Sleep Hygiene Practices and Exercise as Mediators (Effects of Stress and Self Care Practices on Academic Engagement in Undergraduate Students) of the Relationship between Stressful Life Events and Academic Engagement in Undergraduate Students

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Abstract

**CHAPTER 1**

**Introduction**

**Academic Engagement**

Academic engagement is a broad concept including aspects of behavior and both intrinsic and extrinsic characteristics that lend themselves to learning and academic success. There have been a variety of ways in which the research on student engagement has focused and defined academic engagement, identifying relevant factors such as motivation, participation, instructor relationships, achievement, challenging curriculum, and study skills (Chapman, 2003; Zepke & Leach, 2010; Handelsman et al., 2005; *NSSE, 2000,* Skinner & Belmont, 1993). Marks (2000) “conceptualizes engagement as a psychological process, specifically, the attention, interest, investment, and effort students expend in the work of learning. Defined in this way, engagement implies both affective and behavioral participation in the learning experience” (pg. 154-155). Further, Skinner and Belmont (1993) describe how student engagement appears in classroom settings as follows:

Children who are engaged show sustained behavioral involvement in learning activities accompanied by a positive emotional tone. They select tasks at the border of their competencies, initiate action when given the opportunity, and exert intense effort and concentration in the implementation of learning tasks; they show generally positive emotions during ongoing action, including enthusiasm, optimism, curiosity, and interest. The opposite of engagement is disaffection. Disaffected children are passive, do not try hard, and give up easily in the face of challenges [they can] be bored, depressed, anxious, or even angry about their presence in the classroom; they can be withdrawn from learning opportunities or even rebellious towards teachers and classmates (p. 572).

Mention Bonfrenbrenner research (1979) and Steinberg (1996), both referenced in Marks (2000)

A systematic literature review by Zepke and Leach (2010) involved evaluating 93 studies from 10 different countries. Study results identified four perspectives on school engagement that include: Motivation and agency (engaged students are intrinsically motivated and want to exercise their agency), Transactional engagement (students and teachers engage with each other), Institutional support (institutions provide an environment conducive to learning), and Active citizenship (students and institutions work together to enable challenges to social beliefs and practices). Results from this investigation highlight the potential utility of addressing academic engagement from both the macro (institutionally based) and micro (student focused) level. In other words, XXXXX.

To date, various studies have approached school engagement from the macro level, looking at how institutional practices can impact the likelihood of a student to engage and succeed in the academic environment (Froh & Hawkes, 1996; Skinner & Belmont, 1993). For example, Skinner and Belmont examined a more transactional form of engagement with their evaluation of the impact of teacher/student relations on academic engagement. In this study, such relationships were found to predict student engagement. Moreover, the researchers discussed how teacher relations and behaviors influence student motivation, which suggest that XXXXX.

Studies have also evaluated academic engagement from a more intrinsic perspective, often focusing on singular aspects of an individual such as their motivation, attention, participation, and study skills. Unlike previous studies focusing on motivation as a defining characteristic of academic engagement at the college level, Handelsman et al. (2005) approached engagement as a more multi-faceted concept while developing a measure on student course engagement. Handelsman et al. (2005) chose to look at the “micro” level of a student’s engagement rather than evaluate engagement from the “macro” level, which has been addressed by previous research looking at engagement from the perspective of the institution to determine effective programs to enhance engagement in their students (Froh & Hawkes, 1996; NSSE, 2000). Study results in this regard identified four distinct factors of college student engagement: Factor 1 – “skills engagement”, Factor 2 – “emotional engagement”, Factor 3 – “participation/interaction engagement”, and Factor 4 – “performance engagement.” In light of these findings, The Student Course Engagement Questionnaire (SCEQ; Authors (s)), is based on a four-factor pattern: Factor 1 includes study skills, effort, work completion, attendance, and taking and reviewing notes; Factor 2 includes emotional aspects such as desiring to learn and finding ways to make a course interesting or relevant to their lives; Factor 3 includes participatory aspects such as participating in discussions, asking questions, and seeking help when necessary; and finally, Factor 4 includes performance on tests, grades, and confidence about abilities in the specific course.

Academic engagement matters in that research has shown that it is related to successful academic outcomes (Finn & Rock, 1997). Marks (2000) highlights this notion with the following statement: “engagement is an important facet of students' school experience because of its logical relationship to achievement and to optimal human development” (pg. 155). In fact, the very definition of academic engagement is conceptually similar to such outcome measures. As an example, the “Performance Factor” as proposed by Handelsman et al. (2005), which includes grades and performance on tests, is included as a measure of engagement. As such, academic engagement is often evaluated in the literature as a component of its parts, with academic achievement a common area of focus. Finn & Rock (1997) identified this link in a study that involved evaluating graduation rates and levels of academic achievement in a sample of 1,803 minority students. Study results indicate that students with the most successful scholastic outcomes were the most likely to show the highest level of school engagement behaviors.

Disengagement at the college level can lead to failing grades, higher dropout rates, and feeling disenfranchised. Therefore, to optimize performance among college students, it is important to evaluate the variables that impact academic engagement and the mechanisms involved. As suggested by Handelsman et al. (2005), we took the approach of evaluating students on the “micro” level, believing that this approach affords more opportunities for interventions and allows for the evaluation of the potential impact of stress, a variable commonly linked to poor academic outcomes and affect.

College students are inundated with potential stressors, from managing the responsibilities of new-found independence to navigating the intricacies of finding success in a rigorous academic setting. To achieve academic success, it is important for students to be actively engaged in school. Stress, however, has been implicated in reducing school engagement (Lloyd, 1980). For example, a study by XXXXX found XXXX.

Stress, as measured through the number of stressful life events recently experienced, has been found to directly impact academic performance as well as influence other aspects of academic engagement. For example, mood, life satisfaction, attention, and executive functioning have all been found to be negatively affected by high levels of stress. In a study by Minkel et al. (2012), individuals experiencing a night of total sleep deprivation showed less ability to manage stress and showed pronounced levels of anger and anxiety in response to low levels of stress. In another study evaluating the impact of stress, undergraduate students who participated in the most vigorous exercise displayed levels of lower perceived stress (VanKim & Nelson, 2013). Such findings suggest that important mediators exist that influence academic engagement in university students.

Sleep is essential for the consolidation of memory, learning, decision making, alertness, mood, and cognitive performance (Banks & Dinges, 2007; Pilcher & Walters, 1997). Deficits in sleep have been shown to negatively impact academic performance (Gomes et al. 2011; Gilbert & Weaver, 2010). Specifically, sleep quality and duration are correlated with lower academic achievement and course grades in college students (Pilcher, Ginter, & Sadowsky, 1997). It is also important to note that college students do not have good insight into the impact of sleep loss on their cognitive functioning, believing their abilities and functioning to be much higher than those students with adequate sleep levels (Pilcher & Walters, 1997).

Fortunately, good sleep hygiene has been shown to impact sleep quality **(**Brown et al., 2002; Cho et al., 2013**)**. Positive sleep hygiene practices such as keeping a regular sleep/wake schedule, maximizing conditions that are conducive to sleeping, and avoiding the consumption of alcohol and caffeine before bed are associated with improved sleep and consequently with improved performance in activities impacted by sleep (e.g. executive functioning including working memory tasks, reading and math performance, physical conditioning, and emotional regulation).

Similar to sleep, exercise has been shown to positively impact a myriad of life’s functions including mood, mental health, telomere length, cognitive functioning, attention, cardiovascular health, stress levels, academic achievement, and self-esteem (Dunn et al. 2001; Fedeway & Ahn, 2011; Galper et al. 2006; Manger & Motta, 2005; Puterman et al. 2010; Shephard, 1996; Spence et al. 2005; VanKim & Nelson, 2013). One study on the benefits of exercise by Manger and Motta (2005) even found that exercise can help attenuate symptoms of Post-traumatic Stress Disorder (PTSD) as well as anxiety and depression.

Sleep and exercise have been shown to mitigate some of the influences of stress on one’s wellbeing. Specifically, sleep is a restorative process that also reduces stress levels and increases attention, focus, memory, and mood (CITE). In light of this, sleep also can likely influence academic engagement. Consistent with the definition of academic engagement delineated above, aspects of self-care may be essential to the healthy implementation of academic engagement. More specifically, areas of academic engagement directly influenced by self-care practices are proposed to have a greater mediating effect of sleep and exercise on the relationship between stress and academic engagement. For instance, skills engagement, a factor of academic engagement that relates to completing work, paying attention in class, studying, taking notes, and being organized XXXXXX. These areas comprise many aspects of executive functioning which have been shown to be directly impacted by sleep quality and exercise (Fedewa & Ahn, 2011; Sadeh et al., 2003; Turner, Drummond, Salamat, & Brown, 2007). Consequently, sleep hygiene practices focused on optimizing sleep quantity and quality should, in turn, influence the improvement of executive functioning in the classroom. Although self-care practices including good sleep hygiene and physical activity have also been shown to promote mood (Manger & Motta, 2005; Pilcher et al.; 1997), the emotional factor of academic engagement revolves more around the concepts of applying course content to your life and finding ways to make it personally interesting. As such, the impact on mood may influence engagement indirectly because improvements in mood may increase the desire to learn and apply concepts outside of the classroom. Additionally, such improvements in mood might also improve other areas of engagement, including increasing participation in the classroom, improving confidence in one’s performance, and showing effective study skills.

Finally, exercise has been postulated to increase arousal in students. Therefore, because of heightened alertness associated with physical activity, the participatory factor (e.g. participating in discussions, asking questions) of engagement also may benefit. The current study proposes the following research questions and hypotheses:

**Specific Aim 1: To document the effects of stressful life events on academic engagement in undergraduate students.**

*We hypothesize that increased levels of life stressors will be associated with lower levels of academic engagement. We believe that academic engagement will be lower in undergraduate students who experience a greater number of stressful life events.*

**Specific Aim 2: To document the relationship between sleep hygiene and academic engagement in undergraduate students.**

*We hypothesize that as sleep hygiene is impaired so will academic engagement in undergraduate students. We postulate that academic engagement will be lower in undergraduate students who experience reduced levels of healthy sleep hygiene practices.*

**Specific Aim 3: To determine if sleep hygiene mediates the relationship between stressful life events and academic engagement.**

*We hypothesize that students with higher levels of stressful life events will experience lower academic engagement if they show poor sleep hygiene practices. We believe that there will be an interaction effect, with sleep hygiene practices acting as a mediator of the relationship between stressful live events and academic engagement in undergraduate students.*

*Additionally, it is hypothesized that sleep hygiene practices will show the greatest mediating effect on the academic engagement factor of skills engagement due to the research indicating strong associations between sleep quality and executive functioning.*

**Specific Aim 4: To document the effects of physical activity on academic engagement in undergraduate students.**

*We hypothesize that increased levels of exercise (based on number of days per week) for strenuous exercise will be associated with lower levels of Academic Engagement; most specifically for the participation factor. We believe that more moderate and mild forms of exercise will not show the same effect.*

**Specific Aim 5: To determine if exercise mediates/moderates the relationship between stressful life events and academic engagement.**

*We hypothesize that students with higher levels of stressful life events will experience lower academic engagement, specifically in the area of participation, if they show inadequate levels of physical activity. Due to the fact that the positive impacts of exercise seemed to be based on a dosage-threshold, we postulate that this effect will only be seen for elevated levels of strenuous activity.*

**Specific Aim 6: To provide a predictive model of the effects of self-care practices, including both sleep hygiene and exercise, on the relationship between stressful life events and academic engagement.**

*Since self-care practices have been shown to improve various elements of engagement, we believe that the combination of these variables will result in an interaction effect, showing an even greater association with academic engagement.*

Need to discuss this with Sulkowski.

**CHAPTER 2**

**REVIEW OF RELEVANT LITERATURE**

This chapter provides an overview of stress, sleep, and exercise and the research relating these variables to multiple facets of academic engagement. Associated prevalence, , and assessment measures are discussed.

**Stress/Stressful Life Events (SLEs)**

Research has shown that stress as measured through Stressful Life Events (SLE) shows a significant impact on the likelihood of externalizing behaviors, internalizing behaviors, psychopathology and poor mental health, binge eating, lowered life satisfaction or feelings of well-being, delinquent behaviors, negative affect, heightened distress, and poor academic performance (Ash & Huebner, 2001; Cameron et al., 2010; Furniss et al., 2009; Kim et al. 2003; Lloyd et al., 1980; McCullough et al. 2002; McKnight et al. 2003; Suldo & Huebner, 2004; Sulkowski et al., 2011). Using a 6 year longitudinal study design looking at adolescents, Kim et al. (2003) found that SLEs predict not only internalizing behaviors such as anxiety and depression, but also externalizing, delinquent behaviors, as well.

When looking at the myriad impacts of SLEs, various factors have been addressed that have either a direct or indirect impact on academic engagement (AE), including life satisfaction (McKnight et al. 2003 and Suldo & Huebner, 2004), locus-of-control (Ash et al.), and anxiety and time management (Misra & McKean, 2000). Additionally, stress is being seen as a growing concern at the college level as schools see an influx of students seeking mental health resources through university clinics due to issues with stress, and resulting anxiety and depression (Cite the Monitor magazine). These mental health concerns are impacting academic engagement, and, subsequently, retention rates and student success. Stress not only increases the likelihood of mental illness, it impacts the likelihood of resulting behavior problems.

Suldo & Huebner (2004) found that life satisfaction mediated the relationship between stressful life events and psychopathology. They posited that life satisfaction can influence the relationship between stress and the development of behavior problems by acting as a protective factor, reducing the likelihood of these behaviors to develop. In a study evaluating the effects of stressful life events on mental health in a group of young students, Furniss et al. (2009) administered stress and psychiatric symptoms questionnaires to the parents of 1,887 German preschool students with results reflecting a highly significant relationship between the number of stress events and the number of mental health problems in those children.A full evaluation of the overarching impacts of stress is beyond the scope of this research, but the specific impact of stress on students’ functioning is salient to their academic engagement and achievement.

**Stress & Academic Engagement**

As academic engagement is a multifaceted concept, the impact of stress on AE has been evaluated in different ways across studies. Some of the factors investigated have been related to academic performance as a whole, while others have looked more specifically at impacts on mood*,* executive functioning*,* memory, and mental health. Lloyd et al. (1980) looked at life events and found them to be predictive of academic performance in a negative relationship, as stress events increased performance worsened. Interestingly, they identified a threshold (12 items) at which life events began to show detrimental impacts. In a more recent example of the impact of stress on academic performance measures, Vaez & Laflamme (2008) found that some aspects of stress were associated with lower graduation rates. Even early life stress has shown long-term effects on memory, emotional regulation, executive functioning, and cognitive performance (Pechtel & Pizzagalli, 2011).

Research has also shown that stress has a detrimental impact on symptoms of depression (Legget et al., 2016). Legget, Burgard, and Zivin addressed the association between stressful life events and depression, identifying a significant correlation between the two. In efforts to elucidate the mechanism of that relationship, sleep was evaluated as a moderator. Results indicated an interaction effect, whereby sleep influenced the likelihood of depressive symptoms by moderating the impact of stress events. Quality sleep led to less risk for depressive symptoms when stressful life events were elevated. As Legget et al. explained, “Sleeping restfully may allow individuals the rejuvenation needed to manage stress adaptively and reduce depressive symptom burden. Further, this association shows that stressors and risk factors may not always act independently of one another, and intervening on one risk factor, such as sleep disturbance, may have a positive impact on the entire pathway of biopsychosocial risk to depressive symptoms.” Also related to the effects of stress on mental health, stressful life events have been found to predict psychological well-being above and beyond other factors such as global self-concept (McCullough et al., 2000).

McKnight et al. 2003, looked at how SLEs impact a student’s internalizing and externalizing behavior. More specifically, they examined the potential moderating and mediating effects of life satisfaction on this relationship. Their findings indicated several associations with increased SLEs, including a decrease in life satisfaction, an increase in both externalizing and internalizing negative behaviors, and a mediating effect of life satisfaction on maladaptive behaviors. Although a significant mediator, life satisfaction was not found to be a moderator in that relationship.

Such an outcome is expected based on the notion

that when an individual has an overall positive (vs. negative) outlook on her life, which is at least

moderately stable, he or she is less likely to adapt to SLEs in maladaptive ways such as through

internalizing or externalizing behaviors. In other words, we predicted that the relationship between

SLEs, and behavior problems would be smaller for students with high life satisfaction than for

those students with low life satisfaction.

**Stressful Life Events: Acute vs Chronic**

Stress is a multifaceted concept including aspects of both acute and chronic adversity. In looking at how life satisfaction varies based on accumulated SLEs, Ash & Huebner (2001) isolated negative life events from chronic stressors in order to determine their differential impact. They found that the inclusion of both significantly improved predictability. In a similar vein, McCullough et al. (2002) found that negative daily events contributed more variance to participant affect than the contribution of major life events. In research looking at a clinical population of cancer patients, Willard et al. (2016) reported similar findings. Regardless of cancer status, they found that cumulative events, including those that do not meet diagnostic criteria as traumatic events but are more of the everyday school problems and family issues variety, were significantly correlated with psychological functioning, and when teased apart other stressful events showed a greater association with psychological distress than those classified as “Potentially Traumatic Events.”

Crandall et al. (1992) found in their development of The Undergraduate Stress Questionnaire (USQ) that daily hassles resulted in a similar level of perceived stress as major life events. Consequently, they argued that weighted scales were not necessary in the measure of overall stress, since their research indicated that both types of stressors contributed in a similar manner to the overall stress score. They posited that it is more essential to utilize questionnaires that include items that are salient to the subjects whose stress levels are being evaluated. For instance, a measure used with undergraduate students should contain items pertaining to college life and the school environment to accurately depict the potential overall stress of these individuals. The importance of this was underscored by the fact that in their research the subjects were more likely to endorse items related to their university experience than the other stressors on the measure.

In looking at the variables that potentially impact academic performance in first-year undergraduates, Trockel et al. (2000) found that above other variables considered, including perceived stress, mood, exercise, eating, and sleep habits, among others, sleep habits showed the greatest association with student’s grade point averages. Additionally, they found an association between higher GPAs and strength training in these students. Findings of this sort and those of Legget et al. (2016), highlight the need to look closely at the impacting mechanisms, or potentially mediating variables, in the relationship between stress and academic engagement.

**Sleep**

Sleep is essential to a variety of life’s activities. Sleep deprivation has been found to impair multiple tasks in the realms of motor performance, cognitive performance, and even mood (Pilcher & Huffcutt, 1996; Pilcher & Walters, 1997). Some of the areas of cognitive functioning that have been shown to be impacted by sleep disturbances include: working memory, attention, perseveration, cognitive flexibility/inflexibility, creative thinking, decision making, and long-term memory (Alhola & Polo-Kantola, 2007; Harrison & Horne, 1998; Horne, 1988; Redline et al., 2007). In Pilcher and Huffcut’s (1996) meta-analysis of 56 studies examining the impact of sleep loss on performance in adults, they found that cognitive abilities were more impaired than motor abilities. Interestingly, they found that a partial sleep deprivation versus long- or short-term deprivation had the most profound detrimental influence on cognitive performance tasks. This is significant in that the majority of students do not experience full sleep deprivation as measured by above or below 45 total hours of total deprivation. They are more likely to experience the partial deprivation of less than five hours of sleep in a 24-hour period. In this light, the findings of Pilcher and Huffcut’s meta-analysis have particular relevance to the functioning of undergraduate students.

**Sleep and Neurobehavioral and Cognitive Functioning**

Multiple studies have evaluated the impact of sleep on the behavioral and cognitive functioning of children and adolescents (Dahl, 1996; Lavigne et al. 1999; Randazzo, Muehlbach, Schweitzer, & Walsh, 1998; Sadeh, Gruber, & Raviv, 2003; Touchette et al., 2007). Reinforcing the findings of the meta-analysis discussed above, Sadeh et al. (2003) found that even subtle changes in sleep can affect neurobehavioral functioning in children (mean age = 10.6). In this study, sleep habits were either altered by an average of 41 minutes decreased sleep over three nights (restricted sleep group) or by an average 35 minutes increased sleep over the same time period (extended sleep group). Individuals with an increased sleep time showed a better performance on neuropsychological tasks that include skills such as processing speed, attention, memory, and scanning.

Likewise, in another study addressing the relationship between sleep duration and behavioral/cognitive functioning in young children, Touchette et al. (2007) found that a one hour reduction in nightly sleep was correlated with a decreased performance on a picture vocabulary test (a measure of receptive vocabulary and verbal intelligence) and the Block Design subtest of the Wechsler Intelligence Scale for Children – Third Edition (WISC-III) (a measure of visual/spatial skills and nonverbal intelligence). Their results show that decreased duration of sleep may influence language acquisition by impairing the integration of new words into memory. Similar findings by Randazzo et al. (1998) demonstrated in adolescents that restriction in just one night of sleep showed a decrease in executive function which they described as being involved in the “retrieval of knowledge from long-term memory” along with involvement in other functions (p. 866). In childreneven small sleep deficits have been found to impair working memory tasks (Sadeh, Gruber, & Raviv, 2003). Sadeh et al. (2003) documented increased memory performance in children with only a half hour sleep extension. Seventy-seven children in the fourth or sixth grade were evaluated using an actigraph watch (which measures motor activity and sleep-wake patterns in a child’s natural setting) and a sleep-wake diary (which documented self-reported assessments of daytime fatigue, perceived duration to fall asleep, etc.). The watch was worn by participants for five nights, two of which were meant to establish a baseline and three nights to evaluate the treatment conditions. In order to assess their neurobehavioral functioning, the children were given a series of six tests including three that involved working memory: symbol-digit substitution (where the child must identify a rearranged group of digits and symbols from a short presentation of a nine-figure sequence), visual digit span (where the child must recall a visually displayed sequence of numbers), and serial digit learning (where the child must recall verbally presented sequences of numbers). Neurobehavioral functioning was first assessed on the second morning to establish baseline and then again on the sixth morning (at the same time of day) after the treatment of either one hour sleep restriction or extension had been in effect for three nights. The study found that with just a 35-minute sleep extension children showed a significant improvement in memory related activities such as digit span forward as compared to children with no change in sleep duration or sleep restriction.

**Sleep and Academic Engagement/Achievement**

Sleep impairments have a profound influence on the functioning of students in various ways but possibly the most significant effect is in the academic setting. One aspect that is essential for success in the classroom, and is significantly impacted by insufficient sleep, is academic engagement. When transitioning to the college level, students acquire a new level of independence that often involves changes in responsibility and new requirements for more self-motivation and self-control. Students need to be responsible for their own learning, engagement, and outcomes. As a result, identifying ways to maximize academic engagement (AE) becomes essential to the support and success of college students.

Academic engagement is vital for academic learning and success, as it is comprised of variables essential to positive academic outcomes.A number of key variables that are impacted by stress and self-care practices, and that comprise the foundation for scholastic achievement, are found as part of the definition of AE (e.g. executive functioning such as attention, working memory, and organization; mood; grades).

Numerous studies have discussed the negative impact of impaired sleep on aspects related to achievement. Turner, Drummond, Salamat, and Brown (2007) reported that specifically the span of working memory is associated with total sleep deprivation. In another study, working memory scanning speed showed no learning improvement when the participant was sleep deprived, whereas performance improved over time when the subject got adequate sleep (Casement, Broussard, Mullington, & Press, 2006). Casement et al. found a 58% increase in learning for adults who had 8 hours of sleep a night as compared to those that only had 4 hours. Perhaps the most significant aspect of the findings in this study is that the lower sleep group did not show deficits when compared to their baseline. It was only over the course of days and in the context of progressive learning that there appeared to be a differential impact.

Sleep patterns and their relationship with academic performance have commonly been evaluated for children and adolescents. For example, several studies have found correlations between sleep behaviors and achievement (Dewald et al., 2010; Sadeh et al., 2003; Wolfson & Carskadon, 1998). Perfect and colleagues (2014) investigated the impact of sleep problems in children and adolescents and found that impaired sleep was predictive of lower reported grades and school problems. Based on a meta-analysis by Dewald et al. (2010) analyzing the impacts of sleep variables such as sleepiness, sleep quality, and sleep duration on cognitive functioning and academic performance in children and adolescents, it is clear that these influences are not necessarily the same across age groups and separate investigations are necessary to illuminate the specific impacts involved with older students. Accordingly, several researchers have focused on examining this relationship specifically in undergraduate students or across multiple age groups (Gilbert & Weaver, 2010; Gomes et al., 2011; Oginska & Pokorski, 2006; Pagel et al., 2010; Trockel et al. 2002).

In their research, Gilbert & Weaver (2010) postulated that sleep quality may be more salient than psychopathologies, such as depression, as a predictor of poor academic performance. They noted that few university psychologists are assessing sleep when working with college students, and “sleep quality is seldom a direct target of therapeutic interventions.” (pg. 298) Controlling for depression, Gilbert & Weaver evaluated the effects of sleep quality and sleep deprivation on the academic performance of university undergraduates. Participants (mean age = 19.46), screened to rule out depression, were provided multiple measures to determine a global sleep quality (GSQ) score. Additionally, information related to gender, age, and GPA was collected. A significant negative correlation between GSQ and GPA was found, indicating that poorer sleep quality was associated with decreased performance. Sleep length was also found to be a predictor of GPA. Their findings suggest that impaired sleep significantly impacts performance independent of the influence of depression, sleep habits of undergraduate students are poor, and sleep education programs at the college level that focus on sleep hygiene may be beneficial as a therapeutic practice to address the needs of this at-risk population.

A noted limitation of the research of Gilbert & Weaver (2010) is the potential for mediating factors influencing the relationship between sleep quality and academic performance. As an example, they suggest that poor sleep may lead to other negative behaviors (e.g. truancy) that may be the true source of lower performance. In their research, Gomes et al. (2011) also evaluated the impact of sleep on undergraduate students; however, they looked to tease out potential mediating factors by including the variables of attendance, study time, substance usage, exercise, neuroticism, age, and sex, among others, in the study to help determine the specific impact of aspects of impaired sleep on college students and whether sleep shows a significant impact when including other potential predictors of performance (total of 30 potential predictors, four of which were sleep related). Using stepwise multiple regression, they found 5 significant predictors of school marks in order of significance: previous academic achievement, class attendance, frequency of enough sleep, night outings, and sleep quality. When comparing alongside a swath of potential predictors, two of those found to be significant were sleep variables. Interestingly, the association between exercise and GPA was found to be nonsignificant. As other research has indicated an association between exercise and academic performance, these findings may be more of an issue with dose threshold for physical activity as discussed later in the paper. Also, the other two potential sleep predictors evaluated (sleep phase and regularity of sleep schedule) were not found to be significant.

The fact that decreased levels of rapid eye movement (REM) sleep, a stage of sleep characterized by increased dreaming, can also show detrimental effects on the consolidation of learning (De Koninck et al., 1989), helps explain the findings of Gomes and colleagues. Since this stage of sleep is often found later in a night’s sleep, reductions in overall sleep or in the early morning when it occurs most, can have a detrimental effect on learning and retention of knowledge.

Previous research by Trockel et al. (2000) identified sleep habits as the top predictor of academic performance. By evaluating a set of health-related variables in college students, they found that sleep habits had the largest impact on grade point averages. However, unlike the findings of Gomes et al. (2011) the variables with the highest predictive value were those related to wake-up times. In looking further into the aspects of sleep most impacted by disordered sleep behaviors, Pilcher et al. (1997) found that not only is sleep quantity a factor in influencing many of life’s functions, but that sleep quality is important with health, mood, life satisfaction, and even more influential on levels of sleepiness. This is significant in that research like that of Singleton & Wolfson (2009) has shown that not only sleep quantity, but also factors such as daytime sleepiness are strong predictors of GPA.

The findings of Gomes et al. (2011) are in line with a review of the effects of sleep reduction by Banks & Dinges (2007) that discussed how sleep reductions of only a few hours per night accumulated over several nights, can lead to neurobehavioral deficits similar to those found with full sleep deprivation. Specifically, they explained how research has shown that a reduction in sleep over the course of multiple nights can result in impairments in mood, alertness, cognitive functioning, and health factors including detrimental effects on endocrine (increased weight gain and BMI), immune, and cardiovascular responses/systems. In a summary of those aspects of sleep that are influencing achievement, Gomes and colleagues stated, “we may assume that four fundamental sleep patterns are expected to be associated with academic achievement: sleep quantity, sleep quality, sleep regularity, and sleep phase schedules” (pg. ).

Oginska & Pokorski (2006) also provide support for the negative impact of sleep deprivation, in the form of insufficient sleep, on cognitive and affective functioning. By addressing three age groups (adolescents age 14-16, university students age 20-27, and young employees age 30-45) they were able to determine that adolescents showed the biggest discrepancy between the amount of sleep they desired and the amount of sleep they were getting a night. When looking at the impact of sleep deficits across all groups, deficits resulted in universal decline in aspects such as daytime fatigue, apathy, feeling drowsy upon waking, concentration issues, fatigue upon awakening, overall weakness, and reduced inclination to put forth effort. Relating these deficits to the multi-faceted construct of academic engagement, it can be seen that impaired sleep has a myriad of implications in the success and engagement of undergraduate students. Feeling fatigued, lacking concentration, and reduced effort were found to be the areas most correlated with sleep loss in university students. Issues of this kind can impact many of life’s functions, including academic engagement and subsequent scholastic success. More specifically, deficits in these areas may have the greatest impact on the “skills engagement” factor of academic engagement, which is defined by concepts such as “putting forth effort,” “listening carefully in classes,” and “coming to class every day.” Although a relationship was seen for the overall group, apathy was correlated with sleep loss in the adolescent group but was not one of the strongest correlates for the (university) student group. “Emotional engagement” is the factor most tied to the concept of apathy with items such as “finding ways to make the course interesting to me.” Reluctance to put forth effort and difficulties with daytime sleepiness and concentration were highly correlated in undergraduates. These results suggest that emotional engagement may not reflect the same impact of sleep loss as other areas of academic engagement in college students.Consequently, skills engagement characteristics of attendance and active engagement in the form of taking notes, completing homework, and being organized are likely the areas of engagement most influenced by issues with sleep quality and quantity.

**Sleep Habits in Adolescents and Young Adults**

Sleep difficulties are a growing problem, particularly with undergraduate students whose sleep schedules, sleep environments, increased autonomy, and circadian shifts result in circumstances of reduced sleep times and sleep quality (Brown & Buboltz, 2002; Brown et al. 2001; Pilcher et al. 1997). In an effort at identifying the sleep habits of university students, Bulboltz et al. (2001) found that although students averaged just over 8 hours of sleep per night regardless of it being a weekend or weekday, students showed close to a two-hour shift to later sleep onset and wake times on the weekend, indicators of sleep disturbances or problems with sleep were reported by 73% of the students. Additionally, issues regarding sleep quality versus sleep quantity were identified, with students reporting morning fatigue and difficulties with sleep onset latency (i.e. the time it takes to fall asleep). Notably, students perceived themselves as getting less sleep during the week than they actually received, perhaps impacting the level of perceived daytime sleepiness.

Adolescents show a phase shift in their sleeping habits, including later bedtimes and earlier wake times. This phase delay has been documented in several studies and impacts the length and quality of sleep that adolescents receive (Brown et al., 2001; Crowley et al., 2007). Pair this with the responsibilities that come with independence during college, and many students struggle to have healthy sleep practices that promote academic achievement and engagement. For instance, undergraduate students show a pattern of reduced sleep quantity and quality (Gaultney, 2010; Gilbert & Weaver, 2010; Orzech et al. 2011). In a study by Orzech et al. (2011)**,** they foundthat pulling all-nighters was associated with lower GPAs, and interviews with students indicated experiences of impaired memory, concentration, and focus as a result of sleep loss. Using a simple sleep education intervention the researchers saw improvements in the sleep length, latency, and other sleep practices of the participating college students. Other research has indicated a link between reduced sleep and reduced academic performance, as well (Gaultney, 2010). Gaultney **(**2010) examined sleep disorders in college students and found that 27% of students showed a risk for a sleep disorder and those students were more likely to have GPAs that fell in the range of academic jeopardy.

As compared to clinical populations who seek out support for sleep difficulties such as insomnia or other sleep disorders, college students may be less aware that their current functioning may be impaired because of sleep difficulties. For instance, sleep deprived students have been shown to rate themselves higher in cognitive performance when sleep deprived as compared to non-sleep deprived students, even though their performance was significantly more impaired (Pilcher & Walters, 1997). Consequently, it is important to help educate and support healthy sleeping habits for these students in the form of educational sleeping programs focused on effective sleep hygiene (Brown & Bulboltz, 2002). Additionally, students with misperceptions of positive sleep behaviors are more likely to have more impaired sleep habits (Hicks, Lucero-Gorman, & Bautista, 1999). Addressing sleep disorders in these students can help with not only school failure, but with school retention rates. Since it is difficult and often prohibitive to restructure the schedule of university classes to cater to the needs of sleep deprived, a more student-directed intervention may be more effective and less limiting schedule-wise. One suggested method to address the sleep disorders of university students is a psychoeducational program proposed by Brown & Buboltz (2002) based on educating students on positive sleep hygiene practices. They suggest that this program may be implemented as part of residence housing or freshman orientation programs.

**Sleep Hygiene**

Our behaviors and choices are integral to the quality and quantity of sleep we receive. Certain conditions and practices have been found to be more conducive to getting a good night’s rest (Bootzin, & Stevens, 2005; Cho et al., 2013). For instance, light, noise, caffeine, alcohol, sleep schedules, delayed circadian phase, discomfort, rumination, naps, exercise near bedtime, and being upset at bedtime have all been associated with impaired sleep (Brown & Bulbotz, 2002; Brown et al. 2001; Mastin et al., 2006; Stepanski & Wyatt, 2003). There are various measures we can take in order to optimize our sleep, and, consequently, improve aspects of functioning that benefit from adequate sleep.

Sleep hygiene includes behaviors related to improved sleep conditions, and, subsequently, sleep quantity and quality. According to Stepanski and Wyatt (2003) the aspects that commonly are associated with sleep hygiene include consistent/variable sleep bedtimes/waking; light and noise conditions; naps/homeostatic pressure; impact of stimulants/depressives including alcohol, caffeine, and prescription medications; exercising close to bed time; spending time in bed while not sleeping, for example, watching television, reading, etc.; performing mental activities, planning, etc. in bed or just before bedtime; and poor sleep conditions/bedding.

In a study looking at the impacts of sleep hygiene on infants and children, Mendell et al. (2009) found that poor sleep hygiene practices were associated with reduced sleep quantity and quality. For instance, late bedtimes were associated with extended sleep latency times. Additionally, obtaining less sleep (i.e. shorter night’s rest) was associated with late bedtimes, caffeine consumption, lack of a consistent bedtime routine, and having a television in the bedroom.

Delayed Sleep Phase Syndrome (DSPS) is characterized by later sleep onset and wake times, and has been associated with negative academic performance (Brown et al., 2001; Trockel et al., 2000). Brown and colleagues looked specifically at how college students are experiencing DSPS. There findings showed that 11.5% of participants had symptoms consistent with DSPS. The difference between weekday and weekend bedtimes and wake times showed significance, indicating that in both cases students showed a phase delay. Additionally, students reported sleep disrupting behaviors such as napping during the day, issues with sleep latency, in addition to general sleep difficulties

In developing their inventory on sleep hygiene, Mastin et al. (2006) utilized 632 university students to determine the relationship of sleep hygiene practices and adequate sleep. The Sleep Hygiene Index (SHI) correlated with all areas of poor sleep hygiene and sleep hygiene was related to sleep quality. Additionally, the SHI showed good test-restest reliability. The items for the SHI were identified by looking at the sleep hygiene diagnostic criteria found in the International Classification of Sleep Disorders from the American Sleep Disorders Association (1990).

Specifically, the Sleep Hygiene Index (SHI) has been found to be significantly correlated to sleep quality, subjective daytime sleepiness, and other sleep hygiene indices (Brown et al., 2002; Cho et al., 2013; Mastin et al. 2006). Based on an evaluation of the Sleep Hygiene Index, Cho et al. (2013) proposed that the SHI would be more appropriately broken down into two factors, including “sleep disturbing behavior” and “irregular sleep-wake schedule.”

Research on sleep hygiene has shown that it has commonly been used in the treatment of insomnia. In looking at a non-clinical population of university students, Brown, Buboltz, and Soper, 2002 found that sleep practices are associated with quality sleep for this population, as well, and that specific items showed more significance, such as variable sleep schedules, worrying at sleep onset, and being thirsty at bedtime. In addition, they discussed how at the college level, where students often live in dorms, although noise in the environment was also significantly linked to sleep quality, it would be difficult to change this variable using positive sleep hygiene practices, as it is often outside of the student’s control.

Young adults show significantly lower awareness and use of beneficial sleep hygiene practices than adults of other ages (Cho et al., 2013; Voinescu & Szentagotai-Tatar, 2015). Fortunately, sleep hygiene interventions offer an affordable, non-clinical way to address health needs for adults (Irish et al. 2015).

**Exercise**

Physical exercise and fitness has been shown to have a plethora of beneficial impacts on cognition, executive control, learning, academic achievement, mood, self-esteem, attention, working memory, and general health (Budde et al., 2008; Fedeway & Ahn, 2011; Hillman, Castelli, & Buck, 2005; Hillman, Erickson, & Kramer, 2008; Kall et al., 2013; Kristjansson et al., 2010; Pontifex et al. 2009). In a meta-analysis looking at the effects of physical activity/fitness on children’s achievement, Fedewa & Ahn (2011) analyzed 59 studies from 1947 to 2009 and found a significantly positive effect on both achievement and cognitive outcomes. Their overall results were similar to previous meta-analyses that indicated a similar effect of exercise on cognitive outcomes (Sibley & Etnier, 2003; Etnier et al, 2006). Although most areas of evaluated physical activity yielded significantly positive results, the meta-analysis showed that aerobic exercises resulted in the largest impact on cognitive functioning and academic achievement (Fedewa & Ahn, 2011). One area of physical activity that did not show significant results was that of flexibility. A study completed by Pontifex et al. (2009) also found positive effects of aerobic activity. In their study, aerobic exercise showed a larger reduction in response times for working memory than in those conditions with resistance exercises or seated rest. Additionally, the analysis by Fedewa & Ahn suggested an increase in achievement as activity levels increase. It is also interesting to note that the area of achievement most affected in these children was mathematics, followed by positive effects on reading achievement and IQ. Finally, the authors note that the effects were as significant or more so on children with learning or physical disabilities.

As further evidence of the association between physical activity and academic performance, a study completed by Swedish researchers Kall et al. (2013) utilized a school-based physical activity intervention “School in Motion” program for a group of 5th graders in a cross-sectional design to determine whether it impacted the students’ odds of reaching the national goals in areas such as Swedish, English, and mathematics. Their findings indicate that academic achievement rates improved with the implementation of this intervention. Kall et al. discuss how physical activity is often seen as a competing entity against time spent on academic studies. However, as they explain, research has shown that time spent in exercise interventions does not show a negative impact on academic endeavors (Ahamed et al., 2007, Rasberry et al., 2011; Singh et al. 2012). The authors identified potential contributory benefits of physical activity on academic achievement as improved concentration, attention, and other enhanced behaviors conducive to learning, as well as the potential for increasing self-efficacy, reducing stress, inducing arousal, and enhancing mental health.

Research by Rasberry et al. (2011) and Singh et al. (2012) both took a comprehensive look at the relationship of physical activity and academic performance through systematic reviews of the literature. Based on the review of 50 related research studies, Rasberry et al.’s findings suggest an association between school-based physical activity and academic performance, including achievement, cognitive functioning, attitudes related to school, and academic behaviors such as organization, attendance, and on-task behaviors. Although they found a somewhat comparable number of studies reflecting no changes in academic performance as a result of physical activity, subsequent research by Singh and colleagues found a significant and positive relationship between activity and performance. In their review, they used inclusion standards allowing for longitudinal and intervention-based studies only. Additionally, they evaluated the methodological quality of those studies. They found that the highest quality studies showed a positive, significant relationship of physical activity and performance at school.

The prevailing evidence indicates that physical activity is essential to academic success at earlier stages in education. Consequently, it seems evident that it is important to examine the impacts of exercise as they pertain to college students. In their research, Nelson and colleagues (2007) elucidated the tendency for vigorous physical activity (VPA) to decrease from adolescence to adulthood, showing that VPA decreases from high school to college. They also explained that “physical activity is understudied in the college setting,” which elucidates the need for more research on students of this age level (pg. ).

**Exercise Types and Dosages**

As mentioned above,not all exercise is created equal. Various research studies have evaluated, or found as part of a larger study, the types and dosages at which exercise shows the most beneficial impacts (Coe et al., 2006; Fedewa & Ahn, 2011, Pontifex et al. 2009). For instance, Fedewa & Ahn described in their meta-analysis, “In terms of how much physical activity to provide students, a related finding of the current analysis revealed that physical activity provided three times per week exerted the strongest effect on children’s cognitive outcomes and achievement.” (pg. 531).In looking at how activity levels affect achievement in children, Coe et al. found that moderate levels of physical activity did not impact academic performance, while vigorous exercise was significantly associated with higher achievement. They postulate that this may be based on a “threshold level of physical activity” at which the beneficial impacts of exercise occur (pg. 1517).

In research by Galper et al. evaluating the impact of exercise on mental health, they classified physical activity into four groups including inactive (< 1), insufficiently active (1-10), sufficiently active (11-19), and highly active (>=20) based on miles per week of walking, jogging, and running. Although a dose-response was seen for the effects of physical activity level, they found no significant differences between the sufficiently active and highly active groups when it came to the impact on depressive symptoms and emotional well-being. They theorize that the dose-response reaches a plateau at the equivalent of 30 minutes of (almost) daily aerobic activity.

Buckworth & Niggs (2004) found that different sedentary behaviors were negatively correlated with exercise or physical activity showing that discretionary time of college students is often utilized based on gender, with females more likely to watch television and males more likely to spend time on the computer versus exercising. When looking at time spent studying, positive correlations were seen in females for strength training, and with average duration of exercise in both sexes.

Shephard (1996) proposed an explanation for the observed impact of physical activity on achievement, arguing that exercise promotes attention by reducing boredom and increasing arousal. He also raised the possibility that self-esteem may play a role, but argued it is an unlikely explanation in his research given the conditions of his study.

**Exercise and Self-Esteem**

One of the four factors of Academic Engagement identified by Handelsman et al. (200%) is “performance engagement” and a component of that is “being confident that I can learn and do well in the class.” Self-esteem is intrinsically linked to self-confidence. The effects of exercise on global self-esteem were evaluated in a study be Spence et al. 2005. They did a quantitative review of the research and found a small but significant increase in self-esteem associated with exercise and a larger effect size when there were significant changes in physical fitness.

Kristjansson et al. 2008, showed not only a positive correlation between physical activity and academic achievement, but a similar link between physical activity and increased self-esteem in a study evaluating adolescents in Iceland. However, confirming the skepticism of Shephard (1996), they found that self-esteem was a weak mediator of the relationship between physical activity and increased academic performance, stating, “the influence that health behaviors have on academic achievement appears mostly to take place outside the impact of self-esteem.” However, they claim that this lack of mediation on the part of self-esteem “supports the notion that adolescent engagement in healthy behavior remains important if societies wish to simultaneously improve both the health status and academic-achievement goals of young people.” (pg. )

**Exercise and Stress**

Exercise has been shown to improve emotional well-being in a variety of ways. For instance, as a study by Manger & Motta (2005) indicated, a 12-session aerobic exercise intervention improved the symptoms of Post-traumatic Stress Disorder (PTSD), anxiety, and depression. Puterman et al. (2010) found a significant moderating effect of exercise on the impact of perceived stress levels on telomere length (TL), stating that, “Vigorous physical activity appears to protect those experiencing high stress by buffering its relationship with TL” (pg. ). Another study (VanKim & Nelson, 2013) showed that in a sample of over 14,000 undergraduate students, those that met the most vigorous levels of physical activity were less likely to indicate perceived stress and poor mental health. No differences based on sex or ethnicity were identified. They discussed how poor mental health and perceived stress are highly correlated so, consequently, showed similar magnitude and directionality for the association with vigorous physical activity. Additionally, their study suggests that socializing partially moderates the relationship between mental health/perceived stress and physical activity.

The fact that physical activity shows a decline as students advance in age with less likelihood of participating in vigorous exercise at the college level than in earlier years (Vankim & Nelson, 2013; Nelson et al., 2007; Troiano et al. 2007), illustrates the need for research such as this that can help identify the areas of personal care that will have the greatest impact on undergraduate’s academic engagement and subsequent, positive college outcomes. Understanding the pathways for student achievement and engagement can help focus intervention efforts to highlight areas that will be the most beneficial and effective.

The current study looks at how the self-care practices of sleep hygiene and physical activity mediate the relationship between stress and academic engagement. Research has shown that academic engagement is correlated with positive outcomes for achievement, and, in turn, future employment status. Stressful Life Events have been implicated in hindering various aspects of Academic Engagement, including specifically achievement. This calls into question whether the impact of other protective factors such as positive sleep behaviors and regular exercise improves academic engagement for students who are experiencing elevated levels of stress. In other words, if faced with similar stressors are these self-care practices associated with, or impact the likelihood of, improved academic engagement? The implications of providing a predictive model of the likelihood of being academically engaged can be seen in the ability to identify those variables that are most influential, and, subsequently, beneficial for targeting in intervention.

**CHAPTER 3**

**METHODOLOGY**

**Participants**

The current research will be based on previously collected data. Participants included 206 undergraduate students who were part of the educational psychology research pool at a large southeastern university. The participating students were provided the option of completing a research review paper or participating in this study to fulfill a research requirement for their course. This option was provided to students in 3-4 classes over the course of multiple semesters. Volunteers were also obtained from other psychology and education courses.

The participants were asked to first complete a consent form and then multiple questionnaires either at home (if they were part of the educational psychology research pool), or for those students outside the research pool, during a period provided during their class period. Participants were asked to complete all questionnaire answers on a Scantron sheet and return them during the next class period. The participants were instructed to include their names only on the consent form, and on no other documents.

**Measures**

The included questionnaires were meant to determine the following: student’s demographics including age, ethnicity, class standing, and gender; the Undergraduate Stress Questionnaire (USQ) to measure recent stressful life events, the Sleep Hygiene Index (SHI) to measure positive sleep practices, the Leisure Time Exercise Questionnaire (LTEQ) to evaluate exercise habits; and the Student Course Engagement Questionnaire (SCEQ) to determine self-reported levels of academic engagement.

**Undergraduate Stress Questionnaire (USQ).** Unlike other stress measures, the USQ is a self- report questionnaire specifically targeted toward college students, providing items relevant in the life of an undergraduate student (Crandall et al, 1992). It is comprised of 82 common stressful life events and students will be asked to indicate which events have occurred within the last semester using a “yes” or “no” format. As indicated by the research on stress, the questionnaire likewise shows positive correlations with physical symptoms and negative correlations with mood (Crandall et al., 1992). Although in this research, the correlation with mood was only seen in females respondents. The USQ shows adequate validity and reliability.

**Sleep Hygiene Index (SHI).** In order to evaluate the use of sleep hygiene practices, the current study proposes to utilize the Sleep Hygiene Index (SHI). The SHI is a self-report measure comprised of 13 items rated on a five-point scale ranging from 0 (never) to 4 (always). It is a brief measure in comparison to previous, lengthier assessment instruments, showing satisfactory validity and reliability, including good test-retest reliability (Mastin et al. 2006; Cho et al., 2013). Items are based on “the diagnostic criteria for inadequate sleep hygiene in the International Classification of Sleep Disorders (American Sleep Disorders Association, 1990)” (Mastin et al. 2006). High scores indicate more maladaptive sleep hygiene practices, while lower scores demonstrate better sleep hygiene. The total score ranges from 0-52.

**Leasure Time Exercise Questionnaire (LTEQ).** The LTEQ is a self-report questionnaire consisting of a 5-category rating range for three levels of physical activity: “Strenuous,” “Moderate,” and “Mild” exercise. The ratings range from A through E indicating “Never,” “1-2 times,” “3-4 times,” “5-6 times,” and “7 or more times” (per week). Subjects are asked about their average weekly exercise and how often they complete 15 (used 20 minutes in our study) or more minutes of either strenuous, moderate, or mild exercise during their free time. For the three levels of exercise, the questionnaire provides both descriptions of physical states one would experience at that level and specific activity examples (i.e. running for strenuous exercise and bowling for mild exercise). The LTEQ provides information on activity patterns and physical fitness (Godin & Shephard, 1985).

**Student Course Engagement Questionnaire (SCEQ).**  Handelsman et al.’s (2005) SCEQ includes 23 items that are loaded onto four factors, including Factor 1 – Skills Engagement, Factor 2 – Emotional Engagement, Factor 3- Participation/Interaction Engagement, and Factor 4 – Performance Engagement. The measure shows reasonable reliability and internal consistency (Handelsman et al., 2005). The questions on this measure focus on academic engagement at the “micro” scale, and, consequently, items focus on academic achievement, interest in course content, showing effort and completing work, studying, participating in class discussion, and seeking help when needed among other items falling in a four-factor model. As indicated by Handelsman et al. (2005), items are rated on a 5-point rating scale, with the following instructions: “To what extent do the following behaviors, thoughts, and feelings describe you, in this course. Please rate each of them on the following scale: 1 = *not at all characteristic of me*, 2 = *not really characteristic of me*, 3 = *moderately characteristic of me*, 4 = *characteristic of me*, 5= *very characteristic of me*.”

**Procedure**

**Statistical Analyses**

Before addressing the specific questions of the present study, I will evaluate demographic differences in the data as they are related to the dependent variable, including age, gender, ethnicity, and class standing using either t-test, ANOVA, or linear regression as appropriate. For all analyses described below, I will evaluate regression assumptions such as issues regarding multicollinearity, high leverage data points (outliers), and homogeneity of variance, normality of variable distributions, and independence of residuals.

**Specific Aim 1:** To document the effects of stressful life events (SLEs) on academic engagement (AE) in undergraduate students.

**Hypothesis 1:** Increased levels of life stressors are hypothesized to be associated with lower levels of academic engagement. Specifically, we believe that academic engagement as measured by SCEQ will be lower in undergraduate students who experience a greater number of stressful life events as determined by USQ.

**Data analysis 1:** A simple linear regression will be performed to determine the correlation between stress and both overall engagement and each of the four factors of engagement.

**Specific Aim 2:** To document the relationship between sleep hygiene (SH) and academic engagement in undergraduate students.

**Hypothesis 2:** We hypothesize that as sleep hygiene is impaired so will academic engagement in undergraduate students. We postulate that academic engagement will be lower in undergraduate students who experience reduced levels of healthy sleep hygiene practices as measured by the SHI.

**Data Analysis 2:** We will estimate the correlation between sleep hygiene and both overall engagement and the four factors of engagement.

**Specific Aim 3:** To determine if sleep hygiene mediates the relationship between stressful life events and academic engagement.

**Hypothesis 3:**We hypothesize that students with higher levels of stressful life events will experience lower academic engagement if they show poor sleep hygiene practices. We believe that the relationship between stressful life events and academic engagement will be partially or fully explained by sleep hygiene practices in undergraduate students.

Additionally, we hypothesize that sleep hygiene practices will show the greatest mediating effect on the academic engagement factor of skills engagement due to the research indicating strong associations between sleep quality and executive functioning.

**Data Analysis 3:** This evaluation will be conducted using a mediational model as outlined in Muller, Judd, & Yzerbyt (2005).

**Specific Aim 4:** To document the effects of physical activity on academic engagement in undergraduate students.

**Hypothesis 4:** We hypothesize that increased levels of exercise (based on number of days per week) for strenuous exercise will be associated with lower levels of Academic Engagement; most specifically for the participation factor.

**Data Analysis 4:** Linear regression will be used in a similar fashion as with SLEs and SH*.* The scores from the three levels of physical activity (strenuous, moderate, mild) will be combined to calculate a single summary measure based on weighted totals as outlined in the work of Godin & Shephard (1985). Their formula attributes higher weights to exercise of greater intensity which is consistent with the greater impact of high intensity exercise previously documented (Coe et al., 2006; Fedewa & Ahn, 2011). This total score will then be compared as the independent variable against overall academic engagement and each of the four factors of AE.

**Specific Aim 5:** To determine if exercise moderates the relationship between stressful life events and academic engagement.

**Hypothesis 5:**We hypothesize that students with higher levels of stressful life events will experience lower academic engagement, specifically in the area of participation, if they show low levels of physical activity. Due to the fact that the positive impacts of exercise seemed to be based on a dosage-threshold, we postulate that high levels of strenuous activity will reduce the effect of stressful life events on academic engagement.

**Data Analysis 5:** We will evaluate the hypothesis using a moderation model as described in Muller et al. (2005). We will model academic engagement as a function of stressful life events, strenuous exercise, and their interaction.

**Specific Aim 6:** To identify the hierarchical influence of the effects of stressful life events, sleep hygiene, and exercise on academic engagement.

**Hypothesis 6:** Since self-care practices have been shown to improve various elements of engagement, using an exploratory process we will determine how these self-care practices differentially impact academic engagement in order to further identify the aspects that have the greatest impact in influencing academic engagement in undergraduate students.

**Data Analysis 6:**We will model academic engagement as a function of the demographic variables that showed statistical significance in the initial evaluation along with stressful life events, sleep hygiene, and exercise. We will perform an exploratory analysis using multiple regression to explore the hierarchical relationship between stressful life events, sleep hygiene, and exercise, including any relevant demographic variables, as they predict academic engagement, as well as the robustness of these relationships.

**Statistical Analyses**

**Research Question #1:**

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Footnotes