Examining basal RSA as a possible moderator of the effects of cumulative risk on preadolescent appraisal, coping, and adjustment: A mediated moderation model

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Abstract

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Children who have been exposed to cumulative risk (CR) are more likely to have poor physical and psychological health across the lifespan. It has been proposed that early multiple risk exposure contributes to children's adjustment, in part through their effects on children's appraisal and coping. However, it remains unknown how individual differences in children's underlying physiological arousal might differentiate the longitudinal effect of CR on appraisal, coping, and in turn adjustment. The objective of the current study was to examine the additive and interactive effects of CR and individual differences in basal RSA in early childhood on preadolescent adjustment and to test whether these relations were mediated by preadolescent appraisal and coping within a community sample of (N=306) of children. Multiple informants and methods were used to measure CR and basal RSA across four time points in early childhood (M age at T1 = 36 mo., T2 = 45 mo., T3 = 54 mo., T4 = 63mo.), and preadolescent appraisal, coping, and adjustment (M age = 11yr.). Path analyses demonstrated basal RSA did not moderate

the effect of CR on appraisal, coping, and adjustment. Children exposed to higher levels of CR were more likely to experience internalizing and externalizing problems in preadolescence, and this effect was partially mediated by threat appraisal, although the directionality of these relations were unexpected. Despite a lack of mediation among the other dimensions of appraisal and coping, they were associated with concurrent levels of preadolescent adjustment. Findings suggest interventions aimed at promoting appraisal and coping skills may have short-term impacts on adjustment in preadolescence, but a lasting longitudinal effect of early childhood CR on preadolescent adjustment, above the effects of income, suggest community-level interventions aimed at reducing exposure to risk in early childhood might be more effective than individual-level attempts to teach appraisal and coping skills later in life.

Keywords: Cumulative risk, basal RSA, appraisal, coping, moderation, mediation, longitudinal

Examining basal RSA as a possible moderator of the effects of cumulative risk on preadolescent appraisal, coping, and adjustment: A mediated moderation model

Children who have been exposed to multiple contextual risk factors experience the burden of persistent, accumulated stress and adversity, putting them at greater risk for emotional and behavioral problems that not only begin in early childhood but persist across the lifespan (Evans, Li, & Whipple, 2013; Rutter, 1979). Cumulative risk, an index of multiple contextual risk factors such as poverty, single parent households, and parent psychopathology, is an additive measure of risk that acknowledges the often co-occurring, accumulated stressors that many children with adversity face. Cumulative risk reliably has a dose-dependent relation to negative outcomes, such that every additional risk factor a child experiences predicts even poorer outcomes (Greenberg et al., 1999; Sameroff, Seifer, Barocas, Zax, & Greenspan, 1987). Moreover, the effects of cumulative risk have been found to remain after accounting for the effects of low income (Lengua et al., 2014; Zalewski, Lengua, Kiff, & Fisher, 2012), suggesting these effects are pervasive and impactful on child development.

A purported mechanism of the effects of early adversity and risk for later mental health problems is disruptions to cognitive emotion regulation strategies, or cognitive vulnerabilities. Evidence suggests that cumulative risk is related to threat appraisals and avoidant coping, the cognitive strategies examined in this study, and that these are related to greater psychopathology (Santiago, Etter, Wadsworth, & Raviv, 2012; Thompson, Lengua, & Meza, 2015). However, little is known about how early experiences of adversity might shape later cognitive vulnerabilities. Furthermore, not all children who experience early adversity or risk go on to develop cognitive vulnerabilities or psychopathology. A key differentiating factor might be

children's individual differences in emotion regulation or lability. Indeed, low basal RSA, a biomarker of emotional lability and dysregulation, has been linked to internalizing and externalizing problems in at-risk samples of all ages (Beauchaine, 2001; Bush, Stamperdahl, Adler, & Boyce, 2010). However, less is known about the relation between low basal RSA in early childhood and cognitive vulnerabilities in preadolescence.

When children are low in their capacity for emotion regulation or high in emotional lability, as purportedly indicated by lower basal RSA, they may be more emotionally impacted by their early stress experiences, which might foster a perspective of their context and experiences as posing harm and as overwhelming. These perspectives would develop into cognitive styles of threat appraisal and avoidant coping. Therefore, it was hypothesized in the present study that: early cumulative risk would be related to greater use of threat appraisal and avoidant coping strategies in preadolescence, and reduced use of positive appraisal and active coping strategies (H1); threat appraisal and avoidant coping would account for the effects of cumulative risk on internalizing and externalizing symptoms in preadolescence, whereas positive appraisal and active coping would not (H2); and basal RSA in early childhood would alter the relations among cumulative risk (CR), appraisal, and coping, such that higher basal RSA would attenuate the effect of cumulative risk on threat appraisal, avoidant coping, and in turn psychopathology (H3a). In addition, it was hypothesized that cumulative risk would be associated with lower positive appraisal and active coping for preadolescents who were lower in basal RSA in early childhood (H3b).

Mechanism of Risk: Cognitive Vulnerability

A leading explanatory mechanism for the effect of cumulative risk on later psychopathology is children's cognitive self-regulatory strategies, such as appraisal and coping

(Wadsworth, Raviv, Compas, & Connor-Smith, 2005). How children appraise the events in their lives, and then cope with events perceived as stressful can determine the impact of cumulative risk on later psychopathology. Indeed, recent research on appraisal and coping have implicated both self-regulatory strategies as critical mediators of the effect of CR on psychopathology (Thompson et al., 2015; Wadsworth et al., 2005).

Appraisal. Appraisal, or the determination by an individual that an event is or is not stressful, and if stressful, whether one has the resources to deal with the stressful event, is commonly measured via positive and threat appraisal. Positive appraisals incorporate challenge appraisals, or the evaluation of the potential for gain or positive outcomes, as well as resource appraisals, or the evaluation that one has the resources to deal with the event. Threat appraisals are an individual's assessment of harm or future loss. Generally, positive appraisals have been related to fewer adjustment problems whereas threat appraisals have been associated with greater adjustment problems (Gamble, 1994; Jackson & Warren, 2000; Lengua, Sandler, West, Wolchik, & Curran, 1999; Lengua & Long, 2002; Raver, Roy, Pressler, Ursache, & Charles McCoy, 2016; Virgil Sheets, Sandler, & West, 1996).

Theoretically, the relations among appraisal, risk, and mental health can be explained by both classical conditioning and Lazarus' appraisal theory (Delahaij & Van Dam, 2017; Lazarus, 1991). Children may learn to anticipate future events as threatening due to the accumulation of prior stressors with limited time to mentally and physically recover. Learning to appraise events as threatening may occur through modeling and/or reinforcement by parents or other individuals in the child's environment as well (Bandura, 1971; Santiago et al., 2012). The heuristic expectation of threat is reasonable, given the actual increased likelihood of true harm or loss in high-risk environments. Over time, this process may become ingrained, providing few

opportunities to orient differently to new events. Additionally, in line with Lazarus' appraisal theory, which posits that appraisal of events elicit distinct emotions, threat appraisal may serve to steel or numb an individual from the potential distress of unexpected harmful or threatening events. Thus, skewed toward harm, threat appraisal may be the cognitive mechanism by which children, through learned experiences in higher risk contexts, come to be at greater risk for poorer mental health outcomes later in life. Expecting threat may be immediately adaptive in certain contexts; however, prolonged threat orientation can be psychologically and physically taxing over time (Brody et al., 2013).

In contrast, individuals who deploy positive appraisal strategies may be less penetrable to the learned experiences of high-risk environments or may have other protective factors in their lives (e.g., adults who model or encourage positive reframing of stressful events), that limit the expectation for future threat. Miller's review of perceived threat across childhood provides support for this theoretical framework (Miller, 2015). Miller found that chronic stress exposure across lifespan increases the risk for developing heightened vigilance toward threatening stimuli, and this chronic hyperarousal is linked to poor mental health. Although the literature reviewed by Miller evaluated the effects of intimate partner violence as a chronic stressor, exposure to cumulative risk likely contributes to increased threat appraisal via similar processes.

Coping. Coping, or specific, volitionally and intentionally enacted self-regulatory strategies employed when one is faced with stress that has been appraised as exceeding one's resources, is commonly measured via active and avoidant coping (similarly measured as engagement and disengagement coping). This definition of coping is based on the work of Compas and colleagues, who differentiate volitional, intentional acts of coping from general emotion regulation strategies and other less volitional or unintentional coping strategies

(Compas, Connor-Smith, Saltzman, Thomsen, & Wadsworth, 2001; Compas et al., 2017). Active coping strategies involve directing oneself towards/dealing with the problem or related emotions, whereas avoidant coping strategies involve removing oneself/withdrawing from the stressful situation and associated emotions. A meta-analysis of coping in children with cancer found that active coping styles led to more positive adjustment in the face of more controllable, chronic stressors, whereas avoidant coping styles were associated with better outcomes for children who faced less controllable, acute stressors (Aldridge & Roesch, 2007). Research on pediatric cancer has provided support for the role of coping as a mediator of the relation between risk and adjustment, and this has been corroborated by research on other singular stressors as well. For example, avoidant coping was found to explain the relation between stress among children of divorce and internalizing and conduct problems (Sandler, Kim-Bae, & MacKinnon, 2000). Another study found that avoidant coping strategies (defined as "negative coping" in the study) mediated the relation between community violence exposure and posttraumatic stress symptoms, depression, and anxiety in children (Dempsey, 2002).

Cumulative risk might also shape an individual's coping strategies. According to the theoretical framework outlined above, similar processes may explain how children who have been exposed to cumulative risk might also increasingly lean on avoidant coping strategies. Specifically, children in high-risk environments may learn to deploy avoidant coping strategies to psychologically distance themselves from stressors that are often chronic and uncontrollable. In particular, in context of pervasive and chronic stress, active coping efforts maybe be required continuously, which may result in a depletion of effort or energy to utilize active coping for additional or continuing stressors, increasing the likelihood of reliance on avoidance. The use of avoidant coping for problems that cannot be easily solved or will not go away quickly may in

fact be adaptive in the short run, despite being associated with more negative outcomes. Moreover, the immediate relief from distress that children experience due to avoidant coping serves to reinforce this style of coping, which in turn may be further reinforced through modeling and/or direct encouragement from adults. Thus, reinforcement combined with limited restorative time to implement alternative coping strategies (i.e., active coping), might result in style of avoidant coping for children in high-risk environments. Although research has investigated the effects of coping on child outcomes, very few studies have evaluated the effect of chronic adversity or multiple risk exposure in relation to appraisal and coping. Further, there is reason to expect that multiple risk exposure might have differential effects depending on intraindividual differences, such as RSA.

Despite numerous studies providing evidence for coping as mediator of the effect of stress, a recent quantitative and narrative review of coping suggests that these associations are not as consistent across studies as previously assumed. This may be due to differing conceptual and operational definitions of coping as well as limited longitudinal data (Compas et al., 2017). Additionally, it might also be due to the effects of moderating factors that differentiate children's responses to stress. Individual differences in physiological reactivity and regulation might play a critical role in the development of appraisal and coping (Lengua et al., 1999; Santiago et al., 2012; Thompson, Zalewski, & Lengua, 2014), and more importantly, individual differences in emotional regulation vs. lability might result in differential impact of risk or adversity on appraisal and coping (Chang, Shelleby, Cheong, & Shaw, 2012; Corapci, 2008; Dich, Doan, & Evans, 2017; Lengua & Long, 2002). Compas and colleagues' review highlights the gap in knowledge concerning how coping strategies are shaped across development. Arguably, this same gap in knowledge applies to appraisal. A more nuanced analysis, in which stress exposure

in combination with individual differences in children's innate physiological arousal, may help elucidate how appraisal and coping strategies develop. Furthermore, by focusing on the less studied, but severely impactful effect of chronic adversity or multiple risk exposure, we can begin to clarify which cognitive self-regulatory strategies are more or less effective for children experiencing disadvantage.

Conditional effects of risk: RSA as a differentiating or moderating factor

RSA. Currently there is limited research testing how individual differences in children's emotional regulation vs. lability might differentiate the effects of cumulative risk on psychopathology (i.e., moderation). Thus far, researchers have attempted to clarify the role of children's physiology as a susceptibility or resilience marker using indices of the autonomic nervous system (ANS). The two regulatory branches of the ANS, largely responsible for unconscious regulation of bodily functions, are the sympathetic nervous system (SNS) and the parasympathetic nervous system (PNS). While the SNS prepares the body for physical activity (e.g., fight-or-flight response), and contributes to increased heart rate, respiration, and other activating physiological changes, the PNS helps to restore homeostasis, relaxing the body and inhibiting high energy physiological functions (e.g., regulating heart rate). RSA, or vagal tone, which captures PNS functioning, is a sensitive index of variation in heart rate controlled by the vagus nerve fibers located in the tenth cranial nerve. These fibers communicate between brain structures and visceral organs, most notably the heart, through activation or withdrawal of the vagus nerve (i.e., vagal influence). Vagal influence is conceptualized as the vagal "brake", as it slows heart rate in the absence of threat or challenge. In the context of threat or challenge, however, the vagal influence is suppressed (the brake is removed) when activity or attention are required. Accordingly, early individual differences in children's basal RSA functioning are likely

to influence how early risk experiences are received or imbedded, which in turn likely sets the stage for later developing cognitive self-regulation strategies.

Basal RSA (or resting RSA at baseline) is conceptualized as an individual's innate emotional lability, and has been related to a wide range of mental health outcomes such as the expression of aggression, dysregulated emotion, internalizing symptoms, and externalizing symptoms (Beauchaine, Gatzke-Kopp, & Mead, 2007; Hinnant & El-Sheikh, 2009; Katz & Rigterink, 2012; Shannon, Beauchaine, Brenner, Neuhaus, & Gatzke-Kopp, 2007). According to polyvagal theory, higher basal RSA, which facilitates greater dynamic range for RSA regulation during stressful events, promotes physiological restoration and enables a child to remain calm and focused in response to safe, positive experiences (Porges, 1995; Porges, Stephen, Doussard-Roosevelt, & Maiti, 1994). Low basal RSA (higher arousal at rest), on the other hand, is posited as vulnerability to stress (Porges et al., 1994; Porges, 2007). Indeed, high resting RSA has been linked to greater self-regulatory behaviors and adaptive coping in children, whereas children with low basal RSA are thought to become overly vigilant, highly attentive to threat, and less able to cope under stress (Beauchaine, 2001; Blair & Peters, 2003; Fabes & Eisenberg, 1997; Gottman & Katz, 1989; Hinnant & El-Sheikh, 2009). Basal levels of RSA demonstrate stability in infancy, early childhood, and late childhood (Bornstein & Suess, 2000; Calkins & Keane, 2004; El-Sheikh, 2005). Specifically, basal RSA in young children has demonstrated moderate levels of stability between 2 months and five years of age ($r = .30$), with higher stability coefficients in kindergarteners ranging from $r = .41$ to $r = .67$ (Bornstein & Suess, 2000; Fox & Field, 1989). In addition, children demonstrate consistency in their relative rank within a group over time, providing strong support for the conceptualization of basal RSA as an individual

difference construct that may potentially alter the effect of stress exposure across child development (Bornstein & Suess, 2000).

Given basal RSA only demonstrates moderate stability in early childhood, it should be noted that early stress experiences themselves might shape the development of basal RSA. Although this remains a possibility, previous research evaluating the developmental impact of early childhood adversity on basal RSA has yet to demonstrate a clear or consistent effect (Esposito, Koss, Donzella, & Gunnar, 2016). For example, one study evaluating the impact of various childhood adversity variables including child abuse, community violence, and peer victimization found none of the childhood adversity variables were associated with basal RSA (McLaughlin, Alves, & Sheridan, 2014). Similarly, another study found that early adversity had no effect on longitudinal growth changes in basal RSA (Conradt et al., 2014). Overall, the literature examining basal autonomic function in high-risk populations often focuses on its role as a moderator of environmental risk. While the current study also focuses on the role of basal RSA as a moderator, present study findings will take into account the potential direct effects of cumulative risk on basal RSA as well.

RSA as a Moderator of Cumulative Risk. Though research supports the notion that individual differences in basal RSA have been linked to a variety of mental health outcomes that may vary according to contextual risk, researchers have yet to clarify how the interaction of cumulative risk with basal RSA in early childhood may influence the use of higher-order cognitive self-regulatory strategies later in life. There are however a number of studies demonstrating basal RSA as a moderator of the effect of cumulative risk and similar chronic stressors on other child outcomes. For example, Holochwost et al. (2018) evaluated basal RSA as both a mediator and moderator of the effect of cumulative risk on inhibitory control in early

childhood. While their structural equation models demonstrated no evidence of mediation, basal RSA was found to moderate the effect of cumulative risk, such that high-risk children with low basal RSA performed more poorly on laboratory tasks of inhibitory control compared to those with high basal RSA. Given the link between inhibitory control and the use of higher-order cognitive strategies (Taylor et al., 2018), there is reason to believe that basal RSA could moderate the effect of cumulative risk on appraisal and coping strategies as well. Another study by Philbrook, Buckhalt, and El-Sheikh (2020) examined the roles of basal RSA and race as moderators of risk in the relation between adolescents' community violence concerns and their sleep. In this study three-way interactions among race, basal RSA, and community violence were tested as predictors sleep patterns. The pattern of effects demonstrated that African-American youth with greater community violence concerns and lower basal RSA had lower sleep quality than African-Americans youth with fewer violence concerns. All other youth, including African-Americans with high basal RSA, European-Americans with high basal RSA, and European-Americans with low basal RSA, had better sleep quality regardless of community violence concerns. Thus, in the context of a chronic and uncontrollable stressor, similar in nature to cumulative risk, high basal RSA appeared to operate as a protective factor. Given the association between exposure to community violence and an increased reliance on avoidant coping in preadolescents (Reid□Quiñones et al., 2011), results from this study suggest that high basal RSA may also serve as a protective factor on the development of higher-order cognitive strategies in high-risk settings.

Developmentally, preadolescence is a point in development in which we might anticipate increases in children's use of higher-order cognitive strategies. As more complex, abstract cognitive abilities develop (e.g., meta-cognition) in tandem with increased vocabulary and

executive functioning, the responsibility to regulate a child's emotions begin to shift from caregiver to child. Reinforcement of a child's tendency to use distinct appraisal and coping strategies is heavily influenced by early experiences of stress (Zimmer-Gembeck & Skinner, 2011). Moreover, these early stress experiences are likely to show differential effects depending on children's innate emotional lability (basal RSA). In the context of prior literature demonstrating the moderating role of basal RSA in the association of cumulative risk with child outcomes, the present study incorporates this developmental framework and proposes that basal RSA will moderate the effect of cumulative risk, such that in high-risk contexts, high basal RSA in early childhood will predict the effective use of appraisal and coping strategies (i.e., strategies that are associated with fewer adjustment problems or greater positive adjustment) in preadolescence, whereas low basal RSA will show no relation.

This Study: Integrated Framework

In this study, we examine whether early accumulated stress experiences interact with physiological self-regulatory processes in early childhood to predict later developing high-order self-regulatory strategies and adjustment. Specifically, using a community sample of over 300 children and their mothers, we test whether exposure to cumulative risk in early childhood, moderated by baseline RSA, predicts appraisal and coping in preadolescence, and in turn adjustment.

As children become increasingly independent from their caregivers in preadolescence, learning to self-soothe and manage difficult situations, they also undergo rapid cognitive development promoting higher-order processes including metacognition, problem solving, cognitive reframing, and the ability to flexibly match coping strategies to stressful events (Wadsworth et al., 2005; Zimmer-Gembeck & Skinner, 2016). Despite this strong conceptual

framework supported by research in developmental and neurobiological psychology, researchers have yet to understand how these higher-order appraisal and coping processes might be formed or influenced by pertinent environmental and intraindividual factors. According to the literature, the chronic and uncontrollable nature of cumulative risk in early childhood should tax a child's self-regulatory capacity in ways distinct from singular stressors, leading to an even greater likelihood of utilizing threat appraisals and avoidant coping in preadolescence (H1), such that appraisal and coping will account for the effect of cumulative risk on preadolescent adjustment (H2). Furthermore, this relation should vary by individual differences in baseline physiological arousal (H3). That is, basal RSA or a child's innate emotional lability, which becomes reliable and moderately stable in early childhood, should differentiate the effect that early chronic risk exposure has on children's later developing appraisal and coping strategies. In turn, some appraisal and coping strategies may be more or less effective, depending on a child's underlying physiology and their risk context. This integrated framework, which evaluates basal RSA as a potential moderator and appraisal and coping as potential mediators of the effect of cumulative risk on child adjustment, would extend prior research on RSA, appraisal, and coping. Currently mixed findings on the direct effects of basal RSA, appraisal, and coping on children's psychopathology supports the need for more complex models such as the mediated moderation model proposed in this study. This longitudinal developmental model will contribute to our understanding of the etiology of how children learn to cope in chronic stress environments, as well as enhance our ability to understand which coping strategies could have a helpful and meaningful impact on at-risk populations.

Method

Participants

This study was part of a longitudinal study (R01-HD054465, Lengua, PI) examining the development of self-regulation in a group of children at elevated risk for emotional and behavioral problems. This larger study used a longitudinal design to test how contextual adversity, physiological arousal, and parenting influenced the development of self-regulation. Participants were from a community sample (N = 306) of children and their parents assessed at six times, beginning when children were three years old (M = 36.75 mos., SD = 1.31). At the sixth time point, children were approximately 12 years old (R01-MH106482, McLaughlin, PI). The first four time-points were separated by nine months (children's ages at T1 – 36-40 mos., T2 – 45-49 mos., T3 – 54-58 mos., T4 – 63-67mos.), the fifth time-point (T5) was two years after the fourth time-point, when children were approximately 7.5 years old, and the sixth time-point (T6) was collected when children were 10-13 years (*M*=11.0, *SD*=0.59). The participants in the original sample of 306 spanned the full range of income, with 29% of participants at or near poverty (at or below 150% of the 2009 federal poverty threshold), 28% low income (between poverty and local median income), 25% middle to upper income (between local median income and $100,000), and 18% affluent (above $100,000). This provides equal representation across a wide range of contexts and ensures adequate variability on measures of risk, RSA, and psychopathology. Children with disabilities and families who did not speak English were excluded. Participants were recruited from various public and private facilities including preschools, daycares, and health clinics. At time 1, participants were 50% female, 64% European American, 10% Latino or Hispanic, 9% African-American, 3% Asian American, 2% Native or American Indian, and 12% other or multiple racial backgrounds.

Procedures

Children and their female caregivers were assessed during a laboratory visit at the University of Washington, which included neuropsychological assessments, questionnaires, and physiological data collection. The University of Washington Institutional Review Board approved the larger study and informed consent was obtained. First, families were contacted a day or two prior to their actual visit to remind parents of the visit. Transportation logistics were reviewed with each family to determine if there were any changes to the family needing a town car service to pick them up or to remind them of where to park when they arrived. Given the low-income nature of this sample, families were provided free parking right outside the building, in an attempt to make a University campus more comfortable for women who had not been on one before. The family was greeted by two trained undergraduate or post-baccalaureate students who proceeded to work with the family for their session. Mothers and children were shown the rooms they would be working in so children could see their mother would be nearby. Immediately upon entering the child room, mothers and children were consented and assented. Most children were able to separate from their mothers but extra warm up time was allotted for children who had difficulties. Once separated, children completed neuropsychological measures and a baseline assessment of RSA. While children completed the measures with a trained child experimenter, the female primary caregiver participated in a structured interview assessing demographic information and child adjustment outcomes. The parent experimenter read the questions aloud to all mothers as to minimize any bias due to reading abilities. In addition, the experimenters were instructed on specific protocols regarding potential child abuse or high maternal depression. Specifically, experimenters were not to confront the parent about the issue but to report any concerning details to the primary investigator immediately following the session who then followed up with the parent within 48 hours. Mothers and children also

completed parent-child interaction tasks for about ½ hour that were part of the larger study but not included in the present study. Finally, mothers were instructed on how to sample their child's saliva to collect cortisol, a measure that is also not included in the current study. Families were paid $70 for their first visit, and payments increased by $20 for each of the subsequent four visits. Compensation for participation at T6 was $75.

Measures

Cumulative Risk. Cumulative risk was assessed at four time points (T1, T2, T3, & T4) via mother report on seven risk factors: low education, single parent, residential instability, family structure transitions, household density, negative events, and maternal depression. Risk factors were scored as 0 = not present and 1 = present. Risks were defined as not graduating from high school, being a single parent, having the child as an adolescent, changing homes 3 or more times in the previous 3 years at T1 or any move in the 9 months between assessments at T2-T4, divorcing in the child's lifetime at T1 or during the 9 months between assessments at T2-T4, high household density (number of people living in house divided by number of rooms), having a high amount of negative life events (assessed using the General Life Events Schedule for Children (Sandler, Ramirez, & Reynolds, 1986), and having higher depressive symptoms (assessed using the CES-D; Radloff, 1977). Dichotomous risk factors (education, single parent, residential instability, divorce) were scored as 0=not present, 1=present. Continuous risk factor scores (household density, negative events, depression) were converted to proportions of the total possible score so that each score ranges from 0 to 1, so as to mirror the dichotomous variables. The total cumulative risk score was the sum of all component factors. The use of proportion scores and the exclusion of income, so that it may be examined separately, do not provide an indication of the level of risk in the sample comparable to other studies. An alternative CR score

was made by calculating the number of risk factors present, using 1.5 standard deviation cutoffs; this score was correlated .92 with the CR variable used in the present study. Further, inclusion of poverty status in the risk count, made the distribution of risk in this sample nearly identical to reports of children growing up in low income (<200% of the federal poverty threshold) by the National Center for Children in Poverty for 2014 (Evans et al., 2013). That is, 39% have 0 risk factors, 46% have 1-2 risk factors, and 16% have 3+ risk factors. To evaluate the longitudinal effect of cumulative risk in early childhood in the present study, an aggregate T1-T4 CR variable was created by averaging CR across T1, T2, T3, and T4. A mean CR score was calculated as long as the participant had three of the four time points. All cumulative risk variables were significantly positively correlated (r = .50 to .88).

Respiratory Sinus Arrhythmia (RSA). RSA was measured using materials from Biopac PRO Lab 3.7.1 (Goleta, CA). A 2-lead electrocardiograph (ECG) was used. Electrodes were placed on the child's right clavicle and lower left abdomen, with a ground electrode placed on the left chest. The respiratory band was placed under the child's ribcage. After the electrodes and respiratory band were placed, Basal RSA was measured while the experimenter read a 3.5-minute neutral story. Experimenters were trained to read in a neutral tone of voice and were instructed not to elicit speech from the child, as this is known to influence RSA measurement. While collection was underway, a trained technical experimenter flagged both the start and stop times for the ECG data in order to ensure proper collection.

RSA was computed using the methods of Porges (1985). First, ECG R-waves were detected and time-stamped using AcqKnowledge software (Goleta, CA) and then exported, along with original ECG recordings. Custom-purpose Matlab software was used to overlay inter-beat interval (IBI) time series on top of ECG waveforms to inspect accuracy and correct misses and

false alarms of AcqKnowledge's beat detection algorithm. Epochs contaminated by large mechanical artifacts or other electrical interference that obscured or distorted the heartbeat waveforms were excluded from subsequent analysis. Artifact-free segments of corrected IBI sequence from relevant epochs of recording were re-sampled at 2.8 Hz. Each re-sampled segment was filtered with a 21-point 3rd-order polynomial derived from Fig. 3A of Litvack et al. (1995) and subtracted from the unfiltered segment to obtain a high-pass filtered segment. This segment was then converted to a sequence of fourier coefficients via fast-fourier transformation. RSA, defined as the log of the average power of these fourier coefficients falling in the frequency range between 0.24 and 1.04Hz, was reported in units of ln(ms2). The age-specific frequency pass-band used for RSA was intended to match developmentally normal respiration rates as reported elsewhere (Hastings et al., 2008).

In the present study, moderation analyses were conducted using a mean score of basal RSA across the first four time points, spanning ages 36 to 63 months. Although basal RSA demonstrates moderate temporal stability in early childhood, it seemingly demonstrates greater stability in adulthood (El-Sheikh, 2005). To capture a more stable, characterological basal RSA variable during this early childhood period, a mean score was calculated as long as the participant had three of the four time points. Given children demonstrate consistency in their relative rank within a group over time, this aggregate score was unlikely to alter the interpretation of study findings, while simultaneously decreasing the likelihood that any observed effects were the result of the time point in which basal RSA was collected. All basal RSA variables were significantly positively correlated ($r = .37$ to $.83$).

Appraisal and Coping. Child-reported appraisal and coping were assessed at the sixth time-point when children were 12 years of age. During the appraisal assessment, children were

prompted to think about three of the "biggest problems" they had during the past month and rate on a Likert-type scale from "0=not at all" to "3=most of the time" how much they thought each of the thoughts related to those problems. Threat appraisal was assessed using 12 items from the 'What I Felt Scale' (Sheets, Sandler, & West, 1996) and included six dimensions of negative thoughts about life events: negative self-evaluations, negative evaluation by others, rejection, criticism of others harm to others, and loss of desired objects or activities. For T6 threat appraisal, average scores were 5.76 (SD = 5.86, α = .87). Positive appraisal was assessed by combining a challenge appraisal subscale (6 items; e.g. "you thought about all the people and things in your life that could help with the situation") and a resource appraisal subscale (6 items; e.g., "you thought about all the people and things in your life that could help with the situation"). For T6 positive appraisal, average scores were 18.63 (SD = 6.89, α = .87).

Child coping was assessed using the Children's Coping Strategies Checklist (Ayers, Sandler, West, & Roosa, 1996). Children rated on a Likert-type scale from "0=not at all" to "3=most of the time" how often they used each coping behavior when they had a problem during the previous month. Active coping included the strategies: cognitive decision making, control, direct problem solving, positive cognitive restructuring, optimism, and seeking understanding strategies. Avoidant coping included the strategies: cognitive avoidance, avoidant actions, and wishful thinking. The CCSC was originally normed on a sample of 9 to 13-year-olds from predominately lower or middle-class families. For T6 active coping, average scores were 31.92 (SD = 12.99 , α = .92, n of items = 20), and for T6 avoidant coping, average scores were 14.28 (SD = 6.66, α = .81, n of items = 11).

Adjustment. Child reported internalizing and externalizing symptoms as well as positive adjustment were collected at time six when children were 12 years of age.

Internalizing and externalizing problems. Children were administered the 118-item Youth Self-Report (YSR; Achenbach, Dumenci, & Rescorla, 2003). Children report on 3-point Likert-type scale how often a statement best describes them. Children receive a total score on the broad-band internalizing and externalizing problems scales. The YSR is suitable for youths aged 11 to 17, and T scores are based on a normative sample of 1,057 youth. The internal consistency coefficients of these scales were originally found to be .87 and .90 (Achenbach & Rescorla, 2001), and in the current sample they are .84 and .89.

Positive Adjustment. A child self-report positive adjustment score was calculated as the sum of standardized child-report social-competence, global self-worth, and life satisfaction scales. Children were administered the 28-item 'Social Skills Rating System' (SSRS; Gresham & Elliot, 1990), which has shown good validity and internal consistency (Demaray et al., 1995), the global self-worth scale of the 'Perceived Competence Scale for Children' (Harter, 1982) and a life satisfaction measure, which was adapted from the 11-item general positive affect scale of the Mental Health Inventory (Veit & Ware, 1983) (e.g., "during the past month, how often have you felt that the future looks hopeful and promising?"). Internal consistency for the Positive Adjustment scale was .79.

Missingness Analyses. Variables were compared across participants missing and not missing data using *t*-tests of mean differences between the group with complete data and that with missing data (Tabachnick & Fidell, 2011). Families with no missing data across all study variables reported significantly higher income than families with missing data (M not missing = 9.33, SD = 3.58; M missing = 8.14, SD = 4.18, t (304) = 2.69, p = .008). Families with no missing data reported significantly lower T1-T4 cumulative risk scores than families with missing data (M not missing = 0.77, SD = 0.52; M missing = 0.92, SD = 0.64, t (294) = -2.23, p

= .027). Families with missing data did not differ significantly from the families with no missing data on child gender, T1-T4 basal RSA, T6 positive appraisal, T6 threat appraisal, T6 active coping, T6 avoidant coping, T6 internalizing problems, T6 externalizing problems, and T6 positive adjustment. The magnitude of the effects of missingness on income (r = -.152) and T1-T4 Cumulative risk (r = .129) were modest, indicating that it was unlikely that missing data significantly biased the model estimates (Collins et al., 2001), and the use of full-information maximum likelihood estimation (FIMLE) in analyzing the data was appropriate.

Analytic Plan. A mediated moderation model was tested (Figure 1). Mediated moderation occurs when the interaction between independent variables (cumulative risk x basal RSA) predicts a mediator (appraisal and coping), which in turn predicts a dependent variable (preadolescent adjustment) and accounts for the effects of the interaction on the dependent variable. Examining mediation and moderation simultaneously allowed us to identify the processes that underlie the relation between early adversity and preadolescent adjustment, and also provide information about the generalizability of these processes across subpopulations (e.g., children with lower basal RSA and/or living in high-risk contexts) (Baron & Kenny, 1986).

It was hypothesized that early stress experiences, assessed with cumulative risk when children were 3-5 years of age, would predict later use of appraisal and coping strategies in preadolescence, assessed at age 12, and that this association would be moderated by an indicator of early physiological emotional lability, assessed with a mean basal RSA score that was the average of 4 basal RSA values spanning ages 36 to 67 months. Specifically, consistent with previous literature evaluating the effect of early adversity on self-regulation, the relation between cumulative risk and appraisal and coping was expected to be stronger for children with higher as opposed to lower basal RSA (H3a). Threat appraisal and avoidant coping, in turn, were expected

to account for the effects of cumulative risk predicting greater psychopathology and lower positive adjustment (H2). Additionally, relations between cumulative risk and positive appraisal/active coping were hypothesized to emerge where previous direct effects have been inconsistently found, such that the effect of risk on positive appraisal/active coping was attenuated for children with higher basal RSA as opposed to lower basal RSA in high-risk contexts (H3b). Positive appraisal and active coping in turn were expected to account for the effects of cumulative risk predicting less internalizing and externalizing problems and greater positive adjustment in preadolescence (H2). It was hypothesized that basal RSA would not differentiate use of appraisal and coping strategies in low-risk contexts, and in turn their relation to psychopathology and positive adjustment in preadolescents would remain consistent across risk contexts.

All models were evaluated using path models tested in Mplus (Muthen & Muthen, 2009) with full-information maximum likelihood estimation (FIMLE) to account for missing data. Model fit was tested with multiple indices. Good-fitting models are traditionally indicated by non-significant chi-squares. The chi-square ratio (χ^2 / *df)*, which corrects for sample size in larger samples, was also be used, with values between 1 and 3 indicating acceptable fit. Root mean square error of approximation (RMSEA) values below .05 and the comparative fit index (CFI) value above .90 indicate good model fit (McDonald & Ho, 2002). Regression coefficients were used to determine if basal RSA, cumulative risk, and their interaction predicted appraisal and coping, as well as to determine if appraisal and coping predict mental health outcomes. Separate analyses were performed predicting distinct appraisal and coping strategies. Tests of indirect effects were used to evaluate whether appraisal and coping mediated the effects of cumulative

risk and its interaction with basal RSA on internalizing and externalizing problems and positive adjustment.

Results

Descriptive Statistics and Correlations

Descriptive statistics for all study variables are presented in Table 1. Correlations among all study variables are presented in Table 2. Child gender, specifically being male, was significantly related to higher levels of externalizing problems and lower levels of positive adjustment at Time 6. Higher family income at Time 1 was significantly related to lower levels of cumulative risk across Times 1-4, as well as lower internalizing and externalizing problems at Time 6. The aggregate T1-T4 cumulative risk variable was significantly related to higher levels of avoidant coping at Time 6 and higher levels of internalizing and externalizing problems at Time 6. Basal RSA at Times 1-4 and the aggregate T1-T4 basal RSA were not significantly related to the appraisal, coping or adjustment measures. Threat appraisal at Time 6 was significantly related to lower levels of positive appraisal, active coping, and positive adjustment at Time 6, as well as higher levels of avoidant coping, internalizing problems, and externalizing problems at Time 6. Positive appraisal at Time 6 was significantly related to higher levels of avoidant coping, active coping, and positive adjustment at Time 6, as well as lower levels of internalizing problems and externalizing problems at Time 6. Avoidant coping at Time 6 was significantly related to higher levels of active coping, internalizing problems, and externalizing problems at Time 6. Active coping at Time 6 was significantly related to lower levels of internalizing problems, as well as higher levels of positive adjustment at Time 6. Internalizing problems at Time 6 was significantly related to higher levels of externalizing problems, as well

as lower levels of positive adjustment at Time 6. Externalizing problems at Time 6 was significantly related to lower levels of positive adjustment at Time 6.

CR, RSA and their Interaction Effects on Appraisal and Coping

The path model demonstrated good fit to the data ($x^2(4) = 4.073$, p = 0.3962, CFI = 1.000, RMSEA = .008, 90% C.I. = .000 - .087), indicating that the model adequately replicated the observed associations. The results are reported in Table 3. This partial mediation model incorporated direct effects of CR and bRSA on study outcomes, as there was insufficient theory and prior evidence to suggest full mediation of appraisal and coping. In comparison, indices for a full mediation model were ($x^2(13) = 16.001$, p = 0.2491, CFI = .995, RMSEA = .027, 90% C.I. = .000 - .799).

In the model higher income in early childhood prospectively predicted lower levels of threat appraisal in preadolescence. Cumulative risk in early childhood did not predict appraisal and coping in preadolescence as hypothesized (H1). Specifically, cumulative risk significantly predicted lower levels of threat appraisal in preadolescence, above the effects of income. There was a trend toward cumulative risk prospectively predicting greater use of avoidant coping strategies. However, cumulative risk was unrelated to the use of positive appraisal and active coping strategies. In addition, there were no direct effects of RSA on appraisal or coping, nor were there significant interaction effects between cumulative risk and basal RSA. Therefore, basal RSA did not moderate the relations between cumulative risk and appraisal or coping (H3).

CR, RSA, Appraisal, and Coping Effects on Adjustment

Cumulative risk (T1-T4) prospectively predicted higher levels of internalizing and externalizing problems. There was a trend toward higher basal RSA (T1-T4) predicting lower levels of internalizing problems. Above the effects of cumulative risk, positive appraisal was

concurrently related to lower levels of internalizing problems and higher levels of positive adjustment. Threat appraisal was concurrently related to higher levels of internalizing problems and lower levels of positive adjustment. Avoidant coping was concurrently related to higher levels of internalizing problems, whereas active coping was unrelated to adjustment, although there was a trend toward active coping concurrently relating to higher levels of positive adjustment.

Tests of Indirect Effects

Tests of indirect effects were used to assess whether appraisal and coping mediated the effects of cumulative risk on adjustment in preadolescence (H2). There was an indirect effect of early childhood cumulative risk on preadolescent positive adjustment through threat appraisal ($\beta = .084$, $SE = .040$, $p = .035$). Specifically, higher cumulative risk predicted lower levels of threat appraisal, which in turn was related to higher levels of positive adjustment. Similarly, there was a trend toward indirect effects of early childhood cumulative risk on preadolescent internalizing ($\beta = -.060$, $SE = .031$, $p = .059$) and externalizing problems ($\beta = -.057$, $SE = .030$, $p = .057$) through threat appraisal. Higher cumulative risk predicted lower levels of threat appraisal, which in turn was related to lower levels of internalizing problems and lower levels of externalizing problems.

Discussion

This study demonstrated that cumulative risk in early childhood was not associated with preadolescent positive appraisal, active coping, or avoidant coping (H1). This is consistent with a previous study evaluating the longitudinal relations between cumulative risk and positive appraisal and active coping across two years of preadolescence in a similar population (Parrish, Thompson, & Lengua, 2021). However, in this previous study cumulative risk was found to predict avoidant coping one year later, and in particular when child temperament was modeled as

a moderator. In a similar study, Wadsworth & Compas (2002) also demonstrated that high chronic economic strain and high family conflict, both chronic and uncontrollable stressors, were associated with higher levels of avoidant coping among adolescents. Notably however, this study was cross-sectional. Further, the sample in this study was 97% European American. As mentioned earlier, Philbrook et al. (2020) demonstrated that race plays a significant moderating role in the context of chronic stress exposure. Thus, it is possible that the lack of association between cumulative risk and avoidant coping in the present study was affected by the longitudinal nature of the study, as well as the ethnically diverse sample. Therefore, present study findings suggest that a significant relation between cumulative risk and avoidant coping may not hold over a longer developmental time span or may only emerge when intraindividual factors other than basal RSA are modeled.

Contrary to study hypotheses, greater levels of cumulative risk in early childhood prospectively predicted lower levels of threat appraisal in preadolescence (H1). In turn, cumulative risk indirectly predicted positive adjustment through the effect of threat appraisal, such that lower threat appraisal was related to higher levels of positive adjustment. These findings suggest that while cumulative risk may not operate on threat appraisal in the expected direction, there may continue to be a net effect of cumulative risk on positive adjustment over time. Previous research has found a consistent link between cumulative risk and threat appraisal, although this link had typically demonstrated a positive relation. That is, cumulative risk was found to be associated with higher levels of concurrent, but not prospective threat appraisal in preadolescents (Parrish, Thompson, & Lengua, 2021), as well as higher levels of threat appraisal across three time points separated by one year during middle childhood (Thompson, Lengua, & Garcia, 2015). However, given the short-term and concurrent nature of these previous studies, it

is possible that cumulative risk and threat appraisal begin to demonstrate an inverse relation across a longer developmental period. Although there could be many reasons for this inverse relation, one possibility could be that children who endure chronic stress in early childhood become desensitized or accustomed to threat over time, such that they are less likely to appraise events as stressful by the time they reach preadolescence. Thus, there may be a process by which early stress experiences inoculate children or create a level of distress tolerance, as lower threat appraisal was associated with better adjustment.

Nevertheless, in the present study children exposed to higher levels of cumulative risk tended to use greater levels of avoidant coping in preadolescence, which in turn was associated with poorer adjustment. Thus, avoidant coping in preadolescence may become an automated conditioned response pattern to stress, regardless of appraisal style. In effect, there may be a process in which early childhood exposure to cumulative risk gives rise to competing higher-order cognitive strategies in preadolescence, and perhaps a level of cognitive dissonance, such that children become both desensitized to threat yet simultaneously increasingly rely on avoidant coping strategies. Clinically, this may present as specific higher-order cognitive strategies such as dissociation. While dissociation provides immediate relief to individuals whose autonomic nervous systems are continually taxed by the engagement of fight-flight-freeze trauma responses, this avoidant coping strategy disconnects individuals from their present reality, encouraging inaccurate interpretations of threat as well as higher levels of adjustment problems over time (Lansford et al. 2002).

Another reason for the unexpected direction of the effect of cumulative risk on threat appraisal could be that the association of income needs to be taken into account. In the present study higher income predicted lower threat appraisal as one might expect but was unrelated to

adjustment outcomes, whereas cumulative risk directly predicted poorer adjustment above the effects of income. These findings suggest that income and cumulative risk operate distinctly. For instance, living with low income at one time point in early childhood may be less impactful on adjustment when compared to chronic poverty. Indeed, disengagement coping has been found to mediate the relation between chronic poverty and the development of psychopathology in adolescence (Kim et al., 2016). It is possible that the chronicity of the stressor, as opposed to low-income itself, is what leads to poorer adjustment. Thus, in the context of cumulative risk, higher income would likely provide a mental-emotional buffer. Overall, these results suggest future research should take care to distinguish the effects of income from the effects of cumulative risk. Further, other factors associated with low income, such as social mobility (i.e., factors that may affect individuals' capacity to move from a lower-income bracket to a higher-income bracket) that are not accounted for in the cumulative risk score might shape a child's threat appraisal over time.

This study also demonstrated that appraisal and coping strategies did not mediate the relations between early childhood stressors and adjustment as hypothesized, however they were associated with concurrent levels of adjustment (H2). Specifically, positive appraisal was associated with lower levels of internalizing problems and higher levels of positive adjustment. While active coping did not predict adjustment, there was a trend toward active coping relating to higher levels of positive adjustment. Together, these associations suggest that while positive appraisal and active coping may not explain the effect of chronic stress on adjustment across childhood, they could potentially buffer the effect of stress. These findings are partially consistent with previous work by Thompson et al. (2016), which found that positive appraisal and active coping operated as individual difference resource factors but did not mediate the

effect of cumulative risk on adjustment in preadolescence. However, contrary to current findings, they found that threat appraisal and avoidant coping mediated the effect of cumulative risk on adjustment, although this effect was found across a shorter-term, three-year window in preadolescence. Similarly, in a sample of Chinese adolescents, Xiong, Hai, Su, & Li (2021) found that coping mediated the effect of cumulative risk on life satisfaction (but not depression or anxiety), and these effects were observed across two time points. The present study extends prior research by demonstrating that mediation may not hold across longer developmental windows, specifically spanning early childhood into preadolescence. This might suggest that teaching positive appraisal and active coping strategies in preadolescence or adolescence may provide short-term relief of the effect of chronic stress, but ultimately may not be sufficient to curtail the longer-lasting deleterious effects of cumulative risk across the lifespan. Given the short-term mediational effect of appraisal and coping strategies, future research might also explore the moderating effect of appraisal and coping strategies. It may not be the use of a particular coping style (i.e., avoidant versus active) that accounts for the effect of chronic stress on child adjustment, but instead the ability to flexibly deploy a range of coping strategies may attenuate the direct effect of chronic stress. For instance, avoidant strategies may only be problematic when used in isolation. Aldridge and Roesch (2008) found that low-income adolescents who engaged in both active and avoidant strategies fared better than those used just avoidant strategies. Thus, future research might investigate the moderating role of a more stable coping variable, such as ability to flexibly deploy a range of strategies, on the relations between chronic stress and adjustment.

Finally, this study tested the hypothesis that experiences of CR would be moderated by RSA, but there was no support for this hypothesis (H3). In addition to no moderation, this study

found no direct associations of RSA with appraisal, coping or adjustment either. This is inconsistent with research by Hinnant & El-Sheikh (2009), which found a significant relation between low basal RSA and low internalizing and high externalizing symptoms, as expected by polyvagal theory. However, this work was done over a 2-year developmental window, as opposed to across the span from early childhood to preadolescence. There have been no studies that have evaluated the relations between RSA and appraisal and coping across a developmental window as long as the current study, suggesting the predictive validity of basal RSA as an individual difference variable warrants additional longitudinal analysis. Overall, current study non-significant findings between basal RSA and appraisal and coping are consistent with a recent literature review (Parrish, 2019). This review of approximately 19 relevant studies found little evidence for an observable pattern between baseline RSA and coping across the lifespan, and in particular insufficient evidence to support a link in early childhood (Parrish, 2019). This review did however find a small, but consistent pattern for the effect of RSA recovery. RSA recovery refers to a return to baseline or resting levels of RSA post-challenge or exposure to stress. In this context, prolonged RSA recovery is thought to reflect difficulty rebounding and continued sympathetic activation, which becomes depleting over time. Similar to the notion that the flexible deployment of coping strategies may be more relevant to adjustment than the use of particular styles of coping, RSA recovery may be more relevant than basal RSA in relation to the longitudinal impact of chronic stress on the development of higher-order cognitive strategies and adjustment.

Of note, the conceptualization of basal RSA as a moderately stable individual difference factor suggests any changes in basal RSA in early childhood could be due to cumulative risk itself. While the direct effects of cumulative risk on basal RSA were not modeled in the current

study, zero-order correlations provide further context to interpret their potential relations in early childhood. Notably, CR at Times 1, 2, and 3 as well as the mean T1-T4 CR variable showed no significant correlation with basal RSA. This lack of association is consistent with previous research (Esposito et al., 2016). However, CR at Time 4 demonstrated a significant, albeit weak positive correlation with basal RSA at Times 2, 3, and 4. These correlations suggest a time-specific relation between cumulative risk at age 5 and variability in basal RSA across early childhood might exist. Unfortunately, the cross-sectional nature of these correlations limits our ability to interpret the potential developmental impact of CR on basal RSA. Future research that utilizes a longitudinal as opposed to a cross-sectional framework is needed.

Importance and Implications

Many psychosocial interventions teach cognitive self-regulation strategies (e.g., cognitive reappraisal, cognitive flexibility, problem solving) to alleviate the distress and mental health problems that disadvantaged youth experience. However, research demonstrates that interventions are often less effective and at times ineffective for families experiencing adversity (Lundahl, Risser, & Lovejoy, 2006; Sue et al., 2006). This research attempted to clarify which cognitive self-regulation strategies might be effective for whom and under what conditions, as well as inform how psychosocial interventions are used, particularly in populations with varying levels of risk. There has been a necessary shift in research toward effectiveness. While a better understanding of the interaction effect of physiology and risk on appraisal and coping will help identify pathways of resilience among children with disadvantage and bolster existing effectiveness research on evidence-based therapies, and a novel perspective emerges. Present study findings combined with previous literature suggests that, despite our best efforts to understand the role of intra-individual factors such as RSA and appraisal/coping, there is

evidence to suggest any efforts to intervene at the individual level may have only modest effects on adjustment. Typically, research in psychology has demonstrated a bias toward the individual, providing an overwhelming burden on individuals to learn strategies that will help them cope with their life circumstances. While these efforts are not entirely in vain, they can send the message to individuals who are raised in chronically underserved and under-resourced communities that the failure to overcome these circumstances is a failure of the individual (e.g., a lack of grit or resilience). In reality, individuals who manage to escape the trappings of chronic exposure to stress are an exception to the rule. Further, the absence of psychopathology in the context of chronic stress could be considered divorced from reality. It is natural to have depressive symptoms when one's circumstances are depressing. Overall, the state of the literature would suggest that a collective-consciousness in addition to an individual-consciousness may be called for. Community-level interventions, such as programs designed to reduce poverty, racial discrimination, and housing instability (e.g., mutual aid) may be more effective in the prevention of adjustment problems across the lifespan than interventions implemented at the individual-level, such as teaching children how to cope with these injustices.

Strengths and Limitations

The strengths of this study include the longitudinal design that includes repeated assessments of risk and RSA in early childhood and preadolescent assessment of cognitive vulnerabilities and adjustment, allowing clarification of the direction of effects of adversity and physiological arousal on children's mental health. A mediated moderation model linking the altered associations among risk, appraisal, coping, and psychopathology due to basal RSA was tested to examine a nuanced, bioecological understanding of the longitudinal effect of early stress experiences on children's later use of self-regulatory strategies. This helped to clarify that

early childhood intraindividual self-regulatory factors such as basal RSA and the use of distinct coping strategies may have a more concurrent or short-term effect on child adjustment as opposed to a longitudinal effect. Further, the stratified economic status of the sample, combined with the distinct measurement of cumulative risk and income, allowed for greater specificity in testing the effects of stress experiences on appraisal, coping, and adjustment at different levels of risk. This study is unique in that it assesses multiple indicators of adversity and includes measures of adjustment and maladjustment. A possible limitation to this study is the use of a cumulative risk score, as opposed examining individual risk factors. Prior research, however supports the use of a cumulative risk score, since it captures the accumulation of multiple challenges, which in sum have been shown to have a greater effect on development compared to individual factors. While there is not one standard approach to quantifying the burden of multiple risks, this scoring technique is widely used because it is parsimonious and agnostic to the relative importance or interaction among risk factors (Evans et al., 2013). Moreover, the CR scoring in the present study includes factors theoretically and empirically linked to adjustment, and each of these can be examined individually as follow up to tests of the effects of cumulative risk. Another strength of this study is the use of multiple assessment measures including questionnaire and physiological data. Questionnaire data, however, can be biased, and problem behaviors may only be present in certain contexts. While this is a fairly diverse community sample, levels of emotional and behavioral problems were be more limited than they would be in a clinical sample. Regardless, this study was one of the first of its kind to examine the potential impact of environmental and intraindividual factors in early childhood on the preadolescent use of self-regulatory cognitive strategies, providing important developmental information that could be utilized for early intervention or prevention with individuals from at-risk populations.

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Table 1. Descriptives - All Study Variables						
Variable	**Min**	**Max**	**Mean**	**SD**	**Skew**	**Kurtosis**
Gender	0.00	1.00	0.50	0.50	0.01	-2.01
T1 Income	0.50	14.00	8.75	3.93	-0.78	-0.57
T1 CR	0.00	4.50	0.90	0.81	1.83	3.21
T2 CR	0.00	3.94	0.82	0.72	1.54	2.39
T3 CR	0.17	2.99	0.80	0.59	1.61	1.96
T4 CR	0.18	3.51	0.80	0.61	1.77	2.93
T1-T4 CR	0.21	2.95	0.84	0.59	1.52	1.67
T1 bRSA	2.85	8.71	5.93	1.18	-0.06	-0.13
T2 bRSA	2.99	9.52	6.38	1.15	0.14	0.21
T3 bRSA	4.15	9.11	6.75	1.09	-0.14	-0.55
T4 bRSA	3.16	10.28	6.96	1.16	-0.08	0.00
T1-T4 bRSA	4.19	9.43	6.52	0.94	0.37	-0.06
T6 Threat Appraisal	0.00	24.00	5.76	5.86	1.32	1.20
T6 Positive Appraisal	2.00	30.00	18.63	6.89	-0.27	-0.74
T6 Avoidant Coping	0.00	33.00	14.28	6.66	-0.08	-0.40
T6 Active Coping	3.00	60.00	31.92	12.99	0.02	-0.80
T6 YSR Internalizing	0.00	41.00	10.87	7.66	1.11	1.17
T6 YSR Externalizing	0.00	30.00	7.62	5.23	0.96	1.18
T6 Positive Adjustment (s)	-12.77	5.18	0.00	3.09	-0.98	1.20

Note. T1 = Time 1; T2 = Time 2; T3 = Time 3; T4 = Time 4; CR = Cumulative Risk; bRSA = Basal RSA; YSR = Youth Self-Report; (s) = Standardized.

Table 2. Correlations - All Study Variables										
Variable	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	
1. Gender	-	-	-	-	-	-	-	-	-	
2. Income	-.05	-	-	-	-	-	-	-	-	
3. T1 CR	-.01	-.59**	-	-	-	-	-	-	-	
4. T2 CR	-.07	-.46**	.50**	-	-	-	-	-	-	
5. T3 CR	-.02	-.54**	.61**	.66**	-	-	-	-	-	
6. T4 CR	-.05	-.57**	.65**	.62**	.80**	-	-	-	-	
7. T1-T4 CR	-.04	-.65**	.84**	.82**	.88**	.88**	-	-	-	
8. T1 bRSA	-.09	.02	-.06	.00	.03	.06	.01	-	-	
9. T2 bRSA	-.04	.01	.00	.04	.08	.13*	.07	.53**	-	
10. T3 bRSA	.04	-.10	.07	.03	.08	.15*	.09	.50**	.59**	
11. T4 bRSA	.03	-.01	-.01	-.02	.06	.08	.02	.37**	.51**	
12. T1-T4 bRSA	-.01	-.01	-.01	.03	.08	.13*	.06	.79**	.83**	
13. T6 Threat Appraisal	.03	-.08	-.03	-.07	-.03	-.05	-.06	.01	.00	
14. T6 Positive Appraisal	-.10	.07	.02	-.04	-.09	-.04	-.03	.06	-.11	
15. T6 Avoidant Coping	-.02	-.09	.17*	.09	.13	.07	.15*	.05	-.05	
16. T6 Active Coping	-.10	.08	-.03	.02	.00	-.02	-.01	.06	-.05	
17. T6 YSR Internalizing	0.08	-.15*	.16*	.05	.16*	.22**	.17*	-.08	-.05	
18. T6 YSR Externalizing	.21**	-.26**	.20**	.17*	.21**	.26**	.24**	-.08	-.08	
19. T6 Positive Adjustment	-0.17*	.06	.01	.06	-.02	.04	.03	.03	.04	
Variable	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**
1. Gender	-	-	-	-	-	-	-	-	-	-
2. Income	-	-	-	-	-	-	-	-	-	-
3. T1 CR	-	-	-	-	-	-	-	-	-	-
4. T2 CR	-	-	-	-	-	-	-	-	-	-
5. T3 CR	-	-	-	-	-	-	-	-	-	-
6. T4 CR	-	-	-	-	-	-	-	-	-	-
7. T1-T4 CR	-	-	-	-	-	-	-	-	-	-
8. T1 bRSA	-	-	-	-	-	-	-	-	-	-
9. T2 bRSA	-	-	-	-	-	-	-	-	-	-
10. T3 bRSA	-	-	-	-	-	-	-	-	-	-
11. T4 bRSA	.53**	-	-	-	-	-	-	-	-	-
12. T1-T4 bRSA	.83**	.77**	-	-	-	-	-	-	-	-
13. T6 Threat Appraisal	.17*	.02	.03	-	-	-	-	-	-	-
14. T6 Positive Appraisal	-.05	.03	-.05	-.32**	-	-	-	-	-	-
15. T6 Avoidant Coping	.03	.04	.02	.21**	.26**	-	-	-	-	-
16. T6 Active Coping	-.01	-.02	-.02	-.23**	.78**	.44**	-	-	-	-
17. T6 YSR Internalizing	-.03	-.02	-.09	.39**	-.28**	.25**	-.16*	-	-	-
18. T6 YSR Externalizing	.06	-.04	-.06	.33**	-.21**	.17*	-.14	.65**	-	-
19. T6 Positive Adjustment	-.05	.03	.02	-.51**	.51**	-.02	.43**	-.53**	-.39**	-

Note. T1 = Time 1; T2 = Time 2; T3 = Time 3; T4 = Time 4; CR = Cumulative Risk; bRSA = Basal RSA; YSR = Youth Self-Report; (s) = Standardized.

Table 3. Standardized regression coefficients (standard errors) from the path model testing the effects of cumulative risk, basal RSA, and their interaction on changes in appraisal, coping, and adjustment

	Time 6						
	Positive Appraisal	**Threat Appraisal**	**Active Coping**	**Avoidant Coping**	**YSR Internalizing**	**YSR Externalizing**	**Positive Adjustment**
Time 1							
Income	.09 (.10)	-.23 (.10)*	.12 (.10)	.02 (.10)	.02 (.08)	-.10 (.08)	.00 (.08)
Child Gender	-.10 (.07)	.02 (.07)	-.10 (.07)	-.03 (.07)	.05 (.06)	.19 (.06)**	-.09 (.05)□
Time 1-4							
CR	.04 (.10)	-.23 (.10)*	.09 (.10)	.18 (.10)□	.18 (.09)*	.19 (.09)*	.01 (.08)
bRSA	-.04 (.07)	.04 (.08)	-.01 (.07)	.00 (.07)	-.11 (.06)□	-.08 (.06)	.05 (.06)
CRxbRSA	.12 (.07)	.01 (.08)	.09 (.07)	-.09 (.07)	.07 (.07)	-.02 (.07)	-.04 (.06)
Time 6							
Positive Appraisal					-.26 (.10)*	-.13 (.11)	.29 (.09)**
Threat Appraisal					.26 (.07)***	.25 (.07)**	-.36 (.06)***
Active Coping					-.02 (.11)	-.00 (.11)	.17 (.10)□
Avoidant Coping					.27 (.08)***	.12 (.08)	-.10 (.07)

Note: ^{t} < .10, * < .05, ** < .01, *** < .001; T1 = Time 1; T2 = Time 2; T3 = Time 3; T4 = Time 4; CR = Cumulative Risk; bRSA = Basal RSA; CRxbRSA = CR and bRSA interaction term; YSR = Youth Self-Report

Figure 1. Conceptual Model