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Associations between childhood adversity and daily suppression and avoidance in response to stress in adulthood: can neurobiological sensitivity help explain this relationship?

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Abstract

Background and objectives—Although it has been postulated that psychological responses to stress in adulthood are grounded in childhood experiences in the family environment, evidence has been inconsistent. This study tested whether two putative measures of neurobiological sensitivity (vagal flexibility and attentional capacity) moderated the relation between women's reported exposure to a risky childhood environment and current engagement in suppressive or avoidant coping in response to daily stress.

Design and methods—Adult women (*N* = 158) recruited for a study of stress, coping, and aging reported on early adversity (EA) in their childhood family environment and completed a week-long daily diary in which they described their most stressful event of the day and indicated the degree to which they used suppression or avoidance in response to that event. In addition, women completed a visual tracking task during which heart rate variability and attentional capacity were assessed.

Results—Multilevel mixed modeling analyses revealed that greater EA predicted greater suppression and avoidance only among women with higher attentional capacity. Similarly, greater EA predicted greater use of suppression, but only among women with greater vagal flexibility.

Conclusion—Childhood adversity may predispose individuals with high neurobiological sensitivity to a lifetime of maladaptive coping.

Keywords

Risky family environment; neurobiological sensitivity; vagal flexibility; attentional capacity; avoidance; suppression

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Disclosure statement

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Notes

Risky family environments characterized by hostility, chaos, abuse or neglect are associated with a wide range of behavioral and physical health problems later in life (Anda et al., 2006; Repetti, Taylor, & Seeman, 2002). Empirical research in the biological and social sciences has documented that the life-long physical and mental health consequences of a harsh family environment in childhood are at least partially mediated by adversity-induced deficits in self-regulation and maladaptive responses to stress (Taylor & Stanton, 2007). There is, however, considerable individual variability in the extent to which adverse childhood family experiences impact adult well-being (Schafer, Morton, & Ferraro, 2014). One hypothesis is that the association between a risky childhood family environment and how individuals respond to daily stress in adulthood may depend partly upon an individual's neurobiological sensitivity to the environment, defined as having a heightened risk of negative outcomes in risky environments and greater probability of better outcomes in more optimal environments (Bush & Boyce, 2015; Ellis, Boyce, Belsky, Bakermans-Kranenburg, & Van IJzendoorn, 2011; Hartman & Belsky, 2015). The current study investigated whether the relation between perceived risk in the childhood family environment and daily suppressive and avoidant coping in adulthood varies as a function of individual differences in two putative indicators of neurobiological sensitivity.

Maladaptive responses to stress in adulthood and early family experiences

Within a developmental framework, coping has been conceptualized as *action regulation under stress* [emphasis added] or how individuals succeed or fail in mobilizing and directing behavior, emotion, and orientation in the context of stressful circumstances (Skinner & Zimmer-Gembeck, 2007). Numerous theoretical and empirically driven frameworks have sought to define and categorize ways of coping that capture macro-level and micro-level functions (Skinner, Edge, Altman, & Sherwood, 2003). Across all models, there is remarkably consistent empirical evidence showing that certain responses to stress, such as those that focus on emotion management (e.g., avoidance and suppression), are associated with maladaptive health behaviors and poor physical health in adulthood (Lehavot, 2012; Matheson, Jorden, & Anisman, 2008; Wright, Fopma-Loy, & Fischer, 2005; Yang, Brothers, & Andersen, 2008). For example, as reviewed by Taylor and Stanton (2007), longitudinal studies have shown that avoidance predicts increased physical health problems, risky health behaviors, chronic disease progression, and mortality, with fewer studies showing direct connections between better health and more approach-oriented coping (e.g., problem-solving).

Identifying the factors underlying a reliance on avoidance and suppression is critical for interventions aimed at supporting physical and mental health and engagement in health-promoting behaviors. It has been suggested that the development and entrenchment of coping styles unfolds in the context of childhood family experiences and that individuals raised in harsh, rejecting, and/or over-controlling households are less likely to learn adaptive ways of responding to stress (Skinner & Wellborn, 1994). In line with these developmental theories of coping, it has been shown that engagement in avoidance and suppression in adulthood are rooted in adverse experiences in the family environment (McElroy & Hevey, 2014; Roubinov & Luecken, 2013). Illustratively, a greater number of retrospectively reported adverse childhood experiences were associated with these maladaptive coping efforts in a clinical sample of adults (McElroy & Hevey, 2014). However, relations between early experiences and psychological responses to stress in adulthood have not always been replicated (e.g., Helitzer, Graeber, LaNoue, & Newbill, 2015). Individual differences in neurobiological sensitivity may provide insight into the variability seen in adult responses to stress subsequent to childhood family-related adversity (Hartman & Belsky, 2015).

Neurobiological sensitivity, adverse childhood experiences, and coping in adulthood

Although the effects of early life adversity on mental and physical health across the life course are well-demonstrated (Sheikh, Abelsen, & Olsen, 2016; Shonkoff & Garner, 2012), not all individuals exposed to such adversity have maladaptive outcomes. Based on empirical evidence indicating tremendous variability in sensitivity to early experiences, several developmental theories (with different origins and names, e.g., Biological sensitivity to context, Boyce & Ellis, 2005; Differential susceptibility, Belsky & Pluess, 2013; Adaptive calibration model, Del Giudice, Ellis, & Shirtcliff, 2011) have converged on a model of neurobiological sensitivity to context. This model argues that individuals with greater sensitivity – typically through stable characteristics such as genetic, physiological, or temperamental reactivity – are at the greatest risk for negative outcomes in risky environments but exhibit the best outcomes in more optimal environments. A burgeoning wealth of data provide support for neurobiological sensitivity in children (Bush & Boyce, 2015). For example, it has been found that an indicator of genetic sensitivity (indexed by variation in cholinergic genes, which are involved in neural plasticity and learning) predicted the greatest negative affectivity in children exposed to maltreatment and the lowest negative affectivity in non-exposed children (Grazioplene, DeYoung, Rogosch, & Cicchetti, 2013). Although attention to this phenomenon in adulthood has been limited (Hartman & Belsky, 2015), it has been shown that maltreatment in childhood leads to greater negative affectivity among young adults who exhibit either physiological sensitivity to stress (Hagan, Roubinov, Mistler, & Luecken, 2015) or high sensory-processing sensitivity (Aron, Aron, & Davies, 2005).

In addition to empirical support (e.g., Grazioplene et al., 2013), there is a strong theoretical basis for the proposition that individuals exposed to family adversity and who demonstrate heightened neurobiological sensitivity in adulthood would be more likely to employ maladaptive coping strategies in daily life. Presuming neurobiological sensitivity indicators reflect relatively stable trait-like markers of susceptibility to the environment, neurobiologically sensitive individuals would have been highly attuned to negativity in the childhood family environment. Without the ability to physically escape this context, these individuals may have been motivated to engage in strategies that offered relief in the short-term, and avoidant responses have proven to be effective in this regard (Suls & Fletcher, 1985). As such, individuals high in neurobiological sensitivity may have come to rely upon these strategies in other contexts and across the life course.

The current study focused on two indicators of neurobiological sensitivity – one cognitive, one physiological – posited to influence how self-reported qualities of the childhood environment relate to daily psychological responses to stressful events in adulthood: cardiac *vagal flexibility* during attentional demand (as indexed by changes in heart rate variability, a measure of parasympathetic activity) and *attentional capacity* (visual monitoring of external stimuli). Consistent with neurobiological sensitivity theories, it has been found that individuals with greater vagal flexibility – defined as higher heart rate variability at rest (i.e., greater basal parasympathetic activity) coupled with greater decreases in heart rate variability during attentional demand (i.e., deactivation of the parasympathetic nervous system) – show greater social sensitivity to context (Muhtadie, Koslov, Akinola, & Mendes, 2015). Specifically, greater vagal flexibility was associated with *more adaptive* affective, physiological and behavioral responses to contexts that consisted of positive social cues and *less adaptive* responses to contexts that consisted of rejecting social cues. Physiological sensitivity has been linked to a host of maladaptive responses to *negative* family environments (Bush & Boyce, 2015), and it may be that adults who exhibit heightened neurobiological sensitivity and were exposed to an adverse childhood family environment are more likely to engage in avoidance or suppression following daily stressors.

An individual's capacity to monitor external stimuli is another indicator of their sensitivity to the environment. Attention processes are the first cognitive capacities to "come online" in development (Rothbart, Ziaie, & O'boyle, 1992) and underlie both sensitivity and behavioral responses to stress (Cohen, 2014). It has been found that an individual's capacity to attend to and monitor the environment plays a critical role in the execution of coping efforts (Compton et al., 2011; Hocking et al., 2011). Although attending to and monitoring the immediate environment can facilitate appropriate responses, heightened monitoring might also undermine healthy psychological stress responses. Ruchkin, Eisemann, and Hägglöf (1999) suggested that for children living in risky family environments, high attention might facilitate the use of coping strategies that are most likely to prevent additional exposure (e.g., behavioral or cognitive avoidance) or minimize emotional processing of the event (e.g., suppression). Attention is intimately linked with learning and memory, and with greater attentional capacity comes a higher probability that processed information will be stored in long-term memory. In this way, attentional capacity reflects an individual's neurobiological sensitivity and may have implications for avoidance and suppression following daily stressful events, particularly among those with histories of adversity.

The current study

Given that psychological responses to daily stressors appear to shape health (e.g., Affleck, Tennen, Urrows, & Higgins, 1994; Repetti, 1993; Walker, Garber, Smith, Van Slyke, & Claar, 2001), it is critical to identify factors that influence whether individuals from risky family environments develop daily maladaptive coping behaviors. Moreover, it has been found that avoidance and suppression, two responses to stress focused on managing stress-induced thoughts and emotions, are more strongly predictive of health outcomes than deficits in active coping behaviors, such as problem-solving (Lehavot, 2012; Roubinov & Luecken, 2013). As such, the current study examined the relation between perceived childhood family environment (specifically, level of parental warmth and nurturance, extent of parental overprotection or controlling behavior, and experiences of emotional and physical maltreatment) and the daily use of suppression and avoidance in response to the day's most stressful event over a 7-day period in adulthood as a function of two indices of neurobiological sensitivity. We tested the hypothesis that riskier childhood family environments would be related to greater daily use of suppression and avoidance in the context of stress among individuals who exhibited more neurobiological sensitivity, operationalized as greater vagal flexibility and attentional capacity.

Methods

Participants

The current sample is drawn from a larger prospective study of chronic stress and aging. To maximize variability in chronic stress levels, two groups of healthy premenopausal women were recruited to the original study: (1) women who were raising a child with an autism spectrum disorder (ASD; $n = 92$) and (2) women raising a neurotypical child ($n = 91$). In addition, women had to report being a non-smoker between the ages 20 and 50 years with at least one child between the ages 2 and 16 years. Individuals with a major medical disorder or current psychiatric conditions, including bipolar disorder, post-traumatic stress disorder, or eating disorders, were ineligible for the study. The mothers of children with ASD were included if they met criteria for Major Depression, since it is common among caregivers under chronic stress, whereas the mothers of neurotypical children were not eligible for the study if they met criteria for Major Depression. In total, 183 women were recruited via mass mailing, schools, parenting publications in the Northern California area, and direct recruitment at the (blinded) Autism Clinic. As expected by design, mothers of neurotypical children reported significantly *lower* levels of parental stress compared to mothers of a child with an autism spectrum disorder, $t(178) = -8.25$, $p < .001$, on the Parental Stress Scale (Berry & Jones, 1995). Given this, all analyses statistically adjusted for levels of parental stress.

To maximize confidence in the reliability and stability of the coping measures, only those women who completed a daily diary on at least six of the seven days were included in the analytic sample. Of the 183 women, 25 completed only five days or fewer of the 7-day diary, leaving an analytic sample of 158 women (mean age = 42.03 years, SD = 4.75 years). Racial/ethnic group breakdown of the eligible sample was 78% White, 10% Asian/Pacific Islander, 4% Latina, 2% African American, and 6% multiple/other. Approximately 92% of women reported having at least a bachelor's degree, 91% were living with a partner, and average household income before taxes was between $100,000 and $149,000. Women in the analytic sample did not differ from women excluded based on having missing daily diary data in regard to age, household income, weekly average coping styles (suppression or avoidance), or risky childhood family environment scores.

Procedures

This study was approved by the Institutional Review Board at (blinded), and written informed consent was obtained for each participant prior to all study procedures. The study involved a clinic visit and participant completion of a computer-based daily diary over a 7-day period. The daily diary questionnaire included items assessing mood, exercise, sleep, family interaction quality, stressful and positive events, and coping strategies. The clinic visit included a battery of socio-demographic, psychological, and health behavior questionnaires, as well as a physiological assessment including electrocardiography (ECG) to obtain resting heart rate variability and changes in heart rate variability during the visual tracking task. This clinic visit occurred on the fourth day of the 7-day diary period. Participants were paid $110 at the conclusion of the assessment.

Measures

Risky childhood family environment—To capture a range of relational risk in the family environment, an early adversity composite (hereafter referred to as EA) was created by summing the standardized scores on two measures of women's childhood family environment: the 28-item Child Trauma Questionnaire – Short Form (CTQ; Bernstein et al., 2003) and the 25-item Parental Bonding Inventory (PBI; Parker, Tupling, & Brown, 1979). The CTQ is a retrospective measure of experiences of childhood physical, emotional, and sexual abuse as well as emotional and physical neglect. The CTQ (a = .84) has been validated in clinical and non-clinical populations (Bernstein et al., 2003). The PBI is a retrospective measure that assesses participants' perception of the maternal caregiving they received during childhood. The PBI includes two subscales, care (a = .94) and overprotection/control (a = .87), rated on a Likert scale from 0 (very unlike her) to 3 (very much like her). Risky childhood family environments are typically studied in a discrete manner, such as assessing only exposure to child abuse or parenting styles. The goal of the current study, however, was to evaluate the role of a risky childhood family environment broadly, as done in previous studies (e.g., Bouvet-Turcot et al., 2015; Mileva-Seitz et al., 2011), rather than to examine aspects of environment in isolation. To capture the broader concept of "family environment," we combined self-reports of perceived parental over-controllingness; physical, sexual and emotional abuse; physical and emotional neglect; and, lack of warmth into a single factor. To ascertain whether combining the PBI and CTQ was appropriate in this sample, a confirmatory factor analysis was conducted on the 7 subscales of the two measures (the PBI care subscale was reverse scored). The model exhibited adequate fit to the data: CFI = .97; Chi-square = 16.22, p = .04; RMSEA = .08 [95% CI: .02, .14]; SRMR = .04. Internal consistency was a = .77. A composite of EA was computed by averaging standardized total scores from the two measures. Higher EA scores indicate a risker child-rearing environment in women's families of origin.

Daily maladaptive coping responses—At the end of each day of the 7-day study period, women reported on their most stressful event of the day and answered a series of questions about the extent to which they used various coping strategies to deal with that stressful event. The current study focused on two psychological responses to stress: suppression and avoidance. Each strategy was assessed with one item rated on a scale from 0 (not at all) to 4 (a lot) as follows: suppression ("I tried to hide my negative feelings about the situation and did not tell anyone how I am feeling") and avoidance ("I tried to avoid thinking about my feelings and the situation").

Physiological measures—Cardiac measures were acquired continuously during a 5-minute resting baseline period and during the visual tracking task. Upon arrival at the laboratory, trained female research assistants applied sensors in a standard lead II configuration (right arm, left leg) and a respiration band around the upper part of the chest. Signals were acquired with ECG and RESP modules from Biopac (Goleta, CA) collected at 1000 Hz and integrated with a Biopac MP150 system. All data were scored offline and averaged into 1-minute bins using Mindware software HRV 2.6 module (Lafayette, OH), which estimates RSA in accordance with the recommendations of the Society for Psychophysiological Research committee on heart rate variability (Berntson et al., 1997). All minutes of the digitized ECG signal were visually inspected by trained research assistants, and artifacts and incorrectly identified R spikes were edited. A 4 Hz time series was applied to interpolate the interbeat interval (IBI) time series (Berntson, Cacioppo, & Quigley, 1993), and a second order polynomial was applied to minimize non-stationary trends. The residual series was then tapered with a Hanning window and submitted to a Fast Fourier Transform to derive the spectral distribution. RSA was quantified as the integral power within the respiration frequency band (.12 to .4 Hz).[1]

Twelve women did not have valid physiological data due to equipment failure or protocol violations and were excluded from the moderation analyses. These women did not differ from the women with complete physiological data in terms of age, body mass index, income, education, attention task performance, EA score, or average use of suppression or avoidance across the week. To calculate vagal flexibility, we first computed average RSA across the 5-minute baseline period and then subtracted baseline RSA from each participant's minimum RSA value during the attention task. This strategy allowed us to capture the largest range of vagal changes for each person. We then multiplied this change score by a −1 to aid in the interpretation that greater vagal flexibility is indicated by larger numbers. The overall mean of vagal flexibility after this transformation was $M = .75$, SD = .77, range −.70 to 2.96.

Attentional capacity—Measures of attentional capacity in individuals exposed to trauma have often included emotion-laden stimuli (Schoorl, Putman, Van Der Werff, & Van Der Does, 2014). In an effort to separate attentional sensitivity from sensitivity to affective cues, and following the recent work on vagal flexibility (Muhtadie et al., 2015), the current study employed a task that assesses individuals' attentional capacity to orient to and track multiple objects independent of its emotional content. The "Dot Tracking Task" (Cavanagh & Alvarez, 2005) was developed by vision scientists to assess capacity to track multiple items. Each trial began with 12 black dots presented against a gray background. At the beginning of each trial, a subset of these dots flashed yellow for two seconds to designate themselves as the targets to be tracked by the participant. The target dots then returned to black, camouflaging with the others, and participants were required to continue tracking these target dots, along with the distractors, for another 12 seconds as they moved around the screen in random fashion. At the end of each trial, the dots stopped moving and participants used the mouse to identify which among the 12 dots on the screen had been pre-selected as targets (i.e., which subset of dots had flashed yellow at the outset of the trial). Participants

[1]There is controversy regarding whether respiration must be accounted for when measuring heart rate variability. In the present study, respiration rate was calculated in terms of breaths per minute and was examined as a covariate in all analyses: the presence or absence of respiration rate as a covariate did not significantly alter any of the results. Therefore, the more parsimonious models without respiration rate are reported in this article.

completed 16 total trials, with four blocks each comprising four trials. In the four blocks of trials, participants were required to track 2, 3, 4 and 5 targets, respectively, such that the task becomes increasingly difficult as it progresses. In addition to using this task to measure vagal flexibility, this task produces an estimate of attentional capacity, with higher scores indicating greater attentional capacity ($M = 2.12$, SD = .68, range = .72–4.16).

Due to equipment failure, eight individuals' did not have valid attentional capacity scores, and one individual's number of errors on the task exceeded 4 SD above the mean of number of errors for all participants. These nine individuals were excluded in the moderator analyses. They did not differ from those included in regard to age, income, education, EA score, or average use of avoidance, across the week. However, women without valid attention scores used significantly more suppression on average across the week ($M = 1.57$, SD = .70) compared to women included in the analytic sample ($M = .97$, SD = .71), $t(156) = -2.46$, $p = .015$).

Parental stress—Parental stress was measured by self-report on the Parental Stress Scale (Berry & Jones, 1995; $a = .87$), which contains 18 items representing positive and negative components or parenthood with each item rated on a five-point scale from 1 (strongly disagree) to 5 (strongly agree); positive items are reverse coded and all items are summed such that a higher total score reflects greater parenting stress.

Data analytic plan

Missing data (only 1% of cases were missing scores on self-report measures) were addressed using maximum likelihood estimation. Due to the nested structure of the data – repeated measures of daily coping nested within individuals – multilevel modeling analyses were conducted using the SPSS v.22 MIXED procedure. Multilevel models, also known as mixed or hierarchical linear models, provide robust standard errors (Bolger, Stadler, & Laurenceau, 2011). Each model allowed intercepts to vary at random and had fixed slopes. First, we tested for the associations between risky family environment scores (which we refer to as early adversity or EA) and use of each avoidance or suppression in two independent models ($n = 158$). Next, we tested whether vagal flexibility and/or attentional capacity moderated the associations between EA score and each avoidance or suppression ($n = 137$). In separate analyses, vagal flexibility and attentional capacity were each first entered as independent factors, including EA in the models, and then the respective interaction was included in the following step. All predictors were grand mean centered and all models statistically adjusted for level of parental stress. Vagal flexibility models also statistically adjusted for individuals' baseline vagal activity. Significant interactions were probed using guidelines provided in Aiken and West (1991). More specifically, coefficients from the covariate-adjusted full-sample model were used to plot slopes for the association between the predictor and outcome at one standard deviation below and above the mean of the moderating variable and the statistical significance of the coefficients in these simple slopes was examined.

Results

Descriptives

As shown in Table 1, EA score was positively related to average use of suppression and avoidance in response to daily stress across the week. Vagal flexibility and attentional capacity were not correlated with any of the primary variables. Greater parental stress was associated with higher levels of average use of suppression and avoidance as well as higher EA scores.

Primary analyses[2]

Unconditional models predicting suppression and avoidance indicated significant between-person variability (all *p*'s < .01), and ICCs were .22 and.25, respectively, suggesting that about one-quarter of the variation in suppression and avoidance occurred between participants. In two separate multilevel models controlling for parental stress, EA was positively related to suppression, *B* = .16, SE = .08, *p* = .04, and avoidance, *B* = .14, SE = .07, *p* = .04.

Vagal flexibility, EA, and daily coping—Vagal flexibility was examined as a level-2 predictor of the level-1 suppression and avoidance, adjusting for parental stress, EA, and baseline vagal activity. Vagal flexibility was not directly related to either suppression (*p* = .68) or avoidance (*p* = .08). The interaction between vagal flexibility and EA was then entered into the model. There was a significant interaction between EA and vagal flexibility in the prediction of daily suppression, *B* = .25, SE = .10, *p* = .01. The interaction was not significant in the model predicting avoidance, *B* = .13, SE = .09, *p* = .13. Following Aiken and West's (1991) guidelines for probing interactions, simple slopes were computed using the coefficients from the suppression model to determine the shape and significance of the relation between EA and suppression at high (1 SD above the mean) and low (1 SD below the mean) levels of vagal flexibility. As shown in Figure 1, higher EA scores were associated with greater use of daily suppression at higher levels of vagal flexibility in adulthood, *B* = 0.29, SE = 0.12, *p* = .012. In contrast, EA score was not related to use of suppression strategies at lower levels of vagal flexibility, *B* = −0.10, SE = 0.12, *p* = .38.

Attentional capacity, EA, and daily coping—Following the same strategy as was used in the vagal flexibility models, we first examined the link between attentional capacity and suppression and avoidance. Attentional capacity had no main effects on suppression (*p* = .37) or avoidant coping (*p* = .82). There was a significant interaction between EA and attentional capacity in the prediction of suppression, *B* = .32, SE = .13, *p* = .02, and avoidance, *B* = .25, SE = .12, *p* = .03. Again, simple slopes were computed using the coefficients from the above models to determine the relation between EA and each of the two coping strategies (suppression and avoidance) at high (1 SD above the mean) and low (1 SD below the mean) levels of attentional capacity. Consistent with the pattern displayed for

[2]Given that half of this sample of women had been specifically recruited because they had a child with a neurodevelopmental disorder and reported high stress, we also tested three-way interactions between EA, vagal flexibility or attentional capacity, and caregiver status (mother of neurotypical child or mother of child with autism) to ascertain whether relations varied across these two groups of women. All models were non-significant.

vagal flexibility in Figure 1, EA score was significantly positively associated with daily suppression at higher levels of attentional capacity, $B = 0.31$, SE = 0.11, $p < .01$, but not at lower levels of attentional capacity, $B = -0.12$, SE = 0.13, $p = .34$. This same pattern was evident for avoidance as well: As shown in Figure 2, EA score was related to greater avoidance at higher levels of attentional capacity, $B = 0.29$, SE = 0.10, $t(147) = 3.01$, $p < .01$, but not at lower attentional capacity, $B = -0.05$, SE = 0.12, $t(147) = -0.44$, $p = .66$.

Discussion

There is extensive evidence that characteristics of one's childhood family environment influence pathways of health throughout the lifespan (Miller, Chen, & Parker, 2011). Although psychological stress responses such as suppression and avoidance have been identified as important mediators of this relationship (Taylor & Stanton, 2007), there is considerable individual variability in the extent to which a risky childhood family environment impacts coping in adulthood (Helitzer et al., 2015; Roubinov & Luecken, 2013). The current study tested the hypothesis that greater risk in the childhood family environment (i.e., a composite of parental over-control, low parental warmth, neglect, and abuse) would be associated with greater suppression and avoidance in response to the most stressful event of each day – across a period of seven days – among women who demonstrated neurobiological sensitivity (as indicated by greater vagal flexibility and/or attentional capacity) and that lower risk in the family environment would be associated with the least use of suppression and avoidance. We found partial support for this hypothesis. A riskier childhood family environment was associated with greater suppression among women who exhibited greater vagal flexibility and/or high attentional capacity. In addition, a riskier childhood family environment was associated with significantly more avoidance in response to daily events among women with high attentional capacity only. This study adds to the growing evidence that associations between childhood adversity and psychosocial functioning in adulthood are influenced by individual levels of neurobiological sensitivity (e.g., Hagan et al., 2015; Hartman & Belsky, 2015). Findings suggest that women with greater neurobiological sensitivity are more vulnerable to the impact of a risky childhood environment on their subsequent coping abilities in adulthood.

Neurobiological sensitivity theories (e.g., Belsky & Pluess, 2013; Ellis et al., 2011) posit that individuals with who are highly sensitive to the environment – due to genetic factors or physiological or temperamental reactivity – are at the greatest risk for negative outcomes in risky environments but the most positive outcomes in more optimal environments. Notably, in the current study, *lower risk* in the childhood caregiving environment was associated with *less* use of suppressive coping and avoidant coping among those high in neurobiological sensitivity (e.g., Figures 1 and 2); and, there was no association between risky childhood family environments and suppression or avoidance in women with *lower* neurobiological sensitivity. These patterns of association – null effects for less sensitive individuals and heightened effects to both low risk and high risk contexts for those with greater sensitivity – are highly consistent with neurobiological sensitivity theories (Bush & Boyce, 2015; Ellis et al., 2011). The current study extends that literature, which has been predominately based on samples of young children, by demonstrating that greater vagal flexibility and high attentional capacity may operate as indicators of neurobiological sensitivity in the context of daily responses to stress in adulthood.

In the current investigation, neurobiological sensitivity was measured in adulthood only. The levels of vagal flexibility and attentional capacity observed here could reflect similar levels of neurobiological sensitivity prior to adulthood; however, there is not enough empirical evidence to support this claim. The measure used to assess physiological sensitivity (vagal flexibility) has been found to be relatively stable across different situations but only across several weeks (Muhtadie et al., 2015). Given that long-term stability has not been established, we cannot conclude that vagal flexibility is a trait-like indicator. Similarly, attentional capacity reaches maturity in early childhood and becomes stabilized by middle childhood (Zhou et al., 2007), but more research is needed before equating adult capacity with capacity levels earlier in life.

Despite these caveats, it is interesting to speculate what the implications are, if the levels of vagal flexibility and attentional capacity measured here were similar during individuals' childhood and adolescence. Higher vagal flexibility and attentional capacity may have facilitated the early use of coping strategies that served to minimize emotional or cognitive processing of the event (Ruchkin et al., 1999). Theoretically, in the context of an aversive environment, neurobiologically sensitive individuals may have been more prone to respond to stress with automatic efforts, such as suppression or avoidance, that function to provide immediate relief from distress. As sensitive adults, it may be that these women continue to rely on these strategies. It is interesting that greater avoidance was only evident among women who reported riskier childhood environments and exhibited higher attentional capacity but no such association was found for vagal flexibility. Whereas suppression involves recognition of feelings and active non-expression of those feelings, avoidance involves cognitive efforts to escape the feelings. Women with a high capacity for orienting to and tracking multiple stimuli may experience stressors as more aversive and intolerable, leading to greater use of strategies which divert their attention elsewhere.

There are limitations to the study that should be considered when interpreting the results. First, demographic characteristics of the sample may limit generalizability to other populations. The sample included only women with children between the ages 2 and 16 years, and, consistent with the demographics of the region in which the study was conducted, women were primarily from the middle to upper-middle class backgrounds and most were living with a partner. Second, half of the sample was recruited specifically on the basis of having a child with a neurodevelopmental disorder for the purpose of maximizing representation of women with high stress. This may also limit the generalizability of the findings; however, level of parental stress was statistically adjusted for in all analyses, and follow-up three-way interaction analyses with caregiver status found that the interaction between childhood family environment and measures of neurobiological sensitivity did not vary across the two groups. Third, each coping construct was measured with only one item to minimize participant burden related to an already lengthy daily diary instrument. Although one-item measures are regularly used in daily diary studies given the advantages they have over multiple-item instruments, such as greater face validity and cost-effectiveness and reduced participant burden (Iida, Shrout, Laurenceau, & Bolger, 2012), multiple items per construct would increase reliability. Thus, it will be important for the present findings to be replicated using more robust measures of coping that capture cognitive, affective, and behavioral coping responses to daily stress.

Fourth, the assessment of attentional capacity is a novel measure developed by vision scientists to examine the capacity to track multiple objects simultaneously. We used this task here because it allowed us to obtain a measure of vagal flexibility that was tied to attentional processes rather than affective components. Thus, we view the results with attentional capacity as both novel and exploratory; future research should explore the longitudinal stability of this measure. Finally, aspects of the childhood family environment were measured retrospectively and may have been influenced by reporting bias. Although previous research has found that measurement error associated with retrospective reports does not significantly affect estimates of models that examine the long-term impact of EA (Fergusson, Horwood, & Boden, 2011), results would be strengthened by a prospective design.

The current study makes a number of significant contributions to the literature on neurobiological sensitivity and the long-term impact of childhood adversity. It also extends existing research on predictors of daily coping processes. Studies that have examined associations between childhood adversity and coping in adulthood have often targeted particular populations (e.g., individuals with psychiatric disorders or a specific serious illness) or measured only severe abuse or a count of adverse childhood experiences. The present investigation focused on a composite of multiple aspects of relational risk in the family environment (low parental warmth/nurturance, high parental control, neglect, and abuse) in a sample with a broad range of current life stress. In addition, the use of multiple indicators of neurobiological sensitivity, including vagal flexibility and an affect-free measure of attentional capacity, and a daily diary method in which women rated their coping response to the day's most stressful event is notable.

The use of avoidance and suppression in relation to daily stressful life events are problematic given the strong connections that have been found between these strategies and mental health problems in adults who have experienced EA (e.g., Kaplow, Gipson, Horwitz, Burch, & King, 2014). Our finding that riskier childhood family environments interacted with neurobiological sensitivity to predict greater engagement in suppression and avoidance in response to daily stress suggests important conditions that may affect individual trajectories of coping across the life course. If replicated, these findings may help to identify those at greater risk for maladaptive coping as well as point to intervention targets for those at risk.

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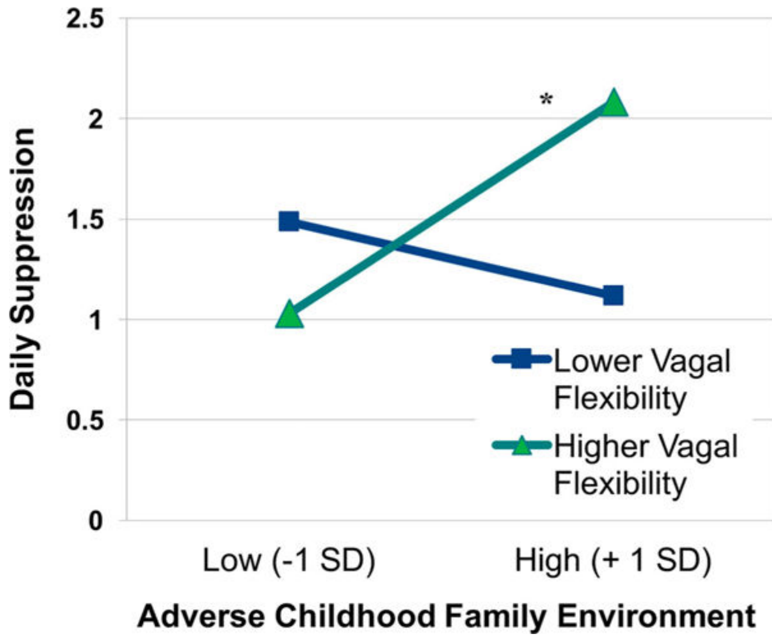

Figure 1.

Illustration of the interaction between continuous risky childhood family environment score and the continuous measure of adult vagal flexibility in the prediction of daily use of suppression coping in adulthood. Associations are plotted for individuals 1 SD above and below the mean in flexibility, using coefficients from the fully adjusted model. Note: $^{*}p < .01$.

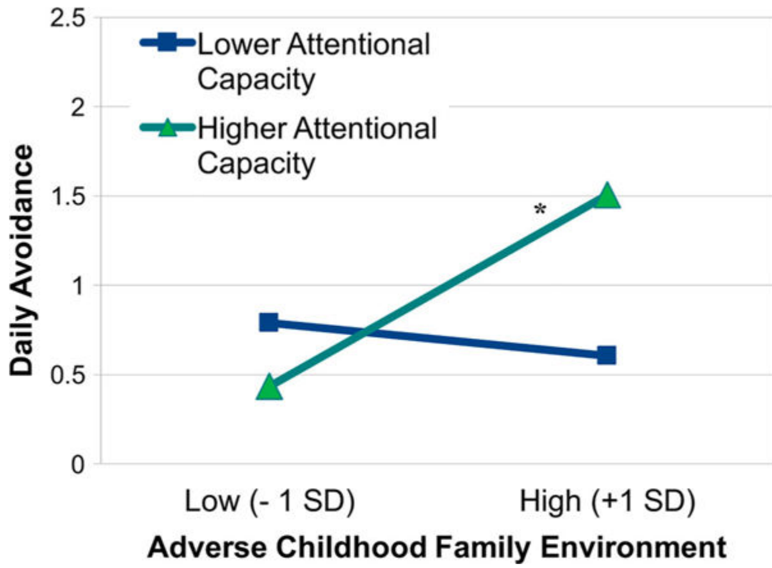

Figure 2.

Illustration of the interaction between continuous risky childhood family environment score and the continuous measure of adult attentional capacity in the prediction of daily use of avoidant coping in adulthood. Associations are plotted for individuals 1 SD above and below the mean of attentional capacity, using coefficients from the fully adjusted model. Note: *$p < .01$.

Table 1

Descriptives for primary variables.

	N	*M* (SD)	1	2	3	4	5	6	7
1. Suppression	158	1.00 (.75)	1.0						
2. Avoidance	158	.77 (.64)	.71**	1.0					
3. EA	158	−.01 (.75)	.21*	.25**	1.0				
4. Attentional capacity	146	2.11 (.68)	.08	.02	.07	1.0			
5. Vagal flexibility	139	.75 (.77)	−.01	−.15	−.00	.05	1.0		
6. Parental stress	156	42 (9.70)	.34**	.37**	.24**	−.03	.02	1.0	
7. Vagal tone	141	5.64 (1.01)	−.10	−.16	.03	.12	.41**	.01	1.0

Note: EA: Early adversity (risky childhood family environment).

* $p < .05$.

** $p < .01$.