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Effects of negative temperament on 5-month-old infants' behavior during the still-face paradigm

Kathryn Yoo [a], Bethany C. Reeb-Sutherland [b,*]

[a] Department of Human Development and Quantitative Methodology, University of Maryland, College Park, MD 20742, United States
[b] Department of Psychology, Florida International University, Miami, FL 33199, United States

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ABSTRACT

Five-month-old infants characterized as low or high on temperamental negativity participated with their mothers in the still-face paradigm. Compared to low negative infants, high negative infants displayed greater negative engagement during reunion suggesting that infant temperament significantly contributes to individual differences in the still-face effect.

The still-face paradigm (SFP; Tronick, Als, Wise, & Brazelton, 1978) is a procedure commonly used to examine the active role of the infant during social interactions. The SFP typically consists of three phases: baseline, still-face, and reunion. During baseline, the mother engages in normal interaction with her infant. During still-face, the mother discontinues interaction and looks at her infant while maintaining a neutral facial expression. Lastly, during reunion, the mother resumes normal interaction. Compared to baseline, the still-face phase induces increased negative and decreased positive affect in the infant, known as the still-face effect (SFE). In addition, during reunion, lower positive and higher negative affect is typically observed in comparison to baseline which is known as the carry-over effect. Changes in the infant's behavior during the still-face phase has been interpreted as being the result of a violation of the infant's expectations of normal social interaction (Tronick et al., 1978). Observed changes in these behaviors have been used to examine potential moderators that may influence mother-infant interactions (for review see Adamson & Frick, 2003; Mesman, van Ijzendoorn, & Bakermans-Kranenburg, 2009).

Several studies have examined maternal characteristics as moderators of the SFE, however much less is known about infant characteristics that may influence the SFE (Mesman et al., 2009). One infant characteristic that may contribute to individual differences in the SFE is temperament. There are several reasons why temperament is highly likely to contribute to observed individual differences in the SFE. First, temperament is known to contribute to individual differences in social interaction and emotion regulation during infancy (Fox, 1998; Fox, Henderson, Marshall, Nichols, & Ghera, 2005). Second, temperamental differences are related to emotional reactions to violations of learned expectations (Alessandri, Sullivan,

* Corresponding author at: Department of Psychology, Florida International University, MMC – DM 258, 11200 SW 8th Street, Miami, FL 33199, United States. Tel.: +1 305 348 4895; fax: +1 305 348 3879.
E-mail address: besuther@fiu.edu (B.C. Reeb-Sutherland).

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& Lewis, 1990; Fagen & Ohr, 1985). Lastly, some temperament assessments include measures of emotional reactivity to violations of social norms (Goldsmith & Rothbart, 1999). Given the likely link between temperament and the SFE, it is somewhat surprising that only a few studies have examined this relation (Braungart-Rieker, Garwood, Powers, & Notaro, 1998; Conradt & Ablow, 2010; Haley & Stansbury, 2003; Tarabulsy et al., 2003). The majority of these studies have reported no association between temperament and behaviors observed during the SFP (Conradt & Ablow, 2010; Haley & Stansbury, 2003; Tarabulsy et al., 2003), while one study has reported that negative temperament is associated with reduced regulatory behaviors during the SFP (Braungart-Rieker et al., 1998). Additionally, other studies have included measures of both temperament and the SFP in their battery of assessments, but did not examine the relation between the two constructs (Cohn, Campbell, & Ross, 1991; Fuertes, Lopes dos Santos, Beeghly, & Tronick, 2007). The paucity of research and inconsistent findings among these studies suggests that additional research is needed to determine temperamental contributions to the SFE.

Most models of temperament include some aspect of negative reactivity (Calkins, Fox, & Marshall, 1996; Goldsmith et al., 1987; Kagan & Snidman, 1991) which describes an infant's tendency to display signs of distress (i.e., crying, fussing, motoric agitation). Maternal report of temperamental negative reactivity has been shown to be positively related to infants' displays of greater negative affect (i.e., fussiness, crying) when there was a violation of learned expectancy (Fagen & Ohr, 1985) suggesting that similar temperamental characteristics may predict infants' negative affect in responding to the expectancy violation produced by the SFP. It has been suggested that infants who display extreme levels of negative reactivity are categorically different in their temperamental profile than infants who display low levels of negative reactivity (Calkins et al., 1996; Kagan & Snidman, 1991) and that categorical models of temperamental negative reactivity are better predictors of later behavior than continuous models (Woodward, Lenzenweger, Kagan, Snidman, & Arcus, 2000). Previous studies examining temperamental influences on the SFE have utilized continuous rather than categorical measures of temperament which may help explain why the vast majority of studies report no temperament-SFE relation, particularly when considering negative reactivity. Therefore, in the current study, a categorical approach was taken by examining behavioral responses during the SFP in infants categorized as high on maternal report of negative reactivity compared to infants categorized as low on maternal report of negative reactivity.

Participants were seen as part of a longitudinal investigation exploring the relation between early associative learning and development of social behavior during the first two years of life. Eighty-five 5-month-old infants (43 male, M age = 5.19 months, SD = .53 months) and their mothers participated in the current study. Infants' behavioral responses during the SFP (Tronick et al., 1978) were examined in relation to maternal report of infants' temperament via the Infant Behavior Questionnaire (IBQ; Rothbart, 1981).

The IBQ (Rothbart, 1981) requires mothers to rate the frequency of their infants' behaviors across a number of temperamental dimensions, including activity, soothability, distress to limitations, fear, and smiling/laughter. Following previous studies (Henderson, Fox, & Rubin, 2001; Rothbart, 1986), distress to limitations and fear subscales were standardized and summed as an index of Negative Reactivity. Two groups of infants were created: high negative (n = 29, 15 male) and low negative (n = 31, 16 male). High and low negative infants' Negative Reactivity scores were in the top and bottom third of the sample, respectively.

During the SFP, the infant was placed in an infant seat facing the mother and the infant's behaviors were videotaped. The SFP consisted of three 2-minute phases: baseline, still-face, and reunion. During the baseline and reunion phases, the mother interacted with her infant as she normally would without the use of toys. During the still-face phase, the mother looked at the infant without smiling, talking, or touching the infant. Infants' behaviors were coded using the Infant and Caregiver Engagement Phases system (ICEP; Weinberg & Tronick, 1999) which includes a set of mutually exclusive infant and mother phases of interactive engagement and regulatory codes which are coded second-by-second. For the infant, behavioral codes include protest, withdrawn, object/environment engagement, social monitor, social positivity, and oral self-comforting. Percentage of time each behavior was displayed was computed by dividing the total time the behavior occurred by the total time of the phase and multiplied by 100. Negative engagement was defined as the sum of protest and withdrawn behaviors as previously suggested (Tronick et al., 2005; Weinberg & Tronick, 1999). Emotion regulation was defined as the sum of object/environment engagement and oral self-comforting. Inter-rater reliability was obtained on 20% of the data by two independent coders (range for α's: .78–.99).

Data from the whole sample (n = 60) was examined for violations of normality and equal variance assumptions. If detected, outliers were removed prior to data analysis. An infant was determined to be an outlier if he or she was at least 2 standard deviations above or below the sample mean and if this trend was found consistently across all phases of the SFP. Given this definition, 3 low negative infants were excluded from current analyses due to excessive displays of negative engagement. Separate repeated measures ANOVAs were conducted for each of the four engagement behaviors (negative engagement, social positivity, emotion regulation, and social monitoring) with Phase (baseline, still-face, reunion) as the within factor and Group (low negative, high negative) as the between factor. Preliminary analysis determined that no sex effects existed and was, therefore, not included in further analyses.

Fig. 1 displays behavioral patterns during the SFP between low and high negative infants. A significant phase × group interaction effect was found for negative engagement ($F(1,55) = 5.675$, $p = .021$, $\eta^2 = .094$, linear trend) showing that high and low negative infants significantly differed in their display of negative engagement across the three phases (Fig. 1a). Follow-up independent samples t-tests revealed that both groups of infants responded similarly during the baseline ($t(55) = -1.311$, $p = .20$, $d = .354$) and still-face ($t(55) = -1.607$, $p = .12$, $d = .433$) phases, however during the reunion phase, high negative infants displayed significantly greater negative engagement compared to the low negative infants ($t(55) = -2.533$, $p = .017$,

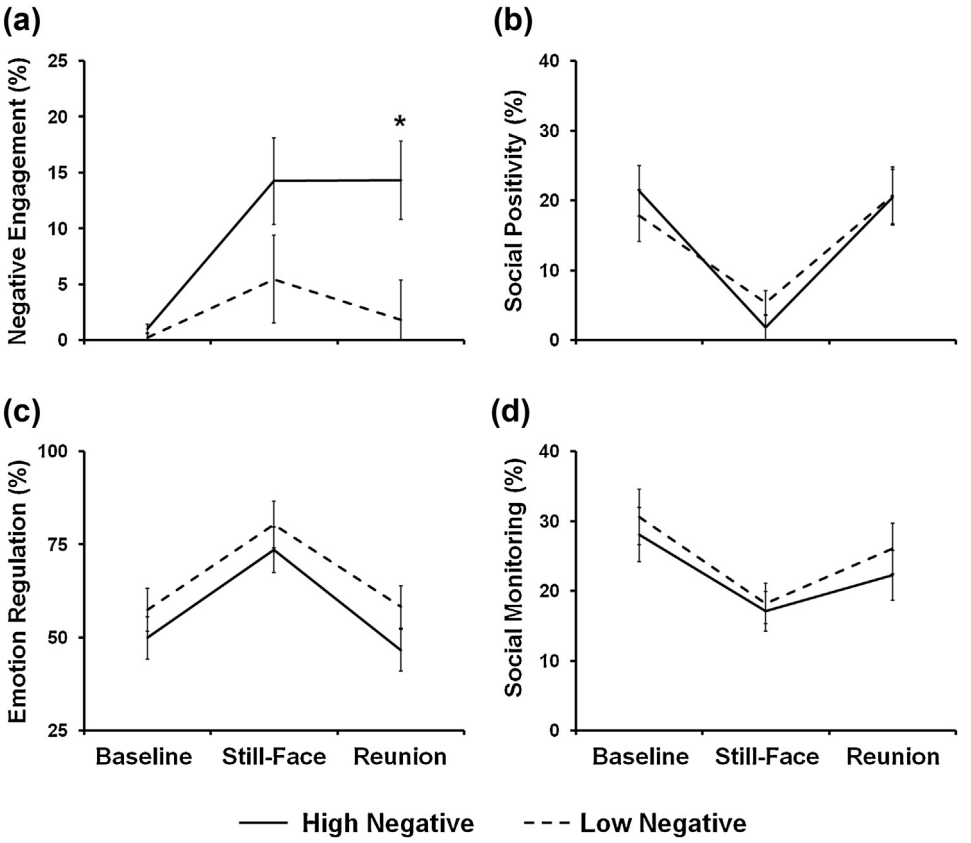

Fig. 1. Effects of negative reactivity on infants' behavior during the still-face paradigm. (a) Infants reported as having high levels of temperamental negative reactivity (high negative, solid line) displayed negative engagement behaviors more often during the reunion phase compared to infants reported as having low levels of temperamental negative reactivity (low negative, dashed line). High and low negative infants did not differ on displays of (b) social positivity, (c) emotion regulation, or (d) social monitoring. *$p < .05$.

$d = .683$). Paired samples t-tests revealed that high and low negative infants both displayed the typical SFE in negative engagement, showing a significant increase if negative engagement from the baseline to the still-face phase (high negative: $t(28) = -2.726$, $p = .011$, $d = 1.030$; low negative: $t(27) = -2.834$, $p = .009$, $d = 1.091$). However, only the low negative infants showed a tendency to decrease in negative engagement from the still-face phase to the reunion phase ($t(27) = 1.959$, $p = .061$, $d = .754$). In contrast, the high negative infants' negative engagement did not differ between the still-face and reunion phases ($t(28) = -.008$, $p = .993$, $d = .003$). In comparison to the baseline phase, the high negative infants displayed significantly greater negative engagement during the reunion phase ($t(28) = -2.806$, $p = .009$, $d = 1.061$) while the low negative infants displayed no difference between the two phases ($t(27) = -1.842$, $p = .10$, $d = .709$).

Similar analyses were conducted for emotion regulation, social positivity, and social monitoring. No significant interaction effects or main effects of group were found. However, as previously reported, a significant main effect of phase was found for each behavior (social positivity: $F(2,110) = 30.726$, $p < .001$, $\eta^2 = .358$, Fig. 1b; emotion regulation: $F(2,110) = 27.227$, $p < .001$, $\eta^2 = .331$, Fig. 1c; social monitoring: $F(2,110) = 13.489$, $p < .001$, $\eta^2 = .197$, Fig. 1d). Between the baseline and still-face phases, infants exhibited a significant decrease in social positivity ($t(56) = 6.392$, $p < .001$, $d = 1.708$) and social monitoring ($t(56) = 4.951$, $p < .001$, $d = 1.323$) as well as a significant increase in emotion regulation ($t(56) = -6.018$, $p < .001$, $d = 1.608$). In contrast, infants displayed a significant increase in social positivity ($t(56) = -6.236$, $p < .001$, $d = 1.667$) and social monitoring ($t(56) = -2.675$, $p = .010$, $d = .715$), but a significant decrease in emotion regulation ($t(56) = 6.435$, $p < .001$, $d = 1.720$) between the still-face and reunion phases. A significant decrease in social monitoring was observed between the baseline and reunion phases ($t(56) = 2.739$, $p = .008$, $d = .732$) while no differences between baseline and reunion were observed for either social positivity ($t(56) = -.481$, $p = .632$, $d = .129$) or emotion regulation ($t(56) = .382$, $p = .704$, $d = .043$).

The aim of the current study was to investigate the specific contributions of infant temperamental negative reactivity to behavioral differences observed during the SFP. We found that infants who were rated by their mothers as high on negative reactivity displayed increased negative engagement during the reunion phase compared to infants rated as low on negative reactivity. Furthermore, high negative infants did not show a difference in their negative engagement between the still-face and reunion phases suggesting that there was a lack in recovery or decrease of negative affect even after the mother

attempted reengagement with her infant. Overall, these findings suggest that negative temperamental biases contribute to the infant's recovery of negative affect following a socially stressful and unexpected situation.

Previous research examining the SFP in typically developing infants have described a phenomenon known as the carry-over effect (Tronick et al., 1978) in which infants continue to display increased negative and decreased positive affect during the reunion phase compared to the baseline phase. In the current study, only the high negative infants displayed a significant increase in negative affect during the reunion phase compared to the baseline phase. In contrast, the low negative infants displayed no difference in negative affect between the baseline and reunion phases. In addition, neither group showed differences in positive affect between the baseline and reunion phases. Therefore, these results demonstrate that only the high negative infants displayed a partial carry-over effect for negative and not positive affect suggesting that perhaps the classic carry-over effect observed among typically developing infants can be significantly influenced by the infant's temperamental negativity.

The few studies that have examined temperamental contributions have reported relatively inconsistent findings. Specifically, three studies found no direct contributions of temperament to the SFE (Conradt & Ablow, 2010; Haley & Stansbury, 2003; Tarabulsy et al., 2003) while one study reported an association between negative temperament and behaviors during the still-face phase (Braungart-Rieker et al., 1998). The current study contributes to these few studies by demonstrating a relation between maternally reported negative reactivity and negative engagement during the reunion phase. Braungart-Rieker and colleagues (1998) reported that high temperamental negativity was not associated with negative affect during the SFP, but was associated with decreased self-comforting and object orientation during the still-face phase. In contrast, we found that extreme levels of temperamental negative reactivity were associated with negative affect during the SFP, particularly during the reunion phase, but was not associated with emotion regulation (i.e., sum of oral self-comforting and object/environment engagement). The inconsistencies observed between these findings may be the result of a number of factors including the use of different measures of temperamental negativity, different statistical approaches (examining continuous vs. categorical measures of temperament), as well as different coding schemes for observing infant behaviors. In addition, other infant factors may contribute to differences among findings including the age of the infant sample as well as sex distribution. To further understand the influence of temperament on infants' behavioral responses during the SFP, additional research needs to be conducted using consistent measures of temperament as well as consistent behavioral measures.

Previous research has shown that temperamental negative reactivity is associated with decreased abilities to regulate emotions (Calkins & Fox, 2002). Contrary to these findings, we did not find any difference in measures of emotion regulation during the SFP between low and high negative infants. However, although these differences were not significant, it is worth noting that the high negative infants were consistently lower in emotion regulation across the SFP compared to the low negative infants. It is possible that the two-minute windows in each of the phases were not sufficiently long enough to reveal significant differences in emotion regulation between the low and high negative infants.

The current study is not without limitations. One limitation is the use of maternal report for the assessment of temperament. It has been suggested that maternal report of infant temperament is not an accurate assessment of the infant's temperamental behavior because the mother's own beliefs and perceptions can bias how she rates her own infant's temperament and that the use of behavioral measures may supply a more objective measure of temperament (Kagan & Fox, 2006). Although it should be noted that behavioral measures of negative reactivity have been shown to be highly correlated with maternal reports of negative reactivity (Calkins et al., 1996). Nevertheless, future studies examining the relation between extreme temperamental characteristics, like negative reactivity, and the SFP should include behavioral measures of temperament. In addition, the current study was limited to the examination of 5-month-old infants; therefore, we are unable to address whether the temperamental differences observed in negative engagement may be observed at earlier or later ages or whether temperamental effects are stable across infancy. Future studies should examine these important questions.

The current study provides evidence that infant negative temperament significantly influences the SFE suggesting that infants are active contributors to changes in social interactions during the SFP. Considering individual differences in infant temperament in the SFE can help reveal the dyadic complexities between the infant and the caregiver that are embedded in the SFP. In the future, noting these individual differences may potentially be useful when examining other moderators of the SFE.

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