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To Engage or Disengage: The Impact of Coping Strategies, Sex, and Stress History on Cortisol Reactivity Among Urban Adolescents

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To Engage or Disengage: The Impact of Coping Strategies, Sex, and Stress History on Cortisol Reactivity Among Urban Adolescents

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Biography

The author was born and raised in Portland, Oregon. She graduated from St. Mary's Academy in Portland and received her Bachelor of Arts degree in Psychology from Northwestern University. She began her Master of Science degree in Psychology in 2019 at DePaul University in Chicago, Illinois.

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Abstract

Stress affects people daily and can prove maladaptive to mental health if chronic or acute. Effective coping responses may mitigate the negative effects of intense or prolonged stress through physiological processes such as HPA axis activity. Previous research has found one specific coping dimension, engagement/disengagement, to be predictive of cortisol reactivity in response to lab-induced stressors. Sex and stress history also contribute to the relationship between coping and cortisol reactivity. However, these processes are not as well understood in adolescent populations and have not been explored across different types of stressors. The present study explored the relationship between coping and cortisol stress reactivity among a diverse sample of 379 adolescents (57.2% female, mean age = 14.99) exposed to four different lab-based stressor tasks. Sex and previous stress history were also analyzed for potential moderating effects. Participants completed questionnaires to assess pubertal development status, stress history, and coping usage. They also completed four different lab-based stress tasks and provided saliva samples to measure cortisol levels. Results showed that adolescents' usage of coping strategies varied significantly by stress task. Greater usage of engagement coping was found to be predictive of cortisol peak, contrary to the hypothesis. Sex and stress history were found to affect coping and cortisol peaks in adolescents. Male adolescents who utilized more disengagement coping exhibited lower cortisol peaks. Greater stress history was associated with greater use of cognitive restructuring, rumination, and engagement coping. Findings from this study provide evidence that coping has a significant impact on cortisol peak in response to several stressors, and coping varies significantly based on the stressor. Sex and stress history are significant variables in the use of coping as well as cortisol peak. These results contribute to a

greater understanding of the relationship between stress management and the physiological stress response in adolescents.

To Engage or Disengage: The Impact of Coping Strategies, Sex, and Stress History on Cortisol Reactivity Among Urban Adolescents

People are frequently affected by traumatic life events, chronic stressors, and stressful life events (Compas et al., 2005). Research has shown that stressors – both acute and chronic – are associated with an increased risk for psychopathology in children and adolescents (Cicchetti & Toth, 1997; Grant et al., 2003; Compas et al., 2005). Not only can stress contribute to poor mental health outcomes, but it can also contribute to poor physical health behaviors such as eating foods high in fat and carbohydrates, drinking alcohol, and smoking (Jackson et al., 2010). However, there are individuals who grow up in chronically stressful conditions or experience intense stressors without poor mental or physical health outcomes. Coping can mitigate the poor health outcomes associated with stress (Compas et al., 2005). Specifically, utilizing appropriate coping techniques in response to stress can lessen the physiological stress responses that ultimately contribute to poor physical and mental health (Sladek et al., 2016). Exploring stress responses and the effects of coping are especially important in adolescent populations because adolescence is a developmental period of elevated cortisol levels, weight gain, anxiety, and depression (Roberts & Lopez-Duran, 2019). This study will look at the relationship between cortisol reactivity, a physiological response to stress, and coping. Sex and previous stress history will be assessed as variables that influence this relationship. Ultimately, understanding this relationship can contribute to our knowledge of how to reduce stress in young, urban populations and improve both their mental and physical health.

Coping Fit

Coping is a self-regulatory process in response to stress that involves conscious volitional efforts to regulate one's own behavior, emotions, cognitions, physiology, and the environment in response to a stressor (Compas et al., 2001). Researchers have organized coping into several different dimensions to better understand it. For instance, coping may be divided into problem- and emotion-focused coping. Lazarus and Folkman (1984) explained that problem-focused coping includes generating solutions and taking direct action to address the stressor whereas emotion-focused coping is focused on one's emotional response and seeking emotional relief. However, this conceptualization has been criticized for its broadness and potential overlap (Compas et al., 1996). An additional dimension had been proposed to address this criticism and that is primary and secondary control coping, which refers to coping that directly influences the events or conditions and coping that involves efforts to accommodate or adapt to the environment (Rudolph et al., 1995). This dimension fails to address certain disengagement strategies such as avoidance or denial (Compas et al., 2001), however. To address that critique, the engagement-disengagement conceptualization was developed. Engagement coping is focused on dealing with the stressor situation or one's emotions whereas disengagement coping refers to efforts to distance oneself emotionally, cognitively, and physically from the stressor. For example, engagement coping includes problem solving or thinking of different ways to solve the problem or fix a situation. Alternatively, disengagement coping includes avoidance or trying to distance oneself from the stressor (Compas et al., 2005). This paper will use the engagement and disengagement conceptualization because the two coping categorizes have been associated with contrasting psychopathological risks between the two coping categories (Compas et al., 2017).

Exploring coping through the dimension of engagement and disengagement has provided insight into how effective coping can reduce stress. Disengagement coping is associated with increased levels of internalizing and externalizing symptoms in response to the Trier Social Stress Task (Compas et al., 2017). Such findings suggest that disengagement coping may not be an effective response to this particular social stressor (Compas et al., 2001). Additionally, engagement coping has been associated with better psychological adjustment in adolescent populations (Compas et al., 2001). While greater use of disengagement coping is associated with worse adjustment to stress (Compas et al., 2001), some researchers suggest these findings might not apply across all types of stressors and populations.

Uncontrollable stressors such as parental death, neighborhood violence, and some forms of chronic illness provide examples of circumstances under which engagement coping strategies such as problem-solving might not be effective (Compas et al., 2005). In fact, greater use of avoidance (disengagement coping) in response to community violence predicted more less self-reported anxiety over time across youth populations (Edlynn et al., 2008). On the other hand, greater use of avoidant emotional coping predicted more severe PTSD and complicated grief among young adults who recently lost a loved one (Schnider et al., 2007). These findings demonstrate that coping effectiveness varies across stressors. It is important that adolescents develop a multitude of coping strategies such as both engagement and disengagement techniques (Wadsworth & Compas, 2002) so that the most effective strategy for each stressor may be used. This matching might ultimately reduce symptoms of psychopathology.

Physiological Stress Responses

When in a stressful situation, there are several physiological responses activated by the hypothalamic pituitary adrenal axis (HPA). This activation results in increased heart rate, sweating, blood pressure, and cortisol (Roberts & Lopez-Duran, 2019). Cortisol is released alongside adrenaline to curb functions that would be nonessential during a fight-or-flight situation (Mayo Clinic Staff, 2019). A normal cortisol reactivity pattern includes a baseline or non-stress induced state of cortisol, a peak in cortisol due to a stressor, and a return to baseline level or a recovery (Dickerson & Kemeny, 2004). In this way, cortisol serves as a direct measurement of physiological responses to stress. However, chronic and acute stress can result in prolonged cortisol reactivity that damages the neural structures that regulate HPA axis activity (Sapolsky & Meaney, 1986). Chronic and acute stressors have also been associated with increased risk of psychopathology in youth populations (Grant et al., 2003), Despite the adverse effects that stress can have on one's health, coping may moderate the relationship between stress and HPA axis regulation as well as the risk for psychopathology (Sladek et al., 2016; Compas et al., 2005).

Coping responses can affect cortisol responses during stressful situations. For example, young adults who utilized more suppression techniques (a form of disengagement coping), demonstrated heightened cortisol reactivity in response to the Trier Social Stress Task (Lam et al., 2009). In another study, adult participants were assigned to utilize suppression coping techniques (e.g., mentally and physically suppressing thoughts and responses to stress) while others were not assigned to cope in any specific way in response to happy and sad video clips. Those who were assigned to suppress their emotions showed heightened cardiovascular activity such as elevated skin conductance level and cardiac interbeat interval (Gross & Levenson, 1997).

These findings show that suppression coping, one form of disengagement coping, impacts both cortisol reactivity and cardiovascular reactivity in adults.

One specific measurement of cortisol reactivity, cortisol peak, is of particular interest. Cortisol peak is defined as the change in cortisol from baseline, or cortisol level prior to the stressor, to the maximum increase in cortisol that typically occurs after exposure to a stressor. Coping strategies that remove one from a stressor, such as disengagement coping strategies, have been associated with greater cortisol reactivity following a stressor. For instance, Janson & Rohleder (2017) found that participants who demonstrated a stronger tendency toward denial coping also exhibited higher peak levels of salivary cortisol following an acute stressor. Such results suggest that a higher cortisol response may be associated with a maladaptive coping strategy. The inverse relationship has been found for the effect that engagement coping has on cortisol peak. Greater levels of trait rumination, an engagement coping strategy, were found to be associated with a less steep increase in cortisol from baseline to peak (Katz, Peckins, & Lyon, 2019). These findings indicate that the type of coping that one in engages affects the amount of cortisol that is released in response to an acute stressor.

The research exploring how coping affects cortisol reactivity in adolescent populations is limited. The research that does exist more often evaluates overall self-report coping and daily cortisol reactivity. For instance, adolescent girls who were more likely to respond to interpersonal stress with engagement coping have demonstrated adaptive daily physiological regulation in the form of steeper diurnal cortisol slopes, lower total cortisol output over the day, and lower cortisol awakening responses (Sladek et al., 2017). Unlike many adult studies, there is not robust evidence for how engagement and disengagement coping affect adolescent cortisol reactivity in response to acute laboratory social-evaluative stressors like the TSST. This study

will attempt to fill this gap in the literature by addressing the question: how does variation in coping affect cortisol reactivity in response to acute stressors among adolescents?

Adolescence

Adolescents are an important population for studying coping because adolescence is a critical period of social, emotional, and physical development (Roberts & Lopez-Duran, 2019). Adolescence is distinct from other phases of life because of significant increases in environmental stressors such as academic pressures and relationships (Cicchetti & Rogosch, 2002). Urban youth may experience an even greater risk for experiencing stressors in the domains of poverty, community violence, and physical violence (Conger et al., 1994; Kliewer et al., 2006; Morrison et al., 1992). This period, typically ages 11 to 18, is also when coping strategies are developing (Roberts & Lopez-Duran, 2019) and cortisol awakening response (CAR) and reactivity become more similar to those of adults (Platje, et al., 2013; Allen et al., 2016). Additionally, the increase in stress and development of coping strategies during adolescence may influence mental health in the future (Compas et al., 2001). This unique youth population will provide insight into a period marked by increases in stress, the development of stress reactivity, and the need for effective coping.

The Impact of Sex and Stress History

Sex and Cortisol. The relationship between cortisol reactivity and coping can vary for multiple reasons such as age, pubertal development, and sex. Sex differences in both cortisol and coping have been found and may be related to each other (Reschke-Hernández et al., 2017; Tamres et al., 2002). Among adults, males have been shown to have greater overall cortisol reactivity compared to females in response to social stresses like the Trier Social Stress Task

(Reschke-Hernández et al., 2017). On the other hand, female adults demonstrate more sustained cortisol awakening response (CAR) compared to adult men over the course of a day (Wüst et al., 2000). These sex differences in cortisol diurnal levels and reactivity have been found in adults but results among adolescents are less clear. Sex differences in wakening cortisol levels emerge at the age of 11 when females begin to have increases. The increases for boys begin around age 13, likely due to puberty (Gunnar et al., 2009). Male adolescents demonstrate greater cortisol levels, including cortisol peak, in response to the TSST compared to female adolescents following the onset of puberty consistent with findings in adult populations (Ordaz & Luna, 2012). Researchers propose that sex differences in cortisol reactivity may occur due to sex differences in perception of the stressor (Roberts & Lopez-Duran, 2018). Additional studies utilizing different types of stressors may identify key differences in cortisol reactivity by sex among adolescent populations.

Pubertal Development. One of the challenges with studying stress and coping during adolescence is the variability with the onset and course of pubertal development. Self-reported pubertal development has been associated with increases in cortisol in response to a public speaking task (van den Bos et al., 2014). Additionally, pubertal development is a stronger predictor of cortisol reactivity than age alone (van den Bos et al., 2014). Previous research demonstrates that pubertal maturation has significant positive correlations with CAR and cortisol secretions in response to social stressors (Gunnar et al., 2009) perhaps because pubertal development increases adolescent's sensitivity to social evaluation (Gunnar & Quevedo, 2007). Pubertal development may also explain some cortisol reactivity differences between males and females. Male adults demonstrate significantly greater cortisol reactivity in response to the TSST (Yim et al., 2009). When controlling for pubertal status, male adolescents demonstrate greater

cortisol reactivity as well (Ordaz & Luna, 2012). However, there is a lack of consistent differences in cortisol reactivity by sex among adolescent populations; this may be due to the increase in sensitivity to social stress during this period for both females and males (Gunnar & Quevedo, 2007). Researchers suggest evaluating cortisol reactivity in response to real-life stressors may reveal sex differences in cortisol reactivity among (Roberts & Lopez-Duran, 2018). Because pubertal status is significantly related to cortisol reactivity in response to social stressors, this study intends to use pubertal status as a control when evaluating sex differences in cortisol reactivity for a variety of stressors.

Sex and Coping. Sex differences in coping responses have been found in adults and adolescents (Tamres et al., 2002; Copeland & Hess, 1995). In a meta-analysis of coping behaviors, researchers found that adult women were more likely to use strategies that involved verbal expressions to others or the self as compared to adult men (Tamres et al., 2002). Such strategies include engagement coping strategies such as seeking emotional support, rumination, and positive self-talk. Additionally, adult women are more likely to engage in more coping strategies compared to adult men (Tamres et al., 2002). However, coping may change over time. For instance, young adult men reported greater use of avoidance, a disengagement coping technique, in response to a variety of stressors. Beyond young adulthood, women scored higher on avoidance across the lifespan (Meléndez et al., 2012). It is therefore possible that sex differences in coping may differ between adult and adolescent populations.

Coping differences by sex have also been found in adolescence. Female adolescents report using more coping strategies that reflected engagement coping techniques such as proactive orientation, positive imagery and self-reliance in response to a variety of stressors (Copeland & Hess, 1995). Male adolescents reporting relying more on disengagement coping

such as physical diversions, passive diversions, and avoidance compared to female adolescents (Copeland & Hess, 1995). Sex differences in coping may vary depending on the stressor. In response to social stress, female adolescents report using problem solving (engagement) more whereas male adolescents report using avoidant coping (disengagement) more. However, sex differences in coping were less significant in response to academic stress (Eschenbeck et al., 2007). While there may be sex differences in coping among adolescents, the differences may vary across situations and types of stress. This study will utilize a variety of stressors to further explore sex differences in coping.

Stress and cortisol. Along with sex, one's stress history may play a significant role in one's coping and cortisol reactivity. Chronic stress has previously been shown to have a deleterious effect on one's mental and physical health. More specifically, research demonstrates chronic stress exposure during childhood can have detrimental effects on the development of one's neural and hormonal systems (Handa & Weiser, 2014; McEwen & Seeman, 1999). This includes the HPA axis, the primary system for stress regulation. In one study of 8 to 14-year-olds, the number of stressful events in the last 12 months were positively significantly correlated with afternoon and evening diurnal cortisol levels (Bevans et al., 2008). In response to the TSST, adolescents with a history of maltreatment such as parental antipathy and physical abuse produced higher amounts of cortisol and slower recoveries than did adolescents with no history of maltreatment (Harkness et al., 2011). Higher concentration of neighborhood disadvantage predicted higher cortisol reactivity and steeper recovery among African American male adolescents in response to the TSST (Hackman et al., 2012). Neighborhood disadvantage measured by lower socioeconomic status and childhood maltreatment are just two types of stressors that have been shown to have significant effects on cortisol reactivity. This study will

explore how stress history in adolescents affects cortisol reactivity in response to numerous types of stressors.

Stress history and coping. Stress history impacts coping utilization. These effects are present in adolescents as well as in adults who experienced childhood maltreatment and other forms of chronic stress (Kim et al., 2016; Cantave et al., 2019). Time spent in poverty between birth and early adolescence predicted greater use of disengagement over engagement coping several years later (Kim et al., 2016). In one study conducted with adult men, participants with a history of maltreatment in childhood more frequently adopted engagement emotion-oriented coping strategies in response to the TSST (Cantave et al., 2019). Not only does stress history affect one's coping strategy utilization, it also may have an interactive effect with cortisol reactivity. In a study of preadolescents, participants were assigned to utilize distraction or avoidance coping in response to the TSST. There were significant differences when accounting for life stressors demonstrated protracted cortisol recovery when primed with distraction, yet more efficient cortisol recovery when primed with avoidance (Bendezu & Wadsworth, 2017). This study will build upon these findings by examining naturally occurring coping strategies in the context of a wider range of stress responses.

Trier Social Stress Task and Inducing Stress

Much of the research cited thus far utilized the Trier Social Stress Task (TSST) to induce stress. The TSST is one of the most utilized stress-response inducing activities in labs due to its consistent ability to induce stress and physiological reactivity (Allen et al., 2016). The task also proves to be a reliable and valid stress test in both adult and adolescent populations (Allen et al., 2016). However, the task only simulates a single type of stress: social. Urban adolescent

populations experience heightened stress exposure to a variety of stressors. In an ongoing study, urban adolescents were interviewed using the Youth Life Stress Interview and interviews were qualitatively analyzed to develop stressor taxonomic categories (Grant et al., 2020). These categories are threat, conflict, loss (or lack), and humiliation. They are each hypothesized to be related to specific physiological, emotion, and mental health outcomes. For instance, unlike the TSST, research indicates that loss and humiliation tasks are expected to dampen physiological systems (Grant et al., 2020). Utilizing stress tasks of different categories better replicates the variety of stressors that urban adolescents experience. This research will incorporate four novel stress-inducing tasks rather than a single social stress task. Doing so will help specify which coping strategies are most effective with each type of stressor.

The Current Study

The way one copes with a stressor can influence the effects that this stressor has on health outcomes. This study explores how coping strategies affect cortisol reactivity in response to different types of stressors among urban adolescents. The current research on coping is clearer among adult populations than it is among adolescents. Additionally, many studies do not assess coping at the same time as the stressor. Disengagement coping may be less effective in reducing cortisol reactivity, but this examination has been limited to social stress thus far. When studying how urban adolescents cope and how coping affects their cortisol reactivity in the moment of the stressor, research ought to consider the variety of stressors they experience. Similarly, the effects of sex and stress history on cortisol reactivity are less understood in this population. There is a need to identify the relationship between coping and cortisol reactivity across a variety of stressors in those youth who experience an increase in stress. It is also crucial to consider the effects that possible confounding variables like sex and stress history have on the relationship

between coping and cortisol reactivity. Such research will provide a comprehensive look at how urban adolescents can best handle stress, develop effective coping strategies, and reduce their risk for poor physical and mental health outcomes.

Hypothesis I. Disengagement coping responses will be predictive of cortisol peak; engagement coping responses will not be predictive of cortisol peak. Adolescents who report utilizing higher levels of disengagement coping strategies will demonstrate greater cortisol peaks.

Research Question I. What is the impact of stress task on coping and cortisol peak? (a) Do disengagement and disengagement coping responses vary by stress task? (b) Does the impact of engagement and disengagement on cortisol peak vary as a function of stress task?

Research Question II. Does the impact of engagement and disengagement on cortisol peak vary as a function of sex among adolescents?

Research Question III. Does the impact of engagement and disengagement on cortisol peak vary as a function of stress history among adolescents?

Method

Participants

Participants were recruited for two waves of data collection: Fall of 2012 and Spring of 2013. For Time 1, adolescent participants (N = 379) were recruited from three diverse urban schools (two K-8th grade schools; one high school). DePaul University Research staff visited classrooms, described the study, and distributed consent forms for parents to sign. Adolescents received a $50 gift card from Target, Old Navy, or Best Buy as an incentive for participation. For Time 2, adolescent participants were recruited by contacting participants directly and they were offered the same gift card compensation. A total of 199 adolescents participated in Time 2 as well. At Time 2, participants had a mean age of 14.99 (*SD* = 1.949), were majority female (57.2% female), and were ethnically/racially diverse (see Table 1).

Table 1
Descriptive Statistics of Ethnicity and Race for Participants of Time 2

Ethnicity or Race	*n*	%
Hispanic	73	36.3
Black	85	42.3
Asian American	28	13.9
American Indian or Alaskan Native	11	5.5
Native Hawaiian or Other Pacific Islander	1	0.5
White or Caucasian	40	19.9
Biracial or Multiracial	28	13.9
Other	24	11.9

Procedure

Youth protocol administration took place at DePaul University during Saturday sessions each lasting 8.5 hours (9:00 AM to 5:30 PM) for both Time 1 and Time 2. Participants were divided into smaller groups of 12-16 students, each of which had 2 or 3 adults supervising the group. Each group completed questionnaires assessing stressors, mental and physical health and academic outcomes, and potential moderators of stress effects. Participants were also randomly assigned to participate in two of four stress tasks along with saliva sample collection and a post-stress task survey. Several health measurements such as salivary/oral measures of cortisol were taken from each participant.

Stressor Protocol

At Time 2, youth participated in two of four minor stress tasks. Each task lasted about 30 minutes. Prior to stressor exposure, youth were fitted with Biopac and Dinamap Pro systems, which monitored heart rate and blood pressure. The tasks were focused on four stressor domains: conflict, loss, threat, and humiliation.

Conflict. For the conflict task, participants were gathered into a group and told that they will win money if they were one of the first two students to complete a shape matching task. Participants were led to believe that two other students in their group had cheated at the task and won the money. In reality, the participants were given a task that cannot be completed and the "students" who won the money were actually confederates, part of the research team.

Loss. For the loss task, participants were asked to play a card-matching game. They were told they have the opportunity to win $50 in gift cards, but only if they found a certain number of matches. The participants would win $50 in gift cards at the beginning of the game, then proceed to lose $10 in gift cards five times throughout the game. In reality, the card game was designed

so that the participants would win the maximum amount of gift card money early on then lose it all.

Threat. For the threat task, participants were told they will complete an aptitude test and that a researcher will use a buzzer to alert them when they get a question wrong or they are going too slowly. In reality, the researcher used the buzzer at two random times during the test, regardless of the participant's performance. The purpose of the task was to study how the participant reacts to threat (in this case, the threat of the buzzer).

Humiliation. For the humiliation task, participants were asked to engage in a game with other students to name US state capitals. The participant was told that, in order to win, they must shout the answer before the other students. Then, during the course of the game, the other students consistently answered the questions before the participant had a chance to, causing the participant to lose the game. In reality, the other students were actually confederates, part of the research team, who had the answers ahead of time. The purpose of the study was to examine how participants react, biologically and emotionally, to mild embarrassment.

Measures

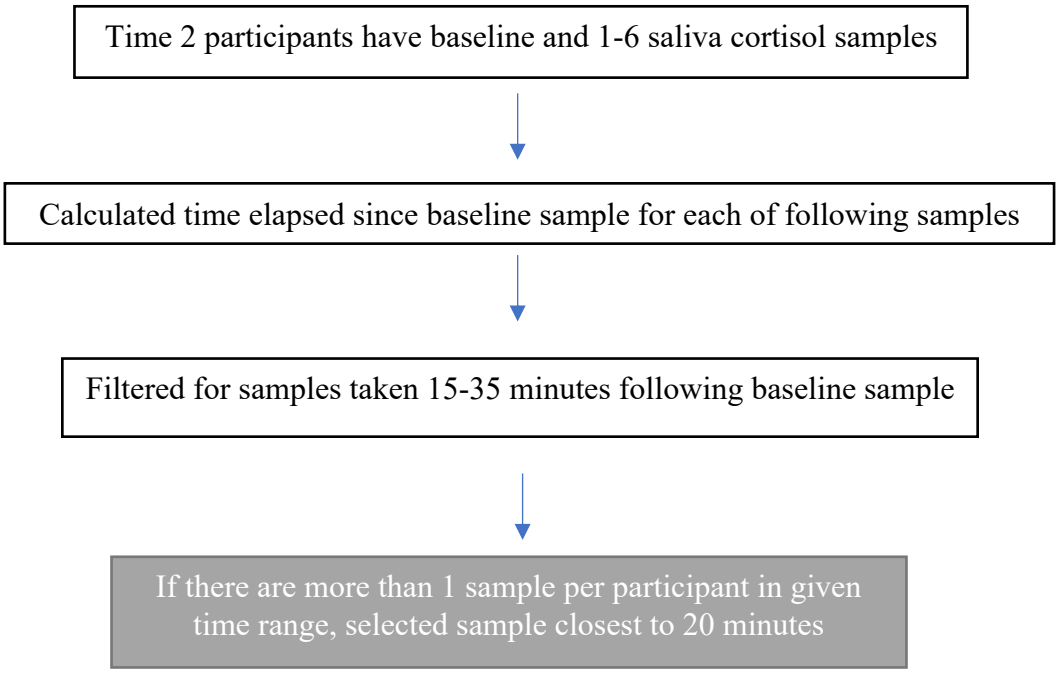
Cortisol Reactivity

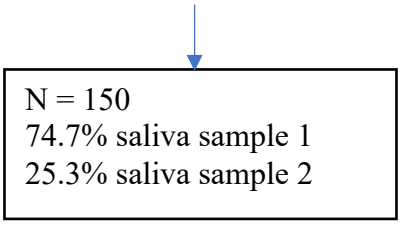
All participants attended a saliva sampling demonstration and practice sample led by research assistants for the cortisol testing. Participants used a passive drool technique – they expressed unstimulated saliva through a small straw into a small polypropylene vial. All samples were labeled with ID number only along with the date and time of each sample. Samples were frozen and centrifuged at an external lab for cortisol concentrations. Saliva samples were gathered from participants before, during and after the minor stressor challenge protocol in Time 2. During Time 2, participants provided a maximum of seven throughout the four minor stressor tasks: one

baseline, four after each of the assigned stress tasks (both lab-induced and interview-induced), and two post-stress task recovery saliva samples. Cortisol values taken during each of the stress tasks were used to create a cortisol peak value. Cortisol peak is calculated by subtracting the cortisol concentration in the baseline saliva sample from the cortisol concentration in the stress task saliva sample. The difference between these two values quantifies the change in cortisol as a result of that stress task.

This study utilized two saliva samples from each participant. Specifically, we decided to select samples that were obtained 15-35 minutes following the baseline value. Doing so ensures that the stress task had enough time to affect the participants' cortisol reactivity (Kirschbaum et al., 1993). Figure 1 provides a flow chart of the procedure for selecting cortisol samples for analyses in this study. This selection criteria resulted in the usage of 150 participants' cortisol samples with an average time elapsed since the baseline sample was obtained of 23.52 minutes (SD = 6.584).

Figure 1
Flow Chart of Cortisol Sample Selection





Coping

Coping was assessed with the Brief Response to Stress Questionnaire (BRSQ). Following each minor stress task, participants were asked to complete the Brief Response to Stress Questionnaire. This survey was created with the guidance of the RSQ's primary author (Kathryn Grant & Bruce Compas, personal communication, March, 2013). It asked participants to report the coping strategies they utilized in response to the stressor they just experienced. Questions rated the use of acceptance, avoidance, cognitive restructuring, distraction, problem-solving, rumination, and social-support seeking on a five-point scale (1 = not at all, 5 = very much).

The scores from each of the Brief Response to Stress Questionnaire items will be used to create a "disengagement" and "engagement" coping score. Preliminary analyses were performed to determine how to best categorize the individual coping items measured in this study: engagement or disengagement. The originally hypothesized classification of disengagement coping included distraction coping, but researchers found distraction coping was more aligned with engagement coping (Compas et al, 2001). Correlations were run with each individual coping item and showed that distraction was most closely related to avoidance coping, an item on the disengagement composite scale (Table 2). The engagement composite included five items: problem solving, cognitive restructuring, acceptance, social support seeking, and rumination

(Compas et al, 2001). The disengagement composite included two items: distraction and avoidance.

Table 2
Correlation Table of Coping Strategy Scores Across Stress Tasks

Coping Strategy	1	2	3	4	5	6	7
1. Problem Solving	-						
2. Cognitive Restructuring	.578**	-					
3. Acceptance	.294**	.428**	-				
4. Distraction	.343**	.369**	.302	-			
5. Avoidance	.305**	.312**	.243**	.726**	-		
6. Social Support Seeking	.337**	.301**	.122*	.247**	.237**	-	
7. Rumination	.395**	.350**	.210**	.330**	.259**	.257**	-

The disengagement and engagement coping scores from the BRSQ were averaged within each lab-induced stress task and then averaged across stress tasks for overall engagement and disengagement coping scores. Additionally, a ratio score was created for coping. The average disengagement coping score was divided by the average engagement coping score for each stress task. An additional ratio coping score was created using the overall average disengagement coping score and the overall average engagement coping score across stress tasks for an overall coping ratio score for each participant. Coping ratio scores were created for those individuals with engagement coping scores greater than zero.

Puberty and Sex

To assess the participants' pubertal development, they were asked to complete the Pubertal Development Scale (Petersen et al., 1988) during Time 1. The self-report survey asked participants to complete questions based on whether they are male or female. Questions for males assessed five dimensions: body hair, facial hair, voice change, skin change, and growth spurt. Participants responded using a four-point scale (1 = no development and 4 = complete

development). Questions for females asked about body hair, skin change, breast development, menstruation, and growth spurt. Female participants answered questions on either a four-point scale or yes-no. Preliminary t-test results found significant differences in PDS scores between male and female participants, $t(138) = 3.709$, $p < .001$. As found in previous research, female scored higher on pubertal development ($M = 16.57$, $SD = 3.03$) compared to males ($M = 14.66$, $SD = 3.01$). PDS scores therefore served as a covariate or control variable with analyses related to sex.

Stress History

The Urban Adolescent Life Experiences Scale (UALES; Allison et al., 1999) was used to measure stressful life events using self-report. The UALES items were designed using low-income urban and ethnically diverse youth (Allison et al. 1999). Participants were asked to rate the frequency with which they experience a particular stressful event on a scale of 1 to 5 (1 =never, 5 = often). Some items from the UALES were removed so that there were no positive events nor significantly high correlations between the stressor and psychological symptoms. The modified UALES had a two-week test-retest reliability of .80 and internal consistency reliability of .92 (Grant et al., 2000).

Time

Cortisol levels vary depending on the time of day, even in adolescent populations (Rotenberg et al., 2012). Because of this, the time of day can have an impact on the cortisol peak values calculating in this study. Time of day, therefore, served as a covariate or control variable when performing analyses with cortisol peak values.

Results

Correlations between each of the variables used for analyses in this study can be found in Table 3. Descriptive statistics for each of the variables across the stress tasks can be found in Table 4.

Table 3
Correlations Between All Variables Used for Analyses

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Time	-												
2. Cortisol peak	.03	-											
3. Prob Solv	.24*	-.07	-										
4. Cog Restruct	.04	-.21	.45**	-									
5. Acceptance	.04	-.19	.33**	.48**	-								
6. Distraction	.29*	-.11	.23*	.20	.27*	-							
7. Avoidance	.22	-.19	.33**	.23*	.21	.83**	-						
8. Soc Supp Seek	.02	-.30**	.31**	.22	.14	.30**	.29*	-					
9. Rumination	.12	-.01	.33**	.34**	.06	.09	.07	.26*	-				
10. Engagement	.15	-.25*	.75**	.78**	.66**	.33**	.34**	.50**	.57**	-			
11. Disengage	.27*	-.15	.29*	.22	.25*	.96**	.95**	.31**	.09	.35**	-		
12. Coping Ratio	.25*	.06	-.17	-.25*	-.06	.72**	.65**	-.05	-.13	-.22	.72**	-	
13. UALES	.08	-.05	.21	.31**	-.03	.10	.06	.12	.36**	.29*	.08	-.13	-
14. PDS	-.06	-.02	.04	.12	.24*	-.09	-.09	-.04	.01	.13	-.10	-.11	.09

Note. Time = time of sample taken, Prob Solv = problem solving, Cog Restruct = cognitive restructuring, Soc Supp Seek = social support seeking, Disengage = Disengagement Coping.
* $p < .05$. ** $p < .01$.

Table 4
Descriptive Statistics for Variables Across the Stress Tasks.

	Total			Loss			Humiliation			Threat			Conflict		
	n	M	SD	n	M	SD	n	M	SD	n	M	SD	n	M	SD
Time	150	13:55	2:27	27	13:53	2:39	25	13:18	2:41	10	13:48	2:25	19	14:02	2:30
Cortisol Peak	150	-.01	.07	27	.01	.08	25	-.02	.04	10	-.05	.15	19	-.01	.03
Prob Solv	76	1.22	1.29	25	.96	1.24	23	1.35	1.19	10	2.10	1.37	18	.94	1.30
Cog Restruct	76	1.50	1.27	25	1.20	1.26	23	1.35	1.30	10	2.20	1.23	18	1.72	1.18
Acceptance	76	1.91	1.36	25	1.68	1.41	23	1.70	1.29	10	2.10	1.52	18	2.39	1.24
Distraction	76	.97	1.25	25	.76	1.09	23	.78	1.04	10	1.30	1.34	18	1.33	1.61
Avoidance	76	.80	1.08	25	.56	.96	23	.70	1.02	10	1.20	1.32	18	1.06	1.16
Soc Supp Seek	76	.37	.83	25	.12	.33	23	.17	.49	10	1.20	1.40	18	.50	.99
Rumination	76	.84	1.10	23	.68	.90	23	.91	1.28	10	1.10	1.20	18	.83	1.10
Engagement	76	1.17	.78	25	.93	.66	23	1.10	.83	10	1.74	.94	18	1.28	.64
Disengagement	76	.89	1.11	25	.66	.98	23	.74	.99	10	1.25	1.30	18	1.19	1.32
Coping Ratio	69	.91	1.28	22	.86	1.21	20	.96	1.51	9	.64	.52	18	1.06	1.42
UALES	137	137.50	19.38	25	132.66	15.86	23	139.57	18.40	9	142.56	10.62	18	138.31	21.20
PDS	141	15.59	3.41	25	15.88	3.15	24	15.21	3.54	10	15.60	2.22	10	16.44	3.38

Note. The sum number of cortisol samples used in each of the individual stress tasks does not equal the total number of cortisol samples selected. Some of the cortisol samples selected did not correspond with the lab-based stress task or there was missing information regarding the stress task.
[a] Time = time of sample taken, Prob Solv = problem solving, Cog Restruct = cognitive restructuring, Soc Supp Seek = social support seeking.

Hypothesis I. Disengagement coping responses will be predictive of cortisol peak; engagement coping responses will not be predictive of cortisol peak. Adolescents who report utilizing higher levels of disengagement coping strategies will demonstrate greater cortisol peak.

Linear Regression analyses were conducted to determine whether engagement coping, disengagement coping, or the coping ratio would be predictive of cortisol peak across the stress tasks. The coping scores averaged across the stress tasks each served as independent variables when predicting the cortisol peak, the dependent variable. The time that the sample was taken served as a covariate in these analyses. Although the regression equation for engagement coping

usage while accounting for time was not significant (R^2 = .067, F(2,72) = 2.594, p = .082), engagement coping was found to be a significant predictor of cortisol. These results show that higher levels of engagement coping were associated with lower cortisol peak values. See full results in Table 5. Neither the disengagement (R^2 = .030, F(2,72) = 1.121, p = .332) nor coping ratio scores (R^2 = .009, F(2,65) = .287, p = .752) were predictive of cortisol peaks across stress tasks.

Table 5

Linear Regression Analysis: Predicting Cortisol Peak from Engagement, Disengagement, and the Coping Ratio

Predictor	*b*	$CI_{95\%}$ for *b*		β	*p*
		Lower	Upper		
Engagement Coping					
(Constant)	-.014	-.109	.081		.764
Time	<.001	.000	.000	.076	.510
Engagement	-.025	-.048	-.048	-.259	.027
Disengagement Coping					
(Constant)	-.037	-.134	.060		.448
Time	-.012	-.028	.004	-.176	.148
Disengagement	<.001	.000	.000	.085	.482
Coping Ratio					
(Constant)	-.049	-.153	.055		.352
Time	<.001	.000	.000	.072	.575
Coping Ratio	.003	-.012	.018	.045	.726

Research Question I. What is the impact of stress task on coping and cortisol peak? (a) Do engagement and disengagement coping responses vary by stress task? (b) Does the impact of engagement and disengagement on cortisol peak vary as a function of stress task?

ANOVA tests were performed to determine if disengagement coping scores, engagement coping scores, and the coping ratio scores varied across the four different lab-based stress tasks: loss, humiliation, threat, and conflict. Engagement coping utilization varied significantly across stress tasks ($F(3,344) = 5.134$, $p = .002$). Engagement coping was significantly higher for the threat stress task ($M = 1.29$, $SD =. 87$) compared to the loss ($M = .84$, $SD =.73$) and the humiliation stress tasks ($M = .94$, $SD = .80$). The coping ratio was also found to vary significantly across stress tasks ($F(3,291)=4.360$, $p = .005$). The coping ratio was significantly higher for humiliation ($M = 1.49$, $SD = 2.71$) compared to loss ($M = .78$, $SD = 1.05$) and threat ($M = .64$, $SD = .75$). Disengagement coping utilization did not vary significantly across the stress tasks ($F(3,344) = 1.671$, $p = .173$). ANOVA results for engagement coping, disengagement coping, and coping ratio usage between the stress tasks can be found in Table 6.

Table 6
ANOVA and Bonferroni of Engagement, Disengagement, and Coping Ratio by Stress Task

					Bonferroni		
Coping Strategy	Stress Task	*n*	*M*	*SD*	Loss	Humiliation	Threat
Engagement	Loss	86	.84	.73			
	Humiliation	87	.94	.80	1.000		
	Threat	86	1.29	.87	.001*	.024*	
	Conflict	89	.98	.77	1.000	1.000	.059
Disengagement	Loss	86	.62	.92			
	Humiliation	87	.95	1.18	1.000		
	Threat	86	.92	1.19	.425	1.000	
	Conflict	89	.86	1.07	.853	1.000	1.000
Coping Ratio	Loss	71	.78	1.05			
	Humiliation	74	1.49	2.71	.043*		
	Threat	78	.64	.75	1.000	.006	
	Conflict	72	.80	.94	1.000	.055	1.000

* $p < .05$

The PROCESS macro in SPSS was utilized to evaluate the moderating effects that stress task has on the relationship between each type of coping (disengagement, engagement, and ratio) and cortisol peak. Model 1, a simple moderation, was used with coping serving as the independent variable to predict cortisol peak, the dependent variable and stress task moderating this relationship. The time that the sample was taken was also a covariate in these analyses. No significant moderating effects were found for any of the relationships between coping and cortisol peak. Full results can be found in Tables 7-9.

Table 7

Moderating Effects of Stress Tasks on the Relationship Between Engagement Coping and Cortisol Peak.

Predictor	b	CI(95%) for b		p
		Lower	Upper	
(Constant)	-.0152	-.1278	.0974	.7880
Engagement	-.0086	-.0550	.0379	.7135
Time	.0582	-.1083	.2247	.4879
Humiliation	-.0292	-.1043	.0459	.4403
Threat	.0474	-.0694	.1641	.4209
Conflict	-.0182	-.1147	.0783	.7073
Eng X Hum	.0007	-.0596	.0610	.9816
Eng X Thr	-.0580	-.1288	.0127	.1063
Eng X Con	-.0025	-.0758	.0708	.9464

Note. Fit for model R^2 = .1532, $F(8,66)$= 1.4930, p = .1767. Sample size = 74.

Table 8

Moderating Effects of Stress Tasks on the Relationship Between Disengagement Coping and Cortisol Peak.

Predictor	*b*	$CI_{95\%}$ for *b*		*p*
		Lower	Upper	
(Constant)	-.0174	-.1235	.0888	.7448
Disengagement	-.0032	-.0251	.0287	.8419
Time	.0516	-.1212	.2244	.5529
Humiliation	-.0271	-.0825	.0283	.3318
Threat	-.0152	-.0933	.0629	.6994
Conflict	-.0236	-.0853	.0382	.4491
Dis X Hum	-.0035	-.0494	.0425	.8811
Dis X Thr	-.0348	-.0851	.0156	.1730
Dis X Con	.0008	-.0416	.0432	.9696

Note. Fit for model R^2= .1192, $F(8,66)$ = 1.1170 p = .3636. Sample size = 69.

Table 9

Moderating Effects of Stress Tasks on the Relationship Between Coping Ratio and Cortisol Peak.

Predictor	*b*	$CI_{95\%}$ for *b*		*p*
		Lower	Upper	
(Constant)	-.0370	-.1487	.0748	.5106
Coping Ratio	.0099	-.0175	.0373	.4734
Time	.0696	-.1123	.2514	.4469
Humiliation	-.0293	-.0873	.0286	.3156
Threat	-.0364	-.1284	.0557	.4324
Conflict	-.0156	-.0763	.0452	.6102
CR X Hum	-.0096	-.0456	.0263	.5932

CR X Thr	-.0660	-.1717	.0398	.2170
CR X Con	-.0115	-.0490	.0261	.5435

Note. Fit for model R^2 = .1453, $F(8,59)$ = 1.2540, p = .2850. Sample size = 67.

Research Question II. Does the impact of engagement and disengagement on cortisol peak vary as a function of sex among adolescents?

ANCOVAs were conducted to determine whether sex affects the relationship between coping and cortisol peak across all of the stress tasks. Three ANCOVAs were conducted using the three types of coping (disengagement, engagement, and ratio). Covariates included the time that the sample taken and pubertal development scores. Statistical tests found no significant results for engagement coping. However, there were significant results for the disengagement coping and coping ratio models. Disengagement coping and sex interacted significantly to predict cortisol peak values, $F(6,55)=8.372$, $p < .001$. Coping ratio and sex interacted significantly, $F(6,30)=6.161$, $p < .001$. Independent T-Tests were performed to evaluate how cortisol peaks differed between high and low levels of disengagement coping and coping ratio by sex. Significant differences in cortisol were only found between high and low levels of disengagement coping for male adolescents ($t(37) = -2.331$, $p = .025$) such that cortisol peaks were significantly greater for males reporting lower disengagement coping scores (See Table 10).

Table 10
Mean Cortisol Peaks For Disengagement Coping and Coping Ratio Usage by Sex.

	Disengagement Coping		Coping Ratio	
Gender	High	Low	High	Low

Female	-.0121	-.0212	-.0180	-.0170
Male	-.0296*	.0072*	-.0257	-.0108

Note: * $p < .05$

The PROCESS macro in SPSS was utilized to evaluate the moderating effects that sex has on the relationship between each type of coping (disengagement, engagement, and ratio) and cortisol peak. Model 1, a simple moderation, was used with coping serving as the independent variable to predict cortisol peak, the dependent variable and participants' sex moderating this relationship. The time that the sample was taken and total PDS score were also covariates in these analyses. No significant moderating effects were found for any of the relationships between coping and cortisol peak. Full results can be found in Table 11.

Table 11

Moderating Effects of Sex on the Relationship Between Engagement, Disengagement, and Coping Ratio and Cortisol Peak.

Predictor	*b*	$CI_{95\%}$ for *b*		*p*
		Lower	Upper	
Engagement				
(Constant)	.0193	-.1599	.1986	.8303
Engagement	-.0452	-.2157	.0353	.2660
Sex	-.0053	-.0726	.0621	.8761
Engagement X Sex	.0125	-.0354	.0603	.6047
Time	.0709	-.1008	.2425	.4128
PDS	-.0022	-.0081	.0036	.4504
Disengagement				

(Constant)	-.0083	-.1745	.1580	.9212
Disengagement	.0012	-.0550	.0573	.9671
Sex	.0124	-.0353	.0600	.6060
Disengagement X Sex	-.0096	-.0434	.0242	.5728
Time	.0920	-.0888	.2727	.3135
PDS	-.0041	-.0100	.0018	.1725
Coping Ratio				
(Constant)	-.0216	-.2162	.1731	.8255
Coping Ratio	.0311	-.0272	.0894	.2901
Sex	.0094	-.0405	.0594	.7074
Coping Ratio X Sex	-.0179	-.0512	.0155	.2883
Time	.0685	-.1261	.2630	.4841
PDS	-.0033	-.0101	.0035	.3385

Note. Fit for model (Engagement) R^2 = .0868, $F(5,67)$ = 1.2733, p = .2858. Sample size = 72.
Fit for model (Disengagement) R^2= .0664, $F(5,67)$ = .9536, p = .4526. Sample size = 72.
Fit for model (Coping Ratio) R^2= .0404, $F(5,60)$ = .5055, p = .7709. Sample size = 65.

Research Question III. Does the impact of engagement and disengagement on cortisol peak vary as a function of stress history among adolescents?

The PROCESS macro in SPSS was utilized to evaluate the moderating effects that stress history has on the relationship between each type of coping (disengagement, engagement, and ratio) and cortisol peak. Model 1, a simple moderation, was used with coping serving as the independent variable to predict cortisol peak, the dependent variable and the total UALES score moderating this relationship. The time that the sample was taken was also a covariate in these

analyses. No significant moderating effects were found for any of the relationships between coping and cortisol peak. Full results can be found in Table 12.

Table 12

Moderating Effects of Stress History on the Relationship Between Engagement, Disengagement, and Coping Ratio and Cortisol Peak.

Predictor	*b*	$CI_{95\%}$ for *b*		*p*
		Lower	Upper	
Engagement				
(Constant)	.0502	-.2106	.3111	.7018
Engagement	-.0409	-.2166	.1348	.6435
UALES	-.0006	-.0025	.0012	.5046
Engagement X UALES	.0002	-.0010	.0014	.7477
Time	.0563	-.1074	.2199	.4947
Disengagement				
(Constant)	.0581	-.1266	.2428	.5319
Disengagement	-.0575	-.1824	.0674	.3615
UALES	-.0008	-.0021	.0004	.1966
Disengagement X UALES	.0003	-.0005	.0012	.4341
Time	.0796	-.0898	.2489	.3516
Coping Ratio				
(Constant)	.0572	-.1405	.2549	.5649
Coping Ratio	-.0260	-.1796	.1276	.7361
UALES	-.0007	-.0020	.0006	.2971
Coping Ratio X UALES	.0002	-.0009	.0013	.7261
Time	.0311	-.1514	.2137	.7343

Note. Fit for model (Engagement) R^2 = .0416, F(4,64) = .6943, p = .5987. Sample size = 69.
Fit for model (Disengagement) R^2 = .0493, F = .8300 (4,64), p = .5111. Sample size = 69.
Fit for model (Coping Ratio) R^2 = .0235, F = .3548 (4,59), p = .8397. Sample size = 64.

Follow-up analyses were done to explore the individual coping variables that comprise the engagement, disengagement, and coping ratio scores. Stress history was correlated significantly with three individual coping items: cognitive restructuring (r(70) = .309, p = .009), rumination (r(70) = .361, p = .002), and engagement coping (r(70) = .291, p = .015) across the stress tasks. Post-hoc linear regressions were conducted between stress history and each of those items. For each of the regressions, the UALES total score served as the independent variable predicting the coping items, the dependent variables. Stress history significantly predicted cognitive restructuring, rumination, and engagement coping scores. Full results can be found in Table 13.

Table 13
Linear Regression Results: Stress History and Cognitive Restructuring, Rumination, and Engagement Coping

Predictor	*b*	$CI_{95\%}$ for *b*		β	*p*
		Lower	Upper		
Cognitive Restructuring					
(Constant)	131.090	124.802	137.378		.000
Cognitive Restructuring	4.262	1.084	7.440	.309	.009
Rumination					
(Constant)	1312.400	127.292	137.507		.000
Rumination	5.716	2.142	9.289	.361	.002
Engagement					
(Constant)	129.472	121.869	137.076		.000

Engagement	6.600	1.348	11.852	.291	.015

Note. Fit for model (Cognitive Restructuring) R^2 = .095, $F(1,68)$=7.160, p = .009 Sample size = 67.
Fit for model (Rumination) R^2 = .130, $F(1,68)$ = 10.199, p = .002, Sample size = 67.
Fit for model (Engagement) R^2 = .085, $F(1,68)$ = 6.289, p = .015, Sample size = 67.

Discussion

The current study examined how variation in coping affects adolescents' cortisol peak following different lab-induced stress tasks. Specifically, this study evaluated how the engagement/disengagement coping classification affects cortisol reactivity as well as whether gender and stress history affects this relationship. The first hypothesis that disengagement coping would predict greater cortisol peak was not supported. The hypothesis that engagement coping would not be predictive of cortisol peak was not supported: engagement coping was found to be predictive of cortisol peak. The first research question explored how the disengagement and engagement coping varied across different stress tasks with engagement coping being used more during the threat stress task and the coping ratio being greater for the humiliation stress task. The second question explored how sex affects the relationship between disengagement and engagement coping and cortisol peaks across the stress tasks was partially supported: males who utilized more disengagement coping had smaller cortisol peaks in response to the stress tasks. The third question explored how stress history affects the relationship between coping and cortisol peaks across the stress tasks and was partially supported: stress history significantly predicted usage of cognitive restructuring, rumination, and overall engagement coping scores.

Coping & Stress Type

The engagement/disengagement coping categorization is based on whether one copes by directly "engaging" with one's reactions to the stressors – physical, emotional, mental – or

removing oneself from the responses to the stress, or "disengaging". Disengagement coping has been associated with elevated physiological stress responses such as elevated cortisol and slower steeper recovery (Gross & Levenson, 1997; Lam et al., 2009). However, the present study did not find disengagement coping to predict greater cortisol peaks. Rather, greater use of engagement coping predicted lower cortisol peaks. A possible reason for this is greater use of coping overall may lead to decreases in cortisol reactivity in response to a stressor (Compas et al., 2005). Previous research has found that greater use of engagement coping is related to more adaptive regulation of stress responses such as cortisol reactivity (Sladek et al., 2017).

Results of this study indicate that adolescents cope differently depending on the type of stressor. The procedure allowed for adolescents to self-report the coping strategies that they decided to implement for each specific stress task. The variation in the coping for the stress tasks shows that adolescent feel that coping strategies should be implemented differently to better "cope" with the stressor. However, the type of stress they experienced did not prove to be a significant moderator in the relationship between coping utilization and cortisol peak. This study was unable to support a match theory, or that certain coping strategies were more effective in regulating cortisol reactivity depending on the type of stressor. The lack of significant results with coping affects cortisol peak as a function of stress task may be due to the reliance on cortisol peak rather than cortisol AUC as in previous studies (Lam et al., 2009, Ordaz & Luna, 2012; Reschke-Hernández et al., 2017; Bendezu & Wadsworth, 2017).

Sex & Stress History

Additionally, moderation analyses found that sex was not a significant moderator in this relationship. Previous literature states that male adolescents and adults tend to have greater cortisol output and slower recovery in response to the TSST compared to females (Ordaz &

Luna, 2012; Reschke-Hernández et al., 2017). Post-hoc T-Test did not find any significant differences in cortisol peak between male and female adolescents in this study. Many studies that have identified consistent sex differences in cortisol reactivity following a stress task utilized multiple cortisol measurements like AUC (Kirschbaum et al., 1992; Seeman et al., 2001; Uhart et al., 2006). Contrary to these studies, this study utilized cortisol peak and was unable to analyze full cortisol reactivity. The lack of differences by sex in cortisol peak may be due to it being one metric of cortisol rather than the cortisol AUC which includes multiple metrics. Furthermore, female adolescents tend to utilize engagement coping more whereas male adolescents use disengagement coping more (Copeland & Hess, 1995). Significant sex differences in coping and cortisol reactivity have only been found in response to the TSST. This study utilized four different stress tasks. Although the moderation model did not prove to be significant, sex seems to have an interactive effect on how disengagement coping affected cortisol peak across the stress tasks among adolescent males but not females. These results provide some initial evidence that sex affects how coping regulates physical stress responses. Sex differences in cortisol reactivity and coping and their relationship may be attributed to hormonal and social differences between male and female adolescents (Roberts & Lopez-Duran, 2019).

Exposure to a multitude of stressors in childhood has significant effects on adolescents' coping and physiological stress response. Previous literature indicates that greater stress history results in higher cortisol reactivity in response to the TSST (Harkness et al., 2011; Hackman et al., 2012). Alternatively, chronic stress has been associated with hypocortisolism which results in small increases in cortisol following a stressor, such as the cortisol peak (Tacket et al., 2017; Adam et al., 2007). The present study did not find stress history to be related to cortisol peaks across various stress tasks. Cortisol peak as a singular metric may not be an accurate indicator of

the complete cortisol stress response given that previous studies incorporated multiple cortisol measurements. Stress history can affect cortisol peak, total cortisol output (AUC), and recovery of cortisol levels (Burke et al., 2005; Blair et al., 2005). Evaluating cortisol reactivity through multiple metrics (total AUC, recovery slope, and peak cortisol values) may provide more information into how stress history affects physiological stress responses. Stress history has also been shown to increase one's reliance on disengagement (Kim et al., 2016). For example, greater exposure to stress over the lifetime, such as poverty, has been shown to be longitudinally predictive of disengagement coping usage in youth populations (Kim et al., 2016). Although the results of this study differ from those of past studies, stress history appears to have an effect on which coping strategies adolescents use across stress tasks. Stress history may have an effect on coping usage because exposure to multiple stressors among children can impair the development of self-regulation skills, increase risk for learned helplessness, and affect their perception of locus of control (Kim et al., 2016; Blair et al., 2011; Evans & Kim, 2013; Boyraz et al., 2019).

Strengths

This study provides several strengths. First, this study was the first of its kind to analyze how adolescents use different coping strategies across different lab-based stress tasks. Few studies have studied how coping affects cortisol reactivity in adolescents, and all of these studies have utilized the TSST (Lam et al., 2009; Bendezu & Wadsworth, 2017). Using four different stress tasks better represents the variety of stressors that adolescents experience rather than a singular social stressor. This research design also allows researchers to evaluate how the relationship between coping and cortisol reactivity differs depending on the stressor. Doing so provides greater validity and variation that could contribute to the design of comprehensive interventions in coping, emotional regulation, and stress management.

This study also added two variables that have been shown to affect coping, cortisol reactivity and their relationship: sex and stress history. Previous studies have analyzed how sex and stress history can affect coping and cortisol reactivity (Lam et al., 2009, Ordaz & Luna, 2012; Reschke-Hernández et al., 2017; Harkness et al., 2011; Hackman et al., 2012; Bendezu & Wadsworth, 2017). Male adolescents have been shown to utilize disengagement coping in responses to socio-evaluative stress and have more elevated cortisol reactivity (Copeland & Hess, 1995; Ordaz & Luna, 2012). Female adolescents have been shown to utilize more coping strategies and use engagement coping more than males (Tamres et al., 2002; Copeland & Hess, 1995). However, to the author's knowledge, there have not been any studies looking at the interactive effects of sex and coping to predict cortisol peaks among adolescent populations. Adolescents with greater stress history have also demonstrated greater reliance on disengagement coping and elevated cortisol reactivity (Harkness et al., 2011; Hackman et al., 2012; Kim et al., 2016; Cantave et al., 2019). Additionally, stress history has been shown to interact with coping to predict cortisol reactivity, which provides evidence for the moderating effects that stress history may have (Bendezu & Wadsworth, 2017). Evaluating these two variables in this study creates a highly comprehensive study. By combining these variables into one study, this study hoped that the moderating analyses would add more specificity to groups of adolescents. These show how the additional variables, such as sex and stress history, can have a significant effect on how adolescents cope and their physical stress responses.

Limitations

This study is not without its limitations. One of the primary limitations of the study was its procedure regarding the saliva samples to obtain cortisol concentrations. The intended procedure would have obtained enough saliva samples to create an area under the curve (AUC)

cortisol value, or overall cortisol output in response to the stressor. Having an AUC value as well as multiple cortisol samples for a singular stress task provides a more comprehensive measurement of cortisol reactivity. Instead, this study had to rely solely on a peak cortisol value. Previous literature on the relationship between coping and cortisol utilizes AUC values (Lam et al., 2009; Ordaz & Luna, 2012; Reschke-Hernández et al., 2017; Bendezu & Wadsworth, 2017). Because this study did not have such values, we could not evaluate how coping across the various stressors affected cortisol reactivity and total output. This limitation may have contributed to the lack of support for the hypothesis as well as contrary findings to previous research. The peak in cortisol merely provides one metric into cortisol reactivity rather than multiple. Additionally, cortisol is only physiological stress metric; future studies should examine how different measures of physiological stress responses such as salivary alpha-amylase (sAA), blood pressure, and heart rate are affected by coping.

An additional limitation as a result of the variation in procedure was that there was less data than anticipated. Because of the possible contamination across the stress tasks, only one sample could be obtained from each participant. Each participant completed two lab-based stress tasks. Between the saliva sample being collected, the saliva samples being processed, the data being uploaded, and the data being filtered for this study, only 150 participants in Time 2 were included for the cortisol analyses. Furthermore, Table 4 shows that only 10 cortisol samples were included for the threat task. However, despite such few samples, significant results were found for the threat stress task. Replicating the study with more samples could provide more statistical power when analyzing the interactive effects that stress task may have on the relationship between coping and cortisol reactivity.

Future Directions for Research

This study provides a need for several different future directions. First, this study allowed participants to self-select coping strategies for each of the stress tasks. Such data demonstrated that participants selected different coping strategies depending on the type of stressor. However, these variations did not seem to have an effect on one's cortisol peak. Other studies have shown that assigned coping can have a direct effect on one's physiological stress responses (Gross & Levenson, 1997; Bendezu & Wadsworth, 2017). One study assigned participants to suppress their emotions in response to stimuli and those participants showed greater cardiovascular responses (Gross & Levenson, 1997). Another study found significant differences in cortisol AUC in response to the TSST between groups assigned to use avoidance or distraction (Bendezu & Wadsworth, 2017). Therefore, future studies ought to use an experimental design: assign coping strategies to the adolescents. Doing so will better evaluate if coping has a direct effect on one's cortisol reactivity and how this varies for different stress tasks. Such results can provide more insight into the coping fit theory.

Second, sex and stress history has been shown to play a significant role in coping strategy usage and cortisol reactivity. Do the effects of sex and stress history vary across different types of stressors? For instance, are sex differences in coping more prevalent during social stressors or for other types of stressors? Previous literature provides evidence for increased stress history having an elevating effect on total cortisol output among adolescents in response to the TSST (Harkness et al., 2011; Hackman et al., 2012). One's stress history may have differing effects on one's stress response system depending on the stressor. Additional analyses with a larger sample can further identify the role that sex and stress history can have in the relationship between coping and cortisol reactivity across various stressors with enough power.

Third, future research ought to incorporate longitudinal studies to evaluate how coping and cortisol reactivity in adolescence translates to adulthood. Previous literature suggests that those who utilize engagement coping more demonstrate more adaptive cortisol levels such as lower total cortisol output over the day levels (Sladek et al., 2017). However, to the author's knowledge, there are no studies that exist that look at the longitudinal relationship between coping and future cortisol reactivity across various stressors in youth populations. Such a study could provide insight into how habitual use of certain coping strategies affects cortisol reactivity over time.

Conclusions

This study aimed to explore how the relationship between coping and cortisol among adolescents varied across different stressful situations. We also analyzed the role that sex and stress history can have on this relationship. Adolescents were found to utilize coping differently based on the stress tasks and greater usage of certain coping strategies predicted one's cortisol change. Sex was shown to be a significant variable in the relationship between coping usage and cortisol peak, while one's stress history had a significant impact on one's coping utilization. These findings provide a greater understanding of how adolescents manage stress, the efficacy of these techniques in reducing physiological stress responses, and the possible variables that may affect these responses. Understanding this relationship can help us better understand how and why adolescents deal with stress the way that they do and lay the groundwork for interventions to improve stress management and, ultimately, mental and physical health.

References

Adam, E. K., Klimes-Dougan, B., & Gunnar, M. R. (2007). Social regulation of the adrenocortical response to stress in infants, children, and adolescents: Implications for psychopathology and education. In D.Coch, G.Dawson, & K.Fischer (Eds.), *Human Behavior, Learning, and the Developing Brain: Atypical Development* (pp. 264–304). New York, NY: Guilford Press.

Allen, A. P., Kennedy, P. J., Dockray, S., Cryan, J. F., Dinan, T. G., & Clarke, G. (2016). The Trier Social Stress Test: Principles and practice. *Neurobiology of stress*, *6*, 113–126. https://doi.org/10.1016/j.ynstr.2016.11.001

Bendezú, J., & Wadsworth, M. (2017). If the coping fits, use it: Preadolescent recent stress exposure differentially predicts post-TSST salivary cortisol recovery. *Developmental Psychobiology*, *59*(7), 848–862. https://doi.org/10.1002/dev.21542

Bevans, K., Cerbone, A., & Overstreet, S. (2008). Relations between recurrent trauma exposure and recent life stress and salivary cortisol among children. *Development and Psychopathology*, *20*(1), 257–272. https://doi.org/10.1017/S0954579408000126

Blair, C., Granger, D., & Peters Razza, R. (2005). Cortisol reactivity is positively related to executive function in preschool children attending head start. *Child Development*, *76*, 554–567. 10.1111/j.1467-8624.2005.00863.x

Blair, C., Raver, C. C., Granger, D., Mills-Koonce, R., & Hibel, L. (2011). Allostasis and allostatic load in the context of poverty in early childhood. Development and Psychopathology, 23, 845–857.

Boyraz, G., Zhu, Y., & Waits, J. B. (2019). Avoidance coping and academic locus of control as mediators of the relationship between posttraumatic stress and academic achievement

among first-year college students. *Anxiety, Stress, and Coping*, *32*(5), 545–558. https://doi.org/10.1080/10615806.2019.1638681

Burke, H. M., Davis, M. C., Otte, C., & Mohr, D. C. (2005). Depression and cortisol responses to psychological stress: A meta-analysis. *Psychoneuroendocrinology*, *30*, 846–856. 10.1016/j.psyneuen.2005.02.010

Cantave, C. Y., Langevin, S., Marin, M, Brendgen, M., Lupien, S., & Ouellet-Morin, I. (2019). Impact of maltreatment on depressive symptoms in young male adults: The mediating and moderating role of cortisol stress response and coping strategies. *Psychoneuroendocrinology*, *103*, 41–48. https://doi.org/10.1016/j.psyneuen.2018.12.235

Mayo Clinic Staff. (2019, March 19). *Chronic stress puts your health at risk*. Mayo Clinic. https://www.mayoclinic.org/healthy-lifestyle/stress-management/in-depth/stress/art-20046037

Cicchetti, D. and Rogosch, F. A. (2002). A Developmental Psychopathology Perspective on Adolescence. *Journal of Consulting and Clinical Psychology*, *70*(1), 6–20. https://doi.org/10.1037/0022-006X.70.1.6

Cicchetti, D. & Toth, S. L. (Eds.) (1997). *Developmental Perspectives on Trauma: Theory, Research and Intervention.* Rochester, NY: Rochester University Press.

Compas, B. & Champion, J. & Reeslund, K. (2005). Coping with Stress: Implications for Preventive Interventions with Adolescents. *Prevention Researcher, 12*(3), 17-20.

Compas, B., Connor-Smith, J., Saltzman, H., Thomsen, A., & Wadsworth, M. (2001). Coping With Stress During Childhood and Adolescence: Problems, Progress, and Potential in

Theory and Research. *Psychological Bulletin*, *127*(1), 87–127. https://doi.org/10.1037/0033-2909.127.1.87

Compas, B. E., Jaser, S. S., Bettis, A. H., Watson, K. H., Gruhn, M. A., Dunbar, J. P., Williams, E., & Thigpen, J. C. (2017). Coping, emotion regulation, and psychopathology in childhood and adolescence: A meta-analysis and narrative review. *Psychological Bulletin*, *143*(9), 939–991. https://doi-org.ezproxy.depaul.edu/10.1037/bul0000110

Compas, B., Worsham, N., Ey, S., & Howell, D. (1996). When Mom or Dad Has Cancer: II. Coping, Cognitive Appraisals, and Psychological Distress in Children of Cancer Patients. *Health Psychology*, *15*(3), 167–175. https://doi.org/10.1037/0278-6133.15.3.167

Conger, R. D., Ge, X., Elder, G. H., Lorenz, F. O., & Simons, R. L. (1994). Economic stress, coercive family process, and developmental problems of adolescents. *Child Development, 65*, 541–561

Copeland, E. and Hess, R. (1995). Differences in Young Adolescents' Coping Strategies Based On Gender and Ethnicity. *The Journal of Early Adolescence*, *15*(2), 203–219. https://doi.org/10.1177/0272431695015002002

Dickerson, S. and Kemeny, M. (2004). Acute Stressors and Cortisol Responses: A Theoretical Integration and Synthesis of Laboratory Research. *Psychological Bulletin*, *130*(3), 355–391. https://doi.org/10.1037/0033-2909.130.3.355

Edlynn, E. S., Gaylord-Harden, N. K., Richards, M. H., & Miller, S. A. (2008). African American inner-city youth exposed to violence: Coping skills as a moderator for anxiety. *American Journal of Orthopsychiatry*, *78*(2), 249–258. https://doi-org.ezproxy.depaul.edu/10.1037/a0013948

Eschenbeck, H., Kohlmann, C. W., and Lohaus, A. (2007). Gender Differences in Coping Strategies in Children and Adolescents. *Journal of Individual Differences*, *28*(1), 18–26. https://doi.org/10.1027/1614-0001.28.1.18

Evans, G. W., & Kim, P. (2013). Childhood poverty, chronic stress, self-regulation and coping. Child Development Perspectives, 7, 43–48.

Grant, K., Carter, J., Marshall, H., DeCator, D., Turek, C, Castro, A., Osnaya, A., Adam, E., Chen, E., Jackson, Y., Burnside, A., McNeela, L., & Achenback, T. (2020). A Comprehensive, Empirically-Based Stressor Classification and Measurement System for Adolescents: Development and Use to Predict Mental Health Outcomes. Manuscript in preparation.

Grant, K. E., Compas, B. E., Stuhlmacher, A. F., Thurm, A. E., McMahon, S. D., & Halpert, J. A. (2003). Stressors and child and adolescent psychopathology: Moving from markers to mechanisms of risk. *Psychological Bulletin*, *129*(3), 447–466. https://doi-org.ezproxy.depaul.edu/10.1037/0033-2909.129.3.447

Grant, K., O'Koon, J., Davis, T., Roache, N., Poindexter, L., Armstrong, M., Minden, J., & McIntosh, J. (2000). Protective Factors Affecting Low-Income Urban African American Youth Exposed to Stress. *The Journal of Early Adolescence*, *20*(4), 388–417. https://doi.org/10.1177/0272431600020004002

Gross, J. and Levenson, R. (1997). Hiding feelings: the acute effects of inhibiting negative and positive emotion. *Journal of Abnormal Psychology (1965)*, *106*(1), 95–103. https://doi.org/10.1037//0021-843X.106.1.95

Gunnar, M. and Quevedo, K. (2007). The Neurobiology of Stress and Development. *Annual Review of Psychology*, *58*(1), 145–173. https://doi.org/10.1146/annurev.psych.58.110405.085605

Gunnar, M., Wewerka, S., Frenn, K., Long, J., & Griggs, C. (2009). Developmental changes in hypothalamus–pituitary–adrenal activity over the transition to adolescence: Normative changes and associations with puberty. *Development and Psychopathology*, *21*(1), 69–85. https://doi.org/10.1017/s0954579409000054

Hackman, D. A., Betancourt, L. M., Brodsky, N. L., Hurt, H., & Farah, M. J. (2012). Neighborhood disadvantage and adolescent stress reactivity. *Frontiers in Human Neuroscience*, *6*, 277–277. https://doi.org/10.3389/fnhum.2012.00277

Handa, R., & Weiser, M. (2014). Gonadal steroid hormones and the hypothalamo–pituitary–adrenal axis. *Frontiers in Neuroendocrinology*, *35*(2), 197–220. https://doi.org/10.1016/j.yfrne.2013.11.001

Harkness, K., Stewart, J., & Wynne-Edwards, K. (2011). Cortisol reactivity to social stress in adolescents: Role of depression severity and child maltreatment. *Psychoneuroendocrinology*, *36*(2), 173–181. https://doi.org/10.1016/j.psyneuen.2010.07.006

Jackson, J., Knight, K., & Rafferty, J. (2010). Race and unhealthy behaviors: chronic stress, the HPA axis, and physical and mental health disparities over the life course. *American Journal of Public Health (1971)*, *100*(5), 933–939. https://doi.org/10.2105/AJPH.2008.143446

Janson, J., & Rohleder, N. (2017). Distraction coping predicts better cortisol recovery after acute psychosocial stress. *Biological Psychology*, *128*, 117–124. https://doi.org/10.1016/j.biopsycho.2017.07.014

Katz, Peckins, M. K., & Lyon, C. C. (2019). Adolescent stress reactivity: Examining physiological, psychological and peer relationship measures with a group stress protocol in a school setting. *Journal of Adolescence (London, England.)*, *74*(C), 45–62. https://doi.org/10.1016/j.adolescence.2019.05.002

Kim, P., Neuendorf, C., Bianco, H., Evans, G. W. (2016). Exposure to Childhood Poverty and Mental Health Symptomatology in Adolescence: A Role of Coping Strategies. *Stress and Health*, *32*(5), 494–502. https://doi.org/10.1002/smi.2646

Kirschbaum, C., Pirke, K. M., & Hellhammer, D. H. (1993). The 'Trier Social Stress Test'--a tool for investigating psychobiological stress responses in a laboratory setting. *Neuropsychobiology*, *28*(1-2), 76–81. https://doi.org/10.1159/000119004

Kirschbaum, C., Wust, S., & Hellhammer, D. (1992). Consistent sex differences in cortisol responses in psychological stress. Psychosomatic Medicine, 54, 648–657.

Kliewer, W., Parrish, K. A., Taylor, K. W., Jackson, K., Walker, J. M. and Shivy, V. A. (2006). Socialization of Coping With Community Violence: Influences of Caregiver Coaching, Modeling, and Family Context. *Child Development, 77*: 605-623. https://doi.org/10.1111/j.1467-8624.2006.00893.x

Lam, S., Dickerson, S. S., Zoccola, P. M. and Zaldivar, F. (2009). Emotion regulation and cortisol reactivity to a social-evaluative speech task. *Psychoneuroendocrinology*, *34*(9), 1355–1362. https://doi.org/10.1016/j.psyneuen.2009.04.006

Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal and coping*. New York: Springer.

McEwen, B. S. and Seeman, T. (1999). Protective and damaging effects of mediators of stress. Elaborating and testing the concepts of allostasis and allostatic load. *Annals of the New York Academy of Sciences*, *896*, 30–47. https://doi.org/10.1111/j.1749-6632.1999.tb08103.x

Meléndez, J. C., Mayordomo, T., Sancho, P., and Tomás, J. M. (2012). Coping Strategies: Gender Differences and Development throughout Life Span. *The Spanish Journal of Psychology*, *15*(3), 1089–1098. https://doi.org/10.5209/rev_SJOP.2012.v15.n3.39399

Morrison, D. R., Blumenthal, C. S., Krysan, M., Sugland, B., and Zill, N. (1992). Urban Families and Urban Problems: Review of the Literature. Child Trends, Inc. https://www.childtrends.org/wp-content/uploads/2013/01/Urban-Families-Urban-Problems.pdf

Ordaz, S. and Luna, B. (2012). Sex differences in physiological reactivity to acute psychosocial stress in adolescence. *Psychoneuroendocrinology*, *37*(8), 1135–1157. https://doi.org/10.1016/j.psyneuen.2012.01.002

Petersen, A. C., Crockett, L., Richards, M., & Boxer, A. (1988). A self-report measure of pubertal status: Reliability, validity, and initial norms. *Journal of youth and adolescence*, *17*(2), 117–133. https://doi.org/10.1007/BF01537962

Platje, E., Vermeiren, R., Branje, S., Doreleijers, T., Meeus, W., Koot, H., Frijns, T., van Lier, P., and Jansen, L. (2013). Long-term stability of the cortisol awakening response over adolescence. *Psychoneuroendocrinology*, *38*(2), 271–280. https://doi.org/10.1016/j.psyneuen.2012.06.007

Pruessner, J. C., Kirschbaum, C., Meinlschmid, G., and Hellhammer, D. H. (2002). Two formulas for computation of the area under the curve represent measures of total hormone

concentration versus time-dependent change. *Psychoneuroendocrinology 28,* 916-931. doi:10.1016/S0306-4530(02)00108-7

Reschke-Hernández, A. E., Okerstrom, K. L., Bowles, A. E., & Tranel, D. (2017). Sex and stress: Men and women show different cortisol responses to psychological stress induced by the Trier social stress test and the Iowa singing social stress test. *Journal of Neuroscience Research*, *95*(1-2), 106–114. https://doi.org/10.1002/jnr.23851

Roberts, A. and Lopez-Duran, N. (2019). Developmental influences on stress response systems: Implications for psychopathology vulnerability in adolescence. *Comprehensive Psychiatry*, *88*, 9–21. https://doi.org/10.1016/j.comppsych.2018.10.008

Sapolsky, R. M. and Meaney, M. J. (1986). Maturation of the adrenocortical stress response: Neuroendocrine control mechanisms and the stress hyporesponsive period. *Brain Research Reviews, 11*(1), 65–76. https://doi.org/10.1016/0165-0173(86)90010-X

Schnider, K. R., Elhai, J. D., & Gray, M. J., & Mallinckrodt, B. (2007). Coping Style Use Predicts Posttraumatic Stress and Complicated Grief Symptom Severity Among College Students Reporting a Traumatic Loss. *Journal of Counseling Psychology*, *54*(3), 344–350. https://doi.org/10.1037/0022-0167.54.3.344

Seeman, T. E., Singer, B., Wilkinson, C. W., & McEwen, B. (2001). Gender differences in age-related changes in HPA axis reactivity. Psychoendocrinology, 26, 225–240.

Sladek, M., Doane, L., Luecken, L. and Eisenberg, N. (2016). Perceived stress, coping, and cortisol reactivity in daily life: A study of adolescents during the first year of college. *Biological Psychology*, *117*, 8–15. https://doi.org/10.1016/j.biopsycho.2016.02.003

Sladek, M., Doane, L., and Stroud, C. (2017). Individual and Day-to-Day Differences in Active Coping Predict Diurnal Cortisol Patterns among Early Adolescent Girls. *Journal of Youth and Adolescence*, *46*(1), 121–135. https://doi.org/10.1007/s10964-016-0591-2

Tackett, J. L., Herzhoff, K., Smack, A. J., Reardon, K. W., & Adam, E. K. (2017). Does socioeconomic status mediate racial differences in the cortisol response in middle childhood? *Health Psychology*, *36*(7), 662–672. https://doi-org.ezproxy.depaul.edu/10.1037/hea0000480.supp

Tamres, L. K., Janicki, D., & Helgeson, V. S. (2002). Sex Differences in Coping Behavior: A Meta-Analytic Review and an Examination of Relative Coping. *Personality and Social Psychology Review*, *6*(1), 2–30. https://doi.org/10.1207/S15327957PSPR0601_1

Uhart, M., Chong, R. Y., Oswald, L., Lin, P. I., & Wand, G. S. (2006). Gender differences in hypothalamic-pituitary-adrenal (HPA) axis reactivity. Psychoneuroendocrinology, 31, 642–654

van den Bos, E., de Rooij, M., Miers, A., Bokhorst, C., & Westenberg, P. (2014). Adolescents' Increasing Stress Response to Social Evaluation: Pubertal Effects on Cortisol and Alpha-Amylase During Public Speaking. *Child Development*, *85*(1), 220–236. https://doi.org/10.1111/cdev.12118

Wadsworth, M.E., & Compas, B.E. (2002). Coping with economic strain and family conflict: The adolescent perspective. *Journal of Research on Adolescence,* 12, 243-274.

Wüst, S., Wolf, J., Hellhammer, D. H., Federenko, I., Schommer, N., & Kirschbaum, C. (2000). The cortisol awakening response - normal values and confounds. *Noise & Health*, *2*(7), 79–88. http://www.ncbi.nlm.nih.gov/pubmed/12689474.

Yim, I., Quas, J., Cahill, L., & Hayakawa, C. (2009). Children's and adults' salivary cortisol responses to an identical psychosocial laboratory stressor. *Psychoneuroendocrinology*, *35*(2), 241–248. https://doi.org/10.1016/j.psyneuen.2009.06.014