The Pennsylvania State University

The Graduate School

College of the Liberal Arts

UNDOING THE DAMAGE OF CHRONIC, UNCONTROLLABLE STRESS: BUILDING A STRONG IDENTITY AND COPING SKILLS

A Dissertation in

Psychology

by

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Submitted in Partial Fulfillment
of the Requirements
for the Degree of

Doctor of Philosophy

August 2018

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Abstract

This study examined how coping (i.e., fleeing and rumination) mediates the relationship between exposure to violence and cortisol stress response in adolescents who are exposed to uncontrollable stress. Additionally, this study examined if the Building a Strong Identity and Coping Skills (BaSICS) intervention, a theoretically grounded intervention designed to improve outcomes for youths who are exposed to high levels of uncontrollable stress, can help normalize their HPA stress response. The exposure to uncontrollable stress has been found to be correlated with how one responds behaviorally and physiologically. Behaviorally, fleeing from a problem and ruminating about the problem are two coping strategies that youths typically use when exposed to uncontrollable stress. Physiologically, it has been found that youths exposed to chronic and uncontrollable stressor tend to have hypo-active cortisol stress response within the hypothalamic-pituitary-adrenal (HPA) axis. However, less is known about how these two mechanisms (HPA and coping) relate to each other and is, thus, explored in this paper. Fifty diverse 5th and 6th graders (M_{age} = 11.28 years, SD = 1.08, Female 61%, 60.4% non-Hispanic African American and 33.3% Hispanic) participated in this study. Participants came from families who had low incomes (median income = $17,540 and 84% received SNAP) and reported high levels of uncontrollable stress: 97% of the sample was exposed to either community violence, physical violence in home or chaos in the home. Results confirmed that a majority of the youths had a hypo-active HPA response. In addition, that the association between exposure to violence and a hypo-active cortisol response was mediated by fleeing from the stressor and ruminating about the problem. Lastly, a post-intervention increase in engagement coping strategies was found to be associated with an increased cortisol response in the reactivity phase of the TSST. These findings are discussed in terms of how socio-emotional interventions like BaSICS can address the adverse effects poverty has on individual and community functioning.

Keywords

Coping
Hypo-active cortisol response
hypothalamic-pituitary-adrenal (HPA) axis
Socio-emotional intervention
Youth empowerment
Collective Coping
Identity Development
Trier Social Stress Task (TSST)
Exposure to Violence
Uncontrollable Stress

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Introduction

Adolescents growing up in urban poverty face an onslaught of stress in their homes, schools, and neighborhoods with which they are developmentally unprepared to cope (Davidson & McEwen, 2012). Chronic and uncontrollable environmental threat in the absence of effective coping is consequentially associated with poor adjustment (Odgers & Jaffee, 2013). Chronic stress exposure, particularly exposure to violence, also interferes with the development of adaptive self-regulation and coping skills, and contributes to dysregulation of the psychobiological stress response including the hypothalamic-pituitary-adrenal (HPA) axis (Wadsworth, 2015). Dysregulated stress responsivity and maladaptive coping repertoires serve as proximal mechanisms of uncontrollable stress' pernicious effects on adolescent health and well-being. As such, youths exposed to chronic uncontrollable stress are at much greater risk for developing psychopathology than their peers (Wadsworth, Evans, Grant, Carter, & Duffy, 2015).

Because standard ways of coping are not as effective for chronic, uncontrollable stress as for other types of stress, youths exposed to high levels of uncontrollable stress often find alternative ways to cope where they often flee from the problem by engaging in substance use, risk-taking behaviors, and illegal activities (Pokhrel et al., 2013). These behaviors, considered negative outcomes in their own right, can also place a child at heightened risk for more negative outcomes and do not directly resolve the problem. Thus, they would be more prone to ruminate about it. According to the Allostatic Load model, an interaction of chronic stress, genetics and social context leads to the risk for a multitude of psychological problems for youths exposed to high stress environments (Juster et al., 2011). Thus, living with chronic uncontrollable stress can lead to a multifinality of outcomes ranging from internalizing (such as PTSD and depression) to externalizing problems (such as ADHD and problems with aggression). Poverty related stress,

for example, is associated with anxiety, depressive symptoms, delinquency, attention problems and somatic complaints for low-income youth living in an urban environment (Santiago, Wadsworth, & Stump, 2011). Thus, efforts to prevent the development of psychopathology for at risk youths cannot only focus on one disorder or clinical outcome, but should rather focus on mechanisms that underlie risk and resilience, such as coping and self-regulation. Such skills and abilities can help develop resilience for multiple psychological problems that could otherwise stem from societal inequalities. Interventions which bolster at-risk young adolescents' ability to cope with both tolerable and uncontrollable stress and repair the damaged HPA and related systems may represent the best proximal route to preventing serious mental and physical health problems (Shonkoff, Boyce, & McEwen, 2009). Hence, the overarching goal of this project is to evaluate the efficacy of a new preventive intervention designed to teach efficacious coping and promote healthy HPA responsivity in young adolescents facing very high levels of chronic, uncontrollable stress and to test the main tenets of the updated Adaptation to Poverty-related Stress theoretical model (Wadsworth, Ahlkvist, McDonald, & Tilghman-Osborne, In Press), which underlies the intervention.

While a growing evidence base supports the link between chronic, uncontrollable stress and a damaged HPA stress response, and a robust literature links "maladaptive" coping to uncontrollable stress, less is known about how these two mechanisms (HPA and coping) are related to each other. Further, while it has been shown that improving coping skills can decrease symptoms of psychopathology, it is yet unknown if expanding and enhancing a youth's coping repertoire can have beneficial effects on the dysregulated HPA stress response. Thus, the overarching goal of this study is to examine the relation between exposure to violence, coping and HPA stress response, which was done in three specific aims. First, this study examined the

HPA stress response for youth exposed to high levels of community violence (an example of chronic, uncontrollable stress). Next, this study examined how coping (i.e., fleeing and rumination) mediated the relation between exposure to violence and HPA stress functioning. Lastly, this study tested the extent to which coping improvement (re)mediates the effect of the intervention on changes in the HPA stress response. Figure 1 illustrates how coping theoretically mediates the relation between high levels of violence and damage to the HPA stress response. Figure 2 shows how the intervention targeting coping will affect HPA responsivity via changes in coping.

Uncontrollable Stress: Violence and HPA Dysregulation

Exposure to chronic, uncontrollable stress—particularly violence—can lead to dysregulation in the HPA, which orchestrates responses during threatening encounters (e.g., Del Giudice, Ellis, & Shirtcliff, 2011). As such, the HPA stress response has been found to be an important mechanism that helps explain the link between stress and psychopathology (Dougherty, Tolep, Smith, & Rose, 2013). Poverty-related stress, which often includes high levels of exposure to violence, appears to have a particularly strong negative effect on a child's developing stress response system. Decades of research have demonstrated that the relation between stress and psychopathology starts in childhood and that this association results at least in part from damage to the physiologic stress response system caused by chronic stress exposure (Thoits, 2010). Exposure to uncontrollable stress can cause the HPA axis to be hyper-activated (elevated reactivity to threat or inability to down-regulate post-threat) or hypo-activated (little activity when a stress response would be appropriate; e.g., Booij, Bouma, de Jonge, Ormel, & Oldehinkel, 2013). While the HPA axis can be either or hyper and hypo-activated due to exposure to uncontrollable stress, there is mounting evidence that youths exposed to high levels

of chronic, uncontrollable stress (such as exposure to violence), tend to have a hypo-activated response (see Chen & Paterson, 2006; Kliewer, 2006; MacMillan et al., 2009; Ouellet-Morin et al., 2011). It is proposed that chronic stress wears down the HPA stress response so much that youths are no longer able to mount an appropriate HPA axis response when exposed to a stressor (Brenner, Zimmerman, Bauermeister, & Caldwell, 2013). Thus, based on the existing literature, the following is hypothesized:

Hypothesis (1a): Participants in this study will present with a hypo-active cortisol response pattern.

Hypothesis (1b): This hypo-active cortisol response pattern will be related to participants' exposure to violence.

Coping Mediating the Relation between Exposure to Violence and HPA Dysregulation

Youths exposed to violence tend to have a dysregulated HPA response and are inclined to utilize more maladaptive coping strategies. However, research documenting an association between HPA stress responding and adolescent coping behaviors is scarce. The limited research that does currently exist demonstrates that this link is feasible, both theoretically and empirically (Bendezú, Perzow, & Wadsworth, 2016; Wadsworth et al., 2016). The Adaptive Calibration Model (ACM; Del Giudice et al., 2011) helps explain how youths physiologically and behaviorally respond to stress across different contexts (e.g., contexts with and without uncontrollable stress, such as violence). ACM argues that the Stress Response System coordinates the individual's physiological response to physical and psychosocial challenges, encodes and filters environmental information, and helps regulate an organism's physiology and behavior across contexts. Particularly relevant to this study, this theory argues that an individual's behavioral and/or cognitive coping with a stressor should map onto their physiologic

response. Further, ACM suggests that individuals learn to adapt coping styles (both behaviorally and physiologically) that optimize survival in their environment, and therefore that 1) environmental stress will be associated with particular types of coping, and that 2) coping styles will be associated with specific physiological response patterns.

Uncontrollable Stress: Violence and Coping. In general, how youths respond to stress has important implications for understanding the development of psychopathology (Odgers et al., 2013). Within this framework, engagement and disengagement coping are two broad categories of coping strategies that are particularly salient for how youths manage stress (Connor-Smith, Compas, Wadsworth, Thomsen, & Saltzman, 2000). Engagement strategies are either aimed at directly engaging with the stressor or one's own response to the stressor (e.g., through active problem solving, emotion regulation and expression). Whereas engagement strategies focus on engaging with the stressor, disengagement coping includes strategies to avoid the stressor by using denial, cognitive and behavioral avoidance and wishful thinking. While engagement strategies have been shown to be effective for coping in less threatening situations, emerging research has begun to show that youths exposed to violence tend to use a coping repertoire that is reliant on fleeing (type of disengagement coping) and rumination (involuntary engagement) instead.

Fleeing. Disengagement coping (e.g., fleeing) is generally associated with poorer functioning in many (Wadsworth & Compas, 2002), but not all contexts. For example, fleeing has been found to be protective for youths exposed to violence (Edlynn, et al., 2008) and marital conflict (O'Brien & Margolin, 1995). Thus, exposure to violence can interfere with the development of coping skills that are adaptive in a variety of contexts (Wadsworth, Raviv, Compas, & Connor-Smith, 2005). It is argued that uncontrollable stress drains resources and

constrains the development of active engagement coping strategies in particular, and leads to greater reliance on avoidance, such as fleeing from the violent act. Avoidant coping can be adaptive in highly stressful, dangerous environments, but is not effective in less threatening contexts (Wadsworth, Raviv, Santiago, & Etter, 2011). Further, when youths flee from a less threatening stressor, they often fail to successfully resolve the situation.

Rumination. Rumination is the psychological phenomenon in which one continually thinks about a stressor and has difficulty shifting from the worry. This has been found to be a strategy that many youths use when they are unable to resolve a stressor effectively using more active means (Burwell & Shirk, 2007). Ruminative youths report higher levels of psychopathology than their peer counterparts who do not ruminate (Compas et al., 2014). Thus, exposure to violence may be associated with using both fleeing and rumination. Adolescents facing the uncontrollable stress of violence therefore, tend to be ill-equipped to cope with the full array of stressors—both tolerable and intolerable—that they will encounter in life. Based on this existing literature, the following is hypothesized:

Hypothesis (2): Youths' exposure to high levels of violence will be associated with using more fleeing and rumination coping strategies.

Coping and Physiological Stress Response. Research on the physiological stress response system has predominantly focused on how types of stressors shape the physiological stress response [see review for Gunnar & Quevedo (2007)] and little research has focused on the relation between coping and physiological stress response**.** However, extant research has documented the possible association between coping style and physiological stress response. For example, engagement and disengagement coping styles have been found to have distinct physiological responses [i.e., through cognitive appraisals, (Kemeny, 2003) and in animal

models (Wood & Bhatnagar, 2015)]. Currently, due to refined measurement of the in-vivo physiological stress response, converging research has shown the importance of examining the physiological stress response at both the time of the stressor (i.e., reactivity phase) and the time following the stressor (i.e., recovery period) because of their distinct patterns and the accompanying underlying processes. The reactivity phase includes the time when an individual is actively exposed to a stressor and is typically captured by the physiologic response between baseline and peak response, whereas the recovery phase is the time following a stressor, captured by the response from peak back to baseline.

Reactivity Phase. Broadly speaking, to successfully manage an acute stressor (i.e., during the reactivity phase), there must be an effective cortisol response (Buchanan, Laures-Gore, & Duff, 2009). The cortisol response appears to be related to cognitive functions that support effective coping. For example, a cortisol response was found to be associated with better memory during a stress task for both adults (Nater et al., 2007) and children (Quas, Yim, Edelstein, Cahill, & Rush, 2011). The link between HPA and engagement coping is further validated by neuropsychological research showing that the Prefrontal Cortex (PFC) is a critical area of the brain for problem solving (i.e. type of engagement coping) and physiologically responding to stress through the HPA axis (Gunnar & Quevedo, 2007). There is PFC activation during both engagement coping and activation of the HPA axis (i.e., increases in cortisol) in response to acute stress. This suggests that active efforts to cope with a stressor may be accompanied by a cortisol response (see Gunnar et al., 2007).

Recovery Phase. As for the recovery phase following an acute stressor, there is emerging evidence that engagement coping is associated with more efficient post-stressor cortisol recovery. Research on coping in general has found that youths who are able to use more

engagement coping (e.g., learning from an experience rather than ruminating on it) have fewer symptoms of psychopathology (Compas et al., 2014). Further, lower levels of psychopathology have been linked with both an adequate cortisol response and efficient down-regulation (Jansen, Gispen-de Wied, Gademan, De Jonge, van der Linden, & Kahn, 1998; Jansen, Gispen-de Wied, & Kahn, 2000). Findings from a study of adult civil servants revealed that those who had more problem engagement and seeking social support (i.e., types of primary control coping) were able to down-regulate cortisol effectively across the day. In contrast, there were no significant down-regulation found for those who used avoidant coping styles (O'Donnell, Badrick, Kumari, & Steptoe, 2008). Even though the above-mentioned study focuses on adults and does not assess the acute stress response, it provides evidence suggesting that engagement coping may help regulate the HPA stress response across the day. As mentioned previously, youths exposed to high amounts of violence tend to use more fleeing and rumination strategies. In contrast to engagement coping, fleeing and rumination are also associated with a distinct HPA stress response, but in this case, with a hypo-cortisol response

Fleeing and Hypo-active Cortisol Response: There is mounting evidence showing a link between fleeing from a problem and not mounting a HPA response. For example, in a study of schizophrenic patients, participants who used more avoidant coping strategies during a public speaking task presented a hypo-active cortisol response (Jansen et al., 1998; Jansen et al., 2000). Accordingly, fleeing from a problem may circumvent activation of the HPA stress response, as suggested by research showing that when exposed to repeated psychosocial stress, the HPA stress response lessens while the sympathetic-adrenal-medullary (SAM) response remains activated (Schommer, Hellhammer, & Kirschbaum, 2003).

A hypo-active cortisol response is believed to stem from damage sustained by the HPA system from over-use (Ouellet-Morin et al., 2011). In addition, cortisol has been found vital in cognitive functioning and problem solving (Gunnar et al., 2007). As such, if youths have depleted cortisol levels and/or do not produce sufficient cortisol in response to a stressor, they could have reduced cognitive resources. This would have negative implications for their use of cognitively demanding engagement types of coping. Thus, the hypo-active HPA response may have a direct effect on the type of coping that is available to an individual. Preliminary evidence to support this claim comes from a study of women who reported high levels of internalized racism (i.e., an example of violence in the form of micro-aggressions). These women had diminished HPA response (i.e., a smaller change in cortisol levels from morning until night) and high levels of avoidance coping, such as fleeing (Tull, Sheu, Butler, & Cornelious, 2005). When these women do not have a strong cortisol response during the reactivity, there would be little cortisol to regulate during the regulation phase. Thus, the relation between fleeing from a problem and HPA stress response is predicted to be most pronounced during the reactivity phase of the stress response and not during the recovery phase. It is predicted that participants who report fleeing from a problem will have less HPA reactivity.

Rumination and HPA Recovery. In general, youths who utilize disengagement coping often have difficulty resolving the stressor, which in turn, can prolong the effects of the stressor. For example, Burwell and Shirk (2007) found that adolescents who used fleeing as a coping strategy also tended to ruminate more about a stressor. Thus, when adolescents use disengagement coping, they may have difficulty down-regulating their HPA stress response. In fact, this very pattern emerged in an experimental study of preadolescents, where those who used more disengagement coping strategies regulated cortisol more slowly and less efficiently after a

laboratory stressor compared to those who used less disengagement strategies (Wadsworth et al., 2016). However, given that the current sample was exposed to very high levels of violence and is therefore likely to have a depleted/hypo-active HPA stress response as argued above, we hypothesize that children in this study may have less cortisol to down-regulate during the regulatory phase following the acute stressor. Consequently, for youths who use fleeing and rumination coping strategies, there may not be enough of a cortisol response to illuminate differences of cortisol regulation during the recovery phase.

The research reviewed above provides evidence of a link between fleeing and rumination with a hypo-active HPA stress response. Unfortunately, this collection of studies is very limited in terms of generalization. First, these studies have largely focused on adult populations (for exception, see Wadsworth et al, 2016) and the link has yet to be vigorously tested in younger populations exposed to violence. This is important because adolescence is a sensitive developmental period characterized by increased demands, challenges, and stressors as well as continued development and refinement of coping, self-regulation, and the physiologic stress response system (Seiffge-Krenke, Aunola, & Nurmi, 2009; Stroud et al., 2009). Consequently, adolescence is a time of increased risk for damage to self-regulation systems as well as an opportunity for positive development of these systems (Steinberg, 2014). Secondly, these studies have tended to focus on diurnal cortisol responses, and less is understood about how youths, and more specifically, youths exposed to high levels of chronic stress, respond to acute stressors. Thus, this study adds to our understanding of how youths' coping style maps onto their physiological response and explores how chronic stress can interfere with this psychobiological system. Based on the existing theory and research, the following is hypothesized:

Hypothesis (3): More fleeing and rumination coping will be associated with a hypo-active HPA stress response.

Malleability of HPA Stress Response through Coping Modification

Without direct experimentation, it is difficult to assess the directionality of the relation between coping and HPA response. In other words, maladaptive coping strategies and HPA dysregulation may be correlated because they are equally influenced by external factors, such as uncontrollable stress. As mentioned previously, uncontrollable stress is correlated significantly with both maladaptive coping (i.e., fleeing and rumination) and HPA dysregulation. To test the direct link between coping and HPA dysregulation, an experimental or quasi-experimental design is needed—ideally either coping or HPA stress response needs to be manipulated to see how the other responds. For this study, we focus on manipulating youths' coping response by teaching them effective engagement coping strategies. Thus, we will be able to test 1) if youths exposed to uncontrollable stress can learn engagement coping skills within a non-life-threatening context and 2) if use of these strategies subsequently affects the child's HPA stress response.

Again, both theory and emerging evidence support the proximal link between HPA stress response and coping. First, according to ACM, the physiologic stress response system adapts to environmental circumstances—unfortunately much of the research on the adaptability of the stress response has focused on young adult populations. There is empirical evidence that young adults who were more engaged in a stress task and had more internal awareness of their performance did better on an academic task than those who reported less engagement during a laboratory stress task (Werner, Duschek, Mattern, & Schandry, 2009). Further, those who actively engage in problem-solving reported less anxiety compared to those who did not use engagement coping strategies (Creswell, Pacilio, Lindsay & Brown, 2014; Werner et al., 2009).

This suggests that more effective coping during a stress task is linked to a more regulated stress response, at least in young adults. Again, the generalizability of these studies is limited—this type of work is needed for younger populations and will ideally entail directly measuring the HPA stress response after coping strategies are taught.

Therefore, to examine the link between coping and HPA response, the study uses preliminary outcome data from a new multi-level intervention that is specifically designed to repair the damaged HPA stress response in youths exposed to chronic, uncontrollable stress. Specifically, the Building a Strong Identity and Coping Skills (BaSICS) program was created for 10 to 12-year-old youths and developed from three key theoretical frameworks (i.e., Adaptation to Poverty-Related Stress model, social identity complexity and social justice education). First, the Adaptation to Poverty-Related Stress model (APRS; Wadsworth et al., 2013) guided the selection of foundational coping skills, which children can utilize to address controllable stress, and upon which complex approaches for coping with uncontrollable stress can be built. Accordingly, both primary and secondary control coping skills—shown to be effective for adolescents coping with poverty-related stress as described above —are taught. Youths exposed to uncontrollable stress would likely benefit from interventions that 1) are aimed at repairing the HPA stress response and 2) use expanded curriculum that focuses dealing with uncontrollable stress specifically. APRS addresses this need by including themes of uncontrollable stress (e.g., exposure to violence) and how to match appropriate coping strategies with situations. For example, using engagement coping when faced with an academic stressor and using disengagement coping when faced with a violent situation demonstrates the use of coping-context matching. In addition to these foundational skills, both social identity complexity and

social justice education are also two domains that have been found to be effective in buffering youths against the negative effects of uncontrollable stress.

Social identity complexity is based on the complementary ethnic identity and social identity models (Killen & Smetana, 2010; Zimmerman et al., 2013), which emphasize adolescent identity development as a resource for overcoming uncontrollable stress stemming from social inequality. There is ample research that shows individuals' positive view of their social (including racial and ethnic) identity and internalized awareness of both social inequality and their unique cultural heritage can buffer youths from the adverse effects of uncontrollable stress. This is shown explicitly for African American (Stevenson, Reed, Bodison, & Bishop, 1997) and Hispanic youths (Romero & Roberts, 2003). However, social identity extends beyond that just of racial and ethnic identity. Identifying with the many prosocial values of a working class social identity is also associated with positive outcomes. Though this source of positive identity has received less attention in the psychological literature, it has also been argued to be protective for youths exposed to uncontrollable stress (Cohen & Varnum, 2016). Consistent with the basic research on the positive association of social identity development and prosocial outcomes, programs aimed at increasing positive identity have shown to be effective in increasing positive outcomes such as school engagement and reduced antisocial behavior (Oyserman, Harrison, & Bybee, 2001). To this end, the BaSICS program incorporated lessons around exploring and developing positive social identities as a strategy to overcome uncontrollable stress for youths from any cultural background.

Finally, BaSICS applies principles of social justice education, designed to "empower students to work toward societal transformation in and through their identities" (Hahn Tapper, 2013, p.427). As a group, participants learn to take action by identifying a problem or need in

their community and developing a community action project to address this need. It is emphasized that such "collaborative coping" is one way to address uncontrollable stress, especially that arising from racial and economic inequality (e.g., Nikitopoulos, Waters, Collins, & Watts, 2009). This is especially important for youths exposed to uncontrollable stress because much of the stress stems from larger societal problems (e.g., income inequality), and thus, it is difficult for one person to take on this stress alone. However, community and social action (i.e., what we term collaborative coping) has been shown to be an effective way to address uncontrollable stress and has been linked to more positive developmental outcomes (Ngwe, Liu, Flay, & Segawa, 2004). The BaSICS program incorporates collaborative coping by having participants identify a need in their community (e.g., an ugly, unsafe and abandoned lot) and develop a social action project to address this need. They are given $250 to problem-solve as a group to address the community need (e.g., adopting and cleaning an abandoned lot at making it available for public use). In this way, participants learn that coping solutions often require more than one person and that collectively they can take action to make things better for themselves and their community.

After the pre-assessment, all participants participated the BaSICS 16 session program intervention that met twice a week for 2 hours after school. It was led by two master-level facilitators and one bachelor-level helper. The program consisted of 3 major parts: coping skills, identity development and community coping, which had been carefully designed and are theoretically grounded (as described above). Each session was structured in the same manner. Youths come into the program and were given a snack for the first 20 minutes. During this time, facilitators oriented youths to session content and helped them finish their uncompleted worksheets from previous sessions. An icebreaker was then introduced signaling the start of the

session. The icebreaker was a fun game that introduces the topic of the session. This was followed by review of the out of group practice (i.e. worksheets that are done at home to practice session content). Subsequently; the content of the session was delivered, which was followed by an engaging activity (e.g., art project) that allowed youths to practice the new content. Lastly, there was a closing circle in which participants presented the work they have completed and discuss the out of group assignment. The session ended with a fun, light game.

Throughout all sessions, facilitators were prompted from the manual to give comprehension checks to the youths in order to ensure that participants understood the content. Further, the helper actively monitored positive youth behavior by tallying and giving specific praise to participants who contributed to the group in a positive manner. Throughout the program, youths were earning up to $250 per group by participating and completing out of group assignments. They used this money in the last part of the program to give back to the community in a meaningful way that has sustained change and overcame a larger community-based stressor. Thus, BaSICS brought together ideas, methods, and principles from multiple spheres of developmental science to help build resilience for youths facing uncontrollable stress. (For more information on the sessions of BaSICS, see Appendix). By helping youths develop active ways to cope with both tolerable and intolerable stress, it was hypothesized that the BaSICS intervention can help protect and repair the psychobiological stress response system after they have been exposed to uncontrollable stress. Specifically, the following is hypothesized:

Hypothesis (4a) Through the BaSICS intervention, young adolescents exposed to violence (i.e., uncontrollable stress) will acquire and be able to demonstrate more engagement coping strategies

Hypothesis (4b) Their cortisol patterns will change from pre-to-post to resemble a more typical physiologic stress response (e.g. increases in reactivity to and recovery from an experimental stressor would indicate less hypo-activation).

Hypothesis (4c) Coping skill acquisition will be associated with cortisol change.

Controls

Age. Developmental status of the youth has been found to be an important variable related to how young adolescents respond to stress, both behaviorally and physiologically. In general, there is compelling evidence that older youths compared to younger youths use more engagement strategies and they have a heightened cortisol in the TSST-C (Stroud et al., 2009). Specifically, the stress response system rapidly develops in puberty in which the HPA axis is a critical area of development and implicated in how adolescents respond to stress (Romeo, 2013). Specifically, the development of the Prefrontal Cortex (PFC) (associated with HPA axis) is critical in pubertal development because this corresponds with the development of the cognitive reappraisal system (McRae et al., 2011), a crucial system for the regulation of emotion. That is, the PFC has been implicated in youths' ability to successfully regulate affect so that they make "responsible" behavioral choices that are more similar to adult decision-making skills (Dahl, 2001). Thus, the major pubertal changes during adolescence are associated with developmental changes in the PFC, which differentiates children from adolescents (Casey, 2015). This corresponds with increases in adolescents' ability to effectively cope with stress (Maier, & Watkins, 2010). As such, age was included as a control variable.

Sex. Similarly, sex has been found to be an important variable in how youths perceive and handle stress both physiologically and behaviorally. For example, compared to males, female youths have a significantly higher cortisol response discussing covert risky problem

behaviors with caregivers (Kobak, Zajac, & Levine, 2009). Behaviorally, there also have been key differences found across sexes with female youths using more engagement coping strategies and male youths using more disengagement coping strategies (Eschenbeck, Kohlmann, & Lohaus, 2007). Given these associations, sex was included as a control variable.

Method

Participants

Fifth and Sixth graders (N=50, M_{age} = 11.28 years, *SD* = 1.08) from a low resource, urban, northeastern US city participated in this study. The majority of participants (61%) was female and was ethnically/racially diverse (60.4% non-Hispanic African-American, 33.3% Hispanic). Families had low incomes (e.g., median income = $17,540 and 84% received SNAP) and participants reported high levels of uncontrollable stress. A total of 97% of the sample was exposed to either community violence, physical violence in home or chaos in the home. More precisely, 87% exposed to community violence (e.g., hearing gun shots, being threatened, seeing someone threatened, having something stolen, being attacked or seeing someone attacked), 23% of the sample was exposed to physical violence in the home (e.g., witnessing family members hitting or hurting each other), and 89% of the sample was exposed to chaos in the home (e.g., family member dying, not having electricity, not able to buy food or moving homes).

Procedure

Participants were recruited via in-person contacts with research representatives who attended local community and school events, and via flyers and informational brochures distributed at child-serving agencies in the community. Interested families were contacted by program staff, screened for age and availability to attend the intervention, and scheduled for a

two-hour pre-assessment appointment during which they were consented for the study. Participants completed the Trier Social Stress Task (TSST; Buske-Kirschbaum et al., 1997), with a 40-minute baseline period (during which they completed self-report measures) followed by a 15-minute stressor task, a 10-minute coping period, a 10-minute coping interview, and a 20-minute relaxation period (See TSST timeline below). Participants and their parent were each paid $25 upon completion of the baseline assessment.

Figure 3. TSST Timeline

Following the initial assessment, youths participated in the 16 session BaSICS program over 8 weeks. After the intervention, participants completed a post-assessment appointment. There was a 10-week delay between pre and post-assessment, which has been shown to eliminate practice effects of the TSST (Petrowski, Wintermann, & Siepmann, 2012). Post-assessment followed the same procedure as baseline assessment.

Measures

Salivary cortisol. Seven saliva samples (T1-T3 = reactivity; T4-T7 = recovery) were taken via passive drool (Davis, Bruce, & Gunnar, 2002). To control for external factors that influence cortisol, participants were directed not to eat a large meal, eat dairy products, brush their teeth, or drink sugary beverages an hour before their appointment. All saliva samples were stored in a biomedical grade freezer prior to the analysis at the CORE Biomarker Lab at Penn State University. Cortisol levels were determined, with a detection levels in the range of 0.003 to 3.0 Kg/dL (range, 0.08Y82.77 nmol/L) using a commercial expanded-range high-sensitivity

enzyme immunosorbent assay kit (Lot #'s 1410510 and 1502503; Salimetrics, LLC, State College, PA).

Coping Skills Acquisition. The Coping Skills Scale (CSS) was used to assess acquisition of engagement coping skills (Raviv & Wadsworth, 2010). Participants' ability to remember and describe the problem-solving steps taught during the intervention was assessed. This is deemed an objective measure because youths either know or do not know the answer.

Response to Stress Questionnaire. The Responses to Stress Questionnaire (RSQ; Connor-Smith et al., 2000) was used to assess Fleeing and Rumination coping strategies. All items were rated on a Likert scale from 1 "*not at all*" to 4 "*a lot*". Ratio scores were calculated for each factor by dividing the sum of each factor by the total score. Adequate internal consistency was found at pre and post respectively for Fleeing ($\alpha = .67$; $\alpha = .53$) and Rumination ($\alpha = .71$; $\alpha = .86$).

Uncontrollable Stress: Exposure to Violence. The Multicultural Events Scale for Adolescents (MESA; Gonzales, Gunnoe, Samaniego & Jackson, 1995) was used to measure uncontrollable stress. The MESA was developed with adolescents of varying ethnicities including African American, European American and Mexican American (Gonzales et al., 1995). Adolescents answered whether events happened to them (0 = *no;* 1 = *yes*) in the past 6 months for the pre-assessment and since the BaSICS program for post-assessment. The MESA Violence/Personal Victimization scale was used to measure the amount of exposure youths had in their neighborhoods. For example, participants were asked if the following had ever happened to them: "You heard gun shots fired at your school or in your neighborhood, "You saw someone commit a crime (e.g., stealing, selling drugs, etc.) in your neighborhood", and "You were

physically attacked by someone not in your family." There was good internal consistency found for pre- and post-assessment ($\alpha = .65$; $\alpha = .65$).

Age. Age was calculated subtracting their date of testing from their date of birth.

Sex. Sex was coded 0 for males and 1 for females.

Missing Data. There was no missing data for pre-intervention data. As for post-intervention data, there was missing data for cortisol (7 participants missing), exposure to violence (39 missing), fleeing (19 missing), rumination (19 missing) and intervention engagement (18 missing). To note, there was a high missing number of follow-up to exposure to violence due to administration errors for the first 32 participants.

Analytic Plan

There were 3 main aims of this study. The first aim was to examine the HPA stress response for participants in a low resource urban setting and test if youths' exposure to violence was correlated with a particular HPA pattern. It was predicted to be a hypo-active cortisol response for this sample. The next aim of this study was to examine if youths' coping style, specifically fleeing and rumination, was significantly associated with their hypo-active physiological response. Lastly, the final aim of this study examined if youths could learn specific engagement coping strategies, and if these acquired coping strategies were consequently associated with a more regulated HPA stress response. An intent-to-treat approach was used in all analyses, wherein missing post-assessment scores were imputed using pre-assessment scores. Additionally, SPSS AMOS version 22 was used for all analyses.

The first aim of the study was divided into two objectives: 1) to test cortisol stress pattern for this population and 2) see if this pattern was associated with exposure to violence. As for the first objective, in order to categorize the typical HPA stress response in this sample, the average

cortisol output during both the reactivity and recovery phases was compared to a normative sample using the same TSST protocol (Stroud et al., 2009). To reduce statistical biases in the salivary cortisol data, outliers more than 3 SD from the mean were winsorized to 2 SD (Smyth, Hucklebridge, Thorn, Evans & Clow, 2013). In 6 saliva samples, insufficient saliva was collected for analysis (occurring randomly across participants). These 6 values were replaced with the mean cortisol value for the corresponding time point. Next, a natural log (ln) transformation was used to normalize all salivary cortisol data (Smyth et al., 2013). To calculate cortisol reactivity and regulation, area under the curve with respect to increase was calculated using ln cortisol values to create aggregate reactivity (i.e., AUCireact) and recovery scores (i.e., AUCirecov). AUCireact was calculated by subtracting T2 baseline from the AUCground-reactivity. AUCirecov was calculated by subtracting T6 from AUCground-recovery. As for the second objective of this aim, Structural Equation Modeling (SEM) was used to test the association between exposure to violence to AUCireact and AUCirecov. These analyses, and all subsequent analyses, controlled for age and gender (i.e., controls were allowed to be freely associated with the main study variable: exposure to violence, coping and HPA stress response).

A joint significance test (MacKinnon, Lockwood, Hoffman, West & Sheets, 2002) was used to test the second aim of study (i.e., if fleeing and rumination mediate the relation between exposure to violence and a hypo-active HPA stress response). In this procedure, the mediation test was only conducted if there was a significant association found in the total effects model (i.e., Violence→Hypo-active HPA). It was predicted that the total effects model would be significant for the reactivity phase and not the recovery phase. Thus, if this path was significant, a mediation test would be conducted to examine whether coping mediated the relation of stress and HPA functioning. Specifically (See Figure 3), paths A (i.e., Violence→Coping) and B

(Coping→HPA functioning) needed to be significant in order to conclude that disengagement coping was an indirect mechanism by which stress was significantly associated with HPA functioning. Lastly, the residual direct effects (paths C) was examined to test the mediation strength.

For the final aim of this study, the intervention effects were tested in two steps. First, repeated measures one-way Anova was used to measure changes from pre- to post-intervention for all study variables: exposure to violence, fleeing, rumination, engagement coping, and HPA stress response. It was expected that there would be a significant change in HPA response and coping styles, but not in levels of exposure to violence. Next, a mediation model was used to test whether youths' HPA response was predicted by the new coping skills acquired or if this was predicted by the underlying stress. Specifically, three separate models were run with fleeing, rumination and learned engagement being used as the mediator. It was predicted that learned engagement strategies would be the only significant predictor of HPA reactivity.

Preliminary Analysis

Bivariate correlations between study variables are presented in Table 1. Exposure to violence was shown to be a key variable as it was associated significantly with a hypo-active cortisol response. Further, rumination and fleeing were correlated suggesting that they are co-occurring for these youths. Lastly, engagement at post was associated with increases in cortisol response at post as well, suggesting that learned strategies are associated with a more regulated HPA stress response. These associations are in line with our hypotheses. As for our controls, our sample tended to have older females, and this was correlated with having more rumination at pre. Given these significant associations, we included both age and sex as covariates in all analyses.

Results

The two objectives of the first aim of this study was to determine 1) the type of HPA response (i.e., hypo vs. hyper cortisol response and 2) how exposure to violence was associated with HPA stress response pattern. Results indicate that this sample, on average, presented a hypo-active cortisol response. Specifically, participants in this study remained below 0.1 micrograms per deciliter throughout the pre-assessment, which is lower than normative samples. That is, in normative samples, youths tend to have a resting cortisol baseline of 0.1 micrograms per deciliter and that level increases to above 0.15 micrograms per deciliter when they are presented with the TSST (Stroud et al., 2009). Thus, the participants in the present study are not showing a cortisol response in either the reactivity or recovery phase of the HPA stress response. As for the second objective, and consistent with our hypothesis, participants' exposure to violence was significantly associated with a hypo-active cortisol stress response during the reactivity phase ($\beta = -.083$, $p = .015$) of the HPA stress response, but not during the recovery phase ($\beta = .001$, $p = .990$). Given these results, the predictors of reactivity phase cortisol change were examined in this study and the recovery phase was excluded.

The second aim of the study was to assess whether the coping style of fleeing and rumination mediated the relation between exposure to violence and a hypo-active cortisol HPA stress response. Given the significant relation between violence and the reactivity phase of the HPA response and the non-significant relation during the recovery phase, the mediation model was only tested for the reactivity phase. Again, consistent with our hypothesis, maladaptive coping mediated the relation between violence and a pre-test hypo-active cortisol reactivity. Specifically, *more* violence exposure was significantly related to *more* fleeing ($\beta = .195$, $p < .001$) and *more* rumination ($\beta = .179$, $p = .005$). Additionally, *more* fleeing was significantly associated with HPA reactivity ($\beta = .185$, $p = .029$). Rumination was at the trend level.

The last aim of this study was to determine if conducting an intervention focused on teaching youths effective engagement coping skills could lead to a more effective HPA coping response, and thus, buffer youth from the negative effects that violence exposure has. Consistent with the hypotheses, a significant increase was found in youths engagement coping strategies $t(32) = 7.70$, $p \leq .001$ from pre- to post-assessment, whereas, their exposure to stress did not significantly change $t(11) = -.167$, $p = .870$. Of note, participants also reported using less maladaptive strategies at post, but this did not reach the significant level (i.e., Flee $t(43) = -.998$, $p = .331$; Rumination $t(31) = -.609$, $p = .547$). As for the HPA stress response, after the intervention, the cortisol response began to normalize with youths showing a significantly higher reactivity level $t(43) = -10.65$, $p \leq .001$. No differences in recovery $t(43) = .47$, $p = .641$ were found. Importantly, no difference was found between pre- and posttest baseline cortisol levels $t(43) = .15$ $p = .88$, providing evidence that there were no practice effects or anticipatory stress responses for this sample.

Lastly, a mediation model was used to determine if engagement coping learned in the intervention accounted for the increase in HPA reactivity. Consistent with our hypothesis, acquired engagement strategies were significantly associated with an increase in HPA reactivity ($\beta = .964$, $p = .022$), and maladaptive coping was not (i.e. Flee $\beta = .164$, $p = .900$; Rumination ($\beta = -.335$, $p = .757$). Importantly as well, in each of these models, violence exposure was no longer significantly associated with the HPA stress response. Additionally, the strength in relation between violence and maladaptive coping strategies weakened from pre- to post-assessment, only reaching trend level at post-test (i.e. Flee $\beta = .152$, $p = .061$; Rumination ($\beta = .170$, $p = .064$).

Discussion

There were three main aims of this study. The first aim was to examine if a population in a low resource area had a hypo-active cortisol HPA stress response and if this was related to their exposure to violence in community. The next aim examined if the coping strategies of fleeing and rumination mediated the relation between exposure to violence and a hypo-active cortisol response. Lastly, this study examined if context-specific coping skills (i.e., using engagement coping strategies in non-life-threatening situations) could be taught in an intervention, and if acquisition of such skills would lead to a more normalized HPA stress response.

As for the first aim of this study, and consistent with our hypothesis, participants for this study presented with a hypo-active cortisol stress response during the TSST and this was associated with their exposure to high levels of violence. While the literature has shown that youths exposed to uncontrollable stress can have either a hyper- or hypo-active cortisol response (Booij et al., 2013), these authors argue that that the chronic exposure to stress—such as in living in poverty and exposed to consistent community violence—may over time cause damage to the HPA stress response. It is not clear whether the hypo-active response in this sample of youths is due to the length of exposure to poverty-related stress in general or if it is specifically the exposure to violence because participants reported being exposed to both high levels of violence and low levels of social mobility (i.e. youths remained in the same neighborhood for most of their lives). Further, this study only examined their exposure to violence in the last 6 months. Future longitudinal studies would be needed to tease apart these aspects. For example, despite findings of hypo-active cortisol responses in violence-exposed youths (Lovallo et al., 2012; MacMillan et al., 2009; Ouellet-Morin et al., 2011), no research has successfully isolated the effects of exposure to violence apart from chronic, uncontrollable stress more generally. Thus,

the field would benefit from research studying varying levels of both chronicity of uncontrollable stress and exposure to violence.

In addition, for the second aim, the link between exposure to violence and a hypo-active cortisol response was found to be mediated by a coping profile that is typical of populations exposed to violence (i.e., fleeing from the stressor and ruminating about the problem). This finding has important implications because it demonstrates how context and highly stressful environments can shape coping strategies for youths that may not be adaptive in all circumstances. It seems that youth in this study are applying coping skills they learned to cope with violence (i.e. fleeing and rumination) and are applying them to the TSST, which is more similar to an academic stressor. Thus, this provides evidence that youths may learn to apply coping strategies in one context and apply them in another, which is consistent with the theoretical model of ACM (Del Giudice et al., 2011). Emerging research has begun to show why youths exposed to stress respond with a fleeing response. Specifically, fleeing has been found to be protective for youths who live in violent environments because they are distancing themselves from danger (Edlynn, et al., 2008). However, the problem arises, as this study demonstrates, that these youths do not resolve the situation. Thus, they are prone to ruminating about the stressor, which has been found to have negative effects and may place youths at increased risk for psychopathology, such as anxiety and depression (Smith & Alloy, 2009; Demeyer, De Lissnyder, Koster, & De Raedt, 2012; Snyder & Hankin 2016). In this case, youths would likely benefit from learning how and when to use which coping strategy so that it appropriately matches with a corresponding environmental stressor (discussed below).

It should also be noted that fleeing and rumination only partially mediated this relationship as exposure to violence still was significantly associated with a hypo-active cortisol

response after both fleeing and rumination were entered into the model. This indicates that other factors are still playing an important role in explaining the relation between exposure to violence and a hypo-active cortisol response. For example, exposure to violence has been associated with stress-related somatic syndromes such as fibromyalgia, chronic fatigue syndrome, temporomandibular disorder, and irritable bowel syndrome (Crofford, 2007). These physical ailments could be playing a direct role in the HPA stress response. In fact, emerging research has shown that telomere erosion (i.e., cellular aging) has been found to be significantly higher for children who are exposed to violence than those who have not (Shalev et al., 2013). Thus, there could be lasting effects at the cellular level in the HPA stress response system due to exposure to stress. This does not mean that youths who are exposed to violence cannot adapt and learn effective coping strategies, but this emphasizes the importance of targeting these children because they may be at a biological disadvantage.

Per our hypothesis, fleeing was found to mediate the relationship between exposure to violence and HPA reactivity. It may seem paradoxical that the link between fleeing and HPA reactivity is positive given that exposure to violence is negatively associated with HPA reactivity and positively associated with fleeing. Some may argue that this positive association between fleeing and HPA reactivity is counter to our hypothesis because fleeing should be associated with a decreased cortisol response, and in this study, we find a positive relation. However, cortisol is not only linked with the HPA response, but it is also present during a SAM stress response, which needs to be taken into account. In fact, the HPA response has been found to be initiated through cortisol production at the end of the SAM response. Thus, when an individual responds to stress, they typically respond with a SAM response, which is followed by an HPA response (Gunnar et al., , 2007). Therefore, if the HPA stress response is damaged, only a small amount of

cortisol level from the initial SAM response would be detected. Thus, for our population, it seems that they are responding with a SAM response, but the cortisol does not reach a threshold level to initiate the HPA response. Future studies should be careful when only using the biomarker cortisol to measure the proxy HPA response because cortisol is a steroid that has been found not only in the SAM response, but has been found to be essential in appropriate functioning of other bodily functions such as metabolic response (Kuehl, et al., 2015; Hewagalamulage, Lee, Clarke & Henry 2016) and immune system response (Abo, Kawate, Itoh & Kumagai, 1981; Jefferies 1991).

To this point, cortisol responses need to be interpreted with care because other factors could be playing a role in the hypo-active response. For example, cortisol has been shown to suppress the autoimmune response when an individual is exposed to environmental irritants such as pollution. Youths who grow up in low income urban settings are often exposed to environmental irritants such as air pollution (Clark, Millet & Marshall 2014) and noise pollution (Casey et al, 2017). Accordingly, environmental factors may be playing an additional role in explaining why youth in this study presented a hypo-active cortisol response initially. For example, when youth are exposed to air pollution, their cortisol response may be over-activated in the attempt to suppress the immune system from constantly reacting to the pollutant in the form rashes or asthma (Buske-Kirschbaum et al, 2003). As for noise pollution, research has shown that youths who live in areas with more noise, have increases in cortisol secretion during the night. Subsequently, they have a hypo-active cortisol response in the morning hours (Ising & Ising, 2002), which was linked to allergies and asthma (Ising et al., 2002). It must be recognized that the stress response is reacting to many types of stressors both psychological and environmental. Thus, it should not be assumed that a hypo-active response stems only from

psychological stress such as exposure to violence, but environmental stressors need to be taken into account as well. Thus, an alternative way of intervening for youths who have a hypo-active cortisol response would be by focusing on reducing environmental stressors, which is one aspect that is taught in the BaSICS program.

As for the last aim of the study, and consistent with our hypotheses, we found that youths who were exposed to violence could learn effective engagement coping strategies that are taught to be applied in non-life-threatening contexts. To note, there was not a significant decrease in the use of fleeing and rumination coping strategies. However, caution should be taken because there were key methodological differences in measuring the coping strategies. Fleeing and rumination were measured using self-report, while engagement strategies were measured objectively by having youths generate an engagement coping strategy. This is important to note because it may be that youths' perception of their coping strategy is slower to change compared to their objective use of that strategy. This study showed that the increases in engagement coping strategies were associated with an increased cortisol response in the reactivity phase of the TSST. This provides evidence that even youths exposed to toxic levels of stress can learn effective coping strategies, which in turn can have implications on the HPA stress system. Importantly as well, after the intervention, the exposure to violence no longer predicted the cortisol reactivity. This provides even more evidence that youths can learn to apply different coping strategies they learn and apply them to an appropriate situation despite their environmental exposures. That is, while the use of fleeing and rumination did not significantly change for these youths in general, both fleeing and rumination were no longer associated with the cortisol stress response during the TSST. Thus, these youths may have learned to reorient their coping strategies and adapt them to the appropriate context. It is very important to note that

the BaSICS intervention focused on teaching youths how to use different coping strategies depending on the situation. For example, if youths were presented with a violent situation, they learned to seek safety before confronting the issue. Conversely, they learned that merely fleeing from a situation does not apply to all situations and practiced identifying when and which strategy to use under differing circumstances. This type of matching strategy is garnering attention in efforts to understand how youths can develop resiliency when exposed to significant adversity (Rutter, 2013). Lastly, some may argue the change in HPA stress response could be accounted for by practice effects. However, this is highly unlikely given that there were no differences found on resting cortisol levels between pre- and post-assessment.

Limitations

Despite being one of the first studies to demonstrate effects that the mechanism of coping has on the HPA stress response, there are some important limitations to note. First, this study was relatively small and focused on urban youths in one northeast U.S. city. Clearly, more research needs to be conducted in other cities and environments to extend the generalizability of these results. In addition, this sample was comprised of predominantly African American participants who are the majority and Hispanic participants who are the fasting growing population in this area. Many youths reported low levels of perceived discrimination, seemed to be unaware of discrimination stemming from economic and social inequalities, and did not realize that schools existed elsewhere that were not over-crowded and struggling for adequate funding. It may be that the African Americans in this sample, who have always lived in the same area and did not have exposure to higher resource areas, are unable to report a difference. As for Hispanics, they often migrated to improve their economic situation, and therefore, they may view the structural racism as discriminatory. Understanding how contextual factors such as

neighborhood context would likely provide further information about how youths develop coping strategies and how their HPA stress response corresponds to such strategies. Further, this study focused on a limited developmental window and only followed youth for 3 months post-intervention. More longitudinal studies are needed in order to better understand how chronic uncontrollable stress is associated with both coping strategies and the HPA stress response. In addition, this study narrowed in on exposure to violence as the source of uncontrollable stress. There are many other types of uncontrollable stress, such as housing and food insecurity, which may have a different impact on both the coping strategies used and the HPA stress response. Clearly, coping with food insecurities will likely differ compared to how an individual copes with violence. Lastly, this study only examined the HPA stress response, which is only part of the stress response system. Future studies would likely benefit from taking a holistic approach because there have been some research findings showing interactions between different sectors of the physiologic stress response. For example, El-Sheikh and colleagues (2011) found that children who had a high cortisol and low respiratory sinus arrhythmia response to a stressor were more likely to have internalizing problems compared to children who had both a high cortisol and high respiratory sinus arrhythmia response. Lastly causal effect of the intervention cannot be confirmed considering that there was no control group. Future studies should include a control group as to strengthen the inference of these findings.

Future Implications

Despite these limitations, this study provides further evidence of the link between environmental stress, coping and HPA stress response functioning. Additionally, it provides evidence that teaching coping strategies that are grounded in theory and that focus on applying coping strategies to the appropriate context may in fact recalibrate the HPA stress response. This

provides a framework that could inform more interventions that not only improve mental health outcomes for at-risk youth, but also provides a framework to understanding how to decrease the mental and physical health disparities between youths who live in poverty and those who do not.

This study has shown one possible avenue for repairing the damaged cortisol response. Future studies need to continue to examine the conditions in which youth develop a hypo- or hyper-cortisol response, and better understand the range for a healthy cortisol HPA response. It seems that there is a u-shaped association between healthy functioning and HPA response. That is, there are poor outcomes associated with both a too low [e.g. hypertension (Wirtz et al., 2007), depression (Stetler, & Miller, 2005), social problems (Ouellet-Morin et al., 2011), chronic illness (Buske-Kirschbaum et al, 2003, lower memory functioning (Raffington, Prindle, Keresztes, Binder, Heim & Shing 2018)] and too high cortisol [e.g., hypertension (Whitworth, Williamson, Mangos & Kelly, 2005) depression (Pruessner, Hellhammer, Pruessner, & Lupien, 2003), chronic disease (Whitworth et al., 2005), narcissism (Reinhard, Konrath, Lopez, & Cameron, 2012) and lower memory functioning (Kirschbaum, Wolf, May, Wippich & Hellhammer, 1996)] response. Interestingly, health problems co-occur with both hypo- and hyperactive cortisol responses. Intervention models would likely benefit from taking an inclusive approach to understanding a healthy cortisol response, recognizing that an efficacious stress response includes both a significant cortisol activation and efficient down-regulation (Jansen et al., 1998; Jansen et al., 2000).

While this study focused on the hypo-active cortisol response, it seems that a similar intervention may be beneficial for those who have a hyper-cortisol response to a stressor as well. For example, Butzer and colleagues (2015) demonstrated that learning emotion regulation skills helped youths with hyper-cortisol levels bring their cortisol response into a healthier level, which

corresponded with improved behavioral functioning. This is an important finding because it could be the case that in the same cohort of youth, some may respond with a hyper-response and others with a hypo-active response. This could be the case when there are youth from various parts of the city where exposure to stress and environmental stressors may vary dramatically. Thus, theoretically, it is possible to treat both cases in the same intervention. For the current study, the sample size was too small to be able to examine the variability of cortisol response (i.e., hyper- vs. hypo-active response) and by average this sample presented with a predominantly hypo-active response.

As mentioned earlier, this study has shown one possible method of improving children's lives by repairing the cortisol HPA response through coping skills, identity development and community focused interventions. As important as these efforts are, they are designed to complement rather than replace concerted efforts to reduce poverty and its associated toxic stress. An added benefit of the intervention described herein is that it empowers youth to take action in their communities and focus on reducing the environmental stress. Thus, youth are learning not only how to improve how they respond to stress, but they are also learning how to take collective action to change the stressor itself. This study was unable to measure how the community stress changed due to these youths' community projects, but extant research has begun to show that these types of community projects do have a positive impact on the community and can reduce environmental stressors for all residents (Farrell, Henry, Bradshaw & Reischl, 2016).

An additional area of interest includes how genetics and the environment interact, which could help illuminate how environmental stress impacts populations across generations. First, evidence has shown that exposure to chronic stress in the prenatal period leads to alterations in

amygdala volume and atrophy of both hippocampus and pyramidal dendrites, which are components essential to a "healthy" stress response (Blair & Raver, 2016). Recent research has shown the expression of genes can change across generations due to the exposure to environmental stressors [i.e., epigenetic (Heim & Binder 2012; Swartz, Hariri & Williamson 2017; Zannas & Chrousos 2017)]. What are the implications for the subsequent generation who inherits epigenetically altered genes? According to ACM, there is evolutionary benefit from the changing phenotypes in that humans are learning to adapt to their environments (Del Giudice et al., 2013). Thus, the adaption of the stress response for populations exposed to high violent neighborhoods may actually be "adaptive" because the stress response would be more adjusted for physical survival in this type of environment. That is, they are responding with a physical response to the stressor in the form of fighting or fleeing (i.e., SAM response). According to ACM, however, there is a tradeoff for physical survival in that cognitive resources are greatly reduced, which can have implications in other important life domains, such as school and employment opportunities. This highlights the importance of having interventions like BaSICS, which aim to help rebuild coping strategies so that youth can more effectively utilize their cognitive resources.

Epigenetic research also shows how interventions like BaSICS can effectively intervene at population levels and across generations. According to ACM, humans are able to adapt to a particular environment while still having genetic variability to adapt if the environment is different than the previous generation. Accordingly, and specific to stress, it has been found that the carriers of the Val and Met alleles have progressively smaller cortisol responses with greater levels of early life adversity (Lovallo et al., 2017), indicating a pattern, but still genetic variability to encourage the survival of humans in multiple environments. This variability is

important factor because despite being exposed to generations of poverty, there will still be some youths within a group—such as in BaSICS—who will be able to benefit from learning new survival strategies. This highlights the importance of having diversity within the groups, which parallels the process that is taken within group. In BaSICS, group participants learn how diversity (e.g., through the range complementary strengths and skills) helps youths come together to take on community stressors that are too difficult for one individual to take on by themselves. This is done through developmental appropriate examples that model this idea. For example, participants were taught that strengths are like cars, and if everyone were a Ferrari, it would be quite difficult for the community to put out a fire when that occurred in the neighborhood. Thus, diversity is seen as a major strength of BaSICS and how participants interact with each other.

To this end, this study has shown that youths' exposure to violence may shape both their coping style and HPA stress response, which is supported by the ACM model. This model also highlights conditional adaption, which is an organism's ability to modify their developmental trajectory and resulting phenotype (Del Giudice et al. 2013). In accordance to this theory, this study has shown evidence that these youths can learn effective coping strategies that seem to help "repair" the HPA response. Despite the small sample size and limited population, this study has important implications that provide initial biological evidence showing that youths have the capability of learning strategies to break the vicious negative cycle of poverty. This study has brought us one step closer in understanding how to build resiliency in youths exposed to high levels of uncontrollable and chronic stress.

Figure 1: ***Uncontrollable Stress Associated with a Damaged HPA Stress Response via Maladaptive Coping***

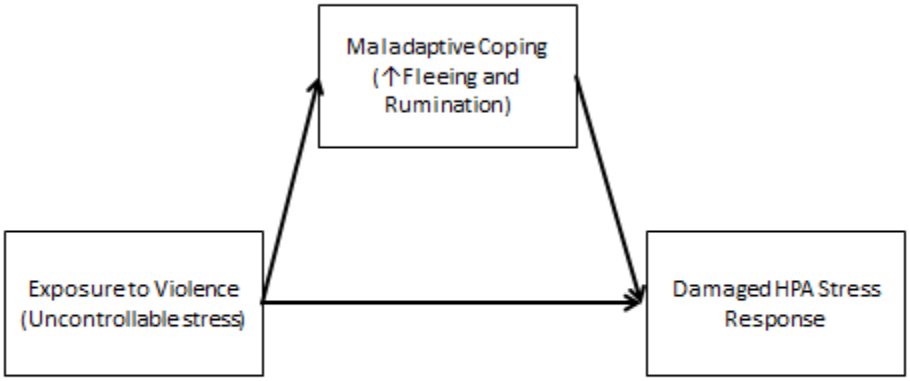


Figure 2: ***BaSICS Intervention Teaching Adaptive Coping Associated with Repaired HPA Stress***

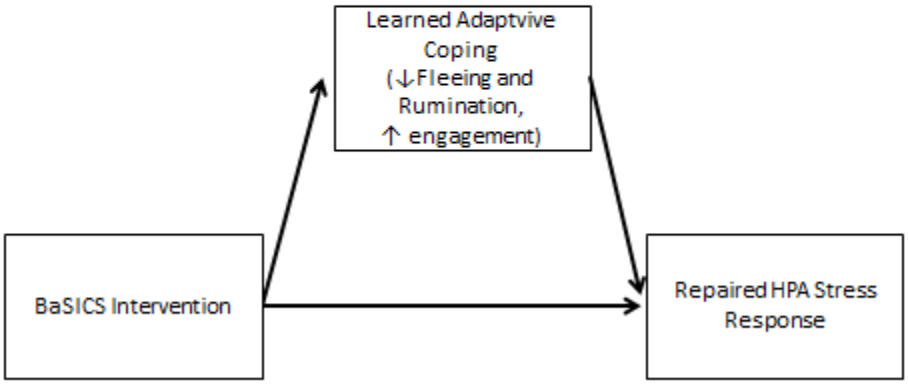
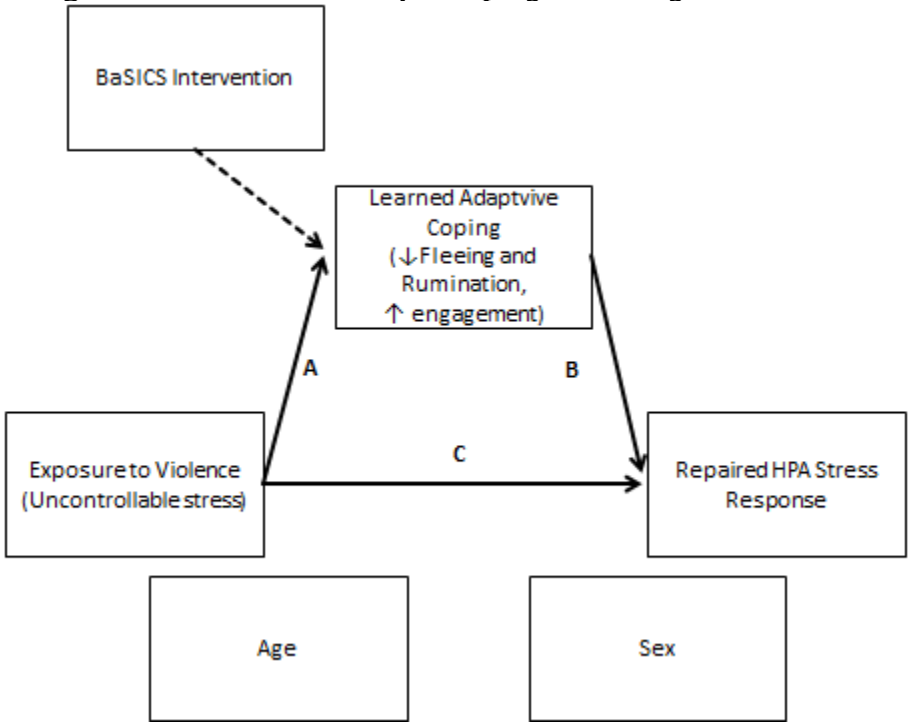


Figure 3: ***Mediation Model for Coping Mediating the Relation between Stress and HPA***



Note: Age and Sex are controls and paths will be freely associated to all study variables.

Table 1: ***Bivariate Correlations, Means and Standard Deviations of Study Variables***

	1	2	3	4	5	6	7	8	9	10
1. Age	-									
2. Sex(Female)	.425*	-								
3. Violence	.067	.367	-							
4. Cortisol-Pre	.044	.252	.585**	-						
5. Flee-Pre	.150	.067	.318	.253	-					
6. Ruminate-Pre	.100	.448*	.391	.007	.440**	-				
7. Cortisol-Post	.316	.194	.097	.081	.156	.010	-			
8. Flee-Post	.088	.351	.374	.015	.556**	.676**	.004	-		
9. Ruminate-Post	.010	.345	.372	.062	.634**	.638**	.106	.727**	-	
10. Engagement-Post	.099	.074	.164	.364*	.200	.296	.347*	.319	.283	-
Means	11.28	61%	2.36	-.12	1.97	2.15	14.28	1.79	1.98	3.03
SD	1.08		2.00	.52	.87	.97	5.42	.79	.96	2.04

Figure 4: ***Cortisol Means by Intervention***

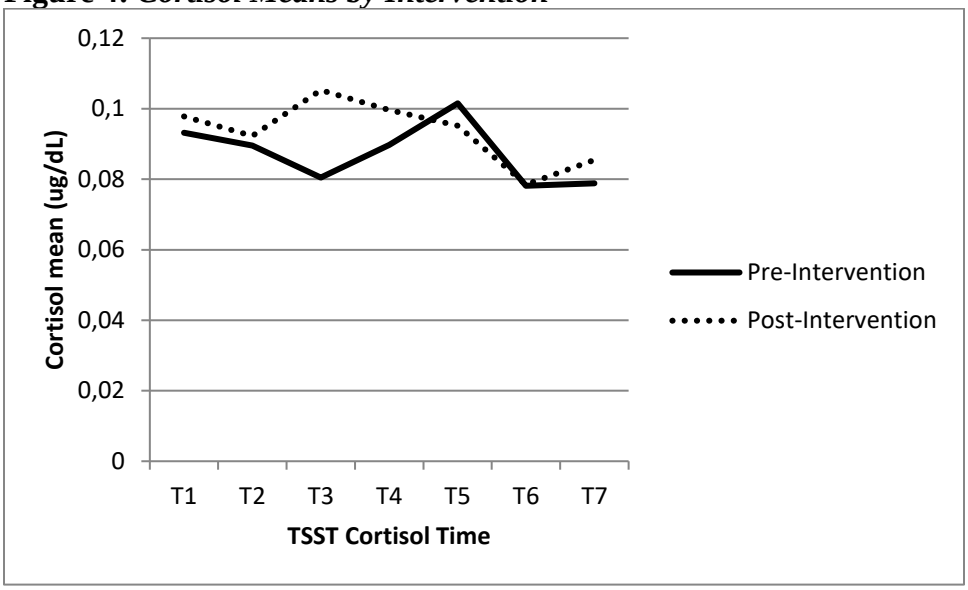


Table 2: ***Main Mediation Model Pre Intervention: Coefficient Values and Significance***

	Violence	Fleeing	Rumination
Simple Effects			
Fleeing Pre	.195***	-	-
Rumination Pre	.179**	-	-
Cortisol Reactivity Pre		-.185*	-.138†
Residual Direct Effects			
Cortisol Reactivity (Flee)	-.100**	.	
Cortisol Reactivity (Rumin)	-.098**		
Total Effects			
Cortisol Reactivity	-.083*	-	-

Note: † $p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$.

Table 3: ***Main Mediation Model Post Intervention: Coefficient Values and Significance***

	Violence	Fleeing	Rumination	Engagement
Simple Effects				
Fleeing Post	.152†	-	-	-
Rumination Post	.170†	-	-	-
Engagement Post	-.179	-	-	-
Cortisol React Post		.164	-.335	.964*
Residual Direct Effects				
Cortisol React (Flee)	-.607	-	-	
Cortisol React (Rumin)	-.519	-	-	
Cortisol React (Engag)	-.182			
Total Effects				
Cortisol Reactivity	-.083*	-	-	

Note: † $p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$.

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Appendix

Building a Strong Identity and Coping Skills (BaSICS) Intervention

Part 1: Coping Skills. The first five sessions of the BaSICS program are dedicated to teaching participants effective coping strategies. This includes teaching primary (e.g., problem solving and emotion regulation) and secondary coping (e.g., cognitive restructuring). The sessions are designed to start with stressors that youths have more control over, which is, personal stress (e.g., failing a test), and broadens to life stressors (e.g., family member going to jail). The icebreakers in the coping skills sessions include group building activities to enhance group cohesion.

Session 1: Program outline, stressors and problem solving: primary coping skills. The first session is an introductory session, which familiarizes the group members with each other, as well as with the facilitators. It also gives an overview of the program. To engage youths in the program, they begin by exploring different types of stressors that they experience. This session focuses on primary control coping skills, which gives them a tool immediately in order to practice active problem solving. Their first group problem solving activity is to develop their group rules to follow during the sessions. Problem solving is taught using the STEPS acronym: **S**ay what the problem is, **T**hink of solutions, **E**xamine each one, **P**ick one and try it out, and **S**ee if it worked. STEPS is an important base for the program and is used consistently throughout all sessions.

Session 2: Feelings identification, triggers, and stress. The second session focuses on helping youth identify emotions (both comfortable and uncomfortable) and their triggers. In general, they learn to identify conditions and situations that create stress. Moreover, they learn about how discrimination and economic stress can trigger emotional responses. Through video

clips, they practice identifying these emotional responses and bodily reactions accompanying them. Lastly, the Photo Essay part of the project is introduced. In this assignment, participants take pictures of their community of both things that they like, and things that they would like to improve. They learn that their community environment, too, can elicit emotions and bodily responses.

Session 3: Learning to calm. The third session focuses on primary control coping skills and, in particular, emotion regulation. The feeling thermometer tool helps demonstrate the difficulty of making healthy smart choices when one is not calm. Relaxation techniques such as progressive muscle relaxation, imagery, diaphragmatic breathing and private calming that can help youths regulate emotions are taught and practiced. Participants also get the opportunity to use biofeedback, in which they objectively see themselves relax. This in turns, helps them understand the effectiveness of these exercises.

Session 4: Adapting yourself to stress: secondary control coping skills. The fourth session focuses on secondary control coping skills, including positive thinking, cognitive restructuring, and distraction. Using a story format, participants are introduced to the idea of cognitive restructuring, in which they get a chance to practice helping a fictional character think differently so that she feels better. The THINK acronym (**T**hink positive, **H**elp from a friend, **I**dentify the silver lining, **N**o replaying bad thoughts, and **K**eep thinking—don't give up) is utilized to identify methods for changing negative thought patterns.

Session 5: Practice practice practice!!! Applying coping to everyday situations. The fifth session gives a chance for facilitators to address any material or concepts that were not adequately covered in previous sessions. In addition, this session gives the opportunity for participants to practice the skills from the previous sessions and apply them to everyday

situations. That is, they practice using coping skills in appropriate contexts (e.g., using distraction techniques may be inappropriate when youths use this to avoid studying for a test).

Part 2: Identity Development and Leadership Skills

The second part of the program focuses on developing identity and leadership skills. Specifically, these sessions help participants explore their personal and cultural identities. They learn how these identities lead to different individual strengths and leadership qualities. The icebreakers in these session focus on identity exploration and appreciating other participants' personal qualities.

Session 6: Leadership: being your best self. The 6th session introduces the idea of leadership and the importance of celebrating cultural identity. This session discusses how personal and cultural identities help shape leaders. Participants identify characteristics of leaders and they begin to explore their own strengths through personal identity silhouettes. In this activity, they identify which qualities and activities define who they are.

Session 7: leadership: being your best self cont. Leadership and identity exploration is continued in this session. This 7th session builds off the last session and helps participants to see themselves as leaders in their lives and in their communities. They make cultural masks to demonstrate strengths from their own culture that contribute to them being a good leader.

Session 8: Social identity complexity, group identity and teamwork. The 8th session focuses on how individual identities can come together to make a stronger group. Youths learn that different individual qualities that contribute in a group can make the group stronger as a whole. The group continues to practice teamwork skills and learn that leaders can contribute to a group in a variety of ways. Lastly, using a story format, youths learn that complex identities

(i.e., being part of many distinct groups) can help them overcome stress in one social group by engaging in activities with others in another social group.

Session 9: ACT NOW: Stereotypes and social action. The 9th session concentrates on societal stress in the importance of collective coping. Youth learn about oppression, prejudice, and discrimination through viewing "A Class Divided" to illustrate how quickly children develop exploitive and oppressive behaviors based on an arbitrary grouping of third graders. They also engage in a "privilege walk" in which they learn how some have advantages just by being born in a particular group.

Part 3: Community Project

The last part of the program focuses on using all the skills participants have learned in the program to engage with the community to make their community a safer, stronger and more beautiful place. They use coping skills, personal identity, leadership skills and collective coping action to work together to overcome a broader community-based stressor.

Session 10: Introducing the community project. Participants identify their group name in session 10. In addition, they go on a community field trip to learn about how other youths have taken positive action in their neighborhood. For example, participants visit an abandoned lot that other youths have transformed into a community park.

Sessions 11-14: Community project work days. These sessions focus on the community project. It gives the participants time to identify their project and to implement it in their neighborhood. Facilitators help guide the participants to select a project that is feasible given the time, and that it suits the goal of coming together as a cohesive group in order to overcome a broader stressor.

Session 15: Wrapping it up, making a difference, staying in touch. In the 15th session, participants review everything that they have learned in the program. They prepare for the final session where they present all of the information from the program and their community project to their families and friends. They also write letters to their future selves describing what they learned in the BaSICS program. Lastly, they initiate a plan to maintain the energy in their project and to stay in contact with other participants in the program.

***Session 16: Celebration and ceremony*.** Participants in the program present all the content that they have learned in the program to their families and friends. Each youth presents at least one aspect of the BaSICS program so that content of each session is presented.

Immediately following the BaSICS intervention, post-assessment data was collected with the same exact procedure as noted above. In addition, follow-up data was collected 3 months after post-assessment. In each assessment period, children and one of their parents each received $25 for their time in completing surveys.

Vita

Education

2013-Present	**Doctoral Candidate**, Clinical Psychology (Child Track) Pennsylvania State University
2013-Present	**Master of Science in Psychology,** Clinical Psychology (Child Track) Pennsylvania State University
2008-2010	**Master of Health Science**, Child and Adolescent Health and Development (Population, Family and Reproductive Health) Johns Hopkins Bloomberg School of Public Health
2001-2005	**Bachelor of Art in Psychology, Minor in Spanish** Department of Psychology, University of Rochester

Clinical Experience

2018-2019	**Psychology Intern,** Behavioral Health Network, Springfield, MA
2010-2018	**Staff Therapist,** Pennsylvania State University Psychological Clinic

Evidence-based Treatment Development, Adaptation and Evaluation

2012- Present	**Building a Strong Identity and Coping Skills (BaSICS)** Pennsylvania State University
2011-2013	**Strengthening Families Program** Pennsylvania State University
2010-2012	**Friendship groups** Pennsylvania State University
2009-2010	**Student Practicum, Adelante Familia** Johns Hopkins School of Public Health
2009-2010	**Student Internship, WINGS Guatemala** Johns Hopkins School of Public Health
2008-2010	**Health Volunteer/Mentor, Mi Espacio** Johns Hopkins School of Public Health
2006-2008	**Good Behavior Game** Vanderbilt University

Fellowships

2010-2015	**Training Interdisciplinary Educational Scientists Fellowship** Pennsylvania State University