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I, Nicholas Anthony Tomeo, hereby submit this original work as part of the requirements for the degree of Doctor of Philosophy in Educational Studies.

It is entitled:  
Correlates between Chronic Stress and Executive Function in College Students

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Correlates between Chronic Stress and Executive Function in College Students

A dissertation submitted to the Graduate School of the University of Cincinnati in partial fulfillment of the requirements for the degree of
Doctor of Philosophy in Educational Studies
in the College of Education, Criminal Justice and Human Services

by
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Abstract

Chronic stress can generate an oversupply of cortisol to the prefrontal cortex, which can lead to impairment in executive function--sound judgment, thoughtful reflection, and higher order thinking. College students, who are in the midst of making life changing decisions, experience a great deal of stress during their matriculation. This study examined relationships between specific stressors and deficits in executive functioning and addressed the following research questions: “Which type of stress is most closely related to deficits in executive function (EF) overall?” “Which of these correlated stressors is most predictive of executive function deficit levels?” and “Which type of stress is most predictive to specific subscales of executive function deficits?” The secondary aim of this study was to answer the question, “What can be done to help college students manage stress?” Primary research data on 121 college students were gathered using two surveys: an adapted version of the Inventory of College Students’ Recent Life Experiences (ICSRLE) and the Barkley Deficits in Executive Functioning Survey-Short Form (BDEFS-SF). This study determined that General Social Mistreatment was the highest correlated stressor with overall executive function deficits. General Social Mistreatment, Developmental Challenges, and Academic Alienation demonstrated significant predictive relationships with overall executive function deficits. Developmental Challenges, and Academic Alienation were also predictive of a number specific types of executive function deficits. Several interventions were also discovered that could be employed in universities to help college students minimize the effects of specific stressors in their life at the university.

Keywords: Executive function, chronic stress, college students, cortisol, triadic model, neuropsychology
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To all of you who had a hand in this project through guidance and encouragement, I say, “Thank you!”
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CHAPTER I

Statement of the Problem

College is all about change—new friends, new freedom, studies, professors, and excitement. Life-changing decisions are also made during the college years, including choices concerning: career, marriage, response to addictive substances, relationships, spirituality, and philosophy (Morey & Dansereau, 2010; Orchowski, Mastroleo, & Borsari, 2012; Spillane, Smith, & Kahler, 2010).

Most college students are at a crossroads in their life. Sound choices in behavior require especially careful judgment, thoughtful reflection, and higher order thinking. These necessary processes are known as Executive Functions (EF). Executive function is an umbrella term that encompasses the higher order processes, a neuropsychological term defining the cognitive control of thought, action, and emotion (Hughes, 2011; Prencipe, Kesek, Cohen, Lamm, Lewis, & Zelazo, 2011). While there is a lack of consensus defining all executive functions (Fischer & Daley, 2006), many of the executive functions listed are: inhibitory control, working memory, abstract reasoning, emotional regulation, long-term decision making, dealing with novelty, sensitivity to future consequences, stimuli processing, attention control, self-awareness, and filtering out unimportant information for planning (Blakemore & Choudhury, 2006; Fischer & Daley, 2006; Spear, 2007; Taylor, Barker, & McHale, 2012). Approximately 33 dimensions of executive function are discussed by various theorists (Barkley, 2012). Many of these dimensions of executive function are needed to make sound, thoughtful life-affecting decisions. When these constructs of executive function are not employed or are unable to be employed by college students, risky life choices can result.
Many decisions made by college students have resulted in risky behavior. For example, based on the *National Household Survey on Drug Abuse* (NHSDA), sponsored by the U.S. Department of Health and Human Services' Substance Abuse and Mental Health Services Administration, 42% of full-time college students, aged 18–22 years, have reported binge drinking and 18% have reported heavy drinking in the past month (as cited in Zeigler, Wang, Yoast, Dickinson, McCaffree, Robinowitz, & Sterling, 2005). The 2002 National Institute on Alcohol Abuse and Alcoholism report on college drinking, *A Call to Action*, indicated that 31% of college students met the diagnostic criteria for alcohol abuse and 6% met criteria for alcohol dependence during that year, based on self-reported drinking behavior. Alcohol abuse can be associated with alcohol poisoning, motor vehicle crashes, alcohol related death, illegal drug usage, sexual assaults, and unwise sexual decisions—behaviors defined as risky (Task Force of the National Advisory Council on Alcohol Abuse and Alcoholism, 2002). Also because those 18-22 years of age are still in the process of neuro-maturation, it is hypothesized that the college student’s brain may be more susceptible to damage from some of these behaviors. Findings through the use of Magnetic Resonance Imaging (MRI) studies indicate that alcohol users of college age are more susceptible than those over 25 years old to neuro-degeneration, impairments in functional brain activity, and the appearance of neuro-cognitive deficits (Zeigler et al., 2005). Yet the unhealthy use of alcohol is not the only risky behavior seen in college students. It is estimated that 9.1 million students between the ages of 15-24 have contracted a sexually transmitted disease (Morey & Dansereau, 2010). Cigarette smoking is a highly addictive and deadly habit sometimes picked up by college students, despite the public warnings. Smoking continues to be embraced by many college students. In a recent survey on a college campus, 32% of the undergraduates surveyed smoked. Given that 32% of the survey sample of
250 undergraduates smoke, there is still much work that needs to be done to develop effective smoking prevention and smoking cessation programs (Van Volkom, 2008).

Executive functioning deficits are demonstrated in many of the decisions made by students on university campuses. In a study conducted by Russell Barkley (2011) using the *Barkley Deficits in Executive Functioning Scale-Long Form* with 1,249 participants between the ages of 18–80+ years, it was determined that those in the 18-29 age group had higher mean levels of executive function deficits than any other age group (p. 54). Table 1 displays the deficit levels of the various age groups.

Table 1

*Executive Functioning Mean Score by Age Groups*

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Mean Score of Executive Function Deficit</th>
</tr>
</thead>
<tbody>
<tr>
<td>18-29</td>
<td>141</td>
</tr>
<tr>
<td>30-39</td>
<td>136</td>
</tr>
<tr>
<td>40-49</td>
<td>131</td>
</tr>
<tr>
<td>50-59</td>
<td>135</td>
</tr>
<tr>
<td>60-69</td>
<td>129</td>
</tr>
<tr>
<td>70-79</td>
<td>129.5</td>
</tr>
<tr>
<td>80+</td>
<td>135.9</td>
</tr>
</tbody>
</table>

*Note: a higher score describes a higher level of deficiency—a lower level of executive function ability*

Neuroscientists have attributed these deficits of many in the 18-29 year old group to a number of factors. One such factor identified by neuroscientists is the relationship between risky decisions and an immature prefrontal cortex, with its weak connections between the amygdala...
and ventral striatum (Ernst, Pine, & Hardin, 2005; Giedd, 2004). Other neuroscientists implicate the effects of chronic stress on the levels of executive functioning in college students (Orem, Petrac, & Bedwell, 2008) as a second factor.

**Four Specific Definitions and Theories of Executive Function**

There are many descriptions of executive functioning found in psychological literature. This section examines four prominent theories and definitions.

**Stuss and Benson’s Hierarchical Model of Executive Functioning Theory**

Stuss and Benson (1986) described thought processes that occur in the frontal lobes of the brain. On Level 1 of their diagram, depicting thought processing, is *Self-Awareness*. Below that (Level 2) is the *Executive Function* level, which includes four components: *anticipation, goal setting, preplanning, and monitoring*. Level 3 includes *Drive* (i.e., drive, motivation, and will) and *Sequencing* (i.e., sequence, set, and integration). *Drive* and *Sequencing* are not considered executive functions; they are governed by the four functions on the EF level. *Drive* and *Sequencing* then govern the nonexecutive functional systems such as *attention, alertness, visual-spatial, autonomic emotional, memory, sensory/perception, language, motor and cognition*.

Stuss and Benson’s theory is described in Table 2.
Table 2

Stuss & Benson’s (1986) Hierarchical Model of Thought Processing

<table>
<thead>
<tr>
<th>Levels</th>
<th>Corresponding activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>Self Awareness</td>
</tr>
<tr>
<td>Level 2</td>
<td>Executive Function: anticipation, goal setting, preplanning, &amp; monitoring</td>
</tr>
<tr>
<td>Level 3</td>
<td>Drive: drive, motivation, &amp; will; Sequencing: sequence, set, &amp; integration</td>
</tr>
</tbody>
</table>

Fuster’s Theory of Cross-temporal Organization (1997)

Fuster’s theory was based on the study of patients with prefrontal cortex injuries. Cross-temporal synthesis is based on three prefrontal cortex (PFC) components: working memory (temporally retrospective function), anticipatory set (planning), and interference control (attention with resistance to distraction). These three functions affect goal-directed behavior. This behavioral determination is temporally decided (judgment based on timing)—“Is this the right time? Should I delay my response? Am I too late?”

Hayes’ Behavioral Theory of Executive Functioning as “Rule-governed” Behavior (Hayes, Gifford, & Ruckstuhl, 1996)

Hayes’ theory proposes that executive functioning is a special subset of rule-governed (verbally regulated—self-directed or provided by others) behavior. Determining these rules for behavior is a function of the prefrontal cortex. The decisions one makes is simply based on previously learned rules or a new rule conceived by the individual making the decision.
Barkley’s Theory of Executive Functioning (2012)

Barkley specifically defines executive function as, “self-regulation across time for the attainment of future goals, typically in social contexts” (Barkley, 2011, p. 13). Barkley’s definition includes and is further explained through five factors or subscales: Self-Management to Time, Self-Organization/Problem Solving, Self-Restraint, Self-motivation, and Self-Regulation of Emotions (Barkley & Murphy, 2011).


Barkley’s definition also includes most, if not all of the functions listed above by Spear (2007), Fischer and Daley (2006), and Blakemore and Choudhury (2006) such as inhibitory control, working memory, abstract reasoning, emotional regulation, long-term decision making, and attention control. Barkley’s multi-dimensional definition more accurately depicts the multiple factors of executive function, and it also addresses social functioning ability (Barkley, 2001). Social factors are important when considering the observed social pathology associated
with prefrontal cortex damage (Barkley, 2012). Therefore, Barkley’s definition (2011) is the one primarily used in this document when discussing executive functioning. Even though there is a lack of consensus defining executive function, theorists assert that a deficient level of executive function is a major determinant of dysfunctional behavior and poor decision making; while higher levels of executive functioning usually lead to a more adaptive, successful life (Janssen, DeMey, & Egger, 2009).

**Physiological Hindrances to Executive Functioning**

Unfortunately, many college students’ executive function skill levels can be lower than what is needed to make sophisticated judgments. The maturation of the regions of the brain most implicated in executive functioning is not yet completed (Baird & Fugelsang, 2004; Wallis, 2004). As an additional hindrance to executive function, previous studies have demonstrated that these regions are further impaired by chronic stress released cortisol. So at this sensitive time of life when sound executive function is needed, developmental issues along with chronic stress can compromise sound executive function.

College has been found to be stressful for many young adults. The transition from high school to college life can be a challenge for some students as they learn to live independently, handle finances, maintain academic standards, and deal with a whole new social life. These can be stressors experienced by a significant number of college students. These life events can bring about various levels of stress. A number of studies have shown that 75% to 80% of college students are moderately stressed, while 10%-12% are severely stressed (Brougham, Zail, Mendoza, & Miller, 2009). In a survey conducted by the American College Health Association, 37% of the college students surveyed indicated that stress interfered with their academic performance. Stress has been related to physical illness, sleep disorders, and psychiatric
disorders (Bear, Conners, & Paradiso, 2007). Stress has also been shown to be related to students dropping out of college, developing maladaptive coping strategies, and participating in risky behaviors (Chiauzzi, Brevard, Thurn, Decembrele, & Lord, 2008). Not only does stress have the potential to harm students physically, the stress faced by today’s college students can also impair executive function.

**Purpose of the Present Study**

This dissertation researched and described the nature of relationships between executive function in college students and stressful life experiences. The literature review examined several elements that affect executive function levels, while focusing on the effects of chronic stress in these areas as related to executive functioning. Primary data gathering and analysis was conducted to determine correlates and predictive values between specific chronic stressors and executive function levels. Research involved assessing a number of college students, using surveys that measure the extent of individual stressors and executive function deficits with the hope of determining which stressor is most predictive of executive function deficits. The aim of this study was to investigate the executive function levels and chronic stress levels of a college student sample. The data were then synthesized to establish if correlations exist between executive function deficits and seven specific descriptives of chronic stress. While it is known that chronic stress affects prefrontal cortex/executive function adversely, very little research (if any) has been done to identify which type of stressor(s) are most correlated with executive function deficits. This writer’s hope was to add to the research on stress and executive function by identifying any correlation between high executive function deficits and specific stressors.

It was hypothesized that specific stressful life events are positively correlated with overall and specific executive function deficits. The primary research questions for this study are,
“Which type of stress is most closely related to deficits in executive function (EF) overall? “Which of these correlated stressors is most predictive of executive function deficit levels?” and “Which type of stress is most predictive to specific subscales of executive function deficits?”

The second aim of this study is to answer the question, “What can be done to help college students manage the stress faced by many and thereby increase executive function ability?”

Even though it is known that stress can impact student performance, few schools provide students with a consistent opportunity to develop and regularly practice stress reduction techniques to aid them academically (Paul, Elam, & Verhulst, 2007). Therefore, following the data analysis, implications and suggested practices are discussed that could be employed to reduce chronic stress and increase executive function levels in college students. These recommendations were based upon acquired knowledge from primary and secondary resources.
CHAPTER II

Literature Review

A number of factors affect the levels of one’s ability to use executive function. This literature review will focus primarily on: brain development, stress, and educational factors.

Brain Development

In discussing executive functioning, one must have a basic understanding of neurology, since what goes on in one’s neurological structure and development is implicated in all human decision making. It is of importance to note that development in the college student’s brain is very active. It changes in the areas of structure, structural connectivity, and neurotransmission (Steinberg, 2010). These dramatic changes continue until around 24 or 25, two to three years after college graduation (Siegel, 2014; Taylor et al., 2012). During this period of development, the brain's efficiency is enhanced through increased myelination and selective removal of synapses (synaptic pruning). The prefrontal cortex, where executive function is primarily housed, undergoes significant changes (Taylor et al., 2012). Sub-cortical gray matter and limbic system structures (e.g., hippocampus and amygdala) increase in volume. At the same time, cortical structures such as the prefrontal cortex decrease in volume, perhaps as a result of synaptic pruning. Through this process, the prefrontal area becomes more efficient as it matures into adulthood and enhances the ability to engage executive functions such as planning, integrating information, abstract thinking, problem solving, judgment, and reasoning. Three prefrontal circuits of the prefrontal cortex have been implicated in executive functioning. The dorsolateral prefrontal circuit is associated with executive cognitive function; the lateral orbital prefrontal circuit is associated with self-regulation, such as inhibition; and the anterior cingulate circuit is associated with activation and motivation (Janssen, De Mey, & Egger, 2009).
Along with the prefrontal cortex, two other regions are influential to a student’s ability to use sound executive function. Along with the prefrontal cortex (PFC), the ventral striatum and the amygdala are also implicated in decision making, based on response and interaction of these three basic structures of the brain. This is referred to as the triadic model of the neurobiology of motivated behavior in adolescence. Motivated behavior is guided by rewards (ventral striatum), avoidance of unpleasant stimuli (amygdala), and the prefrontal cortex regulatory systems (Ernst, Pine, & Hardin, 2005). While each of these regions is associated with various behaviors, the triadic model focuses on a particular behavior associated with each of the three regions and the communication between these three regions. The prefrontal cortex regulates and modulates the striatal and limbic systems. In a real sense, like the conductor of an orchestra, the prefrontal cortex directs decision making based on communication and input especially from the ventral striatum and amygdala/limbic system (Baird & Kudrow, 2012). While the limbic and striatal systems are controlled by the prefrontal cortex, one must remember the coordinator (the prefrontal cortex) is not quite developed itself and is usually the last region to become coordinated (Baird, 2007). Therefore, the ability of an 18 to 25 year old prefrontal cortex, whose task includes encouraging rational thinking, countering appetitive urges, and checking risk-taking behavior, may not be working at a mature level (Selemon, 2013).

**Stress Effects**

A number of factors influencing the prefrontal cortex can affect executive functioning--damage to the prefrontal cortex (Voytek, Davis, Yago, Barcelo, Vogel, & Knight, 2010), natural development of the prefrontal cortex (Wallis, 2004), and chronic stress induced cortisol on the prefrontal cortex (Orem, Petrac, & Bedwell, 2008).
Stress is defined as “A process through which environmental events are interpreted by people in relation to their own values and resources and responded to psychologically, behaviorally, and biologically” (Robinson, 2010, p. 2). Stressors are defined as “events that are interpreted as threatening to an individual which elicit physiological and behavioral responses” (McEwen, 2000, p. 173, as cited by Kalat, 2012).

As college students navigate through campus life--dealing with professors, meeting deadlines, losing sleep, multitasking their way through numerous pressure situations, taking exams, dealing with relationship issues, completing required assignments, and trying to make life-changing decisions, many will face stress (Kohn, Lafreniere, & Gurevich, 1990; Oman, Shapiro, Thoresen, Plante,, & Flinders, 2008). Some will deal with stress and overcome, yet others will find stress turning into an unwelcome travelling companion. That stress will not be temporary but will become chronic and will make its mark on brain functioning and decision making in a negative way (Travis, Baumeister, & Boone, 2009). High psychosocial stress may lead brain regions involved in memory and emotions, such as the hippocampus, amygdala, and prefrontal cortex, to undergo structural remodeling, with impaired memory and higher levels of anxiety and aggression as potential outcomes. Chronic stress may cause cognitive deteriorations and harm one’s ability to engage in sound executive functioning. When the stress becomes chronic, decision making can become impaired (Travis, et al., 2009). This impairment is primarily due to an oversupply of cortisol (Orem, Petrac, & Bedwell, 2008).

A physiological response to stress is the release of cortisol from the adrenal cortex. When released into the blood stream cortisol mobilizes energy reserves to allow one to overcome a perceived threat (Bear, Connors, & Paradiso, 2007). But if the stress remains to the degree of being labeled as chronic, the secretion of cortisol continues. This continuous secretion becomes
harmful to the body and brain. It can suppress the immune system and harm the hippocampus
(Bear et al. 2007) and the prefrontal cortex (Orem, Petrac, & Bedwell, 2008; Petrac, Bedwell,
Renk, Orem, & Sims, 2009). Therefore, chronic stress can hurt one’s ability to effectively
engage executive function in making decisions (Orem et al. 2008). Cortisol, continually
produced during chronic stress, contributes to decreased performance in the functioning of the
prefrontal cortex of the brain, the directing region of executive functioning (Orem et al., 2008).
This is particularly important when considering decisions made by college students, because
chronic stress is commonly experienced by many college students (Feldt, 2008) as are executive
function deficits, (Fischer & Daley, 2006). This effect can be measured with neuropsychological
testing (Petrac et al., 2009).

**Research on chronic stress and executive functioning.** Orem and colleagues (2008)
published a study that explored the relationship between self-perceived chronic stress and
executive functioning abilities. According to Orem and colleagues, stress leads to the release of
cortisol into the prefrontal cortex of the brain. This increased level of cortisol is one factor that
is thought to hinder performance in the prefrontal cortex, home of executive functioning (Orem
et al., 2008 referring to a study by Fuchs et al., 2006). Based on that study, Orem and
colleagues hypothesized that higher levels of self-perceived stress would be related to deficits in
executive functioning-- especially for set-shifting tasks.

Set-shifting is defined as being a general executive function that is demonstrated through
the ability to move back and forth between multiple tasks, operations or mental sets (Orem et al.,
2008). In a study directed by Orem and her compatriots 1,000 undergraduate students completed
an online, 10 item version of the *Perceived Stress Survey* (Cohen, Kamarck, & Mermetstein,
1983). The 8 item *Infrequency Scale* a validity measure modeled after the *Infrequency Scale of*
the Personality Research Form (Jackson, 1984), was also completed by the participants. The Infrequency Scale was used to exclude participants who did not answer the questions consistently.

A small number of participants were then recruited to continue with the rest of the study. They were selected with the goal of creating for the next part of the study a participants’ pool consisting of people with a wide range of Perceived Stress Scale (PSS) scores and an even distribution of age, gender, and race. Eighty-one participants, with an age range of 18-38 years ($M = 20.9$) with Perceived Stress Scale scores ranging from 5 (indicating very little stress) to 31 (substantial perceived stress), were selected to continue.

Trials 3 and 5 from the Comprehensive Trail-Making Test (CTMT from part B of the Halstead-Reitan Neuropsychological Test Battery, Reitan & Wolfson, 1993) were administered to the participants. The CTMT is an assessment that measures attention, psychomotor speed, and mental flexibility. Trial 3 requires participants to draw a line to connect the numbers 1 to 25 as quickly as possible contained in black circles on a page while avoiding distracter black circles. Trial 5 requires participants to draw a line connecting the numbers 1 to 13 (chronologically) and letters A through L (alphabetically) in alternating order while also avoiding the distracter circles. Trial 5 requires additional executive functioning (set-shifting). The results of the testing showed a statistically significant positive correlation between the PSS and the time required to complete Trial 5 ($r = 0.25, p = 0.02; R^2 = 0.06$). No significant correlation was shown with Trial 3 scores and PSS scores. The higher the stress level the more difficulty one had in completing the task that required executive functioning in the area of set-shifting.

In a similar study, Petrac and colleagues (2009) hypothesized that increasing levels of self-perceived stress would be related to deficits in executive functioning, especially on divided-
attention tasks. They explained that research suggested that performance on some complex tasks that place higher demands on the prefrontal cortex may be decreased due to the recent effects of stress (Petrac et al., 2009). In Petrac’s study, 1,266 college students completed an online version of the Perceived Stress Scale (Cohen et al., 1983), a 10 item survey designed to measure the extent that participants felt their lives were unpredictable, uncontrollable, and overloaded over the past month. The survey used a Likert scale of 0 to 4 (0 = never, 4 = very often). From this sample, 200 participants were selected to create a group of individuals with a range of stress levels. These were invited to participate in further testing. Fifty-four participants (27 males and 27 females) agreed to continue the testing. The participants ranged in age from 18 to 27 years.

In an effort to measure divided attention ability, the 54 young adults participated in three Continued Performance Tests (CPT), developed using the Virgil/W v. 1.3.0 software package (ForThought, 1995): For the Visual Continuous Performance Test (V-CPT), 120 individual numbers appeared on a computer screen. Participants were to accurately respond to and identify “target sequences” consisting of the number “1” followed by a “6.” The participants were to press the spacebar after observing a target sequence. For the Auditory Continuous Performance Test (A-CPT), students listened to a voice presenting a random series of letters over speakers attached to a computer. They were instructed to say the word, “Hit,” when they heard the target letters, “K” followed by “A.” A researcher recorded the response. For the Divided Attention Continuous Performance Test (DA-CPT), both the V-CPT and the A-CPT were used simultaneously. It required the use of two computers and was administered using the same procedures as described above. After examining the errors of omission ($r (50) = 0.29, p = 0.04$) and commission ($r (50) = 0.28, p = 0.05$) discovered during the DA-CPT, the results showed a
significant relationship with PSS scores. This study, as expressed by Petrac and colleagues, adds to the growing body of literature that implicates the “prefrontal cortex as being one of the regions deleteriously affected by recent chronic stress, particularly as the prefrontal cortex has been shown to be a primary area involved with divided attention” (Petrac et al. 2009, p. 318).

**Interventions**

**Educational and Environmental Interventions**

Executive function levels are related to neural development, especially in the prefrontal cortex area and in its connections to the amygdala and ventral striatum (Ernst et al. 2005). Executive function is also related to stress levels experienced by college students (Orem et al., 2008). Yet executive function and stress levels can be modified by environmental, educational, psychological, and behavioral factors.

**Effects of environment and learning on executive function.** Executive function is relatively responsive to intervention and training in children and adolescents (Epstein, 2010; Liew, 2012; Scarborough, Lewis, & Kulkarni, 2010; Siegel, 2014; Staiano, Abraham, & Calvert, 2012).

Two learning theories that address the issues of intervention and training are social-cognitive learning and experiential learning. Learning based on both of these theories can affect the ability of young people to improve their executive functioning and decision making skills. Experiential Learning theory refers to the process of learning through active participation of the learners in events or activities that leads to the accumulation of knowledge or skill—learning by doing (Hedin, 2010). These events or activities can be planned by a mentor or a teacher; or these learning events can simply be experiences one encounters as they interact with their environment. As David Kolb (1984) asserted in *Experiential learning: Experience as the source*
of learning and development (as cited in Yardley, Teunissen, & Dornan, 2012), the learning process is something created through the transformation of experience. To gain knowledge requires experience. Experiential learning is also related to social cognitive learning, based on the fact that the social aspect of a person’s existence is a component of their experience. Experience can be a social and a cultural concept, and not just an individual process. This process can be reciprocal; learners actively influence their environment just as the environment influences the learners (Yardley et al., 2012). Executive functioning skills can be developed by practicing the skills in everyday settings and situations, and by setting up experiential learning activities, projects, and social interactions that encourage the use of executive function. Therefore, adults can guide the adolescent to improve their executive function skills in areas of inhibition, flexibility, emotional control, problem solving, and monitoring (Miller, 2005).

Social-Cognitive Learning theory is based on the studies of Albert Bandura. Bandura’s framework of social cognitive theory is based on triadic reciprocality, in which behavior (actions taken), cognitive factors, personal factors (many based on perceived self-efficacy), and environmental events all interact as determinants of each other (Pintrich & Schunk, 1996). Key to this theory is observation and focus on the overt behavior of others. Adolescents learn by observing people they select as models, then choosing to or choosing not to imitate their models (Ryckman, 2013). This choice is guided by vicarious reinforcement, punishment, or accomplishment. If the model’s behavior is reinforced positively or leads to a positive outcome, the adolescent observer develops a tendency to imitate the behavior observed, in anticipation of receiving the rewards observed for behaving in the same way. This tendency is based on the model’s characteristics, the observer’s characteristics, and the behavior’s reward consequences (Schultz & Schultz, 2013). In the social cognitive learning theory, a model can be someone
known by the subject, or someone the subject has observed from afar, such as a celebrity. Adults who work with adolescents, such as teachers and parents, can be effective models of executive function, providing they demonstrate sound executive skills (Miller, 2005).

These two methods of learning interact with each other and can influence one’s ability to use effective executive functioning. Jean Piaget noted (1972, p. 8), “In principle all normal individuals are capable of reaching the level of formal structures on the condition that the social environment and acquired experience provide the subject with the cognitive nourishment and intellectual stimulation necessary for such a construction.” Piaget recognized the part Social Cognitive Learning and Experiential Learning play in reaching the level of formal structures of thinking and behavior. Epstein (2010) suggests that one reason for adolescent executive function deficits has to do with an adolescent’s isolation from adults (lack of adult models, which speaks to social learning theory), infantilization (lack of meaningful, mature experiences), drugs and alcohol, or the impact of peers (peer models instead of adult models, again key to social cognitive theory). Like Piaget, Epstein contends that proper cognitive nourishment and intellectual stimulation will enhance adolescent executive function.

Studies have shown that one’s level of executive function can be influenced by training or experience. This was demonstrated in a report by Tang, Yang, Leve, and Harold (2012). In 2007, eighty college students were randomly assigned to either an experimental group ($n = 40$) or to an active control group. The experimental group was trained in and participated in the use of integrative body-mind training (IBMT), for 20 minutes per day, for five days. Integrative body-mind training involves body relaxation, mental imaging (e.g., imaging a calm sea), and mindfulness training (i.e., awareness of one’s thoughts without judging them). The control group participated in relaxation training and relaxation exercises for the same amount of time—using a
tutor and compact disk with music to direct participants in relaxing various muscle groups. The *Attention Network Test* (ANT) developed by Fan, McCandliss, Sommer, Raz, and Posner (2002) was used as the pretest and post-test. The testing results showed a significant improvement in executive function scores by the IBMT group over the comparison group.

Staiano, Abraham, and Calvert (2012) conducted a study involving 54 African-American students, aged 15-19 years. The students were randomly assigned to one of three conditions: competitive exergame play (played to get the highest scores on the exergame through exercising), cooperative exergame play (played to simply progress), or a no-play control group (did not change their normal activities). A *Nintendo Wii EA Sports Active Exercise* video game was used for treatment of the two exergame groups. This game helps players get in shape while awarding points as participants use routines of cardio, strength training, and sports games. *The Delis-Kaplan Executive Function System* survey (Delis, Kaplin, & Kramer, 2001) was used at baseline. This instrument measures task switching, speed of visual search, attention, temporal sequencing, and mental flexibility. There were no significant baseline score differences between the fifty-four students discovered at pre-test. After completing the measure, the exergame students began sessions on the *Nintendo* system. The exergame students completed one, 30 minute game session per week for ten weeks. At the end of the treatment period all students were administered the *Delis-Kaplan* survey. Adolescents in the competitive exergame group increased their total *Delis-Kaplan* scores by an average of 15.40 points versus the 6.59 points of those in the cooperative group and 2.41 points for those participants in the no-play group. Based on this study, there appears to be a significant relationship between executive function improvements and competitive exercise.
Another study conducted by Schroeder and Kelley (2008) with 315 college students suggests experience has an effect on executive function deficit. In this study, 84 of the students were identified as adult children of alcoholics (ACOA). The *Behavior Rating Inventory of Executive Function* (BRIEF, Roth, Isquiter, & Gioia, 2005), the *Family Environment Scale* (Moos & Moos, 1984), the *Filial Responsibility Scale* (Jurkovic & Thirkfield, 1999), and the *Children of Alcoholics Screening Test* (Jones, 1983) were used in the testing. After determining which participants were considered Adult Children of Alcoholics and which were not ACOA, the results of the BRIEF survey of both groups were compared. The results from the BRIEF scale showed that adult children of alcoholics had more difficulty with behavior regulation ($M = 49.53, SD = 11.75$) than adults who were not children of alcoholics ($M = 46.07, SD = 10.55$). Higher scores indicated more difficulty in the regulation of behavior. As the children were growing into adulthood, their executive function was possibly affected by: what they learned through observation of their parents (Social-Cognitive theory) or what they learned through experience family dysfunction (Experiential theory).

This study suggested that the experience of living with an alcoholic parent was correlated of executive function deficiencies in the children that grew up in that environment. We cannot say this experience was causal because of one key limitation found in the study. This limitation of this study is seen in the fact that genetics was not accounted for in the testing. Since predisposition to alcoholism can be a genetic, heritable trait, the executive function deficits may be due to heritable aspects of alcoholism. Table 3 summarizes studies in educational activities and executive functioning levels.
### Summary of Studies Relating Educational Interventions to Executive Functioning Levels

<table>
<thead>
<tr>
<th>Authors</th>
<th>Participants</th>
<th>Research design</th>
<th>Measures</th>
<th>Findings</th>
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</thead>
<tbody>
<tr>
<td>Tang et al. (2012)</td>
<td>80 college students</td>
<td>Experimental, Pre-test, Post-test</td>
<td><em>Attention Network Test</em></td>
<td>College students who participated in IBMT (mindfulness training) improved their executive function levels over students who participated in simple relaxation exercises. (Experiential learning)</td>
</tr>
<tr>
<td>Tang et al, another study (2012)</td>
<td>46 college students</td>
<td>Experimental, Pre-test, post-test</td>
<td><em>fMRI</em></td>
<td>College students who participated in IBMT increased activation in their prefrontal cortex before during and after the training in contrast to students who participated in simple relaxation exercises. (Experiential Learning)</td>
</tr>
<tr>
<td>Study</td>
<td>Participants</td>
<td>Design</td>
<td>Measures</td>
<td>Findings</td>
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<tr>
<td>Staiano, Abraham &amp; Calvert (2012)</td>
<td>54 adolescents (15-19 years old)</td>
<td>Experimental, Pre-test, Post-test</td>
<td>The Delis-Kaplan Executive Function System</td>
<td>Adolescents who used <em>Nintendo Wii EA Sports Active</em> exercise video game for competitive exercising participating in one, 30 minute game session per week for ten weeks improved their executive functioning skills over a noncompetitive exercise group, and the non-exercise control group. (Experiential Learning)</td>
</tr>
<tr>
<td>Schroeder and Kelley (2008)</td>
<td>315 college students (84 adult children of alcoholics)</td>
<td>Quasi-experimental study comparing ACOA and adults who were non-ACOA.</td>
<td><em>Behavior Rating Inventory of Executive Function,</em> <em>Family Environment Scale,</em> <em>Filial Responsibility Scale</em> <em>Children of Alcoholics Screening Test</em></td>
<td>Adult children of alcoholics (ACOA) had more difficulty with behavior regulation than adults who were not children of alcoholics. EF possibly affected by: observation of their parents or experiencing family dysfunction. (Social and Experiential Learning)</td>
</tr>
</tbody>
</table>

**Effects of environment and learning on neural development.** Studies have shown that learning has also been known to enhance the brain’s physiological development (Bennett & Baird, 2006; Draganski, Gaser, Busch, & Schuierer, 2004). Experience-related cortical plasticity
was first identified during critical periods of development by von Senden in 1960 and in 1977 by Hubel and Weisel (Travis, et al., 2009). Cortical plasticity explains learning. Synaptic connections are strengthened when students learn new facts, skills, and procedures (Travis et al., 2009). Laurence Steinberg (2010) reported that while brain development influences adolescents’ behavior, it does so within an environmental learning context that influences the course of neural development. Proper training can help repair some of the damage done by extended secretion of cortisol.

In one study, researchers tried to determine whether the college experience affected brain structure (Bennett & Baird, 2006). Nineteen first year college students (9 females and 10 males, 18-20 years old) formed the experimental group (E) for the study. The members of the E group had to have moved at least 100 miles from home to attend college to be included. This group completed an MRI scan during the fall term and again about 6 months later.

Twenty participants (12 females and 8 males, 19.-51 years old, M = 26.90) were recruited from the local academic community. These participants had either received their undergraduate degree or were working on it. This was the methodological control group (C1). These participants completed two same day scans. A third group made of 17 participants all over the age of 25 (M = 29.2), 9 females and 8 males, composed an experimental control group (C2). This group completed 2 scans, at 6 months apart. These participants were recruited from the local academic community (students or employees) and were working on a graduate degree or on post doctoral studies. Like group E, all had to have moved at least 100 miles away to attend an undergraduate institution after high school.

Differences in voxel intensity (three dimensional images from MRI images which show matter density) from the first scan and the last one 6 months later were noted in the cingulate,
caudate, insular and claustrum regions of the E group. These regions of the brain are thought to be specifically responsible for the synthesis of information to generate both emotional experience and behavioral response. No changes between scans were noted for groups C1 and C2. The results of the study showed regionally specific changes in brain structure in the E group that occurred during the first year of college, due to the interaction between genetically predetermined and environmentally provoked processes. Bennett and Baird (2006) stated that these structural changes were due to the new environment, stresses, shifts in romantic interests, and changes of first year college life, when one moves away from home. These studies add validity to the notion that brain structure is dynamic and environmentally sensitive.

In a study conducted by Draganski and colleagues (2004), the researchers wanted to determine if environment plays a part in shaping brain structure. They recruited 24 volunteers (21 female and 3 male, $M$ age = 22 years) and divided them into two groups, matched for sex and age. All were given a brain scan (MRI) at the beginning of the study. The first scan showed little difference in gray matter between the two groups. No one knew how to juggle at the beginning of this study. One group was taught to juggle and received a second brain scan, 3 months later, after they had learned to juggle 3 balls for 60 seconds. The non-juggling group was given a second scan, 3 months later, also. The second scan revealed a bilateral expansion in gray matter in the mid-temporal area and the left posterior intraparietal sulcus in the brains of the jugglers. This was not the case for the non-jugglers. Learning to juggle resulted in cortical development in brain regions responsible for touch and movement. This showed that learning can induce cortical development in the motor regions of the brain and that the structure of a person’s brain is not solely based on genetic preprogramming. Brain structure can be guided by environmental and learning processes (Selemon, 2013). It is important to note that while the
participants in this study were not identified as college students, this study indicated the effects of learning on brain structure.

In another study conducted by Tang and associates (2012), an experiment was conducted with 46 students. The students were randomly assigned to an IBMT experimental or a relaxation comparison group. This time, neuroimaging (fMRI) was employed. The results before, during, and after five days of training and participation showed more activity in the prefrontal cortex of the students in the experimental group over the comparison group. While this study did not measure executive function, it did suggest that IBMT is a contributing factor in activating the prefrontal cortex, home of executive function.

**Effects of environment and learning on stress reduction.** Stress can be reduced through education and training. Individual counseling can also be an effective intervention to alleviate stress. A number of clinical approaches that use a cognitive-behavioral educational method are known to be very successful. This intervention requires a few hours of private sessions in a counselor’s office. During these sessions the counselor teaches the client to reframe their perception of the stressor connected to their situation. In a sense, the client is taught to focus less on blame and more on positive thinking and actions (Chiauzzi et al., & Lord, 2008).

Stress can also be reduced through learning stress management techniques in group sessions or classrooms. A number of studies have focused on successful stress management education in the areas of: meditation (Oman, Shapiro, Thoresen, Plante, & Flinders, 2008), mind/body interventions (Winterdyk, Ray, Lafave, Flessati, Huston, Danelesko & Murray, 2008), psychoeducational stress management interventions (Kottler, 2012; Romano, 1992), proactive stress training (Kadhiravin & Kumar, 2012), and online stress reduction methods (Chiauzzi et al., 2008). In one such study with 44 students at a Roman Catholic university in
California, Oman and his associates (2008) randomly allocated the students (18-24 years old) into three groups: a mindfulness based stress reduction group (meditated on readings and body awareness), an eight point program group (that meditated on particular readings), and a control, wait-listed group. The two meditation groups met once per week for 90 minutes to learn and practice their meditation behaviors. All three groups’ stress levels were measured at the beginning of the eight week study, at the end of the study, and eight weeks after the study, using the Perceived Stress Scale (Cohen et al., 1983). Over the 16 week period (pretest, post-test and follow-up test) the stress levels of both of the meditation groups dropped significantly as compared to the control group (Effect size: Tx-Cx = -.39 at the post-test and -.51 at follow-up testing).

During another study, Winterdyk and his colleagues also discovered a number of interventions, taught to college students, helped to relieve the students’ stress (Winterdyk, Ray, Lafave, Flessati, Huston, Danelesko, & Murray, 2008). Seventy one college students completed this study. Following pre-testing, the students were randomly assigned to one of five groups--four experimental groups (nutritional education group, teachings in relaxation techniques group, exercise and strength training group, cognitive behavioral approaches group) or one control group. Each experimental group was trained in a type of stress reliever in weekly, one hour sessions for six weeks. They were encouraged to practice what they learned in session 2-3 times during the intervening week. At the end of the six weeks all participants completed the post-test instruments. The instruments used in testing were the Global Severity Index of the Symptom Checklist-90-R (Derogatis, 1994), the Perceived Stress Scale (Cohen et al., 1983), the Speilberger State-Trait-Anxiety Index (Speilberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983), and the Demographics and Health Habits Survey (Walker, Sechrist, & Pender, 1978).
The data from the five groups were analyzed. Independent t-tests measured the mean scores between the groups, between the pre- and post-tests. The results of running a one-way repeated measures analysis of variance (ANOVA) showed that each of the interventions had a positive impact on reducing self-reported psychological distress, anxiety, and perceptions of stress in the four different experimental groups. The post-test stress levels of the control group registered virtually the same as their pre-test results.

Kadhiravin and Kumar (2012) conducted a study based on proactive stress training with 88 college students (44 students in an experimental group and 44 in a control group) over a period of 21 days. All students completed the following surveys as their pretest and post-test experience: the Perceived Stress Scale ($a = .86$, Cohen, et al., 1983), the Proactive Coping Inventory (internal consistency range = .71 to .85, Greenglass, Schwarzer, & Taubert, 1999) and the General Self-efficacy Scale (internal consistency range = .75 to .91, Schwarzer & Jerusalem, 1995). Those in the experimental group completed training in the areas of: Information on Stress and Coping, Awareness of Maladaptive Coping Skills, Problem Solving Skills, Communication Skills, and Self-Efficacy (perceived competence) as a proactive approach to coping with stress. The control group experienced no training in the area of coping strategies and self-efficacy. Following data analysis, it was determined that the experimental group’s participants’ results differed significantly ($p < .05$) from the results of the control group in the following areas: lower levels of stress, an increase in proactive behavior, an improvement in coping skills, and a stronger perception of self-efficacy.

The management of stress, while experiencing stress, was discussed in a number of studies. These writings advocated teaching students who were experiencing stress, physical techniques that would alleviate the stress. One of the techniques involved Diaphragmatic/Deep
Breathing. This is an exercise that involves concentrating on systematic deep breathing for a short period of time along with three other components: working in a quiet environment, being in a supported--comfortable position, and displaying a receptive attitude. This type of breathing increases oxygen flow to all systems of one’s body, and thereby decreases stress (Kottler, 2012; Romano (1992). For example, Paul, Elam, and Verhust (2007) conducted a longitudinal study with 64 premedical students (53 women and 11 men). During a ten month study period the students were surveyed at three different times using instruments (with ten point Likert-type scale questions) developed by the authors as a pretest, post-test (six weeks later) and follow-up (at the conclusion of the ten months). The pretest measured the students’ feelings and stress levels. The post-test measured student’s feelings, stress levels, and whether they believed the deep breathing techniques were helpful. The follow-up measured the aforementioned items and included three questions regarding future use of the deep breathing techniques. During the ten month study the students were taught, about stress and how to use the deep breathing concentration exercises. As well as being taught the techniques, 5 minutes of guided deep breathing was practiced at the start of each class. The instructor followed a script (designed by a licensed counselor specializing in stress management) to lead the students. During the process and at the conclusion of the study the students noticed positive results of the exercises--increase in concentration and a decrease in test anxiety. Also, their post-test and follow-up surveys indicated a decreased level of perceived stress.

In another study involving 240 students from six 4 year colleges, Chiauzzi et al. (2008), randomized the participants into one of three conditions. One group was assigned to an online program called, *MyStudentBody—Stress* (https://www.mystudentbody.com/), a website developed by Chiauzzi and colleagues. Another group, a control group (CW) was assigned to a
control website, and a third group was identified as a no treatment (NTX) control group. At the beginning of the study, all students completed five online questionnaires rating stress signs, life events, daily hassles, coping skills, and mood. Following the questionnaires the participants in the Student Body group received tailored feedback, interactive relaxation tools, and information on their stress levels, with intervention ideas that explained stress reduction techniques that most applied to their situation. The Control group (CW), with access to a different website, experienced standard, text-based, general information on health issues. There were no tailor made feedback or interactive interventions. Both the MyStudentBody and the CW groups were instructed to visit their online site at least four times over a two week period, for a minimum of 20 minutes per visit. The online activity was monitored by a research assistant on a weekly basis. All participants completed surveys, the Perceived Stress Scale (PSS; Cohen et al., 1983), the Health-Prompting Lifestyle Profile II (HPLP-II), developed by Walker, Sechrist, and Pender (1987), and the College Adjustment Scales (CAS; Anton & Reed, 1991) at baseline, then at 1, 3 and 6 months after the pre-test. The primary outcome measure was the PSS (a 10 item instrument for measuring the perception of stress within the past month using a 5-point Likert scale), while the HPLP-II and the CAS were used as secondary outcome measures. Upon completion of the surveys it was noticed that there was a slight drop in stress levels in the MyStudentBody group after the initial brief two week intervention (4.2 drop compared to a 2.71 drop [CW] and 1.40 drop [NTX]). At the end of the six month study MyStudentBody–Stress students reported changes in several important stress management behaviors and stress-related measure subscales. Also the MyStudentBody–Stress group students evidenced significant satisfaction with and much stronger acceptance and employment of the stress management
techniques over the $CW$ group. This study supports the feasibility of providing stress management interventions to college students without requiring face-to-face contact.

In two studies led by Barnes and colleagues (Barnes, Brown, Krusemark, Campbell, & Rogge, 2007), mindfulness in romantic relationships was examined. In Study 1, 89 college students (18-23 years old) at a large southeastern U.S. university were recruited to participate, in exchange for extra course credit. A total of 82 participants (73% women) actually completed the study. Most participants (87%) were “dating steadily” while another 8% were “dating regularly”; the remainder were “dating casually” (2%) or “engaged/married” (3%). The average length of the romantic relationships was 18.6 months (range 3–85 months). All but one participant indicated that their partnership was an exclusive one.

The participants completed five different surveys. The 15-item dispositional version of the Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003) was used to measure trait mindfulness ($a = .83$). Relationship satisfaction was measured with two scales. The 32-item Dyadic Adjustment Scale (DAS; Spanier, 1976) was modified slightly for use with young, unmarried adults ($a = .85$). The Satisfaction subscale of the Investment Model Scale (IMS; Rusbult, Martz, & Agnew, 1998) was also used ($a = .92$). Participants responded to five face-valid items on a 9-point Likert scale (0 = do not agree at all to 8 = agree completely). Self-control was measured with the 13-item version of the Self-Control Scale (SCS; Tangney, Baumeister, & Boone, 2004; $a = .84$). A sample item is, “I have a hard time breaking bad habits.” Using a 5-point scale (1 = not at all like me to 5 = very much like me), higher scores reflect lower self-control. Accommodation was measured with a 16-item scale ($a = .85$, Rusbult, Verette, Whitney, Slovik, & Lipkus, 1991) consisting of four subscales; two refer to positive or constructive responses to relational conflict (voice and loyalty), and two refer to negative or
destructive responses to relational conflict (exit and neglect). Sample items include: ‘‘When my partner and I are angry with one another, I suggest a compromise solution’’ (voice); ‘‘When we have problems in our relationship, I patiently wait for things to change’’ (loyalty). All items were assessed with a 9-point scale (0 = never to 8 = constantly). This study was conducted using a short-term longitudinal design, in which measures of all relevant constructs were collected twice, 10 weeks apart. At the end of 10 weeks, multiple regression analysis was used. The results of the study indicated that, mindfulness was positively related and predictive with both measures of relationship satisfaction, and with both self-control and accommodation. These results demonstrate that mindfulness is related to greater satisfaction in romantic relationships, and to a greater capacity to manage the stresses that are often experienced in intimate relationships.

The sample in Study 2 consisted of 57 heterosexual couples from a small northeastern U.S. University. To ensure that couples would be able to generate salient relationship conflict topics, to be included in the study the criteria stipulated that couples had to have been dating for at least 3 months (average length of the dating relationships was 13.48 months with a range 4–38 months). Two other criteria were set for purposes of other research (Barnes, 2004): both members of the couple had to be 18–25 years of age (average 20 years old) of age to control for differences in age related cardiovascular reactivity (Blascovich, 2000). Couples were excluded if a member had cardiovascular disease, endocrine disorder, clinical obesity, or used cardiovascular or psychoactive medication. Members in the study (82%) considered their relationship ‘‘serious’’ while 15% reported that it was ‘‘steady,’’ and 4% regarded it as ‘‘casual.’’

First, participants completed forms that described background information and demographics. Then they were asked to complete measures: Mindful Attention Awareness Scale-
(MASS)—to assess their mindfulness disposition, another measure, the *Dyadic Adjustment Scale* (DAS)—assessing their relationship satisfaction, and *Profile of Mood States* (POMS; McNair, Lorr, & Droppleman, 1971)—to assess participants’ current levels of anxiety (9 items) and anger-hostility (12 items) on a 5-point scale (“not at all” to “extremely”) before beginning the problem discussions. Then each couple chose two topics of conflict they were experiencing in their relationship. Following this they were encouraged to discuss the topics for 20 minutes while being videotaped. This period of discussion was also interspersed with times of quiet reflection of the experience. Following that 20 minute period, the anger-hostility and anxiety subscales of the POMS and the MASS were used to reassess current, post-conflict emotions. The video-taped record of conflict was viewed, coded and evaluated using five codes from the *System for Coding Interactions in Dyads* (SCID; Malik & Lindahl, 2004).

Similar to the results discovered in Barnes et al., Study 1 (2007), a positive relation between mindfulness and relationship satisfaction was indicated in Study 2. Also the experimental results then indicated that people higher in dispositional mindfulness, reported a less severe emotional stress response to relationship conflict, evidencing lower levels of post-discussion anxiety and anger-hostility. This relation was explained by the fact that more mindful people entered the conflict discussion with lower anxiety and anger-hostility. Again, mindfulness is described as awareness of one’s thoughts without judging them (Tang et al. 2012). In this study more mindful individuals experienced lower levels of negative emotion, and reported more positive perceptions of the partner and the relationship after the exchange.

Both studies found, that individuals higher in mindfulness reported higher levels of satisfaction with their romantic relationships. Also both studies found evidence supporting a significant role for mindfulness in enhancing beneficial responses to relationship stress. More
mindful individuals experienced lower levels of negative emotion, and reported more positive perceptions of the partner and the relationship after the exchange. Mindfulness was again shown to relate to relationship satisfaction and to predict lower emotional stress responses and positive pre- and post-conflict change in perception of the relationship. Both studies indicated that mindfulness may play an influential role in romantic relationship wellbeing.

Lockwood and Wohl (2012) conducted a study using a 15 week wellness course focused on self efficacy. Closely related to confidence and perception, self-efficacy is an interdisciplinary concept associated with perceived competence, and an ability to successfully change or continue a desired behavior or attitude (Bandura, 1977). The course was based on the education and the promotion of experientially based behavior change. Participants were students at Washburn University in Topeka, Kansas. Seventy-one students participated in the study by enrolling in a course called PE 198-Lifetime Wellness. This class was a two credit class that consisted of meeting one hour per week for a lecture on a wellness subject (i.e., fitness, nutrition, cardiovascular disease, stress management, sexually transmitted disease, and substance abuse), regular exercise outside of the classroom, and specific assigned activities. During a pre-class session of the course the students completed the Test Well Wellness Inventory - Standard Edition (TWI-SE; National Wellness Institute, 1995), the General Self-Efficacy Scale (GSE; Jerusalem & Schwarzer, 1992), and the Physical Self-Efficacy Scale (PSE; Ryckman, Robbins, Thomton & Cantrell, 1992). The Lifetime Wellness Course is a course with lecture on various wellness topics that requires the completion of activity assignments promoting exercise, fitness, and wellness. The course textbook used was An Invitation to Wellness—Making Healthy Choices (Hales, 2007). At the conclusion of the 15 week course the students were tested again using the same measures used during the pre-class session. The results of the testing showed not only an
improvement in physical fitness, but also a significant improvement in the areas of medical self-care, safety, environmental wellness, social wellness, sexuality and emotional wellness. Not only did the results indicate a lifetime wellness program can improve physical health, but this type of course can positively impact physical self-efficacy, perceived physical ability, physical self-presentation, and physical perception. This study’s limitation is seen in the lack of testing using a control group.

In an effort to determine the effects of small social support groups on college students Mattanah, Brooks, Brand, Quimbly, and Ayers (2010) recruited 165 college freshmen to participate in their study. The sample was randomly divided into two groups: an intervention group \( (n = 87) \) and a control group \( (n = 78) \). The intervention group was then randomly assigned to 11 different support groups (six to ten students in each group). The groups met weekly for 90 minutes, guided by two advanced undergraduate clinical psychology students. The facilitators were supervised by the primary investigators of this study—all licensed psychologists. During group sessions the following topics were discussed: (a) creating new social ties; (b) balancing work, academics, and a social life; (c) peer pressure, values, and college life; (d) residential issues; (e) expectations versus realities of college life; and (f) examining old social ties. All participants completed the *UCLA (University of California, Los Angeles) Loneliness Scale* \( (a = .93, \) Russell, Peplau, & Cutrona, 1980) online, during the spring semester of their first year. The scale is composed of 20 items, such as “My social relationships are superficial.” Respondents rated each item using a 4-point Likert-type scale ranging from 1 (never) to 4 (often), with higher scores representing greater feelings of loneliness. The survey was again completed at the end of the nine week study by 51 intervention participants and 45 control participants. Results
indicated a consistent effect of reducing loneliness in all students in the intervention group over the results from the control group (approximately a 5% variance).

Dixon Rayle and Chung (2007) completed a study to determine whether perceived social support could predict a student’s feelings of “mattering” (feeling important and appreciated) and academic stress. Five hundred and thirty-three first year undergraduates participated. The final sample included 48 racial/ethnic minorities and 122 Euro-American males and 90 racial ethnic/minorities and 273 Euro-American females. The mean age of the total sample was 19.64 years. The majority (n = 235) lived on-campus. One hundred and forty-three lived off-campus with family, and 155 lived off-campus with peers or alone.

The *Perceived Social Support Inventory–Friend Scale (PSS-Fr)* and *–Family Scale (PSS-Fa; Procidano & Heller, 1983)* was used to assess an individual’s perceived social support from friends and family. Each assessment had 20 items. A sample question used was, “My college friends enjoy hearing about what I think.” Participants chose between the response options: yes, no, and don’t know. A score of “2” was assigned to a “yes” response; a score of “1” was assigned to a “no” response; and a score of “0” was assigned to a “don’t know” response. A higher total score indicated greater perceived social support. In this study, the Cronbach alphas were .92 for the PSS-Fr scores and .93 for the PSS-Fa scores.

The *Daily Hassles Index for College Stress (DHI; Schafer 1987)* was used to measure perceived academic stress of college students. Higher scores on the DHI have been associated with greater depression and emotional tension, less internal control, and reduced academic retention. The DHI contains 29 items with a 5 point Likert type response format. A “1” indicated “not at all stressful,” while a “5” indicated “highly stressful” in areas such as “being lonely” or
“getting to class on time.” The Cronbach alphas for the DHI scores for the entire sample in the current study was .95.

The Interpersonal and General Mattering Assessment (IGMA), developed by Dixon Rayle (2004) was used to measure perceptions of interpersonal and general mattering to others. The scale included several subscales including mattering to: mother, father, significant other, friends, college, community, and society at large. For this purpose, participants only responded to 14 items assessing perceived mattering to college friends and 14 items assessing perceived mattering to the school/college environment. Sample items include: “Would your college friends miss you if you went away?” and “How important are you to your college?” The 5-point Likert-type response format ranged from “1” (not at all) to “5” (very much). The Cronbach alphas were .94 for the mattering to college friends’ subscale and .93 for the mattering to college subscale.

Even though the study examined the predictive levels of family support and friend support in college, only social support from college friends was a significant predictor of students’ perceptions of mattering to the college environment. It appears that when these first-year students made friends at school and felt supported by their college friends, they reported a greater sense of mattering and significance to their college environments. The beta weight for friend support was significant, ($\beta = .184, t(3) = 2.97, p < .01$); however, family social support ($\beta = .072, t(3) = 1.49, p = .14$) was non-significant. Also, students who perceived more friend and family social support and who felt as if they mattered to the college environment actually experienced less academic stress.

Table 4 summarizes stress intervention studies conducted with college students.
### Table 4

**Stress Intervention Studies with College Students**

<table>
<thead>
<tr>
<th>Authors &amp; Participants</th>
<th>Research design</th>
<th>Measures</th>
<th>Interventions and Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oman et al. (2008); 44 students at a Roman Catholic university in California (age: 18-24 years)</td>
<td>Experimental, longitudinal, Pre-test, post-test, and follow-up, 2 experimental groups and 1 control group. (8 week study)</td>
<td>Perceived Stress Scale</td>
<td>2 Experimental groups participated in a mindfulness based stress reduction group (meditated on readings and body awareness), and an eight point program group (that meditated on particular readings). These groups’ stress levels dropped significantly compared to the control group. Meditation groups met for 90 minutes, once per week, for 8 weeks.</td>
</tr>
<tr>
<td>Winterdyk et al. (2008) 71 college students</td>
<td>Experimental, longitudinal, Pre-test, post-test, 4 experimental groups and 1 control group. (6 week study).</td>
<td>Global Severity Index, Symptom Checklist-90-R, Perceived Stress Scale, Speilberger State-Trait Anxiety Index, Demographics and Health Habits Survey.</td>
<td>Each experimental group participated in a type of stress reliever (nutritional education, teachings in relaxation techniques, exercise and strength training, or cognitive behavioral approaches). There was also a control group. The interventions had a positive effect on reducing stress, anxiety, and perceptions of stress. The experimental groups met 1 hour per week for 6 weeks and were encouraged to practice what they learned 2-3 times during the week.</td>
</tr>
<tr>
<td>Kadhiravin and Kumar (2012) 88 college students</td>
<td>Quasi-experimental, Pre-test, post-test. (3 week study).</td>
<td>Perceived Stress Scale, Proactive Coping Inventory General Self-efficacy Scale</td>
<td>Experimental group completed proactive stress training. Experimental group developed lower levels of stress, an increase in proactive behavior, and an improved perception of self-efficacy than the control group. Took place over 21 days</td>
</tr>
<tr>
<td>Study</td>
<td>Design</td>
<td>Participants</td>
<td>Interventions</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>---------------------------------</td>
<td>---------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Paul, Elam, &amp; Verhust (2007)</td>
<td>Longitudinal, Pre-test, post-test, and follow-up. (10 month study).</td>
<td>64 premedical students</td>
<td>Instruments developed by researchers</td>
</tr>
<tr>
<td>Chiauzzi et al. (2008)</td>
<td>Experimental, 1 experimental group (<em>MyStudentBody—Stress</em> online intervention), 1 control group (basic online intervention) and 1 no-treatment group. Pre-test and Post-test</td>
<td>240 college students</td>
<td><em>Perceived Stress Scale</em> <em>Health-Prompting Lifestyle Profile II</em></td>
</tr>
<tr>
<td>Barnes et al. (2007) Study 1</td>
<td>Longitudinal, Pre-test, Post-test</td>
<td>Mindful Attention Awareness Scale (trait mindfulness)</td>
<td>Mindfulness was positively related and predictive with both measures of relationship satisfaction, and with both self-control and accommodation. These results demonstrate that mindfulness is related to greater satisfaction in romantic relationships, and to a greater capacity to manage the stresses that are often experienced in intimate relationships. 10 week study.</td>
</tr>
<tr>
<td>---</td>
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</tr>
<tr>
<td>82 college students</td>
<td></td>
<td>Dyadic Adjustment Scale (relationship satisfaction)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Investment Model Scale (Relationship satisfaction)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Self-Control Scale (Self-control)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>16 item Accommodation scale by, Rusbult et al., 1991</td>
<td></td>
</tr>
<tr>
<td>Barnes et al. (2007) Study 2</td>
<td>Longitudinal, Pre-test, Post-test</td>
<td>Mindful Attention Awareness Scale (mindfulness disposition),</td>
<td>Study showed a positive relation between mindfulness and relationship satisfaction. Experimental results indicated that people higher in dispositional mindfulness, reported a less severe emotional stress response to relationship conflict, evidencing lower levels of post-discussion anxiety and anger-hostility. This relation was explained by the fact that more mindful people entered the conflict discussion with lower anxiety and anger-hostility. The study also found that more mindful individuals experienced lower levels of negative emotion, and reported more positive perceptions of the partner and the relationship after the exchange.</td>
</tr>
<tr>
<td>57 heterosexual couples (college students)</td>
<td></td>
<td>Dyadic Adjustment Scale (relationship satisfaction),</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Profile of Mood States System (current levels of anxiety), and Coding Interactions in Dyads (video recording)</td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>Participants</td>
<td>Study Design</td>
<td>Measures</td>
</tr>
<tr>
<td>--------------------------------------</td>
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<td>--------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Lockwood and Wohl (2012)</td>
<td>71 college</td>
<td>Longitudinal, Pre-test and Post-test</td>
<td>Test Well Wellness Inventory - Standard Edition, General Self-Efficacy Scale, Physical Self-Efficacy Scale</td>
</tr>
<tr>
<td>Mattanah et al. (2010)</td>
<td>96 freshmen</td>
<td>Nine week Experimental (intervention group + control group), Longitudinal study, Pre-test, Post-test</td>
<td>UCLA Loneliness Scale</td>
</tr>
<tr>
<td>Dixon Rayle &amp; Chung (2007)</td>
<td>533 first year undergraduates</td>
<td>Multiple regression study</td>
<td>Perceived Social Support Inventory–Friend Scale and Family Scale, Daily Hassles Index for College Stress, Interpersonal and General Mattering Assessment</td>
</tr>
</tbody>
</table>
Effects of executive function on stress. The relationship between stress and executive function is reciprocal. Not only does chronic stress have a significant relationship to executive functioning levels; but brain lesions, psychopathology, poor learning strategies, immature brain development or brain disorders that impair executive function levels are associated with the lack of one’s ability to regulate stress (Williams, Suchy, & Rau, 2009). A number of studies examined by Williams and colleagues (2009) implied that levels of executive functioning had a moderating effect on stress processes such as exposure, reactivity, recovery, and restoration. Stress exposure generally refers to frequency and severity of adverse events. Usually individuals who have difficulty staying on task, organizing and planning (displaying an inability to practice sound executive functioning) will place themselves in a position of increased stress exposure. Stress reactivity describes the immediate response to a potentially stressful event as well as an individual’s perception or appraisal of the event. The act of perceiving is related to activity in the prefrontal cortex, home of executive function. It is the prefrontal cortex that is activated to interpret the life events of an individual. This region supports stress-dampening, self-regulatory activity as it attempts to modulate negative emotions during stressful events (Butler, Wilhelm, & Gross, 2006 cited by Williams, Suchy, & Rau, 2009). Stress recovery refers to levels of emotional or physiological arousal after termination of the stressor or the time required for the individual to return to baseline levels after termination of the stressors. This can be monitored with blood pressure levels, seen in worry intensity, or observed in rumination. In a study by Davis and Nolen-Hoeksema (2000), it was shown that individuals who scored lower on the Wisconsin Card Sorting Test (a test that measures an element of executive function) tended to ruminate more. Post-stress restoration is a process of refreshment and repair of various cellular damages after dealing with stress. A sign of positive restoration action is seen in healthy sleep
patterns and a strong immunity system. Poor sleep quality has a negative effect on executive function (Nilsson, Soderstrom, Karlsson, Lekander, Ankerstedt, Lindroth, & Axelsson, 2005). As a number of studies have shown, strong executive functions are associated with high resilience to both stress exposure and to the negative effects of stress. Williams and colleagues (2009) cite a number of sources and studies that show strong executive function skills are central to emotion regulation (Critchley, 2005; Rothbbar & Sheese, 2007). Poor executive functioning is related to more vulnerability to stress exposure (Williams et al. 2009).

**Pilot Study**

In an effort to gain greater understanding of the relationship between various stressors and executive function deficits in college students, this author conducted a pilot study to identify the significant correlations between life experiences that are known to contribute to stress and executive function deficits. The hypothesis for the pilot study was: *Certain types of stress are significantly related to executive functioning deficits.* The research question for this pilot study was, “Which stressor is most predictive of executive function deficits?”

**Participants**

In the spring of 2012, a pilot study was conducted with a convenience sample of undergraduate students at a large Midwestern university. The participants were enrolled in a course on middle childhood and adolescent developmental studies, taught by the PI. Forty students were enrolled in the course and 85% of the class (34 students--11 male, 25 female) chose to participate. The ages of the students ranged from 19 to 30 years old, with a median age of 21. Those who participated in the study were offered extra credit for the class. In keeping with IRB protocol, a short alternative extra credit writing assignment was also offered to those students who preferred not to participate in the study, yet wished to receive extra credit.
Measures

The neuropsychological tests selected for this study were the *Inventory of College Students’ Recent Life Experiences* (ICSRLE) and the *Barkley Deficits in Executive Functioning Scale—Short Form* (BDEFS-SF). The ICSRLE was developed by Kohn, LaFreniere, & Gurevich, (1990) and adapted for this study by changing the period of time covered by the questions from one month to six months. The BDEFS-SF was developed by Russell Barkley (2011). Both surveys collected data relating to what was experienced by these college students over the last six months. Both of these instruments were selected because of their high reliability and validity, their age appropriateness, and their ease of usage with a group of students at one time. See chapter 3 for more extensive descriptions of these measures.

The ICSRLE measures the frequency of seven different life stressors using the following subscales: Developmental Challenge, Time Pressure, Academic Alienation, Romantic Problems, Assorted Annoyances, General Social Mistreatment, and Friendship Problems. For each subscale, participants’ raw scores for each item were totaled, then divided by the highest possible score that could be obtained for each subscale, and then multiplied by 100 to convert the raw scores into percentage scores. This was done because each subscale was comprised of a different number of items. Cronbach’s alpha for the ICSRLE for the pilot study sample was found to be .89 which is an acceptable level for this kind of a measure.

The BDEFS-SF was used because it measures a wide range of executive function elements, including subscales for Self-Management to Time, Self-Organization/Problem Solving, Self-Restraint, Self-Motivation, and Self-Regulation of Emotions (Barkley & Murphy, 2011). Scores were completed for each subscale by summing the scores for each item. Total executive function deficit scores were computed by summing the scores for each subscale. Total
executive function scores could range from 20 to 80, with higher scores indicating high levels of executive function deficits. Cronbach’s Alpha for the BDEFS-SF for the pilot study was found to be .74, indicating an acceptable level of reliability.

Consent forms (see Appendix B) were distributed and explained to the participants thirty minutes before the class session ended. The forms were collected after they were reviewed and signed by participants. The ICSRLE (see Appendix C), and the BDEFS-SF (see Appendix D) surveys were then distributed to the students, in paper format. The students indicated their age and gender on the surveys. Names were not used on the instruments and the PI left the room as the students completed the surveys to maintain confidentiality. Both surveys were completed in 10-20 minutes total and placed in a large envelope in the room. When all of the students left, the PI retrieved the envelope full of completed surveys.

Data from those completing the surveys were collected and stored electronically on an Excel Spreadsheet. On the spreadsheet, the following items were entered, representing the 34 students that completed the study: ID numbers (assigned to each survey packet after collecting the surveys), gender, ICSRLE scores from each subscale, and the BDEFS-SF scores from each subscale, as well as the total BDEFS-SF score for each student.

Data analysis. There was missing data of one item on one student’s ICSRLE survey (Item #31-dealing with “Friendship Problems”). “Mean substitution” was used which involved imputing the missing value for a variable with the mean of all observed values from the instrument item (Vogt, 2007).

The data were then analyzed using SPSS (version 20). First descriptive statistics were examined. Then score distributions were examined using histograms and scatter plots. SPSS was also used to calculate correlations between scores from each of the seven subscales on the
ICSRLE and the total score on the BDEFS-SF. Then a multiple regression was run using unstandardized coefficients and standardized coefficients ($\beta$) to determine if any of the stressors (7 subscales) were predictive of overall executive function deficits.

**Descriptive statistics.** Tables 5 and 6 present descriptive statistics for scores on each subscale of the ICSRLE and the total score of the BDEFS-SF, respectively, for the pilot study sample. The ICSRLE mean raw score for the participants involved in the pilot study was 100.62 with a standard deviation (SD) of 25.10. The mean score for the normative study of the ICSRLE was 93.89 with a standard deviation of 15.89. The pilot study results were higher than the normative scores demonstrating a higher level of stress in the participants of the pilot study. As shown, the largest range for the stressor prevalence scores (as determined by the ICSRLE) was seen in Romance Problems; while the smallest range was for Academic Alienation.

For the BDEFS-SF, the mean score for the sample from the pilot study was 38.18 (range of 27-54, with a standard deviation of 7.91) as seen in table 6. In Barkley’s normative study the mean was 28 with a possible range of 20-80. Compared to the results of Barkley’s study (2011, p. 158), the sample score is as high or higher than 78% (78th percentile) of those in the 18-34 year old category who had been involved in the normative study. Therefore, this sample showed moderately high levels of executive function deficit when compared to the normative sample.
Table 5

Means, Standard Deviations, and Ranges for Subscale Scores on the ICSRLE

<table>
<thead>
<tr>
<th>Type of Stressor</th>
<th>Means</th>
<th>Standard Deviation</th>
<th>Range (Percentage Scores)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developmental Challenge</td>
<td>56.49</td>
<td>16.69</td>
<td>27.3-93.2</td>
</tr>
<tr>
<td>Time Pressure</td>
<td>64.71</td>
<td>18.27</td>
<td>35.7-92.9</td>
</tr>
<tr>
<td>Academic Alienation</td>
<td>43.01</td>
<td>12.34</td>
<td>25.0-70.8</td>
</tr>
<tr>
<td>Romantic Problems</td>
<td>58.49</td>
<td>10.76</td>
<td>25.0-100.0</td>
</tr>
<tr>
<td>Assorted Annoyances</td>
<td>43.24</td>
<td>13.01</td>
<td>29.5-79.5</td>
</tr>
<tr>
<td>General Social Mistreatment</td>
<td>47.19</td>
<td>15.41</td>
<td>25.0-79.2</td>
</tr>
<tr>
<td>Friendship Problems</td>
<td>40.93</td>
<td>15.85</td>
<td>20.8-66.7</td>
</tr>
</tbody>
</table>

*Note: N = 34*

Analyzing the data through SPSS resulted in a description of the means determined by the surveys. Table 6 shows the mean scores for the Executive Function Total.

Table 6

Mean, Standard Deviation, and Range for Total Score on the BDEFS-SF

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Score</td>
<td>38.18</td>
<td>7.971</td>
<td>27-54</td>
</tr>
</tbody>
</table>

*Note: N = 34*

**Correlations between executive function and stress.** Correlations were used to examine relationships between types of specific stressors as measured by subscale scores on the ICSRLE and executive function deficits as measured by total scores on the BDEFS. Results are presented in Table 7. Upon examination of the coefficients, significant positive relationships
(two tailed) were found between scores from all subscales and executive functioning deficit scores except for the Romance Problems. The highest correlation found was between Developmental Challenge and executive function (.694). Moderate correlations were found between Academic Alienation (.492), Time Pressure (.468), General Social Mistreatment (.427), and Assorted Annoyances (.384). Friendship Problems (.309) and Romantic Problems (.226) appeared to have a lower correlation with executive function deficits. Correlation results are presented in Table 7.

Table 7

*Correlations between Subscale Scores on the ICSRLE and Total Scores on the BDEFS-SF*

<table>
<thead>
<tr>
<th>Stressor: Life Experience</th>
<th>Correlation Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>***Developmental Challenge</td>
<td>.694</td>
</tr>
<tr>
<td>**Time Pressure</td>
<td>.468</td>
</tr>
<tr>
<td>**Academic Alienation</td>
<td>.492</td>
</tr>
<tr>
<td>Romantic Problems</td>
<td>.226</td>
</tr>
<tr>
<td>*Assorted Annoyances</td>
<td>.384</td>
</tr>
<tr>
<td>*General Social Mistreatment</td>
<td>.427</td>
</tr>
<tr>
<td>Friendship Problems</td>
<td>.309</td>
</tr>
</tbody>
</table>

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

**Regression.** A multiple regression analysis was conducted to determine if specific stressors measured by subscale scores from the ICSRLE are predictive of total executive function deficit scores from the BDEFS-SF. Results are presented in Table 8. The analysis was found to be significant, $R^2 = .494, F(7, 26) = 3.63, p < .05$, indicating that stressors are good predictors of executive function deficits. This multiple regression accounted for 49% of the
variability as indexed by the $R^2$ statistic. The regression equation for predicting executive function deficits from stressors was found to be $Y = 19.87 + .316 \text{(Development)} + .069 \text{(Time)} + .13 \text{(Academic)} - .02 \text{(Romantic Problems)} - .13 \text{(Annoyances)} - .01 \text{(Social Mistreatment)} - .06 \text{(Friendship Problems)}$. The variable of Developmental Challenge was shown to have the strongest relationship to executive function deficits and the only significant predictive value to executive function deficits as indexed by its $\beta$ value of .66, with a significance of .02 ($p < 0.05$).

Table 8

*Summary of Regression Analysis for Variables Predicting Executive Functioning Deficits (N = 34)*

<table>
<thead>
<tr>
<th>Variable</th>
<th>$B$</th>
<th>$SE\ B$</th>
<th>$\beta$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developmental Challenge*</td>
<td>.32</td>
<td>.13</td>
<td>.66</td>
</tr>
<tr>
<td>Time Pressure</td>
<td>.07</td>
<td>.88</td>
<td>.46</td>
</tr>
<tr>
<td>Academic Alienation</td>
<td>.131</td>
<td>.13</td>
<td>1.03</td>
</tr>
<tr>
<td>Romance Problems</td>
<td>-.05</td>
<td>.12</td>
<td>-.06</td>
</tr>
<tr>
<td>Assorted Annoyances</td>
<td>-.13</td>
<td>.14</td>
<td>-.21</td>
</tr>
<tr>
<td>General Social Mistreatment</td>
<td>-.01</td>
<td>.12</td>
<td>-.02</td>
</tr>
<tr>
<td>Friendship Problems</td>
<td>3.06</td>
<td>.10</td>
<td>-.56</td>
</tr>
</tbody>
</table>

*p < .05

**Discussion of the Pilot Study**

Some of the items included in the subscale of Developmental Challenges covered topics like struggling to meet academic standards, dissatisfaction with one’s various abilities or skills, and being dissatisfied with physical appearance. These results demonstrated that chronic stress
resulting from developmental challenges is most predictive of executive functioning deficits in students who participated in the pilot study.

One limitation of the study was seen in its basic design. While Developmental Challenge had a predictive relationship with executive function, causality cannot be confirmed with correlational analysis. Though Developmental Challenge stressors have the strongest relationship to executive functioning, in order to determine causality, a study using either longitudinal data or an experimental design would need to be employed.

A second limitation of the study is seen in the sample size. The sample size was not large enough to provide sufficient power to detect a moderate effect, as was possibly indicated to exist from these findings. Based on a number of recommendations from different authors, adequate sample size for a multiple regression study should be about fifteen to thirty participants per predictor, a minimum of 105 in this situation (Osbourne, Costello, & Kellow, 2008). While “rule of thumb” statements can be suspect, a sample consisting of 34 participants is inadequate to make a strong prediction when seven independent variables are involved, because potentially significant moderate to small effects may have been missed because of the sample size.

Another limitation is seen in the nature of executive functioning and life stressors. When doing such a study, one must ask, “Which influences which? Do executive function levels influence stress levels or do stress levels affect executive functioning levels? Do people with lower executive function skills have more difficulty handling stress? Is it the executive function skills that influence reaction to stressors and not vice versa? Can a person handle stress better if their executive function skills are higher?”

This research was a beginning look at seven specific stress related experiences and their relationships to college students’ executive functions. While there was a significant predictive
relationship shown between stress caused by Developmental Challenges and executive function deficit, a sample size of 34 was not large enough to provide conclusive, generalizable results. Therefore, it is recommended that this same study would be done again, employing a larger sample size and research that examines the effects of executive function levels on stress experienced by college students.
CHAPTER III
The Current Study

The pilot study described above was a beginning look at specific stressors and their relation to college students’ executive functions. While there was a significant predictive relationship shown between the Developmental Challenge stress variable and executive function deficit, a sample size of 34 was not large enough to provide conclusive generalizable results. The current study was conducted to determine whether the results of the pilot study would be replicated with a larger sample and to address the weakness of the pilot study. Also, the pilot study did not identify relationships between specific stressors and specific types of executive function.

The current study aimed to identify specific stressors related to overall and specific deficits in executive function. The primary research questions for this study were:

“Which type of stress is most closely related to deficits in executive function (EF) overall?”
“Which of these correlated stressors is most predictive of executive function deficit levels?”
“Which type of stress is most predictive to specific subscales of executive function deficits?”

The secondary aim of this study was to answer the question, “What can be done to help college students manage stress?”

In this study, scores for seven specific stressors measured by the ICSRLE survey served as the predictor variables: Developmental Challenge, Time Pressure, Academic Alienation, Romantic Problems, Assorted Annoyances, General Social Mistreatment, and Friendship Problems. Criterion variables included total scores and scores from the following five subscales of the BDEFS-SF: Self-Management to Time, Self-Organization/Problem Solving, Self-
Restraint, Self-Motivation, and Self-Regulation of Emotions. It was hypothesized that specific stressful life events are positively correlated with overall and specific executive function deficits.

**Methods**

The present study utilized methods to obtain the scores from two neuropsychological surveys completed by 121 university students. The surveys were given in an effort to examine correlates between stress related life experiences and executive function deficits. The research protocol for this study was approved by the Institutional Review Board (IRB) at the University of Cincinnati and assigned study number IRB #12-03-19-05.

**Participants**

One hundred and twenty-one undergraduate students (103 female, 18 male; \( M \) age = 19.58 years, age range: 17-29 years) participated in the study. The convenience sample was obtained using an online research participation management program at a large Midwestern university. Students who participated in the study received extra credit in their course. To avoid coercion, students were given the option to participate in the study or complete an alternate assignment for extra credit. Each participant signed an online consent form (see Appendix D) before taking the surveys used in the study.

Based on calculations by Borg and Gall (Mertens, 2010) and Daniel Soper, it was determined 103-105 participants are needed for an effective sample size when there are seven predictor variables. Borg and Gall’s “rule of thumb” suggests that one should have 15 participants for every predictor variable (Mertens, 2010). Since seven subsets of life experiences and their relation to executive functioning deficits were measured, at least 105 participants were required to make the results generalizable. Soper, (http://www.danielsoper.com/statcalc3/default.aspx) suggested the following for determining sample size for a multiple regression study:
Anticipated effect size of 0.15, with a statistical power level of 0.8, and a probability level of 0.05, using 7 predictor variables requires a sample size of 103.

**Measures**

As in the pilot study, the neuropsychological tests selected for the current study were the *Inventory of College Students’ Recent Life Experiences* (ICSRLE- adapted for this study) and the *Barkley Deficits in Executive Functioning Scale—Short Form* (BDEFS-SF). The original ICSRLE was altered slightly by changing the phrase in the directions from “in the last month” to “over the last six months.” This encouraged the students to reflect on their life experiences over the last six months which coincided with the directions in the BDEFS-SF, which also directed the students to think about their executive function experiences “over the last six months.” The instruments (found in Appendices B & C) are self-report surveys designed for college students that use a Likert scale format. The ICSRLE asks the participants to identify the types of stressor they had experienced and the extent of the stress experience during the last six months (Kohn et al., 1990). The BDEFS-SF measures executive function deficits overall in participants as well as deficits in five subscales that comprise the overall executive function deficit (Barkley, 2011).

**Inventory of College Students’ Recent Life Experiences (ICSRLE)**. Participants’ experiences of specific stressors were measured by the ICSRLE, which uses 7 subscales: Developmental Challenge, Time Pressure, Academic Alienation, Romantic Problems, Assorted Annoyances, General Social Mistreatment, and Friendship Problems (Kohn et al., 1990). Table 9 presents descriptions and item numbers for each subscale of the ICSRLE. As shown in Appendix C, the instructions for the participants read: *Please indicate for each experience how much it has been a part of your life over the past 6 months. A “1” will indicate that it was not at all part of your life over the past six months. A “2” will indicate that it was only slightly part of*
your life over that time. A “3” will indicate that it was distinctly part of your life; and a “4” will indicate the experience was very much part of your life. For each subscale, participants’ raw scores for each item were totaled then divided by the highest possible score that could be obtained for each subscale and multiplied by 100 to convert the raw scores into percentage scores. This was done because each subscale was comprised of a different number of items.

Table 9

Descriptions and Item Numbers for the Seven Subscales on the ICSRLE

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Description</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developmental Challenge</td>
<td>Struggle and dissatisfaction with cognitive and physical attributes and abilities (i.e., Lacking self-efficacy)</td>
<td>11 items; 11, 14, 19, 20, 23, 25, 30, 32, 40, 45, 49</td>
</tr>
<tr>
<td>Time Pressure</td>
<td>Struggle with getting things done in a timely way and finding enough time to rest (i.e. Difficulty managing time)</td>
<td>5 items, 13, 15, 18, 27, 29, 41</td>
</tr>
<tr>
<td>Academic Alienation</td>
<td>Dissatisfaction with school (i.e. Poor grades)</td>
<td>6 items; 3, 16, 22, 26, 34, 46</td>
</tr>
<tr>
<td>Romantic Problems</td>
<td>Conflicts with intimate relationships (i.e., Continual arguments with romantic partner)</td>
<td>3 items; 1, 17, 39</td>
</tr>
<tr>
<td>Assorted Annoyances</td>
<td>Miscellaneous Conflicts over life issues (i.e., Many minor troubling life events)</td>
<td>11 items; 7, 10, 21, 28, 35, 36, 37, 38, 43, 47, 48</td>
</tr>
<tr>
<td>General Social Mistreatment</td>
<td>Feelings of isolation or loneliness experienced when contemplating (i.e., Feeling ignored)</td>
<td>6 items; 4, 6, 12, 24, 42, 44</td>
</tr>
<tr>
<td>Friendship Problems</td>
<td>Conflicts with friends (i.e., Disagreements with peers)</td>
<td>4 items; 2, 8, 31, 33</td>
</tr>
</tbody>
</table>
This scale was developed after an 85 item stress survey from Kanner, Coyne, Schaefer and Lazarus (1981) and Burks and Martin (1983) was administered to 100 undergraduates along with the Perceived Stress Scale (Cohen, Kamarack, & Mermelstein, 1983). From this study, 49 items were selected based on significant correlations with the Perceived Stress Scale (Cohen, 1983)—a 14 item self-report measure designed to assess the extent to which an individual perceives different life events as stressful. All data were collected 1 week before Midterms. The ICSRLE demonstrated validity with positive and significant correlations with the other related measures given.

In assessing the reliability of the ICSRLE, Cronbach’s alpha coefficients were moderate to high (Osman, Barrios, Longnecker, & Osman, 1994). The alpha score for the total scale was .922. For each individual subset they were: Developmental Challenge (0.80), Time Pressure (0.80), Academic Alienation (0.78), Romantic Problems (0.69), Assorted Annoyances (0.54), Social Mistreatment (0.80), and Friendship Problems (0.77). The alpha scores for males were 0.88 and 0.89 for females (Kohn et al., 1990).

The alpha scores of the other measures compared to the ICSRLE were:

*Perceived Stress Scale* = 0.86

*Daily Hassles Scale-Revised* = 0.96

*Brief Symptom Inventory* (BSI) = This consisted of nine subscales. In a Factor 1 analysis of the nine BSI subscales and the General Social Mistreatment subscale of the ICSRLE, the factor loadings from the BSI were: Depression (.939), Psychoticism (.870), Interpersonal Sensitivity (.777), Paranoid Ideation (.694), Phobic Anxiety (.672), Hostility (.654), and Obsessive-compulsive (.627). The loading for General Social Mistreatment was .525. Factor 2 of the BSI consisted of five of the seven subscales of the ICSRLE: Developmental Challenge
(.885), Time Pressure (.755), Academic Alienation (.528), Romantic Problems (.274), Assorted Annoyances (.523), and Friendship Problems (.413).

In all, the authors (Osman et al., 1994) of this study confirmed that the ICSRLE alpha coefficients were satisfactory (.922) and validity evidence was shown by the positive and significant correlations of the ICSRLE subscales with related measures of daily hassles. Cronbach’s alpha for the ICSRLE was found to be .867, which indicates satisfactory reliability.

**Barkley Deficits in Executive Functioning Scale: Short Form (BDEFS-SF).** There are two versions of the Barkley Deficits in Executive Functioning Scale—the BDEFS-LF (long form, consisting of 89 items) and the BDEFS-SF (short form, consisting of 20 items). Both instruments measure executive function deficit levels. The BDEFS-SF was selected for this study. Cronbach’s alpha for the total score of the BDEFS-SF was high at .92 (Barkley, 2011). The total score is a summary of the scores for each of the instrument’s five subscales: Self-Management to Time, Self-Organization/Problem Solving, Self-Restraint, Self-Motivation, and Self-Regulation of Emotions (Barkley, 2011). Table 10 presents descriptions and item numbers for each subscale of the BDEFS-SF.
Table 10

*Descriptions and Item Numbers for the 5 Subscales of the BDEFS-SF*

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Deficit Description</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-Management to Time</td>
<td>Problems with procrastination, concentration, advance preparation, and follow-through</td>
<td>$n = 4$ items: 1, 2, 3, 4</td>
</tr>
<tr>
<td>Self-Organization/Problem Solving</td>
<td>Struggles with learning new activities, explain things in proper order, “thinking on my feet” and processing information quickly</td>
<td>$n = 4$ items: 5, 6, 7, 8</td>
</tr>
<tr>
<td>Self-Restraint</td>
<td>Lack of inhibition and the practice of thinking things through before acting</td>
<td>$n = 4$ items: 9, 10, 11, 12</td>
</tr>
<tr>
<td>Self Motivation</td>
<td>Problems with work quality, laziness, and taking the initiative</td>
<td>$n = 4$ items: 13, 14, 15, 16</td>
</tr>
<tr>
<td>Self-Regulation of Emotions</td>
<td>Trouble with calming oneself down, emotional control, positive focus, and overcoming being upset</td>
<td>$n = 4$ items: 17, 18, 19, 20</td>
</tr>
</tbody>
</table>

As shown in Appendix C, the instructions for participants read, *How often have you experienced each of these problems over the past 6 months? Please indicate numerically: 1 = Never or rarely, 2 = Sometimes, 3 = Often, 4 = Very often.* First scores were computed for each student by summing the scores for each item. That gave the total level of executive function deficit for each participant. Total executive function scores could range from 20 to 80, with higher scores indicating higher levels of executive function deficits and a lower level of executive function. The overall executive function deficit mean was then determined. Then,
each of the five subscale scores were computed by summing the scores for the four items representing each subscale.

While considering the validity of the BDEFS-SF, it is important to recall that various scholars in the field of neuropsychology have different definitions for executive functioning (Blakemore & Choudhury, 2006; Fischer & Daley, 2006; Spear, 2007). Barkley’s (2011) operational definition of executive function is “self-regulation across time for the attainment of future goals, typically in social contexts,” (p. 13). This self-regulation is seen in one’s ability to consistently manage and control one’s thought processes, planning, and emotional stability to better oneself and their community. This is what the BDEFS-SF measures. In fact, the author contends his executive functions test is only “modestly related” to the other neuropsychological tests of executive functioning, because most executive function tests only measure a single aspect of executive function, such as set shifting; or working memory in clinical contexts. The BDEFS-SF measures multiple aspects of executive functioning in social settings (Barkley, 2011).

Barkley (2011) compared a prototype of his BDEFS with some other popular neuropsychological tests: The Conner’s CPT—which measures inhibition and attention; the Stroop Color-Word Test—which measures interference control; the Wisconsin Card Sorting Test—which measures problem solving and rule discovery; and the Tower of London Test—which measures problem solving. These tests measure specific facets of executive functioning. Therefore, the results showed that the P-BDEFS test was mildly related to some of the individual tests. In fact, the correlations to the other tests only went as high as .41. This moderate relationship can be attributed to the BDEFS’s focus on at least five aspects of executive functioning; whereas the Conner’s, Stroop, Wisconsin Cord Sorting, and Tower of London tests only measured one or two elements of executive functioning (Barkley, 2011). Barkley contends
that his test “identifies executive functioning at higher levels, of greater behavioral complexity over longer terms, and in socially significant settings and domains of daily life activities,” (Barkley, 2012, p. 80). The BDEFS encompasses more elements of executive function than many of the other executive functioning tests.

The reliability of the BDEFS-SF is high with an internal consistency score at 0.91-0.95, fair to good inter-observer agreement (0.66-0.79), a moderate to high test-retest reliability over a 2-3 week interval (0.62-0.90), and a Pearson score of .80 ($p < .001$) as well as Cronbach’s alpha at .918 for the total score (Barkley, 2011). While the internal consistency ratings are not available for the BDEFS-SF subscales (Barkley, 2011), the internal consistency of the measure based on Cronbach’s alpha for each subscale of for the BDEFS-LF was found to be high: Self-Management to Time, (.949); Self-Organization/Problem Solving, (.958); Self-Restraint, (.930); Self-Motivation, (.914); and Self-Regulation of Emotions, (.946). The test-retest reliability between the BDEFS-SF and the BDEFS-LF Pearson product-moment correlation was .80. Given the BDEFS-SF exceptionally high correlation with the BDEFS-LF, “one could argue that all of the findings here that apply to the BDEFS-LF Total Summary Score could be expected to apply to the corresponding score for the BDEFS-SF” (Barkley, 2011, p. 71).

The face validity of the BDEFS-SF is high also, based on numerous analyses, including factor analyses of a mixed sample of ADHD participants as well as samples of non-ADHD participants in a number of normative studies. The same factor structure was identified by those other than Barkley as they rated the adult participants of those studies. Validity was also demonstrated as Barkley tested various populations with their experiences and approach to life, in such areas as occupational functioning, education, employment status, household income, and marital satisfaction (Barkley, 2011; Barkley & Murphy, 2010).
**Procedures**

A number of the procedures used for the pilot study, cited in Chapter II, were duplicated using the same instruments, research questions, and data analysis, but with a more appropriate sample size and a different method of instrument distribution. This study was conducted online using the Research Activity Management System (RAMS) of the university. The *Inventory of College Students’ Recent Life Experiences* (ICSRLE) and the *Barkley Deficits in Executive Functioning Scale --Short Form* (BDEFS-SF) were given online through the RAMS program. Both surveys were made available during the fall of 2013 using Qualtrics.

All participants received a consent form online that explained the proposed study. The college students who wished to participate signed the consent form electronically, acknowledging an understanding of the study, and giving consent. Submission of their signed consent form through an online process indicated the participants’ consent. The signed form was kept on file, separate from the survey results. No questions from the participants were noted.

Because class credit was given for participation, the professor teaching the class in which credit was given (not the researcher) needed to know who participated. So as the participants signed the consent form, their name was given to the professor providing the credit. Since the surveys were distributed online, each participant was able to take the tests in privacy-wherever and whenever they liked. Names were removed from the data and deleted along with the URLs. Participants also indicated their gender, Grade Point Average, age, and year in college. Students were free to not complete the testing if they experienced any negative feelings or embarrassment. No questions would be asked if they choose to drop out of the study. All students that began the surveys completed the surveys. Any issues could have been reported to IRB, but none were reported.
Data from those completing the surveys were collected and stored electronically on an Excel Spreadsheet and in SPSS (Version 22). On the spreadsheet, the following items were noted, representing the students that completed the study: ID number (assigned to each survey), gender, overall GPA, each participant’s ICSRLE scores from each subscale, their BDEFS-SF scores from each subscale, and the total BDEFS-SF score for each student.

Since there are a different number of items in each subscale of the ICSRLE, the stressor raw scores of each item in each subscale for each participant were totaled and then divided by the highest possible score that could be obtained for each subscale. That calculation converted the raw scores of the ICSRLE into percentage scores.
CHAPTER IV

Results

To test the research questions, demographic information, including gender, scores from each subscale of the ISCRLE, and total score as well as subscale scores from the BDEFS-SF were entered into a database and analyzed using SPSS (Version 22). First, descriptive statistics were examined. Second, correlations were calculated between scores from each of the seven subscales on the ICSRLE and total score and scores from the five subscales on the BDEFS-SF. Third, a multiple regression analysis was run using unstandardized coefficients and standardized coefficients ($\beta$) to determine if any of the stressors represented by seven subscales, were predictive of the overall score and the five specific subscale scores of executive function deficits.

Missing Data

Missing data were discovered. Out of a total of 8,349 items (121 participants multiplied by 69 items to be answered in the surveys), 18 items (0.2%) were left unanswered. Because the proportion of missing values was extremely low (less than 5%) and there was no pattern of missing values, relative to the items discovered, the missing scores were determined to be random. The missing items were handled by taking a participant’s mean score of the subscale containing the missing item, and imputing the mean of that subscale in the missing value’s place (C. Swoboda, personal communication, March 13, 2014). The mean score for that particular subscale was then recalculated.

Both measures, the ICSRLE and the BDEFS-SF used Likert scales, assigning numerals for each descriptive term. While Likert data can be judged to be ordinal or interval at times (Gravetter & Wallnau, 2009), the interval descriptive was selected since numerals were used and
the data was parametric. The ratings of the Likert items were summed to obtain scores for each of the variables from the ICSRLE and the overall score as well as each subscale score for the BDEFS-SF. This aggregation of the indicator scores was therefore treated as interval and parametric. An overall score for the ICSRLE was not used since studies by Orem and colleagues (2008) and Petrac and colleagues (2009) already demonstrated higher levels of self-perceived chronic stress was related to deficits in executive function.

**Descriptive Statistics**

Tables 11 and 12 present descriptive statistics for scores on each subscale of the ICSRLE and for each subscale and total score on the BDEFS-SF, respectively. For the ICSRLE, the highest mean scores were for the Time Pressure (65.11) and Developmental Challenges (57.25) subscales. The mean score for the entire survey was 57.17 with an average standard deviation of 15.23. The ICSRLE normative mean was 53.34, with a standard deviation of 15.85. Thus the mean determined from the current study’s participants was slightly higher than the normative population. As shown, the largest range for the stressor prevalence scores on the ICSRLE was for Romantic Problems and Social Mistreatment; while the smallest ranges were for Academic Alienation and Assorted Annoyances.

The BDEFS-SF subscale scores were summed to obtain a total executive function score for each participant. The mean total score for the sample was 39.07, which is on the higher end of the scale. According to Barkley (2011), this mean score is as high as or higher than 81% (81st percentile) of those in the 18-34 year old category who had been involved in the normative study conducted by Barkley (2011). This sample showed fairly high levels of executive functioning deficits when compared to the normative population. The possible range of total summary
scores that could be obtained from the BDEFS-SF was 20 to 80. The scores for the BDEFS-SF ranged from 21-80, with a standard deviation of 12.14.

Table 11

*Means, Standard Deviations, and Ranges for Subscale Scores on the ICSRLE*

<table>
<thead>
<tr>
<th>Subscale</th>
<th>$M$</th>
<th>$SD$</th>
<th>Range (Percentage Scores)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developmental Challenge</td>
<td>57.25</td>
<td>14.27</td>
<td>27.27-100</td>
</tr>
<tr>
<td>Time Pressure</td>
<td>65.11</td>
<td>14.93</td>
<td>28.57-96.43</td>
</tr>
<tr>
<td>Academic Alienation</td>
<td>42.39</td>
<td>12.51</td>
<td>25.00-79.19</td>
</tr>
<tr>
<td>Romantic Problems</td>
<td>47.93</td>
<td>19.40</td>
<td>25.00-100</td>
</tr>
<tr>
<td>Assorted Annoyances</td>
<td>45.94</td>
<td>13.10</td>
<td>27.27-90.91</td>
</tr>
<tr>
<td>General Social Mistreatment</td>
<td>48.83</td>
<td>17.22</td>
<td>25.00-100</td>
</tr>
<tr>
<td>Friendship Problems</td>
<td>46.59</td>
<td>15.18</td>
<td>25.00-87.50</td>
</tr>
</tbody>
</table>

*Note. N = 121*
Table 12

Means, Standard Deviations, and Ranges for Subscale Scores and Total Score on the BDEFS-SF

<table>
<thead>
<tr>
<th>Subscale</th>
<th>M</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self –Management to Time</td>
<td>9.90</td>
<td>3.15</td>
<td>4-16</td>
</tr>
<tr>
<td>Self - Organization/Problem Solving</td>
<td>7.26</td>
<td>2.74</td>
<td>4-16</td>
</tr>
<tr>
<td>Self-Restraint</td>
<td>7.32</td>
<td>2.92</td>
<td>4-16</td>
</tr>
<tr>
<td>Self-Motivation</td>
<td>6.58</td>
<td>2.64</td>
<td>4-16</td>
</tr>
<tr>
<td>Self Regulation of Emotions</td>
<td>7.98</td>
<td>3.58</td>
<td>4-16</td>
</tr>
<tr>
<td>Total score</td>
<td>39.07</td>
<td>12.14</td>
<td>21-80</td>
</tr>
</tbody>
</table>

The reliability coefficients for each measure and their subscales were also run. The Cronbach’s alpha scores from this sample was found to be .876 for the ICSRLE and .914 for the BDEFS-SF. Both coefficients suggest a very good internal consistency reliability for the measures with this sample. In relation to the subscales, Cronbach’s alpha was used to determine reliability scores if any of the subscale results were deleted. Removal of any of the subscale scores would not affect the reliability substantially. All subscale scores reflect a high degree of reliability. These results are displayed in Table 13.
Table 13

*Cronbach’s Alphas if Subscale Scores were Deleted*

<table>
<thead>
<tr>
<th>Subscale</th>
<th>Cronbach’s alpha if Subscale Scores were Deleted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-Management to Time</td>
<td>.91</td>
</tr>
<tr>
<td>Self-Organization/Problem Solving</td>
<td>.91</td>
</tr>
<tr>
<td>Self-RestRAINT</td>
<td>.90</td>
</tr>
<tr>
<td>Self-Motivation</td>
<td>.90</td>
</tr>
<tr>
<td>Self Regulation of Emotions</td>
<td>.91</td>
</tr>
<tr>
<td>Developmental Challenge</td>
<td>.85</td>
</tr>
<tr>
<td>Time Pressure</td>
<td>.87</td>
</tr>
<tr>
<td>Academic Alienation</td>
<td>.87</td>
</tr>
<tr>
<td>Romantic Problems</td>
<td>.88</td>
</tr>
<tr>
<td>Assorted Annoyances</td>
<td>.84</td>
</tr>
<tr>
<td>General Social Mistreatment</td>
<td>.84</td>
</tr>
<tr>
<td>Friendship Problems</td>
<td>.86</td>
</tr>
</tbody>
</table>

ICSRLE: Cronbach’s alpha = .88
BDEFS-SF: Cronbach’s alpha = .91

**Correlations between Stress and Executive Function Deficits**

To standardize the scores between the predictor and outcome variables, raw scores were converted to Z scores. Pearson Product-moment correlations were used to examine relationships between types of specific stressors as measured by subscale scores on the ICSRLE as well as specific and general executive functioning deficits as measured by subscale and total scores on
the BDEFS-SF. Results are presented in Table 14. Significant, positive relationships were found between various stressors and overall executive function deficit scores. The highest correlation was between General Social Mistreatment (.617) and executive function deficits. Relatively strong relationships were seen between overall executive function deficits and three other stressors: Developmental Challenges (.612), Academic Alienation (.589), and Assorted Annoyances (.532). A moderately high relationship was discovered between overall executive function deficits with Friendship Problems (.488) and Romantic Problems (.411). The lowest correlation was with Time Pressure (.335).

Table 14

_Correlations between Subscale Scores on the ICSRLE and Subscale and Total Scores on the BDEFS-SF_

<table>
<thead>
<tr>
<th>ICSRLE</th>
<th>BDEFS-SF</th>
<th>Self-Management to Time</th>
<th>Self-Organization/ Problem Solving</th>
<th>Self-Restraint</th>
<th>Self-Motivation</th>
<th>Self-Regulation of Emotions</th>
<th>Total EF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developmental Challenge</td>
<td></td>
<td>.463**</td>
<td>.524**</td>
<td>.491**</td>
<td>.627**</td>
<td>.377**</td>
<td>.612*</td>
</tr>
<tr>
<td>Time Pressure</td>
<td></td>
<td>.281**</td>
<td>.212*</td>
<td>.261**</td>
<td>.341**</td>
<td>.246**</td>
<td>.335</td>
</tr>
<tr>
<td>Academic Alienation</td>
<td></td>
<td>.452**</td>
<td>.537**</td>
<td>.508**</td>
<td>.601**</td>
<td>.301**</td>
<td>.589**</td>
</tr>
<tr>
<td>Romantic Problems</td>
<td></td>
<td>.340**</td>
<td>.201*</td>
<td>.359**</td>
<td>.307**</td>
<td>.414**</td>
<td>.411</td>
</tr>
<tr>
<td>Assorted Annoyances</td>
<td></td>
<td>.402**</td>
<td>.314**</td>
<td>.476**</td>
<td>.524**</td>
<td>.400**</td>
<td>.532</td>
</tr>
<tr>
<td>General Social Mistreat-</td>
<td></td>
<td>.472**</td>
<td>.444**</td>
<td>.492**</td>
<td>.561**</td>
<td>.492**</td>
<td>.617**</td>
</tr>
<tr>
<td>Friendship Problems</td>
<td></td>
<td>.352**</td>
<td>.315**</td>
<td>.426**</td>
<td>.449**</td>
<td>.394**</td>
<td>.488</td>
</tr>
</tbody>
</table>

**p < .01; *p < .05
Further examination of correlations indicated relationships within the ICSRLE subscales as well as relationships within the BDEFS-SF subscales. Within the ICSRLE stressor subscales, General Social Mistreatment demonstrated a very strong relationship with Friendship Problems (.71) and Assorted Annoyances (.69). Developmental Challenges was strongly related to Academic Alienation (.66) and Assorted Annoyances (.67).

Among the BDEFS-SF executive function deficit subscales, Self-Motivation demonstrated high correlations with Self-Management to Time (.63), Self-Organization/Problem Solving (.64), and Self-Restraint (.64). All executive function variables demonstrated strong to very strong positive relationships between themselves with correlation coefficients of .48 or higher. These relationships are illustrated in Table 15.
Table 15

Correlations between Subscale Scores on the ICSRLE and the BDEFS-SF

<table>
<thead>
<tr>
<th></th>
<th>DC</th>
<th>TP</th>
<th>AcA</th>
<th>RP</th>
<th>AA</th>
<th>GSM</th>
<th>FP</th>
<th>TM</th>
<th>SO</th>
<th>SR</th>
<th>SM</th>
<th>RE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC</td>
<td>1</td>
<td>.57</td>
<td>.66</td>
<td>.37</td>
<td>.67</td>
<td>.63</td>
<td>.47</td>
<td>.46</td>
<td>.52</td>
<td>.49</td>
<td>.63</td>
<td>.38</td>
</tr>
<tr>
<td>TP</td>
<td>.57</td>
<td>1</td>
<td>.40</td>
<td>.29</td>
<td>.54</td>
<td>.46</td>
<td>.28</td>
<td>.28</td>
<td>.21</td>
<td>.26</td>
<td>.34</td>
<td>.25</td>
</tr>
<tr>
<td>AcA</td>
<td>.66</td>
<td>.40</td>
<td>1</td>
<td>.26</td>
<td>.55</td>
<td>.48</td>
<td>.41</td>
<td>.45</td>
<td>.54</td>
<td>.51</td>
<td>.60</td>
<td>.30</td>
</tr>
<tr>
<td>RP</td>
<td>.37</td>
<td>.29</td>
<td>.26</td>
<td>1</td>
<td>.49</td>
<td>.48</td>
<td>.46</td>
<td>.34</td>
<td>.20</td>
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<td>.31</td>
<td>.41</td>
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<td>.55</td>
<td>.49</td>
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<td>.40</td>
<td>.31</td>
<td>.48</td>
<td>.52</td>
<td>.40</td>
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<tr>
<td>GSM</td>
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<td>.46</td>
<td>.48</td>
<td>.48</td>
<td>.69</td>
<td>1</td>
<td>.71</td>
<td>.47</td>
<td>.44</td>
<td>.49</td>
<td>.56</td>
<td>.49</td>
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<tr>
<td>FP</td>
<td>.47</td>
<td>.28</td>
<td>.41</td>
<td>.46</td>
<td>.64</td>
<td>.71</td>
<td>1</td>
<td>.35</td>
<td>.32</td>
<td>.43</td>
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<td>.39</td>
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<tr>
<td>TM</td>
<td>.46</td>
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<td>.45</td>
<td>.34</td>
<td>.40</td>
<td>.47</td>
<td>.35</td>
<td>1</td>
<td>.48</td>
<td>.58</td>
<td>.63</td>
<td>.49</td>
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<tr>
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<td>.21</td>
<td>.54</td>
<td>.20</td>
<td>.31</td>
<td>.44</td>
<td>.32</td>
<td>.48</td>
<td>1</td>
<td>.54</td>
<td>.64</td>
<td>.49</td>
</tr>
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<td>SR</td>
<td>.49</td>
<td>.26</td>
<td>.51</td>
<td>.36</td>
<td>.48</td>
<td>.49</td>
<td>.43</td>
<td>.58</td>
<td>.54</td>
<td>1</td>
<td>.64</td>
<td>.55</td>
</tr>
<tr>
<td>SM</td>
<td>.62</td>
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<td>.31</td>
<td>.52</td>
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<td>.45</td>
<td>.63</td>
<td>.64</td>
<td>.64</td>
<td>1</td>
<td>.52</td>
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<tr>
<td>RE</td>
<td>.38</td>
<td>.25</td>
<td>.30</td>
<td>.41</td>
<td>.40</td>
<td>.49</td>
<td>.39</td>
<td>.49</td>
<td>.49</td>
<td>.55</td>
<td>.52</td>
<td>1</td>
</tr>
</tbody>
</table>

Variables: Developmental Challenge (DC), Time Pressure (TP), Academic Alienation (AcA), Romantic Problems (RP), Assorted Annoyances (AA), General Social Mistreatment (GSM), Friendship Problems (FP), Self-Management to Time (TM), Self-Organization/Problem Solving (SO), Self-Restraint (SR), Self-Motivation (SM), & Self-Regulation of Emotions (RE)
Regression

A multiple regression analysis was conducted to determine if specific stressors measured by subscale scores from the ICSRLE are predictive of total executive function deficit scores from the BDEFS-SF. Results are presented in Table 16. The analysis was found to be statistically significant $R^2 = .527$, $F(7, 113) = 18.02$, $p < .05$, indicating that stressors are good predictors of executive function deficits. This multiple regression accounted for 50% of the variability, as indexed by $R^2$ statistic. The regression equation for predicting executive function deficits from stressors was found to be $Y = .307 + .26$ (Development) - .09 (Time) + .357 (Academic) +103 (Romantic Problems) - .05 (Annoyances) + .27 (Social Mistreatment) + .03 (Friendship Problems). Though multiple predictor variables (i.e., stressors) were correlated with executive function scores, three variables best explained the variance: (1) Academic Alienation ($\beta = .294, p = .001$), (2) General Social Mistreatment ($\beta = .308, p = .006$), and (3) Developmental Challenge ($\beta = .241, p = .028$).
<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developmental Challenge</td>
<td>.24</td>
<td>.11</td>
<td>.24*</td>
</tr>
<tr>
<td>Time Pressure</td>
<td>.09</td>
<td>.08</td>
<td>-.09</td>
</tr>
<tr>
<td>Academic Alienation</td>
<td>.29</td>
<td>.09</td>
<td>.29***</td>
</tr>
<tr>
<td>Romantic Problems</td>
<td>.13</td>
<td>.08</td>
<td>.13</td>
</tr>
<tr>
<td>Assorted Annoyances</td>
<td>-.04</td>
<td>.11</td>
<td>-.04</td>
</tr>
<tr>
<td>General Social Mistreatment</td>
<td>.31</td>
<td>.11</td>
<td>.31**</td>
</tr>
<tr>
<td>Friendship Problems</td>
<td>.03</td>
<td>.099</td>
<td>.03</td>
</tr>
</tbody>
</table>

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

Items for “Developmental Challenge, Academic Alienation, and General Social Mistreatment” are shown in Tables 17, 18, and 19 as described by the ICSRLE with their corresponding item numbers.
Table 17

*Descriptions of Developmental Challenge Stressors*

Items from the ICSRLE Representing Developmental Challenges (Osman, et al., 1994)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>11.</td>
<td>Struggling to meet your own academic standards</td>
</tr>
<tr>
<td>14.</td>
<td>Struggling to meet the academic standards of others</td>
</tr>
<tr>
<td>19.</td>
<td>Dissatisfaction with your mathematical ability</td>
</tr>
<tr>
<td>20</td>
<td>Important decisions about your future career</td>
</tr>
<tr>
<td>23.</td>
<td>Important decisions about your education</td>
</tr>
<tr>
<td>25.</td>
<td>Lower grades than you hoped for</td>
</tr>
<tr>
<td>30.</td>
<td>Finding courses too demanding</td>
</tr>
<tr>
<td>32.</td>
<td>Hard effort to get ahead</td>
</tr>
<tr>
<td>40.</td>
<td>Dissatisfaction with your ability at written expression</td>
</tr>
<tr>
<td>45.</td>
<td>Dissatisfaction with your physical appearance</td>
</tr>
<tr>
<td>49.</td>
<td>Dissatisfaction with your athletic skills</td>
</tr>
</tbody>
</table>

Table 18

*Descriptions of Academic Alienation Stressors*

Items from the ICSRLE Representing Academic Alienation (Osman, et al., 1994)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3.</td>
<td>Conflict with professor(s)</td>
</tr>
<tr>
<td>16.</td>
<td>Dissatisfaction with school</td>
</tr>
<tr>
<td>22.</td>
<td>Dissatisfaction with your reading ability</td>
</tr>
<tr>
<td>26.</td>
<td>Conflict with a teaching assistant</td>
</tr>
<tr>
<td>34.</td>
<td>Disliking your studies</td>
</tr>
<tr>
<td>46.</td>
<td>Finding course(s) uninteresting</td>
</tr>
</tbody>
</table>
Table 19

*Descriptions of General Social Treatment Stressors*

Items from the ICSRLE Representing General Social Mistreatment (Osman, et al., 1994)

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td>Social rejection</td>
</tr>
<tr>
<td>6.</td>
<td>Being taken for granted</td>
</tr>
<tr>
<td>12.</td>
<td>Being taken advantage of</td>
</tr>
<tr>
<td>24.</td>
<td>Loneliness</td>
</tr>
<tr>
<td>42.</td>
<td>Social isolation</td>
</tr>
<tr>
<td>44.</td>
<td>Being ignored</td>
</tr>
</tbody>
</table>

In order to isolate the predictive value of the seven stressors on the five executive function subscales multiple regression analyses were used to examine relationships. The Bonferroni Inequality correction ($\alpha = 0.05/5 = 0.01$) was employed to avoid a Type I error inflation (Stevens, 2009). Developmental Challenge demonstrated a predictive relationship with Self-Organization/Problem Solving ($r = .534, p = .005$) and Self-Motivation ($r = .627, p = .007$). A predictive relationship was also demonstrated between Academic Alienation and Self Motivation ($r = .601, p = .001$), Self-Organization/Problem Solving ($r = .545, p = .001$) and Self-Restraint ($r = .508, p = .006$). The predictive relationships are illustrated in Tables 20, 21, 22, 23, and 24.
Table 20

Summary of Regression Analysis for Variables Predicting Self-Management to Time Executive Functioning Deficits (N = 121)

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developmental Challenge</td>
<td>.03</td>
<td>.03</td>
<td>.15</td>
</tr>
<tr>
<td>Time Pressure</td>
<td>-.006</td>
<td>.02</td>
<td>-.03</td>
</tr>
<tr>
<td>Academic Alienation</td>
<td>.06</td>
<td>.03</td>
<td>.24</td>
</tr>
<tr>
<td>Romantic Problems</td>
<td>.02</td>
<td>.02</td>
<td>.14</td>
</tr>
<tr>
<td>Assorted Annoyances</td>
<td>-.04</td>
<td>.03</td>
<td>-.05</td>
</tr>
<tr>
<td>General Social Mistreatment</td>
<td>.05</td>
<td>.02</td>
<td>.26</td>
</tr>
<tr>
<td>Friendship Problems</td>
<td>-.01</td>
<td>.03</td>
<td>-.02</td>
</tr>
</tbody>
</table>

*p < .01
Table 21

Summary of Regression Analysis for Variables Predicting Self-Organization/Problem Solving Executive Functioning Deficits (N = 121)

<table>
<thead>
<tr>
<th>Variable</th>
<th>$B$</th>
<th>$SE_B$</th>
<th>$\beta$</th>
</tr>
</thead>
<tbody>
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<td>.02</td>
<td>.35*</td>
</tr>
<tr>
<td>Time Pressure</td>
<td>-.03</td>
<td>.02</td>
<td>-.14</td>
</tr>
<tr>
<td>Academic Alienation</td>
<td>.08</td>
<td>.02</td>
<td>.36*</td>
</tr>
<tr>
<td>Romantic Problems</td>
<td>.00</td>
<td>.12</td>
<td>.004</td>
</tr>
<tr>
<td>Assorted Annoyances</td>
<td>-.05</td>
<td>.03</td>
<td>-.24</td>
</tr>
<tr>
<td>General Social Mistreatment</td>
<td>.04</td>
<td>.02</td>
<td>.27</td>
</tr>
<tr>
<td>Friendship Problems</td>
<td>.00</td>
<td>.02</td>
<td>.00</td>
</tr>
</tbody>
</table>

*p < .01
Table 22

Summary of Regression Analysis for Variables Predicting Self-Restraint Executive Functioning Deficits (N = 121)

<table>
<thead>
<tr>
<th>Variable</th>
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<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developmental Challenge</td>
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<td>.03</td>
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</tr>
<tr>
<td>Time Pressure</td>
<td>-.02</td>
<td>.02</td>
<td>-.10</td>
</tr>
<tr>
<td>Academic Alienation</td>
<td>.07</td>
<td>.02</td>
<td>.28*</td>
</tr>
<tr>
<td>Romantic Problems</td>
<td>.12</td>
<td>.01</td>
<td>.13</td>
</tr>
<tr>
<td>Assorted Annoyances</td>
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<tr>
<td>General Social Mistreatment</td>
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<td>Friendship Problems</td>
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*p < .01
Table 23

Summary of Regression Analysis for Variables Predicting Self-Motivation Executive Functioning Deficits (N = 121)

<table>
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<th>Variable</th>
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<th>β</th>
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</thead>
<tbody>
<tr>
<td>Developmental Challenge</td>
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<td>.02</td>
<td>.31*</td>
</tr>
<tr>
<td>Time Pressure</td>
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<td>.02</td>
<td>-.08</td>
</tr>
<tr>
<td>Academic Alienation</td>
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<td>.02</td>
<td>.30*</td>
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<td>Romantic Problems</td>
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<td>.01</td>
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<td>Assorted Annoyances</td>
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<td>.02</td>
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<tr>
<td>General Social Mistreatment</td>
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<td>.02</td>
<td>.21</td>
</tr>
<tr>
<td>Friendship Problems</td>
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<td>.02</td>
<td>.04</td>
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*p < .01
Table 24

Summary of Regression Analysis for Variables Predicting Self-Regulation of Emotions Executive Functioning Deficits (N = 121)

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<th>Variable</th>
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</thead>
<tbody>
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<td>Time Pressure</td>
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<td>.03</td>
<td>-.03</td>
</tr>
<tr>
<td>Academic Alienation</td>
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<td>.05</td>
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<tr>
<td>Romantic Problems</td>
<td>.04</td>
<td>.02</td>
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<tr>
<td>Assorted Annoyances</td>
<td>.00</td>
<td>.04</td>
<td>.00</td>
</tr>
<tr>
<td>General Social Mistreatment</td>
<td>.07</td>
<td>.03</td>
<td>.31</td>
</tr>
<tr>
<td>Friendship Problems</td>
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<td>.03</td>
<td>.03</td>
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</table>

*p < .01
CHAPTER V

Discussion

The two foundational studies by Orem and colleagues (2008) and Petrac and colleagues (2009) were used as a beginning point for this study. While their research showed a relationship between self-perceived stressful experiences and executive function deficit, this current work sought to determine which kind of stressors are most related to executive functioning deficiencies. The hypothesis for this study stated, “Specific stressful life events are positively correlated with overall and specific executive function deficits.” This hypothesis was supported from the data gathered in this study as the research questions were answered.

One of the primary research questions for this study was, “Which type of stress is most closely related to deficits in executive function (EF) overall?” Six stressors showed a strong positive, overall relationship with executive functioning deficits. The highest correlation was demonstrated by General Social Mistreatment—indicated by loneliness, feelings of rejection, or perceptions of being ignored. Relatively strong relationships were seen between overall executive function deficits and three other stressors: Developmental Challenge—indicated by low self-esteem, lack of self-efficacy, or dissatisfaction with physical or intellectual abilities; Academic Alienation—indicated by conflicts in the classroom, disliking one’s classes, or finding courses uninteresting; and Assorted Annoyances—indicated by miscellaneous conflicts over life issues or many minor troubling life events. A moderately high correlational relationship was discovered between overall executive function deficits with Friendship Problems—indicated by conflicts with friends or disagreements with peers; and Romantic Problems—indicated by conflicts with intimate relationships. The lowest correlation was with Time Pressure—indicated by struggles with getting things done in a timely way and finding enough time to rest.
Further examination of correlations indicated relationships within the ICSRLE subscales as well as relationships within the BDEFS-SF variable subscales. From the ICSRLE scales, General Social Mistreatment demonstrated a very strong relationship with Friendship Problems and a strong relationship with Assorted Annoyances. Developmental Challenge was strongly related to Academic Alienation, and Assorted Annoyances.

Among the BDEFS-SF variables, Self-Motivation deficits—indicated by problems with work quality, laziness, and taking the initiative, demonstrated high correlations with: Self-Management to Time deficits—indicated by problems with procrastination, concentration, advance preparation, and follow-through; Self-Organization/Problem Solving deficits—indicated by struggles with learning new activities, explaining things in proper order, “thinking on my feet” and processing information quickly; and Self-Restraint deficits—indicated by the lack of inhibition and the practice of not thinking things through before acting. Self-Regulation of Emotions deficits—indicated by having trouble with calming oneself down, emotional control, positive focus, and overcoming being upset, also demonstrated a strong positive relationship with the other 4 executive function deficit subscales. In fact, all executive function variables demonstrated moderate to strong positive relationships between themselves with correlation coefficients of .48 or higher. It appears that deficits in all executive function subscales are interrelated.

The second primary research question was, “Which of these correlated stressors is most predictive of executive function deficit levels?” Though multiple predictor variables (i.e., stressors) were correlated with executive function scores, three variables best explained the variance: (1) Academic Alienation, (2) General Social Mistreatment (3) Developmental Challenge. Higher scores in these areas predicted higher overall executive function deficits. The
more one experiences difficulty with any of these three predictors the more likely that person will experience deficiencies in executive function as defined by Barkley (2011) to be “Self-regulation across time for the attainment of future goals, typically in social contexts” (p. 13).

The final primary research question was, “Which type of stress is most predictive to specific subscales of executive function deficits?” A high level of Developmental Challenge, demonstrated a predictive relationship with two executive function deficit subscales: Self-Organization/Problem Solving and Self-Motivation. Self-Organization/Problem Solving applies to struggles with: learning new things, processing information quickly, or “thinking on one’s feet.” Self-Motivation deficiencies are demonstrated by laziness or lack of initiative (Barkley, 2011).

Like Developmental Challenge, Academic Alienation also demonstrated a predictive relationship with Self-Organization/Problem Solving and Self-Motivation in college students. Academic Alienation also predicted struggles with Self-Restraint. Self-Restraint is demonstrated by lack of inhibition and the lack of thinking things through (Barkley, 2011).

Time Pressure ($M = 65.11$) was shown to be the most prevalent stressor experienced by this sample. Yet it was not related significantly to executive function deficits ($p = .28$). What this score may indicate is that while a subscale may show a high raw score, what determines the effect on the dependent variable is more related to how that stressor is interpreted by an individual. It is conjectured that experiencing a struggle with getting things done or finding time to rest may be perceived by the college student as temporary and not something to cause chronic anxiety or stress. Whereas, feeling inadequate (i.e., Developmental Challenge) or being dissatisfied with school (i.e., Academic Alienation) or feeling lonely or isolated (i.e., General Social Mistreatment) may be interpreted as more permanent, and thereby more affective.
There are a number of factors that can impair the level of executive functioning in traditional undergraduate college students (18-23 years old). The literature review in this study examined two of the factors—an immature neurodevelopmental system and intense chronic stress. In the area of neurodevelopmental studies, Baird and Fugelsang (2004), Geidd (2004), Ernst and colleagues (2005), Steinberg (2010), and Selemon (2013) reported that the development of the prefrontal cortex, home of executive functioning and its moderating connections with the ventral striatum--reward center of the brain and the amygdala—region of emotions and protection, do not reach an adult structural level until approximately twenty-five years old. Therefore the consistent use of executive function in many college students is naturally impaired due to brain structure. While this information has added a piece of background important to this study, it has not been the major focus of this study.

The primary focus of this study has been on stress that is deemed chronic, or long lasting. This type of stress can send a damaging oversupply of cortisol to the prefrontal cortex. Since chronic stress is experienced by many college students, and chronic stress is correlated with executive function deficits, many students experience high levels of executive function impairment.

This study was an examination of the correlates of stress and executive function through secondary and primary research. With the completion of this study, the information and results were examined and analyzed. Following the analysis, intervention and application was determined. Based on the correlation studies and regression studies discussed in this project, 3 stressful life experiences were discovered to be strongly related to executive function deficit levels: Academic Alienation, General Social Mistreatment, and Developmental Challenge.
Limitations

While Developmental Challenge, Academic Alienation, and Social Mistreatment had predictive relationships with Executive Function, causality cannot be confirmed with correlational analysis. Though these three stressors have the strongest relationships to executive functioning deficits, in order to determine causality, a study using longitudinal data in an experimental design would need to be employed.

A second limitation of the study is seen in the gender sample size. The sample size as a whole, was large enough to provide sufficient power to detect possible effects, but not specific gender effects. When the results of the female participants were eliminated, only results from 18 male students were left. The participants of the sample used in the study were from the Education and Nursing departments of the university. Traditionally there are a far greater number of female students in both of those courses of study. This inequity was reflected in the gender of the participants in this study. The small male sample was not large enough to give one adequate power to generalize results showing correlations and predictors for the male population. As stated before, adequate sample size for a multiple regression study should be approximately 15 participants per predictor, a minimum of about 105 in this situation (Osbourne, 2008). A sample consisting of 18 male participants is inadequate to make a strong prediction for the male college population when seven independent variables are involved.

A third limitation with the study is seen in its deficit model design. High scores for both surveys meant negative results such as harmful stress levels or impaired levels of executive function. A great deal of stress was correlated with a great level of executive function deficiency. A better survey model would be one that focused on strengths and areas for
development. Adapting the Likert scale numbers in both instruments by using reverse coding would refocus the results toward strengths and positive results.

Another limitation is seen in the nature of executive functioning and life stressors. When doing such a study, one must ask, “Which influences which? Do executive function levels influence stress effects or do stress levels affect executive functioning levels? Do people with lower executive function skills have more difficulty handling stress? Is it the executive function skills that influence reaction to stressors and not vice versa? Can a person handle stress better if their executive function skills are higher?” As was pointed out during this study, higher executive function levels can decrease the level of stress one feels.

A final limitation was seen in one of the instruments itself. ICSRLE only measures seven stressful life experiences. The ICSRLE does not measure stress because of illness or financial issues. Both of these can be stress experienced by college students. It would be helpful to find or develop an instrument that measured more than the stressors referred to by the ICSRLE.

**Recommendations**

The second aim of this study is to answer the question, “*What can be done to help college students manage the stress faced by many?*” After determining the predictor stresses, the secondary purpose of this research was to suggest interventions to decrease stress and thereby enhance executive function in college students. Specific interventions that have been shown to reduce general stress and specific types of stress most correlated with executive function deficits in college students are discussed here. A number of studies were discussed in Chapter II relating to stress management through: meditation, educational techniques, learning theory, psycho-educational interventions, healthy lifestyle, coping strategies, and online programs. The conclusions drawn could be used by campus counseling centers, university administrators, and
professors to provide guidance, formulate intervention, and develop learning environments conducive to reducing chronic stress and increasing executive function skills in college students during these most critical years of decision making. The following are some of the recommended interventions.

**Increasing Executive Functioning Levels**

Stress effects can be relieved through increasing executive function levels. One can improve executive functioning skills through learning--*social cognitive learning*, acquired through observation of others, and *experiential learning* acquired through experience. These provide the individual with the cognitive nourishment and intellectual stimulation necessary for further development of executive function. A number of studies have championed interventions that were aimed directly at increasing executive function skills. Tang’s studies (2012) indicated that mindfulness training actually increased the level of executive function in students and the activity in the prefrontal cortex. Mindfulness involves becoming aware of one’s thoughts without judging them. In another study focusing on executive functioning in general, Staiano and colleagues (2012) demonstrated the positive effects on executive function when students regularly used a *Nintendo Wii EA Sports Active* exercise video game for competitive exercising.

A number of other studies have shown strong executive functions are associated with high resilience to both stress exposure and to the negative effects of stress. Poor executive functioning is related to more vulnerability to stress exposure. In the study previously mentioned by Williams, Suchy, and Rau, (2009), levels of executive functioning had a moderating effect on stress processes such as exposure, reactivity, recovery, and restoration, thereby decreasing one’s level of stress.
Decreasing Stress In General

Another direction one can go to relieve stress is to use an intervention designed to specifically decrease stress. The following interventions are aimed at directly diminishing the effects of stress.

Oman and his associates (2008) discovered that training students in mindfulness while using meditation by incorporating assigned readings and/or body awareness decreased stress. The mindfulness training consisted of 90 minute meetings once per week to learn and practice meditation behaviors for 8 weeks.

The study conducted by Chiauzzi and colleagues (2008), indicated an online program called, MyStudentBody—Stress (https://www.mystudentbody.com/), a website developed by Chiauzzi and colleagues was helpful in reducing stress in college students. MyStudentBody—Stress provides individual, tailored feedback, interactive relaxation tools, and information on their stress levels with intervention ideas that explained stress reduction techniques that most applied to their situation. Effective use of this tool required the student to visit the online site at least four times over a two week period, for a minimum of 20 minutes per visit for a six month period.

Winterdyk and his colleagues (2008) discovered a number of interventions, taught to college students, helped to relieve the students’ stress. Their interventions consisted of training a group of students in the areas of nutritional education, teachings in relaxation techniques, exercise and strength training, or cognitive behavioral approaches in weekly, one hour sessions for six weeks. The students were then encouraged to practice what they learned in session, 2-3 times during the intervening week.
**Handling Specific Stressors**

**Handling Academic Alienation stress.** One of the techniques discovered to relieve stress in the area of Academic Alienation involved Diaphragmatic/Deep Breathing. This is an exercise that involves concentrating on systematic deep breathing for a short period of time. This type of breathing increases oxygen flow to all systems of one’s body, and thereby decreases stress (Kottler, 2012; Romano, 1992). For example, Paul, Elam, and Verhust (2007) discovered in their study that the training in the area of stress and deep breathing began the process of providing academic stress. Following the initial training, five minutes of guided deep breathing was practiced at the start of two classes for an entire school year (95 times). This process reduced stress the area of academics significantly.

**Handling General Social Mistreatment stress.** The study conducted by Mattanah, Brooks, Brand, Quimbly, and Ayers (2012) outlines the positive effects of small social support groups on college students. In this study it was discovered that dividing college students into small support groups of six to ten students in each group to discuss (a) creating new social ties; (b) balancing work, academics, and a social life; (c) peer pressure, values, and college life; (d) residential issues; (e) expectations versus realities of college life; and (f) examining old social ties. Students meeting in these groups experienced less social stress over time. These groups met weekly for 90 minutes each, for nine weeks, guided by facilitators, and were effective in reducing stress.

**Handling Developmental Challenge stress.** In an effort to decrease stress related to Developmental Challenge, a number of interventions were designed to increase self-efficacy and perceived competence. Self-efficacy is related to confidence and self-perception. In many ways self-efficacy speaks to Developmental Challenges as described by the items in ICSRLE (i.e.,
Dissatisfaction with ones abilities, appearance, and skills). Kadhiravin and Kumar (2012) conducted a study based on proactive stress training in the areas of: Information on Stress and Coping, Awareness of Maladaptive Coping Skills, Problem Solving Skills, Communication Skills, Perceived Competence, and Self-Efficacy. On completion of this program the participants indicated lower levels of stress, increased proactive behavior and an improved perception of self-efficacy. The training advocated by Kadhiravin and Kumar is a twenty-one day training program.

Lockwood and Wohl (2012) conducted a study using a fifteen week wellness course focused on self-efficacy. The course recommended, Lifetime Wellness, was a two credit class that consisted of meeting one hour per week for a lecture on a wellness subject (fitness, nutrition, cardiovascular disease, stress management, sexually transmitted diseases, substance abuse), regular exercise outside of the classroom, and other specific assigned activities. The textbook used was An Invitation to Wellness--Making Healthy Choices (Hales, 2007). Participation in this fifteen week program was shown to improve a college student’s self-perception and health.

**Conclusion**

This study has examined stress and its relationship to executive functioning. It has looked at studies in executive function and stress through the eyes of neuroscience and psychology. This study has also described a number of interventions designed to increase the level of executive function to mediate the deleterious effects of stress on the thought process of college students. Various successful stress reducing interventions have been successfully employed in multiple universities--wellness courses, mindfulness training, social support groups, proactive training, deep-breathing exercises, and online stress helps. As Paul and her colleagues (2007) alluded in their study, even though it is known that stress can impact the thought processes of
college students, very few schools provide students with a consistent opportunity to develop and regularly practice stress reduction techniques to aid them. This author contends that using any of the techniques described above may prove successful in alleviating the chronic stress that permeates the university community and is predictive of executive function deficits. Perhaps it would be wise for universities to re-examine their curriculum and include stress relieving interventions as part of their degree programs and student services.
References


Jurkovic, G. J., & Thirkfield, A. (1999). *Filial Responsibility Scale-Adult (FRS-A)*. Unpublished document, Department of Psychology, Georgia State University, Atlanta, GA.


Task Force of the National Advisory Council on Alcohol Abuse and Alcoholism (2002). A call to action: changing the culture of drinking at U.S. colleges, *National Institute on Alcohol Abuse and Alcoholism, Bethesda (MD)*.


Appendices
Appendix A
Deep Breathing Script
(As read in class during Paul, Elam, and Verhust study; 2007).

Feet flat on the floor, hands comfortably in your lap or on the desk, sitting up straight—allow yourself to be supported by your chair … and

Let your eyes drift slowly closed, top lid … touching the bottom lid, looking at the insides of your eyelids … …

And let your body be still except for your breathing

Going at your own pace … notice your inhale … … … & exhale … … … (time for 2+ cycles after giving directive)

With your next inhalation, pull your in-breath deep into your abdominal area … like filling up a balloon with air … …

Then …. exhale out … out …. out … until you can't exhale anymore (time for 2+ cycles)

Inhaling again, deep into your abdomen …not holding on with your belly muscles—there's no need to hold on with your body … … And on the exhalation, let your navel push back towards your spine on the exhale out …. out … … out

Deeply …. not forcing your breath, but not skimping on it either … continue at your own pace (time for 2+ cycles)

Notice how on the inhale, the air is slightly cool past the tip of your nose … And how on
the exhale … the air is now slightly warm past the tip of your nose (2+ cycles)

Notice how on the in-breath, your rib cage pulls apart … … then collapses on the exhale (time for 2+ cycles)

With your next inhalation/exhalation cycles, try counting your breath … so that

If you inhale for 1… 2… 3…, then exhale … for 1… 2… 3…

Your inhalations and exhalations might be shorter or longer, it doesn't matter …take the time now to try to match them (at least 5 complete cycles)

Bringing yourself back to the room … open your eyes … … and take this calm feeling with you for the day.”
Appendix B

Consent Form for Pilot Study, University of Cincinnati

Department: Educational Studies

Principal Investigator: Nicholas A. Tomeo, M.S. Ed., P.C.

Title of Study: “Stressor Affects on Executive Functioning in College Students”

Introduction:

You are being asked to take part in a pilot study. Please read this paper carefully and ask questions about anything that you do not understand.

Who is doing this research study?

The person in charge of this research study is Nicholas Tomeo of the University of Cincinnati (UC) Department of Educational Studies.

What is the purpose of this research study?

The purpose of this research study is to determine if there is a relationship between the types of life experiences of college students and cognitive skills. This will contribute to our understanding of adolescent/young adult development.

Who will be in this research study?

About 40 UC college students will take part in this pilot study.

What will you be asked to do in this research study, and how long will it take?

You will be asked to participate in filling two surveys that ask about your experiences and decision making skills.

These surveys will take about 20-30 minutes to complete.
Are there any risks to being in this research study?

It is not expected that you will be exposed to any risk by being in this study.

Are there any benefits from being in this research study?

Your participation in this study may help students involved in Educational Studies learn more about the connection between cognitive development and the environment.

What will you get because of being in this research study?

You will not be paid to take part in this study, but you will receive extra credit on your final exam for Middle Childhood and Adolescent Development.

Do you have choices about taking part in this research study?

If you do not want to take part in this research study you are free not to participate. There is an alternative extra credit you can do instead.

How will your research information be kept confidential?

No names will be used on the surveys.

The professor will leave the room as the surveys are taken.

All research data will be kept on a password-protected computer.

The research data will be destroyed at the end of the project.

Your response data will be deleted from computer files after 6 months of storage.

Should data from this research study be published, you will not be identified by name.

Agents of the University of Cincinnati may inspect study records for audit or quality assurance purposes.

What are your legal rights in this research study?

Nothing in this consent form waives any legal rights you may have. This consent form also does not release the investigator, the institution, or its agents from liability for negligence.
What if you have questions about this research study?

If you have any questions or concerns about this research study, you should contact Nicholas Tomeo at the University of Cincinnati, email tomeona@uc.edu or telephone 513-5244-8482.

Do you HAVE to take part in this research study?

No one has to be in this research study. Refusing to take part will NOT cause any penalty or loss of benefits that you would otherwise have. You may skip any questions that you don’t want to answer.

You may start and then change your mind and stop at any time. To stop being in the study, you should tell Nicholas Tomeo at the contacts listed above.

AGREEMENT:

I have read this information and have received answers to any questions I asked. I give my consent to participate in this research study.

Participant Name  ____________________________________________

Date ____________________________________________________________________
Appendix C

Inventory of College Students Recent Life Experiences (ICSRLE)

Following is a list of experiences which many students have some time or other. Please indicate for each experience how much it has been a part of your life over the past 6 months. A “1” will indicate that it was not at all part of your life over the past six months. A “2” will indicate that it was only slightly part of your life over that time. “3” will indicate that it was distinctly part of your life; and “4” will indicate the experience was very much part of your life.

*Intensity of Experience of Past 6 Months*

1 = not at all part of my life
2 = only slightly part of my life
3 = distinctly part of my life
4 = very much part of my life

<table>
<thead>
<tr>
<th>Experiences</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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</thead>
<tbody>
<tr>
<td>1. Conflicts with boyfriend’s/girlfriend’s/spouse’s family</td>
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<tr>
<td>2. Being let down or disappointed by friends</td>
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<td>3. Conflict with professor(s)</td>
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<td>4. Social rejection</td>
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<td>5. Too many things to do at once</td>
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<td>6. Being taken for granted</td>
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<td>7. Financial conflicts with family members</td>
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<td>8. Having your trust betrayed by a friend</td>
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<td>9. Separation from people you care about</td>
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<td>10. having your contributions overlooked</td>
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<td>11. Struggling to meet your own academic standards</td>
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<td>12. Being taken advantage of</td>
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<td>13. Not enough leisure time</td>
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<td>14.</td>
<td>Struggling to meet the academic standards of others</td>
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<td>15.</td>
<td>A lot of responsibilities</td>
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<td>16.</td>
<td>Dissatisfaction with school</td>
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<td>17.</td>
<td>Decisions about intimate relationship(s)</td>
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<td>18.</td>
<td>Not enough time to meet your obligations</td>
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<td>19.</td>
<td>Dissatisfaction with your mathematical ability</td>
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<td>20.</td>
<td>Important decisions about your future career</td>
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<td>21.</td>
<td>Financial burdens</td>
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<td>22.</td>
<td>Dissatisfaction with your reading ability</td>
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<td>23.</td>
<td>Important decisions about your education</td>
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<td>24.</td>
<td>Loneliness</td>
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<td>25.</td>
<td>lower grades than you hoped for</td>
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<td>26.</td>
<td>Conflict with teaching assistant(s)</td>
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<td>27.</td>
<td>Not enough time for sleep</td>
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<td>28.</td>
<td>Conflicts with your family</td>
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<td>29.</td>
<td>Heavy demands from extracurricular activities</td>
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<td>30.</td>
<td>Finding courses too demanding</td>
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<td>31.</td>
<td>Conflicts with friends</td>
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<td>32.</td>
<td>Hard effort to get ahead</td>
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<td>33.</td>
<td>Poor health of a friend</td>
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<td>34.</td>
<td>Disliking your studies</td>
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<td>35.</td>
<td>Getting “ripped off” or cheated in the purchase of services</td>
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<td>36.</td>
<td>Social conflicts over smoking</td>
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<td>37. Difficulties with transportation</td>
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<td>38. Disliking fellow student(s)</td>
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<td>39. Conflicts with boyfriend/girlfriend/spouse</td>
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<td>40. Dissatisfaction with your ability at written expression</td>
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<td>41. Interruptions of your school work</td>
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<td>42. Social isolation</td>
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<td>43. Long waits to get service (e.g., at banks, stores, etc.)</td>
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<td>44. Being ignored</td>
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<td>45. Dissatisfaction with your physical appearance</td>
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<td>46. Finding course(s) uninteresting</td>
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<td>47. Gossip concerning someone you care about</td>
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<td>48. Failing to get expected job</td>
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<td>49. Dissatisfaction with your athletic skills</td>
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Appendix D

Barkley Deficits in Executive Functioning Scale-Short Form-Inventory
Russell A Barkley (2011)

*How often have you experienced each of these problems over the past 6 months? Please indicate numerically: 1 = Never or rarely, 2 = Sometimes, 3 = Often, 4 = Very often*

_____1. Procrastinate or put off things until the last minute

_____2. Can’t seem to hold in mind things I need to remember to do

_____3. Not motivated to prepare in advance for things I know I am supposed to do

_____4. Have trouble doing what I tell myself to do

_____5. Have trouble learning new or complex activities as well as others

_____6. Have difficulty explaining things in their proper order or sequence

_____7. Unable to “think on my feet” or respond as effectively as others to unexpected events

_____8. I don’t seem to process information as quickly or as accurately as others

_____9. Unable to inhibit my reactions or responses to events or others

_____10. Make impulsive comments to others

_____11. Likely to do things without considering the consequences for doing them

_____12. Fail to consider past relevant events or past personal experiences before responding to situations (I act without thinking)

_____13. Do not put as much effort into my work as I should or than others are able to do

_____14. Others tell me I am lazy or unmotivated

_____15. Inconsistent in the quality or quantity of my work performance

_____16. Unable to work as well as others without supervision or frequent instruction

_____17. Have trouble calming myself down once I am emotionally upset
18. Cannot seem to regain emotional control and become more reasonable once I am emotional

19. Cannot seem to distract myself away from whatever is upsetting me to help calm me down. I can’t refocus my mind to a more positive framework

20. I remain emotional or upset longer than others

Total score ________________________
Appendix E

Adult Consent Form for Research Study (Online)

University of Cincinnati

Department: Educational Studies

Principal Investigator: Nicholas A. Tomeo, M.S. Ed., P.C.

Faculty Advisor: Rhonda Brown, Ph.D.

Title of Study: Correlating Executive Function Levels and Life Experiences in College Students (EFLE)

Introduction:

You are being asked to take part in a research study. Please read this paper carefully and ask questions about anything that you do not understand.

Who is doing this research study?

The person in charge of this research study is Nicholas Tomeo of the University of Cincinnati (UC) Department of Educational Studies. He is being guided in this research by Rhonda Brown, Ph.D.

What is the purpose of this research study?

The purpose of this research study is to determine if there is a relationship between the types of life experiences of college students and cognitive skills. This will contribute to our understanding of adolescent/young adult development.
Who will be in this research study?

About 120 UC college students in the Research Activity Management System (RAMS) will be asked to take part in this study.

What will you be asked to do in this research study, and how long will it take?

- You will be asked to participate in filling two surveys that ask about your experiences and decision making skills.
- Both surveys will take about 25 minutes total, to complete.

Are there any risks to being in this research study?

- It is not expected that you will be exposed to any risk by being in this research study.

Are there any benefits from being in this research study?

- Your participation in this study may help students involved in Educational Studies learn more about the connection between cognitive development and the environment.

What will you get because of being in this research study?

- You will not be paid to take part in this study, but you will receive credit towards your course requirements for research participation.

Do you have choices about taking part in this research study?

- If you do not want to take part in this research study you are free not to participate.

How will your research information be kept confidential?

- Information about you will be kept private by using an ID code to link your responses on both surveys.
- ID numbers will be used on all forms rather than names.
- The master list will be kept locked in the researcher’s office.
- All research data will be kept on a password-protected computer.
- The research data and ID codes will be destroyed at the end of the project.
- Your response data will be deleted from computer files after 6 months of storage.
- Should data from this research study be published, you will not be identified by name.
Agents of the University of Cincinnati may inspect study records for audit or quality assurance purposes.
The researcher cannot promise that information sent by the internet or email will be private. However, the University of Cincinnati has many levels of security to their computer system.

What are your legal rights in this research study?

Nothing in this consent form waives any legal rights you may have. This consent form also does not release the investigator, the institution, or its agents from liability for negligence.

What if you have questions about this research study?

If you have any questions or concerns about this research study, you should contact Nicholas Tomeo at the University of Cincinnati, email tomeona@mail.uc.edu or telephone 513-558-3132. Or you may contact my advisor, Dr. Brown, at brownro@ucmail.uc.edu.

The UC Institutional Review Board reviews all research projects that involve human participants to be sure the rights and welfare of participants are protected.

If you have questions about your rights as a participant or complaints about the study, you may contact the UC IRB at (513) 558-5259. Or, you may call the UC Research Compliance Hotline at (800) 889-1547, or write to the IRB, 300 University Hall, ML 0567, 51 Goodman Drive, Cincinnati, OH 45221-0567, or email the IRB office at irb@ucmail.uc.edu.

Do you HAVE to take part in this research study?

No one has to be in this research study. Refusing to take part will NOT cause any penalty or loss of benefits that you would otherwise have. You may skip any questions that you don’t want to answer.
You may start and then change your mind and stop at any time. To stop being in the study, you should tell Nicholas Tomeo at the contacts listed above.

AGREEMENT:

I have read this information and have received answers to any questions I asked. I give my consent to participate in this research study.

Consent:

Print this page if you would like a copy for your records. By selecting “I agree” and providing your name below, you confirm that you have read the above information and give your consent to participate in this research study.

- [ ] I Agree
- [ ] I Disagree (please exit the survey)

- Please provide your name below to confirm your consent. Your name will be separated from the rest of your survey, to maintain confidentiality.
- [ ]