

Temperament as a moderator of the association of cumulative risk with
pre-adolescent appraisal and coping

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Abstract

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Aims: Individual differences in temperament, particularly emotionality and self-regulation, have been found to predict internalizing and externalizing problems during children's transition to adolescence. Temperament has also been linked both concurrently and longitudinally to appraisal and coping processes, which in turn have been found to mediate the effect of cumulative risk on internalizing and externalizing problems in children of the same age. While prior research has begun to document how cumulative risk shapes the development of appraisal and coping processes over time, there remains a dearth of longitudinal research, particularly in representative samples, on the factors that may exacerbate or mitigate the effect of cumulative risk on appraisal and coping in pre-adolescents. Thus, given previous literature on the relations among temperament, cumulative risk, and appraisal and coping processes, the goal of the present study is to clarify how individual differences in temperament moderate the effect of cumulative risk on coping and appraisal. *Method:* The present research examined temperament negative emotionality and effortful control as moderators of the prospective effects of cumulative risk on appraisal and coping styles using a community sample (N=316) of preadolescent children (M age =9.5 at T1) studied longitudinally across 1 year. *Findings:* Overall, cumulative risk predicted greater use of threat appraisal relative to positive appraisal and greater use of avoidant coping relative to active coping. Effortful control predicted greater use of positive appraisal relative to threat appraisal and greater use of active coping relative to avoidant coping. Negative emotionality predicted greater use of threat appraisal relative to positive appraisal and greater use of avoidant coping relative to active coping. Prospective analyses evaluating the interactive effect of cumulative risk and temperament predicting distinct appraisal and coping strategies one year later, controlling for initial levels, revealed four moderation effects. Effortful control interacted with cumulative risk to predict rank order changes in positive appraisal, active coping,

and avoidant coping, such that higher effortful control lead to greater use of positive appraisal and avoidant coping in high risk settings. In contrast, lower effortful control lead to less use of active coping in high risk settings. Negative emotionality also interacted with cumulative risk to predict rank order changes in active coping, such that lower negative emotionality tended to lead to greater use of active coping in high risk settings, whereas higher negative emotionality tended to lead to greater use of active coping in low risk settings (although neither of the slopes for high and low levels of negative emotionality were significant).

Conclusions: Overall, findings help to elucidate how exposure to an accumulation of risks interacts with temperament to shape the development of appraisal and coping in preadolescence. Further, although separate moderation findings must be interpreted in consideration of the overall use of appraisal and coping strategies, effortful control appears to be a potential resource to children for the future use of positive appraisal, active coping, and avoidant coping, whereas negative emotionality may serve as a vulnerability factor for the use of less active coping in the context of risk.

Youth experiencing the burden of multiple risk factors or stressors in their lives are at greater risk for developing poor physical and mental health outcomes (Brody et al., 2013; Rutter, 1979; Sameroff, 2000). The burden of accumulated and persistent stress associated with multiple risk exposure is commonly measured with cumulative risk, an additive model of risk that captures development within and across multiple contexts including individual, interpersonal, and environmental domains (Bronfenbrenner, 1979). A wide body of literature has demonstrated cumulative risk to be a reliable and powerful predictor of a host of poor child outcomes including psychopathology, social-emotional problems, and lower academic achievement (Evans, Li, & Whipple, 2013). Recently, a call to identify the mechanisms of the relation between cumulative risk and poor outcomes in children has implicated appraisal and coping strategies as both potential moderators and mediators of these relations (Aldridge & Roesch, 2007; Compas et al., 2017; Lengua & Long, 2002; Thompson, Lengua, & Meza, 2015). Unfortunately, while there is a strong body of evidence demonstrating the deleterious effect of cumulative risk on children's mental health and adjustment, there is a dearth of research evaluating the impact of cumulative risk on stress response processes, such as appraisal and coping, that might account for these effects. Furthermore, there is reason to believe that children respond differently to cumulative risk depending on their own emotionality and self-regulation temperament characteristics (Chang, Shelleby, Cheong, & Shaw, 2012; Dich, Doan, & Evans, 2017; Thompson et al., 2015), and that those characteristics can shape appraisal and coping, which might have implications for the impact of cumulative risk on stress responses. Specifically, we have yet to determine how cumulative risk, in combination with individual differences in temperament, may shape the use of appraisal and coping strategies themselves.

Cumulative risk is an index of multiple contextual risk factors including but not limited to low income status, ethnic minority status, single-parent household, residential overcrowding, neighborhood danger, and maternal depression, all of which are known predictors of psychological adjustment in children (Evans et al., 2013; Sameroff, Seifer, Barocas, Zax, & Greenspan, 1987). These singular factors might be standardized or dichotomized, and summed for each individual, resulting in a total cumulative risk score that has a dose-dependent relation with child adjustment, such that the presence of each additional risk factor predicts a greater likelihood of poor outcomes (Evans et al., 2013; Rutter, 1979). The superior predictive power of cumulative risk (when compared to singular factors) is often explained by the

mediating role of allostatic load, an index of cumulative wear and tear on the body caused by repeated mobilizations of multiple physiological systems over time in response to environmental demands (Evans et al., 2013). Theoretically, high cumulative risk increases the probability that children will have to continually engage multiple response systems, increasingly taxing their capacity for self-regulation with every additional demand. Furthermore, high cumulative risk corresponds to less down time for regulatory systems to restore themselves as they must continue to respond to a higher rate of demands. Although much is known about the relation of cumulative risk to children's adjustment, less is known about how cumulative risk may shape children's higher order self-regulation processes, such as appraisal and coping (Compas et al., 2017).

Appraisal is 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. Appraisal styles can be grouped into two general categories: positive and threat. 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; Sheets, Sandler, & West, 1996).

Cumulative risk might shape an individual's appraisal style, thereby implicating appraisal as a critical mediator of the effects of cumulative risk on adjustment. Bandura's social learning theory and Lazarus' appraisal theory provide a theoretical framework for these relations (Bandura, 1971; Delahaij & Van Dam, 2017; Lazarus, 1991). According to social learning theory, children may learn to anticipate future events as threatening due to an accumulation of prior stressors, with limited time to mentally and physically recover (i.e., due to increased allostatic load). Learning to appraise events as threatening may occur through modeling and/or reinforcement by parents or other individuals in the children's environment (Santiago, Etter, Wadsworth, & Raviv, 2012). This heuristic expectation of threat is reasonable, given the actual increased likelihood of true harm or loss in high risk environments. Overtime, this process may become ingrained, providing fewer 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 also 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. Individuals who tend to deploy positive appraisal strategies on the other hand, may be less penetrable to the learned experiences of a high-risk environment, 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. Though more evidence is needed, Miller's review of the literature on perceived threat across development provides strong support for this theoretical framework (Miller, 2015). Although this work was focused exclusively on children exposed to intimate partner violence, there are many parallels relevant to children exposed to cumulative risk.

Coping is defined as specific, volitionally and intentionally enacted self-regulatory strategies employed when one is faced with stress that has been appraised as exceeding the resources of the individual (Compas, Connor-Smith, Saltzman, Thomsen, & Wadsworth, 2001; Eisenberg, Fabes, & Guthrie, 1997; Lazarus & Folkman, 1984). Generally, coping strategies can be grouped into two categories: active and avoidant. 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. In a meta-analysis of coping in children with cancer, Aldridge & Roesch (2007) found that active coping styles lead to more positive adjustment outcomes 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.

Cumulative risk might also shape an individual's coping strategies, and coping, in turn, might be another critical mediator of the effects of cumulative risk on adjustment. Coping has been found to account for the effect of stress on physical health and psychological adjustment. Evidence from the study of pediatric cancer has provided strong support for these mediated relations (Aldridge & Roesch, 2007), but research on singular stressors other than pediatric cancer implicate coping as a mechanism as well. One study, for example, found that avoidant coping, operationalized as cognitive avoidance and avoidant actions, mediated the relation between stress and internalizing problems and conduct problems among

children of divorce (Sandler, Kim-Bae, & MacKinnon, 2000). Another found that “negative” coping, which included 8 items such as ignoring the problem, crying, hitting/fighting, and screaming/yelling, mediated the relation between community violence and posttraumatic stress symptoms, depression, and anxiety (Dempsey, 2002). Despite evidence of mediation however, a recent quantitative and narrative review of coping suggests that these associations may not be 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).

In light of the theoretical framework outlined above to explain the process by which cumulative risk might lead to greater threat appraisal, similar processes may explain how children who have been exposed to cumulative risk might also increasingly lean on avoidant coping strategies. That is, 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 and 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. Compas and colleagues’ review highlighted the gap in knowledge concerning how coping strategies are shaped over time across development. Arguably, this same gap in knowledge applies to appraisal. 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 context might have differential effects depending on intraindividual differences, such as temperament.

Temperament, or relatively stable individual differences in reactivity and self-regulation, likely influences the association of cumulative risk, appraisal, coping and child adjustment (Lengua & Long,

2002; Rothbart, 1989; Rothbart, 1981; Thompson, Zalewski, & Lengua, 2014). Individual differences in reactivity, sometimes referred to as emotionality, are typically assessed by measuring the arousal of fear and frustration, whereas differences in self-regulation, operationalized as shifting and focusing attention as well as the inhibition of thoughts and behaviors, are typically assessed with measures of effortful control and impulsivity (reversed). Both reactivity and self-regulation domains of temperament affect the individual's initial automatic response to stress and may constrain or facilitate certain types of higher-order appraisal/coping characteristics, such as the ability to sustain and shift attention toward or away from a stressor, baseline levels of arousal, and the ability to use strategies to deal with negative emotions (Compas et al., 2004; 2001). Negative emotionality, a facet of reactivity, is thought to increase the likelihood of intense or overwhelming emotional arousal in response to negative events, increasing children's reliance on threat appraisals and avoidance, due to narrowed attentional focus or cognitive inflexibility. In contrast, self-regulation is thought to increase children's attentional control and facilitate the use of more complex cognitive abilities thereby leading to greater use of positive appraisals and active coping. Indeed, temperament has been found to predict rank-order changes in appraisal and coping in the context of stress, though the various relations among negative emotionality, effortful control, appraisal and coping were somewhat conflicting (Thompson et al., 2014). For example, in a study by Thompson and colleagues, effortful control was related to relative decreases in threat appraisal, and frustration (a facet of negative emotionality) was associated with relative decreases in active coping, as expected. Impulsivity (a reverse-coded facet of self-regulation), on the other hand, was associated with not only increases in avoidant coping (as expected), but also increases in positive appraisal (contrary to expectation). Overall, Thompson et al. (2014) found appraisal and coping mediated the effects of temperament on adjustment, though this relation was not examined under varying levels of risk. These complex and conflicting findings provide incentive to further unpack the relations among stress, temperament, appraisal, and coping. A more nuanced analysis in which stress exposure in combination with individual differences in children's underlying self-regulation and reactivity, may help elucidate how appraisal and coping strategies develop.

Few studies have tested the longitudinal effect of cumulative risk on appraisal and coping, and even fewer studies have examined for whom or under what conditions cumulative risk may lead to the

use of differential appraisal and coping strategies (i.e., moderation). In an extensive literature review of cumulative risk by Evans and colleagues, very few moderation studies demonstrated significant interactions for the effect of cumulative risk on child outcomes (Evans et al., 2013). Of the moderation studies reviewed, only two studies evaluated intraindividual moderators (i.e., not gender) relevant to the self-regulatory processes underpinning appraisal and coping. One longitudinal study found that for children high in negative emotionality, cumulative risk had an increased negative impact on emotion dysregulation (Chang et al., 2012). A second, cross-sectional study, found that the adverse impact of cumulative risk on social competence was buffered by low inhibition (Corapci, 2008). In both studies, temperament moderated the effect of cumulative risk on the outcome of interest. Lengua and Long (2002) found limited support for moderation among stress, temperament, coping, and adjustment problems. They found that the number of negative life events a child was exposed to was more strongly associated with internalizing problems in children who were low in self-regulation compared to children who were high in self-regulation. They also found that negative emotionality was moderately correlated with active coping for children below the median in self-regulation, but unrelated to active coping for children above the median in self-regulation. These differences were interpreted cautiously, however, as the overall test for differences was nonsignificant, perhaps due to a small sample size. A recent study evaluated the moderating effect of negative emotionality on the relation between cumulative risk exposure and internalizing symptoms, externalizing symptoms, and allostatic load. High negative emotionality was found to have an exacerbating effect with cumulative risk on internalizing and externalizing problems, though this effect did not depend on the environmental context. In contrast, high negative emotionality mitigated the effect of cumulative risk on allostatic load, suggesting negative emotionality may be physiologically adaptive in high risk settings (Dich et al., 2017). These findings highlight the importance of considering individual differences in the presence of varying environmental contexts. No present studies to our knowledge, however, have examined the moderating effects of temperament on the relation between cumulative risk and appraisal and coping strategies, which are believed to be undergoing maturation across middle to late childhood. Thus, the present study aims to better understand the relations among cumulative risk, temperament, and appraisal and coping in preadolescence.

This study tested whether exposure to cumulative risk, moderated by individual differences in temperament, predicted changes in appraisal and coping one year later. These relations were tested using longitudinal data across one year in preadolescence at a time when the underlying cognitive abilities required to deploy higher order appraisal and coping strategies are theorized to develop. As children become increasingly independent from their caregivers, 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, Raviv, Compas, & Connor-Smith, 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 influenced by pertinent environmental and intraindividual factors. According to existing literature, the chronic and uncontrollable nature of cumulative risk should tax a child's self-regulatory capacity in ways distinct from singular stressors, leading to an even greater likelihood of threat appraisals and avoidant coping. Furthermore, this relation can be expected to vary by individual differences in temperament.

The first aim was to examine how temperament and risk related to the degree to which people use positive relative to threat appraisal as well as active relative avoidant coping. Given the mixed findings on coping strategies in the literature, an overall ratio score was used to compare and contrast relative use of coping strategies with analyses of individual factors of coping (i.e., active or avoidant). An overall ratio score was also calculated for appraisal (i.e. positive vs. threat). To our knowledge, no prior studies have analyzed appraisal in this way, but ratio analysis should provide additional context will provide information on the relative use of appraisal (positive vs. threat), which will inform the interpretation of interaction effects. We hypothesized that (1) negative emotionality would be associated with more threat appraisal relative to positive appraisal as well as more avoidant coping relative to active coping, (2) effortful control would be associated with more positive appraisal relative to threat appraisal as well as more active coping relative to avoidant coping, and (3) cumulative risk would be associated with more threat appraisal relative to positive appraisal as well as more avoidant coping relative to active coping. The second aim was to examine temperament as a moderator of the association of cumulative risk and

appraisal and coping. We hypothesized that (4) negative emotionality would exacerbate the effects of cumulative risk on threat appraisal and avoidant coping, (5) effortful control would mitigate the effects of cumulative risk on threat appraisal and avoidant coping, and (6) interaction effects will emerge between cumulative risk and positive appraisal as well as cumulative risk and active coping when temperament is incorporated as a moderator in the model. Previous direct associations between cumulative risk and positive appraisal and cumulative risk and active coping were not found in a prior study in this same sample.

Method

Participants

Participants were 316 children (53% female) and their mothers who were assessed via in-home interviews at two time points, separated by one year. At Time 1 interviews children were in 3rd-5th grade (M age = 9.6 years, range = 7.8-12 years). Children with developmental disabilities (except learning disabilities) and families who were not fluent in English were excluded to ensure adequate comprehension of the questionnaire measures. Participants were a community-based sample, recruited through public schools in the US Pacific Northwest urban area, selected to represent a variety of sociodemographic characteristics. Annual family income was evenly distributed with 12% less than \$20,000; 23% \$21,000-40,000; 18% \$41,000-60,000; 14% \$61,000-80,000; 16% \$81,000-100,000; and 17% over \$100,000. A female primary caregiver was required to participate. Mothers' modal level of educational attainment was college/university graduate and ranged from 9 individuals with less than a high school diploma to 20 individuals with advanced degrees. Seventy-two percent of families were two-parent households. The race and ethnicity of the children in the sample included 59% European/White, 29% African-American, 7% multiple/other ethnicities, 2% Asian/Pacific Islander, 2% Hispanic, and 1% Native American.

Procedures

Questionnaire measures were administered during 2.5-hour structured interviews in the family home. Home-based interviews were used to encourage the participation of difficult-to-recruit families. After confidentiality was explained, mothers signed informed consent forms and children signed assent forms. Mothers and children were interviewed individually at two time-points, scheduled 1 year apart.

Trained interviewers read aloud all instructions and questionnaires to participants to minimize interpretation errors and combat potential literacy problems. Families received \$40 and \$50 compensation at T1 and T2, respectively.

Measures

Cumulative Risk. An index of cumulative risk was used to assess a lifetime of accumulated stress experiences associated with demographic, psychosocial, and environmental risk factors. To capture the additive nature of risk, 11 standardized risk indicators were summed, with higher scores reflecting greater exposure to risk.

Demographic risk factors included educational risk (mothers who had not completed high school), poverty (families at or below the 1998 federal Health and Human Services Poverty Guidelines—a function of income and family size), single-parent status, adolescent parent status (mother less than 19 at the target child's birth), racial or ethnic minority status, and family density (the ratio of the number of people in the home to the number of rooms in the home).

Psychosocial risk factors included negative life events, maternal depression, and family history of problems. Negative life events were assessed using mother and child report on the General Life Events Schedule for Children (Sandler et al. 1986). Mothers and children reported on the number of negative life events that had occurred over the previous year. Maternal depression in the previous month was measured by the 20-item Center for Epidemiological Studies-Depression Scale (Radloff, 1977). Internal consistency for the depression scale was .84.

Environmental risk factors included the quality of the home and the neighborhood environment. Quality of the home was assessed with mother and child reports on the cleanliness, safety, amenities, and size of the house using the Post-Visit Inventory (PVI; Dodge, Bates, & Pettit, 1990). Internal consistency was .74 for mother report and .72 for child report. Neighborhood risk was assessed by mother report on the Neighborhood Questionnaire (NQ), which assessed neighborhood safety, social involvement, and services (Conduct Problems Prevention Research Group, 1991) as well as interviewer ratings on the PVI, which assessed the apparent safety of the neighborhood. Internal consistency was .76 for both the NQ and PVI.

Appraisal. Child appraisal was assessed at Time 1 and Time 2. 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 the 24-item ‘What I Felt Scale’ (Sheets et al., 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. Internal consistency for threat appraisal was .88 at T1 and T2. Positive appraisal was assessed by combining a challenge appraisal subscale (7 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”). Challenge and resource subscales correlated .76 and .75 at T1 and T2. Internal consistency for positive appraisal were .83 and .84 at T1 and T2. In addition to positive and threat appraisal scale scores, ratio scores were calculated to compare the relative use of positive appraisal to threat appraisal. First, proportions scores of positive and threat appraisal were computed by dividing individuals’ appraisal scores by their respective scale maximum score (39 for positive appraisal; 36 for threat appraisal). Next, ratio scores were calculated by dividing positive appraisal proportion scores by threat appraisal proportion scores. Higher scores reflect greater use of positive appraisal *relative* to threat appraisal.

Coping. Child coping was assessed at Time 1 and Time 2 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 cognitive decision making, control, direct problem solving, positive cognitive restructuring, optimism, and seeking understanding strategies. Avoidant coping included cognitive avoidance, avoidant actions, and wishful thinking. Internal consistency for active and avoidant coping were .88 and .89 and .76 and .82 at T1 and T2, respectively. In addition to active and avoidant coping scale scores, ratio scores were calculated to compare the relative use of active coping to avoidance coping. First, proportions scores of active and avoidant coping were computed by dividing individuals’ coping scores by their respective scale maximum score (72 for active coping; 36 for avoidant coping). Next, ratio scores were calculated by dividing active coping proportion scores by avoidant coping

proportion scores. Higher scores reflect greater use of active coping *relative* to avoidant coping. This ratio scoring varies slightly from methods used by Connor-Smith and colleagues, but better accounts for measurement bias in the present study by weighting items more equally across both active and avoidant scales (Connor-Smith, Compas, Wadsworth, Thomsen, & Saltzman, 2000). Ratio scores used in the present study were strongly correlated ($r = .81$ to $.82$) with those calculated using the Connor-Smith and colleagues method.

Temperament. Child temperament negative emotionality and effortful control were assessed at Time 1 with mother and child reports on the impulsivity and inhibitory control subscales of the Child Behavior Questionnaire (CBQ; Goldsmith & Rothbart, 1991) and the fear, irritability, and attention subscales of the Early Adolescent Temperament Questionnaire (EATQ; Capaldi & Rothbart, 1992). Negative emotionality, the reactivity facet of temperament, consisted of combined fear and frustration subscales. The internal consistencies for mother and child reported negative emotionality were $\alpha = .74$ and $\alpha = .79$, respectively, and they were correlated $.18$. The internal consistency of the composite mother- and child-reported measure of negative emotionality was $.78$. Effortful control, the self-regulation facet of temperament, consisted of combined attention and inhibitory control subscales for mother- and child-report ($\alpha = .87$ and $\alpha = .75$, respectively), which were correlated $.23$. The composite alpha reliability for mother- and child-reported effortful control was $.84$.

Results

Analytic plan

Descriptive statistics, including frequencies, ranges, means, and standard deviations, were examined for all study variables to assess the data for irregularities (e.g., miscoded variables, unlikely values) and to ensure the data had been cleaned and aggregated properly across multiple informants. Correlations among study variables were examined to determine how to combine subscales and multi-informant reports, assess potential covariates, such as gender and age, and assess the plausibility of hypotheses. Ratio scores of appraisal and coping were calculated to assess relative use of positive versus threat appraisal as well as relative use of active versus avoidant coping. Ratio scores were used in

examining the direct prediction of appraisal and coping by cumulative risk and temperament, and to provide clarifying information about the cumulative risk x temperament moderation effects on appraisal and coping. Hierarchical multiple regression analyses were conducted to test study aims in Mplus 6.11 (Muthén and Muthén, 2010). Full Information Maximum Likelihood Estimation (FIMLE) was used to address missing data. To examine the first aim, we tested the main effects of negative emotionality, effortful control, and cumulative risk on appraisal and coping using the ratio score. To examine the second aim, interaction terms (cumulative risk x negative emotionality, cumulative risk x effortful control) were calculated by multiplying the centered variables in each term, and both direct and interaction effects were entered into separate regression models for positive appraisal, threat appraisal, active coping, and avoidant coping. Significant interactions were probed at one standard deviation above and below the mean on cumulative risk and temperament. Prior levels of appraisal or coping were controlled to assess relative increases or decreases in appraisal/coping across one year. All models controlled for child age and sex.

Descriptive statistics and correlations

Descriptive statistics are presented in Table 1. Correlations among study variables, presented in Table 2, were examined to identify covariates and assess the plausibility of proposed associations. Age was negatively related to positive appraisal, avoidant coping, and negative emotionality; therefore, age was included as a covariate due to the theorized connection between older age and greater cognitive capacities. Sex was not correlated with any of the study variables but was included as a covariate given differences in mental health have been shown to emerge across gender in preadolescence (Carlson & Grant, 2008; Sontag & Graber, 2010). Negative emotionality was related to higher initial levels of cumulative risk, threat appraisal, and avoidant coping, whereas effortful control was related to lower initial levels of cumulative risk, threat appraisal, and avoidant coping. Positive appraisal and active coping were unrelated to both cumulative risk and temperament. Positive and threat appraisal were moderately, positively correlated suggesting that they are not independent or mutually exclusive. Accordingly, to compare relative use of positive versus threat appraisal, a ratio score was calculated by dividing the proportion score of positive appraisal by the proportion score of threat appraisal. Higher scores reflected greater use of positive relative to threat appraisal. Active and avoidant coping were also moderately,

positively correlated with one another warranting ratio score analysis. Similar methods to calculate the ratio score of appraisal were used to compare relative use of active versus avoidant coping. Higher scores reflected greater use of active relative to avoidant coping. Correlations among temperament, risk, appraisal, and coping suggested the hypothesized associations were plausible.

Cumulative risk, temperament and their interaction as predictors of appraisal

Regression analyses predicting the ratio score of positive versus threat appraisal revealed three concurrent, direct effects of negative emotionality, effortful control, and cumulative risk. Children who were higher in negative emotionality tended to use less positive appraisal relative to threat appraisal ($\beta = -.217$, $SE = .058$, $p = .000$), whereas children who were higher in effortful control tended to use more positive appraisal relative to threat appraisal ($\beta = .117$, $SE = .058$, $p = .045$). Children who were exposed to higher cumulative risk also tended to use less positive appraisal relative to threat appraisal ($\beta = -.148$, $SE = .057$, $p = .009$).

Regression analyses predicting rank order changes in positive appraisal revealed no direct effects of cumulative risk or temperament, and no significant interaction effect of cumulative risk with negative emotionality. However, a significant interaction of cumulative risk with effortful control predicted rank order changes in positive appraisal one year later (See Table 4). Probing the interaction effect of cumulative risk and effortful control on changes in positive appraisal showed that the effect of cumulative risk on increases in positive appraisal was significant for children high in effortful control ($b = 0.452$, $p = 0.011$), but was non-significant for children low in effortful control ($b = -.092$, $p = 0.604$). In children who were high in effortful control, children's level of positive appraisal increased (controlling for initial levels) as their level of risk increased. In contrast, children who were low in effortful control appeared to have no change in their use of positive appraisal depending on their level of risk.

Regression analyses predicting rank order changes in threat appraisal revealed no significant direct effects of cumulative risk or cumulative risk x temperament interaction effects. There was, however, a direct effect of effortful control predicting decreases in threat appraisal, one year later ($\beta = -.214$, $SE = .077$, $p = .006$).

Cumulative risk, temperament and their interaction as predictors of coping

Regression analyses predicting the ratio score of active versus avoidant coping revealed three direct effects of negative emotionality, effortful control, and cumulative risk. Children who were higher in negative emotionality tended to use less active coping relative to avoidant coping ($\beta = -.268$, $SE = .056$, $p = .000$), whereas children who were higher in effortful control tended to use more active coping relative to avoidant coping ($\beta = .141$, $SE = .057$, $p = .013$), concurrently. Children who were exposed to higher cumulative risk also tended to use less active coping relative to avoidant coping ($\beta = -.237$, $SE = .081$, $p = .004$), one year later.

Regression analyses predicting active coping revealed no direct effect of cumulative risk or temperament on rank order changes in active coping. However, there were significant effects of the interaction of cumulative risk with negative emotionality, as well as cumulative risk with effortful control, predicting rank order changes in active coping one year later (Table 2). Probing the interaction at one standard deviation above and below the mean of negative emotionality demonstrated neither slope of high nor low levels of negative emotionality were significant (High NE: $b = -0.508$, $p = 0.114$; Low NE: $b = 0.428$, $p = 0.235$). However, the pattern of the interaction indicates opposite effects for high and low levels of negative emotionality at different levels of cumulative risk. For children who were high in negative emotionality, children's level of active coping decreased (controlling for initial levels) as their level of cumulative risk increased. That is, children with higher negative reactivity, who were initially less likely to use active coping, tended to use even less active coping over time in higher stress environments. In contrast, at lower levels of risk, children high in negative emotionality increased their use of active coping. Probing the interaction effect of cumulative risk and effortful control on changes in active coping demonstrated that the slope of low effortful control was significant ($b = -0.681$, $p = 0.041$), but the slope of high effortful control was not significant ($b = 0.561$, $p = 0.092$). In children who were low in effortful control, children's level of active coping decreased as their level of risk increased. In contrast, though the slope was only trending toward significance, for children who were high in effortful control, their use of active coping tended to increase as their level of risk increased.

Regression analyses predicting avoidant coping revealed direct effect of cumulative risk ($\beta = .27$, $p = .015$), but not temperament on changes in avoidant coping. The interaction of cumulative risk and negative emotionality did not predict rank order changes in avoidant coping. However, the interaction

of cumulative risk with effortful control did (Table 3). Probing the interaction demonstrated that the slope of high effortful control was significant ($b = 0.598, p = 0.000$), but the slope of low effortful control was not significant ($b = -0.178, p = 0.280$). In children who were high in effortful control, children's level of avoidant coping increased (controlling for initial levels) as their level of risk increased, whereas no rank order changes in use of avoidant coping, were found for children who were low in effortful control, depending on level of risk. Considering that children who are high in effortful control reported using more active coping relative to avoidant coping overall, this finding suggests that children with high effortful control, who generally use less avoidant coping, increase their use of avoidant coping at higher levels of cumulative risk.

Discussion

This study investigated the moderating effect of children's individual differences in negative emotionality and effortful control on the relation between early cumulative risk exposure and preadolescents' use of appraisal and coping strategies. Though appraisal and coping strategies have been implicated as critical mediators of the effect of early accumulated stress experiences, little is known about how early stress experiences may shape the development of appraisal and coping in preadolescence, and even less is known about how individual differences might confer or mitigate the effect of risk on these strategies. Using longitudinal data, this study hypothesized that negative emotionality would exacerbate the effects of cumulative risk on threat appraisal and avoidant coping, and effortful control would mitigate the effects of cumulative risk on threat appraisal and avoidant coping. In addition, it was hypothesized that relations would emerge between cumulative risk and positive appraisal and active coping, where direct associations were not found in a previous study of this same sample, when temperament was examined as a moderator of those effects. Consistent with prior research, concurrent ratio score analyses demonstrated that overall, cumulative risk was associated with greater use of threat appraisal (relative to positive appraisal) and avoidant coping (relative to active coping), children with greater negative emotionality were more likely to use threat appraisal (relative to positive appraisal) and avoidant coping (relative to active coping), and children with greater effortful control were more likely to use positive appraisal (relative to threat appraisal) and active coping (relative to avoidant coping). However, differential relations emerged when cumulative risk and temperament, and their

interactions, were examined as predictors of relative changes in specific appraisal and coping strategies over time.

Tests of direct effects of cumulative risk predicting relative changes in specific appraisal and coping strategies revealed that while exposure to cumulative risk is deleterious, it may not be deterministic with respect to the future use of cognitive self-regulation strategies in preadolescence. This study found a direct effect of cumulative risk predicting greater use of avoidant coping over time. However, no other direct, prospective effects of cumulative risk predicting positive appraisal, threat appraisal, or active coping were found. Previous findings in this sample using a different statistical model demonstrated multiple concurrent relations between cumulative risk, appraisal, and coping, but only one prospective direct effect of cumulative risk predicting threat appraisal (Thompson et al., 2015). Therefore, the combination of previous and current findings suggests that while cumulative risk may impact children's concurrent use, and occasionally predict children's future use, of threat appraisal or avoidant coping, it does not predict changes in positive appraisal and active coping strategies in preadolescence. That is, even in the face of cumulative risk, children's positive appraisal and active coping might remain intact rather than decrease. Importantly, moderation analyses suggest that cumulative risk may have a predominantly interactive, as opposed to direct effect, when modeled with individual differences in temperament across time.

Indeed, children's individual differences in temperament may determine whether or not cumulative risk impacts the future use of appraisal and coping in preadolescence. A previous study in this sample found a direct, prospective effect of effortful control such that children with more regulated temperaments (i.e., greater effortful control) tended to use less threat appraisal over time, thereby implicating effortful control as protective factor against the prospective use of threat appraisal. However, similar to cumulative risk, no other direct, prospective effects of effortful control predicted the use of positive appraisal, active coping, or avoidant coping over time (Thompson et al., 2014). Nor did negative emotionality predict the use of any appraisal or coping strategies over time. The few observed direct effects of cumulative risk and temperament suggest that their relations with coping might be more complicated and dependent upon each other.

In fact, several significant interaction effects suggest that the effect of cumulative risk on changes in children's appraisal and coping are dependent on their temperament characteristics. First, effortful control appeared to operate as a protective factor in higher risk contexts, promoting greater use of positive appraisal. While cumulative risk did not directly affect change in positive appraisal, it operated on change in positive appraisal across varying levels of effortful control. Second, children who were lower in effortful control tended to use less active coping strategies in higher risk contexts. Thus, effortful control may be a potential resource for children to maintain the use of active coping strategies to deal with the increasing demands of higher risk contexts. Third, it appears that in higher risk contexts, children with high effortful control also tended to engage in more avoidant coping strategies over time. Though this finding appears contradictory to study hypotheses, it must be interpreted in context. Overall, children who are high in effortful control generally used more active coping relative to avoidant coping. Thus, in high risk contexts children who were higher in effortful control were using more of *every* coping strategy over time. Fourth, negative emotionality appears to exacerbate the effect of cumulative risk on active coping, such that children with higher negative reactivity tended to use even less active coping one year later in higher stress environments. On the contrary, at lower levels of risk, children high in negative emotionality increased their use of active coping. This is perhaps because even in a low stress context, their own heightened negative emotionality creates emotional distress and increases their need for additional coping.

Notably, a lack of moderation predicting threat appraisal suggests that threat appraisal may be a better reflection of concomitant environmental and intra-individual stressors as opposed to the result of the interaction of these stressors over time. This may be because a style of threat appraisal has already formed by preadolescence, making it more dispositional and, therefore, less malleable or susceptible to the effects of cumulative risk. Moreover, negative emotionality did not appear to interact with cumulative risk to predict threat appraisal, positive appraisal, or avoidant coping. Promisingly, this would suggest that despite reliably predicting adjustment problems in preadolescence, negative emotionality does not additionally exacerbate the effect of cumulative risk on threat appraisal and avoidant coping (Lengua, 2006).

There are several strengths of this study, including the use of a longitudinal design and relatively large sample with substantial variation in cumulative risk. However, some limitations of this study are acknowledged. First, one must be careful not to extrapolate the current study findings on coping as multiple taxonomies of coping exist in the literature. In our study, it reasonable to make comparisons between active coping and engagement coping as well as avoidant coping and disengagement coping. However, primary versus secondary control coping, which have been extensively studied in the literature, are both subsumed into the active coping construct in this study (Compas et al., 2017). Given extensive literature on primary and secondary control coping, future research should attempt to differentiate their distinct relations to risk and temperament as well. Second, the present study relied on questionnaire data, which could result in measurement bias although there is strong evidence to suggest that questionnaire data reliably measure children's coping (Compas et al., 2017). Multiple informants (i.e., mother and child) were used to reduce its impact. A novel contribution to the literature provided by the present study was the use of ratio scoring in the analysis of appraisal. Although ratio scoring, sometimes referred to as proportion scoring, has been used to analyze coping, no other study to our knowledge has applied this method to appraisal. Arguably, ratio scoring provided important context for the interpretation of moderation analyses and is recommended for further research.

Overall, the present study has made gains toward realizing how children and adolescents cope with chronic adversity as well as the environmental-individual transactional process. Present study findings help to elucidate how exposure to an accumulation of risks do in fact interact with temperament to shape the development of appraisal and coping in preadolescence. Further, they provide implications for interventions aimed at thwarting the effects of cumulative risk on child development. An important future direction will be to examine whether these developmental effects of cumulative risk and temperament on appraisal and coping predict children's adjustment outcomes and whether the changes in appraisal and coping can be determined to reflect adaptive or vulnerability processes.

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Table 1 Descriptive statistics for variables included in this study

	Mean	SD	Range
Sex	1.47	.50	1.00 - 2.00
Age	9.63	.97	7.80 - 12.00
Risk (T1)	-.03	5.27	-9.68 - 18.52
PosApp (T1)	21.22	7.70	0.00 - 37.00
ThtApp (T1)	9.74	7.06	0.00 - 34.00
ActCop (T1)	39.11	13.69	4.00 - 69.00
AvdCop (T1)	18.58	6.53	1.00 - 36.00
PosApp (T2)	19.45	8.11	1.30 - 37.70
ThtApp (T2)	6.56	6.42	0.00 - 28.36
ActCop (T2)	38.42	14.41	0.00 - 72.00
AvdCop (T2)	16.99	6.96	2.00 - 36.00
NegEm (T1)	22.62	3.34	12.25 - 30.80
EffCon (T1)	28.80	3.88	14.50 - 37.25

Note. Risk= cumulative risk; PosApp= positive appraisal; ThtApp= threat appraisal; ActCop= active coping; AvCop= avoidant coping; (T1)=Time 1; (T2)=Time 2. N = 316. * $p < .05$ ** $p < .01$. Two-tailed. Values are based on observed data (not estimated)

Table 2. Correlations among study variables

	Sex	Age	Risk (T1)	PosApp (T1)	ThtApp (T1)	ActCop (T1)	AvdCop (T1)	PosApp (T2)	ThtApp (T2)	ActCop (T2)
Sex	1	-	-	-	-	-	-	-	-	-
Age	.08	1	-	-	-	-	-	-	-	-
Risk (T1)	.05	-.09	1	-	-	-	-	-	-	-
PosApp (T1)	.05	-.11*	.11	1	-	-	-	-	-	-
ThtApp (T1)	-.04	-.10	.32**	.30**	1	-	-	-	-	-
ActCop (T1)	.07	-.06	.03	.73**	.14*	1	-	-	-	-
AvdCop (T1)	.07	-.22**	.23**	.50**	.43**	.57**	1	-	-	-
PosApp (T2)	-.10	-.05	.11	.28**	.11	.25**	.15*	1	-	-
ThtApp (T2)	.05	-.08	.16*	.12	.40**	.02	.14	.16*	1	-
ActCop (T2)	-.07	-.03	-.05	.31**	.11	.32**	.13	.70**	.20**	1
AvdCop (T2)	-.01	-.12	.20**	.10	.32**	.07	.26**	.41**	.50**	.50**
NegEm(T1)	-.05	-.11*	.35**	.09	.40**	-.02	.33**	-.00	-.03	-.03
EffCon(T1)	-.08	.01	-.24**	-.04	-.31**	.09	-.12*	.06	.07	.07

Note. Risk= cumulative risk; PosApp= positive appraisal; ThtApp= threat appraisal; ActCop= active coping; AvdCop= avoidant coping; (T1)=Time 1; (T2)=Time 2. $N = 316$. * $p < .05$ ** $p < .01$. Two-tailed.

Table 3. Regression models for Positive Appraisal

Measurement	Concurrent T1 Positive Appraisal				Prospective T2 Positive Appraisal			
	B	SE	β	P	B	SE	β	P
Risk	.09	.09	.06	.295	.20	.13	.13	.121
NegEm	.20	.14	.09	.139	-.06	.20	-.03	.749
Risk*NegEm	.01	.03	.03	.563	-.06	.04	-.14	.114
Risk	.14	.08	.10	.096	.18	.12	.10	.156
EffCon	-.04	.12	-.02	.714	.05	.18	.02	.775
Risk*EffCon	.02	.02	.06	.327	.07	.04	.15	.053

Note. Covariates: Child Sex, Age, T1 outcome (in prospective analyses only). B=unstandardized beta; SE=standard error; β =standardized beta; p=significance level; Risk=cumulative risk; NegEm=negative emotionality; EffCon=effortful control. All terms centered. *N* = 311.

Table 4. Regression models for Threat Appraisal

Measurement	Concurrent T1 Threat Appraisal				Prospective T2 Threat Appraisal			
	B	SE	β	P	B	SE	β	P
Risk	.25	.07	.19	.001	.01	.10	.01	.904
NegEm	.73	.12	.34	.000	.18	.16	.09	.250
Risk*NegEm	.03	.02	.08	.135	-.00	.03	-.01	.953
Risk	.34	.07	.25	.000	-.01	.10	-.00	.953
EffCon	-.54	.10	-.28	.000	-.21	.14	-.21	.006
Risk*EffCon	.01	.02	.01	.818	.04	.03	.11	.143

Note. Covariates: Child Sex, Age, T1 outcome (in prospective analyses only). B=unstandardized beta; SE=standard error; β =standardized beta; p=significance level; Risk=cumulative risk; NegEm=negative emotionality; EffCon=effortful control. All terms centered. *N* = 311.

Table 5. Regression models for Active Coping

Measurement	Concurrent T1 Active Coping				Prospective T2 Active Coping			
	B	SE	β	P	B	SE	β	P
Risk	.01	.16	.01	.931	-.04	.23	-.01	.861
NegEm	.04	.25	.01	.865	.20	.35	.05	.561
Risk*NegEm	.06	.05	.08	.179	-.14	.07	-.14	.051
Risk	.11	.15	.05	.443	-.06	.22	-.02	.786
EffCon	.34	.21	.09	.113	-.12	.32	-.03	.701
Risk*EffCon	.00	.04	.01	.936	.16	.06	.20	.010

Note. Covariates: Child Sex, Age, T1 outcome (in prospective analyses only). B=unstandardized beta; SE=standard error; β =standardized beta; p=significance level; Risk=cumulative risk; NegEm=negative emotionality; EffCon=effortful control. All terms centered. *N* = 311.

Table 6. Regression models for Avoidant Coping

Measurement	Concurrent T1 Avoidant Coping				Prospective T2 Avoidant Coping			
	B	SE	β	P	B	SE	β	P
Risk	.14	.07	.11	.052	.27	.11	.18	.015
NegEm	.58	.11	.29	.000	-.03	.18	.00	.865
Risk*NegEm	-.01	.02	-.02	.776	-.06	.04	-.12	.094
Risk	.22	.07	.18	.001	.21	.11	.16	.042
EffCon	-.22	.10	-.13	.023	-.23	.15	-.12	.124
Risk*EffCon	.03	.02	.07	.188	.10	.03	.25	.001

Note. Covariates: Child Sex, Age, T1 outcome (in prospective analyses only). B=unstandardized beta; SE=standard error; β =standardized beta; p=significance level; Risk=cumulative risk; NegEm=negative emotionality; EffCon=effortful control. All terms centered. *N* = 311.

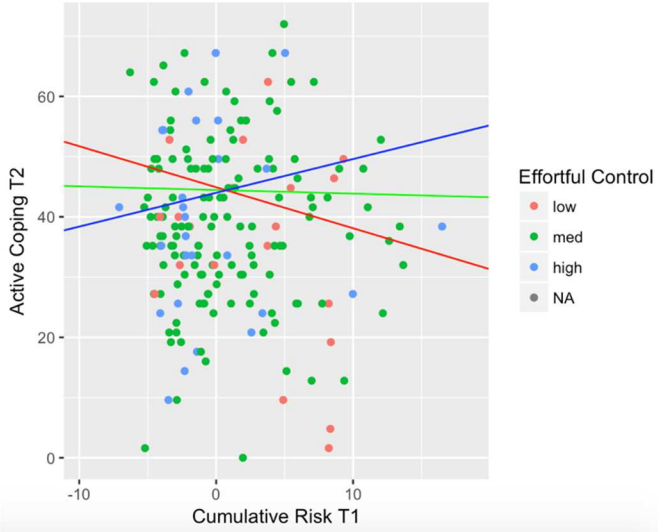
Table 7. Regression models for Appraisal Ratio (Positive/Threat Appraisal)

Measurement	Concurrent T1 Appraisal Ratio			Prospective T2 Appraisal Ratio		
	β	SE	P	β	SE	P
Risk	-.11	.06	.072	-.07	.09	.485
NegEm	-.22	.06	.000	-.13	.09	.121
Risk*NegEm	.04	.06	.483	-.137	.10	.148
Risk	-.15	.06	.009	-.10	.09	.286
EffCon	.12	.06	.045	.12	.09	.185
Risk*EffCon	-.043	.06	.455	.06	.09	.537

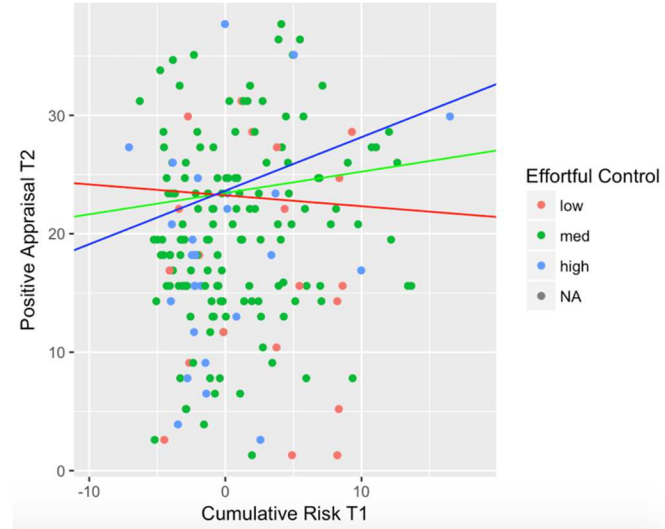
Note. Covariates: Child Sex, Age, T1 outcome (in prospective analyses only). B=unstandardized beta; SE=standard error; β =standardized beta; p=significance level; Risk=cumulative risk; NegEm=negative emotionality; EffCon=effortful control. All terms centered. $N = 311$.

**higher scores indicate greater use of active coping, lower scores indicate greater use of avoidant coping*

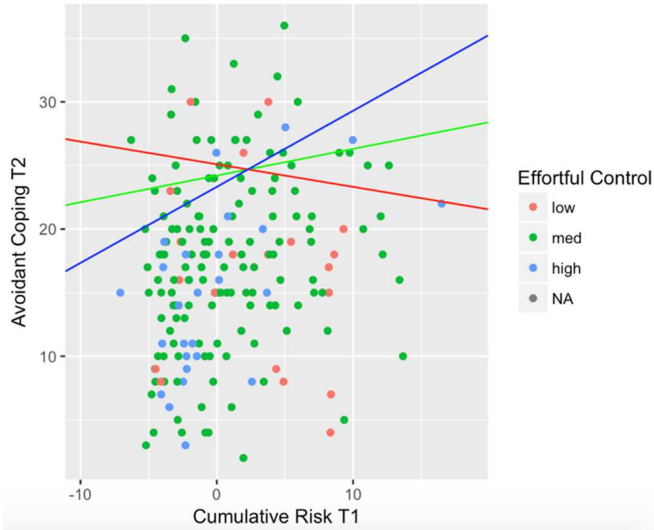
Active Coping Interaction Plot



Positive Appraisal Interaction Plot



Avoidant Coping Interaction Plot



Active Coping Interaction Plot

