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Toddler Dysregulated Fear Predicts Continued Risk for Social Anxiety Symptoms in Early Adolescence

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Abstract

Identifying early risk factors for the development of social anxiety symptoms has important translational implications. Accurately identifying which children are at the highest risk is of critical importance, especially if we can identify risk early in development. We examined continued risk for social anxiety symptoms at the transition to adolescence in a community sample of children (n = 112) observed for high fearfulness at age 2 and tracked for social anxiety symptoms from preschool through age 6. In our previous studies, we found that a pattern of dysregulated fear (DF), characterized by high fear in low threat contexts, predicted social anxiety symptoms at ages 3, 4, 5 and 6 years across two samples. In the current study, we re-evaluated these children at 11-13 years of age using parent- and child reports of social anxiety symptoms, parental monitoring, and peer relationship quality. DF uniquely predicted adolescents' social anxiety symptoms above and beyond the prediction made by more proximal measures of behavioral (e.g., kindergarten social withdrawal) and concurrent environmental risk factors (e.g., parental monitoring, peer relationships). Implications for early detection, prevention and intervention are discussed.

Toddler Dysregulated Fear Predicts Continued Risk for Social Anxiety Symptoms in Early Adolescence

Social Anxiety Disorder (SAD) is among the most common forms of pediatric psychopathology (Burstein et al., 2012; Duchesne, Larose, Vitaro, & Tremblay, 2010; Merikangas, He, Burstein, et al., 2010). However, considerable heterogeneity exists in the developmental predictors, trajectories of SAD development, and outcomes for these children. Anxiety symptoms can be first detected in toddlerhood (Pine & Klein, 2008), and can be seen in the preschool age years, most commonly involving symptoms of social anxiety disorder, separation anxiety disorder, and generalized anxiety disorder (Franz et al., 2013). However, in terms of prevalence of anxiety disorders (all subtypes), which reaches approximately 32% by adolescence (Merikangas, He, Brody, et al. 2010), there is a dearth of information about young children's symptoms, critical information for advancing early detection and amelioration of this highly prevalent form of psychological distress.

The need for early identification of risk for anxiety disorder is evident. Childhood anxiety symptoms are associated with significant impairment in familial, social, and academic domains (Duchesne et al., 2010) and are frequently comorbid with other internalizing symptoms, particularly depression (Essau, Conradt, & Petermann, 1999; Sonntag, Wittchen, Höfler, Kessler, & Stein, 2000). For instance, anxiety symptoms have pervasive negative effects on children including declines in academic performance (Merikangas et al., 2010), lower social competence (Pine & Klein, 2008), greater likelihood of peer rejection (Flanagan, Erath, & Bierman, 2008), concurrent depression (Biederman et al., 2007), and increased risk of substance use/abuse (Wolitzky-Taylor, Bobova, Zinbarg, Mineka, & Craske, 2012). Furthermore, untreated, early anxiety disorders increase risks for long-term mental and physical health problems (Flanagan et al., 2008; Bierman, 2008;

Biederman et al., 2007). Therefore, it is important to identify early in development which children are at highest risk for developing clinically meaningful and stable anxiety symptoms.

Extreme fearful temperament, identified in infancy or early childhood, is highly stable and is the best earlier predictor of social withdrawal and anxiety symptoms later in childhood and in adolescence (Chronis-Tuscano et al., 2009; Hirshfeld-Becker et al., 2007. Despite the robust prediction, not all temperamentally fearful children become socially withdrawn, or develop anxiety symptoms. Several moderating factors have been examined (Degnan, Almas, & Fox, 2010; Ollendick & Benoit, 2012), including maternal overprotection or overcontrol (Johnson et al., 2016; Lewis-Morrarty et al., 2012), social reticence (Degnan et al., 2014), and attention bias to threat (Pérez-Edgar et al., 2011). Another possible reason for this discontinuity is that there is considerable heterogeneity among children identified as temperamentally fearful who may be at differential risk for maladaptive developmental outcomes.

In our work, we have tackled the heterogeneity issue head on by identifying a form of heightened fearfulness. Specifically, this form is characterized by a pattern of fearful behavior where fear is most extreme, relative to other children, in low-threat situations (e.g., puppet show) (Buss, 2011). What is particularly unique about this pattern of fearful behavior is that children exhibiting high fear in low threat situations are quite often not the same children identified as behaviorally inhibited, nor are they distinguishable from other fearful/shy children if they are observed only in high threat situations (e.g., spider) (Buss, 2011). This pattern of dysregulated fear (DF), shown in two longitudinal samples, (1) is stable from age 2 to age 5 (Buss, 2011); (2) predicts social withdrawal/inhibition in preschool (Buss, 2011; Buss et al., 2018); (3) predicts social reticence with unfamiliar peers in the laboratory at age 5 (Buss et al., 2013); (4) is associated with a distinct pattern of physiology,

neural and attentional processes (Buss et al., 2018; Morales, Pérez-Edgar, & Buss, 2015; Phelps, Brooker, & Buss, 2016); and (5) predicts SAD symptoms at age 6 (Buss et al., 2013).

What is still unknown is whether DF continues to confer risk for social anxiety symptoms as these at-risk children transition into adolescence. Available epidemiological evidence suggests that adolescence represents a developmental period of elevated risk for anxiety, as rates of anxiety increase sharply during this period (Copeland, Angold, Shanahan, & Costello, 2014; Merikangas et al., 2010). SAD is also associated with an increased risk for depression (Biederman et al., 2007), with some evidence suggesting that the presence of SAD in childhood is associated with a near 3-fold increase in depression by young adulthood (Copeland et al., 2014). Furthermore, symptoms of social anxiety have been found to mediate the longitudinal link between childhood fearfulness and lifetime depression (Gladstone & Parker, 2006).

Socioemotional trajectories are shaped by the environmental context in which children and adolescents are embedded. Parents' own anxiety and threat biases can influence the way parents behave toward their children. For instance, maternal anxiety is often associated with overprotective behavior (Gar, Hudson, & Rapee, 2005; Kennedy, Rapee, & Edwards, 2009). Some mothers of fearful infants can have difficulty being sensitive, responsive, and appropriately supportive of their infants' needs (Gartstein et al., 2010), often perceiving them as vulnerable (Dadds & Roth, 2001). In response to fearful behaviors, parents may engage in a controlling and intrusive pattern of behavior including overprotective parenting (Johnson et al., 2016; Lewis-Morrarty et al., 2012; Mount, Crockenberg, Jó, & Wagar, 2010). These behaviors have been associated with the maintenance of shy behavior and increasing anxiety symptoms (Duchesne et al., 2010). Over-involved parenting is particularly fundamental in the development of anxiety disorders (Murray, Creswell, & Cooper, 2009), accounting for substantial variation in anxiety

symptoms during childhood (Van Der Bruggen, Stams, & Bögels, 2008). This empirical evidence supports models of anxiety development that argues for a mutually reinforcing parent-child dynamic (Dadds & Roth, 2001). In this model, when a child experiences fear, they solicit (directly or indirectly) support from their parent. This in turn results in the effective alleviation of the child's distress, thus reinforcing the parent's overprotective behavior and the child's need for parent intervention, and eventually increases risk for anxiety development (Dadds & Roth, 2001). We have tested this process and have demonstrated that overprotection mediates the relation between toddler fear and later social anxiety in preschool and kindergarten (Kiel & Buss, 2011, 2012, 2014). In contrast, parents who are sensitive to their fearful children's needs (i.e., intervene only when child coping resources are exhausted), display warmth, and appropriately support autonomy have children who do not increase in social wariness or fear reactivity (Booth-LaForce & Oxford, 2008; Kiel, Premo, & Buss, 2015). Therefore, one goal of the current study was to examine the role of parental overprotection in predicting social anxiety symptoms during adolescence.

As children transition through late childhood into adolescence, peer relationships become more important and introduce new experiences that can increase risk for social anxiety development (see Henderson, Green & Wick, 2018; Rubin, Barstead, Smith & Bowker, 2018 for reviews of this literature for BI children). Temperamentally fearful and anxious children display social reticence and often avoid interaction with same-age peers (Buss et al., 2013; Degnan et al., 2014; Fox, Henderson, Rubin, Calkins, & Schmidt, 2001). The tendency to withdraw from novel, unfamiliar social situations makes these children less assertive, and by the transition to adolescence, they are more likely to experience peer rejection/victimization. Fearful children also have fewer friends compared to their peers and report greater anxiety and loneliness than others (Suway, Degnan, Sussman, & Fox, 2012); and these differences extend through adolescence and adulthood (Gest, 1997). This type of

social withdrawal may prevent the development of age-appropriate social skills, leading to negative self-perceptions and lower self-esteem (Rubin, Burgess, Kennedy, & Stewart, 2003) and difficulty establishing high quality friendships (Rubin, Wojslawowicz, Rose-Krasnor, Booth-LaForce & Burgess, 2006). Withdrawn children likewise experience less peer acceptance (Hymel, Rubin, Rowden, & LeMare, 1990), more peer rejection (Gazelle & Faldowski, 2014), and more depressive symptoms (Erath, Flanagan, Bierman, & Tu, 2010). Therefore, in the current study, kindergarten-age social withdrawal and adolescents' concurrent peer relationships were examined as additional risk indicators for social anxiety for DF children.

The goals of the current study were to assess, at the transition to early adolescence (~ages 11-13), (1) continued risk for social anxiety symptoms for DF children. We hypothesized that DF would predict greater social anxiety in early adolescence. Given evidence for gender differences in the prevalence of anxiety symptoms in adolescence (McLean, Asnaani, Litz, & Hofmann, 2011), we also explored gender differences. (2) We examined the extent to which developmentally more proximal risk factors such as social reticence (from early childhood), as well as concurrent peer relationships and parental monitoring, were associated with for social anxiety in adolescence. We explored this in a series of additive models, in which we hypothesized that DF would predict social anxiety symptoms over and above these more proximal risk factors. We also explored whether the effect of DF on social anxiety in adolescence was mediated through these proximal risk factors although we did not hypothesize that this would be the case. Finally, in line with previous work (Johnson et al., 2016; Lewis-Morrarty et al., 2012; Bosquet & Egeland, 2006; Williams et al., 2009), we also examined parenting and peer relations as potential moderators of the relation between DF and social anxiety in adolescence.

Method

Participants

The participants were 112 2-year-old children and their mothers who were recruited for a larger longitudinal study through recorded local birth announcements (M_{age} = 24.05 months, SD_{age} = 1.50 months; 43.8% female). The sample was a low-risk, community sample from large, midwestern university town. The majority of the sample was middle to upper-middle class (1.8% = $16,000 – 20,000; 4.5% = $21,000 – 30,000; 10.9% = $31,000 – 40,000; 18.2% = $41,000 – 50,000; 9.1% = $51,000 – 60, 000; 42.7% = above $61,000), college educated (8.2% = high school education; 21.9% = some college or technical education; 30.9% = college graduate; 36.3% = graduate training), and largely White (91.9% White, 3.6% African-American, 1.8% Hispanic, 1.8% Asian-American, and .9% South American Indian). At this initial timepoint, 70% of the children had siblings ($M_{siblings}$ = 1.05, $SD_{siblings}$ = 1.15, range = 0-9). A subset of this original sample completed a number of follow-up surveys approximately 11 years later as the children reached adolescence (N = 61, M_{age} = 12.96 years, SD_{age} = .73, 42.6% female). Family demographics of the subsample remained largely consistent. The majority of the sample remained middle to upper-middle class (3.1% = $21,000 – 30,000; 1.5% = $31,000 – 40,000; 4.6% = $41,000 – 50,000; 1.5% = $51,000 – 60, 000; 86.2% = above $61,000); college educated (6.2% = high school education; 12.3% = some college or technical education; 24.6% = college graduate; 52.3% = graduate training); and largely White (91.8% White, 4.9% African-American, 1.6% Hispanic, and 1.6% South American Indian). At this follow-up timepoint, 95% of the children had siblings ($M_{siblings}$ = 3.79, $SD_{siblings}$ = 4, range = 2-6). Further information about attrition is presented in Results.

Procedures

During the initial 2-year-old laboratory visit, the mothers and their children completed a series of tasks that included six novel tasks. These tasks included low-threat episodes (*Clown* and *Puppet Show*), medium threat episodes (*Stranger Working* and *Stranger*

Approach) and high-threat episodes (*Robot* and *Spider*) developed out of the Laboratory Temperament Assessment Battery (Lab-TAB: Goldsmith, Reilly, Lemery, Longley, & Prescott, (1994) and previous studies designed to observe toddler behavior (Buss, 2011). Two low-threat episodes, *Clown* and *Puppet Show*, involved a second experimenter dressed as a clown or using puppets behind a stage who then enthusiastically asked the toddler to play a series of short games. Two medium-threat episodes involved either a female stranger working in the room for 2 minutes (*Stranger Working*) or a male stranger who began a short conversation with the toddler (*Stranger Approach*). Two high threat episodes involved remote controlled toys, a robot in the corner and a large spider attached to a truck that approached the toddler and then retreated two times with 10 seconds in between each movement.

Behavioral coding was used to construct the measures of dysregulated fear and maternal overprotectiveness described below. For more detail on the coding system, refer to previous studies (Buss, 2011). Coders achieved reliability of at least .65 kappa and .80 percent agreement with the master coder prior to coding these measures independently. Throughout the coding of the six episodes, reliability on about 15-20% of the cases was assessed to avoid coder drift and same reliability criterion was achieved.

During the fall of kindergarten, parents completed several questionnaires to assess children's behavioral and social-emotional adjustment. At the early adolescent follow-up (ages 11-13), the youth and their families completed a set of online questionnaires. The youth measures described below assessed fear and anxiety in home, school, and other social contexts. Parental measures assessed youth's anxiety as well as parent protectiveness, monitoring, and control.

Measures

Dysregulated Fear. We conceptualize dysregulated fear as change, specifically for a DF pattern, the lack of change, in level of fear elicited across episodes that vary in threat levels (see Buss, 2011 for full details). To measure fear, we created composites made up of the average of the following variables for each episode (coded second-by-second); the duration of proximity to mother, freezing, bodily fear, and facial fear and a reverse-scored latency to freeze (coding % agreement 80-100%; Kappa, .61-.73). We then used these fear composites as the dependent variable in a multilevel model, accounting for within toddler nesting of episodes, with threat level of the episodes (a contrast variable) as the predictor. We then extracted each toddler's slope using the Empirical Bayes estimate to analyze individual differences in changes of fear across the different threat level episodes. Higher and more positive slopes indicated different levels of fear across the episodes consistent with expected regulation based on the threat levels of the episodes. Less positive or negative slopes indicated little to no change, or higher fear, across the episodes. As we reported previously, slope and intercept were highly correlated (r = -.80) demonstrating that those toddlers with flatter slopes started out at higher levels of fear in the low threat situations. For the current analyses, we reversed the values for the DF slope such that higher scores indicate greater dysregulated fear. Note that this is different than in other publications (Buss, 2011; Buss et al., 2013).

Anxiety Symptoms

Parent-reported Anxiety. Parents completed the Screen for Child Anxiety Related Disorders (SCARED; Birmaher, Khetarpal, Cully, Brent, & McKenzie, 1995) as a part of the 11-year follow-up to assess their youth's levels of anxiety (e.g. My child doesn't like to be with people he/she doesn't know well). Parents rated items that ranged from 0 (*Not true or hardly ever true*) to 2 (*Very true or often true*). For the current study, we used the sum of the 7 items from the Social Anxiety (α=.85) scale.

Youth-reported Anxiety. Youth completed two instruments to measure social anxiety symptoms. First, youth also completed the SCARED (Birmaher et al., 1995) Youth rated items that ranged from 0 (*Not true or hardly ever true*) to 2 (*Very true or often true*) (e.g. I do not like to be with people I don't know well). Again, we used the sum of the 7 items from the Social Anxiety scale (α=.77). Youth also completed the Social Anxiety Scale for Adolescents (SAS-A; (La Greca & Stone, 1993) to assess social anxiety symptoms. The SAS-A questionnaire include 18 items that are designed to measure youth's subjective experience of social anxiety, including fear of negative evaluation (e.g. I worry about what others think of me) and social avoidance in new situations or more generally (e.g., I only talk to people I know really well) and were rated on a 5-point scale, 1 (*Not at all*) to 5 (*All of the time*). The total sum of all items was used in analyses (α=.93).

Covariates

Kindergarten Social Withdrawal. During the fall of kindergarten, mothers completed the Social Inhibition scales from the McArthur Health and Behavior Questionnaire (HBQ; Armstrong & Goldstein, 2003). Three items (e.g. "Shy with other children") were rated by mothers on a scale from 0 (*rarely applies*) to 2 (*certainly applies*) (α=.77). This measure of social withdrawal was used as a covariate in the current study.

Adolescent Peer Relationships. At the adolescent follow-up, youth completed a peer relations scale, which consisted of 14 items drawn from instruments designed to assess different facets of peer relationship. For the current study, we created a total peer relations score (α=.87), which consisted of subscales of social self-concept (Harter, 1988), friendship quality (Bukowski, Hoza, & Boivin, 1994), and perceived victimization (reverse scored) (Schwartz, Farver, Chang, & Lee-Shin, 2002).

Adolescent Parental Protectiveness. Children completed a maternal overprotectiveness questionnaire (MO; Edwards, Rapee, Kennedy, & Spence, 2010). This

measure included 13 items that assessed protective behaviors that mother engaged in when they were children (e.g. "When I was a child, my mother would often do things for me I could do for myself"). Children rated how much they agreed with the various statements on a scale from 1 (*Strongly disagree*) to 5 (*Strongly agree*) (α=.86).

Adolescent Parental Monitoring. Parents completed the Parental Monitoring Questionnaire (PMQ; Kerr & Stattin, 2000) to assess their knowledge of their children's activities (e.g. "Do you know what friends your child spends time with in their free time?"). The 24 items from this questionnaire were rated on a scale from 1 (*Almost Never*) to 5 (*Almost Always*) (α=.78).

Statistical Analyses

Prior to analyses, all of the study variables were examined for distribution and univariate and multivariate outliers. Next, descriptive statistics and correlations were computed to examine the bivariate associations among study variables. Finally, a series of hierarchical regression analyses were conducted to examine the predictive relations among DF at age 2 and social anxiety symptoms reported during the adolescent follow-up. To account for the potential effects of more proximal correlates of anxiety symptoms, measures of social inhibition, parenting, and peer relations were covaried. Additionally, gender was included as a covariate in the final model to examine whether it predicted adolescents' social anxiety symptoms. In each model, the main effect of DF was entered in step 1, social withdrawal at kindergarten assessment was entered as a covariate in step 2, and parenting and peer variables assessed during the adolescent follow-up were entered in step 3. Finally, each of the proximal risk factors was tested as a potential mediator of the longitudinal relation between DF and adolescent anxiety symptom outcomes.

Of the 112 families who participated in the laboratory visit at 2 years, 61 families provided data at the early adolescent follow-up (M_{age} = 12.96 years, *SD* = .73). A systematic

evaluation of the attrition effects indicated that those that dropped out between age 2 assessment and kindergarten assessment (18.8%) and kindergarten assessment and adolescent follow-up (44.6%) did not differ from those that participated in the adolescent follow-up study with respect to participant gender, age, race, family socioeconomic status, parent marital status, or parent-rated toddler temperamental or behavioral traits (e.g., inhibition to novelty, internalizing behaviors, fearfulness) ($.06 < p < .99$).[1]

To account for the missing data due to attrition, multiple imputation (MI) was employed. We used MI based on simulation research evidence suggesting that MI performs very well for small samples (as small as $N = 50$) or for samples with up to 50% of missing data (Graham, 2009). Following the current guidelines to enhance inferences for datasets with up to 50% missing, 40 imputations were completed and pooled using the multivariate imputation by chained equations using the MICE package (van Buuren & Groothuis-Oudshoorn, 2011) in the R computing environment (R version 3.5.0, 2018) (R Development Core Team, 2008). Test of mediation was completed using the Lavaan package (Rosseel, 2012), also in the R environment.

Results

[1] This percent attrition is consistent with other longitudinal samples with similar characteristics and gaps between assessment ages (see Gillom & Shaw, 2004; Motti-Stefanidi, Asendorpf, & Masten, 2012; Schulenberg, Bryant, & O'Malley, 2004).

Data screening and descriptive statistics. There was no evidence of significant skew or kurtosis for the study variables. One multivariate outlier was identified for youth self-reported anxiety using the Mahalanobis Distance and was removed from subsequent analysis. Descriptive statistics and correlations for all study variables are presented in Table 1. Approximately 49% of the sample scored at or above the cut-off score established for the social anxiety subscale of the SCARED and 16% of the youth scored above the cut-off score for the SAS-A. The concordance between parent and youth self-reported social anxiety subscale of the SCARED was moderate. DF was correlated with 2 of the 3 indices of adolescent social anxiety, both parent and youth reported social anxiety symptoms. To examine whether gender differences were present across study measures, independent t-tests were completed. Gender differences were not observed for any outcomes examined in this study (*t*-values ranging from 0.006 to 1.253).

Analyses of attrition and missing data. Families who did not complete assessments at each wave of the study did not differ from those that completed all study assessments on any of the demographic or predictor variables *p*'s > .36. As the pattern of missingness was not found to depend on the observed data, there was no evidence that the assumption of missing completely at random (MCAR) was violated. Complete case analysis (i.e. listwise deletion) and MI yielded the same pattern of results. Therefore, pooled estimates obtained from the 40 MI datasets are reported below.

Hierarchical Regression Analyses. Results of the three regression models predicting youth self-reported and parent-reported social anxiety are presented in Table 2. Consistent with our hypotheses, DF predicted greater parent-reported SCARED social anxiety and youth self-reported SAS-A total score in the models that included DF as the unique predictor (Model 1). However, DF did not predict SCARED social anxiety as reported by the youth (b = .11, p = .13). Turning to Model 2 where kindergarten social withdrawal was

added to the model, DF remained a significant predictor of the youth self-reported SAS-A total score when kindergarten-age social withdrawal was covaried. Finally, to examine the unique contribution of DF relative to more proximal predictors, concurrent parental monitoring, protectiveness, and adolescent's peer relations were entered as covariates in the models examining social anxiety outcomes (Model 3). DF continued to predict higher level of parent-reported SCARED social anxiety beyond the significant concurrent relation between parental monitoring and parent-reported social anxiety symptoms. Likewise, in the model predicting youth SAS-A total score, only DF and youths' concurrent peer relations predicted higher level of adolescents' social anxiety symptoms. Finally, there was a marginally significant relation between DF and youth self-reported SCARED social anxiety, such that DF predicted greater social anxiety symptoms, while controlling for the significant contribution of concurrent peer relations (b = .13, p = .07). In sum, DF assessed at age 2 emerged as a predictor of adolescents' symptoms of social anxiety as reported by adolescents and their parents. These predictive relations remained significant while accounting for the effects of more proximal correlates of parental control and peer relations.

Tests of Mediation and Moderation Effects. For each measure of adolescent anxiety symptom outcomes, four mediation models were tested with the following mediators: kindergarten social withdrawal, parental monitoring, parental protectiveness, and peer relations. As shown in Table 3, there was no evidence of a significant mediation involving any of the four potential mediator variables. Therefore, the predictive relation between DF and adolescent social anxiety symptoms could not be accounted for by proximal psychosocial indicators of anxiety risk.

Finally, we examined the possibility that DF interacted with parent monitoring, parental protectiveness and peer relations to predict adolescent anxiety symptom outcomes.

We tested these interactions individually across all three anxiety-symptom outcomes. As shown in Table 4, there was no evidence of moderation for any of the analyses.

Discussion

Dysregulated fear (DF)—a type of fearful temperament characterized by high levels of fear in low-threat situations—has been identified as a robust predictor of childhood social anxiety spectrum symptoms. Specifically, in our initial study, toddlers demonstrating a DF profile were found to be at an elevated risk for social withdrawal upon their transition to kindergarten (Buss, 2011) and were also more likely to develop symptoms of social anxiety by age 6 (Buss et al., 2013). The present study examined whether the pattern of DF observed at age 2 continued to predict specific risk for social anxiety symptoms into early adolescence. Findings of the present study supported the study hypotheses. We found that DF uniquely predicted adolescents' social anxiety symptoms—as reported by youth and their parents—above and beyond the prediction from more proximal measures of behavioral (e.g., kindergarten social withdrawal) and environmental risk factors (e.g., high parental monitoring, poor peer relationships).

Consistent with prior research documenting an association between fearful temperamental traits observed during the second year of life and social anxiety symptoms in adolescence (Clauss & Blackford, 2012), we found that toddlers' DF was associated with elevated social anxiety symptoms in adolescence. It has been suggested that the longitudinal linkage between fearful temperamental traits and social anxiety symptoms in adolescence is attributable to the preservation of emotional, behavioral, and biological profile that specifically predisposes an individual to fear and to withdraw from novel social situations (C. E. Schwartz, Snidman, & Kagan, 1999). Indeed, our findings supported the previous finding that DF is a specific risk for social withdrawal at children's transition to kindergarten (Buss, 2011); the present findings indicate that, as predicted, this social anxiety risk trajectory

continued into early adolescence. Moreover, the DF profile was found to predict social anxiety symptoms in adolescence, above and beyond the prediction made by social withdrawal behaviors assessed at children's transition to kindergarten. This suggests that the unique pattern of toddler fear in situations that pose low threat, and that are not feared by most toddlers, may represent risk for their later development of social anxiety problems. Understanding the circumstances that exacerbate and mitigate this risk is the next important step in this program of research.

Extensive literature has documented the role of environmental factors that alter temperamentally fearful toddlers' trajectories toward anxiety-related outcomes. In particular, parental overprotectiveness has been identified as a factor that increases one's risk for anxiety in early childhood (Kiel & Buss, 2011; Kiel & Maack, 2012; Kiel et al., 2015) and adolescence (Rapee, 2009). Similarly, certain aspects of peer relationships (e.g., victimization, rejection) not only influence children's risk for anxiety symptomatology but are also likely to reflect the extent of social impairment associated with social anxiety (Erath et al., 2007; Su, Pettit & Erath, 2016). Given the importance of the proximal influence of parents and peers on adolescents' social anxiety symptom presentation, we investigated the longitudinal association between DF and adolescents' social anxiety symptoms, while accounting for concurrent measures of anxiety-related parenting behaviors and peer relationships. It is noteworthy that DF profile observed during toddlerhood uniquely predicted adolescents' social anxiety symptoms, above and beyond the concurrent associations between social anxiety and adolescents' experiences of parenting and peer relations. Moreover, we found that the significant predictions of DF held for both parent and self-reported symptoms of adolescent social anxiety symptoms. However, it is interesting to note that for youth self-report a significant effect was only found using the SAS-A, despite similar effect sizes and a high correlation between the two youth-reported measures. We

speculate that this is largely due to differences between the two self-reported instruments. SAS-A is a comprehensive measure of social anxiety symptoms covering fear of negative evaluation, social avoidance of new people, and general social avoidance whereas the SCARED is designed as a screening instrument with only seven social anxiety items. The SAS-A may be the more sensitive method for capturing the range of variation in youth-reported social anxiety symptoms. It is interesting that DF is more predictive of self-report items that comprise social anxiety diagnostic criteria than of a milder set of social anxiety/shyness symptoms.

While there is evidence in the extant literature that the link between early fearful temperament and anxiety outcomes are moderated by parenting (e.g., Degnan et al., 2010; Lewis-Morrarty et al., 2012; Williams et al., 2009) and peer relationships (Bosquet & Egeland, 2006; Degnan et al., 2014), we did not observe a moderation effect in our analyses. Notably, the mediation models further indicated that the longitudinal relation between DF and adolescent social anxiety symptoms was not attributable to these more temporally proximal risk factors of social anxiety symptoms in adolescence. In other words, although these are known risk factors for social anxiety development, perhaps for children whose early appearing fearfulness persists through adolescence, these other factors appear not to contribute to the trajectory to adolescent social anxiety. In this way, the results provide further support to DF as a meaningful developmental antecedent of youth anxiety risk that may directly and uniquely shape youths' trajectory of social anxiety risk over an extended period of childhood.

These null findings are not entirely consistent with the extant literature, including our own work. For instance, in examining parenting as a mediator, we have demonstrated that maternal overprotection mediates the association from toddler fearful temperament to social withdrawal at age 6 (Kiel & Buss, 2011; 2014). We provide two possible explanations for

these differences. First, it may be that the effects of parental overprotection have a stronger influence earlier in development. In our previous work, maternal overprotection was observed concurrent with fearful temperament at age 2 (Kiel & Buss, 2011; 2012; 2014), and most of the work is also focused in early childhood (e.g., Rapee, 2014; Rapee, Kennedy, Ingram, Edwards, & Sweeney, 2010). Consistent with the models of anxious parenting (Dadds & Roth, 2006; Ollendick & Benoit, 2012), this protective behavior for fearful children reinforces the fear, rather than dampening it (Buss & Kiel, 2011) and increases risk for anxiety symptoms across development. Second, although there is evidence that these types of parenting behaviors are stable (Kiel & Buss, 2011), the type of and the contexts in which the protective behavior is observed across development may be important as well. As we have repeatedly demonstrated with DF, it is in low-threat contexts where these behaviors (DF and parenting) matter the most (Buss, 2011; Kiel & Buss, 2012). The type of overprotective parenting and monitoring measured in the current study tap into more general or global assessments of these parenting practices, and do not capture specific parent behaviors in specific contexts.

Despite evidence in the literature for gender differences in anxiety during adolescence (Beesdo, Knappe, & Pine et al., 2009; McLean et al., 2011), we did not find that gender was associated with outcomes or predictors. Evidence for gender differences in our previous work has been limited as well. Specifically, the DF profile contains equal representation of boys and girls (Buss, 2011) which is consistent with the temperament literature early in development whereby most gender differences emerge only in parent reported behaviors (Chaplin & Aldao, 2013). Moreover, gender differences are often found as moderating effects in our longitudinal work (Buss, Brooker, & Leuty, 2008) and consistent with the broader literature (e.g., Kiel & Hummel, 2017). The robust findings of sex-based differences in the emergence of social anxiety disorder – with differences in the onset during early adolescence

favoring girls (Beesdo et al., 2009) warrants further examination of differences in trajectories and differential risk factors for girls v. boys. For instance, there is accumulating evidence linking anxiety development, especially in girls, to aspects of pubertal development (Carter, Silverman, & Jaccard, 2011; Negriff, Hillman & Dorn, 2011; Reardon, Leen-Feldner & Hayward, 2009). Examination of pubertal effects was beyond the scope and design of the current study and we did not include a rigorous measure of pubertal development. However, we did have a single item drawn from the *Pubertal Development Scale* (Peterson et al., 1988), youth-reported question on perceived pubertal timing ("Has your physical development (body changes) been earlier, about the same, or later than friends your age?). Posthoc analyses between this item and all study variables, including gender, revealed no significant associations. Given the limitations of the single-item measure and narrow age-range of the current study, these null-findings are not particularly informative. Future work should address how pubertal development and/or pubertal timing may interact with gender and early temperamental vulnerability to predict the development of anxiety in long-term longitudinal studies.

There are a few limitations, which limit the generalizability of the results. This study followed a low-risk community sample of children and the follow-up was conducted exclusively via survey; therefore, we were only able to assess the presence of symptoms rather than focusing on diagnoses of social anxiety. There was a relatively large gap between the assessments in this sample (prior assessment in spring of kindergarten), precluding a full picture of intervening processes. Because of the large gap between assessments, there was significant attrition; however, this is largely consistent with our studies from similar samples (see Gillom & Shaw, 2004; Motti-Stefanidi, Asendorpf, & Masten, 2012; Schulenberg, Bryant, & O'Malley, 2004) and we found no evidence for systematic attrition based on early temperamental risk. As previously mentioned, we did not include a rigorous measure of

pubertal status or timing, despite evidence in the extant literature that puberty has been associated with anxiety symptoms for girls (Carter et al., 2011; Negriff et al., 2011; Reardon et al., 2009). Despite these limitations, it is striking that toddler DF nonetheless predicted adolescent social anxiety symptoms, which clearly warrants further study with different samples. Future research should also improve on assessment of more proximal influences, which may exacerbate or mitigate the risk posed by toddler DF. We controlled for two important proximal factors known to be associated with anxiety in late childhood and adolescence—parental monitoring/overprotection and peer relationship quality – and future longitudinal research would benefit from examination of the bidirectional influences of child DF on these factors and of these factors on toddler fear.

Conclusion and Implications

In conclusion, our results extend prior research highlighting DF predicts social anxiety symptoms into early adolescence. Prior to this report, DF has been shown to predict social anxiety symptoms up to age 6 (Buss et al., 2013). However, other studies have demonstrated that a stable fearful temperament has been linked to social anxiety development into adolescence (Chronis-Toscano et al., 2009). These results provide the first evidence that DF at the very early age of 24 months predicts social anxiety symptoms in adolescents, even after taking into consideration the social wariness that children experienced during the kindergarten years, concurrent reports of peer difficulties, and parental overprotection and monitoring behavior in early adolescence. These findings are striking as they contribute to our understanding of the lasting impact of early temperamental risk for maladaptive trajectories and highlight the unique contribution of DF.

Considerable heterogeneity in symptomatology, risk factors, and biomarkers exists across anxious adolescents (Shackman, Fox, Oler, Shelton, Davidson, & Kalin, 2013). Such a pattern of heterogeneity underscores the importance of (1) understanding the developmental

etiology of those that are at highest risk for anxiety, (2) identifying individual patterns of symptom trajectory, (3) creating an evidence base of treatments matched to distinct symptom patterns, and (4) translating evidence-based treatments into practice. We contend that early identification of those at highest risk will have important translational implications to address these four gaps in the field. We have accumulated evidence across studies now that implicate DF as such a marker (Buss, 2011; Buss et al., 2013; 2018). Further longitudinal, mechanistic work is needed to (a) identify the cascade of experiences across childhood and adolescence; and (b) to examine underlying processes accounting for the link between high fear to low threat situations and the development of social anxiety symptoms.

Table 1. Descriptive Statistics and Bivariate Correlations among Study Variables.

Variable	Mean	*SD*	Range	Skew	Kurtosis	1	2	3	4	5	6	7	8
Age 2													
1. DF	14.11	5.56	28.35	-.89	.45	---							
Kindergarten													
2. Social Withdrawal	0.54	0.34	1.50	.18	-.26	.32**	---						
Adolescence													
3. Monitoring	44.31	7.46	34.00	.42	.29	-.14	.07	---					
4. Protection	50.22	8.63	32.00	-.22	-.76	.22	.24†	-.24†	---				
5. Peer Relations	56.95	9.22	36.00	-1.01	.47	.001	.04	-.18	.40**	---			
6. SCARED-SC (PR)	3.87	3.32	11.00	.56	-.92	.29*	.15	.20	.06	-.15	---		
7. SCARED-SC (YR)	4.18	2.92	12.00	.46	-.30	.22	.08	.22	-.06	-.16	.29*	---	
8. SAS-A (YR)	36.63	12.98	58.00	.92	.69	.30*	.08	.11	-.03	-.27*	.25†	.68***	---

Note: SCARED-SC= Screen for Child Anxiety Related Emotional Disorders-Social Anxiety subscale; SAS-A= Social Anxiety Scale for Adolescents; PR=parent report; YR=youth-report

† $p < .10$ * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 2. Hierarchical regressions predicting adolescent social anxiety symptoms

	SCARED-SC (Parent)					SCARED-SC (Youth)					SAS-A (Youth)				
	R^2	F	B	β	*p*	R^2	F	B	β	*p*	R^2	F	B	β	*p*
Model 1	**.09**	**6.06**	**---**	**---**	**.01**	.05	1.78	---	---	.18	**.09**	**3.73**	---	---	**.05**
DF	---	---	**0.17**	**0.29**	**.02**	---	---	0.09	0.17	.18	**---**	**---**	**.69**	**0.29**	**.03**
Model 2	.10	4.06	---	---	.04	.05	1.67	---	---	.20	.09	3.73	---	---	.05
DF	---	---	**0.16**	**0.27**	**.03**	---	---	0.09	0.18	.18	**---**	**---**	**0.71**	**0.30**	**.03**
Soc With	---	---	0.49	0.05	.68	---	---	0.31	-0.03	.79	---	---	-1.19	-0.03	.82
Model 3	.19	2.50			.04	.16	1.72	---	---	.15	.22	3.29	---	---	.01
DF			**0.18**	**0.30**	**.02**			0.12	0.23	.08			**0.73**	**0.31**	**.02**
Soc With	---	---	0.11	0.01	.92	---	---	-0.51	-0.06	.67	---	---	-1.34	-0.03	.80
Monitoring	---	---	0.11	0.24	.05	---	---	0.10	0.26	.05	---	---	0.22	0.12	.32
Protection	---	--	0.03	0.08	.52	---	---	-0.01	-0.03	.84	---	---	-0.01	-0.01	.97
Peer Rel.	---	---	-0.06	-0.18	.14	---	---	-0.03	-0.11	.44	---	---	-0.38	-0.25	.06
Gender	---	---	0.48	0.07	.48	---	---	0.01	0.003	.98			3.61	0.14	.19

Note: SCARED-SC = Screen for child anxiety related emotional disorders-social anxiety subscale; SAS-A = Social anxiety scale for adolescents; DF = Slope score for dysregulated fear; Soc With = Kindergarten social withdrawal; Peer Rel = Peer relations.

Table 3. Tests of mediation effects involving proximal risk indicators

Standardized estimates of indirect effects												
	SCARED-SC (Parent)				SCARED-SC (Youth)				SAS-A (Youth)			
Mediator	β	SE	95% CI		β	SE	95% CI		β	SE	95% CI	
Soc With	-0.01	.03	-.07	.03	.004	.02	-.04	.05	.04	.12	-.21	.29
Monitoring	0.03	.03	-.01	.11	.03	.03	-.01	.12	.09	.11	-.03	.45
Protection	0.002	.03	-.04	.06	.02	.02	-.01	.10	.09	.10	-.04	.39
Peer Rel	<0.001	.02	-.05	.05	-.001	.02	-.05	.04	-.004	.14	-.39	.20

Note: SCARED-SC = Screen for child anxiety related emotional disorders-social anxiety subscale; SAS-A = Social anxiety scale for adolescents; DF = Slope score for dysregulated fear; Soc With = Kindergarten social withdrawal; Peer Rel = Peer relations.

Table 4. Proximal environmental variables as moderators of the relation between DF and adolescent social anxiety symptoms

		SCARED-SC (Parent)				SCARED-SC (Youth)				SASA-TS (Youth)			
		R^2	F	B	*p*	R^2	F	B	*p*	R^2	F	B	*p*
Model 1		.11	1.98		.12	.05	0.46		.71	.10	1.69		.17
	DF	---	---	0.27	.05	---	---	0.11	.36	---	---	0.17	.21
	Soc. With	---	---	-0.05	.70	---	---	0.25	.96	---	---	0.01	.97
	DF x SW	---	---	0.02	.86	---	---	0.10	.93	---	---	0.09	.48
	Gender	---	---	0.10	.65	---	---	0.04	.93	---	---	0.30	.20
Model 2		.14	0.77		.51	.11	1.14		.34	.11	1.45		.23
	DF	---	---	0.28	.02	---	---	0.16	.47	---	---	0.15	.26
	Monitoring	---	---	-0.33	.12	---	---	-0.15	.09	---	---	0.18	.15
	DF x PM	---	---	0.18	.55	---	---	-0.07	.43	---	---	0.02	.86
	Gender	---	---	0.07	.62	---	---	0.05	.84	---	---	0.34	.14
Model 3		.10	0.33		.80	.07	0.60		.61	.08	1.01		.39
	DF	---	---	0.30	.13	---	---	0.16	.32	---	---	0.18	.22
	Protection	---	---	-0.02	.12	---	---	-0.15	.21	---	---	-0.10	.43
	DF x PO	---	---	-0.06	.12	---	---	-0.07	.54	---	---	0.01	.95
	Gender	---	---	0.10	.21	---	---	0.05	.81	---	---	0.33	.15
Model 4		.12	0.46		.71	.09	0.68		.57	.15	1.99		.12
	DF	---	---	0.29	.03	---	---	-0.13	.40	---	---	.17	.20
	Peer Rel.	---	---	-0.13	.26	---	---	-0.20	.13	---	---	.27	.05
	DF x PR	---	---	0.01	.92	---	---	-0.06	.68	---	---	.04	.77
	Gender	---	---	0.11	.61	---	---	0.05	.81	---	---	.34	.13

Note: SCARED-SC = Screen for child anxiety related emotional disorders-social anxiety subscale; SAS-A = Social anxiety scale for adolescents; DF = Slope score for dysregulated fear; SW = Kindergarten social withdrawal; PM = Parent Monitoring; PO = Parent Protectiveness; Peer Rel. = Peer relations.

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