reduce negative arousal - avoidance, orientation, self-comforting, and communicative behaviors, were examined during periods of changing level of arousal. When these behaviors were exhibited for longer durations when negative arousal decreased, we might infer that they functioned in a regulatory capacity. While our analyses do not directly assess the causal relationship between these behaviors and change in reactivity, our findings suggest that behaviors hypothesized to reduce negative arousal may differ in terms of their function and development. Moreover, while some of the behaviors appeared to function to decrease arousal, their effectiveness was dependent upon the initial level of negative reactivity. Finally, there appears to be different developmental trajectories for the regulatory function of the observed behaviors.

Two behaviors, avoidance and communicative behaviors, appear not to function in early infancy as regulators of distress when infants are frustrated. At 5 months of age, avoidance behaviors were exhibited longer when the infants' arms were restrained. However, when examining whether these behaviors functioned to reduce distress we found that they were more likely to be used when negative arousal was on the increase. The same effect was found for communicative behaviors at 10 months of age. Nonnegative vocalizations and gestures were exhibited for longer durations during periods of increasing arousal rather than decreasing arousal.
These findings are likely due to the procedures used by the present study to elicit negative reactivity but may, indeed, reflect developmental shifts in attempts at regulating. Because the 5-month-old infants were restrained, arching the back and struggling to get out of the chair accompanied by high negative affect may be the most effective means for removing the restraints. The emotional reaction of anger is believed to motivate infants to remove obstacles which are blocking the goal (Izard, 1977). Thus, avoidance may temporarily function to regulate distress. When the obstacle is not successfully removed by either the infant or the caretaker, as was the case in the present study, then we might expect these behaviors to accompany increases in negative arousal (Weinberg and Tronick, in press). The same may be said for communicative behaviors which were also observed more often during periods of increasing arousal. The 10 month procedure which had a noninteractive mother remove a toy from the infants' reach, may have contributed to this finding. Directing nonnegative vocalizations and gestures toward the mother without obtaining the expected response (i.e., returning the toy, soothing verbalizations) are likely to produce increases in negative arousal. On the other hand, these behaviors may not be as well organized toward intentionally communicating and regulating distress at this point in development. Rather, vocalizations and gestures may continue to function as expressions of distress. Gustafson and Green (1991) reported a significant increase in communicative cries (those accompanied by visual regard and gestures) between the ages of 9 and 12 months. Perhaps, once language is acquired it can communicate affect with less intensity (Bloom & Beckwith, 1989).

One behavior, self-comforting, was highly preferred by both 5- and 10- month-old infants and also appeared to have some regulatory function. When their hands were available, 5-month-old infants were more likely to self-comfort than use attentional or avoidance behaviors. Self-
comforting behaviors continued to be preferred at 10 months of age despite increasing motoric, attentional and communicative abilities. The ability of self-comforting behaviors to regulate distress, however, appears to be limited at 5 months but effective at 10 months of age. Though inspection of the means (see Table 2) suggest that there was a tendency for 5-month-olds to use more self-comforting behaviors to reduce negativity, by 10 months of age infants were using self-comforting behaviors significantly more during periods of decreasing negative arousal. This was true regardless of how distressed the infant was at the beginning of the interval.

Self-comforting behaviors as defined by the present study were finger and thumb-sucking activity, as well as, the clasping and pulling on hands, feet or hair. While there is little known about the effectiveness of self-manipulation to reduce negative arousal, studies of non-nutritive sucking have concluded that it is an effective "buffer" to overstimulation (Bruner, 1972). Using heart rate activity as an index of arousal, Campos (1989), found that non-nutritive sucking reduced pain-elicited distress in newborns.

In early infancy, hand to mouth behaviors may be a fortuitous event. However, with the development of visual-motor coordination and repeated successful attempts, infants may come to learn the effectiveness of such behaviors in reducing or blocking negative arousal. The results of the present study suggest this may occur between the ages of 5 and 10 months. This finding is supported by Rothbart et al.'s (1992) longitudinal study which found increases in self-comforting behaviors between 6 and 13 months.

It is important to emphasize that the procedures used to elicit negative reactivity at 5 and 10 months were different and that this difference may have contributed to the lack of findings for 5 month self-comforting behavior. Mean reactivity levels for the arm restraint and arm release episodes suggest that even after the stressor was removed 5-month-olds increased in their
negativity across the procedure. It may be that this increasing distress inhibited the recruitment and effectiveness of self-comforting behaviors to reduce negative arousal. Indeed, when we examined self-comforting during periods of increasing arousal and compared initial negative reactivity scores, we found fussy infants used significantly more self-comforting than infants who were more distressed.

Orienting behaviors, though not exhibited as often as avoidance during 5 month arm restraint, also appear to function to reduce negative affect. When the initial level of negative reactivity was examined, however, we found that orienting was exhibited more when infants were mildly distressed. This was true for both the arm restraint and arm release episodes of the 5 month procedure. In addition, like self-comforting behaviors, orienting appeared to be used differentially depending on the age of the infant. While 5 month orienting behaviors were more likely to be exhibited during periods of decreasing arousal, albeit when negative arousal was at low levels, this was not demonstrated for 10-month-olds.

Just prior to 5 months of age, when infants' reaching and grasping skills are emerging, they turn their focus from human faces to objects (Kaye & Fogel, 1980). This developmental change may enhance the 5-month-old infants' ability to use orienting toward objects to modulate distress. The ability to orient toward other objects may help to temporarily redirect the infants' attention away from the object of their frustration. Furthermore, looking at the mother may act as a source of comfort (Mayes & Carter, 1990). However, when highly distressed, it appears that infants are inhibited in recruiting their orienting skills.

While the developmental literature suggests increases in 10-month-olds' abilities to deploy orienting strategies which may be used to regulate negative arousal, our data suggests that orienting was not used for this purpose under the conditions presented to our 10 month sample.
Recall, however, that our coding system excluded orienting toward the toy. Inspection of the mean durations of toy orientation for the 10-month-olds indicate that infants spent much of their time orienting toward the toy. Moreover, toy orientation was more likely to occur during periods of increasing arousal. By 10 months of age, infants are capable of sharing their interest in an object by altering their gaze back and forth between the object and a social partner (Bakeman & Adamson, 1984). It may be that in the present study, the 10-month-old infants were altering their gaze between the toy and mother. The unresponsiveness of the mother, therefore, furthered their frustration rather than modulated their distress. Examining these behaviors under conditions in which the mother is not directly involved in the elicitation of distress would clarify whether 10-month-olds use attentional strategies to regulate negative arousal.

The purpose of the present study was to examine whether behaviors available to the young infant functioned to regulate negative arousal. Our findings were mixed but it appears that by 10 months of age, self-comforting behaviors are successful in reducing or minimizing negative arousal. Orienting behaviors also appeared to function to reduce negative arousal but only during periods of low negative reactivity. While communicative and avoidance behaviors were not exhibited most often during periods of decreasing arousal, it may be that in other contexts and under other conditions they would function in a regulatory way. The procedures designed by the present study to elicit negative reactivity may have limited our findings. Future research might look at these behaviors in response to several different elicitors of negative reactivity.

The present study was also limited by the method of assessing change in negative reactivity. Infants possess significant lability in their emotional responsiveness. While the coding system used by the present study was designed to represent the rate and intensity of cries,
it may be that 10 second changes in negative reactivity are too broad to capture the more subtle fluctuations in reactivity and regulation. It is interesting to note, however, that the number of epochs during which no change in reactivity occurred was significantly larger than increasing or decreasing epochs for both 5- and 10-month olds. Our data analytic strategy also prevented us from drawing causal conclusions about the behaviors under study. A more microanalytic approach which examines the moment-by-moment sequencing of affect and regulatory behaviors would clarify the causal role of these behaviors in modulating and reducing negative arousal.

Finally, it is very likely that individual differences play a significant role in the preference and effectiveness of these behaviors in regulating negative arousal. For example, some infants may have more advanced attentional skills and prefer them over other behaviors to regulate while other infants may depend primarily on communicative strategies (see Braungart & Stifter, 1994). Nevertheless, the results of the present study suggest that some of the behaviors hypothesized to "regulate" distress function successfully in that capacity.
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Footnotes

1. While it is recognized that regulatory behaviors can be elicited in response to high levels of both positive and negative arousal or reactivity (see Stifter & Moyer, 1991), for the purposes of this paper, arousal is considered to be negative and will be used interchangeably with reactivity, distress, and negative affect.

2. Intercorrelations between the variables that made up the composites were all significant with one exception - scan and escape behaviors during arm restraint, $r = -.002$, $p < .98$.

3. Non-negative vocalizations were coded during the 5 month procedure. Because of the low occurrence (< 15%) and mean duration (< .50 seconds) for this code it was dropped from subsequent analyses.

4. Analysis of variance with toy orientation as the dependent variable and cry change group (Increaser, Decreaser, No change) as the independent variable was significant, $F(2,723) = 3.95$, $p < .02$. Follow-up contrasts found differences between increasers and both the no change group, $F(1,723) = 6.98$, $p < .01$, and the decreasers, $F(1,723) = 3.45$, $p < .06$ (Ms = 5.38, 5.08, 4.11 for Increasers, No Change, Decreasers, respectively).
Table 1

Description and coding of the 5 and 10 month regulatory behavior

<table>
<thead>
<tr>
<th>Behavior</th>
<th>Description</th>
<th>Episode*</th>
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<tbody>
<tr>
<td>Mother orient</td>
<td>Eyes focused on the mother's face</td>
<td>AR, AL, TR</td>
</tr>
<tr>
<td>Object orient</td>
<td>Eyes focused on objects (e.g., infant seat, camera, own body)</td>
<td>AR, AL, TR</td>
</tr>
<tr>
<td>Toy orient</td>
<td>Eyes focused on the removed toy</td>
<td>TR</td>
</tr>
<tr>
<td>Scan</td>
<td>Eyes not focused on any object, infant looks around the room</td>
<td>AR, AL, TR</td>
</tr>
<tr>
<td>Escape</td>
<td>Body arches and/or turns away from mother</td>
<td>AR, AL, TR</td>
</tr>
<tr>
<td>Self-comfort</td>
<td>Clasping of hands, hair, face, feet or sucking of fingers or thumb</td>
<td>AL, TR</td>
</tr>
<tr>
<td>Gestures</td>
<td>Hand wave, point, and/or bang on chair</td>
<td>TR</td>
</tr>
<tr>
<td>Vocalizations</td>
<td>Nonnegative vocalizations - infant's gaze</td>
<td>AR, AL, TR</td>
</tr>
</tbody>
</table>

* AR - arm restraint, AL - arm release, TR - toy removal
Table 2

Means and standard deviations of regulatory behaviors by negative reactivity change group

<table>
<thead>
<tr>
<th></th>
<th>Decreasers</th>
<th>Increasers</th>
<th>No Change</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>5 Month Arm Restraint</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avoidance</td>
<td>3.68 (2.35)a</td>
<td>4.25 (2.39)ab</td>
<td>3.27 (2.43)b</td>
<td>3.55 (2.94)</td>
</tr>
<tr>
<td>Orientation</td>
<td>2.38 (1.67)a</td>
<td>1.82 (1.58)ab</td>
<td>2.11 (1.79)b</td>
<td>2.08 (1.73)</td>
</tr>
<tr>
<td>5 Month Arm Release</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avoidance</td>
<td>1.92 (1.89)</td>
<td>1.94 (1.96)</td>
<td>1.97 (2.06)</td>
<td>1.96 (2.02)</td>
</tr>
<tr>
<td>Orientation</td>
<td>2.31 (1.73)</td>
<td>1.90 (1.70)</td>
<td>2.17 (1.83)</td>
<td>2.16 (1.80)</td>
</tr>
<tr>
<td>Self-comfort</td>
<td>2.96 (3.56)</td>
<td>2.29 (3.02)</td>
<td>2.54 (3.56)</td>
<td>2.57 (3.50)</td>
</tr>
<tr>
<td>10 Month Toy Removal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avoidance</td>
<td>1.19 (1.47)</td>
<td>1.27 (1.70)</td>
<td>1.16 (1.42)</td>
<td>1.19 (1.51)</td>
</tr>
<tr>
<td>Orientation</td>
<td>1.60 (1.40)</td>
<td>1.17 (1.15)</td>
<td>1.20 (1.21)</td>
<td>1.26 (1.24)</td>
</tr>
<tr>
<td>Self-comfort</td>
<td>3.61 (3.78)a</td>
<td>2.32 (3.10)</td>
<td>2.22 (3.25)a</td>
<td>2.47 (3.34)</td>
</tr>
<tr>
<td>Communicative</td>
<td>1.01 (1.33)ab</td>
<td>1.35 (1.49)a</td>
<td>1.40 (1.42)b</td>
<td>1.32 (1.43)</td>
</tr>
</tbody>
</table>

Note: Means with the same superscript are significantly different from one another at p < .05.
Table 3
Means and standard deviations of regulatory behaviors by level of negative reactivity+

<table>
<thead>
<tr>
<th>Level of Negative Reactivity</th>
<th>One</th>
<th>Two</th>
<th>Three</th>
<th>Four</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>5 Month Arm Restraint</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avoidance</td>
<td>2.66 (2.0)abc</td>
<td>4.09 (2.1)a</td>
<td>4.19 (2.8)b</td>
<td>4.38 (1.5)c</td>
</tr>
<tr>
<td>Orientation</td>
<td>2.97 (1.6)ac</td>
<td>2.70 (1.6)b</td>
<td>2.03 (1.5)a</td>
<td>0.25 (0.5)abc</td>
</tr>
<tr>
<td>5 Month Arm Release</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avoidance</td>
<td>0.90 (1.6)</td>
<td>1.50 (1.8)</td>
<td>2.04 (1.8)</td>
<td>2.32 (1.9)</td>
</tr>
<tr>
<td>Orientation</td>
<td>3.70 (1.7)a</td>
<td>3.50 (2.0)b</td>
<td>2.77 (1.3)c</td>
<td>1.34 (1.3)abc</td>
</tr>
<tr>
<td>Self-comforting</td>
<td>2.40 (2.8)</td>
<td>5.50 (4.6)</td>
<td>3.38 (3.6)</td>
<td>2.43 (3.5)</td>
</tr>
<tr>
<td>10 Month Toy Removal</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avoidance</td>
<td>1.43 (2.0)</td>
<td>1.11 (1.4)</td>
<td>1.31 (1.4)</td>
<td>0.86 (1.3)</td>
</tr>
<tr>
<td>Orientation</td>
<td>1.83 (1.5)</td>
<td>1.85 (1.5)</td>
<td>1.38 (1.3)</td>
<td>1.61 (1.5)</td>
</tr>
<tr>
<td>Self-comforting</td>
<td>4.00 (4.1)</td>
<td>3.56 (3.8)</td>
<td>3.63 (3.5)</td>
<td>3.36 (3.5)</td>
</tr>
<tr>
<td>Communicative</td>
<td>0.80 (1.3)</td>
<td>1.18 (1.6)</td>
<td>0.98 (1.3)</td>
<td>0.93 (1.1)</td>
</tr>
</tbody>
</table>

Note: Means with the same superscript are significantly different from one another at p < .05.

+ For cries that decreased in negative reactivity only, arm restraint N = 96; arm release N = 57; toy removal N = 140.
Figure 1
Comparison between regulatory behaviors exhibited during 5 month arm restraint, 5 month arm release, and 10 month toy removal.