The Role of Gender, Mindfulness, Rumination and Sleep Attitudes on Sleep Quality in College Students Before and After a Sleep Education Intervention

Noemi C. Agagianian

Collaborators: Tamaru Mau, Kylie O’Neill-Mullin, Gabriel Olsen

Advisor: Seth Gillihan

Haverford College

Department of Psychology
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Abstract

College students are notorious for their poor sleep quality and sleep hygiene practices. Clinicians and researchers have made an effort to create successful interventions that would aid students in creating better sleep hygiene practices, but results from these studies have been mixed. The current study aims to expand on previous work by taking into account attitudes toward the importance of sleep and adding a reflection exercise at the end of the presentation. In addition, the current work assessed the role of gender, trait mindfulness, and trait rumination on students’ sleep quality and likelihood of implementing sleep hygiene guidelines. Results indicate that the intervention had no significant effect on students’ self-reported sleep quality. However, a significant correlation was found between trait mindfulness and sleep quality. Furthermore, significant differences in sleep quality and mindfulness were found between students who lived by themselves and those who lived with a roommate. Implications of these findings and future directions are discussed.
Introduction

"Your life is a reflection of how you sleep, and how you sleep is a reflection of your life."

- Dr. Rafael Pelayo

Stanford sleep specialist Dr. Rafael Pelayo (Stanford Med, 2013) had it right in this insightful quote on the reciprocal effects of sleep on life quality. Sleep is a complex phenomenon and both affects and is affected by one’s lifestyle. Sleep is considered a basic biological need and people spend up to a third of their lives sleeping. Because of its crucial role in human functioning, doctors and researchers have begun investigating sleep: what it is, how people sleep, and how sleep affects people. Further, some effort has been taken to improve sleep, and researchers have shown that sleep habits and quality are modifiable. Some studies have shown that symptoms of insomnia and overall sleep quality can be improved among adults through sleep interventions, such as Cognitive Behavioral Therapy (Rybarczyk et al., 2005) and Tai Chi Chih classes (Irwin et al., 2008). More recently and because of sleep’s crucial role in healthy development and basic functioning, researchers have focused more of their efforts on improving sleep quality and quantity in adolescents and young adults.

Sleep interventions have had inconsistent effects on youth and college students. We propose that this inconsistency is due in part to existing studies’ not having taken into account participants’ attitudes towards sleep. One of the main postulations of this paper is that a high regard for the importance of sleep will affect how successful a sleep education program will be among college students. However, I argue that even with a positive attitude towards sleep, students’ sleep may not adequately improve post-intervention because there are critical biological (e.g., circadian rhythms) and psychological (e.g.,
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mindfulness, rumination, etc.) differences within people that may moderate the
effectiveness of sleep interventions. In this paper, I will discuss these factors in more
depth and assess their relevance to students’ sleep quality and whether biological and
psychological differences must be addressed in future interventions in order to improve
an intervention’s efficacy. The primary research question in this paper, then, is: why have
some sleep intervention programs to date not been successful and are there modifications
that may improve an intervention’s efficacy? The role of mindfulness, rumination, sleep
hygiene knowledge and practices, and attitudes towards sleep as moderators of the effects
of a sleep intervention program on sleep quality and quantity will be explored.

Sleep Statistics

College students are notorious for their poor sleep habits. Studies have shown that
as few as 11% of students report getting good sleep, while 73% report occasional sleep-
related problems and another 15% report poor sleep quality (Buboltz et al., 2001).
Buboltz and colleagues (2001) found that 18% of men and 30% of women experienced
insomnia within a three-month period and that, on average, 10% or more of students
experienced difficulty falling asleep, disturbed sleep and night awakenings at least
several times a week. Furthermore, over 50% of students reported feeling tired in the
mornings (Buboltz et al., 2001). These findings are not new – research has shown that
poor sleep patterns among college students have been around for decades, but that they
have significantly increased over time. Whereas only 24% of college students reported
dissatisfaction with their sleep in 1978, the percentage nearly tripled (71%) by 2000
(Hicks et al., 2001). The steadily growing rate of sleep problems in adolescents and
college students suggests that poor sleep is gradually becoming the norm.
In addition to experiencing dissatisfaction with their sleep, college students report an inconsistency in the amount of hours of sleep they get per night as well as when they get that sleep. Researchers have found, for example, that students sometimes get as little as 2 hours of sleep or as much as 10, although averages range closer to 6.5 to 7.5 hours (Galambos, et al. 2009; 2013). Furthermore, students sleep an average of 49 minutes more on the weekends than on weekdays and an average of 20 minutes more in the beginning of the semester than at mid-semester, suggesting that students’ sleep schedules may be quite irregular (Galambos et al., 2009). Other studies have also identified a discrepancy between the amount of sleep that students get during the academic semester and the amount they get during vacations (Warner et al., 2008). In a study on Australian students’ actual and ideal sleep times, Warner and colleagues (2008) found that students get more than their ideal amount of sleep on weekends and holidays but less during the week; further, the difference between total sleep time during the school year and holidays was approximately 77 minutes. Changing sleep schedules over the course of a week, month or year is a marker of unhealthy sleep habits and may result in poor sleep quality. We will return to this idea in the sleep hygiene section.

Another factor that has been shown to affect sleep quality is gender. Gender has been found to be a significant moderator of sleep quality, with women reporting more sleep problems than men. Studies have found that women reported longer sleep latencies, more nighttime awakenings and poorer sleep quality than men (Breslau et al., 1996; Buboltz et al., 2001; Tsai and Li, 2004). Some women go on to have children and because infants have been shown to affect maternal sleep more than paternal sleep (Venn et al., 2008), childbearing may make women more prone to having their sleep quality
GENDER, MINDFULNESS, RUMINATION AND SLEEP ATTITUDES ON SLEEP QUALITY compromised. Studies thus far have not clearly shown whether a gender difference in sleep quality exists among college students, and the current study will explore whether the gender differences found in past research arise in college.

The literature has shown that sleep varies as a function of time and gender, but these numbers do not paint an adequate picture of why these statistics are important. As we will see in the next section, poor sleep may play a critical role in well-being and daily functioning.

Repercussions of Poor Sleep

A good night of sleep is a critical component of a healthy lifestyle, with negative impacts of sleep disturbances and deprivation affecting many domains of a person’s life. Sleep has been shown to influence mental health (Pilcher et al., 1998; Kamdar et al., 2004) and daily functioning (Gaultney, 2010). The National Sleep Foundation (2013) has found that, across cultures, people report that sleep deprivation negatively affects their work productivity, social life, leisure activities, family life, home responsibilities, mood, intimate relations and health.

Poor sleep in college students has been shown to have profoundly negative effects on cognitive functioning. In a study by Pilcher and Walters (1997), college students were randomly assigned to either a full night’s sleep (i.e., 8 hours) or no sleep before completing a cognitively demanding task. Students who got no sleep performed significantly worse; moreover, they reported exerting more effort and concentration on the task and thought that they performed significantly better than the other group that slept for 8 hours thought they did. Over time, this effect of sleep deprivation may have profound effects on students’ academic achievements. Although students may feel like they are putting effort into their work, they may not be performing their best. Over four
years, the cumulative effects of poorer performance despite higher confidence can significantly alter students’ overall college careers. In an assessment of sleep disorders administered to college students, Gaultney (2010) found that the students who were at a risk for at least one sleep disorder were also more likely to be in academic jeopardy (i.e., have a GPA under 2.0).

In addition to poorer performance, sleep loss and fatigue may also impact students’ academic choices. Engle-Friedman and colleagues (2002) found that sleep-deprived students chose less demanding problems to work on. If sleep deprivation leads people to choose activities that are less arduous, there may be serious implications for long-term education and career outcomes. Continuous sleep deprivation may lead students to set smaller goals and take on fewer challenges; over the course of years, this accumulation of choices for less demanding tasks could result in drastic deviations from a person’s initially set goals, which may decrease life satisfaction and psychological well-being.

Furthermore, another means by which poor sleep quality and negative health effects are correlated is through engagement in more risky behaviors. Among a large sample of undergraduate students, Vail-Smith and colleagues (2009) found that poor sleep quality was associated with risk behaviors such as physical aggression, suicide ideation, smoking, alcohol and marijuana use, and physical inactivity. The adverse long-term implications of these behaviors –for example, substance dependence or abuse, obesity, cancer and death – underscore the significance of sleep on people’s long-term well-being. Regardless of whether the effects of sleep deprivation or poor sleep quality
are subtle or overt, or short-term or long-term, we can conclude that sleep is critical and that it is important to take measures to improve quality of sleep.

In order to effectively implement interventions that improve students’ sleep, however, we must first identify and understand the factors that affect sleep. Several psychological personality traits may affect sleep and, as we will see in the next section, mindfulness has had strong empirical support in its association with improved sleep quality.

**Mindfulness**

A concept stemming from Buddhist meditation practices, mindfulness is a state of consciousness that involves being aware of oneself and one’s surroundings. The idea of mindfulness was originally taken from Eastern philosophy, which emphasized a spiritual component and viewed mindfulness as a form of introspective awareness. From a Western standpoint, the definition and practice of mindfulness is non-religious and places an emphasis on the awareness of both internal and external experiences (Keng et al., 2011). Since it has been adapted to a more Western frame of mind, mindfulness has occupied the interest of many researchers and clinicians largely because of its marked benefits. However, even within Western practice and literature, definitions of mindfulness have been varied.

The concept of mindfulness was first introduced within the psychological and health literature by Jon Kabat-Zinn (1982) and the concept and practice have since been incorporated into the treatments of various physical and psychological disorders. Mindfulness is “the awareness that arises through ‘paying attention in a particular way: on purpose in the present moment, and nonjudgmentally’” (Kabat-Zinn, 1994, in Keng et
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al., 2011, p. 1042). It has also been described as a state of prolonged consciousness,
which is thought to encompass both awareness and attention (Brown & Ryan, 2003).
From this and other preliminary descriptions, a two-component definition of mindfulness
developed: Mindfulness can be described as a state of sustained attention of immediate
internal and external experiences along with a state of acceptance with a curious and non-
judgmental orientation towards these experiences (Bishop et al., 2004; Hayes & Feldman,
2004).

More recently, Baer and colleagues (2006) have empirically examined the various
definitions and measures of mindfulness and have consolidated these various aspects into
a more precise understanding of the term. Their analysis revealed five distinct facets of
mindfulness, which they used to develop the Five Facet Mindfulness Questionnaire
(FFMQ). This comprehensive measure of mindfulness identifies the following five
facets: nonreactivity to inner experience, attention to thoughts and feelings, acting with
awareness and nondistraction, describing experiences with words, and nonjudgment of
internal and external experiences.

Trait mindfulness has been associated with psychological and physical well-being
and increases in mindfulness have been associated with overall improvements in life
quality. Studies have found that high levels of mindfulness have been linked to the
following psychological outcomes: lower neuroticism (Brown & Ryan, 2003), less
anxiety (Brown and Ryan, 2003; Hazlett-Stevens, 2012), lower levels of depression
(Brown and Ryan, 2003; Hazlett-Stevens, 2012), higher self-esteem (Brown and Ryan,
2003) and positive affect (Brown and Ryan, 2003; Caldwell et al., 2010), lower negative
affect (Brown and Ryan, 2003; Carlson and Garland, 2005; Caldwell et al., 2010; Prazak
et al., 2012), and greater life-satisfaction (Brown and Ryan, 2003). In terms of physical well-being, mindfulness has been found to be associated with cardiovascular health (Prazak et al., 2012), immune functioning (Carlson et al., 2003) and lower levels of cortisol (Carlson et al., 2004), among others.

In addition to all of the psychological and physical health-related variables mentioned above, mindfulness has also been associated with better sleep quality (Caldwell et al., 2010; Carlson & Garland, 2005; Howell et al., 2010; Lundh, 2005; Ong et al., 2009; Murphy et al., 2012; Roberts & Danoff-Burg, 2010; Murphy et al., 2012). Specifically, most of the literature on mindfulness and sleep quality has focused on the effects of a mindfulness-based intervention on sleep. For example, researchers found that mindfulness-based stress reduction (MBSR), an eight-week course developed by Kabat-Zinn (Kabat-Zinn, J., 1982) for the purpose of increasing mindfulness skills, was comparable to pharmacotherapy (PCT) for the treatment of primary chronic insomnia (Gross et al., 2011). Specifically, Gross and colleagues (2011) found that patients who received MBSR training experienced significant improvements in total sleep time, sleep onset latency and sleep efficiency compared to patients who received PCT. In another study, Carlson and Garland (2005) found that the MBSR program significantly improved sleep quality in cancer patients.

Other studies have found a similar effect of MBSR, Mindfulness-Based Cognitive Therapy (MBCT) or other mindfulness-based interventions on sleep quality in patients with insomnia (Ong et al., 2009), working adults (Klatt et al., 2008) and college students (Caldwell et al., 2010). Their findings suggest that increases in mindfulness lead to improvements in sleep quality. Ong and colleagues (2009), for example, treated insomnia
patients with an intervention that combined MBSR with MBCT and found that improvements in mindfulness were correlated with fewer symptoms of insomnia at 6-month and 12-month follow-ups. These studies, however, have several limitations that restrict the generalizability of their findings.

In the study on working adults, Klatt and colleagues (2008) found that participants who received a shortened version of the MBSR intervention had statistically significant improvements in perceived stress and mindfulness. Both the wait-list group and the intervention group experienced improvements in sleep quality but the group that received the MBSR intervention had statistically significant improvements in subjective sleep quality, sleep latency and daytime dysfunction, which the control group did not experience. This study, however, has several limitations. It did not assess mindfulness or stress in the control group, so it is inconclusive whether the treatment actually increased participants’ level of mindfulness. As such, it is impossible to draw definitive conclusions about whether the sleep quality improvements were caused by increases in levels of mindfulness. It would have been especially important to assess mindfulness and stress changes in the control group in order to establish whether the MBSR program had any unique significant effects on the experimental group.

Lastly, Caldwell and colleagues (2010) assessed the effect of movement-based courses (i.e., Pilates, Taiji Quan and Gyrokinesis) on changes in mindfulness and sleep quality. They concluded that movement-based courses generated changes in mindfulness, which were associated with improvements in sleep quality. However, their interpretation assumes that the movement-based courses increased levels of mindfulness, which were then responsible for better sleep. It is also possible that the directionality is reversed, with
the movement-based courses producing better sleep quality, leading to improvements in mindfulness, especially in light of the documented effect of exercise on sleep (Lang et al., 2013). There is a dearth of research looking at the effects of sleep quality on mindfulness, and the exact process by which mindfulness and sleep quality are related remains unknown. Nonetheless, there seems to an effect of mindfulness-based interventions on sleep quality.

The characteristics of mindfulness may help individuals react more productively in the face of sleep problems. As defined above, mindfulness is a state of ongoing awareness and attention, marked by non-reaction and non-judgment to internal and external events. By having the ability to stay consciously present in the moment without judging or attempting to control one’s feelings and experiences, one begins to experience improvements in behavioral self-regulation, metacognitive awareness (the notion that a person can be aware of and distance himself from his thoughts), perceived stress, rumination and affect (Brown and Ryan, 2003; Howell et al., 2009; Keng et al., 2011). For example, by being more aware of one’s internal and external states and needs, there is more opportunity to change one’s behavior in order to meet those needs (i.e., behavioral self-regulation); similarly, by recognizing his or her momentary feelings and accepting them for what they are, a person can choose not to allow them to have an effect on his or her life (i.e., metacognitive awareness). People can recognize and dismiss negative internal and external states (e.g., feeling lonely or having an upcoming due date) and by not dwelling on these states, they can lower their levels of perceived stress, dispositional rumination and negative affect. Research has shown that these latter characteristics contribute to insomnia, suggesting that mindfulness (which is associated
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with lower levels of perceived stress, rumination and negative affect) does have a positive
association with better sleep quality.

There are two processes by which insomnia develops and maintains itself (Lundh,
2005), and mindfulness may help explain how these processes are related to sleep quality.
The first of these processes is referred to as sleep-interfering processes and is composed
of various arousal-producing processes, which include engaging in arousing pre-sleep
activities (e.g., exercising), reading or watching television in bed, and worrying about
sleep or other matters. The second is known as sleep-interpreting processes and refers to
dysfunctional beliefs and unrealistic expectations about sleep and the impact of poor
sleep – for example, the belief that one will be completely incompetent and unable to
perform following a night of poor sleep. According to Lundh (2005), sleep-interfering
processes often lead to poor sleep quality and quantity, but it is the sleep-interpreting
processes that contribute to the overall negative effect and impairment that a person
experiences as a result of a poor night of sleep. It is feasible that mindfulness mediates
the relationship between these cognitions and sleep quality. With higher levels of
mindfulness and lower levels of stress and negative affect, a person has less opportunity
to engage in sleep-interfering processes. He or she may also be more aware of his or her
thoughts and actions, leading to more behavioral self-regulation that promotes better
sleep (e.g., engaging in relaxing and non-arousing activities immediately prior to going to
bed). These benefits of mindfulness, though particularly beneficial for people suffering
from insomnia, may improve sleep quality for non-insomniacs as well.

However, the benefits discussed above do not necessarily suggest that the
relationship between mindfulness and sleep quality is largely one-directional, with
changes in mindfulness causing changes in sleep. Although research thus far has suggested that psychological and physical benefits follow an increase in trait mindfulness (Shapiro et al., 2008), there is a scarcity of research that examines whether increases in psychological or physical well-being lead to increases in trait mindfulness. Most research to date has examined the effect of a mindfulness-based therapy (e.g., Mindfulness-Based Stress Reduction, Mindfulness Meditation, Mindfulness-Based Cognitive Therapy, etc.), which aims to increase trait mindfulness, on sleep quality (Carlson and Shapiro, 2005; Caldwell et al., 2010; Ong et al., 2009; Ong et al., 2010), suggesting that changes in mindfulness might cause changes in sleep. It would be interesting, however, to examine the effect of a sleep intervention program on trait mindfulness. Specifically, do people become more mindful after participating in a sleep intervention program? There is little evidence in the literature that would support this possibility, but it makes sense that better-rested people would be more willing to try to maintain constant attention and an ongoing state of awareness.

Mindfulness is not the only trait, however, that affects sleep quality. In the next section, we will turn to another character trait, rumination, which may also have large implications for sleep quality.

**Rumination**

Trait rumination involves a tendency to repeatedly think over negative thoughts, and may be related to symptoms of insomnia and general sleep disturbances. Rumination has been differentiated from the somewhat similar construct of worry. Although they share similar cognitive processes, they have differing temporal orientations. Worry is primarily characterized by a “cognitive focus on future negative events [that] is
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potentially adaptive” whereas rumination involves “repetitive, unwanted, past-oriented
thoughts about negative content” (Zoccola et al., 2009). Furthermore, worry’s focus on
the future suggests that it is more related to anxiety than is rumination (Takano et al.,
2012). Takano and colleagues (2012) have also suggested that ruminative thinking is
more strongly associated with problems in one’s “core self-concept, and is motivated by
needs to understand deep meanings, gain insight, and solve problems,” whereas worry is
said to include more of an “external focus in order to anticipate and prepare for the
threats and demands from one’s environment” (p. 780).

Both worry and rumination have been thought to be associated with sleep-related
problems; however, recent work has suggested that rumination plays a larger role in sleep
disturbances and symptoms of insomnia than worry does (Carney et al., 2010). Therefore,
the content and focus of this section will be on rumination as it relates to issues with pre-
sleep arousal. We will discuss the various facets and definitions of rumination and
consider the implications of a ruminative mindset on sleep quality among college
students.

The definition of rumination has undergone subtle changes since it first became a
subject of interest to researchers as a part of the response style theory of depression
(Nolen-Hoeksema, 1991). According to the response style theory, people either have
ruminating, distracting or problem-solving responses to internal and external stimuli.
Rumination initially was defined as “the process of thinking perseveratively about one’s
feelings and problems rather than in terms of the specific content of thoughts” (Nolen-
Hoeksema et al., 2008). Most recently, Querstret and Cropley (2012) report a change in
the literature that now differentiates between affective and problem-solving rumination.
One of the main distinctions between these two types of rumination is that affective rumination is characterized by high psychophysiological arousal whereas problem-solving rumination is thought to occur without any arousal (Cropley & Zijlstra, 2011, as cited in Querstret & Cropley, 2012). Affective rumination, in other words, is much more intrusive than problem-solving rumination, which has also been referred to as problem-solving pondering. Other researchers have referred to these same subtypes of rumination as maladaptive rumination, which is comparable to affective rumination, and adaptive rumination, which seems to be similar to problem-solving rumination. Yet another way that the literature has defined maladaptive and adaptive rumination is as uncontrollable and controllable rumination (Raes & Williams, 2010). The distinction between these two types of rumination makes sense as a problem-solving focus generally implies that there is a goal in mind and that, once that goal is accomplished (i.e., the problem is fixed), ruminative thinking is no longer necessary and it is terminated; in an affective state of mind, however, there is no goal in mind and thus no established point at which one decides to stop ruminating. In fact, engaging in affective rumination may be an automatic process, which we will discuss in more depth in the next section.

Among working adults, rumination has been linked to poor sleep quality and fatigue. In a study of over 700 adults assessing work-related rumination, sleep quality and fatigue, Querstret and Cropley (2012) found that affective rumination is more detrimental to health and well-being than is problem-solving rumination. Specifically, affective rumination was more associated with acute and chronic fatigue, which may be indicative of overall daytime tiredness. Rumination has been found to mediate the effects of stress on sleep quality (Berset et al., 2011). This study, however, did not differentiate between
the two types of rumination proposed by Cropley and Zijistra (2011). The evidence suggests that rumination has a negative role on sleep quality and fatigue among working adults.

Although the studies thus far focus on the link between rumination and sleep in working adults, this association has also been studied in college students. Thomsen and colleagues (2003) assessed the relationship between rumination, negative emotions, and sleep quality on university students and found that not only was rumination independently associated with negative mood but it was also negatively associated with sleep quality. Participants who scored higher on trait rumination generally had worse scores on several components of sleep quality, including poor overall sleep quality, longer sleep onset and more sleep disturbances. Additionally, rumination was negatively associated with general sleep satisfaction. Given that rumination has been linked to insomnia and that pre-sleep arousing activities or thoughts (i.e., repetitive or ruminative thinking) are seen as components of bad sleep hygiene practices, rumination is a significant predictor of sleep disturbances.

Efforts have been made to experimentally assess the role of rumination on sleep quality. In 2007, Guastella and Moulds were the first to induce rumination in the laboratory in order to understand the relationship between rumination and sleep quality. Undergraduate college students were tested and identified as low and high trait ruminators and were all subject to a mid-term exam (a stressful event) before being assigned to either a pre-sleep rumination or distraction condition (thinking about a non-relevant topic). Results showed a main effect of trait rumination but none was found for stressor-specific rumination. Further, Guastella and Moulds (2007) did not find an
interaction between trait and stressor-specific rumination, suggesting that trait rumination alone can predict poorer sleep quality. Zoccola and colleagues (2009) replicated this finding and also identified an interaction between trait and stressor-specific rumination. In their study, participants were assessed for trait-rumination and stressor-specific rumination, at the beginning of the experiment and after a 5-minute speech they were asked to deliver, respectively. They found that participants who had the highest trait rumination and who engaged in the most stressor-specific rumination experienced the longest objective sleep onset latency, measured by a wrist actigraph (a device that continuously records activity and movement). In both of these studies, there seems to be a main effect of trait rumination; further, it seems that stressor-specific rumination may have some impact on sleep quality, although future work would have to replicate and expand Zoccola and colleagues’ (2009) findings to understand the extent to which stressor-specific rumination interacts with trait rumination.

Research suggests that women are more likely than men to engage in ruminative thinking (Nolen-Hoeksema & Jackson, 2001), which may explain why women experience poorer sleep quality (Breslau et al., 1996; Buboltz et al., 2001; Tsai & Li, 2004). These findings suggest that the relationship between gender and sleep quality may be mediated by rumination. However, there is not enough evidence to make a conclusive statement about the relationship between gender, rumination and sleep quality. Future work should examine the nature of this relationship and whether there is an interaction between gender and rumination or if there are only main effects of each factor on sleep quality.
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Research thus far supports a relationship between trait rumination and sleep quality, with rumination having a largely negative impact on sleep quality. We have already discussed rumination and mindfulness and their independent effects on sleep, and in the next section, we will discuss the possibility of an interaction between mindfulness, rumination, and sleep quality.

**Mindfulness, Rumination, and Sleep Quality**

Research has begun to uncover the processes by which mindfulness and rumination may be related. Although very little research has looked at both traits, there seems to be a general consensus in the literature that these two characteristics are primarily negatively associated with one another. That is, a higher level of dispositional rumination is generally correlated with lower levels of trait mindfulness (e.g., Marks et al., 2010; Ciesla et al., 2013).

Mindfulness and rumination have been found to play a role in the extent to which life stressors impact a person’s psychological well-being (Marks et al., 2010; Ciesla et al., 2012). Marks and colleagues (2010) found that trait rumination mediated the relationship between life stressors and depression, anxiety, and stress, but that trait mindfulness also mediated this same relationship. Similarly, Ciesla and colleagues (2012) found that a combination of low trait mindfulness and high daily stressors predicted dysphoric moods and that this relationship was mediated by dispositional rumination. In other words, higher levels of mindfulness predicts better mood partly because it means that one ruminates less. However, these authors do not take into account either the role of sleep or the subtypes of rumination discussed above in determining the extent to which mindfulness and rumination impact psychological well-being. These studies also do not
explain how mindfulness and rumination are related, which is critical to understand if we wish to establish a link between these two personality characteristics.

In studies looking at the effects of mindfulness-based interventions on depression, it has been “theorized that mindfulness training defuses the cognitive interlock that occurs automatically during maladaptive rumination” (Teasdale et al., 1995, as cited by Heeren and Philippot, 2011). For one, a person can decrease his or her ruminative thinking just by being more attentive and realizing that he or she engaging in a negative repetitive thought process. Secondl, by being more aware of one’s ruminative thought processes, one can actively choose to redirect these unproductive thoughts to more productive ones. Further, by having a nonjudgmental and accepting frame of mind, a person might never develop a ruminative mindset because he or she has already accepted what has happened. A person with a ruminative disposition may be more likely to focus on the causes and consequences of a negative mood, whereas a person who is more mindful might just accept that he or she is feeling down and, instead of focusing on that feeling, continue on with his or her day.

Although mindfulness has been linked to rumination, it might be that it is strongly correlated to only one type of rumination. Specifically, mindfulness may be positively linked to problem-solving rumination and negatively associated with affective rumination. Heeren and Philippot (2011) found that mindfulness training decreases maladaptive rumination and increases adaptive rumination. They described maladaptive rumination as a focus on why an action was performed and what its potential consequences might be; further, maladaptive rumination is said to reduce concreteness in thinking because it promotes negative overgeneralizations. In contrast, adaptive
rumination is defined as focusing more on the specific details of how an action was performed and is associated with more concrete thinking. When controlling for symptoms of depression, both current and prior, in college students, Raes and Williams (2010) found that mindfulness was negatively associated with uncontrollable rumination. They suggest that trait mindfulness helps individuals control their ruminative dispositions, which prevents their thoughts from escalating into an uncontrollable cycle of negative thoughts. The literature evidently supports a distinction between the subtypes of rumination and their association with mindfulness.

What the literature has not yet established, however, is how the relationship between mindfulness and rumination affects sleep quality. It seems likely that, since mindfulness and rumination have been linked to each other and independently to sleep, high trait mindfulness and low affective rumination will have significant main effects on sleep quality. Furthermore, since gender affects sleep quality and is linked to rumination, we should expect to see additive effects of gender, trait mindfulness, and trait rumination. These effects would mean that males with high trait mindfulness and low affective rumination would have the best sleep quality, while women with low trait mindfulness and high affective rumination would have the worst sleep quality.

Mindfulness, rumination, and gender seem to have a significant impact on sleep quality, but they are only a few of the factors that influence sleep. One variable that sleep researchers have identified as critical in its role on sleep quality is sleep hygiene practices, which we will discuss in the next section.

Sleep Hygiene

Sleep hygiene comprises behaviors that promote sleep quality. The National Sleep Foundation (2013) includes eight measures people can take to increase their sleep
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hygiene. These measures include not taking naps during the day, avoiding stimulants (e.g., coffee) a specified number of hours before bedtime, exercising vigorously in the mornings or lightly at night, avoiding large meals right before sleeping, ensuring adequate exposure to natural light during the day, establishing regular and relaxing routines before bedtime, spending time in bed only when sleeping, and ensuring that the sleep environment is quiet, dark and cool. Abiding by these rules and practices can lead to better sleep, which can protect people from some of the repercussions of poor sleep discussed earlier.

The 2013 National Sleep Poll, which surveyed people from the US, Canada, Mexico, United Kingdom, Germany and Japan on their sleep habits, showed that it is not just students who sleep less than the recommended eight hours a night. While eight hours is just an estimate and ideal hours asleep vary for each individual, anything significantly less than eight hours of sleep per night is likely to lead to sleep deprivation and all of the undesirable health and performance consequences of sleep deprivation. The poll showed that, in all of these surveyed countries, less than 30% of people get eight or more hours of sleep on workdays; on non-workdays, these numbers increase to approximately 50% in all countries (with the exception being Japan, with only 38% reporting eight or more hours of sleep on weekends). In the USA, 21% of people reported getting 6 or less hours of sleep on weekdays and 12% reported getting 6 or less hours of sleep on weekends; average hours asleep was 6 hours 31 minutes and 7 hours and 22 minutes on weekdays and non-workdays, respectively. Furthermore, more than 50% of participants in the USA reported napping, which is considered a poor sleep hygiene practice, in the past two weeks. These findings show that inconsistent sleep habits apply to more than just college
students, extending to the larger population. Since diminished sleep quality and quantity seem to be long-term problems that carry over into adulthood, it is critical to assess what cognitive and behavioral factors contribute to sleep.

The degree to which a person practices good sleep habits has been associated with sleep quality. In one study looking at self-reports of sleep quality and sleep hygiene in Italian and American adolescents, researchers found that cross-cultural differences in sleep quality are largely a result of sleep hygiene practices (LeBourgeous, et al., 2005). Overall, Italian adolescents had significantly better sleep hygiene practices and sleep quality compared to American adolescents. These findings suggest that sleep hygiene practices are related to sleep quality. Further, this cultural difference demands the question of why one group of adolescents has better sleep hygiene practices and quality compared to the other. One possible explanation for this difference may be young people’s attitudes towards sleep.

For students who experience poor sleep quality, it is important to improve sleep habits at a relatively young age (i.e., college) in order to prevent the onset of sleep disorders. Changes in sleep hygiene may improve the sleep quality for some people but not for others, with better sleepers being more receptive to improvements in sleep quality gained from better sleep hygiene practices. Poor sleepers (e.g., insomniacs) have an underlying pathology that they need to address and for these people, changing sleep hygiene behaviors may not be enough to improve overall sleep quality. Poor sleep hygiene practices typically are not a cause of insomnia, but may still affect sleep quality (Lacks and Rotert, 1986). More specifically, sleep hygiene practices have been directly correlated with sleep outcomes in “good sleepers” and college students (Suen et al.,
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2010), whereas they have not been to shown to have this same association in patients with insomnia (Yang et al., 2010). However, one domain of sleep hygiene, sleep-arousing behaviors, has been associated with sleep outcome in insomnia patients. These types of behaviors include doing activities in bed that are unrelated to sleep, exercising or not relaxing before sleep, and worrying about unresolved matters or one’s inability to fall or stay asleep. Some of these behaviors reflect aspects of rumination and suggest that personality traits (e.g., mindfulness and rumination) may be associated with the onset of sleep disorders.

If daily behaviors and character differences affect sleep quality, then it is feasible that changes in these factors will affect sleep quality. In the next section, we will discuss how researchers have attempted to improve sleep quality through sleep interventions.

Sleep Interventions

Research reviewed thus far has shown that poor sleep quality and quantity have both short- and long-term effects, and more recent work has begun searching for ways to improve sleep quality and quantity. One way to improve sleep is simply to ask students (and nonstudents) to sleep more. In one study, Kamdar and colleagues (2004) asked students to sleep more and found that in the first three days, students’ sleep quantity significantly increased but found that after 8-10 days, sleep quantity began to taper off (although it was still higher than baseline). They found that an increase in sleep quantity among college undergraduates was associated with improvements in daytime alertness, vigilance and mood.

Asking people to sleep more, however, is not always a practical solution. As we saw from Kamdar and colleagues’ (2004) study, asking students to sleep more may increase their sleep quantity temporarily but may not have lasting effects. The
participants in that study may not have been able to sustain their increased amount of sleep because they did not necessarily have the time to get a full night’s sleep. With the constant demands and responsibilities from school, work, friends and family, it is sometimes difficult for people to set aside a full 8 hours a night for rest. Another way to improve students’ sleep is to focus on quality and not quantity, and one way researchers have done this is by attempting to change the various sleep practices that contribute to poor sleep quality.

Psychologists and researchers concerned with the increasing sleep problems among adolescents and young adults have tried to devise nonpharmacologic solutions for improving sleep quality among this cohort as well as the population at large (Bootzin & Perlis, 1992). Some common solutions may address specific sleep problems (e.g., circadian rhythm disorders) and may be implemented on an individual basis (e.g., cognitive behavioral therapy), but addressing sleep hygiene practices may be a more general solution to improving overall sleep quality. Good sleep hygiene practices can easily be taught to large groups of people at once because they are easy to understand and require relatively small changes in people’s lives (e.g., not drinking caffeine within 6 hours of bedtime). Further, if there is no severe sleep disorder present, improving sleep hygiene practices may be enough to improve sleep quality.

Sleep education programs are one way by which researchers have attempted to improve sleep quality among adolescents and young adults. One of the earlier intervention programs was a sleep management college class implemented over the course of a semester (Tsai and Li, 2004). Each week students met and discussed a new sleep hygiene practice over the course of an 18-week semester; however, sleep patterns
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and habits did not significantly improve by the end of the course. This lack of effect may be attributed to the fact that the students who voluntarily signed up for this study may have been students who were already interested in the topic and may have had more knowledge about good sleep hygiene than the typical college student. Another explanation for the lack of effect is that the students who were in the control group were friends of the students in the class, which could have negatively influenced the data in two ways. First, friends may directly influence their friends’ sleep habits (i.e., by giving their friends advice on how to improve their sleep) and second, they may indirectly influence their friends’ sleep habits (e.g., by accommodating their sleep schedule to match their friends’).

Although the sleep management course implemented by Tsai and Li (2004) was not very effective, other interventions have had more promising results. The Sleep Treatment and Education Program for Students (STEPS) was designed by Brown and colleagues (2006) and implemented during a 30-minute oral presentation at the beginning of the semester. The topics of the lecture included the impact of poor sleep on mood and performance and an overview of good sleep hygiene practices. Compared to the control group, students who received the intervention had improved sleep hygiene practices: They napped less, went to bed hungry less often and took fewer caffeinated medications. Furthermore, while the treatment group’s quality of sleep and sleep hygiene practices improved, the control group’s worsened over the course of the first 6 weeks of the semester. Thus the STEPS program is a simple and brief sleep hygiene intervention that may prevent students’ sleep from deteriorating over the course of the semester.
In another intervention, researchers looked at the effects of two e-mail delivered programs on sleep quality and symptoms of depression (Trockel et al., 2011). The two programs, Refresh and Breathe, were delivered once a week for 2 months. Refresh is a sleep-health promotion program based on principles of cognitive behavior therapy; in contrast, the objective of the Breathe program was solely to help students improve their emotional health and to cope with stress. Trockel and colleagues (2011) found that participants in the Refresh treatment group had significantly greater improvements in sleep quality and depression scores specifically in students with poor sleep quality at baseline. Their findings suggest that sleep intervention programs implemented at colleges may be beneficial for students with poor sleep hygiene practices, but not necessarily for students whose sleep habits are already good. Furthermore, this study suggests that an intervention program delivered by e-mail, which is relatively easy for a college to incorporate into its freshman curriculum, may help students improve well-being and daily functioning by getting better sleep. Both the STEPS and Refresh programs provide preliminary insight for developing interventions that improve college students’ sleep quality.

The studies discussed thus far suggest that changing college students’ sleep practices is simple and effective given that students have room for improvement. However, some evidence suggests that simply supplying information about good sleep hygiene practices may not be enough. Awareness does not predict sleep quality – instead there may be a complex relationship between awareness, sleep hygiene practices and sleep quality (Brown et al., 2010). Brown and colleagues (2010) found no association between awareness of good sleep practices and sleep quality. What was found, however,
GENDER, MINDFULNESS, RUMINATION AND SLEEP ATTITUDES ON SLEEP QUALITY was a weak correlation between sleep hygiene awareness and practices and a strong correlation between good sleep hygiene practices and good sleep quality. This finding suggests that knowledge of good sleep hygiene practices does not necessarily coincide with good sleep quality.

In order for researchers and clinicians to be able to create successful sleep interventions, the link between sleep hygiene awareness and practices should be further explored. Some researchers have turned their attention to attitudes towards sleep in order to gain a more robust understanding of why sleep hygiene awareness sometimes does and sometimes does not translate into sleep hygiene behaviors.

**Attitudes Towards Sleep**

A common notion about college is that students must choose two of the following activities: sleeping, studying, and making friends. The belief is that college students do not have enough time to accomplish all three activities and must sacrifice one of three things: their health, grades or social life. The pressure to perform highly and to meet the demands of college life may be enough for some students to sacrifice their sleep and choose, instead, to focus their attention on their academics and social life. Further, students may have dysfunctional underlying beliefs about sleep that lead them to prioritize everything else. A few example of these beliefs may include notions that people who get a full night’s sleep have too much time or are lazy, beliefs that one could catch up on sleep anytime, or even beliefs that sleep is a general waste of time. Students who hold these beliefs firmly in mind may be more likely to engage in maladaptive sleep hygiene practices, such as not having a consistent sleep schedule.
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In order to understand why some students prioritize sleep and why others do not, we need to assess how attitudes towards sleep influence pro-sleep behaviors. One framework through which this relationship can be understood is the Theory of Planned Behavior (TPB). According to the TPB, a person must have the intention to change a behavior in order to change the behavior; this intention is driven by three factors: one’s attitude toward the behavior, the subjective norm, and level of perceived behavioral control (Ajzen, 1991). Applying the TPB to pro-sleep behaviors, we can imagine that the intention to carry out good sleep hygiene practices is driven by a positive and constructive attitude towards sleep (i.e., that sleep is important to one’s well-being and should be a priority in one’s life), the subjective norms regarding sleep (e.g., the notion that academics should precede sleep), and one’s perceived behavioral control in the implementation of proper sleep hygiene behaviors (i.e., feeling that one has the ability and means to change one’s sleep-related behaviors).

The TPB may shed light on how intentions and attitudes, which are merely a product of one’s mindset, affect sleep quality, an actual physiological experience. We know, based on our previous discussion on sleep hygiene, that behavior (i.e., good sleep hygiene practices) directly affects sleep quality. From the TPB, we learn that intentions are a key predictor of behavior; this theory suggests, as alluded to above, that students may not be making pro-sleep choices because of negative attitudes towards sleep, a subjective norm in opposition to good sleep hygiene practices, and a lack of perceived behavioral control over one’s ability to maintain pro-sleep behaviors. Therefore, because behaviors directly influence sleep quality and because behaviors are predicted by the TPB, we can hypothesize that intentions are also an important predictor of sleep quality.
A few studies have looked at the efficacy of the TPB in explaining why some interventions have been more successful than others in improving sleep hygiene practices. Knowlden and colleagues (2012), for example, reported a strong association between each of the TPB’s factors and actual behavior, with perceived behavioral control having the strongest correlation. In a review on the success of sleep intervention programs, Blunden and colleagues (2012) found that research on the efficacy of sleep intervention programs has yielded largely inconsistent results. They reviewed eight studies and four pilot studies assessing various sleep interventions among children, adolescents and college students, and found that sleep knowledge (what these interventions mainly aimed to change) did not correlate with changes in sleep duration or sleep hygiene behaviors. They argue that there may be a number of reasons why these programs did not produce the desired results and suggest that considering the TPB when designing intervention programs may maximize program efficacy.

By examining previously attempted programs, Blunden and colleagues (2012) have identified three key components for a successful program. First, it must provide information on the skills and strategies necessary in order for a person to make changes in his or her life; second, it must assert and emphasize the need for a change, which should motivate a person’s intent to change behavior; and lastly, it should target enough people that it can potentially change the greater social norm.

More recent work on the implementation of sleep hygiene practices has looked at additional processes that drive pro-sleep behaviors. Kor and Mullan (2011) looked at Australian undergraduate students’ sleep hygiene behaviors and found that, in addition to the factors that contribute to intention, past behavior and response inhibition were also
GENDER, MINDFULNESS, RUMINATION AND SLEEP ATTITUDES ON SLEEP QUALITY positively correlated with behavioral outcomes. Response inhibition, which is a facet of self-regulation, may be responsible for a student’s ability to resist tempting alternatives to sleep. For example, if one’s peers are staying up late and watching a movie, one may be tempted to join in on the fun but a high response inhibition would allow one to inhibit the impulse to join the novel or desirable activity and instead do what is more practical (e.g., get a full night’s sleep before an exam).

A follow-up study by Todd and Mullan (2013) suggested that behavior could be even better explained if self-regulation is incorporated into the original TPB model. They found that two facets of self-regulation – cognitive flexibility and behavioral inhibition (or response inhibition) – were correlated with sleep hygiene. The combined research on the topic suggests that past behavior and cognitive flexibility (i.e., the willingness to change one’s thoughts and actions in order to be more proactive about one’s health) were important predictors in the implementation of sleep hygiene behaviors. Although these studies provide little insight as to how to improve sleep hygiene through an intervention program, they do suggest that these programs must do more than just inform students of good sleep practices.

Sleep intervention programs may be able to better address the role of attitudes and intentions in adherence to good sleep hygiene practices by asking students to reflect on their own sleep hygiene behaviors and on how they could improve these practices. If students were asked to actively reflect on their own behaviors as they relate to the material they are exposed to (i.e., during the intervention), they may be better able to realize ways by which they can improve their own sleep hygiene. Students may realize, for example, that their sleep hygiene is quite different from healthy sleep hygiene.
practices and, moreover, may realize that a few small changes in daily behavior may improve their sleep quality. Further, if he or she is asked specifically to think of how he or she could implement these changes, an intention to work towards better sleep habits may be created. A reflection exercise after a sleep education intervention may be one means by which sleep intervention programs can more successfully improve sleep quality, although no such studies, to the best of our knowledge, exist.

As we have seen, there have been many attempts to improve sleep quality and some have been more successful than others. Since sleep is crucial to physical and psychology well-being, as well as performance, an effective sleep intervention program could improve the lives of many students. We have also seen, however, that the etiology of poor sleep is complex and that many factors contribute to a good night of sleep. Specifically, we have addressed the role of mindfulness, rumination, sleep hygiene practices, and attitudes and intentions towards the importance of sleep as they relate to sleep. In the present study, we aim to try to improve sleep quality among college students and to also investigate what factors prevent students from implementing the good sleep hygiene practices discussed in the intervention that would help improve their sleep quality.

**The Present Study**

Many factors contribute to quality of sleep but some factors may be easier to change than others. Some sleep hygiene practices are behaviors that college students may be able to change easily and may have the potential to improve their sleep quality. As a result, we decided to expand on previous efforts to change sleep habits and designed a comprehensive research question that also addresses the role of attitudes and perceived
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self-efficacy as potential barriers to the implementation of the sleep hygiene behaviors. A central question in our investigation is whether attitudes towards sleep at baseline will have an effect on changes in sleep hygiene practices post-intervention. In addition, we raise the question and possibility that this sleep education intervention will improve levels of trait mindfulness.

Hypotheses

Based on the reviewed literature on lifestyle factors, personality traits and previously implemented sleep interventions, we made the following hypotheses:

H1: A brief sleep hygiene intervention will significantly improve sleep quality in the treatment versus control group.

H1a: The relationship between sleep education and improved sleep quality will be mediated by improved sleep hygiene practices.

H1b: Attitudes towards the importance of sleep will moderate the relationship between the intervention and sleep quality, so that students with better attitudes towards sleep will experience more improvement in their sleep quality compared to students with worse sleep attitudes.

H1c: Participants assigned to the intervention who were also asked to reflect on how they could implement better sleep hygiene practices into their own lives will have larger improvements in sleep quality at follow-up compared to participants assigned to the intervention who were asked to reflect on how they could improve their time management skills.

H2: Trait mindfulness and rumination will have a main effect on sleep quality.
H2a: Higher scores on trait mindfulness will be associated with better sleep quality.

H2b: Higher scores on affective trait rumination will be correlated with poorer sleep quality.

H2c: Higher scores on problem-solving rumination (i.e., adaptive rumination) will be correlated with better sleep quality.

H3: Trait mindfulness will have a main effect on the number of barriers participants report at post-intervention, such that participants with higher trait mindfulness will report fewer barriers to implementing good sleep hygiene practices at post-intervention than participants with lower trait mindfulness.

H4: Gender will have a main effect on sleep quality.

H4a: Women will have significantly worse sleep quality than men.

H4b: The relationship between gender and sleep quality will be mediated by rumination.

H4c: There will be additive main effects of gender, rumination type and trait mindfulness, such that male participants with higher trait mindfulness and lower levels of affective rumination will experience the best sleep quality and women with low trait mindfulness and high levels of affective rumination will experience the worst sleep quality.

**Method**

**Design**
This study was a pre-post randomized controlled trial, in which three introductory psychology classes were randomized to either a sleep education intervention or control condition. Within the groups receiving the intervention program, students were randomized into one of two post-lecture reflection prompts. Half the students received a reflection prompt asking them to respond to and reflect on the information they received from the intervention, while the other group was asked to respond to an unrelated control prompt. Participants completed questionnaires at baseline, two weeks and four weeks post-intervention. Questionnaires were identical for all participants, with the exception that participants in the experimental group received a brief measure asking about what prevented them from implementing the knowledge of good sleep hygiene practices they received during the intervention.

Participants

We recruited students from three introductory psychology courses at a private liberal arts college in the northeastern United States. All students, regardless of condition, were asked to complete baseline and follow-up questionnaires. Students were given the opportunity to participate in the current study at the beginning of the semester and were compensated for their participation with course credit and small monetary incentives at various points of the study.

Intervention Description

The intervention was adapted from Clark (2010) and included a slide presentation on sleep hygiene guidelines. The presentation focused on the importance of sleep and on the ways that students can improve their sleep quality, including information on when to go to bed, what common beverages have caffeine and when to stop consuming these beverages, and advice against using electronics in bed. In her presentation guidelines,
Clark also included a script, which was also used in the present study in conjunction with the PowerPoint slides. The length of the presentation was approximately 30 minutes and was administered by a Psychology faculty member, who is also the advisor of the current study.

**Measures**

**Demographics.** Sex, age, year in school, race, living situation (i.e. whether or not the participant has a roommate) and overall college Grade Point Average (GPA) were collected as demographics at baseline.

**Sleep Quality.** The Pittsburgh Sleep Quality Index (PSQI) is a 19-item measure of sleep quality and sleep disturbances over a one-month time period. PSQI measures distributed at the follow-up assessments asked for self-reported sleep quality and disturbances over the previous week. The items assess seven components of sleep: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. Questions are given a score of 0-3 points; “good” sleepers are those individuals with an overall PSQI score of less than five, while “poor” sleepers are those individuals with an overall PSQI score of greater than five. In addition to indicating acceptable levels of internal homogeneity, test-retest reliability and validity, Buysse and colleagues (1989) found that the PSQI yielded a sensitivity of 89.6% and a specificity of 86.5%. See Appendix A for a full copy of this measure.

**Sleepiness.** The Epworth Sleepiness Scale was developed by Murray Johns (1991) in order to assess a person’s usual level of daytime sleepiness. Seven items inquire about the likelihood that one will fall asleep during certain activities (e.g. while reading,
watching television or talking to someone) and are rated on a scale of zero (no chance of
dozing) to three (high chance of dozing). A total score between zero and seven indicates
that a person is unlikely to be abnormally sleepy, scores between eight and nine indicate
an average amount of daytime sleepiness, 10 to 15 indicates a possibility of having
excessive sleepiness, and scores above 16 indicate excessive sleepiness. ESS was found
to have a high level of internal consistency with a Cronbach’s alpha of .82 (Johns, 1992).
See Appendix B for a full copy of this measure. Analysis of test-retest reliability
demonstrated strong coefficients across time, .5 9-.71.

**Sleep Hygiene.** The Sleep Hygiene Index (SHI) is a 13-item self-report measure
assessing sleep hygiene practices with a higher score suggesting poorer sleep hygiene
practices (Mastin et al., 2006). Items are rated on a 5-point Likert scale, with zero
indicating that a participant never engages in that specific practice and five indicating that
a participant always engages in that practice. The SHI includes questions such as “I go to
bed feeling stressed, angry, upset or nervous” and “I take daytime naps lasting two or
more hours.” Test-retest reliability was determined to be good (r = .71) and Cronbach’s
alpha (.66) was adequate (Mastin et al., 2006). See Appendix C for a full copy of this
measure.

**Circadian Preference.** Smith and colleagues (1989) conducted a factor analysis
on three pre-existing scales assessing morning and evening preferences and developed a
composite measure of circadian preferences. An evening preference indicates that an
individual’s peak in terms of concentration and performance is in the evening hours,
while a morning preference suggests that this peak occurs earlier in the day. Further,
circadian preferences measure whether people are more likely to stay awake late into the
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night or wake up early. The 13-item measure is scored on a Likert-type scale, with some
questions having a total of four points and others having a total of five points, with a total
score under 22 indicating an evening preference and a total score over 44 indicating a
clear morning preference. Sample items include “How alert do you feel during the first
half hour after having awakened in the morning?” and “When would you prefer to rise
(provided you have a full day’s work – 8 hours) if you were totally free to arrange your
time?” Predictive and construct validity were found to be high (Guthrie et al., 1995). See
Appendix D for a full copy of this measure.

**Rumination and Reflection.** A 16-item short form of the Rumination-Reflection
Questionnaire was used as the measure of rumination in the current study. The original
Rumination-Reflection Questionnaire is a 24-item measure assessing adaptive and
maladaptive rumination (Trapnell & Campbell, 1999). Half of the questions are designed
to assess trait rumination, while the other half assesses a more reflective subtype of
rumination. Items are rated on a five-point Likert-type scale, with one indicating strong
disagreement and five indicating strong agreement. Alpha reliabilities were assessed for
two shorter versions of the scale, one with six items for each measure and one with eight
items, and they were found to be comparable to that of the original 24-item scale. The 16-
item short form was found to have slightly higher reliability (Cronbach’s $\alpha = .83$ and $\alpha =
.84$ for rumination and reflection, respectively) than the 14-item short form (Cronbach’s $\alpha =
.77$ and $\alpha = .81$ for rumination and reflection, respectively). See Appendix F for a full
copy of this measure.

**Mindfulness.** Baer and colleagues (2006) developed a 39-item instrument
assessing trait mindfulness after conducting a factor analysis on existing measures of

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mindfulness. A 20-item short form of the Five-Facet Mindfulness Questionnaire (FFMQ) was used in the current study. Items are rated on a 5-point Likert-type scale and assess the following facets: nonreactivity to inner experience ($\alpha = .75$); observing or attending to sensations, perceptions, thoughts and feelings ($\alpha = .83$); acting with awareness, concentration and nondistraction ($\alpha = .87$); describing and labeling with words ($\alpha = .91$); nonjudging of experience ($\alpha = .87$). Reliability analysis revealed that Crombach’s alpha was also high in the current study ($\alpha = .77$). Examples of items include “When I do things, my mind wanders off and I’m easily distracted” and “I watch my feelings without getting lost in them.” The FFMQ has been shown to have good construct validity (Baer et al., 2008). See Appendix E for a full copy of this measure.

**Attitudes Toward Sleep.** The 12-item Attitudes Toward Sleep questionnaire was developed specifically for the purpose of this study. The items were designed to assess attitudes towards the importance of sleep and include participants’ agreements or disagreements with statements such as “Sleep is a waste of time” and “I can always catch up on sleep on the weekend.” Items are rated on a 7-point Likert-type scale, with a 1 indicating that a participant “[disagrees] very much” and a 7 indicating that a participant “[agrees] very much.” The Attitudes Toward Sleep scale had good internal consistency ($\alpha = .88$), but was found to have a higher Crombach’s Alpha without one item. The item, “I think that sleeping is a luxury” was removed in order to strengthen the reliability of ATS scale ($\alpha = .88$). See Appendix G for a full copy of this measure.

**Procedure**

Participants in all three course sections were given a baseline questionnaire during the fourth week of the semester. Surveys were sent to all students, and participants were
invited to complete questionnaires on their own time. Students received .5 course credits for completion of the baseline survey. Participants in the experimental group were then subjected to a thirty-minute presentation on the importance of sleep and sleep hygiene practices during normal class time. The control group had their normal class session. Students in the experimental group were discouraged from discussing the contents of the sleep hygiene education intervention with students in other classes.

Students in the experimental group were randomized to complete a brief online follow-up survey asking them to reflect on one of two prompts. Half of the students were asked to write about how they would implement the sleep hygiene guidelines in their own lives while the other half were asked to write about how they planned to manage their time for the remainder of the semester.

All participants were asked to complete follow-up questionnaires at two and four-weeks post-intervention. Students in the experimental groups received a questionnaire that included the following measures: PSQI, ESS, SHI, barriers to implementing sleep hygiene guidelines, attitudes towards sleep, and mindfulness. Students in the control group were given the same follow-up questionnaires, but were not asked about what prevented them from implementing the sleep hygiene guidelines. Participants received .5 course credit for completing the first follow-up, and $5 for completing the second follow-up. Participants who completed all parts of the study were entered into a $50 lottery.

**Data Analysis**

All participants who completed baseline and follow-up questionnaires were included in the statistical analyses performed on IBM SPSS. To check for baseline between-group differences in students’ PSQI, ESS, SHI, CSM, FFMQ, RRQ, and
attitudes toward sleep, we will conduct one-way ANOVAs with condition as a between-subjects factor.

To test hypothesis 1, a 3x2 repeated measures Analysis of Variance with three levels of time and a between-subjects factor of condition will be used to assess the impact of the sleep education intervention on sleep quality. Hypotheses 1a and 1b will first be tested using one-way ANOVAs. If main effects are found for hypothesis 1a, a linear regression will be run to test for if the path between the intervention and improved sleep quality is improved by participants’ attitudes toward sleep. A 3x2 repeated measures ANOVA with three levels of time and a between-subjects factor of condition will also be used to test hypothesis 1c, which predicted that participants who were assigned to the sleep reflection condition will show larger improvements in sleep quality compared to those who were assigned to the time management reflection group.

Hypothesis 2 will be tested using one-way ANOVAs and correlations. Specifically, the ANOVAs will be used to test for main effects of mindfulness and rumination on sleep quality. Correlations will also be used to confirm findings. One-way ANOVAs with barriers as the dependent variable and mindfulness as a covariate will be used to test hypothesis 3 predicting that mindfulness will moderate the amount of barriers reported at both follow-up assessments. Lastly, two one-way ANOVAs will be used to test hypotheses 4a and 4b, which make predictions about gender differences in sleep quality and rumination. In order to test the effects of one variable above and beyond those of another for hypothesis 4c, gender, trait mindfulness, and trait rumination will be entered into a linear regression model as continuous predictors and sleep quality will be entered as the outcome.
Results

Participants

A total of 52 participants completed the components necessary to be considered eligible for data analysis. Participants were included in data analysis if they completed baseline and at least one follow-up survey. Thirty-three participants in the experimental group (male, 12; female, 22) and 19 participants in the control group (M = 9, F = 8) completed baseline and at least one follow-up measure. The 33 participants in the experimental group were randomized into a time-management or no reflection group (N = 16) and a sleep reflection group (N = 17). The flowchart in Figure 1 provides a complete breakdown of which participants completed which follow-up measures.

Figure 1. Participant Flowchart
Descriptive statistics revealed that participants primarily held freshmen (N=37, 68.5%), sophomore (N = 11, 20.4%), or junior (N = 4, 7.4%) statuses. Most students categorized themselves as “White” (N=41, 75.9%), followed by “Chinese” (N = 5, 9.3%) and Hispanic or Latino (N = 2, 3.7%). Most participants reported having their own room (N = 33, 61.1%) or having one roommate (N = 18, 33.3%). One participant reported living off campus with a roommate. Lastly, participants’ Grade Point Averages (GPAs) ranged from 2.7 to 4.0 (M = 3.53, SD = 0.252). Table 1 provides a complete breakdown of participant characteristics.

Table 1. Baseline Demographics Table

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<tr>
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<td>2</td>
<td>4%</td>
<td>2</td>
<td>4%</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>1</td>
<td>2%</td>
<td>2</td>
<td>4%</td>
</tr>
<tr>
<td>Non-Hispanic</td>
<td>32</td>
<td>62%</td>
<td>17</td>
<td>33%</td>
</tr>
<tr>
<td>Housing</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>23</td>
<td>44%</td>
<td>10</td>
<td>19%</td>
</tr>
<tr>
<td>Roommate</td>
<td>10</td>
<td>19%</td>
<td>8</td>
<td>15%</td>
</tr>
<tr>
<td>Off Campus</td>
<td>0</td>
<td>0%</td>
<td>1</td>
<td>2%</td>
</tr>
</tbody>
</table>

Outcome Variables

A one-way ANOVA was run to check for between-group baseline differences. There were no significant between-group differences in scores for the SHI, $F(1,50) = .003, p = .958$; the CSM circadian preference scale, $F(1,39) = 2.467, p = .124$; the ESS, $F(1,50) = .450, p = .505$; the global PSQI, $F(1,43) = 1.605, p = .212$; the FFMQ, $F(1,50)$
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= .492, \( p = .486 \); or the RRQ, \( F(1,50) = .944, p = .336 \). Between-group baseline differences were only observed for the Attitudes Toward Sleep questionnaire, \( F(1,50) = 8.694, p = .005 \), with worse sleep attitudes occurring in the control group (M = 47.21, SD = 8.52) than in the experimental group (M = 37.42, SD = 12.91). Table 2 provides a breakdown of differences in means between experimental and control subjects.

### Table 2. Baseline Clinical Characteristics Table

<table>
<thead>
<tr>
<th></th>
<th>Experimental Mean</th>
<th>Experimental SD</th>
<th>Control Mean</th>
<th>Control SD</th>
<th>( F )</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global PSQI</td>
<td>5.37</td>
<td>2.06</td>
<td>6.33</td>
<td>3.05</td>
<td>1.602</td>
<td>.212</td>
</tr>
<tr>
<td>SHI</td>
<td>36.18</td>
<td>5.53</td>
<td>36.26</td>
<td>5.13</td>
<td>.003</td>
<td>.958</td>
</tr>
<tr>
<td>ESS</td>
<td>8.79</td>
<td>3.38</td>
<td>9.47</td>
<td>3.84</td>
<td>.450</td>
<td>.505</td>
</tr>
<tr>
<td>CSM</td>
<td>31.21</td>
<td>6.02</td>
<td>28.17</td>
<td>4.53</td>
<td>2.467</td>
<td>.124</td>
</tr>
<tr>
<td>FFMQ</td>
<td>63.70</td>
<td>8.36</td>
<td>61.89</td>
<td>9.84</td>
<td>.492</td>
<td>.486</td>
</tr>
<tr>
<td>RRQ</td>
<td>55.76</td>
<td>10.80</td>
<td>58.42</td>
<td>6.65</td>
<td>.944</td>
<td>.336</td>
</tr>
<tr>
<td>Ruminative</td>
<td>28.88</td>
<td>5.81</td>
<td>31.73</td>
<td>5.74</td>
<td>2.940</td>
<td>.093</td>
</tr>
<tr>
<td>Reflective</td>
<td>26.88</td>
<td>7.72</td>
<td>26.68</td>
<td>1.29</td>
<td>.009</td>
<td>.924</td>
</tr>
<tr>
<td>Attitudes Toward Sleep</td>
<td>37.42</td>
<td>12.91</td>
<td>47.21</td>
<td>8.53</td>
<td>8.694</td>
<td>.005</td>
</tr>
<tr>
<td>Luxury</td>
<td>4.00</td>
<td>1.73</td>
<td>4.42</td>
<td>1.77</td>
<td>.700</td>
<td>.407</td>
</tr>
<tr>
<td>Not normal</td>
<td>3.12</td>
<td>1.60</td>
<td>3.89</td>
<td>1.60</td>
<td>2.834</td>
<td>.099</td>
</tr>
<tr>
<td>Importance Varies</td>
<td>3.82</td>
<td>1.93</td>
<td>5.58</td>
<td>1.02</td>
<td>13.590</td>
<td>.001</td>
</tr>
<tr>
<td>Sleep can be made up</td>
<td>3.15</td>
<td>1.79</td>
<td>3.63</td>
<td>1.80</td>
<td>.865</td>
<td>.357</td>
</tr>
<tr>
<td>Sleep means laziness</td>
<td>2.12</td>
<td>1.02</td>
<td>2.58</td>
<td>1.43</td>
<td>1.801</td>
<td>.186</td>
</tr>
<tr>
<td>Waste of time</td>
<td>1.85</td>
<td>1.30</td>
<td>3.05</td>
<td>2.04</td>
<td>6.767</td>
<td>.012</td>
</tr>
<tr>
<td>First thing I give up</td>
<td>4.36</td>
<td>1.82</td>
<td>5.26</td>
<td>1.70</td>
<td>3.101</td>
<td>.084</td>
</tr>
<tr>
<td>Norm is lack of sleep</td>
<td>3.82</td>
<td>1.88</td>
<td>4.68</td>
<td>1.20</td>
<td>3.523</td>
<td>.077</td>
</tr>
<tr>
<td>Unproductive</td>
<td>2.36</td>
<td>1.48</td>
<td>3.11</td>
<td>1.88</td>
<td>2.485</td>
<td>.121</td>
</tr>
<tr>
<td>Mental toughness</td>
<td>2.61</td>
<td>1.78</td>
<td>2.63</td>
<td>1.50</td>
<td>.003</td>
<td>.958</td>
</tr>
<tr>
<td>Social life first</td>
<td>3.03</td>
<td>1.49</td>
<td>3.84</td>
<td>1.46</td>
<td>3.629</td>
<td>.063</td>
</tr>
<tr>
<td>Sacrifice sleep to succeed</td>
<td>3.18</td>
<td>1.76</td>
<td>4.53</td>
<td>1.39</td>
<td>8.155</td>
<td>.006</td>
</tr>
</tbody>
</table>

A break down of PSQI items revealed that students slept just after midnight (M = 12:37, SD = 2.09) and had an average sleep onset of 16.62 minutes (SD = 11.27). Students self-reported their subjective quality of sleep as “fairly good” (M = 2.06, SD = .57), with 1 indicating “very good” and 4 indicating “bad.”

Descriptive statistics for attitudes toward sleep at baseline were also obtained for each component of the Attitude Toward Sleep scale, with higher numbers reflecting
Hypothesis Testing

Hypothesis 1. To test the first hypothesis, a 3x2 repeated measures ANOVA was run with three levels of time and two groups (experimental and control). No significant results were found for PSQI changes over time ($p = .200, F = 1.725$), or for time and group interaction ($p = .486, F = .500$). Because no significant changes over time were observed in either the experimental or control groups, hypothesis 1a could not be tested. In other words, we could not assess if sleep hygiene practices mediated the relationship between the intervention and sleep quality because there was no change in sleep quality from baseline to post-intervention. In order to test hypothesis 1b, a one-way ANOVA was run to assess for main effects of condition and attitudes. No observed main effect of the intervention, $F(1,43) = 1.605, p = .212$, or attitudes towards sleep, $F(1,40) = 2.376, p = .131$, were found. There was no moderation effect of attitudes and group on overall sleep quality.

Hypothesis 1c was also tested using a 3x2 repeated measures ANOVA with three levels of time and two groups (sleep reflection, time management/no reflection). No significant results were found, suggesting that PSQI scores did not change more if participants were in one reflection type group versus another, $F(1,18) = .544, p = .470$. Thus, hypotheses 1 through 1c were not supported.

Hypothesis 2. Multiple one-way ANOVAs were run to test whether trait mindfulness and trait rumination had any main effects on sleep quality. Hypothesis 2 was partially supported. While baseline measures of trait rumination did not reveal a
significant main effect on sleep quality, $F(1,43) = 1.222, p = .275$, baseline measures of trait mindfulness had a significant main effect on PSQI scores, $F(1,43) = 4.303, p = .044$. Further, a Pearson correlation revealed a significant negative correlation between trait mindfulness and PSQI scores at baseline, $r = -.302, n = 45, p = .044$, supporting hypothesis 2a. Since a higher PSQI score reflects poorer sleep quality, a significant negative correlation means that trait mindfulness was significantly correlated with better sleep quality. There were no significant correlations between PSQI scores and composite rumination scores ($p = .275, r = .166$) or problem-solving rumination scores ($p = .994, r = -.001$). Therefore, hypotheses 2b and 2c were not supported.

**Hypothesis 3.** Two one-way ANOVAs were run with barriers at follow-up 1 and 2 as the dependent variables and baseline trait mindfulness as the covariate in order to test hypothesis 3, which predicted that the amount of barriers participants report at the first and second follow-up will be moderated by mindfulness. Trait mindfulness did not have a main effect on the amount of barriers reported at the first follow-up, $F(1,47) = 1.308, p = .259$, or at the second follow-up, $F(1,20) = .312, p = .583$. Thus, hypothesis 3 was not supported.

**Hypothesis 4.** To test whether there was a gender effect on global PSQI scores at baseline, a one-way between subjects ANOVA was run. Results revealed no significant differences in sleep quality between males ($M = 5.52, SD = 2.60$) and females ($M = 5.81, SD = 2.51$) at baseline, $F(2,42) = .463, p = .633$. Hypothesis 4b, which predicted that the relationship between gender and sleep quality would be mediated by rumination, was tested using a one-way ANOVA with trait rumination, affective rumination and problem-solving rumination as the dependent variables. There were no significant between-group
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Differences of RRQ composite scores for gender, with women (M = 57.97, SD = 9.92) and men (M = 54.52, SD = 8.74) scoring similarly, $F(2,49) = 1.309, p = .279$. No significant between-subjects effects were found for affective rumination, $F(2,49) = 1.013, p = .371$ or problem-solving rumination, $F(2,49) = .652, p = .525$.

To test hypothesis 4c and in the interest of testing the effects of one variable above and beyond another, we ran a linear regression model with gender, trait mindfulness and trait rumination as continuous predictors and sleep quality as the outcome. Results indicate that there were no significant main effects for gender ($p = .552, t = .599$) or trait rumination ($p = .313, t = 1.021$). Trait mindfulness was the only significant predictor of sleep quality ($p = .043, t = -2.086$). This result is corroborated by the results from hypothesis 2a, which revealed a significant negative relationship between FFMQ and PSQI scores ($p = .044, r = -.302$).

Additional Results

Additional analyses revealed several significant Pearson correlations. Table 3 provides values for all exploratory correlational analyses. Trait mindfulness and affective rumination, $r = -.465, p = .001$, and trait mindfulness and problem-solving rumination, $r = .466, p = .001$. Trait mindfulness was also significantly negatively correlated with attitudes towards sleep, $r = -.303, p = .01$. As was predicted by hypothesis 2a and was also shown in the preceding hypothesis testing section, PSQI scores were significantly negatively correlated with mindfulness scores, $r = -.302, p = .01$. Surprisingly, PSQI scores were also correlated with participants’ living arrangements, so that participants with roommates scored lower on PSQI than participants without roommates, $r = -.367, p = .01$. The reflective component of the RRQ was significantly negatively correlated with
attitudes toward sleep, such that higher problem-solving rumination was associated with healthier sleep attitudes, $r = -0.338$, $p = 0.01$. Lastly, a significant negative correlation was found between attitudes and CSM, indicating worse attitudes toward sleep in participants who have a preference for the night than in participants who have a morning preference, $r = -0.350$, $p = 0.01$.

A between-subjects ANOVA was used to test whether FFMQ scores changed as a result of the sleep education intervention. No significant changes were found, $F(1,32) = 2.326$, $p = 0.137$, but there was a small improvement in FFMQ scores in the experimental compared to the control group. Figure 2 shows this difference, although we should keep in mind that these are non-significant findings.
Due to high correlations between sleep quality, trait mindfulness, and participants’ living situations, two one-way ANOVAs were run in order to test for main effect of living situation on PSQI and FFMQ scores. We found a significant between-subjects effect of living situation on PSQI scores, $F(2,42) = 4.087, p = .024$, so that participants with their own rooms had poorer sleep quality ($M = 6.48, SD = 2.69$) than participants who had a roommate ($M = 4.53, SD = 1.48$). Furthermore, a significant between-subjects effect of living situation was also found for mindfulness scores, $F(2,49) = 4.331, p = .019$, so that participants with their own rooms scored lower on the FFMQ
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(M = 60.55, SD = 7.97) than did participants who had a roommate (M = 67.72, SD = 9.03).

Discussion

Hypothesis Testing

Our first hypothesis was not supported, indicating that the sleep education intervention did not improve students’ sleep quality. As discussed in the introduction of this paper, researchers have had varying success with sleep education programs in the past. Clark (2010) found a significant between-subjects effect of the sleep education intervention, which was also used for the current study. However, the sample size in that study (N = 834) was much larger than that in the current research and may provide a partial explanation for the current lack of significant results. The inconsistency between our data and data from previous research suggests either that the effects of the particular sleep intervention used are small (and thus, only noticeable in larger sample sizes) or that a sleep education presentation may not be enough to profoundly improve sleep quality.

Since participants’ reported sleep quality did not change from baseline to post-intervention, it was difficult to assess whether improvements in sleep hygiene practices or attitudes towards sleep would have mediated any changes. Thus, hypothesis 1a was not supported, indicating that sleep hygiene practices did not mediate the changes in sleep quality from baseline to post-intervention. The relationship between the intervention and sleep quality was not moderated by attitudes toward the importance of sleep because there was no significant effect of attitudes on sleep quality. Further, there was no found main effect of attitudes on sleep quality and thus, hypothesis 1b was also not supported.
Results did not support hypothesis 1c as there were no significant differences in sleep quality between the sleep reflection and the time management reflection group. Although it was hypothesized that the sleep reflection would improve sleep quality, these lack of significant results are not necessarily surprising. It is also possible that the sleep reflections did not aid improvements in sleep quality because students did not put much thought or effort into the reflection activity. Students who were asked to reflect on the sleep presentation may not have been paying full attention during the lecture, or may have forgotten some of the guideline details when they did sit down to write the reflection, which may have been on the day of the presentation or as late as three days after. If students waited until the last minute to fill out the reflection and did not pay attention to the presentation, they would have not benefited from the activity in the way that we had anticipated. Similarly, the presentation may not have produced the predicted results because students may not have been listening. This may be due to a lack of accountability for any of the information presented during the presentation.

In line with hypothesis 2a, results confirmed that trait mindfulness had a main effect on sleep quality. In other words, participants who were more mindful at baseline slept better. Students who score higher on mindfulness may be more likely to sleep better because when they lie down to go to sleep, they are probably more aware of the present moment and less likely to engage in distractive activities such as thinking about what they did the day before or what they need to be doing the next day. The literature has shown that mindfulness-based interventions, which are designed to increase participants’ trait mindfulness, improve sleep quality. The current study provides preliminary supportive evidence for the strong relationship between mindfulness and sleep.
Hypotheses 2b and 2c, however, were not supported, and no significant correlations were found between affective rumination, problem-solving rumination, and sleep quality. The lack of significant correlations is surprising given that affective rumination was significantly negatively correlated with mindfulness and problem-solving rumination was significantly positively correlated with mindfulness. One possible explanation for this result is that high trait ruminators may not be high ruminators at bedtime. Since the cohort used for this study were college students, it is possible that students were so exhausted from meeting the demands of college expectations (i.e., classes, work, extracurricular activities, social obligations, etc.) that they fall asleep soon getting into bed (M = 16.62 minutes). This would account for why mindfulness and both subtypes of rumination were correlated, but the subtypes of rumination and sleep quality were not.

Although sleep quality was associated with mindfulness, there were no significant changes in sleep quality or sleep hygiene practices over time. Hypothesis 3, which postulated that trait mindfulness would moderate the impact of the intervention on sleep hygiene practices, was not supported. The intervention did not work as anticipated, and students’ sleep hygiene practices did not change from baseline to post-intervention. Further, we did not find any evidence that students who scored higher on trait mindfulness also implemented better sleep hygiene practices into their daily lives after the presentation. The lack of significant results here does not suggest that mindfulness would not have had an effect on the implementation of sleep hygiene practices. It is more likely that it reflects a lack of intentionality on the part of the student participants to apply the suggested guidelines into their own lives. In the introduction, we discussed the role of
intentionality in the Theory of Planned Behavior. As was stated previously, the TPB proposes that behavior is a direct result of intention, which is shaped by one’s attitude toward the behavior, the subjective norm, and the level of perceived behavioral control. Using the TPB as basis, we can postulate that one reason participants did not implement better sleep hygiene practices after the presentation was not due to low trait mindfulness, but actually due to their lack of intention to make behavioral changes.

Hypothesis 4a was not supported, suggesting that college men and women experience similar sleep quality. However, although not significant, there was a small gender difference in the current study. Women scored just slightly worse on the PSQI than men, which points toward the possibility that college may be the start of a downward progression in sleep quality for women. As discussed earlier, research has shown that men experience better sleep quality than women. It remains unclear why these past findings were not supported in the current study, but one possible explanation is that the lack of significant results in the current study suggests that men and women experience similar sleep quality up until their college years. Hypothesis 4b was not supported due to a lack of significant differences between men and women’s sleep quality. In other words, rumination did not account for any variance in sleep quality. Analyses for hypothesis 4c revealed that trait mindfulness to be a significant predictor of sleep quality. Refer to the discussion for hypothesis 2a for a more meticulous discussion on the relationship between mindfulness and sleep quality. Hypothesis 4c did not find gender and rumination to be significant predictors of sleep quality, which makes sense given that neither gender nor trait rumination had a main effect on PSQI scores.

**Exploratory Analyses**
Additional analyses found a small trend towards an increase in mindfulness scores over time. Although not significant, FFMQ scores in the experimental group gradually increased while those in the control group gradually decreased. This makes sense given that previous findings and the current study have shown that sleep quality and trait mindfulness are related. It follows that if sleep quality improves, trait mindfulness would also improve. Thus, contingent on the success of future interventions, this result suggests a possibility for mindfulness scores to improve with enhanced sleep quality.

Lastly, exploratory analyses showed that participants who lived with roommates scored higher on mindfulness and also experienced better sleep quality. These findings were unexpected, and may reflect a self-selection bias in students’ living situations. Students who chose to live with a roommate may have been more mindful and had better sleep quality from the beginning. Hence, they may have been more comfortable sharing a room and accommodating to another person’s needs. Furthermore, by accommodating to each other’s needs, roommates may be creating and following a more regular schedule than they normally would have followed. While no supportive evidence for this phenomenon exists in the literature to date, the current findings can be taken as preliminary data that future researchers should explore.

Implications

The current study reaffirms previous findings that sleep hygiene interventions are difficult to implement, and produce mixed results, among college students. The thirty-minute presentation that was used as an intervention in this study was not adequate to produce changes in students’ sleep hygiene behaviors. In other words, the intervention did not significantly change students’ attitudes toward sleep. Further, because students’
overall sleep quality did not improve, we can deduce that their understanding of the subjective norm or their perceived behavioral control over their own sleep hygiene habits were also not modified by the study. If we define behavioral change, as TPB defines it, to consist of the above three components, then we can assume that the intervention failed to meet one or more of these components. The intervention was unlikely to change the subjective norm about healthy sleep habits as it was delivered to only 56 students. Even if it successfully changed the subjective norm of the 56 students who attended the presentation, it could not have changed the norm for the remainder of the students at this college. The intervention also did not have much control over changing students’ perceived behavioral control over their sleep hygiene habits. Participants largely felt that their recreational activities and established personal habits prevented them from changing their sleep hygiene behaviors, which is a factor that the intervention had no control over. For example, some students reported that they did not keep a regular sleep schedule even on weekends because of homework, athletic team meetings, or social events. While the intervention had the potential to alter students’ attitudes, the results suggest that for this study, this was not the case. It is unclear why the current intervention failed to reproduce significant findings from previous studies, but one explanation for this lack of consistency in the literature is timing of follow-up. Kamdar and colleagues (2004) were able to get students to sleep more immediately after asking them to, but the effects of their intervention lasted only several days. Likewise, it is possible that the current intervention produced immediate effects that our follow-up assessments were unable to catch due to timing. If follow-up questionnaires were administered several days post-intervention, we may have observed different results. It is also possible, however, that
these lack of findings suggest that a typical lecture may not be a good format for producing sleep-related changes in college students.

Variations in trait mindfulness has been shown to have a wide range of effects on health, and the current research has provided support in favor of these findings. Our only fully supported hypothesis involved the positive relationship between mindfulness and sleep quality. The close relationship between mindfulness and sleep quality, as well as the negative correlation between mindfulness and affective rumination, suggests that mindfulness is a trait that sleep researchers should focus on more. If mindfulness has the ability to improve certain aspects of life, as this study and previous research suggests, then it is a trait clinicians should work on with patients in therapy. Since mindfulness-based therapies have had more success in improving sleep quality than have sleep education interventions, programs that are aimed at improving college students’ sleep quality should further explore mindfulness-based interventions.

Lastly, our study found that students who lived by themselves were more likely to experience worse sleep quality and to score lower on trait mindfulness. Sleep interventions designed for college students should address how students’ living situations can influence their sleep hygiene practices and their ability to change these practices. Clinicians should be advised that there might be underlying reasons why students choose the living situations that they do. As mentioned earlier, students who choose to live by themselves may be the students who also experience poorer sleep. This association makes sense as it seems plausible that students with poor sleep quality would want to avoid the risk of getting placed with a roommate who snores, studies late into the night, has a series
of loud alarms in the morning, or has any other type of habit that may interfere with the students’ already poor sleep.

Overall, our study confirmed previous findings that college students have poor sleep quality (i.e., both experimental and control participants had a mean PSQI score over 5, which is a strong indicator of poor sleep) and sleep hygiene practices. Because college is the time when people build life-long beliefs and habits, it is critical that students’ poor sleep habits are addressed early on in their college days. This study, however, also confirmed that it is difficult to improve college students’ sleep with a short in-class presentation. It may be more practical, for example, for good sleep hygiene practices to be taught in smaller groups or in one-on-one meetings. A smaller group setting would allow for more personalization of the material and more room for discussion, which may produce more changes in students’ attitudes and behaviors.

Strengths and Limitations

The present study had several strengths. The study incorporated a reflection activity after the presentation in order to have students contemplate the material they were presented with and how they could use that material to make changes in their own lives. Because the intervention was not successful, however, we were unable to determine if the reflections would have had an effect on impact of the presentation on sleep quality. The inclusion of the Attitude Toward Sleep scale and the Barriers questionnaire was a unique contribution of our study to the sleep intervention literature. Past studies have not assessed how attitudes toward sleep affect sleep hygiene practices, nor have they followed up to ask what kept participants from implementing the sleep hygiene guidelines. The data from these two measures can be used in the future to assess how a
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sleep education intervention could address specific difficulties students had with
guideline implementation. Lastly, our study included two follow-up assessment points.
Using two points of follow-up was a strength in the current study because it allows us to
test if any changes were made two weeks post-intervention and whether these changes
would still be relevant four weeks post-intervention.

Several crucial limitations of the current study may have accounted for a lack of
significant results. In between the first and second follow-up assessments, participants
went on spring break. This may have interfered with our second follow-up assessment
because participants may have changed their sleep schedules during the break due to
travel or rest purposes. Because of the shift in sleep schedules during that week, the PSQI
scores that were collected at the four-week follow-up may not reflect normal mid-
semester sleep habits. However, the use of college students as the primary cohort for this
study may also have had its limitations. Compared to a consistent 40 hour per week job,
college is characterized by a varying schedule, with high demands placed on different
student at different times. On top of classes, students’ involvement with work-study,
athletics, and other extracurricular activities may make it very difficult for them to have
ultimate control over their own sleep schedules. As a result, the current sleep study on
college students may not reflect how individual students anticipate living during their
post-baccalaureate years. Thus, it is possible that the data collected on attitudes toward
sleep may reflect a short-term view of sleep rather than a life-long value.

As alluded to earlier in our discussion, students did not choose whether they
wanted to hear the presentation as it was incorporated into regular class time. They were
recruited through introductory psychology courses, and all students, regardless of
participation, were subjected to the 30-minute sleep education presentation. These students may not have been interested in improving their sleep quality and thus, might not have paid attention during the lecture. Furthermore, not all of the students who were subjected to the presentation participated in the current study. It is unclear whether the students who chose not to fill out the questionnaires would have been any different or reacted differently than the students who filled out all necessary components of the study.

The most compromising limitation of our study is the self-report nature of the administered questionnaires. Self-reported answers may be subject to bias, especially with regard to reporting objective measures such as sleep. It is very well possible, then, that students were inadvertently inaccurate about their reported sleep quality, quantity, and hygiene behaviors. Furthermore, the initial questionnaire was administered with a small error that may have restricted the reliability of our initial data. The question asking participants to report the number of hours spent asleep, on average, during the previous month was accidentally omitted. A short follow-up survey was then administered in an attempt to collect this data point from all of the individuals who filled out the initial questionnaire. Sending out the follow-up question several days later may have elicited a different answered than what would have been collected if the question had been included in the originally administrated questionnaire. Moreover, several student participants failed to fill out the follow-up survey and thus several data points were missing from the final data analysis.

Future Work

Researchers should focus future efforts on developing a more targeted intervention that better addresses college students’ lifestyles. The data from the barriers
A questionnaire should be utilized in order to understand what prevented students from implementing better sleep hygiene practices in the current study. Using this information, researchers can develop a more comprehensive curriculum that may elicit more behavioral changes. The relationship between mindfulness and sleep quality should further be explored among college students. A mindfulness-based intervention that includes healthy sleep hygiene guidelines may be a more effective alternative to the intervention used in the current study. Lastly, researchers should continue exploring the relationship between living situations and sleep quality. Since it remains unclear as to why students with roommates slept better than students with their own rooms, this relationship warrants further investigation.
Appendix A: Pittsburgh Sleep Quality Index (PSQI)

The Pittsburgh Sleep Quality Index (PSQI)

Instructions: The following questions relate to your usual sleep habits during the past month only. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions. During the past month,

1. When have you usually gone to bed? ____________
2. How long (in minutes) has it taken you to fall asleep each night? ____________
3. When have you usually gotten up in the morning? ____________
4. How many hours of actual sleep do you get at night? (This may be different than the number of hours you spend in bed) ____________

5. During the past month, how often have you had trouble sleeping because you...
   - Cannot get to sleep within 30 minutes
   - Wake up in the middle of the night or early morning
   - Have to get up to use the bathroom
   - Cannot breathe comfortably
   - Cough or snore loudly
   - Feel too cold
   - Feel too hot
   - Have bad dreams
   - Have pain
   - Other reason(s), please describe, including how often you have had trouble sleeping because of this reason(s): 

<table>
<thead>
<tr>
<th></th>
<th>Not during the past month (0)</th>
<th>Less than once a week (1)</th>
<th>Once or twice a week (2)</th>
<th>Three or more times a week (3)</th>
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<tbody>
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<td>i.</td>
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<td>j.</td>
<td>Other reason(s), please describe, including how often you have had trouble sleeping because of this reason(s):</td>
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</tbody>
</table>

6. During the past month, how often have you taken medicine (prescribed or ‘over the counter’) to help you sleep?

7. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

8. During the past month, how much of a problem has it been for you to keep up enthusiasm to get things done?
   - Very good (0)
   - Fairly good (1)
   - Fairly bad (2)
   - Very bad (3)

9. During the past month, how would you rate your sleep quality overall?
Appendix B: Epworth Sleepiness Scale

**How Sleepy Are You?**
How likely are you to doze off or fall asleep in the following situations? You should rate your chances of dozing off, not just feeling tired. Even if you have not done some of these things recently try to determine how they would have affected you. For each situation, decide whether or not you would have:

- No chance of dozing = 0
- Slight chance of dozing = 1
- Moderate chance of dozing = 2
- High chance of dozing = 3

Write down the number corresponding to your choice in the right hand column. Total your score below.

<table>
<thead>
<tr>
<th>Situation</th>
<th>Chance of Dozing</th>
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</thead>
<tbody>
<tr>
<td>Sitting and reading</td>
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<tr>
<td>Watching TV</td>
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<td>Sitting inactive in a public place (e.g., a theater or a meeting)</td>
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<tr>
<td>As a passenger in a car for an hour without a break</td>
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<tr>
<td>Lying down to rest in the afternoon when circumstances permit</td>
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<td>Sitting and talking to someone</td>
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<td>Sitting quietly after a lunch without alcohol</td>
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<td>In a car, while stopped for a few minutes in traffic</td>
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Total Score = ____________________________
Appendix C: Sleep Hygiene Index

<table>
<thead>
<tr>
<th>Number</th>
<th>Question</th>
<th>always</th>
<th>frequently</th>
<th>sometimes</th>
<th>rarely</th>
<th>never</th>
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<tbody>
<tr>
<td>1</td>
<td>You take daytime naps lasting two or more hours too close to bedtime</td>
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<td>2</td>
<td>You go to bed at different times from day to day</td>
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<td>3</td>
<td>You get out of bed at different times from day to day</td>
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<td>4</td>
<td>You exercise to the point of sweating within 1 h of going to bed</td>
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<td>5</td>
<td>You stay in bed longer than you should two or three times a week</td>
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<td>7</td>
<td>You do something that may wake you before bedtime (for example: play video games, use the internet, watch TV)</td>
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<td>8</td>
<td>You go to bed feeling stressed, angry, upset or nervous</td>
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<td>9</td>
<td>You use their bed for things other than sleeping (for example: watch television, eat)</td>
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<td>10</td>
<td>You sleep on an uncomfortable bed (for example: poor mattress or pillow, too much or not enough blankets)</td>
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<td>11</td>
<td>You sleep in an uncomfortable bedroom (for example: too bright, too stuffy, too hot, too cold, or too noisy)</td>
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<td>13</td>
<td>You think, plan, or worry when in bed</td>
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<td>14</td>
<td>You drink a lot of alcohol or coffee close to bedtime</td>
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<td>15</td>
<td>You smoke</td>
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</table>
Appendix D: Composite Morningness Questionnaire

Directions: Please check the response for each item that best describes you.

1) Considering only your own “feeling best” rhythm, at what time would you get up if you were entirely free to plan your day?
   5) 5:00-6:30 a.m.
   4) 6:30-7:45 a.m.
   3) 7:45-9:45 a.m.
   2) 9:45-11:00 a.m.
   1) 11:00 a.m. – 12:00 (noon)

2) Considering your only “feeling best” rhythm, at what time would you go to bed if you were entirely free to plan your evening?
   5) 8:00-9:00 p.m.
   4) 9:00-10:15 p.m.
   3) 10:15 p.m. – 12:30 a.m.
   2) 12:30-1:45 a.m.
   1) 1:45-3:00 a.m.

3) Assuming normal circumstance, how easy do you find getting up in the morning? (check one.)
   1) Not at all easy
   2) Slightly easy
   3) Fairly easy
   4) Very easy

4) How alert do you feel during the first half hour after having awakened in the morning? (check one.)
   1) Not at all alert
   2) Slightly alert
   3) Fairly alert
   4) Very alert

5) During the first half hour after having awakened in the morning, how tired do you feel? (check one.)
   1) Very tired
   2) Fairly tired
   3) Fairly refreshed
   4) Very refreshed

6) You have decided to engage in some physical exercise. A friend suggests that you do this one hour twice a week and the best time for him is 7:00-8:00 a.m. Bearing in mind nothing else but your own “feeling best” rhythm, how do you think you would perform?
   4) Would be in good form
3) Would be in reasonable form  
2) Would find it difficult  
1) Would find it very difficult  

7) At what time in the evening do you feel tired and, as a result, in need of sleep?  
5) 8:00-9:00 p.m.  
4) 9:00-10:15 p.m.  
3) 10:15 p.m. – 12:30 a.m.  
2) 12:30-1:45 a.m.  
1) 1:45-3:00 a.m.  

8) You wish to be at your peak performance for a test which you know is going to be mentally exhausting and lasting for two hours. You are entirely free to plan your day, and considering your own “feeling best” rhythm, which ONE of the four testing times would you choose?  
4) 8:00-10:00 a.m.  
3) 11:00 a.m.-1:00 p.m.  
2) 3:00-5:00 p.m.  
1) 7:00-9:00 p.m.  

9) One hears about “morning” and “evening” types of people. Which one of these types do you consider yourself to be?  
4) Definitely a morning type  
3) More a morning than an evening type  
2) More an evening than a morning type  
1) Definitely an evening type  

10) When would you prefer to rise (provided you have a full day’s work – 8 hours) if you were totally free to arrange your time?  
4) Before 6:30 a.m.  
3) 6:30-7:30 a.m.  
2) 7:30-8:30 a.m.  
1) 8:30 a.m. or later  

11) If you always had to rise at 6:00 a.m., what do you think it would be like?  
1) Very difficult and unpleasant  
2) Rather difficult and unpleasant  
3) A little unpleasant but no great problem  
4) Easy and not unpleasant  

12) How long a time does it usually take before you “recover your senses” in the morning after rising from a night’s sleep?  
4) 0-10 minutes  
3) 11-20 minutes  
2) 21-40 minutes  
1) More than 40 minutes
13) Please indicate to what extent you are a morning or evening active individual
   4) Pronounced morning active (morning alert and evening tired)
   3) To some extent, morning active
   2) To some extent, evening active
   1) Pronounced evening active (morning tired and evening alert)
Appendix E: Five Facet Mindfulness Questionnaire

Please rate each of the following statements using the scale provided.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Never or very rarely true</th>
<th>Rarely true</th>
<th>Sometimes true</th>
<th>Often true</th>
<th>Very often or always true</th>
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<tbody>
<tr>
<td>When I do things, my mind wanders off and I’m easy distracted.</td>
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<td>I don’t pay attention to what I’m doing because I’m daydreaming, worrying, or otherwise distracted.</td>
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<td>I watch my feelings without getting lost in them.</td>
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<td>I am easily distracted.</td>
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<td>I believe some of my thoughts are abnormal or bad and I shouldn’t think that way.</td>
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<td>I pay attention to sensation, such as the wind in my hair or sun on my face.</td>
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<td>I have trouble thinking of the right words to express how I feel about things.</td>
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<td>I find it difficult to stay focused on what’s happening in the present.</td>
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<td>When I have distressing thoughts or images, I “step back”</td>
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</table>
and am aware of the thought or image without getting taken over by it.

I pay attention to sounds, such as clocks ticking, birds chirping, or cars passing.

In difficult situations, I can pause without immediately reacting.

When I have a sensation in my body, it's difficult for me to describe it because I can't find the right words.

When I have distressing thoughts or images, I feel calm soon after.

I tell myself that I shouldn't be thinking the way I'm thinking.

I notice the smells and aromas of things.

I think some of my emotions are bad or inappropriate and I shouldn't feel them.

I notice visual elements in art of nature, such as colors, shapes, textures, or patterns of light and shadow.

My natural tendency is to put my experiences into words.
When I have distressing thoughts or images, I judge myself as good or bad depending what the thought or image is about.

I can usually describe how I feel at the moment in considerable detail.
Appendix F: Rumination-Reflection Questionnaire

For each of the statements, please indicate your level of agreement or disagreement by choosing one of the scale categories to the right of each statement.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
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<tbody>
<tr>
<td>My attention is often focused on aspects of myself I wish I’d stop thinking about.</td>
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<td>Sometimes it is hard for me to shut off thoughts about myself.</td>
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<tr>
<td>I tend to “ruminate” or dwell over things that happen to me for a really long time afterward.</td>
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<td>I don’t waste time rethinking things that are over and done with.</td>
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<td>I never ruminate or dwell on myself for very long.</td>
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<td>It is easy for me to put unwanted thoughts out of my mind.</td>
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<td>I often reflect on episodes in my life that I should no longer concern myself with.</td>
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<td>I spent a great deal of time thinking back over my embarrassing or disappointing moments.</td>
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<td>Philosophical or abstract thinking doesn’t appeal to me that much.</td>
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<td>Statement</td>
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<tr>
<td>I'm not really a meditative type of person.</td>
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<tr>
<td>I love exploring my &quot;inner&quot; self.</td>
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<td>I don't really care for introspective or self-reflective thinking.</td>
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<td>I love to meditate on the nature and meaning of things.</td>
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<td>I often love to look at my life in philosophical ways.</td>
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<td>I love analyzing why I do things.</td>
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<td>People often say I'm a &quot;deep&quot;, introspective type of person.</td>
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</table>
Appendix G: Attitudes Toward Sleep Scale

Please indicate the extent to which you agree with the following statements about sleep among college students using the scale below.

I think that:

<table>
<thead>
<tr>
<th>Statement</th>
<th>Disagree Very Much</th>
<th>Disagree Somewhat</th>
<th>Neither Agree nor Disagree</th>
<th>Agree Somewhat</th>
<th>Agree</th>
<th>Agree Very Much</th>
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</thead>
<tbody>
<tr>
<td>Sleeping is a luxury.</td>
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<td>Adequate sleep is not normal.</td>
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<td>The importance of sleep varies during the school year.</td>
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<td>I can always sleep in later to make up for sleep deprivation.</td>
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<td>People who get enough sleep probably aren't working hard enough.</td>
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<td>Sleeping feels like a waste of time.</td>
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<td>Sleep is the first thing I give up when I'm especially busy.</td>
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<td>Being sleep deprived is the norm.</td>
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<td>Being productive requires not getting enough sleep.</td>
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<td>Going without sleep shows mental and physical toughness.</td>
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<td>It's more important to have a rich social life than to get enough sleep.</td>
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<td>People who are determined to succeed must be willing to sacrifice their sleep.</td>
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</table>
References


GENDER, MINDFULNESS, RUMINATION AND SLEEP ATTITUDES ON SLEEP QUALITY


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GENDER, MINDFULNESS, RUMINATION AND SLEEP ATTITUDES ON SLEEP QUALITY


GENDER, MINDFULNESS, RUMINATION AND SLEEP ATTITUDES ON SLEEP QUALITY


Marks, A., Sobanski, D and Hine, D. (2010). Do Dispositional Rumination and/or Mindfulness Moderate the Relationship between Life Hassles and Psychological


GENDER, MINDFULNESS, RUMINATION AND SLEEP ATTITUDES ON SLEEP QUALITY


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