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Approach-related emotion, toddlers' persistence, and negative reactions to failure

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Abstract

Approach behavior, defined as differences in behavior to an incentive event and anger at its removal, was assessed during contingency learning in 87 5-month-olds was related to maternal ratings of mastery behaviors at two years. Mothers reported on infants' concurrent temperament, as well as the occurrence of anger and tantrums, and their own anger at 12 months. Approach behavior was expected to predict persistence with objects and persistent motor behavior, but not negative reactions to failure. Negative reactions to failure were expected to be mediated by a distress-prone temperament. The moderating effect of maternal anger on these relations was also explored using conditional process regression models. Controlling for soothability, early approach behavior predicted toddlers' persistence, especially gross motor persistence, moderated by maternal anger. With more maternal anger, approach behavior and toddler's persistence were more strongly related. Distress to limits, infant anger at 12 months, and maternal anger were significantly correlated, but only infant anger was related to negative reactions to failure. Prior to six months, goal-directed behavior is related to later behavioral persistence, but maternal responses to child anger are an important contributor to this relation and by 12 months, infant anger directly predicts mastery frustration at two years.

Evolutionary accounts and functional theories of emotion both agree that anger is characterized by increased activation directed toward a blocked goal or obstacle and has negative valence. As such, this adaptive form of anger has long been viewed as part of the approach emotional system (Carver, Sutton, & Scheier, 2000; Gray, 1991; Greenberg, 2017; Schneirla, 1959). Approach behaviors are motor actions associated with stimulus attention (e.g. reaching, pulling to obtain objects), but they also have an emotional component. Interest, curiosity, and determination are approach emotions, for example. Carver and Harmon-Jones (Carver & Harmon-Jones, 2009; Carver, et al., 2000; E. Harmon-Jones & C. Harmon-Jones, 2013; C. Harmon-Jones, Schmeichel, Mennitt, & E. Harmon-Jones, 2011; E. Harmon-Jones, Lueck, Fearn, & C. Harmon-Jones, 2006) have called attention to anger's unique aspect as a negative approach emotion. Yet, the view of anger as part of approach motivation has been slow to influence the developmental literature on emotion, most likely because anger has negative rather than positive emotional valence. Thus, approach-related aspects of anger have not typically been examined. Our goal was to explore the relations

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between young infant's approach-related emotion and other behaviors with which approach-related emotion is theoretically or conceptually linked.

Infant contingency learning and anger responses to its disruption offer a way of assessing approach behavior and approach-related anger prior to six months of age. This body of work consistently has found that greater anger expression during contingency disruption (i.e., an extinction procedure) and increased instrumental action occur when the contingent goal was disrupted, although the two measures of increased activation and anger expression were weakly correlated (Crossman, Sullivan, Hitchcock & Lewis, 2009; Sullivan & Lewis, 2003; Sullivan, Lewis, & Alessandri, 1992). In other work, individual differences in the infants' anger expressions to the blocked goal were related to interest expressions when the contingent goal was restored (Lewis, Sullivan, Ramsay, & Alessandri, 1992). Additionally, tantrums of 20-month-old toddlers, measured in terms of either onset or severity, were unrelated to anger expressions at 5 months (Sullivan & Lewis, 2012).

Because these results support the view that individual differences in contingency response and anger at its disruption (i.e., approach-related anger) may provide a measure of approach behavior and emotion, we developed a general model to explore relations between infant approach in this context with theoretically-linked behavioral sequelae such as behavioral persistence and negative reactions to failed goal-directed activity in toddlers (See Figure 1). Persistence at play with objects and during motor activities, the primary measures at two years, were hypothesized to develop from early approach behavior. Negative reactions to failure at two years, on the other hand, were expected to show different or possibly unique mediation by early temperamental negativity, because they may be comprised of both poorly regulated anger to blocked goals and distress.

Behavioral persistence at challenging or effortful tasks is a key aspect of mastery motivation observed in toddlers and preschoolers (Busch-Rossnagel & Morgan, 2013; MacTurk & Morgan, 1995; Messer, 1993). The behavior and emotion observed in contingency learning and similar instrumental tasks is a hypothesized precursor of such mastery motivation with later persistence reflecting the cumulative history of contingency experiences of infants prior to 9 months (Dichter-Blancher, Busch-Rossnagel & Knauf-Jensen, 1997; MacTurk & Morgan, 1995; Morgan, Wang, Liao & Xu, 2013). These studies and the linkage of approach-related anger to subjective feelings of determination in adults (C. Harmon-Jones et al., 2011) support the idea that individual differences in anger resulting from thwarted approach may be related to later differences in persistence. We sought to model this relation taking potential mediators of maternal behavior and child temperament into account.

Some empirical evidence on one form of persistence frequently observed in young children has been related to early approach as well as to maternal behavior. Assertiveness or the pursuit of one's agenda despite interruption or competing demands, an early form of self-efficacy or autonomy-striving, was related to approach-related anger, but not to negativity or protest to the disruption (Lewis, Sullivan & Kim, 2015). Although toddlers' willfulness has been linked to positive socialization techniques of mothers, including supportive maternal behavior, autonomy-granting, and low depressive symptoms, Lewis et al. (2015) found no consistent association with early maternal contingency. In other work, highly willful toddlers

also initiated more positive interactions with mothers than did low-willful toddlers, leading the investigators to conclude that in toddlers, active resistance to parental demands reflects children's motivation to control events rather than poor parenting (Dix, Stewart, Gershoff, & Day, 2007). Differences in approach-related anger expression specifically also have been related to child surgency and attention in preschoolers (He et al., 2013). Such findings, support the idea that early individual differences in approach behavior and emotion are related to positive child characteristics and that maternal anger/annoyance would have limited impact on mastery behaviors except at high levels of maternal anger.

Negative reactions to failure at two years of age is a measure of frustration at the inability to accomplish goals, and reflects the negative aspect of mastery attempts. This construct is related conceptually to tantrums in the second year of life. Tantrums at this age are thought to reflect developmental characteristics of mastery and autonomy-striving (Birigen, Campos, Emde, & Applebaum, 2008). Typically peaking between 18 and 24 months (Potegal & Archer, 2004), tantrums are not considered problematic unless they persist beyond toddlerhood and are protracted, self-injurious, or aggressive (Belden, Thomson, & Luby, 2008;; Carlson, Potegal, Margulies, Gutkovitch, & Wall, 2009; Lorber, Del Vecchio, & Slep, 2015). Severe tantrums after the age of 4–5 years are thought to indicate poor anger regulation due either to underlying vulnerabilities or to problematic interactive processes (Carlson, et al., 2009).). In addition to modeling persistence, we explored in a separate model relations between early approach-related emotion and negative reactions to failure. We expected negative reactions to failure to be inversely related to approach and to reflect more negative temperament.

By including approach-related anger in our approach construct, we also sought to explore several issues that complicate study of the development of individual differences in anger. A key issue addressed by including anger expressions in the operational definition of infant approach are that negative emotion has been viewed as undifferentiated throughout the first year of life. Infant emotion research generally finds that anger and sad/distress expressions co-occur to many emotion elicitors and that there is limited evidence for emotion-context specificity (Camras & Shutter, 2010).

The temperament literature also tends to support the view of undifferentiated anger. Despite the careful parsing of infant reactivity along several emotion-relevant dimensions, maternal reports of temperament in early infancy tend to reduce statistically to three broad factors: positive affectivity, negative affectivity, and orienting/regulatory capacity (Putnam et al., 2014). At the same time, approach-related anger to contingency disruption has been unrelated to maternal reports of temperament in any simple way, suggesting the constructs may differ. Specifically, distress to limits, the dimension with greatest face validity with anger/frustration, was unrelated to anger expression (Crossman et al., 2009). Likewise, having a relatively more negative temperament contributed little variance to toddler persistence, but persistence was predicted by approach-related anger measured during contingency disruption (Lewis, et al., 2015). Although temperamental irritability during contingency learning itself has been reported to have a modest relation to learning performance, this relation was due to the irritability of non-learners included in the sample (Lemelin, Tarabulsky, & Provost, 2002). Moreover, this relation held whether learning status

was operationally defined as a continuous learning score or as a dichotomous (yes/no) variable. These investigators suggested that irritability during learning might reflect an inability to manage incoming information, mediated by greater negativity to environmental and task novelty, clearly temperament factors. How and when approach-related anger may be distinguished from irritable anger/distress is a difficult problem. However, findings from empirical work on emotional components of tantrums and their timing suggested a strategy for exploring this issue in our model.

The constructs of distress to limits and negative reactions to failure may share features of tantrum behavior which appears to include both anger and distress components, organized as a bi-phasic process (Potegal & Davidson, 2003). Behaviorally, tantrums are comprised of rapid-rising, intense anger followed by less intense, slower-fading distress. The anger component of tantrums has an organized, hierarchical pattern of increased activation and escalating vocal behavior to blocked play, empirically observable by 15 months of age (Potegal, Robison, Anderson, Jordan, & Shapiro, 2007). The organization of tantrums as a dynamic, bi-phasic process suggests that the initial anger of tantrums may be goal-focused. Additionally, it may be that the secondary distress component is more indicative of temperamental distress-proneness. Although it is unclear exactly when in development this biphasic organization of anger and distress arises, its presence by 15 months implies that the anger component of tantrums might be separable from distress, and potentially from temperamental negativity. Negative temperament seems to reflect either generalized negative reactivity, or the shared variance between anger and distress processes. The contingency learning and disruption procedure provided an opportunity to explore this issue at five months, because the anger expressions observed upon contingency disruption are thought to result from thwarted approach rather than heightened distress.

To test the explanatory value of distress to limits in accounting for any observed relations between approach and anger expressions and later toddler behavior, we included it as a mediator in our models. To the extent that anger expression in response to contingency can be accounted for by temperament, a mediating relation with distress to limits should be observed (as shown in Figure 1). To the extent that anger/approach behavior is being measured, distress to limits will not explain an approach-persistence relation. Similarly, maternal report of infant anger severity at 12 months was included as a second mediator. We expected 12-month anger to be at least moderately correlated with distress to limits, reflecting some continuity with early temperament, but we also expected it might also reflect the more differentiated organization of anger/distress reactions thought to emerge in the second year. Potentially, different mediating effects might be observed in our models of the relations between approach and the mastery-related outcomes of persistence and negative reactions to failure.

We also considered whether any observed relation between approach and toddler behavior was conditional on maternal responses to toddlers' anger. We evaluated maternal anger as a moderator of the hypothesized approach-outcome relations given the large literature on interactive effects in early socialization. Among clinically-referred dyads, externalizing problems in preschool-age children were predicted by earlier negative parenting and mutually angry, hostile interactions, indicating that maternal anger to toddlers' anger is a

risk factor (Davies & Cicchetti, 2014; Lorber & Egeland, 2009). Maternal emotion, appraisals of child behavior, and physiological reactivity may lead to over-reactive, inappropriate extremes of parenting (over-permissiveness, punitiveness or unresponsiveness), eliciting child negativity as well as less effective behavioral management by mothers (Lorber, 2012; Lorber, Mitnick, & Slep, 2016). If such processes are present in non-clinical samples, it is important to know when they first influence child emotionality. Interactions promoting the exacerbation of anger and tantrums are likely cumulative as infants become increasingly mobile and independent. It was expected that maternal anger in response to toddlers' anger might exacerbate negative reactions at two (Lorber & Egeland, 2011). Influences on persistence were more exploratory, because primarily relations between positive maternal behavior and persistence have been observed.

Finally, soothability, a temperament dimension that captures self-calming or ability to down-regulate negative affect, has been related to differences in learning status and cardiac-regulation (Crossman, et al., 2009; Sullivan, 2016). We therefore included it as a covariate (not shown in Figure 1).

In summary, the hypotheses were: 1) controlling for soothability, approach behavior to contingency and its disruption would be related to greater persistence, but not to greater negative reactions to failure, consistent with demonstrated links between persistence and toddler autonomy-striving (Dichter-Blancher, et al., 1997); 2) controlling for soothability, distress-proneness and infants' 12-month anger severity would be correlated and would mediate the approach-persistence relation to the extent that infant distress-prone reactivity accounts for any relation between approach-related anger and later persistence; 3) controlling for soothability, a more distress-prone temperament and/or greater anger severity at 12 months would be related to negative reactions to failure, mediating any observed relation between approach and negative reactions to failure, and 4) maternal anger would moderate the effect of infant approach such that negative reactions to failure would be greater when maternal anger was greater. Differences in persistence were also expected to be evident when maternal anger was greater, if moderation was observed.

Method

Participants

A convenience sample of 103 healthy newborns (37 weeks GA; birth weight > 5 lbs; 54% female) and their mothers were recruited for study at University-affiliated teaching hospitals prior to discharge by an experienced research assistant. The diverse sample represented the surrounding metro/suburban area. Sixteen infants were missing data due to attrition at the final visit (11) or incomplete or missing 12-month data (5), resulting in a final N of 87. Infants lost to follow-up did not differ in age, gender, parity, maternal marital status, ethnicity or other demographic characteristics from those who completed the study. Detailed demographic information on the sample is provided in the supplementary material.

The attrition rate between each contact point was approximately 10%, within the expected range for longitudinal visits at our laboratory. Infants with missing data did not differ significantly in their behavior or their 5-month temperament ratings from those with

complete data. Five additional infants were excluded from the sample initially for health issues (i.e., maternal expression of a developmental or health concerns, or diagnosis of a medical or sensory problem including heart murmur; questionable vision or hearing).

Procedures

There were two laboratory visits (5 months, 24 months) and one interim phone contact (12 months). At the 5-month visit, each infant was observed in a standard learning procedure. A detailed description is provided below. Birthday cards were sent when all children reached 12 months of age and mothers were reminded that they would be contacted via phone to answer questions about their child's emotions and development at this age. At 24 months, toddlers received a standardized assessment to confirm that they were developing appropriately while, mothers completed a questionnaire on tantrums and anger. The procedures at each contact point were explained to the mothers who had the opportunity to ask questions and sign IRB-approved consent forms.

Five-month assessment—Infants were scheduled when mothers expected them to be alert and playful. Mothers completed the Infant Behavior Questionnaire [IBQ] (Rothbart & Gartstein, 2000) to assess temperament. Infants ($M = 23$ weeks, $SD = 2.0$) were trained to pull a ribbon to activate an audiovisual event using a well-established operant learning procedure (Crossman et al., 2009; Sullivan, 2016; Sullivan et al., 1992). As in these studies, rate of pulling (i.e., a motor activity whose goal was to access the contingent incentive) was assessed during a period of non-incentive. Anger expressions during this period were simultaneously scored. Increased pulling and anger displays in this context reflect behavioral persistence in accessing a stimulus and were the measure of approach behavior (Lewis et al., 2015).

Each infant sat in front of a monitor with mothers nearby, but out of view. A ribbon attached to a soft elastic cuff was placed on the infants' right wrist. The session consisted of three phases: baseline, contingency, and disruption/extinction. In the initial 2-m *baseline* phase, we recorded the frequency of pulling without incentive. This was followed by a 6-m *contingency learning* phase during which each pull activated the 3-s audiovisual event. The 6-m period is sufficient to observe learning at this age, but brief enough to minimize boredom or crying (Crossman et al., 2009; Sullivan, 2016). Any fussing, defined as intermittent, voiced, low level negative affect during learning was timed via a stopwatch by the research assistant. If fussiness escalated into continuous crying that lasted for more than 60 seconds, the session was terminated. Following this learning phase, infants experienced another 1-m of non-reinforcement; the *disruption/extinction* phase.

The infant's face and shoulders were recorded throughout the session for subsequent scoring of facial expressions during the disruption. Two coders were trained to a minimum of 80% reliability on pre-coded stills and digital videos from a prior study and were blind to infant performance during the lab. Interim reliability checks were done on 10% of randomly selected study participants. *Kappa* coefficients indicated that coders sustained above chance agreement ($\kappa = .87$).

Infants' anger expressions during the disruption phase were scored second by second using MAX facial expression codes (Izard, 1995) as infants show little anger during contingency learning (Crossman et al., 2009; Sullivan, 2016), but approximately 50–60% of infants who learn tend to display anger during the disruption/extinction phase, ranging in duration from 1 to more than 53 seconds of anger (Crossman et al., 2009; Sullivan & Lewis, 2012).

Measures

Table 1 lists summarizes all the measures and lists the age at which they were collected.

Infant approach (5 months)—A composite approach score was derived from the learning behavior (pulling) and the occurrence of anger expression when the contingency incentive was disrupted. It reflected consistent access of the incentive event while also accounting for the occurrence of anger expressions when the contingency was disrupted. Infants' pulling rate determined whether each individually sustained an increase in pulling equal to or greater than 1.15 times their baseline average ($M_{\text{contingency}}/M_{\text{baseline}}$). This minimum learning criterion discriminates reliably between those infants who rapidly respond to the contingency in a single session and those who do not (Crossman et al., 2009; Sullivan, 2016) and has been used to distinguish learners from nonlearners in other work (Lemelin et al., 2002). Infants meeting criterion were responsive to the contingency, i.e., increased pulling, and therefore displayed approach behavior toward the stimulus. Those who did not learn were categorized as having shown little or no approach and met the criterion for excessive fussing during the contingency phase. Anger expression observed during contingency disruption was divided into three categories: low and high anger by median split and no anger during disruption. Infants were then grouped into five ordinal categories reflecting less or more approach behavior. The ranked approach categories were: 1) those showing little or no approach (35% of the sample), 2) approach with increasing fussiness during the session (13%), 3) approach and anger to disruption less than the median (15%), 4) approach with anger to disruption above the median (17%), and 5) approach without anger in response to disruption (20%). The pulling and anger expression data corresponding to each of these categories is reported in Table 1.

Temperament (5 months)—This well-constructed, widely-used, reliable maternal report of infant temperament allows mothers to rate six dimensions on a 1–7 scale (Rothbart & Gartstein, 2000). For this study, the dimensions selected for analysis were Soothability and Distress to Limits. Soothability is often included in composite positive temperament scores, but it served in this study as a measure of infants' ability to scale down-regulation of negative affect, rather than as a measure of positive temperament. Soothability has been associated with differences in cardiac regulation during learning contingency (Sullivan, 2016). Distress to Limits or negativity in response to restriction is a component of negative temperament and has considerable face validity with tantrums and negative responses to frustration. It also predicts later externalizing behavior in clinically-referred samples by 8 months of age (Lorber et al., 2014).

Twelve-month anger—At 12 months, mothers reported on tantrums and anger using an instrument developed for this study (Sullivan, 2012). The 17 scenarios were selected from a

set of 25 that were piloted with an independent sample of 50 mothers of toddlers who rated the frequency of occurrence of each scenario. The scenarios retained in the current study were reported to occur at least weekly by 75% of mothers. To further insure that maternal reports of their own anger were based on actual, rather than hypothetical, events in their children's lives, mothers in the study were also asked to report the frequency of occurrence of each scenario. Only scenarios with non-zero occurrence were used to calculate maternal anger severity in this study.

Mothers rated 1) the frequency of tantrum occurrence on a 7-point scale ranging from never to more than once per day, and 2) the frequency of everyday contexts in which toddler's anger expressions might occur a 5-point scale, ranging from "Never or less than once per week" to "Very often, every day or more than once per day", as well as the severity of anger in those contexts, also using a 5-point scale ranging from "No anger" to "Full tantrum". The twelve-month anger severity served as the measure of negativity at this age in addition to the earlier rating of distress to limits at 5 months. Tantrum frequency was assessed for descriptive purposes and for cross-validation of the 12-month anger measures. Tantrums were defined for mothers as a sudden outburst of negative emotion in relation to a restriction or the child's inability to do something. Mothers were also provided a checklist of behaviors to indicate those they typically observed to confirm that they were characterized by at minimum, screams, shouts or intense crying.

The contexts rated for anger severity were 17 common, pretested scenarios in which toddlers might become angry or frustrated (See supplementary material). Cronbach's alpha, calculated on 80 questionnaires with complete data on all items was .76. Deletion of any single item from the analysis did not suppress alphas below .74. In addition, mothers also rated their own anger/annoyance in each scenario from (1) not at all angry/annoyed to (5) very angry. The ratings were averaged across reported scenarios to yield the average levels of 12-month anger for the child and anger severity of the mother. Split-half reliability for each scale was .80 for context frequency; .84 for child anger severity and .84 for maternal anger. Reliability for tantrum frequency cannot be reported because it was a single item. Only 12-month anger severity and maternal anger were included in the models.

Toddler Behavior—Persistent behavior and negative reactions to failure at two years of age were assessed on the *Dimensions of Mastery Questionnaire* [DMQ] (Busch-Rossnagel & Morgan, 2013). This 45-item questionnaire obtains maternal report of a toddler's motivation to persist at challenging tasks without undue frustration. Mothers rate several behavioral domains of persistence (35 items) and Negative Reactions to Failure (5 items). The scales have reported internal consistencies of .68 – .83, consistent with the range of alphas observed in this study (.65 – .81). Parent and teacher ratings, as well as older children's self-ratings on DMQ correlate significantly with observed behavioral persistence (Morgan, et al., 2013). The analyses focused on two scales that were conceptually similar to the infant measure of persistent pulling and goal-directed anger in response to removal of the contingency goal. Object-Related Persistence (Object P) and Gross Motor Persistence (Gross Motor P), as well as the Negative Reactions to Failure scale. Thus, both persistence (2 scales) and negative reactions to failed goal-directed behaviors were assessed as outcomes in separate models.

Results

Data Analysis Plan

Table 1 summarizes all the measures used in modeling, their source, and the variables derived from them. The distributions and descriptive statistics of all data were inspected initially, and preliminary analyses were run to determine whether any demographic or family variables (e.g., gender, birth order, number of hours of nonmaternal care, etc.) should be included as covariates. None were significantly related to the study variables (all $ps > .10$). Then, the bivariate correlations between these variables were inspected. Thereafter, three conditional process regression models were assessed using techniques developed by Hayes (2013) to evaluate the conceptual model (Figure 1) for each of the three outcomes and to obtain population-based estimates of any observed mediation or moderation. A fourth model predicting tantrum frequency was not significant ($p > .05$), so only the three models of the DMQ persistence and negative reactivity scales are reported. Using G-POWER (Faul, Erdfelder, Buchner, & Lang, 2009), the sufficient sample size for an alpha of 0.05, power of 0.80, and a medium effect size (0.15) was an N of 85.

Descriptive data at 5 months—The learning data were inspected to assess whether the approach scores reflected the raw learning and emotion data. The means of the learning ratio score (contingency response/baseline response) and anger expressions during disruption are presented in Table 1 adjacent to the category descriptors. The ranked categories differed significantly on each measure by Kruskal-Wallis test ($p < .05$ for both), but did not differ on distress to limits or soothability ratings, supporting the approach categorization. The correlations between the learning ratio score and distress to limits and soothability were nonsignificant ($r_{87} = -.16$ and $.02$, respectively). Correlations between infant anger expressions and these temperament dimensions were $.03$ for soothability, and $-.04$ for distress to limits.

Descriptive data at 12-months—The onset and the frequency of tantrums reported by mothers for this sample are summarized for comparison with other samples. The mean age of tantrum onset was 12.26 months ($SD = 0.37$). Although 94% of the children reportedly expressed anger at 12 months, tantrums were less frequent. The modal response (53%) was a tantrum occurrence of “less than once per week”, with 2% having more than one per day. Tantrum frequency at this age was related to Negative Reactions to Failure at two years ($r_{88} = .25$, $p < .05$). Tantrum frequency was modestly related to both 12-month anger severity ($r_{101} = .37$, $p < .01$) and to infant distress to limits ($r_{103} = .22$, $p < .05$), but not to soothability ($-.17$, ns), anger expression at 5 months ($.21$), the learning score ($-.02$, ns). Maternal anger was also unrelated to tantrum frequency at 12 months ($.02$, ns). Means of 12-month anger-severity and maternal anger, as well as their correlations with 5-month variables, are reported in Table 2. Maternal anger was related to 5-month distress to limits ratings as well as to 12-month anger.

Modeling toddler persistence and negative reactions to failure—Table 2 presents the bivariate correlations between the variables used in the conceptual models and the means and standard deviations for the continuous measures. All significance levels are two-tailed.

Correlations among the DMQ scale scores showed that Object P and Gross Motor P were related to one another (p 's $< .01$), but were inversely related to Negative Reactions to Failure, the relation with Gross Motor P being significant ($p < .05$). Object P and Gross Motor P were retained as separate measures of persistence as they reflect different behavioral domains and because pulling, a gross motor behavior, was the index of learning. Because the bivariate correlations indicated that soothability was related to DMQ persistence scores, but not to Negative Reactions to Failure, distress to limits or to 12-month anger severity, it was retained as a covariate in the model. Distress to limits was entered as a mediator along with its correlate, 12-month anger severity, in each of the models. Infant approach behavior was the focal predictor of each of the DMQ outcomes. The models also examined whether the observed relation between Approach and each DMQ outcome was moderated when mothers expressed anger in response to their toddlers' anger.

To locate effects, tests of indirect effects were conducted with each model. Interactions were assessed using percentiles and bias-corrected, confidence intervals estimated using bootstrapping (Hayes, 2013). The number of bootstrap samples used to generate these bias-corrected intervals was 1,000. The final, summary model is described for each outcome. Graphical presentation of interaction terms employs recommended techniques for locating significant effects by plotting the conditional direct effect of Approach on each outcome at 10th, 25th, 50th, 75th, and 90th percentiles of Maternal Anger in the models (Hayes, 2013).

Infant Approach Emotion and Toddler's Object Persistence (Object P)

Main hypothesis—We expected that persistence with objects would be related to infants' early approach behavior, potentially moderated by maternal anger. The overall model predicted persistence with objects ($R^2 = .17$, $F_{6,80} = 2.78$, $p = .02$). Soothability, the covariate, was related to Object P ($Beta = .11$, $SE = .05$, $t = 2.39$, $p < .02$ [$CI, .02:.20$]). A conditional effect of maternal anger was observed ($Beta = -.38$, $SE = .04$, $t = 2.38$, $p < .02$ [$CI, .02:.19$]). The interaction between approach and maternal anger severity approached statistical significance ($Beta = .17$, $SE = .09$, $t = 1.92$, $p < .06$, [$CI, .01: 0.35$]). Figure 2 shows these effect sizes with 95% confidence intervals plotted against the size of the interaction. The effect estimate appears on the vertical axis and the moderator of parent anger severity appears on the horizontal axis. A horizontal reference line indicates the effect estimate of zero. The plotted lines show the mean value at selected points on the range of parent anger severity in the model (specifically, the 10th, 25th, 50th, 75th and 90th percentiles) as well as the 95% confidence intervals over the 10th through 90th percentiles. Where the intervals do not include the effect estimate of zero, a significant moderation effect is found. Maternal anger had little impact on the relation between approach style and persistence except at the highest percentiles. Approach was related to Object P when maternal anger level was higher. At this level of maternal anger, approach behavior enhanced Object P as the confidence intervals exclude zero.

Mediation—We hypothesized that the direct relation between approach and persistence might be accounted for in part by distress to limits and/or 12-month infant anger severity. Tests of indirect effects found no evidence of mediation. That is, controlling for soothability,

neither infants' distress to limits at 5 months nor 12-month anger severity accounted for the observed relations between infant approach behavior and later persistence with objects.

Infant Approach Emotion and Toddler's Gross Motor Persistence (Gross Motor P)

Main hypothesis—We expected that persistence in gross motor activities would be related to infants' early approach behavior, moderated by maternal anger. This regression model also predicted Gross Motor P ($R^2 = .15$, $F_{6,80} = 2.28$, $p = .04$). Soothability again directly predicted greater persistence ($Beta = .15$, $t = 2.61$, $p < .01$ [CI , 0.14 : 1.05]). A conditional effect of maternal anger was again observed ($Beta = .11$, $t = 2.16$, $p < .03$). Figure 3 shows these effect sizes with their respective 95% confidence intervals, plotted as described above. When maternal anger was highest, its effect on the Approach/Gross Motor P relation was strongest. At all other levels, the effect was nonsignificant as the confidence intervals include zero.

Mediation—No mediation effects were observed. That is, controlling for soothability, neither infants' distress to limits at 5 months nor 12-month anger severity accounted for the observed relations between infant approach behavior and later gross motor persistence.

Infant Approach and Negative Reactions to Failure

Main hypothesis—We expected that negative reactions to failure would be related to infants' early approach behavior, moderated by maternal anger. This model also significantly predicted Negative Reactions to Failure ($R^2 = .20$, $F_{6,80} = 3.30$, $p < .006$). However, there were no direct effects of soothability or approach, and no evidence of moderation by maternal anger severity.

Mediation—The mediation hypothesis was unsupported for distress to limits or its downstream correlate, 12-month anger severity. There was a direct effect of 12-month anger severity on the outcome without significant mediation, however ($Beta = .48$, $SE = .17$, $t = 2.84$, $p > .006$, [CI , $.14$: $.82$]). Infants reported to express more anger to in common everyday contexts at 12-months reacted more negatively when they were unsuccessful at two years of age. Those in the highest quartile of 12-month anger were most likely to display more failure reactions at 24 months; $F_{3,91} = 7.55$, $p < .001$, $M_{Q1} = 2.65$, [CI 's 2.5 : 2.76] vs. $M_{Q4} = 3.44$ [CI 's 3.38 : 3.50]. Quartiles 1–3 differed statistically from the highest quartile but not from each other (Dunnett's C: all p 's $< .03$, mean diff range: 0.43 – 0.70).

Discussion

Persistence and negative reactions to failure assess positive and negative emotional processes when toddlers are unable to attain goals. We found differential predictability of these constructs from infant measures of temperament and emotion. In this community sample, appropriate approach responses to contingency at 5 months, indirectly predicted gross motor, and to a lesser extent object-related persistence, but not negative reactions to failure. A soothable temperament, a covariate, was also related to both forms of persistence, but not to negative reactions to failure. Only 12-month infant anger directly predicted negative reactions to failure.

Persistence

Soothability's relation with both forms of persistence was expected as mastery motivation has been associated with positive affect in that literature. Readily soothable infants may be more able to focus their attention on external events and thus spend more time mastering their own gross motor skills and interacting with objects. The ability to self-distract by engaging with objects and motor play may also help dampen negativity.

Although approach-related emotion did not directly predict either form of persistence, moderation by maternal anger was observed. The uppermost range of maternal anger reported, which in this study was only mild, moderated effects of infants' approach on both object-related and gross motor persistence. An impact of mild levels of maternal anger on persistence is consistent with considerable literature suggesting that maternal negative emotion has an impact on children's emotional behavior. However, it begs the question of why a relation between approach behavior and persistence with objects and gross motor behavior is enhanced. Two possible mechanisms may account for enhanced approach/persistence relations. Approach behaviors reflect determination and autonomy-striving in response to thwarted action (C. Harmon-Jones et al., 2011; Lewis et al., 2015; Sullivan, 2014). Low levels of maternal anger in response to toddlers' behavior may elicit greater child persistence through increased arousal or agitation. We do not know how mothers express or display their annoyance, but this account assumes that they do in a way that is perceived by the child. The literature also supports that infants are sensitive to other's emotion changes (Geangu, Hauf, Bhardwaj, & Bentz, 2011). A second possibility is that mild maternal anger elicits similar levels of anger and determination in the child, an emotion contagion process described as "coercive cycles" of negative interaction (Lorber & Egeland, 2011). Child anger to unresponsive parenting is a demonstrated predictor of subsequent externalizing behavior, but has not typically been studied in community samples (Davies & Cicchetti, 2014).

Negative reactions to failure

Negative reactions to failure at two years are frustration at thwarted mastery attempts. They were modestly associated in the bivariate correlations to tantrum frequency and to 5-month distress to limits, but were related only to infants' 12-month anger in the final model. They were unrelated to early approach behavior. This pattern confirmed the conceptual coherence of this construct with the 12-month rating with loss of efficacy whereas the correlation of distress to limits with both these measures reflects shared variance with distress negativity.

Lack of mediation and alternative models

Inclusion of anger to contingency disruption as a component of approach behavior allowed us to evaluate whether a specific temperament dimension, distress to limits, explained any observed relation between early approach behavior and toddler's behavior and negative reactions to failure. The absence of any effect of distress to limits in any of the models was unexpected because a distress-prone temperament has been shown to contribute to both anger and/or tantrum behavior in clinically-referred samples (Lorber et al., 2014). Two factors are suggested to account for the lack of mediation. Distress to limits, infant anger severity, and maternal anger were all significantly correlated. If the mediating effect of either

infant variable is small, the moderating effect of maternal anger, or controlling for soothability, may have outweighed them. Alternatively, the mediating effect was hypothesized to be at the higher levels of distress to limits, so it may be that an insufficient number of infants at the highest levels (11 infants in this community sample were above the 90th percentile) precluded our observing this effect.

Negative temperament cannot be ruled out in explaining variance in the observed relation between 12-month anger severity and negative reactions to failure, however. We were unable to test mediation of this relation due to the structure of our measurement plan. Our assessment of distress to limits at 5 months preceded the 12-month anger assessment which violates the required temporal sequence of mediators to be intervening variables or contemporaneous with the predictors. In our model, 12-month anger was modeled only as a downstream correlate of distress to limits, which was confirmed, suggesting some reliability in maternal report across this age. Distress to limits was also related to maternal reports of their own anger, suggesting that having a distress-prone infant may feed maternal anger over time.

Limitations and implications

Overall this study illustrates that the transition between the first and second year is an important time to study anger, tantrum onset, and maternal reactions to anger as well as the contribution of temperament and maternal behavior to anger in relation to later mastery behavior. The results imply that children who are high in approach, as assessed by their behavioral and emotional responses to contingency learning, may be differentially susceptible to even mild levels of parental anger. Direct observation will need to confirm this mechanism. All other measures were based on maternal report. The range of maternal anger in this study was also limited. It is striking, that effects were observed at these low levels, but under-reporting may have occurred. Further, whether and how this level of maternal annoyance is communicated to the child cannot be addressed without behavioral measures. On the other hand, the IBQ and the DMQ scales are reliable and well-validated. The toddler anger questionnaire developed for the study also may have potential usefulness as a research tool as the results provide some support for its validity. Observation of toddlers and mothers, and the inclusion of reports from fathers or alternative caregivers, would allow replication of the model, reduce self-report bias, and allow better identification of mechanisms.

Finally, for those interested in emotional development, the results imply that the field should not be satisfied with the current consensus that early negative affect is undifferentiated. Approach-related anger may be parsed from other forms of negative reactivity by focusing on behavioral activation and anger expressions surrounding access to and loss of an incentive event. Although this study did not use sophisticated statistical methods for deriving an approach score (e.g., cluster analysis) due to limited sample size, the behaviors on which our categorization was based were reliably observed and operationally defined. As such, they are amenable to replication. The benefits of deriving such a measure, if replicable, is that it would allow better understanding of 1) how undifferentiated negative emotion in the first months of life becomes organized over the first two years of life, and 2) whether individual differences in this organization are related to temperament or socialization factors.

The answers to these and related questions are of broad interest to those seeking to understand the trajectories of emotional development in normal as well as clinical populations.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

- Belden AC, Thomson NR, Luby J. Temper tantrums in healthy vs. depressed and disruptive preschoolers: Defining tantrum behaviors associated with clinical problems. *Journal of Pediatrics*. 2008; 152:117–122. DOI: 10.1016/j.jpeds.2007.06.030 [PubMed: 18154912]
- Birigen Z, Campos JJ, Emde RN, Applebaum M. The development of autonomy: The role of walking onset and its timing. *Perceptual and Motor Skills*. 2008; 106:395–414. DOI: 10.2466/pms.106.2.395-414 [PubMed: 18556897]
- Busch-Rossnagel NA, Morgan GA. Introduction to Section Three: Overview and analysis. In: Barrett KA, Fox NA, Morgan GA, Fidler DJ, Daunhauer LA, editors *Handbook of self-regulatory processes in development: New directions and international perspectives*. New York, NY: Psychology Press; 2013. 247–264.
- Camras LA, Shutter JM. Emotional facial expressions in infancy. *Emotion Review*. 2010; 2:120–129. DOI: 10.1177/1754073909352529
- Carlson GA, Potegal M, Margulies D, Gutkovich Z, Basile J. Rages--what are they and who has them? *Journal Of Child And Adolescent Psychopharmacology*. 2009; 19:281–288. DOI: 10.1089/cap.2008.0108 [PubMed: 19519263]
- Carver CS, Harmon-Jones E. Anger is an approach-relate affect. *Psychological Bulletin*. 2009; 135:183–204. DOI: 10.1037/a0013965 [PubMed: 19254075]
- Carver CS, Sutton SK, Scheier MS. Action, emotion, and personality: Emerging conceptual integration. *Personality & Social Psychology Bulletin*. 2000; 26:741–751. DOI: 10.1177/0146167200268008
- Crossman AM, Sullivan MW, Hitchcock DM, Lewis M. When frustration is repeated: behavioral and emotion responses during extinction over time. *Emotion*. 2009; 9:92–100. DOI: 10.1037/a0014614 [PubMed: 19186920]
- Davies PT, Cicchetti D. How and why does the 5-HTTLPR gene moderate associations between maternal unresponsiveness and children's disruptive problems? *Child Development*. 2014; 85:484–500. DOI: 10.1111/cdev.12148 [PubMed: 24033129]
- Dichter-Blancher TB, Busch-Rossnagel NA, Knauf-Jensen DE. Mastery motivation: Appropriate tasks for toddlers. *Infant Behavior and Development*. 1997; 20:545–548.
- Dix T, Stewart AD, Gershoff ET, Day WH. Autonomy and children's reactions to being controlled: Evidence that both compliance and defiance may be positive markers in development. *Child Development*. 2007; 78:1204–1222. DOI: 10.1111/j.1467-8624.2007.01061.x [PubMed: 17650134]
- Faul F, Erdfelder E, Buchner A, Lang AG. Statistical power analyses using G*Power 3.1: tests for correlation and regression analyses. *Behavior Research Methods*. 2009; 41:1149–1160. DOI: 10.3758/BRM.41.4.1149 [PubMed: 19897823]

- Geangu E, Hauf P, Bhardwaj R, Bentz W. Infant pupil diameter changes in response to others' positive and negative emotion. *PLoS ONE*. 2011; 6:1–10. doi:www.plosone.org.
- Gray JA. Neural systems, emotion and personality. *Neurobiology of Learning, Emotion, and Affect*. 1991; 4:273–396.
- Greenberg G. Approach/Withdrawal Theory. In: Vonk J, Shachelford TK, editors *Encyclopedia of Animal Cognition and Behavior*. Springer International Publishers AG; New York: 2017. doi: 10.1007/978-3-319-47829_1074
- Harmon-Jones C, Schmeichel BJ, Mennitt E, Harmon-Jones E. The expression of determination: Similarities between anger and approach-related positive affect. *Journal of Personality and Social Psychology*. 2011 Mar. 100:172–181. DOI: 10.1037/a0020966 [PubMed: 20853981]
- Harmon-Jones E, Harmon-Jones C. What is approach emotion? *Emotion Review*. 2013; 5:291–295. DOI: 10.1177/1754073913477509
- Harmon-Jones E, Lueck L, Fearn M, Harmon-Jones C. The effect of personal relevance and approach-related action expectation on relative left frontal cortical activity. *Psychological Science*. 2006; 17:434–440. DOI: 10.1111/j.1467-9280.2006.01724.x [PubMed: 16683932]
- Hayes AF. *Introduction to mediation, moderation, and conditional process analysis*. New York: The Guilford Press; 2013.
- He J, Qiu P, Park K, Young, Xu Q, Potegal M. Young Chinese children's anger and distress: Emotion category and intensity identified by the time course of behaviors. *International Journal of Behavioral Development*. 2013; 37:349–356.
- Izard CE. *The Maximally Discriminative Facial Coding System (Revised)*. Newark, DE: University of Delaware; 1995.
- Lemelin J, Tarabulsky G, Provost MA. Relations between measures of irritability and contingency detection at 6 months. *Infancy*. 2002; 3:543–554.
- Lewis M, Sullivan MW, Ramsay D, Alessandri SM. Individual differences in anger and sad expressions during extinction: Antecedents and consequences. *Infant Behavior and Development*. 1992; 15:443–452.
- Lewis M, Sullivan MW, Kim HM. Infant approach and withdrawal in response to a goal blockage: Its antecedent causes and its effect on toddler persistence. *Developmental Psychology*. 2015; 51:1553–1563. DOI: 10.1037/dev0000043 [PubMed: 26389608]
- Lorber MF. The role of maternal emotion regulation in over-reactive and lax discipline. *Journal of Family Psychology*. 2012; 26:642–647. DOI: 10.1037/a0029109 [PubMed: 22888786]
- Lorber MF, Del Vecchio T, Slep AM. Infant externalizing behavior as a self-organizing construct. *Developmental Psychology*. 2014; 50:1854–1861. DOI: 10.1037/a0036985 [PubMed: 24866289]
- Lorber MF, Del Vecchio T, Slep AM. The emergence and evolution of infant externalizing behavior. *Development and Psychopathology*. 2015; 27:663–680. DOI: 10.1017/S0954579414000923 [PubMed: 25212988]
- Lorber MF, Egeland B. Infancy parenting and externalizing psychopathology from childhood through adulthood: Developmental trends. *Developmental Psychology*. 2009; 45:909–912. DOI: 10.1037/a0015675 [PubMed: 19586169]
- Lorber MF, Egeland B. Parenting and infant difficulty: Testing a mutual exacerbation hypothesis to predict early onset conduct problems. *Child Development*. 2011; 82:2006–2020. DOI: 10.1111/j.1467-8624.2011.01652.x [PubMed: 22026438]
- Lorber MF, Mitnick DM, Slep AM. Parents' Experience of Flooding in Discipline Encounters: Associations With Discipline and Interplay With Related Factors. *Journal of Family Psychology*. 2016; 30:470–479. DOI: 10.1037/fam0000176 [PubMed: 26690330]
- MacTurk RH, Morgan GA. *Mastery motivation: Origins, conceptualizations, and applications*. Westport, CT: Ablex; 1995.
- Messer DJ. *Mastery motivation in early childhood: Development, measurement and social processes*. New York: Routledge; 1993.
- Morgan GA, Wang J, Liao H, Xu Q. Using the Dimensions of Mastery Questionnaire (DMQ) to assess mastery motivation of English- and Chinese-speaking children: Psychometrics and implications for self-regulation. In: Barrett KA, Fox NA, Morgan GA, Fidler DJ, Daunhauer LA,

editors Handbook of self-regulatory processes in development: New directions and international perspectives. New York, NY: Psychology Press; 2013. 305–335.

- Potegal M, Archer J. Sex differences in childhood anger and aggression. *Child and Adolescent Psychiatric Clinics of North America*. 2004; 13:513–528. DOI: 10.1016/j.chc.2004.02.004 [PubMed: 15183371]
- Potegal M, Davidson RJ. Temper tantrums in young children: 1. Behavioral composition. *Journal of Developmental and Behavioral Pediatrics*. 2003; 24:140–147. [PubMed: 12806225]
- Potegal M, Robison S, Anderson F, Jordan C, Shapiro E. Sequence and priming in 15 month-olds' reactions to brief arm restraint: evidence for a hierarchy of anger responses. *Aggressive Behavior*. 2007; 33:508–518. DOI: 10.1002/ab.20207 [PubMed: 17918278]
- Putnam SP, Helig AL, Gartstein MA, Rothbart MK, Leerkes E. Development of short and very short forms of the Infant Behavior Questionnaire-revised. *Journal of Personality Assessment*. 2014; 96:445–458. DOI: 10.1080/00223891.2013.841171 [PubMed: 24206185]
- Rothbart MK, Gartstein MA. The Infant Behavior Questionnaire. 2000. Retrievable via <https://research.bowdoin.edu/rothbart-temperament-questionnaires/instrument-descriptions/the-infant-behavior-questionnaire/>
- Schneirla TC. An evolutionary and developmental theory of biphasic processes underlying approach and withdrawal. In: Jones MR, editor *Nebraska Symposium on Motivation*. Vol. 7. Lincoln, NB: University of Nebraska Press; 1959. 1–42.
- Sullivan MW. The Toddler Behavior Questionnaire. 2012. Copyright Rutgers University and M. W. Sullivan. Unpublished instrument. Available from Rutgers Scholarly Open Access Repository. <http://dx.doi.org/doi:10.7282/T3028VNP>
- Sullivan MW. Infant expressions in an approach/withdrawal framework. *J Genetic Psychology*. 2014; 175:472–493. DOI: 10.1080/00221325.2014.964169
- Sullivan MW. Vagal tone during infant contingency learning and its disruption. *Developmental Psychobiology*. 2016; 58:366–381. DOI: 10.1002/dev.21376 [PubMed: 26517573]
- Sullivan MW, Lewis M. Relations of Early Goal Blockage Response and Gender to Subsequent Tantrum Behavior. *Infancy*. 2012; 17:159–178. DOI: 10.1111/j.1532-7078.2011.0007 [PubMed: 22408573]
- Sullivan MW, Lewis M, Alessandri SM. Cross-age stability in emotional expressions during learning and extinction. *Developmental Psychology*. 1992; 28:58–63.

Figure 1.

Figure 2.

Figure 3.

Table 1

Overview of Measures and Variables by Contact Point

Measure	Source	Variable
Five Months (<i>M</i> age = 23 w <i>SD</i> 2.0)		
<u>Approach Score</u> : a. Online record of pulling during learning phase b. Coded seconds of MAX anger during contingency disruption	Infant	Rank order (1–5) based on behavioral responses: 1. Little or no approach with distress
		Did not meet criterion; Pulling rate is below baseline. No disruption phase
		<i>M</i> Learning ratio = 0.70 <i>SE</i> = 0.04; > 60 s vocal distress during contingency
		2. Low approach
		Learning criterion met, but cried to criterion prior to disruption. No disruption phase
		<i>M</i> Learning ratio = 1.22 <i>SE</i> = 0.38; > 60 s vocal distress during contingency
		3. Approach with low anger to disruption
		Met criterion. Below median anger (11.0) displayed to contingency disruption.
		<i>M</i> Learning ratio = 1.68; <i>SE</i> = 0.13 <i>M</i> Anger expression = 4.17 <i>SE</i> = 0.69
		4. Approach with more anger to disruption
		Met criterion. Above median anger (11.0) displayed to contingency disruption.
		<i>M</i> Learning ratio = 2.25; <i>SE</i> = .03 <i>M</i> Anger expression = 27.30 <i>SE</i> = 0.69
		5. High approach
		Met criterion. Approach behavior during disruption with no observable anger expression.
		<i>M</i> Learning ratio = 12.57; <i>SE</i> = 5.81 <i>M</i> Anger expression: 6.86 <i>SE</i> = 2.84
<u>Temperament</u> : a. Distress to Limits b. Soothability	Maternal Report	Rating on a 7-point scale of low to high on each dimension of the IBQ.
Twelve Months (<i>M</i> age = 13.03 m <i>SD</i> 2.05)		
<u>Child Anger Severity</u> in everyday contexts	Maternal Report	Rating on a 5-point scale, ranging from little or no anger/annoyance to extreme anger.
<u>Maternal Anger</u> in response to child's anger in the same contexts.	Self-Report	Rating on a 5-point scale, ranging from little or no anger/annoyance to extreme anger.
<u>Frequency of tantrums</u>	Maternal Report	Rating on a 7-point scale ranging from none to > 1 per day.
Two Years (<i>M</i> age = 22.56 m <i>SD</i> 2.02)		
Dimensions of Mastery Persistence subscales: a. <u>Object-related</u> b. <u>Gross Motor</u>	Maternal Report	Rating on a 5-point scale ranging from low to high.
Negative Reactions to failure on the DMQ	Maternal Report	Rating on a 5-point scale ranging from low to high

Table 2

Bivariate Correlations of Variables Used in the Models (N = 87)

Variable Name	1	2	3	4	5	6	7	Mean (SD)
1 Approach Rank				1.80 (1.50)				
2 Soothability	-.02				4.89 (1.03)			
3 Distress to Limits	-.04	.14				3.57 (0.84)		
4 Anger Severity	-.08	.06	.52**			3.52 (0.52)		
5 Maternal Anger	-.02	.04	.28*	.58**			1.49 (0.38)	
6 Object Persistence	.18	.22*	-.22*	-.22*	-.19		3.53 (0.46)	
7 Gross Motor	.13	.26*	-.03	-.16	-.14	.74**		3.89 (0.55)
8 Negative Reaction to Failure	-.09	-.09	.25*	.42**	.17	-.16	-.27*	2.91 (0.60)

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).