Published in final edited form as:
Infant Behav Dev. 2009 June ; 32(3): 336–339. doi:10.1016/j.infbeh.2009.02.005.

Comparing emotional reactivity and regulation in infants born ELGA and VLGA

Peggy C. Maclean[a,*], **Sarah J. Erickson**[a], and **Jean R. Lowe**[b]

[a] Department of Psychology, University of New Mexico, Albuquerque, NM, United States

[b] Department of Neonatology, University of New Mexico Children's Hospital, Albuquerque, NM, United States

Abstract

Emotional reactivity and regulation behaviors were compared in infants born extremely low gestational age (ELGA) and very low gestational age (VLGA) during the still-face procedure. Infants born ELGA demonstrated greater emotional reactivity and displayed less frequent gaze avoidance, more frequent gestures, and more self-comforting behaviors.

Keywords

Emotional reactivity; Emotion regulation; Infants born prematurely; Stress response; Still-face procedure

Recent studies indicate that infants who are more easily distressed (i.e., higher emotional reactivity) and who have difficulty regulating their distress (i.e., emotion regulation difficulties) following a stressor have an increased risk of developing behavioral problems (Crockenberg, Leerkes, & Bárrig Jó, 2008). Studies show that emotion regulation behaviors help explain individual differences in stress responses such that certain regulatory behaviors appear more effective at decreasing distress compared to others. For instance, infants who engage in more gaze avoidance and self-comforting behaviors show less negative affect during stressors and are more effective at decreasing their negative affect when distressed (Braungart-Reiker & Stifter, 1996). Avoidance and communicative behaviors, on the other hand, are associated with increases in negative affect during stressors (Braungart-Reiker & Stifter, 1996).

Although studies indicate that infants born preterm display greater emotional reactivity and emotion regulation difficulties compared to infants born full-term (Eckerman, Hsu, Molitor, Leung, & Golstein, 1999), few studies have examined emotional reactivity and regulation among infants born preterm of varying gestational ages. Because previous studies indicate that infants born earlier in gestation have poorer neonatal and developmental outcomes (Voss, Neubauer, Wachtendorf, Verhey, & Kattner, 2007), infants born of extremely low gestational age (ELGA; 23–28 weeks gestation) may be especially vulnerable to displaying emotion reactivity and regulation difficulties compared to infants born of very low gestational age (VLGA; 29–32 weeks gestation). No studies to our knowledge, however, have compared both emotional reactivity and emotion regulation behaviors in preterm populations of varying gestational ages.

[*]Corresponding author at: Department of Psychology, Logan Hall, 1 University of New Mexico MSC03 2220, Albuquerque, NM 87131, United States. Tel.: +1 505 277 0635, fax: +1 505 277 1394., pmaclean@unm.edu (P.C. Maclean).

The present study compared both emotional reactivity and emotion regulation behaviors in 6–8-month-old infants born VLGA and ELGA using the still-face procedure (Tronick, Als, Adamson, Wise, & Brazelton, 1978). The age range used in this study is consistent with previous studies examining emotion regulation behaviors in infants between the ages of 5 and 10 months (e.g., Braungart-Reiker & Stifter, 1996). The still-face procedure used in this study is a standardized, laboratory-based interpersonal stressor that has been found to be a valid stressor for 3–10-month-old infants (Stifter & Braungart, 1995). In order to assess emotional reactivity, we examined changes in infant affect during the still-face episode. Four categories of emotion regulation behaviors were also examined: gaze avoidance, gestures as a communicative behavior, avoidance, and self-comforting behaviors (Weinberg & Tronick, 1994). Based on previous findings indicating that infants born at earlier gestational age have poorer neonatal and developmental outcomes (Voss et al., 2007), we hypothesized that infants born ELGA would display higher emotional reactivity (i.e., increased negative affect) during the still-face stressor compared to infants born VLGA. In addition, given that little is known regarding the emotion regulation behaviors used by 6–8-month-old infants born preterm, we compared the regulatory behaviors used by infants born preterm of varying gestation. We hypothesized that infants born ELGA would use less of the adaptive and more of the maladaptive regulatory behaviors compared to infants born VLGA. Specifically, we hypothesized that infants born ELGA would display less frequent gaze avoidance and self-comforting behaviors and more frequent gestures and avoidance behaviors. In addition, to better understand the relationship between emotional reactivity and emotion regulation behaviors, we examined the relationship between emotional reactivity and regulation behaviors across the ELGA and VLGA groups.

1. Methods

1.1. Participants

The study included 34 infants born ELGA (23–28 weeks gestation) and 17 infants born VLGA (29–32 weeks gestation) between the ages of 6 and 8 months (age adjusted for prematurity). Infants were included if they were were born at or prior to 32 weeks gestation and resided with their biological families. Exclusion criteria included: prenatal drug exposure, visual/hearing impairment, genetic abnormality, monozyotic twin and small for gestational age status.

Infant and maternal characteristics for both groups are shown in Table 1. As expected, infants born ELGA had significantly lower birth weights ($t(49) = -4.85$, $p < .0001$), longer NICU hospitalization stays ($t(49) = 5.84$, $p < .0001$), and longer ventilation periods ($t(49) = 3.62$, $p < .001$) compared to infants born VLGA. Infant age at testing, maternal age at infant's birth, Apgar scores, ethnicity, maternal marital status, gender, and Bayley Infant Scales of Development-II Mental Developmental Index scores did not differ significantly between groups.

1.2. Procedures

The still-face paradigm (Tronick et al., 1978) consists of three consecutive 120-s episodes: (1) a baseline episode of face-to-face mother–infant interaction (free play); (2) an episode of maternal unresponsiveness, during which the mother maintains a neutral, motionless face (still-face); and (3) an episode of recovery and renewed mother-infant interaction (second free play). Mothers sat approximately 18–36 inches from their infants, who were in car seats or high chairs. During free play episodes mothers were instructed to play with their children as they normally would. During the still-face episode (episode 2), mothers were instructed to express a neutral facial expression, avoiding eye contact and interaction with their infants.

The still-face episode was videotaped and coded for infant affect and emotion regulation behaviors.

Infant affect was coded using the following coding schema: −3 (rhythmic crying for ≥3 s), −2 (shorter cry in duration, a protest or yell), −1 (mild fuss/frown), 0 (baby is neutral), +1 (corners of the mouth straight, soft coo), +2 (corners of the mouth go up, cheeks raised, chuckle or small giggle), +3 (laugh, must be ≥ s). In order to examine emotional reactivity, changes in affect over the still-face duration was obtained. The change in affect over still-face duration was defined as the slope over 120 s (i.e., affect slope over the still-face episode, referred to as affect slope).

Emotion regulation coding was based on the Infant Regulatory Scoring System coding manual (Tronick & Weinberg, 1990). The individual IRSS codes were used to create four categories similar to those in the IRSS manual, but with slight modification based on frequency of occurrences and relevant literature. Gaze avoidance included the infants looking away from their mothers, such as looking at a proximal object; looking at something in the room; and closing their eyes. This category was similar to the IRSS gaze category, except that it excluded the IRSS code for looking at mother's face. This code was excluded since studies indicate that it is the ability to look away from a stressful stimulus that is associated with a decrease in distress (e.g., Crockenberg & Leerkes, 2004) and during the still-face paradigm, the stressful stimulus is the mother (or the mother's unresponsiveness). As a result, only gaze behaviors that represent an avoidance of mother's face were included in our category. Gestures included the infants leaning forward towards their mothers and one- and two-hand reaches. This category overlapped with the IRSS gesture category, except that it excluded the IRSS code for stereotypic/repetitive gestures, which was omitted due to lack of occurrence (i.e., occurred less than 0.02% of the still-face). Self-comforting behaviors included the infants sucking on their bodies, sucking on an object, touching their heads or faces, and clasping their hands together. This category was similar to the IRSS self-comforting category, except that it excluded the IRSS code for rocking behavior since being strapped in car seat or high chair prevented infants from rocking. Avoidance behaviors included the infants trying to get away/escape, arching their backs, and/or screening both eyes with their hands or arms. This category overlapped with the distance/avoidance IRSS category with the exception of visual scanning, which was ommitted due to infrequent occurrence (i.e., occurred less than 0.01% of the still-face). Due to overall infrequency of avoidance behaviors (i.e., occurred less than 0.05% of the still-face), this category was not used in subsequent analyses. In order to prevent overlap between infant affect and emotion regulation coding, vocalizations were not included in the communication coding. Percent duration scores for each category was obtained, representing the percent of time infants used each behavior during the still-face episode.

Two research assistants coded infant affect and emotion regulation behaviors using 1-s time intervals. Each emotion regulation category was coded independently and co-occurrence of codes could occur. Interrater reliability was obtained on 20% of still-face videos using Cohen's kappa interrater agreement coefficients (Cohen, 1960). Mean reliability for emotional regulation behaviors and infant affect coding was 0.86 and 0.93, respectively.

2. Results

In order to examine whether infants born ELGA and VLGA differed significantly on emotional reactivity and emotion regulation behaviors, a series of *t*-tests were conducted. Infants born ELGA evidenced a significantly greater negative affect slope than did infants born VLGA ($t(44.9) = -3.10$, $p < .01$), suggesting greater emotional reactivity in infants born ELGA (Table 1). Infants born ELGA also displayed less frequent gaze avoidance

behaviors ($t(39.1) = -2.24$, $p < .05$), more frequent gestures ($t(39.4) = 2.25$, $p < .05$), and more self-comforting behaviors ($t(46.8) = 2.12$, $p < .05$) during the still-face episode compared to infants born VLGA.

ANCOVA analyses were then used to examine the association of emotional reactivity (i.e., affect slope) on emotion regulation behaviors (gaze avoidance, gestures, self-comforting behaviors) across group (ELGA, VLGA). Findings indicated that across ELGA and VLGA groups, an increased use of gestures was associated with affect becoming more negative (i.e., affect slope decreased; $F(1, 46) = 3.49$, $p = .038$). A non-significant interaction term in this analysis suggests that the slopes of these associations (affect slope and gesture use) was similar in the two groups. The associations between change in affect and gaze avoidance, and self-comforting behaviors were non-significant.

3. Discussion

The primary purpose of the study was to better understand emotional reactivity and emotion regulation efforts in infants born preterm of varying gestation using a standardized still-face stressor. Most studies examining outcomes of infants born preterm have focused on comparing preterm and healthy full-term infants on a host of cognitive and socio-emotional outcomes (Aylward, 2002). Although this type of research provides valuable information regarding the difficulties faced by infants born preterm, it provides little information regarding the heterogeneity within the preterm population, including difficulties faced by infants born preterm of varying gestation.

As anticipated, infants born ELGA displayed greater emotional reactivity compared to infants born VLGA. This finding is consistent with claims that infants born earlier in gestation are at greater risk of displaying affective disturbances (Aylward, 2002). As previously noted, however, our study is the first to compare emotional reactivity of infants born ELGA and VLGA during a standardized stressor, such as the still-face procedure.

Our emotion regulation findings indicate that infants born ELGA display gaze avoidance behaviors less frequently and gestures more frequently than infants born VLGA. As previously noted, gaze aversion has been shown to be an adaptive mean of emotional regulation in that infants who are able to look away from a distressing stimulus show less negative affect during stressors (Braungart-Reiker & Stifter, 1996). Previous studies have also shown that communicative behaviors, such as gestures, are associated with increases in negative affect during stressors (Braungart-Reiker & Stifter, 1996), indicating that communication behaviors are less effective at regulating negative emotions. Together these findings indicate that infants born ELGA use less of the more effective gaze avoidance behaviors and more of the less effective communication behaviors (i.e., gestures), suggesting a possible underlying difficulty with emotion regulation.

The finding of higher self-comforting behaviors among infants born ELGA, however, is contrary to what we expected. Given that previous studies have shown that self-comforting behaviors are associated with decreases in negative affect during stressors (Braungart-Reiker & Stifter, 1996), we expected that infants born ELGA would use less self-comforting behaviors compared to infants born VLGA. Although infants born ELGA used more self-comforting behaviors, the emotional reactivity findings of increasing negative affect during the still-face episode among infants born ELGA suggests that self-comforting may not have effectively helped decrease distress in these infants. In order to better understand this association, however, future studies should examine the relationship between self-comforting behaviors and negative affect using time series analyses.

Together these findings suggest that infants born earlier in gestation show greater vulnerability in terms of greater emotional reactivity and less adaptive emotion regulation efforts during a standardized stressor. Additionally, the emotion reactivity finding combined with the emotion regulation findings suggest that infants born ELGA may have more difficulty effectively regulating their distress through our current conceptualization of regulatory behaviors.

Because little is known about the relationship between emotional reactivity and emotion regulation behaviors, the secondary purpose of this study was to investigate the relationship between emotional reactivity and regulation across preterm groups. Our findings indicate that the use of increased gestures was associated with affect becoming more negative in both preterm groups (ELGA, VLGA). This supports previous findings indicating that communicative behaviors are associated with increases in negative affect during stressors (Braungart-Reiker & Stifter, 1996). Future studies may benefit from using time-series analyses since although they would not demonstrate causality, they could further our understanding of how particular emotion regulation behaviors are followed by changes in affect.

The current study was limited by its small and unequal ELGA and VLGA sample sizes as well as its limited statistical power. Another question not answerable from our data is whether or not the differences we found are developmental lags in these capacities or are reflective of injury related to prematurity. Longitudinal data are needed for such a study. Additionally, the inclusion of physiological measures of emotional reactivity would have supplemented the behavioral measure of emotional reactivity used in this study. Despite its limitations, however, the present study extends previous research on medical severity by comparing infants born preterm of varying gestational age on emotional reactivity and emotion regulation behaviors. Our findings support the claim that infants born earlier in gestation, such as those born <28 weeks, are at greater risk for displaying emotional reactivity and emotion regulation difficulties.

Overall, our findings speak to the importance of helping parents of infants born ELGA assist their infants' emotion regulation efforts. Helping parents assist their infants' regulation efforts (e.g., helping them shift their attention away from the stimulus causing distress) when stressed or overstimulated will support their infants efforts at modulating their affective states and employing adaptive regulation strategies.

Acknowledgments

This research was supported by DHHS/NIH/NCRR/GCRC Grant #5M01 RR00997. A fuller report will be provided upon request.

References

Aylward GP. Cognitive and neuropsychological outcomes: more than IQ scores. Mental Retardation and Developmental Disability Research Reviews. 2002; 8:234–240.

Braungart-Reiker JM, Stifter CA. Infants' responses to frustrating situations: Continuity and change in reactivity and regulation. Child Development. 1996; 67:1767–1779. [PubMed: 8890506]

Cohen J. A coefficient agreement for nominal scales. Educational and Psychological Measurement. 1960; 20:37–46.

Crockenberg SC, Leerkes EM. Infant and maternal behaviors regulate infant reactivity to novelty at 6 months. Developmental Psychology. 2004; 40:1123–1132. [PubMed: 15535761]

Crockenberg SC, Leerkes EM, Bárrig Jó PS. Predicting aggressive behavior in the third year from infant reactivity and regulation as moderated by maternal behavior. Development and Psychopathology. 2008; 20:37–54. [PubMed: 18211727]

Eckerman CO, Hsu HC, Molitor A, Leung EHL, Goldstein RF. Infant arousal in an en-face exchange with a new partner: Effects of prematurity and perinatal biological risk. Developmental Psychology. 1999; 35:282–293. [PubMed: 9923482]

Stifter CA, Braungart JM. The regulation of negative reactivity in infancy: Function and development. Developmental Psychology. 1995; 31(3):448–455.

Tronick EZ, Als H, Adamson L, Wise S, Brazelton TB. The infant's response to entrapment between contradictory messages in face-to-face interaction. Journal of American Academy of Child Psychiatry. 1978; 17:1–13.

Tronick, EZ.; Weinberg, MK. The infant regulatory scoring system. Boston, MA: Children's Hosptial/ Havard Medical School; 1990. Unpublished manuscript

Voss W, Neubauer AP, Wachtendorf M, Verhey JF, Kattner E. Outcome in extremely low birth weight infants: What is the minimum age for reliable developmental prognosis? Acta Paediatrica. 2007; 96:342–347. [PubMed: 17407453]

Weinberg KM, Tronick EZ. Beyond the face: An empirical study of infant affective configurations of facial, vocal, gestural, and regulatory behaviors. Child Development. 1994; 65:1503–1515. [PubMed: 7982365]

Table 1

Group differences on emotional reactivity and emotion regulation behaviors

	ELGA sample (*N* = 34)		VLGA sample (*N* = 17)		
Variables	**M**	**S.D.**	**M**	**S.D.**	**Significance**
Slope	−0.004	0.0057	−0.001	0.002	$t(44.9) = -3.10$, $p < .01$
Gaze avoidance	0.741	0.189	0.844	0.126	$t(39.1) = -2.24$, $p < .05$
Gestures	0.062	0.121	0.013	0.026	$t(39.4) = 2.25$, $p < .05$
Self-comforting	0.216	0.278	0.099	0.111	$t(46.8) = 2.12$, $p < .05$

Note. ELGA: extremely low gestational age; VLGA: very low gestational age.