EMOTION REGULATION, COPING, AND EXECUTIVE FUNCTIONING IN RISK FOR DEPRESSION: AN INTEGRATIVE APPROACH

By

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CHAPTER I

BACKGROUND

Exposure to acute and chronic stress is implicated in the etiology and course of psychopathology as well as physical illness and disease. Further, individuals who have difficulty regulating their emotions and employ less adaptive coping strategies when faced with stressful events are at even greater risk for developing psychological, behavioral, and physical difficulties (e.g., Compas *et al*., 2001; Skinner & Zimmer-Gembeck, 2007). In spite of the importance of coping and emotion-regulation for understanding the effects of stress, research of emotion regulation abilities and coping strategies in dealing with stress have been pursued in two separate and generally unrelated research literatures (Compas *et al*., 2009; Gross, 2002). Further, executive functions, including working memory and attention, may provide a foundation that individuals draw upon to both cope with stress and regulate emotions (Campbell *et al.,* 2009), but the links between executive function and these processes have also been examined separately.

The current study analyzes the relationship between executive functioning, emotion regulation, and patterns of coping strategies in older adolescents and young adults. The association between these patterns and the presence of symptoms of anxiety and depression is discussed in terms of coping, emotion regulation, and emotional control. I first provide a brief review the constructs of executive function, emotion-regulation, and coping and then summarize research that has examined the connections

between these important processes. Finally, I outline the goals and hypotheses for the current study.

Executive Function, Working Memory, and Attention

Executive functions are a group of cognitive processes that regulate an individual's ability to organize thoughts and activities, prioritize tasks, manage time efficiently, and make decisions (Lezak *et al.,* 2004). While the category of executive functions is multidimensional, these processes are involved in the production of novel thought and behavior patterns that are outside the automatic, routine activations usually elicited by environmental stimuli (Norman & Shallice, 1980). Many believe executive functions to be integral to goal-directed behavior reflecting higher level thought processes in humans (e.g., Banich, 2009; Goldberg, 2001). As such, executive functions must be called upon in order to inhibit a prepotent response and replace it with a more optimal approach taking into account unique circumstances. This is often important when a robust, habitual reaction must be inhibited, or an unusually complex set of circumstances must be overcome. For example, an unpleasant environmental stimulus may automatically evoke feelings of anger, sadness, or fear. Such an event may range from being caught in an unexpected traffic jam to receiving a call about some disappointing news while in the middle of a project at work. In either case, it is necessary to inhibit the automatic negative emotions, thoughts, and behaviors that may follow in an effort to perform the task at hand.

As evidenced by a literature of case studies dating back nearly 200 years, individuals with acquired lesions to regions of the prefrontal cortex were unable to carry

out such higher-level (executive) tasks of controlled cognition (Luria, 1966). Based on this early work and subsequent experimental research, performance of executive functions is most often tied to several regions of the prefrontal cortex (PFC), with significant focus on the dorsolateral and medial PFC, as well as the anterior cingulate cortex. Classic neuropsychological paradigms, such as the Wisconsin Card Sort Test, continue to be used to assess executive functions in both patients with localized brain damage (Aron, 2008) and healthy individuals examined using functional imaging techniques (Lie, 2006). Such studies have repeatedly validated the core conceptualization of some individual executive functions as controlled cognitive processes, as their performance is causally linked to the prefrontal cortex.

Working memory, one salient type of executive function, has been defined as the short-term integration, processing, and retrieval of information (Baddeley & Hitch, 1974). It is utilized when information from the environment must be manipulated while being held in short-term memory stores. The Digit Span subtest of the WAIS-IV, utilized in this study, is a frequently used measure of working memory abilities. In this task, a participant is asked to verbally repeat a string of numbers that that have been presented orally by an experimenter. Next, the participant is asked to reverse the order of the string of numbers, and in the final step of the task, the participant is asked to state the digits in numerical order when repeating them. As an individual must be able to manipulate information while remembering it for a short time, active on-line monitoring is necessary for the performance of working memory tasks (Barch et al., 2001). Deficits in working memory have been found in a range of clinical populations including patients with

schizophrenia (Park & Holzman, 1992; Smith, Park, & Cornblatt, 2006), ADHD (Martinussen *et al*., 2005), and Alzheimer's Disease (Baddeley *et al*., 1991).

Selective attention is another key executive function domain. It includes both the ability to limit attentional inputs to only those that are task-relevant and to shift attentional focus among relevant information (Derryberry & Rothbart, 1997). In many cases, this may involve the active allocation of cognitive resources to attend to aspects of external stimuli that are task- or situation-relevant, regardless of their salience (Rothbart, Derryberry & Posner, 1994). An often-cited example of selective attention is the Stroop task, in which participants are asked to name the colors of incompatible words (Stroop, 1935). The participant must attend to a specific characteristic of the stimulus, namely the color, while inhibiting both attentional allocation and a behavioral response corresponding to the more over-learned stimulus characteristic, the word meaning.

Tasks such as the Stroop provide an index of top-down, effortful control of attention. However, selective attention may also be a non-conscious, non-effortful, and uncontrolled process. For example, in the dot-probe paradigm (MacLeod et al., 1986), participants are asked to indicate the location of a marker on a screen after two stimuli have been displayed sub- or supraliminally. Stimuli for which an individual possesses a bias in attention will be probed with a shorter response latency. Such a bias has often been tied to hypervigilance to threatening cues, which evokes an emotional response. Thus, the emotional quality of sensory stimuli may produce a bottom-up attentional shift based in the avoidance of evolutionary dangers and hypervigilance to threat (Ohman, 2005). Such responses have been tied to the activation of more primitive limbic regions

including the amygdala (Vuillemier & Huang, 2009), as opposed to prefrontal substrates underlying effortful cognitive control of attention (Miller & Cohen, 2001).

Selective attention is also closely linked to working memory. The active on-line monitoring of information necessary for working memory requires selective attention towards the essential stimulus characteristics (Lavie, 2005). Fukuda and Vogel (2009) suggest that the well-documented relationship between poor memory and attentional abilities in humans may be rooted in an inability to selectively attend to task-relevant information. Such results indicate that many of the domains of executive function may share significant overlap. These domains may thus not necessarily act as entirely distinct processes, but may instead interact to produce the complex cognitive and behavioral outputs characteristic of executive functions.

A growing literature of neuroimaging studies has provided further evidence for prefrontal involvement in many higher-level cognitive functions. Although studies using functional magnetic resonance imaging (fMRI) techniques are inherently correlational, much information has been gleaned from connectivity studies of healthy individuals performing tasks of working memory and attention inside the scanner. For example, using a scan protocol producing high temporal resolution, Cohen and colleagues (1997) showed patterns of prefrontal and parietal activation during a working memory task. While no interaction was found between task load and activation time for the dorsolateral PFC, activation in the posterior parietal cortex represented an interaction between task load and time. These results suggest a relationship between the attentional and mental manipulation functions of the dorsolateral PFC and the maintenance role of the posterior parietal cortex in working memory.

Emotion Regulation

Working memory and attention domains of executive function may play an important role in the regulation of emotion. Before examining these links, it is first necessary to define what is meant by the terms "emotion" and "emotion regulation" under this hypothesis. The modal model of emotion defines an emotion as a human-environment interaction requiring attention that involves considerable personal significance and evokes a complex, continuously evolving response (Gross & Thompson, 2007). The environment may include external stimuli or internal representations involving thoughts and memories. Emotions have historically been divided into primary and secondary categories. Primary emotions include anger, sadness, fear, happiness, disgust, and surprise. Secondary emotions include shame, pride, and nervousness. While primary emotions are direct responses to environmental stimuli and constitute a biological preparation for appraisal and response (Izard, 2002), secondary emotions occur as a result of primary emotions. Seminal work by Zajonc (1980) posited the primacy of emotions in human thought and behavior patterns, stating that, "preferences need no inferences." That is, our beliefs about our likes and dislikes are based in automatic affective responses and do not require higher order cognitive processes. Further, the Differential Emotion Theory (Izard, 1977) conceptualizes emotional experiences as motivational states linked to the neural representation of a particular emotion.

Chronic and acute life stress has often been associated with negative emotional responses and negative psychological outcomes including depression and anxiety. However, a growing body of literature has linked the presence of positive emotionality to adaptive coping during acute stress by means of an enhanced utilization of cognitive

resources (Folkman & Moskowitz, 2000). This may lead to situations in which a stimulus that was initially considered a stressor evolves into a challenge to be overcome through a process of personal growth and transformation.

Emotion regulation is best characterized as individuals' efforts to affect the type and timing of their own emotions as well as their personal experience and expression of these internal states (Mauss *et al*., 2007). It consists of the set of processes that allow for the increase, decrease, or maintenance of an affective state (Davidson *et al.,* 2000). While some behaviors may be performed to alter the emotions of others, emotion regulation generally refers to processes focused on the self and one's own emotions.

A multi-stage process model of emotion generation maintains that regulation can occur during several sequential steps in the generation of an emotion (Gross, 1998). At any of these stages, emotion regulation can be an automatic or controlled process (Gross & Thompson, 2007). Conscious, controlled strategies dominate the literature and will be the focus of this study. These strategies require effort, and studies have shown that individuals are able to accurately report their own use of them in daily activities (Connor-Smith et al., 2000; Connor-Smith & Compas, 2004). However, emotion regulation can also be automatic, and an individual may be unaware when such a strategy is employed (Masters, 1991). An example of an automatic emotion-regulation strategy is the unconscious diversion of attention away from a negative stimulus. Emotion regulation also includes both the up-regulation of positive emotions and the down-regulation of negative emotions (Gross, 1998). However, research by Gross and colleagues indicates that adolescents and young adults down-regulate negative emotions more often than they up-regulate positive ones (Gross & Thompson, 2007). This study will therefore focus

primarily on participants' self-reported ability to deal with negative emotions and the strategies they employ.

Executive Functions in Emotion Regulation

Cognitive control involves reciprocal interactions between PFC regions that perform higher-level inhibitory control processes and other cortical and subcortical structures that encode sensory inputs (Miller & Cohen, 2001). Through selective attention, prefrontal regions may up-regulate focus on a specific representation or stimulus quality and retain goal-relevant information while avoiding environmental noise (Derryberry & Rothbart, 1997). The information being held in mind can be manipulated through working memory processes (Baddeley & Hitch, 1974). The interaction of these PFC functions with other cortical and subcortical emotion-processing regions may provide the neural basis for processes integral to emotion regulation (Ochsner *et al*., 2002).

Previous research has indicated that attentional control is integral to the process of responding to and coping with stress (Compas & Boyer, 2001). This link between attention and coping has been supported by findings from research with several medical populations, including children with recurrent abdominal pain (Boyer et al., 2006) and adult women with breast cancer (Glinder *et al*., 2007). Results from a study by Walker and colleagues (1997) show that children with recurrent abdominal pain who attend more to pain have increased somatization and pain symptoms. One possible link between attention and the processes of coping and emotion regulation may be the requirement of several executive function abilities in order to adequate reappraise a stressful situation.

Further, studies relying on experimental neuropsychological and neuroimaging techniques have indicated that cognitive reappraisal calls on both selective attention and working memory skills in addition to several other higher-level cognitive functions including inhibition and monitoring of response conflict (Ochsner *et al*., 2002). Selective attention is necessary to maintain concentration on essential aspects of the stressor without interference from other information that may be emotionally salient, but ultimately irrelevant. Working memory allows for the reframing of the current information in more neutral or positive terms. During this process, constant monitoring is necessary to resolve response conflicts that may occur between the top-down reappraisals and the bottom-up processes of emotion generation (Barch *et al*., 2001). Continuous on-line assessment of one's internal state with respect to the outside environment provides constantly updated information regarding an individual's current emotional state (Paradiso *et al*., 1999).

Coping

Current emotion regulation theory and research is rooted in the broader stress and coping view of affective modulation. Coping has historically been defined as "cognitive and behavioral efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of the person" (Lazarus & Folkman, 1984). The construct has evolved over time in the psychological literature, with the historical conceptualization suggesting that it include efforts directed towards resolving a stressful environmental interaction (problem-focused coping) or reducing negative emotions resulting from stress (emotion-focused coping) (Eisenberg, Fabes, & Guthrie,

1997). More recently, Compas et al. (2001) proposed a model of coping defined as, "conscious volitional efforts to regulate emotion, cognition, behavior, physiology, and the environment in response to stressful events or circumstances." This definition makes explicit links between coping and processes of regulation, including emotion regulation. From this perspective, coping includes the purposeful regulation of emotions in response to stress (Compas, 2009).

Consensus has slowly been emerging in how to best categorize the various dimensions of this multidimensional construct. Skinner and colleagues (2003) identified over 400 categories or types of coping that have been represented in research on this construct. Previous categories include problem- vs. emotion-focused coping as described earlier, approach vs. avoidance, active vs. passive, as well as primary vs. secondary control coping, and engagement vs. disengagement coping. Primary control coping refers to an attempt to impact occurrences or situations, whereas secondary control coping refers to an attempt to enhance one's fit with respect to the situation (Rothbaum, Weisz, & Snyder, 1982). The engagement/disengagement dimension is based on the "fight or flight" responses that occur during a stressful encounter or event (Cannon, 1933). Engagement strategies involve approach, and disengagement strategies involve avoidance reactions (Krohne, 1996).

While the problem- and emotion-focused distinction of this process may be important historically, an alternative three-factor model of coping proposed by Connor-Smith *et al*. (2000) has been validated successfully in several populations. Further, confirmatory factor analyses using data from over 700 adolescents and young adults (Connor-Smith *et al*., 2000) indicate that volitional coping is best broken down into three

domains, each encompassing several subtypes: primary control engagement coping (problem solving, emotional expression, and emotional modulation); secondary control engagement coping (cognitive restructuring, positive thinking, acceptance, and distraction); and disengagement coping (wishful thinking and denial). This view is also in line with Skinner and colleagues' (2003) findings. Results from their analysis suggest replacing traditional approaches that draw on opposing process models (e.g. problem- vs. emotion-focused and approach vs. avoidance) with hierarchical categories of active strategies. The current study will draw on this three-factor model.

Coping and Emotion Regulation

While coping overlaps significantly with emotion regulation in that both aim to reduce negative emotions caused by life stress, many believe that considerable differences exist between the fields of emotion regulation and coping. First, in addition to altering emotional reactions to environmental stressors, coping encompasses any actions taken to directly eliminate the environmental source of stress (Compas *et al*., 1999; 2009). Second, emotion regulation remains agnostic with respect to emotional valence. Whereas coping generally assumes the down-regulation of a negative emotion, emotion regulation also includes the maintenance or augmentation of a positive emotion (Eisenberg, Fabes, & Guthrie, 1997). However, Austenfeld and Stanton (2004) have begun to reconcile this distinction with their description of emotional approach coping. This method of coping involves acknowledging, expressing, and understanding emotions in response to stressors and provides an alternative to emotion-focused coping, which has been previously associated with poorer psychological and health-related outcomes.

Further, Compas *et al*. (2010) have shown that secondary control coping is related to both the down regulation of negative affect (sadness) and up regulation of positive affect.

The current study will focus on the use of secondary control engagement coping strategies, which require active engagement with the emotions brought on by a stressor. We will focus specifically on cognitive restructuring, best understood as an individual's "attempts to redefine stressful, negative situations as neutral or positive experiences" (Elman & Gilbert, 1984). Cognitive restructuring is often used interchangeably with the concept of cognitive reappraisal described extensively in the emotion regulation literature as "changing the way one thinks about a potentially emotion-eliciting event" (John & Gross, 2004). Since case studies of lesion patients reported labile affect as a main outcome of damage to the PFC, emotion regulation has been associated with several prefrontal areas including the orbitofronal cortex, the dorsolateral PFC, and the anterior cingulate cortex. Current fMRI research has specifically linked the process of cognitive reappraisal to altered activations in these areas. For example, Ochsner *et al.* (2002) found increased activation of the lateral and medial PFC and decreased activation of the medial orbitofrontal PFC and amygdala during a cognitive reappraisal task in healthy individuals.

Emotion Regulation Deficits and Psychopathology

Deficits in emotion regulation in the presence of stress have been tied to many DSM Axis I diagnoses in adults, including mood, anxiety, eating, and substance use disorders, as well as all Axis II personality disorders (e.g., Campbell-Sills & Barlow, 2007; Gross & Levenson, 1997; Miller, Rathus, & Linehan, 2007). In addition, a

deficiency in regulating negative emotions has been linked to depressive symptoms and disorders in children (Compas, Jaser, & Benson, 2009).

The biological and psychological mechanisms underlying these relationships continue to remain unclear, however. For example, several possibilities have emerged to explain the role of emotion regulation deficits in Major Depressive Disorder (Rottenberg, Gross, & Gotlib, 2005). One hypothesis links depression to a decreased ability to experience positive emotions. This notion stems from a series of past findings describing decreased positive affect in individuals suffering from major depressive disorder (Tellegen, 1985). More recent research has expanded on this view by examining the underlying neurobiology of this phenomenon. Davidson and Tomarken (1989) found evidence for frontal laterality in the experience of positive and negative affect. Specifically, left anterior frontal regions have been associated with approach behaviors, and Henriques and Davidson (1991) found that hypoactivation in left anterior frontal regions in depressed individuals. However, evidence also exists to suggest that an increased negative emotional reactivity may be strongly involved in depression. While this second hypothesis is more in-line with current descriptions of depressive symptomatology, laboratory studies of emotion generation and regulation in individuals suffering from depression suggest that the condition involves overall decreased emotional reactivity (McFarland & Klein, 2008). A third hypothesis seeks to reconcile these two models by positing that depression involves an evolutionary disengagement with environmental stimuli (Rottenberg *et al*., 2005). Emotional reactivity represents an engagement response to stimuli. In producing an overall disengagement, depression results in lowered emotional reactivity, including both positive and negative forms.

Coping Deficits and Psychopathology

As described earlier, engagement and disengagement represent two broad categories of coping. Literature focused on stress and coping has linked maladaptive coping strategies, including disengagement, to several forms of psychopathology (Compas *et al*., 2001). Disengagement coping is related to both internalizing and externalizing problems in children and young adults (e.g., Langrock *et al*., 2002; Wadsworth & Compas, 2002). Conversely, the use of primary and secondary control engagement coping strategies is related to a lower levels of both internalizing and externalizing symptoms in adolescents and young adults (e.g., Compas *et al*., 2006a; Connor-Smith *et al*., 2000; Jaser *et al*., 2008).

Several downstream effects of the use of adaptive coping strategies have also been explored the domains of social functioning and health-related outcomes. Adolescents who report using engagement coping strategies exhibit higher overall levels of adjustment and social competence when compared to those who use disengagement strategies (Compas *et al*., 2001). In several studies of children and adolescents with illnesses and chronic health conditions including diabetes, chronic pain, and acute lymphoblastic leukemia, use of secondary control engagement coping was linked to both better social functioning and more positive levels of biological markers indicative of disease state (e.g., Campbell *et al*., 2009; Compas *et al*., 2006b).

Recent research has established links between coping and executive function. For example, Campbell *et al*. (2009) drew on neurocognitive and psychological measures in order to analyze psychosocial outcomes in survivors of childhood acute lymphocytic leukemia. Measures of executive function were significantly correlated with the use of

secondary control coping strategies and emotional and behavioral problems. Further, secondary control coping accounted for the relationship between coping and emotional/behavioral problems. Results from the study suggest cognitive deficits in domains such as working memory may underlie the use of maladaptive coping and emotion regulation strategies leading to poorer psychosocial functioning in these children.

Current Study

The current study aims to investigate the relationship between executive functioning ability and the use of coping and emotion regulation strategies in college-age older adolescents and young adults. As previous research has indicated a role for both working memory and attention in cognitive reappraisal, both behavioral and self-report measures of executive functioning were collected to gain a multimodal assessment of these specific abilities. The Working Memory subscale of the WAIS-IV and self-report measures attentional control and cognitive processing abilities are thus hypothesized to show meaningful correlations with self-report measures of emotion regulation and reactivity. It is hypothesized that individuals with greater working memory and attentional control abilities will be better able to down regulate negative emotions brought on by environmental stressors.

This study also examines the relationship between self-reported emotion regulation abilities and use of adaptive coping strategies. While significant overlap exists between these two constructs, few studies have explored the relations between basic emotion regulation processes and strategies employed to cope with specific stressors. It is

predicted that emotion regulation abilities will be significantly related to the types of coping strategies utilized under stress. Specifically, self-reported ability to down-regulate negative emotions using effortful, controlled strategies will be related to the use of secondary control engagement coping strategies (including cognitive restructuring). A secondary goal of this analysis is to evaluate the role of emotion regulation and coping strategies in the development of psychopathology. Little is known about the links between executive function, emotion regulation, coping, and psychopathology. It is predicted that a lower ability to regulate emotions and less adaptive use of coping strategies will be correlated with greater presence of depression and anxiety symptoms in this sample.

CHAPTER II

METHODS

Participants

Participants for this study included 60 undergraduate students currently enrolled at Vanderbilt University. All participants were recruited through the on-line SONA subject pool management system, which allows students to receive credits for completing on-campus research studies required for many undergraduate behavioral science courses. The only requirement for inclusion in the study was current full-time enrollment status as an undergraduate student at Vanderbilt. Data were collected as part of a larger study looking to validate, with a large sample, a revised version of the Responses to Stress Questionnaire (see below), a comprehensive self-report questionnaire that assesses coping and responses to stress in a group of older adolescents and young adults. The mean age of the sample was 19.3 years (SD = 1.2), range 18 to 22 years, and consisted of 44 females (73.3%) and 16 males (26.7%). The sample was 68.3% Caucasian.

Measures

Executive Functioning. The Wechsler Adult Intelligence Scale 4th Edition (WAIS-IV) is a standardized measure of cognitive ability for adolescents and adults between the ages of 16 and 89 years. The IQ and index scores are both presented as age-based standard scores with a mean of 100 and a standard deviation of 15. Percentile ranks (PR) indicate an individual's performance relative to a national sample and indicate the

percentage of test takers in the national sample who had lower scores than the individual. The range for each individual subtest scaled scores is from 1 to 19; scores from 8 to 12 are considered average.

Graduate research assistants administered the Digit Span and Arithmetic subtests of the WAIS-IV to all participants to obtain an index of working memory abilities. The Digit Span subtest measures auditory short-term memory and sequential processing. It is comprised of three parts. In the first, the participant must repeat a string of digits as stated. In the second, the participant must repeat a string of digits in reverse order. In the final part, the participant must state the digits in numerical order. The Arithmetic subtest requires participants to solve numerical reasoning problems that are read aloud by the test administrator without the use of paper and pencil. The Working Memory Index (WMI) combines these two subtest scores to assess ability to memorize new information, hold it in short-term memory, concentrate, and manipulate that information to produce some result or reasoning processes. It is important in higher-order thinking, learning, and achievement as well as cognitive flexibility and planning ability, learning and the ability to self-monitor.

As part of the packet of questionnaires given during the assessment session, all participants filled out the Behavior Rating Inventory of Executive Function –Adult Version (BRIEF; Gioia *et al.,* 2000). The BRIEF is a 75-item assessment of impairment in several domains of executive functioning. Participants age 18 to 90 years rate behavior frequency on a 3-point Likert scale (0 to 2). The questionnaire contains 75 items covering 9 non-overlappping clinical scales and 3 validity scales. These theoretically and statistically derived scales comprise two broader indices of Behavioral Regulation

(Inhibit, Shift, Emotional Control) and Metacognition (Initiate, Working Memory, Plan/Organize, Organization of Materials, Self-Monitor, Task Monitor). The three validity scales identify unlikely response patterns in the domains of Negativity, Inconsistency, and Infrequency. The BRIEF has demonstrated satisfactory internal consistency reliability and has been normed on appropriate census populations in the US (Roth, Isquith, & Gioia, 2005).

All participants also completed the Attentional Control Scale (ACS-P; Derryberry & Reed, 2002). The ACS-P is designed to measure two major components of attention (focusing and shifting). The ACS-P consists of 20 items that are rated on a four-point Likert scale from 1 (almost never) to 4 (always). This questionnaire has demonstrated adequate internal consistency reliability in several populations, including healthy, anxious, and ADHD samples (Derryberry & Reed, 2002).

Emotion Regulation. All participants completed the Emotion Regulation Questionnaire (ERQ). The ERQ (Gross & John, 2003) is a self-report measure of emotion regulation strategies pertaining to cognitive reappraisal and suppression of emotions. The ERQ has shown adequate internal consistency and test-re-test reliability. Further, it has demonstrated adequate convergent and discriminant validity against measures of coping, mood state, rumination, and personality (Gross & John, 2003). Only the 6-item Reappraisal scale of the ERQ was analyzed in this study (6 items; $\alpha = .85$).

All participants also completed the Difficulties in Emotion Regulation Scale (DERS). The DERS is a 36-item self-report measure that assesses various challenges in ability to regulate emotional experience and expression. These include non-acceptance, an inability to engage in goal-directed behavior, lack of impulse control, emotional

unawareness, limited access to emotion regulation strategies, and lack of emotional clarity. The DERS has shown adequate internal consistency and test-retest reliability. In addition, it has demonstrated adequate construct validity in its relation to the Expectancies for Negative Mood Regulation scale (NMR), experiential avoidance, and emotional expressivity. The DERS has also shown adequate incremental validity over the NMR and adequate predictive validity for self-harm behaviors and intimate partner abuse.

Coping. Data for this study were collected to validate a revised version of the Responses to Stress Questionnaire, a coping measure designed and previously validated by Compas and colleagues (Connor-Smith *et al*., 2000). All participants thus completed a revised version of the RSQ (i.e., RSQ-II), which also includes items measuring volitional coping responses and involuntary responses to stress. Engagement and disengagement responses are included for volitional and involuntary responses, with the volitional engagement responses further divided into primary and secondary control coping. This study analyzed responses to secondary control engagement coping items, which included cognitive restructuring (e.g., I tell myself that things could be worse), positive thinking (e.g., I tell myself that everything will be alright), acceptance (e.g., I just take things the way they are, I go with the flow), and distraction (e.g., I imagine something really fun or exciting happening in my life) (12 items; $\alpha = .78$). The 6 items assessing cognitive reappraisal from the Secondary Control Coping Scale were also included separately in this analysis (6 items; $\alpha = .79$). This "cognitive reappraisal parcel" was used as a direct and more specific comparison to the ERQ Reappraisal scale.

Examples of items from the measures of emotion-regulation and coping are presented in Table 1.

Table 1. Secondary Control Coping Factor and ERQ Reappraisal Items.

Secondary Control Coping Scale	**ERQ**
Cognitive Restructuring	**Reappraisal**
I think about the things I'm learning from the situation, or something good that will come from it.	When I want to feel more *positive* emotion (such as joy or amusement), I *change what I'm thinking about.*
When problems with other kids come up, I tell myself that I can get through it.	When I want to feel less *negative* emotion (such as sadness or anger), I *change what I'm thinking about*.
When I'm having problems with other kids, I tell myself that things will be all right no matter what happens	When I'm faced with a stressful situation, I make myself *think about it* in a way that helps me stay calm.
I think of ways to laugh about the problem so that it won't seem so bad.	When I want to feel more *positive* emotion, I *change the way I'm thinking* about the situation.
When problems with other kids come up, I look for something positive in the situation.	I control my emotions by *changing the way I think* about the situation I'm in.
I think of a new and more positive way of looking at the situation.	When I want to feel less *negative* emotion, I *change the way I'm thinking* about the situation.
Distraction	
I think about happy things or do fun activities to take my mind off the problem or how I'm feeling.	
I keep my mind off problems with other kids by doing something else (e.g. exercising, watching TV, seeing friends, playing video games).	
To take a break from the problem, I think about something good that has happened or will happen in my life.	
Acceptance	
When I'm having problems with other kids, I realize that I can just live with things the way they are.	
I take things as they are; I go with the flow.	
I accept that there are parts of this problem that I cannot change.	

Psychopathology. Symptoms of internalizing and externalizing problems were assessed by the Adult Self Report, a widely used self-report measure assessing emotional and behavioral problems, as well as social competence that has been normed on a nationally representative sample (Achenbach & Rescorla, 2001). It includes 113 items scored on a three-point scale indicating how descriptive the items are of the individual during the preceding six months. The measure produces individual profiles for empirically based syndromes as well as DSM-oriented scales. The measure includes both Borderline and Clinical cutoffs that can be used to describe an individual's responses with respect to the normative sample, taking into account the participant's gender. For the narrow-band scales (anxiety/depression, affective problems), the Borderline range includes *T* scores ranging from 65-69, and *T* scores of 70 (98^{th} %ile) and above fall in the Clinical range. For broad-band scales (internalizing, externalizing), the Borderline cut-off is a *T* score of 63, and the Clinical cut-off is a *T* score of 67 (95^{th} %ile). The measure maintains high test-retest reliabilities and internal consistency scores for all subscales in a nationally representative sample. The current analyses utilized the Affective Problems scale as an index of depressive symptoms (items include lack of enjoyment, sleep disruption, appetite disturbance, sadness, suicidal ideation, underactivity, feelings of worthlessness). Internal consistency estimates of the anxious/depressed, DSM depression, and internalizing scale for the current sample were α = .88, .79, and .91, respectively.

Demographics. All participants also completed a demographics questionnaire to collect information on family structure, annual family income, parent education level, and non-academic extracurricular or work activities.

Procedure

The Vanderbilt Institutional Review Board approved the protocol for this study. All participants were recruited for participation using the on-line SONA system for Vanderbilt undergraduate students. Participants signed up for an assessment session by responding to an announcement on the website, and participation credits were awarded via the website once a participant had successfully completed the study. A graduate research assistant obtained informed, written consent from all participants at the beginning of each assessment session. Each participant was then given a packet of self-report questionnaires to fill out in a quiet, well-lit room monitored by a graduate research assistant or the study principal investigator. Participants were also each escorted individually to a separate room, where a graduate research assistant conducted the neurocognitive assessment. The study was considered complete once the participant had finished both the questionnaire packet and the neurocognitive assessment. The entire session lasted approximately 90 minutes per participant.

Data Analyses

Data analytic focused on using descriptive statistics to analyze the demographics of the current sample. Pearson correlations were used to examine the relationships between measures of executive functioning, emotion regulation abilities, coping strategies, and levels of psychopathology. Step-wise linear regression analysis was used to ascertain the contributions to total variance in internalizing psychopathology accounted for by executive functioning, emotion regulation, and coping.

CHAPTER III

RESULTS

Descriptive Statistics: Emotion Regulation, Coping, Psychological Symptoms, and Executive Functioning

Descriptive statistics including means, standard deviations, as well as minimum and maximum scores for participants' self-reported emotion regulation abilities and use of coping strategies are presented in Table 2.

Table 2. Descriptive Statistics for Emotion Regulation and Coping Measures

	Mean (*SD*)	Min	Max
RSQ-II Secondary Control Coping	.19 (.03)	.09	.28
RSQ-II Reappraisal Parcel	.10 (.02)	.04	.16
ERQ Reappraisal	4.87 (1.11)	2.17	6.83
DERS Total	74.00 (20.49)	39.00	127.00

Note. Scores on the RSQ-II are proportion scores reflecting the percentage of the total score on the measure that fell in Secondary Control Coping.

Scores for the ERQ Reappraisal Scale represent an average of the responses given on the six Reappraisal items of the ERQ, which are each scored from 1 to 7. In this study, the mean score on the ERQ was found to be 4.87 with a standard deviation of 1.11. These results were similar to those found by Gross and John (2003) in a sample of nearly 800 undergraduates ($M = 4.60$, $SD = .94$ for males; $M = 4.61$, $SD = 1.02$ for females).

Scores for the DERS represent sum total scores for all scale items. A mean of 74.00 and standard deviation of 20.49 were obtained for this measure in the current study.

These results are in line with those found by Gratz and Roemer (2004) in a sample of approximately 360 undergraduate students (M = 80.66, SD = 18.79 for males; M = 77.99, SD = 20.72 for females).

The RSQ-II uses proportional scoring. Proportion scores are thus reported for the RSQ-II Secondary Control Coping scale and reappraisal parcel. These scores take into account the total number of items endorsed when reporting the factor statistics. Because of changes made in current version of the RSQ-II (i.e., an increase in the number of items on the measure), these scores cannot be compared to proportion scores from previous studies. The distributions of scores in the current study for measures of coping and emotion regulation were not highly skewed (all standard deviations were less than the means), and sufficient variability is present to examine the relationships between these variables and other measures of executive functioning and psychopathology used in this study.

Descriptive statistics including means, standard deviations, as well as minimum and maximum scores for participants' levels of positive and negative emotionality as well as depressive and anxiety symptoms are presented in Table 3.

Table 3. Descriptive Statistics for Mood and Symptoms of Psychopathology

	Mean (SD)	Min	Max
PANAS Positive Emotionality	36.05 (5.57)	20.00	49.00
PANAS Negative Emotionality	17.28 (5.89)	10.00	40.00
ASR Depression and Anxiety Symptoms (*T* scores)	56.98 (8.07)	50.00	81.00
ASR DSM Depression (*T* scores)	55.12 (6.91)	50.00	76.00
ASR Total Internalizing (*T* scores)	57.08 (7.15)	50.00	72.00

Scores obtained on the PANAS indicate that participants in the current study had higher levels of positive emotions (M = 36.05, SD = 5.57) than negative emotions (M = 17.28, SD = 5.89). These results were similar to those found by Watson, Clark, and Tellegen (1988) in a sample of 660 undergraduate students (Positive Affect M = 29.7, SD = 7.9; Negative Affect M = 14.8, SD = 5.4). The depression/anxiety symptom T scores (M = 57.0, SD = 8.0), DSM depression scale (M = 55.1, SD = 6.9), and total internalizing symptom scale (M = 57.1, SD = 7.1) on the ASR all reflect a moderate elevation of approximately one-half standard deviation above the normative mean for symptoms of psychopathology. A total of 3.3% and 5.0% of the current sample fell above T = 70 (98%ile) for DSM depression and depression/anxiety symptoms, respectively. In addition, 11.7% of the current sample fell about T = 67 (95%ile) for internalizing symptoms. Therefore, the rate of individuals above the clinical sample is between approximately 1.5-2.5 times what would be expected in a normal sample, indicating that this sample is exhibiting mild to moderate levels of distress.

Descriptive statistics including means, standard deviations, as well as minimum and maximum scores for participants' executive functioning abilities as measured by the WAIS-IV WMI and BRIEF are presented in Table 4.

Table 4. Descriptive Statistics for Executive Functioning Abilities

	Mean (*SD*)	Min	Max
WAIS-IV WMI	108.72 (9.88)	89.00	133.00
BRIEF MI	52.17 (10.16)	36.00	76.00
WMI+ MI Composite z-scores	0.00 (.79)	-1.47	1.55
ACS-P	49.50 (8.94)	33.00	76.00

The WMI scores (M = 108.7, SD = 9.9) indicate that the sample is significantly above the normative mean and exhibits decreased variability on this cognitive measure. Results on the Metacognition Index of the BRIEF, which includes items related to working memory ability, indicate that this sample is similar to the normative sample (M = 52.2, SD = 10.2). Standard scores from the WMI were combined with the standard scores from the BRIEF to create an index of working memory ability taking into account self-report and behavioral data on working memory abilities. This index (M = 0.00, SD = .79) indicates moderate constraint in the variability of this sample. However, the minimum and maximum values demonstrate no significant skewing of this sample on measures of cognitive functioning.

Correlations Among Emotion Regulation, Coping, Psychopathology, and Executive Functions

Pearson correlations among all measures used in this study are reported in Table 5.

Table 5. Correlations Among Measures of Emotion Regulation, Coping, Psychopathology, and Executive Functioning.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
1. RSQ-II Secondary Control Coping	--											
2. RSQ-II Reappraisal Parcel	.93***	--										
3. ERQ Reappraisal	.29*	.24	--									
4. DERS	-.71***	-.70***	-.31*	--								
5. WAIS-IV WMI	.03	.08	-.14	.01	--							
6. BRIEF MI	-.26*	-.26*	.04	.32*	.26*	--						
7. WMI+ MI Composite	-.15	-.12	-.07	.21	.80***	.80***	--					
8. ACS-P	-.34**	-.23	-.05	.35**	-.01	.59***	-.02	--				
9. PANAS Positive Emotionality	.33*	.32*	.24	-.46***	.10	-.26*	-.23	-.36**	--			
10. PANAS Negative Emotionality	-.67***	-.61***	-.32*	.67***	.11	.37**	-.31*	.35**	-.36**	--		
11. ASR Depression and Anxiety Symptoms	-.64***	-.61***	-.22	.69***	-.02	.29*	.17	.25	-.40**	.86***	--	
12. ASR DSM Depression	-.59***	-.57***	-.25	.63***	.14	.34**	.30*	.26	-.35**	.82***	.84***	--
13. ASR Total Internalizing	-.45***	-.37***	-.04	.60***	.01	.57***	.35**	.55***	-.35**	.64***	.65***	.70***

*p<.05, **p<.01, ***p<.001

The first set of correlations that are important to examine are those related to measures of coping and emotion regulation, as seen in the upper left corner of the matrix. In this sample, significant correlations were found among the measures of coping and emotion regulation. The Secondary Control Coping Scale of the RSQ-II was significantly related to the ERQ reappraisal scale ($r = .29$, $p < .05$) and significantly negatively related to the DERS ($r = -.71$, $p < .001$). Further, the ERQ reappraisal index was also significantly related to the DERS ($r = -.31$, $p < .05$).

The next set of correlations that are noteworthy are shown in the center portion of the matrix. The measures of coping and emotion regulation and their correlations with executive functioning can be found there. While the WAIS-IV WMI was not significantly correlated with any of the measures of emotion regulation or coping administered in this study, the BRIEF MI (higher scores indicate more problems in executive functions) was significantly related to these measures. The BRIEF MI was significantly related to the DERS ($r = .32$, $p < .05$) and significantly negatively related to the Secondary Control Coping Scale of the RSQ-II ($r = -.26$, $p < .05$), but did not correlate significantly with the ERQ. In addition, the ACS-P was significantly related to the DERS ($r = .35$, $p < .01$) and significantly negatively related to the Secondary Control Coping Scale of the RSQ-II ($r = -.36$, $p < .01$), but also did not correlate significantly with the ERQ. While the WM index score was composed of z score transformations of both the WAIS-IV WMI and the BRIEF MI, no significant correlations were found between this index and any measure of emotion regulation or coping.

Finally, a number of significant relationships were found between measures of emotion regulation, coping, executive functioning and measures of positive and negative

affect and symptoms of psychopathology; these can be found at the bottom of the matrix. Levels of positive emotions on the PANAS were significantly related to the Secondary Control Coping Scale of the RSQ-II (r = .33, p < .05) and significantly negatively related to the DERS (r = -.26, p < .05), BRIEF MI (r = -.26, p < .05), and the ACS-P (r = -.36, p < .01). Finally, positive emotions were significantly negatively related to negative emotionality on the PANAS (r = -.36, p < .01), depression/anxiety symptoms on the ASR (r = -.40, p < .01), DSM depression on the ASR (r = -.35, p < .01), and total internalizing symptoms on the ASR (r = -.35, p < .01). Levels of negative emotions on the PANAS were significantly negatively related to the Secondary Control Coping Scale of the RSQ-II (r = -.67, p < .001) as well as the Reappraisal scale of the ERQ (r = -.32, p < .05). In addition, negative emotions were significantly correlated with the BRIEF MI (r = .37, p < .01) and ACS-P (r = .35, p < .01), and significantly negatively correlated with the WMI/MI composite index (r = -.31, p < .05). Finally, negative emotions were strongly correlated with depression/anxiety symptoms on the ASR (r = .86, p < .001), DSM depression on the ASR (r = .82, p < .001), and total internalizing symptoms on the ASR (r = .64, p < .001). The ASR measure of DSM depressive symptoms was significantly negatively related to the Secondary Control Coping Scale of the RSQ-II (r =-.59, p < .001) and significantly positively related to the DERS (r = .63, p < .001). However, no significant relationship was found between the ERQ and measures of depression. Finally, the BRIEF MI was significantly related to DSM depressive symptoms (r = .34, p < .01), but no significant correlations were found between the WAIS-IV WMI or WMI/MI composite and depressive symptoms. The ACS-P was also not significantly correlated with depression symptoms.

Linear Multiple Regression Analyses

Stepwise linear regression analyses were conducted to predict depressive symptoms on all five measures of emotionality and psychopathology using the BRIEF MI, ERQ Reappraisal score, and Secondary Control Coping score from the RSQ-II. Based on the correlations shown above in Table 5, we constructed regressions beginning with the ERQ Reappraisal score because it was the least strongly related to all other measures used in this study. We wanted to examine how it functions on its own and along with other measures of coping and executive functioning in predicting emotionality and psychopathology. The DERS was not examined in this regression analysis due to the high level of multicollinearity that would have been produced by its strong correlation with the Secondary Control Coping scale of the RSQ-II.

Table 6. Step-wise Regression Predicting Positive Emotions on the PANAS with BRIEF MI, ERQ Reappraisal Score, and Secondary Control Coping Score from the RSQ-II.

	β	sr^2
Block 1 R^2 Δ =.07 *		
BRIEF MI	-.26*	.070
Block 2 R^2 Δ = .06 *		
BRIEF MI	-.27*	.079
ERQ Reappraisal	.25	.066
Block 3 R^2 Δ = .04 *		
BRIEF MI	-.21	.047
ERQ Reappraisal	.18	.034
Secondary Control Coping	.22	.048
Block 4 R^2 Total = .17 *		

*p<.05, **p<.01, ***p<.001

As can be seen in Table 6, the BRIEF MI was significant in predicting positive emotions alone (β = -.26, p < .05) and remains significant when the ERQ Reappraisal

score is added (β = -.27, p < .05). Both the ERQ Reappraisal score and the Secondary Control Coping Score from the RSQ-II were not significant in predicting positive emotions in this model.

Table 7. Step-wise Regression Predicting Negative Emotions on the PANAS with BRIEF MI, ERQ Reappraisal Score, and Secondary Control Coping Score from the RSQ-II.

	β	sr^2
Block 1 R^2 Δ =.14 **		
BRIEF MI	.37**	.14
Block 2 R^2 Δ = .11 ***		
BRIEF MI	.38**	.16
ERQ Reappraisal	-.33**	.13
Block 3 R^2 Δ = .26 ***		
BRIEF MI	.23*	.089
ERQ Reappraisal	-.16	.047
Secondary Control Coping	-.56***	.35
Block 4 R^2 Total = .51 ***		

*p<.05, **p<.01, ***p<.001

As can be seen in Table 7, the BRIEF MI is significant in predicting negative emotions alone (β = .37, p < .01), when the ERQ Reappraisal score is added in the second step (β = .38, p < .01), and when the Secondary Control Coping score from the RSQ-II is also added in the third step of the equation (β = .23, p < .05). While the ERQ Reappraisal score is significant when added to the BRIEF MI in the second step (β = -.33, p < .01), it is no longer significant when the Secondary Control Coping score from the RSQ-II, which is significant (β = -.56, p < .001), is added in the third step.

Table 8. Step-wise Regression Predicting Symptoms of Depression and Anxiety on the ASR with the BRIEF MI, ERQ Reappraisal Score, and Secondary Control Coping Score from the RSQ-II.

	β	sr^2
Block 1 R^2 Δ =.08 *		
BRIEF MI	.29*	.081
Block 2 R^2 Δ = .05 *		
BRIEF MI	.29*	.090
ERQ Reappraisal	-.23	.058
Block 3 R^2 Δ = .30 ***		
BRIEF MI	.13	.026
ERQ Reappraisal	-.05	.0042
Secondary Control Coping	-.59***	.34
Block 4 R^2 Total = .43 ***		

*p<.05, **p<.01, ***p<.001

As can be seen in Table 8, the BRIEF MI was significant in predicting symptoms of depression and anxiety alone (β = .29, p < .05) and remains significant (β = .29, p < .05) when the ERQ Reappraisal score is added, which is not significant. In the final step of the model, only the Secondary Control Coping Score from the RSQ-II was significant in predicting symptoms of anxiety and depression in this model (β = -.59, p < .001).

Table 9. Step-wise Regression Predicting DSM Depression on the ASR with the BRIEF MI, ERQ Reappraisal Score, and Secondary Control Coping Score from the RSQ-II.

	β	sr^2
Block 1 R^2 Δ =.011**		
BRIEF MI	.34**	.11
Block 2 R^2 Δ = .07 **		
BRIEF MI	.35**	.13
ERQ Reappraisal	-.26*	.075
Block 3 R^2 Δ = .22 ***		
BRIEF MI	.21	.060
ERQ Reappraisal	-.10	.016
Secondary Control Coping	-.51***	.26
Block 4 R^2 Total = .40 ***		

*p<.05, **p<.01, ***p<.001

As can be seen in Table 9, the BRIEF MI is significant in predicting DSM depression alone (β = .34, p < .01) and when the ERQ Reappraisal score is added in the second step (β = .35, p < .01). While the ERQ Reappraisal score is significant when added to the BRIEF MI in the second step (β = -.26, p < .05), it is no longer significant when the Secondary Control Coping score from the RSQ-II, which is significant (β = -.51, p < .001), is added in the third step.

Table 10. Step-wise Regression Predicting Internalizing Symptoms on the ASR with BRIEF MI, ERQ Reappraisal Score, and Secondary Control Coping Score from RSQ-II.

	β	sr^2
Block 1 R^2 Δ =.32***		
BRIEF MI	.57***	.33
Block 2 R^2 Δ = .004 ***		
BRIEF MI	.57***	.33
ERQ Reappraisal	-.06	.0056
Block 3 R^2 Δ = .09 ***		
BRIEF MI	.48***	.27
ERQ Reappraisal	.04	.0024
Secondary Control Coping	-.34**	.14
Block 4 R^2 Total = .43 ***		

*p<.05, **p<.01, ***p<.001

As can be seen in Table 10, the BRIEF MI is significant in predicting internalizing symptoms alone (β = .57, p < .001) and remains significant (β = .57, p < .001) when the ERQ Reappraisal score, which is not significant, is added in the second step. It remains significant when the Secondary Control Coping score from the RSQ-II is also added in the third step of the equation (β = .48, p < .001). The Secondary Control Coping score from the RSQ-II is also significant in predicting internalizing symptoms when added in the third step of the equation (β = -.34, p < .01).

CHAPTER IV

DISCUSSION

The current study investigated the relations between executive functioning ability and the use of coping and emotion regulation strategies in college-age older adolescents and young adults. In addition, this study also examined the relationship between self-reported emotion regulation abilities and use of adaptive coping strategies as well as the role of emotion regulation and coping strategies in the development of symptoms of depression. Both self-report and behavioral measures of executive functioning were used in addition to self-report measures of coping, emotion regulation, and depressive symptoms.

All measures functioned as expected in this sample. While the mean score on the WAIS-IV measures of working memory (M = 108.72, SD = 9.88) were higher than the normative population, this elevation is in line with the use of a sample drawn from the undergraduate introductory psychology courses at a highly selective university. Further, the variance on the WAIS WMI was more constrained than in the normative population. The BRIEF-MI mean for this sample was, however, similar to the normative population. In addition, results on measures of emotion regulation were comparable to those described in the literature for college students. Finally, results on the ASR indicate that the sample was experiencing mild to moderate distress in domains of depression and anxiety compared to a normative sample. Therefore, although the sample analyzed was one of convenience, meaningful variation was found for measures of executive

functioning, emotion regulation, and coping in addition to internalizing symptoms of psychopathology. Such results allowed us to construct correlation and regression models in order to examine the links between coping, emotion regulation, and psychopathology, and the role of executive functions in this relationship.

While the WMI from the WAIS-IV did not correlate significantly with measures of coping, emotion regulation, or psychopathology, these results are in line with those found in previous research. In a study of both survivors of childhood acute lymphocytic leukemia and healthy controls by Campbell *et al.* (2009), measures of executive function were significantly related to coping and emotional problems in the cancer survivors, but no significant relations were found in the healthy control sample between measures of several domains of executive functioning, including working memory, and measures of coping. These authors attributed this pattern of findings to the relatively reduced variance in these measures in the control sample relative to the sample of cancer survivors. The overall elevations and decreased variability for the WAIS-IV WMI index in the current sample may indicate that the role of executive functioning in adaptive coping and emotion regulation may be more pronounced in individuals with lower levels of cognitive abilities. A replication of this analysis with a sample with more diverse and variable levels of cognitive function will be helpful in identifying specific populations in which cognitive processing abilities may more robustly mediate this relationship. Such findings may provide a possible intervention point for decreasing risk of depressive psychopathology in specific populations.

In the current study, the BRIEF-MI did however exhibit significant relationships with measures of all three constructs, indicating a relationship between cognitive

processes, coping, and emotion regulation abilities. When z scores of the WAIS-IV WMI and BRIEF-MI were combined to create an index of working memory abilities, the composite score was correlated significantly with measures of psychopathology. This difference in results between behavioral and self-report measures may be due to several factors. Specifically, the effect of shared or common method variance in self-report measures may have artificially inflated the correlations between the BRIEF-MI, ERQ, and RSQ-II scales.

Unexpectedly, the ERQ Reappraisal scale correlated less strongly than expected with other measures of emotion regulation and coping. Further, the ERQ Reappraisal scale was not related to the ASR scales of depression and anxiety symptoms, DSM depressive symptoms, and total internalizing symptoms. In contrast, the Secondary Control Coping scale of the RSQ-II was significantly related to other measures of emotion regulation as well as the measures of psychopathology. The six items from the Secondary Control Coping scale of the RSQ-II assessing cognitive reappraisal were also analyzed separately as an independent item-parcel to provide a more direct comparison to the ERQ Reappraisal scale. The reappraisal item-parcel from the RSQ-II was not significantly related to the ERQ Reappraisal scale but did correlate significantly with all measure of psychopathology used in this study. Taken together, these results may suggest that the construct of "coping," and specifically the concept of secondary control coping, may be more strongly related to the risk of developing psychopathology than cognitive reappraisal as measured by the ERQ. By asking a narrower, constrained set of items, the ERQ may have sacrificed some validity in order to achieve high reliability among the items. The Reappraisal parcel from the RSQ-II may have more validly

sampled the range of behaviors that are related to emotional problems, and the Secondary Control Coping scale may provide an even broader index of these adaptive strategies.

The DERS was strongly correlated with most other measures of emotion regulation, coping, and psychopathology in this study. The questionnaire, which is intended to measure "difficulties in emotion regulation," includes several items describing overt symptoms of emotional experience (e.g., "When I'm upset, I start to feel very bad about myself."). The overlap of these items with symptoms of psychopathology may inflate correlations between the DERS and measures of psychopathology focused on depression and anxiety symptoms. Therefore, in order to avoid effects of multicolinearity, the DERS was not included in the regression analyses.

The stepwise linear regression analyses in this study examined the BRIEF MI and ERQ Reappraisal scale as predictors of outcome measures of emotionality and psychopathology. Overall, the BRIEF MI was a significant predictor of most the ASR symptom measures but was no longer significant when the Secondary Control Coping scale from the RSQ-II was added. These findings replicate those reported by Campbell *et al.* (2009) in which coping accounted for the relationship between executive function and emotional/behavioral problems in childhood cancer survivors. The ERQ Reappraisal Scale generally did not significantly predict outcome measures of emotionality and psychopathology, particularly when it was included in the regression models along with the RSQ secondary control coping scale. These findings also suggest that the assessment of secondary control coping may provide a broader and more sensitive index of the role of working memory in relation to depressive symptoms and may be superior for the assessment of potential mediators of cognitive behavioral interventions for depression.

Through an ongoing collaboration with another institution with a larger, more heterogeneous student population, we expect to increase sample variance on all measures and shift the mean on the WAIS-IV closer to that of the normative population. When analyses are repeated for this enhanced sample, we predict more anticipated effects, especially with respect to the role of working memory as measured by the WAIS-IV in emotion regulation and coping.

While measures of coping and emotion regulation were correlated in this study, this relationship was not as strong as originally predicted. Further, coping outweighed emotion regulation in predicting internalizing symptoms, including symptoms of depression. Gross and Thompson (2007) have posited that emotion regulation is distinct from coping. According to this view, emotion-regulation reflects only the alteration of one's emotions towards a stressor without action directed toward the stressor itself and may include the up-regulation of positive emotion in addition to the down-regulation of negative emotion. However, more recent additions to the coping literature have begun to reconcile the latter aspect by focusing on the role of positive affect in coping (Compas *et al.*, 2010) as well as emotional approach strategies (Austenfeld & Stanton, 2004) that have been linked to better psychological and health-related outcomes.

Overall, the current conceptualization of coping may represent a broader array of strategies that may be used during stressful situations as compared to emotion regulation. This more inclusive description may also provide an advantage in predicting depressive symptoms. While the ERQ is divided into two scales, Suppression and Reappraisal, the scales on the RSQ-II each include items related to several interrelated constructs. For example, the Secondary Control Coping scale analyzed in this study draws on strategies

involving reappraisal, distraction, and acceptance. We believe that individuals may not necessarily use cognitive reappraisal in isolation, but rather combine this process with others in order to deal with stress, a view that is supported by several confirmatory factor analytic studies (e.g., Compas *et al*., 2006a; Connor-Smith *et al.,* 2000; Wadsworth *et al.,* 2004).

Further, the cognitive reappraisal parcel composed of 6 individual items was analyzed in this study as a more direct comparison to the ERQ Reappraisal scale. Even when this more narrow focus was used, the RSQ-II items were more highly correlated with measures of emotionality and psychopathology than the ERQ Reappraisal scale. It is likely that this is due to the wider range of examples of reappraisal captured by the RSQ-II (*i.e.,* learning from the problem, laughing about the problem) compared the ERQ, which is focused almost exclusively on thinking about a problem in a different way. The ERQ achieved adequate reliability ($\alpha = .85$) through the inclusion of several similar items all of which focus on alternate ways of thinking about a situation. However, the high reliability of these items may have at the expense of a more varied and valid sampling of how people reappraise in stressful situations.

The link between executive functioning and coping found in this study may also provide additional evidence that the assessment of coping may offer a more comprehensive representation of the processes underlying the risk for depression. A body of previous research has examined the relationship between executive functions, including attention and working memory, and the regulation of emotions (Ochsner *et al.,* 2002). Through selective attention, prefrontal regions may up-regulate focus on a specific representation or stimulus quality and retain goal-relevant information while avoiding

environmental noise (Derryberry & Rothbart, 1997). The information being held in mind can be manipulated through working memory processes (Baddeley & Hitch, 1974). Through reciprocal interactions between the PFC and other cortical and subcortical regions, both working memory and selective attention may facilitate emotion regulation and coping strategies such as cognitive reappraisal. However, a stronger relationship found between measures of executive functioning and coping compared to emotion regulation was found in the current study. These results further suggest that the assessment of coping may provide a better indication of an individual's risk for psychopathology. Moreover, if future studies do find an increased role of executive functioning in emotion regulation and coping at lower levels of cognitive abilities, the broader, more heterogeneous characterization of coping may provide a better indication of when intervention in cognitive processing may impact psychopathology.

It will be important for future studies to focus on the use of multiple methods in order to further examine the interrelationships among constructs analyzed in this study. First, experimental neuropsychology paradigms may be used to measure other aspects of executive functioning that may be linked to the processes of coping and emotion regulation. For example, the dot-probe task, an indicator of attentional bias and selective attention, may provide insight into non-conscious, non-effortful, and uncontrolled processes of cognition that are integral to the development of hypervigilance in anxiety and depression. Second, laboratory stress tasks may be helpful when used alongside questionnaires in learning about how individuals cope with stress and regulate their emotions. The Trier Social Stress Task has historically been used in order to affect acute stress in a controlled environment (Kirschbaum, Pirke, & Hellhamer, 1993). An

alternative role-play task in which the participant must interact with a confederate playing the part of a noisy neighbor has also been used and found to be a more ecologically valid example of stress in this population (Luecken, Kraft, & Hagan, 2009). Third, additional measures of the effects of stress may further elucidate the psychological and physiological processes related to coping and emotion regulation in both healthy individuals and those suffering from psychopathology. For example, heart rate reactivity, galvanic skin response, and salivary cortisol measures may be obtained during laboratory stress tasks and experimental neuropsychological measures (Ellenbogen *et al.,* 2002). This multi-method approach may shed further light on the psychobiology of both acute and chronic stress and how individual differences in coping strategies and physiological reactions may influence both psychological and health-related outcomes.

Finally, as the current study examined coping and emotion regulation as mediators of the relation between executive function and psychopathology, the investigation of the neural bases of cognitive function in this context in future studies may be valuable. Much of the original evidence for a prefrontal role in executive functions stems from individual case studies of patients with acquired brain lesions to these areas (Luria, 1966). Many of these patients developed a cluster of behaviors known as "dysexecutive syndrome," which describes a general use of disorganized strategies in approaching familiar tasks. Most well-known is perhaps the study of Phineas Gage, a railroad worker who survived an accident in which a metal rod destroyed much of his frontal lobes. After the event, reports indicate that he became increasingly irrational and emotionally labile and made erratic decisions (Damasio, 2005; Harlow, 1868).

More recently, Miller and Cohen (2001) have proposed a model for primary involvement of the PFC in higher-level cognitive functions. Labeled "cognitive control," Miller and Cohen describe a phenomenon in which prefrontal processes regulate sensory inputs to control behavioral output. Further, they suggest that cognitive control involves any operation that biases the processing of multiple inputs to favor the most appropriate solution to the task. Through reciprocal interactions with the sensory and motor cortices as well as several subcortical structures, the PFC's execution of cognitive control may help to produce a multitude of operations that comprise executive functioning (Damasio, 2005). These domains include, but are not limited to, working memory, attention, set-shifting, and response inhibition.

Research using neuropsychological, neuroimaging, and electrophysiological modalities has implicated the lateral PFC in working memory tasks (Cabeza & Nyberg, 2000), the anterior cingulate cortex in inhibitory processes and overriding response conflict (Barch *et al.,* 2001), and the medial PFC in characterizing one's own or another's emotions (Paradiso *et al*., 1999). Based on these previous findings, Oschner *et al.* (2002) conducted a neuroimaging study to examine regional activation during a cognitive reappraisal task and provide further evidence for prefrontal involvement in human emotion regulation. Results of the study indicated increased activation in the lateral and medial PFC and decreased activation in the amygdala and orbitofrontal cortex during a cognitive reappraisal task. These findings lend support to bidirectional top-down, cortico-limbic as well as bottom-up, limbic-cortical influences on emotion regulation. In addition, results suggest that the process of cognitive reapprsaisal may influence emotion generation and evaluation functions of the amygdala and orbitofrontal cortex.

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