University of Cincinnati

Date: 6/14/2011

I, Adam P Knowlden , hereby submit this original work as part of the requirements for the degree of Master of Science in Health Education.

It is entitled:

Theory of Planned Behavior Based Predictors of Sleep Intentions and Behaviors in Undergraduate College Students at a Midwestern University

Student's name: **Adam P Knowlden**

This work and its defense approved by:

Committee chair: Manoj Sharma, MBBS, PhD

Committee member: Amy Bernard, PhD

1800

Theory of Planned Behavior Based Predictors of Sleep Intentions and Behaviors in Undergraduate College Students at a Midwestern University

A thesis submitted to the

Graduate School

of the University of Cincinnati

in partial fulfillment of the

requirements for the degree of

MASTER OF SCIENCE

in the Department of Health Promotion and Education

of the College of Education, Criminal Justice, and Human Services

by

Adam P. Knowlden, M.B.A.

June, 2011

Committee Chair: Manoj Sharma, M.B.B.S, MCHES, Ph.D

Abstract

AN ABSTRACT OF THE THESIS FOR THE MASTERS OF SCIENCE DEGREE IN HEALTH PROMOTION AND EDUCATION, PRESENTED JUNE 9, 2011 AT THE UNIVERSITY OF CINCINNATI

TITLE: Theory of Planned Behavior Based Predictors of Sleep Intentions and Behaviors in Undergraduate College Students at a Midwestern University

MASTERS COMMITTEE MEMBERS: Dr. Manoj Sharma, Chair

Dr. Amy Bernard

Sleeping 7 to 8 hours on a daily basis is an essential element of optimal health. The purpose of this study was to operationalize the constructs of the Theory of Planned Behavior (TpB) to predict the sleep intentions and behaviors of undergraduate college students attending a Midwestern University. Data were collected from cross-sectional convenience samples over three phases. Phase I encompassed collecting qualitative data (n=11) for instrument item generation. Phase II entailed collecting data (n=37) for reliability testing. Phase III data (n=197) assessed the efficacy of the instrument to predict the sleep intentions and behaviors of the sample. For phase III, a power analysis was conducted to determine a sufficient sample size (α = 0.05, β = 0.80, ρ = 0.20). Instrumentation included readability by Flesch-Kincaid ease and grade level tests, face and content validity by a panel of six experts, reliability by test-retest, construct validation applying confirmatory factor analysis, and internal consistency by Cronbach's alpha. Multiple linear regression modeled the predictors of perceived behavioral control (β=0.457, t=7.882, $p < 0.001$), subjective norm (β=0.179, t=3.000, $p = 0.003$), and attitude toward the behavior (β=0.231, t=3.865, $p < 0.001$) on behavioral intention. Collectively, the significant predictors produced an $R^2_{adjusted}$ value of 0.362 (F (3, 196) = 38.133, $p < 0.001$), suggesting the

model accounted for 36.2% of the variance in the behavioral intention to obtain adequate sleep in the sample of participants. Binary logistic regression was employed to model adequate sleep behavior. Behavioral intention (B=0.067, Wald χ^2 (1) = 4.440, p = 0.036) and sleep hygiene (B=0.055, Wald χ^2 (1) = 10.006, p = 0.002) were found to be significant predictors of sleep behavior; conversely, gender was not significant in the prediction of sleep behavior (B=0.475, Wald χ^2 (1) = 1.670, p = 0.196). Analysis revealed that for each one unit increase in behavioral intention the odds of obtaining adequate sleep increased by 7.0%. Similarly, for each one unit increase in sleep hygiene the odds of obtaining adequate sleep behavior increased by 5.7%. The TpB was found to be a useful framework for designing health promotion and education interventions for improving the sleep intentions and behaviors of undergraduate students. The results of this investigation provided a valid and reliable instrument for application in the measurement of TpB based interventions targeting undergraduate sleep health.

Acknowledgments

To Dr. Manoj Sharma: I would like to express my sincere appreciation for your mentorship and advice throughout this study. I have learned a tremendous amount and look forward to working with you on future research endeavors.

To Dr. Amy Bernard: Thank you for your feedback and advice in helping to shape the design of this study. I appreciate the time and effort you spent working with me on this thesis.

Dedication

This thesis is dedicated to my late Grandmother, Bonnie J. Lohr.

Table of Contents

List of Tables

List of Figures

Chapter One

The Purpose

Sleeping 7 to 8 hours on a daily basis is an essential element of optimum health (Belloc & Breslow, 1972). Epidemiological evidence has associated both deficient (<7 hours) and excessive sleep duration (>8 hours) with increased rates of morbidity (Gangwisch, et al., 2007; Hall et al., 2008) and mortality (Hublin, Partinen, Koskenvuo, & Kaprio, 2007). Injurious health outcomes associated with inadequate sleep include cardiovascular disease (Ayas et al., 2003), diabetes mellitus (Gangwisch et al., 2007), depression (Strine & Chapman, 2005), automobile and occupational accidents (Lockley et al., 2004), as well as learning and memory problems (Stickgold, Hobson, Fosse, & Fosse, 2001).

The causal factors explicating the association between inadequate sleep duration and an increased risk of all-cause mortality remain unclear (Hublin et al., 2007; Youngstedt & Kripke, 2004). As sleep is a modulator of hormone release, cardiovascular function, and glucose regulation, Bixler (2009) postulated that short sleep duration contributes to an increased risk of cardiometabolic disorders including hypertension, as well as metabolic syndrome, and diabetes mellitus. Conversely, Youngstedt and Kripke (2004) have proposed that mortality rates associated with excessive sleep duration are a consequence of sleep fragmentation, lethargy, and a decreased photoperiod. Evidence indicated a bi-directional relationship between sleep and health such that inadequate sleep contributes to the progression of a number of medical and psychiatric disorders, and that these same disorders, in turn, contribute to poor sleep quality (Zee & Turek, 2006).

Sleep restriction is commonplace in society. A study examining population-based data (n=110,441) collected between 2004 and 2007 revealed 28.3% of U.S. adults slept six or fewer

hours per night (Krueger & Friedman, 2009). The *2009 Sleep in America Poll* (National Sleep Foundation, 2009) found 20% of respondents (n=1,000) received less than 6 hours of sleep per night. Research indicates behavioral determinants and health-related factors are at the core of curtailed sleep durations (Monk, Buysse, Rose, Hall, & Kupfer, 2000).

The inclusion of sleep health in the Healthy People 2020 objectives emphasizes the magnitude of this pertinent health issue. In 2009, the Centers for Disease Control and Prevention (CDC) incorporated a sleep module into the Behavioral Risk Factor Surveillance System. Analysis of the data found 35.3% of respondents (n=75,571) reported having less than 7 hours of sleep on average during a 24 hour period, 37.9% reported unintentionally falling asleep during the day at least one day in the preceding 30 days, and 4.7% reported falling asleep while driving in the preceding 30 days (CDC, 2011) . The Healthy People report clarified the scope of the national agenda by setting an objective to increase the percentage of adults who receive sufficient sleep from the 2008 baseline level of 69.6% to 70.9% by 2020 (United States Department of Human Services, 2010).

The sleep behaviors of college populations mirror the deleterious trends reported in the general public. Data collected by Hicks, Fernandez, and Pellegrini (2001b) over a period of three decades revealed a 14% decrease in undergraduate college students' (n=9,543) median hours of sleep: 7.75 hours in 1969; 7.13 hours in 1979; 6.75 hours in 1989; and 6.65 hours in 2001. In a recent investigation, Lund, Reider, Whiting, and Prichard (2010) reported that only 29.4% of college students (n=1,125) received eight hours or more of total sleep per night. Strikingly, a quarter of the participants indicated they received less than 6.5 hours of sleep per night. A significant amount of the study population reported erratic sleeping patterns including

staying up a full 24 hours at least once in the past month (20%) and staying up until 3:00 a.m. at least once per week (35%).

In addition to reduced sleep duration, college students are also experiencing reduced sleep quality (Jensen, 2003). In their analysis of the prevalence of sleep difficulties in college students, Buboltz, Brown, and Soper (2001) noted that 73% of students (n=191) experienced occasional sleeping problems and that only 11% met the criteria for good sleep quality; in their investigation, difficulties with sleep latency, morning fatigue, and waking too early were cited as primarly sleep distruptors. Similarly, data collected by Hicks, Fernandez, and Pellegrini (2001a) indicated that students (n=9,543) in 2000 were 2.96 times more likely to report sleep dissatisfaction than students in 1978. The data set also revealed a linear increase in sleep dissatisfaction: 24% in 1978, 53% in 1988, and 71% in 2000.

Salient symptoms of sleep deprivation among college populations include impairment of neurocognitive and psychomotor performance, emotional imbalance, and overall lower life satisfaction (Curcio, Ferrara, & De Gennaro, 2006). Interestingly, students are often unaware of the impact sleep restriction has on their ability to perform cognitive tasks (Brown, Buboltz, & Soper, 2006). A study conducted by Pilcher and Walters (1997) found that sleep-deprived college students performed considerably worse on a complex task than non-deprived participants; yet, deprived participants reported significantly higher levels of estimated performance and concentration than did non-deprived participants.

Sleep hygiene is an effective methodology for improving sleep quality (Stepanski & Wyatt, 2003). Sleep hygiene operates under the assumption that behavioral and environmental conditions can be modified to enhance sleep quality (Stepanski & Wyatt, 2003). In principle, sleep hygiene consists of a series of best practices designed to optimize the biological processes

that regulate human sleep. The majority of college students who practice poor sleeping habits are unacquainted with behaviors that promote healthy sleep. Hicks, Lucero-Gorman, Bautista, and Hicks (1999) tested the mean differences in scores of sleep hygiene knowledge and sleep hygiene practices scales (Lacks & Roter, 1987) among four ethnic groups of university students (n=963). Results showed that Euro-Americans scored significantly higher on both scales than each of the other three groups; however, Hicks and colleagues noted that all of the groups exhibited poor sleep hygiene knowledge. The researchers pointed to the Euro-American group, which scored the highest on sleep hygiene knowledge but answered only 57% of the scale's items correctly.

Brown and colleagues (2006) cautioned educators to take into consideration the general lack of sleep hygiene knowledge exhibited among college students as opposed to attributing students' poor sleeping habits to deviant lifestyle choices. Concurrently, satisfactory sleep appears to be a salient health concern among college students. A survey conducted by the American College Health Association (ACHA) revealed 79.7% (n=20,992) of students had not received information on sleep difficulties from their colleges, yet 52.7% (n=13,769) were interested in receiving information on this important health issue (ACHA, 2008).

Theoretical Framework of Study

The Theory of Planned Behavior (TpB) (Ajzen, 1991) is highly predictive of human actions, serving as the model for more than 1,200 empirical studies of behavioral prediction and change (Ajzen, 2011). The TpB posits that the intention to perform a behavior is the immediate antecedent of the given behavior. Intentions are postulated to capture the motivational factors that influence behavior (Ajzen, 1991). Behavioral intention, in turn, is the function of three latent variables: attitude toward the behavior, subjective norms, and perceived behavioral

control. Attitude toward a behavior refers to an individual's overall feeling of like or dislike toward a given behavior (Sharma & Romas, 2008). Subjective norm encompasses an individual's perception of the social pressure to perform or not perform a given behavior (Francis et al., 2004). Perceived behavioral control determines the extent to which an individual believes they are capable of performing the behavior in question (Sharma & Romas, 2008). A value-expectancy theory, the TpB assumes human behavior is rational and guided by logical thought processes. The causal chain of the TpB implies that altering domain-specific beliefs can assist in ameliorating unhealthy behaviors. This underpinning, along with its parsimonious nature, has established the TpB as an effective theoretical framework for developing health promotion and health education interventions. Mastin, Bryson, and Corwyn (2006) developed a novel instrument to assess sleep hygiene factors based on criteria developed by the American Academy of Sleep Medicine. The Sleep Hygiene Index (SHI) consists of 13 items measured by 5-point Likert scales. Item scores are summed to provide a global assessment of sleep hygiene.

Statement of the Problem

Sleeping 7 to 8 hours on a daily basis is a critical component of optimal health (Belloc & Breslow, 1972). Despite this, a growing body of evidence suggests voluntary sleep restriction is on the rise in society; both in the general public and in college populations (Lund, Reider, Whiting, & Prichard, 2010; Zee & Turek, 2006). The purpose of this study was to operationalize the constructs of the Theory of Planned Behavior (TpB) (Ajzen, 1991) to predict the sleep intentions and behaviors of undergraduate college students attending a Midwestern University. In addition to the standard TpB constructs, this study also assessed gender and sleep hygiene as supplemental predictor variables of adequate sleep behavior. While a number of studies have examined the sleep behaviors of the general population, college populations have received

minimal attention (Buboltz, Brown, & Soper, 2001). The present study represented the first attempt to investigate the sleep behaviors of college students applying the TpB. As well, it was one of the first to employ the Sleep Hygiene Index (SHI) (Mastin et al., 2006). The findings of this study specified a theory-based model for predicting the sleep intentions and behaviors of undergraduate college students. Findings from the SHI aided in identifying sleep-related factors amendable to modification in the study population. Ultimately, the results of this investigation provided a valid and reliable instrument for application in the development and measurement of interventions designed to promote healthy sleep behaviors among undergraduate college student populations.

Research Questions

The following questions were explored in this study:

1. To what extent are the TpB constructs of perceived behavioral, subjective norm, and attitude toward the behavior associated with behavioral intention to obtain adequate sleep in undergraduate students?
2. To what extent is the TpB construct of behavioral intention associated with sleep behavior in undergraduate students?
3. To what extent are the constructs of sleep hygiene and gender related to sleep behavior in undergraduate students?
4. To what extent do the constructs of perceived behavioral, subjective norm, and attitude toward the behavior predict behavioral intention to obtain adequate sleep behavior in undergraduate students?
5. To what extent do the constructs of behavioral intention, sleep hygiene, and gender predict sleep behavior in undergraduate students?

Hypotheses

To address the research questions, two primary outcome variables were investigated: behavioral intention and sleep behavior. Behavioral intention was operationalized as a continuous variable. The independent variables associated with behavioral intention included perceived behavioral control, subjective norm, and attitude toward the behavior. Sleep behavior was operationalized as a dichotomous variable. The independent variables associated with sleep behavior included behavioral intention, gender, and sleep hygiene. The rationale for the selection of variables was based on the theoretical framework of the TpB as well as factors purported to impact sleep behaviors identified in the literature. In investigating the two outcome variables, a series of four hypotheses sets emerged. Combined, a total of 8 hypotheses were investigated in this study. Significance levels for rejecting null hypotheses were set *a priori* at $p < 0.05$.

Hypotheses set 1: Tests for relationships among predictor variables on behavioral intention. The first set of hypotheses tested the relationships among a group of variables correlated on behavioral intention. Within this context, the independent variables included perceived behavioral control, subjective norm, and attitude toward the behavior. The rationale for the selection of predictors was based on the constructs of the TpB.

1. Null hypothesis: Perceived behavioral control (PBC) will not have a significant relationship with behavioral intention to obtain adequate sleep (BI) in undergraduate students.

   H_0: $r_{PBC|BI} = 0$

   Alternative hypothesis: Perceived behavioral control (PBC) will have a significant relationship with behavioral intention to obtain adequate sleep (BI) in undergraduate students.

H_A: $r_{PBC|BI} \neq 0$

2. Null hypothesis: Subjective norm (SN) will not have a significant relationship with behavioral intention to obtain adequate sleep (BI) in undergraduate students.

   H_0: $r_{SN|BI} = 0$

   Alternative hypothesis: Subjective norm (SN) will have a significant relationship with behavioral intention to obtain adequate sleep (BI) in undergraduate students.

   H_A: $r_{SN|BI} \neq 0$

3. Null hypothesis: Attitude toward the behavior (ATT) will not have a significant relationship with behavioral intention to obtain adequate sleep (BI) in undergraduate students.

   H_0: $r_{ATT|BI} = 0$

   Alternative hypothesis: Attitude toward the behavior (ATT) will have a significant relationship with behavioral intention to obtain adequate sleep (BI) in undergraduate students.

   H_A: $r_{ATT|BI} \neq 0$

Hypotheses set 2: Tests for relationships among predictor variables on sleep behavior. The second set of hypotheses tested the relationships among a group of predictor variables correlated on sleep behavior. Within this context, the tested variables included behavioral intention, gender, and sleep hygiene.

4. Null hypothesis: Behavioral intention (BI) will not have a significant relationship with sleep behavior (SB) in undergraduate students.

   H_0: $r_{BI|SB} = 0$

   Alternative hypothesis: Behavioral intention (BI) will have a significant relationship with sleep behavior (SB) in undergraduate students.

H_A: $r_{BI|SB} \neq 0$

5. Null hypothesis: Gender (GN) will not have a significant relationship with sleep behavior (SB) in undergraduate students.

   H_0: $r_{GN|SB} = 0$

   Alternative hypothesis: Gender (GN) will have a significant relationship with sleep behavior (SB) in undergraduate students.

   H_A: $r_{GN|SB} \neq 0$

6. Null hypothesis: Sleep hygiene (SH) will not have a significant relationship with sleep behavior (SB) in undergraduate students.

   H_0: $r_{SH|SB} = 0$

   Alternative hypothesis: Sleep hygiene (SH) will have a significant relationship with sleep behavior (SB) in undergraduate students.

   H_A: $r_{SH|SB} \neq 0$

Hypotheses set 3: Test for significance of TpB predictor variables regressed on behavioral intention. In accordance with the framework of the TpB, the third set of hypotheses tested the significance of perceived behavioral control, subjective norm, and attitude toward the behavior in the prediction of behavioral intention to obtain adequate sleep.

7. Null hypothesis: Perceived behavioral control (β_1), subjective norm (β_2), and attitude toward the behavior (β_3), considered together do not significantly predict behavioral intention to obtain adequate sleep in undergraduate students (Y).

   H_0: $\beta_1 = \beta_2 = \beta_3 = 0$

Alternative hypothesis: Perceived behavioral control (β_1), subjective norm (β_2), and attitude toward the behavior (β_3), considered together do significantly predict behavioral intention to obtain adequate sleep in undergraduate students (*Y*).

H_A: $\beta_j \neq 0$ for at least one *j*

Hypotheses set 4: Tests for significance of predictors regressed on sleep behavior. Hypotheses set four tested the significance of behavioral intention, sleep hygiene, and gender to predict the likelihood of achieving adequate sleep behavior. Several studies have reported that college women experience more sleep disturbances than college men. Tsai and Li (2004b) observed that women had longer sleep onset latency, more nighttime awakenings, and overall poorer sleep quality than men. Sleep researchers have noted the importance of sleep hygiene in achieving quality sleep (Hicks et al., 1999; Mastin et al., 2006). Subsequently, the variables gender and sleep hygiene were examined as potential supplementary predictors of behavior.

8. Null hypothesis: Behavioral intention (β_1), sleep hygiene (β_2), and gender (β_3) considered together do not significantly predict sleep behavior in undergraduate students (*Y*).

   H_0: $\beta_1 = \beta_2 = \beta_3 = 0$

   Alternative hypothesis: Behavioral intention (β_1), sleep hygiene (β_2), and gender (β_3) considered together do significantly predict sleep behavior in undergraduate students (*Y*).

   H_A: $\beta_j \neq 0$

Table 1.1 summarizes the null hypotheses tested in this investigation. Figure 1.1 illustrates the *a priori* theoretical research model for predicting the sleep intentions and behaviors of the sample of undergraduate college students.

Table 1.1

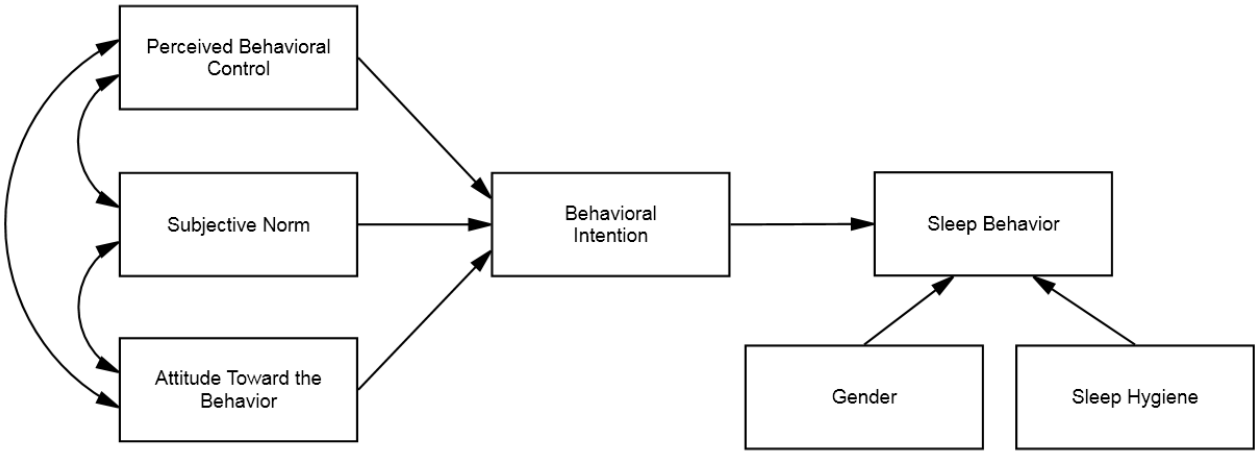
Table of Null Hypotheses (n=8)

Set	H_0 No.	DV	IV	Test Employed	H_0*
1	1	BI	PBC	Correlation Coefficient (*r*)	H_0: $r_{PBC \mid BI} = 0$
	2	BI	SN	Correlation Coefficient (*r*)	H_0: $r_{SN \mid BI} = 0$
	3	BI	ATT	Correlation Coefficient (*r*)	H_0: $r_{ATT \mid BI} = 0$
2	4	SB	BI	Correlation Coefficient (*r*)	H_0: $r_{BI \mid SB} = 0$
	5	SB	GN	Correlation Coefficient (*r*)	H_0: $r_{GN \mid SB} = 0$
	6	SB	SH	Correlation Coefficient (*r*)	H_0: $r_{SH \mid SB} = 0$
3	7	BI	PBC, ATT, SN	Significance (*F* test)	H_0: $\beta_1 = \beta_2 = \beta_3 = 0$
4	8	SB	BI, SH, GN	Significance (χ^2)	H_0: $\beta_1 = \beta_2 = \beta_3 = 0$

Note. DV=Dependent variable; IV=Independent variable; BI=Behavioral intention; SB= Sleep Behavior; PBC=Perceived behavioral control; ATT=Attitude toward the behavior; SN=Subjective norm; GN=Gender; SH=Sleep hygiene. *Significance levels for all hypotheses set *a priori* at $p < 0.05$.

Figure 1.1

Proposed Theoretical Model for Predicting the Sleep Intentions and Behaviors of Undergraduate College Students



Operational Definitions

Operational definitions provided measurement parameters for the variables studied in this investigation. Table 1.2 summarizes the operational definitions, item numbers, and score ranges of the indicator variables.

Adequate sleep behavior. TpB construct defined in terms of a single, observable action with a specific target, action, context, and time (TACT) (Sharma & Romas, 2008). For the purposes of this study, adequate sleep behavior was defined as undergraduate students (target) achieving 420 – 480 minutes [7 to 8 hours] (time) of sleep (action) every night (context). The adequate sleep behavior (referred to as sleep behavior throughout this study) variable was assessed through self-report by items 18 and 19 of the instrument. During data screening, the sleep behavior construct was recoded into a single variable representing total minutes of sleep obtained in the previous 24 hours at night time.

Expressed as an inequality, adequate sleep behavior was defined as $420 \leq x \leq 480$; where x represents adequate sleep behavior in minutes. Conversely, inadequate sleep behavior was defined as $420 > y > 480$; where y is equal to inadequate sleep behavior in minutes. For pragmatic purposes, inadequate sleep behavior was classified into two categories; insufficient duration of sleep (<7 hours; <420 minutes) and excessive duration of sleep (>8 hours; >480 minutes).

Attitude to obtain adequate sleep. TpB construct defined as an individual's overall feeling of like or dislike towards obtaining adequate sleep behavior. The attitude to obtain adequate sleep construct (referred to as attitude toward the behavior throughout this study) was assessed by items 5 through 10 of the instrument and had a score that ranged from 6 to 42.

Behavioral intention to obtain adequate sleep. TpB construct defined as the intention to perform adequate sleep behavior. The behavioral intention construct was also assessed in terms of the TACT principle. For the purposes of this study, behavioral intention to obtain adequate sleep (referred to as behavioral intention throughout this study) was defined as undergraduate students (target) intention to sleep (action) for 7 to 8 hours (time) every night (context). This construct was assessed by items 15 through 17 of the instrument and had a score that ranged from 3 to 21.

Perceived behavioral control to obtain adequate sleep. TpB construct defined as how much an individual believes they are in control of obtaining adequate sleep behavior. The perceived behavioral control construct (referred to as perceived behavioral control throughout this study) was assessed by items 1 through 4 of the instrument and had a score that ranged from 4 to 28.

Sleep hygiene. Sleep hygiene construct, measured by the SHI (Mastin et al., 2006). The original format of the SHI consisted of 13-items measured by 5-point Likert scales. For the purposes of this study, the original 5-point Likert scales were converted to 7-point Likert scales for instrument consistency. In addition, the scale endpoints were reversed such that lower scores indicated a more maladaptive sleep hygiene status. Items were scored from 1 to 7 and summed to provide a global score ranging from 13 to 91. This construct was assessed by items 19 through 31 of the instrument.

Subjective norm to obtain adequate sleep. TpB construct defined an individual's belief that the significant others in their lives think they should or should not obtain adequate sleep. The subjective norm to obtain adequate sleep construct (referred to as subjective norm throughout this study) was assessed by items 11 through 14 of the instrument and had a score that ranged from 4 to 28.

Race/ethnicity. For the purposes of this study, race/ethnicity was limited to the following categories: African American, Asian, Hispanic, Multi-racial, Caucasian, and Other. This selection was in accordance with categories established by the university utilized for data collection (University of Cincinnati Diversity Initiative, 2010).

Undergraduate students. For the purpose of this study, undergraduate students were defined as college students of undergraduate status between the ages of 18 and 24 enrolled at the University of Cincinnati in between March 2010 and February of 2011 who were unmarried and did not reside with a parent or legal guardian.

Table 1.2

Constructs and Operational Definitions

Construct and Operational Definition	Measurement: Item(s)	Measurement: Score Range
• Adequate sleep behavior: TpB construct defined as undergraduate students (target) achieving 420 – 480 minutes [7-8 hours] (time) of sleep (action) every night (context)	18	0 – 1,440
• Attitude to obtain adequate sleep: TpB construct defined as an individual's overall feeling of like or dislike towards obtaining adequate sleep behavior	5 – 10	6 – 42
• Behavioral intention to obtain adequate sleep: TpB construct defined as the intention to perform adequate sleep behavior	15 – 17	3 – 21
• Perceived behavioral control to obtain adequate sleep: TpB construct defined as how much an individual believes they are in control of obtaining adequate sleep behavior.	1 – 4	4 – 28
• Sleep hygiene: SHI construct providing a global sleep hygiene score.	19 – 31	13 – 91
• Subjective norm to obtain adequate sleep: TpB construct defined an individual's belief that the significant others in their lives think they should or should not obtain adequate sleep.	11 – 14	4 – 28
• Race/ethnicity: For the purposes of this study, race/ethnicity was limited to the following categories: African American, Asian, Hispanic, Multi-racial, Caucasian, and Other.	41	N/A
• Undergraduate students: For the purposes of this study, undergraduate students were defined as college students of undergraduate status between the ages of 18 and 24 enrolled at the University of Cincinnati between March 2010 and February 2011 who were unmarried and did not reside with a parent or legal guardian.	Inclusion criteria	N/A

Delimitations

Participation in this study was delimited to college students of undergraduate status between the ages of 18 and 24 enrolled at the University of Cincinnati between March 2010 and February of 2011 who were unmarried and did not reside with a parent or legal guardian. For phase I data collection, a systematic random sample of every tenth student who came through the main entrance of Union Hall on March 6, 2010 was solicited to participate in the qualitative elicitation study. Therefore, participation for phase I was delimited to students traversing Union Hall on the specified date. Phase II test-retest participants received hard copies of the TpB instrument. Data were collected from volunteering students registered for Personal Health Behavior (HPE 133) on Wednesday, November 17, 2010 and Wednesday, December 1, 2010 as well as volunteering students registered for Lifestyle Health and Fitness (HFL 191) on Tuesday, January 18, 2011 and Tuesday, January 25, 2011. Subsequently, participation in reliability testing was delimited to students enrolled in the aforementioned classes during the specified dates. Participation for phase III data collection was delimited to those students with an active university e-mail address on record with the Office of the Registrar during February 2011.

Limitations

In interpreting the results of this study, the following limitations were considered:

1. The results were based on the self-reporting accuracy, integrity, and honesty of the participants.
2. Misinterpretation of the instrument items may have skewed participant responses.
3. Non-probability quota sampling was used to recruit all study participants. Subsequently, the results of the study cannot be generalized beyond the study participants.

4. This study examines sleep intentions and sleep behaviors within the context of voluntary sleep restriction. The instrument did not contain items querying medically diagnosed biological sleep disorders.
5. A cross-sectional study design was utilized in this investigation. This methodology is commonplace within the social and behavioral sciences for analyzing the characteristics of a population; specifically, the thoughts, opinion, feelings, and behaviors of individuals during a defined period in time (Crosby, DiClemente, Salazar, 2006). An additional function of this design type is its ability to determine the relationships among variables. Limitations of this design type include an inability to infer causation or establish directionality among variables.
6. There are limitations inherent to the TpB. Primarily, the TpB does not explain affective processing. An underlying assumption of the TpB is that humans engage in behavior-related decisions based on rational thought processes; however, unhealthy behaviors are often rooted in irrationality. Therefore, it was understood there were limitations inherent to the TpB.

Assumptions

In conducting this study it was assumed respondents would answer the instrument items accurately and with integrity. Sleep was considered to be a habitual human behavior; therefore, it was assumed recall would not be problematic. Based on the literature review, it was assumed sleep restriction among college students was primarily voluntary in nature and not due to medically diagnosed biological sleep disorders. Misinterpretation of the questionnaire items was assumed to be minimal due to the methodical rigidity of the instrumentation process. Given the

strong tradition of the TpB in accurately predicting behavior it was assumed the theory would advance an efficacious model for predicting sleep intentions and behaviors.

Summary

In this chapter, the justification for a theory-based model of college students' sleep intentions and behaviors was delineated. In addition, the rationale for studying the sleep hygiene practices of the study population was provided. Finally, the research questions, hypotheses, operational definitions, delimitations, limitations and assumptions of the study were described. The next chapter discusses the origins of sleep science, physiology of human sleep, health consequences of inadequate sleep, sleep education, and sleep research related to college students.

Chapter Two

Review of Literature

Sleeping 7 to 8 hours on a daily basis is a critical component of optimal health (Belloc & Breslow, 1972). Despite this, a growing body of evidence suggests voluntary sleep restriction is on the rise in society; both in the general public and in college populations (Lund, Reider, Whiting, & Prichard, 2010; Zee & Turek, 2006). The purpose of this study was to operationalize the constructs of the Theory of Planned Behavior (TpB) (Ajzen, 1991) to predict the sleep intentions and behaviors of undergraduate college students attending a Midwestern University. In addition to the standard TpB constructs, this study also assessed gender and sleep hygiene as supplemental predictor variables of adequate sleep behavior. While a number of studies have examined the sleep behaviors of the general population, college populations have received minimal attention (Buboltz, Brown, & Soper, 2001). The present study represented the first attempt to investigate the sleep behaviors of college students applying the TpB. As well, it was one of the first to employ the Sleep Hygiene Index (SHI) (Mastin et al., 2006). The findings of this study specified a theory-based model for predicting the sleep intentions and behaviors of undergraduate college students. Findings from the SHI aided in identifying sleep-related factors amendable to modification in the study population. Ultimately, the results of this investigation provided a valid and reliable instrument for application in the development and measurement of interventions designed to promote healthy sleep behaviors among undergraduate college student populations.

In this chapter, the origins of sleep science, physiology of human sleep, health consequences of inadequate sleep, sleep education, and sleep research related to college students will be explored. The chapter opens by delineating the landmarks leading up to the modern

scientific understanding of human sleep. Next, an overview of sleep physiology is provided. Topics reviewed include sleep architecture, mechanisms of sleep-wake regulation, and contemporary sleep theory. The following section examines sleep and health-related concerns. Subject matters encompass epidemiology, sleep loss in society, etiology of sleep restriction, neurobehavioral consequences of sleep deprivation, and sleep disorders. The next theme, sleep hygiene and alertness management, investigates methodologies for improving sleep quality and managing fatigue. The culmination of the review focuses on sleep and college populations. In this portion, trends, population analyses, sleep education, interventions, and program recommendations are covered. The penultimate segment discusses the Theories of Reasoned Action and Planned Behavior as well as the Sleep Hygiene Index. The chapter concludes with a summary of major findings. Combined, these sections provide a broad and integrative perspective on the topic of sleep and college students.

Eligibility of Articles

Eligibility of articles for this review was determined by applying inclusion and exclusion criteria to pre-established outline headings. Literature searches of Academic Search Premier, CINAHL Plus with Full Text, ERIC, MEDLINE with Full Text, and Psychology and Behavioral Sciences Collection were reviewed for relevance to the outline headings. Titles and abstracts were evaluated by the principal investigator (PI) using the following inclusion criteria: 1) publication in the English language, 2) publication between 1999 and 2011, 3) articles focused on a) sleep science; b) sleep physiology; c) sleep and health; d) sleep education; e) sleep and college students; and f) the TpB. Exclusion criteria consisted of publications in languages other than English, publications prior to 1999, and studies on sleep that did not meet the focus of this literature review. A total of 111 studies met the inclusion criteria. Seminal works referenced by

the authors of the publications that met the original inclusion criteria were also considered without language or date restrictions. A total of 38 articles met these criteria. Overall, 149 sources were consulted for this review. All sources were managed using EndNote X3 bibliographic software (Thomson Reuters, 2009).

Historicity of Sleep Science

The first milestone in sleep science occurred in 1875 when Richard Caton, an English physician, detected electrical currents originating from the brains of animal subjects (Caton, 1875). In 1929, German psychiatrist Hans Berger succeeded in becoming the first to record electrical activity of the human brain (Berger, 1929). Berger was credited with the discovery of electroencephalography (EEG), a non-invasive technique for quantitatively measuring electrical cerebral activity (Tudor, Tudor, & Tudor, 2005). Berger conducted the first sleep EEG recording and observed that alpha rhythms disappeared once study participants fell asleep (Hirshkowitz, 2004). Berger's breakthrough experiment provided an operational definition of sleep onset, establishing a fundamental paradigm for investigating sleep and sleep disorders (Hirshkowitz, 2004).

In the mid-1930s, Loomis and colleagues recorded the first continuous overnight EEG, which led to the development of the sleep stage classification system (Loomis, Harvey, & Hobart, 1937). Aserinsky and Kleitman (1953) refined the classification in the 1950s with the discovery of rapid-eye movement sleep (REM). Verification of muscle atonia during REM sleep by Jouvet, Michel, and Courjon (1959) established the modern taxonomy of human sleep stages (Hirshkowitz, 2004). Jouvet and colleagues further advanced the field by postulating that REM sleep was a third state of consciousness, characterized as an active brain within an inactive body (Hirshkowitz, 2004).

As the field progressed, concerns regarding the reproducibility and inter-rater reliability of sleep scoring began to emerge (Deak & Epstein, 2009). In response, the Association for the Psychophysiological Study of Sleep chartered an ad hoc committee of sleep scientists in 1967 with advancing a standardized methodology for recording and scoring sleep stages (Shirakawa et al., 2001). The effort led to the publication of *The Manual of Standardized Terminology, Techniques and Scoring System for Sleep Stages of Human Subjects* in 1968 (Rechtschaffen & Kales, 1968). Subsequent to this seminal work, sleep scientists were able to corroborate and compare research results. Sleep researchers widely accepted the manual for nearly 40 years (Deak & Epstein, 2009). However, advances in the field called for the full-scale revision of the scoring guidebook (Shirakawa et al., 2001). In the early 2000s, The American Academy of Sleep Medicine (AASM) commissioned the development of the updated manual, which resulted in the publication of *The AASM Manual for the Scoring of Sleep and Associated Events: Rules, Terminology, and Technical Specifications* (Iber, Ancoli-Israel, Chesson, & Quan, 2007).

The first sleep disorder clinic was established at Stanford University School of Medicine in the 1970s (Kilduff et al., 2008). The clinic initially set out to study narcolepsy patients but later grew to investigate an array of sleep disorders. By 2009, over 1,500 sleep centers and laboratories were accredited by the AASM (Deak & Epstein, 2009). In conducting sleep research, researchers used polysomnography (PSG) to simultaneously monitor and record the three physiologic variables that compose the primary stages of sleep and wakefulness (Markov & Goldman, 2006). The diagnostic tools incorporated in PSG include

- electroencephalogram (EEG) to record brain activity,
- electromyogram (EMG) to record muscle tone, and
- electro-oculogram (EOG) to record eye movements (Markov & Goldman, 2006).

Sleep Physiology

Sleep architecture. Sleep is comprised of two distinct states spanning five stages of activity (Sinton & McCarley, 2004). Collectively, this construction is referred to as sleep architecture. The first state, non-REM (NREM), is classified into four stages corresponding to EEG readings along a continuum of relative sleep depth (Sinton & McCarley, 2004). The second sleep state, REM, is characterized by episodic bursts of rapid eye movement and muscle atonia (Fuller, Gooley, & Saper, 2006). NREM and REM sleep occur in alternating cycles lasting 90 to 120 minutes (Hirshkowitz, 2004). A total of four to seven cycles transpire over the course of a complete sleep episode (Markov & Goldman, 2006). The first sleep cycle consists of approximately 80 minutes of NREM and culminates with 10 minutes of REM (Markov & Goldman, 2006). With each successive sleep cycle the amount of NREM decreases as the proportion of REM increases (Hirshkowitz, 2004).

NREM stage one sleep plays a pivotal role in the initial wake-to-sleep transition, generally lasting 1 to 7 minutes (Fuller et al., 2006). This stage, referred to as light sleep, is associated with a low arousal threshold (Markov & Goldman, 2006). Stage two persists approximately 10 to 25 minutes in the initial sleep cycle and increases in length with each consecutive cycle, eventually composing 45% to 55% of total sleep duration (Hirshkowitz, 2004). Stage three has a brief interval and consists of only 5% to 8% of total sleep (Markov & Goldman, 2006). The final NREM phase, stage four, continues approximately 20 to 40 minutes during the initial sleep cycle, constituting 10% to 15% of total sleep (Markov & Goldman, 2006). Typically, stages three and four are merged and referred to as slow-wave sleep (Fuller et al., 2006). REM sleep is most often associated with dreaming. During the REM state the pons sends inhibitor input to the spinal cord to prevent the physical enactment of dreams (Attarian,

Schenck, & Mahowald, 2000). With each successive sleep cycle, the length of time spent in REM sleep increases, ultimately accounting for 20% to 25% of a sleep epoch (Markov & Goldman, 2006).

Mechanisms of sleep-wake regulation. Sleep and wakefulness are regulated by the homeostatic drive for sleep and the body's endogenous pacemaker, the circadian rhythm (Mackiewicz et al., 2007). Located in the preoptic area of the hypothalamus, the homeostatic system stimulates the propensity for sleep. The impetus towards sleep accumulates exponentially throughout the day until satisfied (Benington, 2000). As wakefulness is prolonged, the drive intensifies until the pressure to sleep becomes irresistible (Hirshkowitz, 2004). Concomitantly, the circadian cycle regulates the diurnal sleep-wake sequence (Reid & Burgess, 2005). Controlled by the suprachiasmatic nucleus located in the hypothalamus (Hirshkowitz, 2004), the biological pacemaker is synchronized to the external environment (Reid & Burgess, 2005). Coinciding with temporal cues, the circadian clock promotes wakefulness in rhythmic oscillations with peaks in the late morning and early evening and troughs in the mid-afternoon and middle of the night.

The two-process model of sleep regulation details the interaction between these biological forces (Tononi & Cirelli, 2006). To illustrate the model, researchers define the homeostatic component as process S and the circadian system as process C (Borbély, 1982). Process S promotes sleep and increases in propensity in a roughly linear manner during wakefulness, peaks prior to sleep onset, and dissipates precipitously as sleep ensues (Borbély & Achermann, 1999). Concurrently, process C counteracts process S by promoting wakefulness (Borbély & Achermann, 1999). Controlled by environmental cues such as light and meal timing, the endogenous circadian rhythm (process C) operates according to an intrinsic 24-hour

timekeeping system which gradually wanes as the state of wake progresses (Borbély & Achermann, 1999). As the body's homeostatic drive for sleep is satisfied, the circadian waking drive increases in intensity and the cycle begins anew (Tononi & Cirelli, 2006).

Sleep theory. The specific function(s) of sleep remain elusive to science (Mackiewicz et al., 2007). Studies of sleep and sleep deprivation haven led to the development of three broad categories of contemporary sleep axioms: energy conservation, information processing and synaptic plasticity, and restoration of key cellular components (Mignot, 2008).

Hypotheses which posit that sleep functions to conserve energy are rooted in the construct of natural selection (Markov & Goldman, 2006). According to these models, animal activity and prey availability peak at specific times of the day (Mignot, 2008). Subsequently, sleep increases the likelihood of survival by reducing energy expenditure during periods of torpor. While the energy economics theory is substantiated by numerous examples in nature, it fails to explain the selection of REM sleep, which, in most species, results in a state of increased energy expenditure (Mignot, 2008).

Evidence suggests that sleep facilitates learning and memory through changes in brain plasticity (the capacity of the brain to change with learning) and synaptogenesis (creation of new synapses) (Vyazovskiy, Cirelli, Pfister-Genskow, Faraguna, & Tononi, 2008). As wakefulness is associated with learning and the strengthening of synapses, Tononi and Cirelli (2006) postulated that sleep regulates synaptic homeostasis. According to this theory, space and energy limitations make learning unsustainable in a state of perpetual wakefulness (Tononi & Cirelli, 2006). Sleep provides a condition of external disconnect from the environment allowing for synaptic downsizing (Tononi & Cirelli, 2006). This process leaves only the most robust connections intact, providing the energy and space for renewed learning (Mignot, 2008). Tononi and

Cirelli's hypothesis predicts that synaptic downsizing increases the strength of the remaining connections, thereby improving learning performance. Although their hypothesis accounts for numerous experimental observations, it does not take into account the role of REM sleep in learning (Mignot, 2008).

Restoration hypotheses propose that key cellular components of macromolecule biosynthesis are expended during periods of extended wakefulness (Mackiewicz et al., 2007). Subsequently, cellular stress is amplified, and sleep is required to restore the synthesis of depleted macromolecules (Mackiewicz et al., 2007). The greatest strength of this theory is its cellular basis, which makes it applicable to all organisms and tissues (Mignot, 2008). However, the reported changes in gene expressions are correlational and may be the result of biological processes distinct from sleep (Mignot, 2008). In addition, similar to other sleep theories, the restoration hypothesis primarily explains NREM sleep and does not fully elucidate the function of REM sleep (Mignot, 2008).

Sleep across the lifespan. Sleep requirements and architecture evolve over time, with sleep generally becoming less efficacious with age (Markov & Goldman, 2006). Infants require approximately 16 to 18 hours of sleep per day and spend a considerable amount of time in REM sleep (Roffwarg, Muzio, & Dement, 1966). Infants gradually sleep more at night as circadian rhythms became entrained and responsiveness to social cues increase (Mirmiran, Maas, & Ariagno, 2003). Sleep duration decreases by 2 to 5 hours in childhood (Roffwarg et al., 1966), possibly due to gradual decreases in daytime napping and the introduction of school routines (Jenni & O'Connor, 2005).

Adolescents require 9 to 10 hours of sleep, though research has found that this duration is rarely met (Mercer, Merritt, & Cowell, 1998). Adulthood is associated with earlier sleep and

wake times (Dijk, Duffy, & Czeisler, 2000). Elderly adults tend to experience a decrease in sleep quality (Van Cauter, Leproult, & Plat, 2000). Although the causes for this are multifaceted, the elderly are known to experience a decrease in melatonin levels due to aging of the hypothalamic nuclei, the organ responsible for modulating circadian rhythms (Garfinkel, Laudon, Nof, & Zisapel, 1995).

Sleep and Health

Sleeping 7 to 8 hours on a daily basis has long been identified as a critical element of optimum health (Belloc & Breslow, 1972). Notwithstanding, research indicates sleep deprivation is highly prevalent in society. Subsequently, the deleterious outcomes of this apparent trend have become a topic of growing concern within the scientific community (Bixler, 2009). Epidemiological evidence has associated both insufficient (<7 hours) and excessive (>8 hours) sleep durations with increased rates of morbidity (Gangwisch, et al., 2007; Hall et al., 2008) and mortality (Hublin, Partinen, Koskenvuo, & Kaprio, 2007). The majority of studies report U-shaped, parabolic relationships which indicate that sleep durations that fall outside of the 7 to 8 hour range adversely impact health (Bixler, 2009). Injurious health consequences linked to long and short sleep duration include

- cardiovascular disease (Ayas et al., 2003) and diabetes (Gangwisch et al., 2007),
- depression (Strine & Chapman, 2005),
- automobile and occupational accidents (Teran-Santos, Jimenez-Gomez, & Cordero-Guevara, 1999; Lockley et al., 2004), as well as
- learning and memory problems (Stickgold, Hobson, Fosse, & Fosse, 2001).

These findings have led many researchers to conclude that habitual sleep duration of 7 to 8 hours is essential for health maintenance (Banks & Dinges, 2007; Bixler, 2009).

The causal factors explicating the association between inadequate sleep duration and an increased risk of all-cause mortality remain unclear (Hublin et al., 2007; Youngstedt & Kripke, 2004). As sleep is a modulator of hormone release, cardiovascular function, and glucose regulation, Bixler (2009) postulated that short sleep duration contributes to an increased risk of cardiometabolic disorders including hypertension, as well as metabolic syndrome, and diabetes mellitus. Conversely, Youngstedt and Kripke (2004) have proposed that mortality rates associated with excessive sleep duration are a consequence of sleep fragmentation, lethargy, and a decreased photoperiod. Furthermore, evidence indicates a bi-directional relationship between sleep and health such that inadequate sleep contributes to the progression of a number of medical and psychiatric disorders, and that these same disorders, in turn, contribute to poor sleep quality (Zee & Turek, 2006).

Sleep restriction. Partial sleep deprivation (PSD) is described as a nocturnal sleep state that is interrupted or reduced (Weinger & Ancoli-Israel, 2002). Banks and Dinges (2007) suggest that PSD can manifest in three ways. The first type prevents sleep from being physiologically consolidated, resulting in sleep fragmentation. Sleep fragmentation disrupts the normal sleep stage sequencing pattern, resulting in decreased sleep efficiency; measured by time spent in physiological sleep compared to the amount of time spent in bed (Banks & Dinges, 2007). This type of PSD is commonly seen in certain sleep disorders such as obstructive sleep apnea (Bennett, Langford, Stradling, & Davies, 1998). The second type of PSD is classified as selective sleep deprivation. This form of PSD is marked by sleep fragmentation which results in a stage-specific deficiency. Banks and Dinges (2007) classify the third category as sleep restriction and define this form of PSD as a reduction in total sleep duration. Sleep restriction is attributed to medical conditions, sleep disorders, work schedules, social and domestic

responsibilities, and lifestyle choices (Banks & Dinges, 2007; Weinger & Ancoli-Israel, 2002). Sleep debt is considered to be a consequence of cumulative sleep restriction (Van Dongen, Maislin, Mullington & Dinges, 2003).

Sleep restriction in society. Sleep loss is widespread in industrial societies (Curcio, Ferrara, & De Gennaro, 2006). Several studies have noted a downward trend in the amount of sleep Americans receive. In 1960, the American Cancer Society reported a modal sleep duration of 8.0–8.9 hours of sleep; by 1995 the modal category of the survey indicated that sleep duration had decreased to 7 hours (Knutson, Spiegel, Penev, & Van Cauter, 2007). A study examining population-based data (n=110,441) collected between 2004 and 2007 revealed that 28.3% of U.S. adults slept six or fewer hours per night and 8.5% slept nine or more hours (Krueger & Friedman, 2009). In its 2005 *Sleep in America Poll*, the NSF (2005) noted a consistent downward trend in the proportion of respondents acquiring a full 8 hours of sleep on weekdays: 38% in 2001, 30% in 2002, and 26% in 2005 (NSF, 2005).

Sleep restriction in the U.S. The *2009 Sleep in America Poll* (NSF, 2009) found that 20% of respondents (n=1,000) received less than 6 hours of sleep per night. Nearly 30% reported their sleep had been disturbed due to distress over personal finances, the national economy, and employment. The poll also revealed that compared to respondents who slept 8 hours per night, those who received inadequate sleep were, as a result of their sleep-deprived state, less likely to work at maximum efficiency, exercise regularly, or maintain a healthy diet. Short sleepers were found to be more than twice as likely to miss family events, leisure activities, or work functions due to sleepiness or sleep problems. In addition, sleep-deprived respondents were twice as likely to engage in unhealthy behaviors such as consuming foods high in sugar, drinking caffeinated beverages, and using tobacco products to compensate for their lethargic state. Interestingly, 42%

of those polled believed that adequate sleep was as important as diet and exercise for general health. Despite these findings, participants indicated they were not receiving the proper amount of sleep required to function optimally. On average, respondents reported receiving 6 hours 40 minutes of sleep per night during the week and 7 hours 7 minutes on the weekends. The results also showed that 54% of respondents operated a motor vehicle in a lethargic state at least once in the past year and 28% reported doing so at least once per month.

Global trends in sleep restriction. Short sleep duration and reduced sleep quality is not unique to American culture. A Finnish study conducted by Kronholm and colleagues (2008) between 1972 and 2005 discovered an 18 minute decrease in sleep duration among the population (n=251,083) in addition to an increase in sleep complaints, primarily among middle-aged men. Liu et al. (2000) investigated sleep loss and daytime sleepiness in the general adult population of Japan and found that 29% of those surveyed (n=3,030) slept less than 6 hours per night with 23% reporting insufficient sleep. In accordance with these findings, the researchers reported prevalence rates of insomnia at 21% and excessive daytime sleepiness at 15%.

Although the evidence indicates a trend towards diminishing sleep duration and quality, there are limitations with the methods used to arrive at these findings. Magee, Iverson, Huang, and Caputi (2008) noted that the majority of data were collected through self-report. Several researchers have delineated the limitations of this approach and contend that objective measures of recording sleep are needed to establish the validity of epidemiological results, particularly in terms of morbidity and mortality factors as related to sleep duration (Youngstedt, 2005). Furthermore, some researchers remain unconvinced that the reduction hypothesis is viable, citing a lack of comparison data from the pre-industrial era (Kronholm et al., 2008).

Sleep and ethnicity. The *2010 Sleep in America Poll* (NSF, 2010) focused on the issue of sleep and ethnicity. The findings of the study uncovered stark differences in the sleep habits and attitudes of Asians, Black/African-Americans, Hispanics, and Whites. Across the ethnic continuum, approximately one-third of respondents (n=1,007) reported that they did not receive sufficient sleep on workdays and weekends to function at optimal levels. Black/African-Americans received the least amount of sleep and suggested that they only required 7 hours 5 minutes of sleep to function optimally; markedly less than Asians and Hispanics who reported they required 7 hours 29 minutes to function at their best. When queried about sleep partners, Whites (21%) were least likely to report they slept alone; however, Whites were much more likely to report sleeping with their pets (16%). Among those with children, Asians (28%) and Hispanics (22%) were the most likely group to state they slept in the same room with their children.

In regards to sleep and health status, a large portion of respondents with sleep problems indicated they did not take action to improve their sleep or consult with their health care provider about issues related to sleep. Yet, 83% of Whites, 81% of Asians, 78% of Hispanics and 76% of Blacks/African-Americans surveyed completely agreed/mostly agreed with the statement "insufficient or poor sleep is associated with health problems". Asians (31%) were the least likely group to be asked about the status of their sleep by a health care professional or doctor compared to Whites (56%), Hispanics (48%), and Blacks/African-Americans (45%). Additionally, Asians (15%) indicated they were more likely to seek advice about sleep from family or friends. Alternatively, during episodes of unresolved sleep problems, Black/African-Americans were more likely to speak with their doctor or seek information on-line rather than to seek counsel from friends or family.

Sleep disorders appear to be a common issue among adults of all ethnicities. According to the survey, Whites (20%), Blacks/African-Americans (19%) and Hispanics (19%) were almost twice as likely as Asians (10%) to have been diagnosed with a sleep disorder. Sleep apnea was particularly prevalent among Blacks/African-Americans (14%) compared to Whites (6%) or Asians (4%). Conversely, Whites reported higher rates of insomnia (10%) than Asians (4%) or Blacks/African-Americans (3%). Additionally, Whites (6%) reported restless legs syndrome more often than Blacks/African-Americans (1%).

Sleep disturbances related to employment, relationship, financial, and health-related concerns appeared frequently across the ethnic spectrum. Hispanics (38%) and Blacks/African-Americans (33%) reported that any one of these concerns disturbed their sleep at least a few nights per week, compared to Whites (28%) and/or Asians (25%). Astoundingly, Hispanics (19%) and Blacks/African-Americans (19%) stated their sleep was disturbed every night or almost every night by at least one of these concerns.

Among the four ethnicities surveyed, approximately 20% reported that sleepiness or sleep-related problems caused them to miss an event in the past month. A similar percentage reported that sleepiness had a negative impact on their relationships. Overall, 37% of Whites, 33% of Hispanics, 32% of Asians and 31% of Blacks/African-Americans indicated sleepiness has had an adverse effect on their quality of life.

Etiology of sleep restriction. Epidemiological data has uncovered several antecedents of inadequate sleep duration including

- socioeconomic status (Patel, 2007),
- stress (Kronholm et al., 2008),
- sleep complaints (Grandner & Kripke, 2004),

- age-related factors (Ohayon, Carskadon, Guilleminault, & Vitiello, 2004),
- being single (Krueger & Friedman, 2009),
- working long hours (Scott et al., 2007), as well as
- unhealthy behaviors such as smoking, alcohol consumption, and sedentary lifestyles (Bixler, 2009).

Conversely, data has identified supportive marriages (Friedman et al., 2005) and parenting as determinants that encourage healthy sleeping patterns (Umberson, 1987).

Behavioral dynamics and health-related factors are at the core of curtailed sleep durations (Monk, Buysse, Rose, Hall, & Kupfer, 2000; Tamakoshi & Ohno, 2004). Behavioral components are interlinked to evolving societal norms and encompass lifestyle factors such as shift work, prolonged working hours, jet lag, and maintaining irregular sleep schedules (Caldwell, Caldwell, & Schmidt, 2008). Consequently, sleep researchers Zee and Turek (2006) have cited voluntary sleep restriction as the primary factor responsible for insufficient sleep in modern society.

Sleep disorders represent a biological or psychological inability to achieve healthy sleep (Szentkirályi, Madarász, & Novák, 2009). There are approximately 90 classified sleep disorders with the greater part being characterized by one of three symptoms: excessive daytime sleepiness, difficulty in initiating or maintaining sleep, and irregular events occurring during sleep (Panossian & Avidan, 2009). In 2003, it was reported that between 50 and 70 million Americans suffered from chronic sleep and wakefulness disorders (U.S. Department of Health and Human Services, 2003). The most common sleep disorders included insomnia, narcolepsy, obstructive sleep apnea syndrome, restless leg syndrome, and shift wake-sleep disorder (Szentkirályi et al., 2009).

Neurobehavioral consequences of sleep restriction. Sleep restriction degrades behavioral alertness and cognitive performance (Minkel, Banks, & Dinges, 2009). Moreover, these deteriorating effects are dose-dependent, resulting in exacerbated conditions of cognitive dysfunction (Banks & Dinges, 2007; Belenky et al., 2003). To cope with sleep restriction, the body alters its normal sleep architecture by intensifying particular sleep stages while simultaneously diminishing others. Studies have uncovered that healthy adults restricted to 4 hours of sleep for multiple nights spend less time in NREM stage two and REM sleep, yet maintain the same amount of NREM slow-wave sleep relative to a typical 8-hour sleep episode (Belenky et al., 2003). Although the research demonstrates that the body conserves slow-wave sleep during periods of sustained sleep restriction, cognitive deficits continue to escalate, suggesting that the brain is unable to adapt to sleep deprivation without sacrificing neurocognitive performance (Banks & Dinges, 2007).

Psychomotor vigilance. From a neurological perspective, alertness refers to a sustained state of attention required for accurate performance of cognitive tasks (Tomasi et al., 2009). Alertness impacts attention processes and is highly impacted by sleep deprivation (Kendall, Kautz, Russo, & Killgore, 2006). Sleep deprivation has been shown to disrupt communication between the multiple brain regions responsible for managing attention (Fan, McCandliss, Fossella, Flombaum, & Posner, 2005). Studies have shown that to maintain arousal in a sleep-deprived state, the brain is forced to focus its cognitive resources on warding off the homeostatic drive for sleep, leaving a capacity deficit for tasks requiring alertness (Tomasi et al., 2009).

Psychomotor vigilance is particularly sensitive to sleep restriction. Research has demonstrated that sleep deprivation increases delays in alertness (Balkin et al., 2004). In an experiment conducted by Van Dongen and colleagues (2003), cognitive performance

impairments of participants that slept 6 hours or less per night over 14 consecutive days were equivalent to cognitive performance impairments of participants subjected to two nights of total sleep deprivation. Surprisingly, the sleep deprived study participants appeared unaware of their fatigued state, as indicated by their scores on standardized sleepiness scales.

Transportation safety issues exemplify the reality of sleep restriction's impact on psychomotor vigilance (Carskadon, 2004). Numerous investigations have implicated sleep loss as a primary cause of automobile accidents (Carskadon, 2004). Sleep-related collisions have been estimated to have an annual economic cost of $43 to $65 billion (Leger, 1994). Data analyzed by gender and age indicates young males under age 30 are the group most likely to be involved in sleep-related crashes (National Institutes of Health, National Heart, Lung, and Blood Institute [NHLBI], 1998). Interestingly, sleep-related motor vehicle accidents correspond to circadian variations in sleepiness, primarily occurring between the hours of 2:00 a.m. to 8:00 a.m. and mid-afternoon (Pack et al., 1995). Multiple jobs, shift work, and sleep restriction are the salient factors contributing to sleep-related accidents (NHLBI, 1998). Sleep deprivation has also been shown to impair psychomotor performance in a manner similar to intoxication at or above the legal alcohol limit (Dawson & Reid, 1997).

Mental health. Researchers have found that sleep deprivation generates feelings of tension, anger, and uneasiness while concomitantly diminishing drive and motivation (Kim et al., 2001). In a pioneering study, Yoo, Gujar, Hu, Jolesz, and Walker (2007) demonstrated that insufficient sleep duration degrades distressful emotional coping capabilities. In their experiment, both sleep-deprived and non-sleep-deprived groups were exposed to negative visual stimuli. Incorporating brain scans, the researchers observed that in the sleep-deprived group, the amygdala—the region of the brain hypothesized to stimulate emotional responses—exhibited a

60% greater activation rate compared to the normal sleep group. In the non-sleep-deprived group, the prefrontal cortex—the logic center of the brain believed to be responsible for modulating emotional reactions—dampened the reaction of the amygdala. The variation in brain activity between the two groups suggested there was a disconnect between the prefrontal cortex and the amygdala in the sleep-deprived group, explaining the more intense emotional response. The researchers demonstrated that in a state of sleep deprivation, emotional coping is curtailed and reaction to aversive stimuli is insufficiently regulated by the brain.

Memory and learning. Sleep restriction has been shown to obstruct higher cognitive functions including attention, memory, abstract thinking, creativity, and problem solving (Harrison & Horne, 2000). Human memory is categorized into short-term memory, also called working memory, and three systems of long-term memory (LTM) (Rauchs, Desgranges, Foret, & Eustache, 2005). LTM is divided into two branches: declarative and non-declarative (Walker & Stickgold, 2006). Declarative memory refers to consciously accessible memories and is classified as either episodic or semantic (Gais & Born, 2004). Episodic memories include autobiographical recollections of one's life such as birthdays or other memorable events (Tulving & Markowitsch, 1998). Semantic memories include facts, information, and general knowledge that had been acquired, devoid of the temporal context in which the information was obtained (Tulving & Markowitsch, 1998). Non-declarative memories are acquired and recalled without conscious thought and are related to procedural tasks such as performing a skill or problem solving (Walker & Stickgold, 2006). Memory classifications provide a convenient methodology for experimentation; however, memory systems rarely operate in isolation. For example, higher learning requires the conjoint effort of memory types (Walker & Stickgold, 2006).

The introduction of the declarative/non-declarative dichotomy gave rise to a renewed interest in the relationship between sleep and synaptic plasticity (Gais & Born, 2004). Research has strengthened the relationship between sleep and the memory-learning processes, yet the extent of sleep's role in this process is the subject of much debate (Siegel, 2001). Memory formations are thought to occur in distinct stages over time, beginning with memory encoding (Walker & Stickgold, 2006). Encoding includes the processing of a physical sensory input into the memory. Researchers hypothesize that once a memory is encoded it undergoes memory consolidation, a process which was suspected of making a labile memory increasingly stable (Walker & Stickgold, 2006). Sleep is considered a mediator of memory consolidation, yet it remains to be determined which aspects of memory are affected by sleep (Curcio et al., 2006). Nevertheless, researchers have concluded that both REM and NREM are necessary for learning and that sleep loss impairs the consolidation of declarative and procedural memories (Curcio et al., 2006).

Learning and memory are fundamental to academic accomplishment (Brown, Buboltz, & Soper, 2006). Albeit, validating a causal relationship between sleep restriction and academic performance is difficult due to limitations in study design, the use of subjective measures such as self-reported grade point average, and the inability to control for potential confounding variables (Curcio et al., 2006).

Physiological consequences of sleep restriction. Epidemiological evidence has associated short (<7 hours) and long (>8 hours) sleep durations with an increased risk of all-cause mortality (Bixler, 2009). In addition, numerous physiological indices are altered by sleep restriction including

- a reduction in T cells (Irwin et al., 1996),

- a reduction in glucose tolerance (Spiegel, Leproult, & Van Cauter, 1999),
- a reduction in leptin levels (Spiegel et al., 2004),
- an increase in blood pressure (Tochikubo, Ikeda, Miyajima, & Ishii, 1996), and
- elevated levels of C-reactive protein (Meier-Ewert et al., 2004).

Researchers speculate that these short-term alterations serve as a catalyst for the negative health implications revealed in the epidemiological research (Banks & Dinges, 2007).

Cardiovascular morbidity has been associated with sleep restriction in numerous epidemiological studies (Banks & Dinges, 2007). The causal sequence linking chronic sleep restriction with increased risk of cardiovascular disease has yet to be identified. Researchers speculate that elevated levels of C-reactive protein, which rise in response to inflammation in the body and have been demonstrated to increase during sleep restriction, contribute to the cardiovascular morbidity rates reported in epidemiological investigations (Banks & Dinges, 2007; Meier-Ewert et al., 2004).

Chronic sleep restriction has been shown to negatively affect endocrine function and carbohydrate metabolism, leading many researchers to speculate a causal relationship between sleep restriction and obesity (Spiegel et al., 2004). Several studies have examined the parallel between the current obesity epidemic and the growing societal trend of chronic sleep curtailment (Magee et al., 2008; Marshall, Glozier, & Grunstein, 2008). Potential causal pathways connecting insufficient sleep and obesity include impaired glucose metabolism, an increase in caloric intake caused by hyperphagia, feelings of fatigue contributing to lower physical activity levels, and a decline in core body temperature affecting energy expenditure via thermoregulation (Knutson et al., 2007; Patel et al., 2004). Obesity is also a primary risk factor for obstructive sleep apnea, a type of sleep-disordered breathing linked to hypertension. Despite the heightened

media attention regarding the possible link between sleep and obesity, Marshall et al. (2008) caution that the evidence that sleep duration is causally linked to obesity remains inconclusive and advise against the promotion of sleep behavior modification as an intervention for obesity.

Sleep disorders. There are approximately 90 classified sleep disorders identified by the AASM's (2001) *International Classification of Sleep Disorders*. The American Psychiatric Association's (APA) *Diagnostic and Statistical Manual of Mental Disorders* (2000) organizes sleep disorders into four comprehensive sections.

Primary sleep disorders. Primary sleep disorders are speculated to develop from abnormalities in the physiological functions that regulate sleep (APA, 2000). This category is divided into two general types: dyssomnias and parasomnias. Dyssomnias are characterized by an inability to fall asleep or stay asleep. This spectrum of disorders includes circadian rhythm disorder, narcolepsy, and breathing-related disorders such as obstructive sleep apnea syndrome, primary insomnia, and primary hypersomnia. Parasomnias are the second type of primary sleep disorders. Parasomnias disrupt the sleep-wake cycle by activating physiological systems at inappropriate times. Sleepwalking, nightmare, and sleep terror disorders are examples of parasomnias.

Circadian rhythm somnipathies encompass the family of sleep disorders affecting the timing of sleep (APA, 2000). This category includes a number of disorder types relevant to behavioral components of sleep restriction including delayed sleep phase, jet lag, and shift work. Of particular interest to this research report is the delayed sleep phase type characterized by a delay of the sleep-wake cycle relative to societal demands. Essentially, this disorder represents a circadian mismatch. Individuals with this condition initiate sleep, maintain sleep, and awaken consistently when left to their own sleep schedule, yet they exhibit difficulty modifying their

sleep pattern to coincide with traditionally-timed social and occupational obligations. As a result, these individuals are frequently chronically sleep deprived. Delayed sleep phase type is distinguished from volitional patterns of delayed sleep hours by the ability of the individual to fall asleep at earlier times after a period of recovery sleep.

Sleep disorders related to another mental disorder. Sleep disturbances are frequent features of psychiatric disorders (APA, 2000). The primary characteristic of this category is the presence of insomnia or hypersomnia temporally or causally related to another mental disorder. Hypersomnia is diagnosed as excessive nighttime sleep or repeated daytime sleep episodes lasting for at least one month. Alternatively, insomnia is categorized as the inability to initiate sleep, maintain sleep, or receive restorative sleep. Insomnia is associated with a mental disorder in more than one-third of cases (Ohayon, 2002), with the most common disorder being depression (Breslau, Roth, Rosenthal, & Andreski, 1996).

Insomnia is the most widely reported sleep problem, afflicting an estimated 10% of the general adult population (Jensen, 2003). To treat insomnia, clinicians rely upon a variety of treatment modalities including pharmacotherapy, psychological therapy, light therapy, and exercise (Espie & Kyle, 2009). Pharmacotherapy is the most frequent method used for treating acute insomnia. This approach incorporates the prescription of sedative-hypnotics to induce or maintain sleep. Psychological therapy, primarily in the form of cognitive behavioral therapy, is considered the ideal modality for treating chronic insomnia (Jacobs, Pace-Schott, Stickgold, & Otto, 2004). Cognitive behavioral therapy consists of a range of psychotherapeutic methods including stimulus control treatment, sleep restriction therapy, cognitive control, thought suppression, imagery and relaxation, cognitive restricting, and paradoxical intention (Espie & Kyle, 2009). Light therapy and exercise are based on the physiology of human circadian

rhythms. Internal biorhythms are particularly sensitive to environmental cues, and selective light exposure is presumed to aid in resetting circadian rhythms (Bjorvatn & Pallesen, 2009). As well, physically active individuals have been found have higher sleep quality (Youngstedt, 2005). An explanation for this phenomenon has not been resolved, but it is often attributed to behavioral patterning as opposed to aerobic fitness (Espie & Kyle, 2009).

Sleep disorders due to a general medical condition are typically assumed to be a direct result of a general medical condition affecting physiological functioning (APA, 2000). *Substance-induced sleep disorder*s relate to sleep disturbances resulting from the use of a substance, including medications (APA, 2000).

Sleep Hygiene and Alertness Management

Sleep hygiene (SH) and alertness management (AM) are effective methodologies for improving sleep quality (Stepanski & Wyatt, 2003) and enhancing alertness (Caldwell et al., 2008). As standalones, these techniques are not used for the treatment of sleep disorders (Espie & Kyle, 2009) but are considered beneficial to the general population to assist in optimizing sleep and coping with the unwanted effects of unavoidable fatigue.

Sleep hygiene. SH operates under the assumption that behavioral and environmental factors can be modified to enhance sleep quality (Stepanski & Wyatt, 2003). SH consists of a series of practices designed to optimize the biological processes regulating human sleep. From the time of its conception in 1977 by Peter Hauri, the opinions of what constitute ideal SH have continued to evolve (Stepanski & Wyatt, 2003). Hauri (1991) has suggested that many of the SH principles are relative to each individual and should be subjected to trial-and-error and analyzed over time through the maintenance of a sleep log. Hauri has noted that in practice most patients

are only capable of adopting three or four SH principles at a time as the implementation of the rules often requires significant behavioral modification.

Habitual sleep/wake time. Adhering to a consistent wake/sleep time promotes optimal sleep propensity and consolidation (Stepanski & Wyatt, 2003). Hauri (1991) has advised establishing a regular wake time and incorporating a sleep log to determine optimal sleep duration. It is commonly accepted that the circadian and homeostatic processes will eventually synchronize to the fixed wake time, and sleep time would regulate itself automatically. Hauri has asserted that the innate circadian rhythm is longer than 24 hours in adolescents and young adults. Maintaining a regular arousal time is alleged to aid in consolidating this extended duration into a 24-hour time frame.

Napping. Daytime naps have been shown to have an adverse effect on nocturnal sleep quality by diminishing the homeostatic pressure for sleep (Stepanski & Wyatt, 2003). Notwithstanding, short naps of 15 minutes can improve performance, while longer late-afternoon naps have the potential to disrupt nocturnal sleep quality (Sousa, Araújo, & Azevedo, 2007). Hauri (1991) has recommended that naps be explored as an option and, if found to be beneficial, tailored according to individual need.

Caffeine. Caffeine is the most popular psychostimulant for thwarting sleepiness (Nehlig, 1999). The neuromodulator adenosine is believed to be an endogenous sleep-promoting substance that increases in tandem with the sleep homeostat (Porkka-Heiskanen, Alanko, Kalinchuk, & Stenberg, 2002). Caffeine is believed to block adenosine receptors in the central nervous system thereby staving off the homeostatic drive for sleep. Caffeine has a half-life of 6 hours therefore it is recommended to not consume caffeine within 6 hours of scheduled sleep

time. Restricting caffeine consumption prior to sleep time is one of the few consistent recommendations proposed by SH experts (Stepanski & Wyatt, 2003).

Alcohol and tobacco. Alcohol has several inimical effects on SH including suppression of REM sleep, sleep fragmentation, and delay of sleep latency (Stepanski & Wyatt, 2003). Low doses of alcohol can assist in promoting sleep onset; however, alcohol consumed up to 6 hours prior to sleep time has been empirically verified to result in sleep fragmentation (Landolt, Roth, Dijk, & Borbely, 1996). Consequently, it is generally recommended that alcohol be avoided prior to sleep and not be employed as a hypnotic (Hauri, 1991). Similar to caffeine, alcohol avoidance is one of the few SH practices that is recommended across the research (Stepanski & Wyatt, 2003). As well, nicotine is considered a mild stimulant and thus should be avoided prior to sleep (Hauri, 1991). However, the full effect of nicotine's interaction on sleep remains unclear (Stepanski & Wyatt, 2003).

Body temperature and passive heating. The circadian rhythm is assessed by measuring core temperature. Hauri (1991) has contended that sleep quality is tied to a natural trough in the daily temperature curve. Intense exercise is known to cause an increase in core temperature resulting in a compensatory decrease in core temperature 4 to 6 hours post-workout (Horne & Staff, 1983). The subsequent decrease in core temperature leads to a cooling effect that is believed to assist in promoting sleep. Exercise performed later in the day is also thought to increase sleep depth (Youngstedt, 2005). While biologically plausible, the evidence is mixed on the sleep-promoting efficacy of exercise (Driver & Taylor, 2000). Passive heating, such as remaining in a hot bath for 30 minutes, has been advocated as a mechanism to prompt core temperature reaction (Horne & Reid, 1985). Liao (2002) reported that passive heating increased the depth of sleep in elderly individuals with insomnia. The cooling aftereffect was observed

peaking approximately 2 to 4 hours post-passive heating and could be incorporated as an alternative to intense exercise (Hauri, 1991).

Environment. In addition to the homeostatic and circadian processes, the autonomic nervous system assists in regulating sleep. Sleep onset requires a decrease in sympathetic activity and an increase in parasympathetic equilibrium (Hirshkowitz, 2004). Stimuli which amplify sympathetic activity disrupt sleep, irrespective of whether the origin of the stimuli is endogenous or exogenous (Hirshkowitz, 2004). This premise explains why caffeine consumption (exogenous) or anxiety-focused rumination (endogenous) promotes wakefulness when entertained near sleep onset (Hirshkowitz, 2004). Researchers speculate that this mechanism exists for survival purposes, such as when hazardous conditions require the body to maintain wakefulness. However, this function is also suspected to hinder sleep and promote insomnia. Environmental SH practices are believed to promote nocturnal tranquility in a manner similar to classical conditioning (Hirshkowitz, 2004).

A number of environmental factors have been proposed to foster SH such as eliminating light and noise from the bedroom, regulating bedroom temperature, eliminating light-emitting bedroom clocks, ensuring the bed is comfortable and suitable for sleep, and using the bedroom exclusively for sleep (Friedman et al., 2000; Hauri, 1991). Nightly rituals are believed to serve as triggers to prepare the mind for sleep (Friedman et al., 2000). Mild routines have been recommended and are encouraged to be used in conjunction with other SH practices to reinforce sleep latency. The creation of a "worry list" can cultivate an environment conducive to sleep by assisting in allaying mental stress (Friedman et al., 2000). Integrating this technique requires the individual to develop a list of tasks and goals that have to be completed in the near future and mentally detaching from the list to clear the mind of anxiety-producing thoughts.

Inadequate sleep hygiene. The AASM (2001) has established a set of criteria for diagnosing inadequate SH. Inadequate SH is characterized by practices that produce increased arousal and practices that contradict the known principles of sleep organization. The central tenet of inadequate SH is that the practices are under the behavioral control of the individual and are not the result of an underlying physiological or psychological disorder.

Studies show that arousal can be augmented by substances such as caffeine, tobacco, and alcohol (AASM, 2001). Stress and excitement also contribute and include stimulating activities occurring within close proximity to sleep time such as intense physical activity, involved mental tasks, or social events. Environmental arousers—for example, allowing light to seep into the bedroom—are also labeled as sleep disruptions. The biological processes that regulate sleep are also susceptible to inadequate SH. Spending too much time in bed, excessive variation in sleep/wake time, and taking naps throughout the day are considered indicators of poor SH.

Alertness management (AM). The context of modern society has led many researchers to conclude that stints of voluntary sleep restriction are inescapable. AM incorporates a blend of SH techniques and fatigue management strategies to mitigate the effects of unavoidable sleep loss (Caldwell et al., 2008). Fatigue is an enervator of several psychological functions including accuracy and focus, multi-tasking, social interaction, emotional stability, and rational thought.

Optimizing sleep. In general, this tactic coincides with SH practices with an additional recommendation to use hypnotics to cope with situations that make sleep onset difficult such as shift lag, poor sleep environments, or unconventional schedules (Caldwell et al., 2008). A variety of hypnotics are available, and consideration of the ideal soporific is dependent upon a number of factors. Temazepam has a half-life of 8 to 10 hours and is considered useful for increasing sleep duration. Extended-release zolpidem improves sleep maintenance without the

extended half-life of temazepam. Zolpidem or zaleplon are ideal for short-sleep periods and have a lower post-sleep sedation side effect. Alternative medications such as melatonin and valerian are also viable options; however, very little research exists to substantiate their effectiveness or safety.

Fatigue countermeasures. Caldwell and colleagues (2008) recommend five strategies for temporarily preserving performance during a state of fatigue. The authors recommend that these strategies be utilized intermittently as needed and that regular sleep be resumed as soon as conditions permit.

Limiting time on task and rest breaks. Restraining the total duration of time available to work promotes healthier sleep habits and offsets the effects of time-on-task fatigue (Rosa & Bonnet, 1993). Rest periods taken during a work shift assist in counteracting the negative neurocognitive side effects of sleep loss. However, the benefits of a rest period during a sleep-deprived state are minimal for long-term performance (Pigeau et al., 1995).

Napping and posture. A nap taken during periods of prolonged wakefulness is the most effective non-pharmaceutical method for bolstering alertness. Bonnet (1991) found that a nap taken prior to a 52-hour block of continuous work sustained performance for 24 hours when compared to a non-nap group; however, the benefits dissipated by the second night of sleep loss.

Nap timing and length are important aspects to consider. Nap duration is directly proportional to performance benefit (Caldwell et al., 2008). Daytime naps taken in a non-sleep-deprived state have been recommended for improving night-work performance. For planning a nap, experts contend that an important consideration is the timing of the nap in relation to the circadian phase. The circadian rhythm regulates core body temperature. Sleep propensity is the greatest when the core body temperature troughs and lowest when the core body temperature

peaks. Generally, core temperature peaks in the early evening and troughs during the pre-dawn and early morning hours. Nap inducement can be difficult to initiate during temperature peaks, yet naps during this phase tend to produce the least amount of post-sleep lethargy. Naps initiated during the circadian trough offer the best performance benefits but are accompanied by a higher likelihood of sleep inertia (Bonnet, 1991).

Certain postures aid in inhibiting fatigue. Upright positions reduce sleepiness compared to prone positions (Dinges, Orne, & Orne, 1985). During periods when fatigue was high, working in a standing position can preserve alertness (Caldwell et al., 2008).

Psychoactive stimulants. Caffeine is a short-acting stimulant clinically demonstrated to reduce performance deficits associated with sleep loss (Caldwell et al., 2008). Controlled experiments have found that caffeine improves performance at doses of 75 to 100 mg following acute restriction of sleep and at doses of 200 to 600 mg after a night of total sleep loss (Bonnet, Dinges, Roehrs, Rogers, & Wesensten, 2005). However, frequent use of caffeine results in tolerance and produces withdrawal side-effects (Bonnet et al., 2005).

Sleep and College Students

Psychographics. Undergraduate students are confronted with a complex array of social, academic, and personal dynamics which have the potential to negatively influence their sleeping patterns. For many incoming undergraduate students, the family support and structure present during high school is replaced by a more disorganized lifestyle (Brown, Soper, & Buboltz, 2001). Congruent with this novel level of autonomy, students also have to cope with the stress of academic responsibility (Pilcher, Ginter, & Sadowsky, 1997). Students frequently rate their first year of college as one of the most stressful events of their lives (Wong, Cheung, Chan, Ma, & Tang, 2006), citing examinations, concerns about future success, and meeting professor

expectations as salient academic stressors (Murphy & Archer, 1996). Ecological forces have a strong effect on behavior as students seek to develop social relationships and adjust to cultural norms (Vela-Bueno, Fernandez-Mendoza, & Olavarrieta-Bernardino, 2009). Researchers have noted that although any one of these factors have the capacity to negatively impact sleep patterns, the interplay between these elements increases the likelihood students will embrace self-imposed sleep restriction (Jensen, 2003).

To meet the social and academic pressures of university life, students often adopt unhealthy sleeping behaviors (Brown et al., 2006). Adjusted sleep patterns typically involve self-imposed sleep restriction throughout the week and extended sleep duration on the weekends (Brown et al., 2001; Machado, Varella, & Andrade, 1998). This cycle often becomes more pronounced in proximity to tests and final examinations, with the potential of resulting in episodes of 24 to 48 hours of total sleep deprivation (Pilcher & Walters, 1997). Such variability in sleeping behaviors helps explain why college students frequently report symptoms consistent with delayed sleep phase syndrome (Brown et al., 2001; Lack, 1986).

In tandem with intense lifestyle changes, undergraduate students endure a maturational flux as they complete the transition from adolescence to adulthood (Vela-Bueno et al., 2009). Vela-Bueno and colleagues (2009) assert that these developmental changes play an important role in some of the common sleep complaints of this cohort including disturbances of the sleep-wakefulness circadian rhythm, insufficient sleep, and excessive daytime sleepiness. The natural proclivity towards sleep difficulties in this group coupled with the stress of college life accentuates the need for SH education.

Sleep quantity. Shorter sleep durations among college populations mirror the increasing trend of sleep restriction reported in the general population. Data collected by Hicks, Fernandez,

and Pellegrini (2001b) from university undergraduates (n=9,543) over a period of three decades revealed a 14% decrease in students' median hours of sleep: 7.75 in 1969; 7.13 in 1979; 6.75 in 1989; and 6.65 in 2001. Hicks et al. suggested that inadequate sleep duration reflected a new college norm and that this trend could have important health implications.

Hicks et al. (1999) investigated the sleep duration of four ethnic groups of university students and discovered ethnicity to be significantly related to sleep duration. Self-reported sleep duration for African-Americans was 6.94 hours per night; for Asians 6.86 hours per night; for Euro-Americans 7.18 hours per night; and for Hispanics 7.10 hours per night. Concurrent with the global trend in increasing sleep restriction, university students worldwide report insufficient sleep (Vela-Bueno et al., 2009). A survey of 17,465 college students from 24 countries found that 21% of respondents slept less than 7 hours per night, with the lowest mean sleep durations among students from Japan, Korea, Taiwan, and Thailand (Steptoe, Peacey, & Wardle, 2006).

Sleep quality. In addition to duration, students are also experiencing reduced sleep quality (Jensen, 2003). Sleep quality encompasses quantitative components of sleep including sleep duration, latency, and fragmentation in addition to qualitative components such as "depth" and "restfulness" of sleep (Buysse et al., 1989). Several standardized instruments including the Pittsburg Sleep Quality Index and Epworth Sleepiness Scale have been developed to asses sleep qualilty.

In their analysis of the prevalence of sleep difficulties in college students, Buboltz and colleagues (2001) noted that 73% of students (n=191) experienced occasional sleeping problems and that only 11% met the criteria for good sleep quality; citing difficulties with sleep latency, morning fatigue, and waking too early as primarly sleep distruptors.

Similarly, data collected by Hicks and colleagues (2001a) indicated that students (n=9,543) in 2000 were 2.96 times more likely to report sleep dissatisfaction than students in 1978. The data set also revealed a linear increase in sleep dissatisfaction: 24% in 1978, 53% in 1988, and 71% in 2000. Several studies have reported that college women experience more sleep disturbances than college men (Brown et al., 2001; Buboltz et al., 2001). Tsai and Li (2004b) observed that women had longer sleep latency, more nighttime awakenings, and overall poorer sleep quality than men.

Determinants of reduced sleep quality. Research has uncovered several factors associated with college students' reduced sleep quality. Brown, Buboltz, and Soper (2002) concluded that varying sleep schedules, going to bed thirsty, environmental noise, and worrying while falling asleep contributed to students' poor sleep quality. Taub and Berger (1974) discovered that even among students who received 8 hours of sleep per, those that shifted their sleep schedules by 2 hours or more on the weekend reported greater levels of depression, decreased sociability, and more cognitive difficulties. Vranesh, Madrid, Bautista, Ching, and Hicks (1999) found that students overly concerned about effectively managing their time to meet academic demands were more likely to report sleep problems.

In a recent investigation, Patel and colleagues (2008) reported a 30% snoring prevalence rate (n=2,200) among college a population. Snoring is considered an early symptom of sleep disordered breathing, a condition that disrupts sleep and is associated with numerous co-morbidities. Marijuana use and alcohol consumption have also been associated with increased daytime sleepiness among college students (Jean-Louis, von Gizycki, Zizi, & Nunes, 1998).

A contemporary study conducted by Lund, Reider, Whiting, and Prichard (2010) examined factors that contributed to sleep difficulties among college populations. The

investigators surveyed a diverse group of full-time undergraduate college students (N=1,125; 420 male, 705 female) between 17 and 24. The research team employed five scales to measure sleep, mood, and stress of the participant. The instruments utilized included the Pittsburgh Sleep Quality Index ($\alpha = 0.73$), the Epworth Sleepiness Scale ($\alpha = 0.75$), the Horne-Ostberg Morningness Eveningness Scale ($\alpha = 0.86$), the Subjective Units of Distress Scale, and the Profile of Mood States ($\alpha = 0.79$).

The findings of the study indicated the majority of respondents were chronically sleep restricted. Only 29.4% of the students reported receiving 8 hours or more of total sleep per night with 25% indicating they received less than 6.5 hours per night. As with other studies, the researchers found college students' sleeping patterns were highly restricted on weeknights and extended on the weekends. Unique to this study, the data revealed that sleep schedules varied significantly by year in school. First-year and sophomore students reported later bedtimes and rise times than juniors and seniors during the weekends. As well, male participants indicated later bedtimes and rise times during the week than females. Moreover, 20% of students reported staying up 24 hours at least once in the last month, and 35% reported staying up until 3:00 a.m. at least once a week.

Poor sleep quality was found to be associated with significantly higher self-reported negative moods, physical illness and the incorporation of alcohol, prescription, over-the-counter, and recreational drugs to regulate sleep and wakefulness. Over half of the respondents reported lacking motivation throughout the week due to sleep loss; 32% reported a 30 minute delay in sleep latency; and over one-third cited stress, excess noise, and co-sleeping as factors that contributed to sleep disturbances on a weekly basis.

Lund and colleagues (2010) cited perceived stress as the primary predictor of poor sleep quality. Their findings indicated that stress interfered with sleep in 20.1% of respondents at least once per week. Women were found to report more stress-related sleep disturbances than men. When asked to specify the reasons for their sleep disturbances, 35% of the respondents indicated academic concerns, racing thoughts, or concerns over the future. When asked what factor would be most likely to compromise their sleep, 64% of respondents cited academic or emotional stress.

College sleep education. From a psychological perspective, college students often view sleep as an expendable requirement that can be compensated for at a later time (Curcio et al., 2006)—thus, the oft-reported cycle of weekday sleep deprivation and weekend sleep indulgence (NSF, 2009). However, research exploring sleep debt has revealed this strategy to be ineffective in dissipating the negative ramifications of sleep deprivation (Buboltz et al., 2001; Sousa et al., 2007). Additionally, sleep research indicates the final 2 hours of an 8 hour sleep epoch as the most critical for memory consolidation. Subsequently, students who habitually receive fewer than 8 hours of sleep per night may be depriving themselves of their maximum learning potential.

Interestingly, students are often unaware of the impact sleep restriction has on their ability to perform cognitive tasks (Brown et al., 2006). A study conducted by Pilcher and Walters (1997) found that although sleep-deprived college students performed considerably worse on a complex task than non-deprived participants, deprived participants reported significantly higher levels of estimated performance and concentration than did non-deprived participants. Remarkably, these findings coincide with Van Dongen and colleagues' (2003) study of the general population, in which participants underestimated the impact sleep deprivation had on their cognitive abilities and performance readiness.

The majority of college students who practice poor sleep habits are unacquainted with behaviors that promote healthy sleep. Hicks and colleagues (1999) tested the mean differences in scores of SH knowledge and SH practices scales (Lacks & Roter, 1987) among four ethic groups of university students (n=963). Results showed that Euro-Americans scored significantly higher on both scales than each of the other three groups; however, Hicks et al. noted that all of the groups exhibited poor SH knowledge. The researchers pointed to the Euro-American group, which scored the highest on SH knowledge but answered only 57% of the scale's items correctly. Such findings have compelled Brown et al. (2006) to caution educators to consider the general lack of SH knowledge among college students as opposed to attributing student's poor sleeping habits to deviant lifestyle choices.

A clear indicator of poor SH, late-afternoon napping, highlights the extent of this knowledge gap. While naps of 15 minute have been demonstrated to improve cognitive performance, longer late-afternoon naps reduce nocturnal sleep quality and are associated with irregular sleep-wakefulness schedules (Sousa et al., 2007). In a study examining the napping behaviors of Spanish undergraduates, Vela-Bueno and colleagues (2008) reported long post-lunch naps as a common coping mechanism employed by students to mitigate daytime sleepiness.

A similar investigation conducted by Digdon and Rhodes (2009) found that students with evening-type circadian preferences are more likely to take long naps to manage sleepiness than intermediate-circadian types. Intermediate types were found to confront sleepiness by spending time outdoors or exercising as opposed to evening types, who were more prone to consume caffeine in the evening. The evening group also ranked taking long naps as a more effective method for dealing with sleepiness than intermediate types.

College Sleep Health Interventions. ***Justification.*** Such glaring deficits in SH knowledge demonstrate the capacity of interventions to improve the sleep practices of college students (Brown et al., 2006). Furthermore, satisfactory sleep is a pertinent health concern to college students. A 2008 survey conducted by the American College Health Association revealed that 79.7% (n=20,992) of students had not received information on sleep difficulties from their colleges, yet 52.7% (n=13,769) were interested in receiving information on this health topic (ACHA, 2008). Although the need for college sleep health interventions is readily apparent, such programs have been met with limited success.

Intervention 1. A preliminary study conducted by Tsai and Li (2004a) incorporated a two-credit sleep management course for undergraduate students. Throughout the semester, SH concepts were introduced and discussed intermittently. In conjunction with the course, students (n=327) maintained sleep logs for three 7-day periods in the months of March, April, and May. Data were also collected from students not enrolled in the course to serve as the control group (n=65). A total of 12 variables were elicited from the logs.

Students in both the control and experimental groups showed significant changes in sleep variables as the academic term progressed. Nap time and sleep quality were the only variables associated with the sleep course. Women in the experimental group decreased their nap time in April and May, yet women in both groups reported greater frequencies of fragmented sleep. Sleep quality slowly improved over the course of the academic term for the experimental group but not for the control group. However, the size of the control group limited the ability of the researchers to reliably assess whether the effects were related to the course. The researchers concluded that the course had only a mild and limited impact on sleep quality and nap duration.

Intervention 2. Brown and colleagues (2006) implemented a psychoeducational intervention targeted at improving the sleep quality of university students. The sleep education program incorporated SH guidelines and stimulus control instructions (SCI). Brown et al. described SCI as a method for enhancing the association between the bedroom and sleepiness, i.e., using the bedroom only for sleep and not as a location for doing homework or casual lounging. The research project had four purposes: 1) develop a sound and realistic sleep education program, 2) scientifically evaluate changes in knowledge of healthy sleep habits, 3) determine the impact of the program on participants' sleep quality and habits, and 4) ascertain if the program could prevent sleep difficulties from developing over the course of the academic term.

The study utilized a double-blind, repeated measures experimental design. The researchers hypothesized that students in the treatment group would report improved SH knowledge, sleep habits, and sleep quality over a 6-week period. The control condition initially consisted of 95 participants with 66 remaining at post-treatment. The treatment condition originally consisted of 82 participants with 56 remaining at post-treatment. Both groups completed a battery of surveys prior to the treatment condition and at 6 weeks post-treatment. The survey instruments included The Pittsburgh Sleep Quality Index, to measure sleep quality; The Sleep Hygiene Awareness and Practices Scale, to measure sleep hygiene knowledge; and The Sleep Habits Survey, to estimate the respondents' sleep habits. The treatment condition consisted of the Sleep Treatment and Education Program for Students (STEPS) developed by the research team. The STEPS program included a 30 minute lecture with accompanying handouts which incorporated SH and SCI as well as information about caffeine content in commonly used substances. The control condition consisted of a 30 minute lecture about the scientific method.

The results of the study found that students in the treatment group took fewer naps, went to bed less hungry, and took fewer medications with caffeine at 6 weeks post-intervention. Sleep quality of the treatment group also improved, with students reporting shorter sleep onset time and fewer sleep disturbances. Both groups decreased pre-sleep relaxation time; however, the treatment group had a smaller reduction. The researchers attributed this to a phenomenon noted in previous studies—that sleep duration decreased as the academic term progressed. Yet, the lesser pre-relaxation time of the treatment group demonstrated that the STEPS program could assist in offsetting poor sleep habits as the academic term advanced.

One of the primary limitations of the study was the inclusion of all students as opposed to only those students with sleep difficulties. Moreover, the researchers did not attempt to ensure equal numbers of men and women participants. Additional limitations included a relatively short duration of time between pre- and post-test data collection as well as the possibility of a testing effect.

Impact. Although the outcomes of the aforementioned interventions were limited, it must be noted that only two sleep education programs have been reported in the literature. To maximize the impact of such interventions, researchers have recommended educational programs be integrated with policy-level initiatives. Table 2.1 elucidates the key educational and policy recommendations of researchers. At the time of this investigation there were no policy-level interventions employed in university settings reported in the literature.

Table 2.1

Summary of Key Recommendations of Studies Exploring College Sleep Education

Study	Key recommendations
Buboltz, Brown, & Soper, 2001	• Universities provide students with training about healthy sleep habits • Campus administrators evaluate course schedules and offer later classes • Determine how college and community activities such as sports schedules and work routines contribute to sleep difficulties • Healthcare providers review sleep schedules as a mandatory component of student visits
Brown, Soper, & Buboltz, 2001	• Incorporate sleep education program into student orientation • Universities offer more late morning/afternoon classes
Brown & Buboltz, 2002	• Sleep hygiene instructions: cease from using caffeine within 4-5 of planned sleep time, reduce alcohol consumption, avoid naps, promote regular exercise, reduce sleep variability to less than 2 hours, bright light exposure • Stimulus control instructions: use bed only for sleep

(Continued)

Table 2.1: Continued

Summary of Key Recommendations of Studies Exploring College Sleep Education

Study	Key recommendations
Brown, Buboltz, & Soper, 2002	• Maintain consistent sleep-wake schedule • Do not go to bed thirsty • Reduce environmental noise; may require changing dormitory quiet hours, use of earplugs, consultation with resident advisors
Jensen, 2003	• Introduction of sleep education into college curriculum • College counselors must become educated about empirical techniques and therapeutic approaches as opposed to exclusively implementing psychotherapy.
Brown, Buboltz, & Soper, 2006	• Implementation of a psychoeducational sleep programs • Universities offer courses later in the day • College counseling personnel trained in cognitive and behavioral sleep interventions

(Continued)

Table 2.1: Continued

Summary of Key Recommendations of Studies Exploring College Sleep Education

Study	Key recommendations
Digdon, 2008	• When implementing education programs take students' prior beliefs into account, i.e. students who display evening circadian preferences may dismiss regular exercise if they believe exercise is less efficacious in coping with sleepiness than napping • Subjective education: knowledge of sleep hygiene does not translate into higher sleep quality if students do not believe the recommendations apply to their individual sleep behaviors
Vela-Bueno et al., 2008	• Campus awareness campaigns highlighting the importance of sleep; seminars and programs • University administrators provide later class start times • Encourage napping that lasts no longer than 20-30 min

(Continued)

The Theories of Reasoned Action and Planned Behavior

The Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TpB) assist in predicting and explaining the complex nature of health behaviors (Casper, 2007). Both models posit that behavior is goal-oriented and results from defined cognitive processes that arise as individuals assess their environment. The TRA and the TpB define *behavior* as an observable action delineated in terms of its target, action, context, and time (Sharma & Romas, 2008). According to these theories, *behavioral intention* is the most immediate antecedent of behavior. Intention is described as an individuals' readiness to perform a specific behavior. Conceptually, the constructs of the TRA and the TpB are considered independent predictors of intention.

Theory of Reasoned Action. The constructs of the TRA predict volitional behaviors; that is, behaviors that are intentional and explicitly under the control of the individual. The TRA postulates that behavioral intention is the function of two factors: attitude toward the behavior and subjective norm. The construct of *attitude toward the behavior* refers to the overall feeling of like or dislike toward a given behavior (Sharma & Romas, 2008). Attitude is shaped by *behavioral beliefs*, which reflect an individuals' disposition towards performing a specific behavior, and *outcome evaluations*, which refer to the value an individual associates with engaging in a behavior. In addition to attitudes, the TRA hypothesizes that *subjective norms* are a salient determinant of behavioral intentions (Francis et al., 2004). The subjective norm construct is comprised of *normative beliefs* and *motivation to comply*. Normative beliefs are an individual's perception about how referent others would like them to act in regards to an explicit behavior. Motivation to comply, in turn, is the degree to which an individual is willing to act in accordance with the referent group.

Theory of Planned Behavior. Although the TRA is a strong predictor of volitional behavior, it is unable to account for behaviors that are beyond the complete control of the individual. To compensate, Azjen (1991) proposed the addition of the *perceived behavioral control* construct. Perceived behavioral control is divided into two components: *control beliefs* and *perceived power*. Control beliefs describe beliefs related to external and internal factors that can impede or promote the performance of a behavior. Perceived power is the perception of ease or difficulty an individual ascribes to a behavior. Additionally, Azjen (1991) posited that to the extent to which perceived behavioral control was accurate, it could serve as a proximal measure of actual control and predict behavior. The addition of this construct led to the evolution of the TRA into its modern form of the TpB.

A value-expectancy theory, the TpB assumes human behavior is rational and guided by logical thought processes. The causal chain of the TpB implies that altering domain-specific beliefs can assist in modifying unhealthy behaviors. This underpinning, along with its parsimonious nature, has established the TpB as an effective theoretical framework for developing health promotion and health education interventions.

The present study represented the first attempt to investigate the sleeping behaviors of college students using the TpB. The TpB has proven to be highly predictive of human behavior, serving as the model for more than 900 empirical studies of behavioral prediction and change (Ajzen, 2010). The proposed study focused on three potential predictors of sleep behavior: attitude toward the behavior, subjective norm, and perceived behavioral control. By assessing these constructs, public health researchers can develop health education and promotion interventions that promote the adoption of healthy sleep patterns among undergraduate college student populations.

Sleep Hygiene Index

The Sleep Hygiene Index (SHI) was developed by Mastin and colleagues (2006) to address methodological limitations inherent in previous instruments designed to assess sleep hygiene. In assessing the psychometric properties of the instrument, Mastin et al. (2006) recruited volunteering psychology students (n=603) over two academic semesters. The research team (2006) reported significant internal consistency ($\alpha = 0.66$) and stability over time (r (139) = 0.71, $p<0.01$).

The instrument was also found to be positively correlated to the associated features of inadequate sleep hygiene as well as the total scores of other widely used instruments in the field of sleep research including the Epworth Sleepiness Scale ($r(599) = 0.244$, $p<0.01$) and the Pittsburgh Sleep Quality Index ($r(269) = 0.481$, $p<0.01$). In addition, the component scores of the SHI and the Pittsburgh Sleep Quality Index were positively correlated ($p<0.05$ or less). In their results, Mastin and colleagues (2006) contended that sleep hygiene is strongly related to sleep quality. They also stated that their research demonstrated the first evidence that sleep hygiene is modestly related to perceptions of daytime sleepiness. However, the researchers noted that they incorporated a non-probability sample making it is difficult to generalize their findings across age groups.

The SHI consists of 13 items measured by 5-point Likert scales. Items are scored from 1-5 and summed to provide a global assessment of sleep hygiene from a range of 13-65. In the original SHI, higher scores were indicative of a more maladaptive sleep hygiene status. Sample items include “I take daytime naps lasting two or more hours”, “I use alcohol, tobacco, or caffeine within 4 hours of going to bed or after going to bed”, and “I think, plan, or worry when I am in bed”.

For the purposes of this study, the original 5-point Likert scales were converted to 7-point Likert scales for instrument consistency. In addition, the scale endpoints were reversed such that lower scores indicated a more maladaptive sleep hygiene status. Items were scored from 1 to 7 and summed to provide a global score ranging from 13 to 91.

Summary

The 20th century witnessed monumental leaps in the scientific understanding of human sleep. Sleep research was developed into a testable science with the discovery of electroencephalography and later refined with the introduction of polysomnography. These advancements provided a deeper understanding of sleep physiology and the impact of sleep on human health. Although a putative theory of sleep currently eludes scientists, the interaction between the homeostatic mechanism and circadian rhythm in the modulation of sleep and wakefulness has been successfully described by the two-process model of sleep regulation.

Sleeping 7 to 8 hours on a daily basis has long been identified as a critical element of optimum health. Despite this, a mounting body of evidence suggests that sleep restriction is on the rise in the society; both in the general public and among college populations. Epidemiological research has uncovered the health ramifications of this trend, associating both insufficient and excessive sleep durations with increased rates of morbidity and mortality. Sleep restriction has also been shown to have neurobehavioral consequences. Salient symptoms of sleep deprivation include impairment of neurocognitive and psychomotor performance, emotional imbalance, and overall lower life satisfaction. Physiological indices including reduced leptin levels and elevated levels of C-reactive proteins have also been found to be altered by sleep restriction. Researchers speculate that these short-term alterations could serve as a catalyst for the long-term negative health implications revealed in the epidemiological research.

SH and AM are effective methodologies for improving sleep quality and enhancing alertness. SH includes a framework for optimizing the biological processes that regulate human sleep. AM incorporates a blend of sleep hygiene techniques and fatigue management strategies to mitigate the effects of unavoidable sleep loss.

Undergraduate students are confronted with a complex array of social, academic, and personal dynamics which have the potential to negatively influence sleeping patterns. The interplay between these elements increases the likelihood that students will embrace self-imposed sleep restriction. The overall reduction of sleep quantity and quality reported in the general population mirrors the trends found by researchers among college populations. Sleep education is a promising method for improving the sleep behaviors of college students. A deficit in sleep hygiene practices coupled with college students' interest in achieving quality sleep suggests that undergraduate students can benefit from sleep education interventions. Applying the TpB to predict the sleep behaviors and intentions of college students will provide a critical framework for the development of interventions that promote the adoption of healthy sleep habits among undergraduate populations. The SHI can assist in identifying behaviors amendable to modification.

Chapter Three

Methods

Sleeping 7 to 8 hours on a daily basis is a critical component of optimal health (Belloc & Breslow, 1972). Despite this, a growing body of evidence suggests voluntary sleep restriction is on the rise in society; both in the general public and in college populations (Lund, Reider, Whiting, & Prichard, 2010; Zee & Turek, 2006). The purpose of this study was to operationalize the constructs of the Theory of Planned Behavior (TpB) (Ajzen, 1991) to predict the sleep intentions and behaviors of undergraduate college students attending a Midwestern University. In addition to the standard TpB constructs, this study also assessed gender and sleep hygiene as supplemental predictor variables of adequate sleep behavior. While a number of studies have examined the sleep behaviors of the general population, college populations have received minimal attention (Buboltz, Brown, & Soper, 2001). The present study represented the first attempt to investigate the sleep behaviors of college students applying the TpB. As well, it was one of the first to employ the Sleep Hygiene Index (SHI) (Mastin et al., 2006). The findings of this study specified a theory-based model for predicting the sleep intentions and behaviors of undergraduate college students. Findings from the SHI aided in identifying sleep-related factors amendable to modification in the study population. Ultimately, the results of this investigation provided a valid and reliable instrument for application in the development and measurement of interventions designed to promote healthy sleep behaviors among undergraduate college student populations. In this chapter, the study design, study participants, process of instrumentation, procedures, and data analyses conducted for this study are described.

Study Design

A cross-sectional research design was utilized in this study. Cross-sectional designs are popular within the social and behavioral sciences for exploratory research; specifically, analyzing the attitudes and behaviors of a population (Crosby, DiClemente, Salazar, 2006). An additional function of this design type is its ability to determine the relationships among variables. Due to its static, non-experimental structure, the primary limitation of this design type is the inability to infer causation or establish directionality. Despite the drawbacks inherent in its nature, a cross-sectional design was determined to be the most efficient method for addressing the research queries posed in this investigation.

Population and Sample

Inclusion criteria. The sample for this study consisted of undergraduate college students between the ages of 18 and 24 enrolled at a large Midwestern public University who were unmarried and did not reside with a parent or legal guardian. In the academic year 2009-2010, 30,417 undergraduate students were enrolled at the selected university (University of Cincinnati UC Facts, 2010). The data collection protocol for this investigation was divided into three phases. Phase I encompassed collecting qualitative data for the purpose of instrument item generation. Phase II entailed collecting data for the purpose of conducting instrumentation test-retest procedures. Phase III data collection assessed the efficacy of the instrument to predict the sleep intentions and behaviors of the sample.

Data collection sample sizes. Construction of a TpB measurement instrument involves employment of both qualitative and quantitative techniques (Francis et al. 2004). Fundamentally, theory-based instruments are comprised of indicator variables, or items, which are used to measure unobserved, latent constructs. In the context of the TpB, items are initially

generated based on the findings of a qualitative elicitation study. Once the initial items are operationalized, refinement of the indicators transpires in the form of face/content validity and test-retest reliably. Next, internal consistency reliability and construct validity are used to reify the TpB constructs. Finally, the predictive validity of the psychometric instrument is determined through inferential statistical tests.

Phase I. Phase I encompassed collecting qualitative data for the purpose of instrument item generation. In qualitative research, data saturation determines sample size rather than power analyses (Munhall, 2010). In studying phenomena, qualitative researcher traditionally rely on samples sizes of 8 to 15 to achieve data saturation. For the purpose of this study, a sample size within this range was deemed adequate for initial item generation.

Phase II. Phase II entailed collecting data for the purpose of conducting instrumentation test-retest procedures. Instrument stability evaluates the extent to which similar results are obtained on two separate administrations (Polit & Hunger, 2004). As the test-retest technique is susceptible to the learning effect, maturation effect, and nonresponse bias, the time between testing intervals is typically fixed at one to two weeks. Sample sizes for assessing stability typically range from 30 to 50. A minimum of 30 valid responses is sought to achieve adequate correlation coefficients. Therefore, a sample size of no less than 30 was set for phase II data collection.

Phase III. Phase III data assessed the efficacy of the instrument to predict the sleep intentions and behaviors of the sample. A power analysis was conducted to calculate a sample size necessary to accept or reject the null hypotheses associated with the study. Power analyses assist in determining the minimal required sample size to detect a statistically significant effect.

Small sample sizes are desirable for many reasons including resource efficiency and optimizing significance.

The null hypothesis (H_0) is a hypothesis of skepticism. Essentially, H_0 states that there is no statistically significant difference or relationship between quantitative variables. Conversely, the alternative hypothesis (H_A) states there is a statistically significant difference or relationship between the quantitative variables being tested. A statistical test is a procedure which, when data are fed into it, either rejects or accepts H_0. In reality, either H_0 or H_A is true; however, statistical tests are fallible and capable or leading researchers to make erroneous judgments about the nature of H_0 and H_A. Two of the most common spurious judgments include the Type I (false positive) and Type II (false negative) error. The Type I error is the probability of a statistical test rejecting H_0 when in reality H_0 is true. Alternatively, the Type II error is the probability of a statistical test accepting H_0 when H_A is true. Presented as conditional probabilities,

- Type I error = Pr(Test rejects H_0 | H_0 is true)
- Type II error = Pr(Test accepts H_0 | H_1 is true).

To compensate, researchers build statistical tests to control for Type I errors at a prescribed level, alpha (α). By convention, α is set at 0.05. The Type II error, denoted by β, is also traditionally established at 0.80. The complement of beta (1-β) is the probability of rejecting H_0. The conditional probability1-β is referred to as the power of a statistical test. A power analysis provides the probability of obtaining a significant result (rejecting H_0). Therefore, a power of 0.80 establishes a 20% risk of committing a Type II error.

A power analysis is comprised of four components (Polit & Beck, 2004). The first is the significance criterion, alpha (α). The more stringent α is, the lower the resulting power level. The second criterion is the sample size (n); as n increases, power increases. The third condition,

population effect size (γ), measures how strong the effect of an independent variable is on the dependent variable in the population. The final criterion is the power (1-β), which is the probability of rejecting H_0. Once α and 1-β are specified, γ can be determined (Polit & Beck, 2004). The effect size represents the magnitude of the relationship between the research variables. Consequently, if relationships are strong they can be detected at statistically significant levels even with small research samples. Conversely, if relationships are modest, larger sample sizes are required to avoid committing Type II errors.

Pearson product-moment correlation coefficients (Pearson's *r*) are traditionally used to determine relationships between the theoretical constructs of the TpB. Pearson's *r* is a measure of linear dependence, or correlation, between two variables. Pearson's *r* has both descriptive and inferential properties (Polit & Beck, 2004). In its role as a descriptive statistic, Pearson's *r* summarizes the magnitude and direction of a relationship between two variables. From an inferential perspective, Pearson's *r* is used to evaluate hypotheses concerning population correlations. As Pearson's *r* is a sample-based index, it can be considered an estimate of the unknown population parameter—the population correlation coefficient (ρ). In calculating sample size, the estimated value of γ is ρ; the expected population correlation coefficient.

To determine the appropriate sample size requirements for various powers when using Pearson's *r*, Polit and Beck's (2004, p.500) Population Correlation Coefficient Sample Size Estimate table was consulted. In the social and behavioral sciences, there are typically numerous predictors resulting in correlations at approximately 0.20 for a set of predictors. For pragmatic purposes a power of 0.80 is the conventional standard applied in social and behavioral sciences. Subsequently, an alpha of 0.05 and a power of 0.80 were considered for this investigation. A power equal to 0.80 indicates a 20% risk of committing a Type II error. Given this criteria, H_0

would be incorrectly rejected 5 times out of 100 and incorrectly retained 20 times out of 100. In applying this methodology a sample size of 197 was found to fit the criteria (Polit & Beck, 2004, p.500). For the purpose of this study, it was determined that a quota sample of no less than 197 responses would be sought in order to obtain the accepted 0.80 power level.

Participants for phase III were recruited through an electronic invitation delivered via the university e-mail system. Respondents were polled from a sampling frame of 22,436 students on record with the Registrar's electronic mailing list during the time of this study. Respondents were delimited by the Registrar's data base software to undergraduate students between 18 and 24 years old. Additional inclusion conditions for the study were satisfied by logic criteria integrated into the electronic instrument. Participation was voluntary and no incentives were offered. As such, a conservative response rate of 1–3% was considered. The electronic version of the instrument was made available in February 2011. Data collection for the study ceased once the quota sample of 197 was satisfied.

Instrumentation

Participants completed a three-section, 43-item instrument designed to measure sleep intentions, sleep behaviors, sleep hygiene, and demographic variables. The first section addressed the extent to which the constructs of the TpB accounted for variance in the sleep intentions and behaviors of the sample. The second section explored the relationship between the sleep hygiene and sleep behavior constructs. The final section assessed the demographic variables of the respondents.

Section one: Theory of Planned Behavior Constructs. Section one of the instrument was comprised of 18 items which were designed to assess the proximal constructs of the TpB. In developing the instrument, the PI adhered to the guidelines developed by Francis et al. (2004).

This manual provided instruction in developing a questionnaire based on the TpB. In addition, Ajzen's (2002) recommendations for crafting TpB items were consulted. Section one's items were framed according to the results of a qualitative elicitation study conducted by the PI. The process of qualitative data interpretation consists of five phases: describing, organizing, connecting, corroborating, and representing the account (Crabtree & Miller, 1999). Crabtree and Miller caution that the five stages of qualitative analysis should not be considered linear or sequential, but rather interconnected and overlapping.

The *describing phase* is characterized by self-examination. During the describing phase, qualitative researchers must ensure they adhere to the philosophical underpinning associated with their given research method. A common error among qualitative researchers is to switch from an anti-positivist paradigm to a positivist paradigm during the process of data analysis and interpretation.

The *organizing* and *connecting phases* constitute the processes for organizing and interpreting qualitative data. The manner in which data is organized assists in answering the fundamental research question(s) of the study. Crabtree and Miller (1999) have classified three strategies for organizing and connecting qualitative data. The first strategy, the editing style, employs a line-by-line approach to data analysis for the purpose of constant comparison. The interpreter does not use a template per say, but searches for meaningful segments in the text, which are then coded and categorized into explanatory patterns. Grounded theory often utilizes this method of interpretation.

The second organizing style, immersion and crystallization, is the most demanding of the three interpretive styles (Crabtree & Miller, 1999). This method relies heavily on intuition and is therefore the most difficult approach to delineate. Immersion has been described as a process in

which a researcher or team of researchers become fully engaged with a set of data. Typically researchers accomplish immersion by reading and examining the data over a prolonged period of time. Crystallization is the process of temporarily suspending the process of immersion to reflect on the analysis experience, and attempt to identify and articulate patterns identified during immersion. These dyadic processes continue cyclically until the data has been thoroughly examined and all meaningful patterns have been extracted. Immersion and crystallization is the method of interpretation applied in Heideggerian hermeneutical phenomenology.

The template style of data organization relies on guidance from a theory, research tradition, pre-existing knowledge, or a summary reading of a given text. The data coding process for the template organizing style incorporates a pre-determined code manual to interpret the collected data. Units of data are often behavioral in nature and are refined iteratively during the connecting phase and categorized *a priori* according to a theory's fundamental constructs. The template style of data organization was applied in the elicitation study to assist in the process of item generation.

The *corroborating/legitimating phase* of qualitative data analysis involves verification of the elucidations derived from the data. Generally, this phase is accomplished in two ways. One approach is to request the participants of the study verify data interpretation. An additional strategy is to have a team of researchers independently interpret the data. Upon completing the independent analyses, similarities and differences among interpretations are extrapolated. *Legitimating* the findings occurs when the research team reaches a consensus on the various interpretations. The final phase of qualitative data analysis involves dissemination of the findings. The *representation of the account phase* explains how the research findings will be reported.

Institutional Review Board (IRB) approval was sought and obtained to administer the qualitative investigation (see Appendix A). A total of 11 participants were sought for the elicitation study. Due to data saturation, sample sizes of 8 to 15 are common in qualitative research. Inclusion criteria included undergraduate college students between the ages of 18 and 24 enrolled at the University of Cincinnati who were not married and did not reside with a parent or legal guardian. To ensure adequate population representation, responses from six females and five males were collected. Sample questions included "what do you believe are the advantages of sleeping 7 to 8 hours a night on a daily basis?" and "what factors or circumstances would enable you to sleep 7 to 8 hours a night on a daily basis?" Participants were asked to respond in a free-response format. Results were independently analyzed by the PI and his committee chair to increase validity. The responses were labeled and listed in order of frequency into three categories: attitude toward the behavior, subjective norm, and perceived behavioral control. Table 3.1 summarizes the results of the qualitative elicitation study.

Table 3.1

Summary of Qualitative Elicitation Study Analysis

Pre-determined Codes and Associated Questions	Most Frequent Responses
Attitude Toward the Behavior	
1. *What do you believe are the advantages of sleeping for seven to eight hours each night?*	• Greater Energy • Focus • Increased Productivity
2. *What do you believe are the disadvantages of sleeping for seven to eight hours each night?*?	• Less time to complete work • Less social time
3. *Is there anything else you associate with your own views about sleeping for seven to eight hours each night?*	• Sleep increases well-being • Sufficient sleep increases chances of attending class • Requires a routine sleep schedule and time management

Subjective Norm

4. *Are there any individual or groups who would approve of your sleeping for seven to eight hours each night?*	• Parents • Professors • Employers
5. *Are there any individual or groups who would disapprove of your sleeping for seven to eight hours each night?*	• Friends • Roommates
6. *Is there anything else you associate with other people's views about sleeping for seven to eight hours each night?*	• Adequate sleep improves socialization and mood • Sleep habits are a personal choice • Friends should encourage each other to sleep

Perceived Behavioral Control

7. *What factors or circumstances would enable you to receive seven to eight hours of sleep per night?*	• Less school work • Fewer work hours • Abstaining from social events at night • Less stress • Quiet dorms • Time management • Less early classes
8. *What factors or circumstances would make it difficult or impossible for you to sleep seven to eight hours each night?*	• Irregular sleep schedule • Stress, anxiety • Early classes • Incomplete tasks
9. *Are there any other issues that come to mind when you think about sleeping for seven to eight hours each night?*	• Emotional problems • Issues with maintaining academic responsibilities • Distractions and obligations make it difficult to achieve healthy sleep • Roommates can affect sleep quality and duration

The first draft of the TpB section of the instrument was assembled based on the results of the qualitative elicitation study conducted by the student researcher and his committee chair. In developing this section, it was implicitly understood that, with the exception of behavior, the variables of the TpB were latent constructs comprised of indicator variables. Within this context, researchers are able to measure either proximal or distal constructs of the TpB (Francis et al. 2004. For the purposes of this study, proximal constructs were assessed.

Section one content. *Section one, part a.* The first set of items in section one of the instrument assessed perceived behavioral control to obtain adequate sleep. A 7-point semantic differential scale was employed to measure each item. Items reflected participants' confidence that they were capable of performing the target behavior (Francis et al., 2004). This was achieved by assessing respondents' self-efficacy and their beliefs about the controllability of the behavior. Self-efficacy was assessed by asking respondents to report how difficult the behavior was to perform and how confident they were that they could perform it (Frances et al., 2004). Sample items included "If I wanted to, I am confident that I could sleep for 7 to 8 hours every night; completely disagree—completely agree" and, "For me, to sleep 7 to 8 hours every night is; not practical—practical." Controllability was assessed by asking respondents to indicate whether performing the behavior was within their power or whether factors beyond their control determined their behavior (Frances et al., 2004). Sample items included, "It is up to me whether or not I sleep 7 to 8 hours every night; completely disagree—completely agree" and, "I have complete control over my ability to sleep 7 to 8 hours every night; no control—complete control." A total of four items were used to assess this construct (items 1, 2, 3, and 4). A range of scores from 4 to 28 were possible for Part A. The mean of the item scores was calculated to

provide an overall perceived behavioral control score. Higher scores reflected a greater level of control over the target behavior.

Section one, part b. The second set of items in section one employed an attitudinal scale to assess the respondents' overall evaluation of obtaining adequate sleep (Ajzen, 2002). Bi-polar adjectives were applied to evaluate attitude toward the behavior. The stem statement that preceded the list of adjectives was, "For me to sleep for 7 to 8 hours every night would be…" Both instrumental and affective items were included to fully gauge how the respondents evaluated the behavior (Ajzen, 2002). Sample endpoints included, "not enjoyable—enjoyable", "detrimental to my social life—beneficial to my social life"; "bad—good". Items were measured on a 7-point semantic differential scale. A total of six items were used to assess this construct (items 5, 6, 7, 8, 9, and 10). A range of scores from 6 to 42 were possible for Part B. The mean of the item scores was calculated to provide an overall attitude toward the behavior score. Higher scores indicated a more positive attitude toward the target behavior.

Section one, part c. Referent others are generally perceived as approving of desirable behaviors and disapproving of undesirable behaviors (Ajzen, 2002). Subjective norm to obtain adequate sleep was measured using injunctive and descriptive items. A 7-point semantic differential scale was incorporated to measure each item. A total of four items were used to assess this construct (items 11, 12, 13, and 14). Sample items included, "Most people who are important to me think that I should sleep 7 to 8 hours every night; completely disagree—completely agree" and, "My friends want me to sleep 7 to 8 hours every night; completely disagree—completely agree" A range of scores from 4 to 28 were possible for Part C. The mean of the item scores was calculated to provide an overall subjective norm score. Higher scores reflected a greater social pressure to perform the target behavior.

Section one, part d. Behavioral intention to obtain adequate sleep was gauged through three items (items 15, 16, and 17). A 7-point semantic differential scale was utilized to measure each item. The phrases "I intend", "I will try", and "I plan" were employed to gauge the intention of the participants to perform the target behavior within the next 24 hours. Parallel verbiage was incorporated to ensure the items had a strong internal consistency. Scores for Part D could range from 3 to 21. The mean of the item scores was calculated to provide an overall behavioral intention score. Higher scores reflected a greater intention to perform the target behavior.

Section one, part e. Adequate sleep behavior was assessed through self-report employing 24-hour recall of the previous night's sleep (item 18). Participants were asked, "In the past 24 hours, how many hours/minutes did you sleep at night time?" Participants were asked to record their response. Given the habitual nature of human sleep it was assumed recall would not be problematic. Responses for the sleep behavior construct were transformed from total hours and minutes to total minutes of sleep accrued at night time in the past 24 hours. Theoretically, scores for Part E could range from 0 to 1,440. The mean of the item scores was calculated to provide an overall adequate sleep behavior score.

Scores within the range of 420 to 480 total minutes of sleep (equivalent to 7 to 8 hours) were considered to have met this study's operational definition of adequate sleep behavior; conversely, scores outside of this range were considered to have met this study's operational definition of inadequate sleep behavior. Expressed as an inequality, adequate sleep behavior was defined as $420 \leq x \leq 480$; where x represents adequate sleep behavior in minutes. Conversely, inadequate sleep behavior was defined as $420 > y > 480$; where y equals inadequate sleep behavior in minutes. For pragmatic purposes, inadequate sleep behavior was dichotomized into

two categories; insufficient duration of sleep (<420 minutes; <7 hours) and excessive duration of sleep (>480 minutes; >8 hours).

Section two: Sleep Hygiene Index. The second section of the instrument (questions 19-31) measured the sleep hygiene status of the population using the Sleep Hygiene Index (SHI) developed by Mastin et al. (2006). In assessing the psychometric properties of the instrument, Mastin et al. (2006) recruited volunteering psychology students (n=623) across two academic semesters. The research team reported significant internal consistency ($\alpha = 0.66$) and stability over time ($r(139) = 0.71$, $p<0.01$).

The SHI was also found to be positively correlated to the associated features of inadequate sleep hygiene as well as the total scores of other widely used instruments in the field of sleep research including the Epworth Sleepiness Scale ($r(599) = 0.244$, $p<0.01$) and the Pittsburgh Sleep Quality Index ($r(269) = 0.481$, $p<0.01$). In addition, the component scores of the SHI and the Pittsburgh Sleep Quality Index were positively correlated ($p<0.05$). In their results, Mastin and colleagues (2006) contended that sleep hygiene is related to sleep quality. They also stated that their research was the first to validate that sleep hygiene was modestly related to perceptions of daytime sleepiness. However, the researchers noted that they incorporated a non-probability sample making it difficult to generalize their findings beyond the sample.

The original format of the SHI consisted of 13-items measured using 5-point Likert scales. For the purposes of this study, the original 5-point Likert scales were converted to 7-point Likert scales for instrument consistency. In addition, the scale endpoints were reversed such that lower scores indicated a more maladaptive sleep hygiene status. Items were scored from 1 to 7 and summed to provide a global score range of 13 to 91.

Sample items included “I take daytime naps lasting two or more hours”, “I use alcohol, tobacco, or caffeine within 4 hours going to bed or after going to bed”, and “I think, plan, or worry when I am in bed”. Permission to use the SHI (Mastin et al., 2006) and to convert the original 5-point Likert scales was granted by the instrument’s primary developer, Dr. David F. Mastin (see Appendix E). Dr. Mastin also agreed to serve on the panel of experts. A word processed version of the SHI instrument was delivered electronically to the student researcher by the developer.

Several factors prompted the PI to include this instrument in the present study. First, the SHI appeared to be the most advanced instrument of its kind for assessing sleep hygiene. Secondly, the SHI was tested on a college population which made it more relevant to the current investigation. As well, the instrument was shorter in length than its predecessors thus increasing the likelihood of obtaining a higher response rate. Finally, it was expected that assessing the sleep hygiene of the study population would aid in the development of future health education and promotion interventions. Permission was sought and obtained to use the SHI from the Dr. Mastin. The original version of the instrument has been provided (see Appendix F).

Section three: demographic information. The final section of the instrument was devoted to collecting demographic information of the sample. Multiple choice questions were used to obtain gender, year of student, enrollment status, employment status, parental status, race/ethnicity, and college major. For race/ethnicity, the following categories were available as options: African American, Asian, Hispanic, Multi-racial, Caucasian, and Other (University of Cincinnati Diversity Initiative, 2010). Available options for college major included: Architecture, Behavioral & Social Sciences, Business, Computers & Technology, Construction & Building Trades, Culture & Languages, Design, Education, Engineering, Humanities, Law &

Social Justice, Medicine & Health, Natural Science & Math, Performing Arts & Music, Politics, Social Service, and Other (University of Cincinnati, 2010). Self-reported age, overall grade point average, total credit hours, average number of hours worked per week, and number of children were acquired using short answer format. The information collected in section three was used solely to determine the demographic parameters of the sample and was not specific enough to identify unique respondents. Sections one, two, and three were combined to create a single, 43-item instrument (see Appendix G).

Instrumentation methodology. ***Readability.*** The Flesch Reading Ease Test and Flesch-Kincaid Grade Level Test (Flesch, 1948) were used to assess readability of the instrument. The instrument was word processed in Microsoft Word Professional 2007© and analyzed by the software's readability statistics function. Based on the findings of the software, the instrument had a Flesch Reading Ease score of 72.6. Scores ranging from70 to 79 are categorized as "fairly easy" in terms of reading ease (Flesch, 1948). The software populated a Flesch-Kincaid Grade Level test score of 5.7; indicating the reading level of the instrument was between a fifth and sixth grade-school reading level according to United States educational standards (Woodmansey, 2010). Given that the target population was undergraduate students, the readability scores of the instrument were considered acceptable. Upon confirming objective readability, the instrument was presented to a panel of experts to affirm readability, face and content validity.

Face and content validity. A panel of six experts (see Appendix B) evaluated readability, face validity, and content validity of the instrument over a two-round review process. Panel members were sought based on their relative areas of expertise as derived from the literature review. Once potential jurors were identified, e-mail solicitations were sent requesting their services and willingness to participate in the instrumentation process. The final panel

consisted of two target population experts, two sleep behavior experts, and two TpB experts (see Appendix C).

Each panel member was sent a cover letter explaining the purpose of the study, a copy of the draft instrument, and a feedback assessment form to evaluate readability, face validity, and content validity of the instrument (see Appendix C). Members were also asked to provide a general critique of the instrument and to make suggestions for improvement based upon their individual areas of expertise. The researcher requested that the feedback materials be returned within a two-week time frame. Modifications were made to the instrument based on the jurors' feedback. After incorporating the recommended amendments suggested by the panel, a modified version of the instrument was delivered to the panel members for a second round of review. For stage two, jurors received a summarized list of the changes made to the instrument, a copy of the revised instrument, as well as an instrument assessment form (see Appendix D). Once more, jurors were requested to submit feedback within a two-week time frame. Subsequent to round two, the panel reached a consensus on the validity of the instrument. The post-panel version of the instrument was presented at the PI's thesis proposal hearing. Adjustments were made to the instrument based on the thesis committee's recommendations.

Reliability. *Methods.* Reliably is fundamental to the scientific principle of reproducibility (Polit & Beck, 2004). Reliability assesses an instrument's ability to yield the same results over repeated trials. Instrument reliability is particularly critical for measurement and evaluation of health education and promotion interventions. Intervention researchers frequently gauge the success of their programs based upon whether theoretical constructs have been modified from pre- to post-intervention. Unreliable instruments can produce erroneous measurements and therefore skew the results of an intervention.

Two common methods for assessing reliability include evaluation of an instrument's stability and internal consistency. Stability is established by administering a test twice to the same sample of participants at two intervals. As the test-retest technique is susceptible to the learning effect, maturation effect, and nonresponse bias, the time between testing intervals is typically fixed at one to two weeks. Internal consistency gauges the reliability of a set of indicators. Based on achieving an adequate Cronbach's alpha coefficient, a set of indicators is justified in being combined into a single scale and operationalized as a construct.

Reliability analysis. Instrument temporality was assessed using test-retest reliability during phase II of the data collection process. Test-retest participants received a hardcopy version of the instrument at one and two week intervals. For pragmatic purposes it was determined that test-retest participants would be recruited from intact classrooms to increase the likelihood of acquiring re-test results. Data were collected over two rounds. Volunteering students registered for Personal Health Behavior (HPE 133) were elicited on Wednesday, November 17, 2010 and again on Wednesday, December 1, 2010. A total of 15 valid samples were acquired during round one. Round two participants were recruited on Tuesday, January 18, 2011 and again on Tuesday, January 25, 2011 from students registered for Lifestyle Health and Fitness (HFL 191). A total of 22 valid samples were acquired during round two. Test-retest participant data were used exclusively to determine the reliability of the instrument and were not factored into the results of this study.

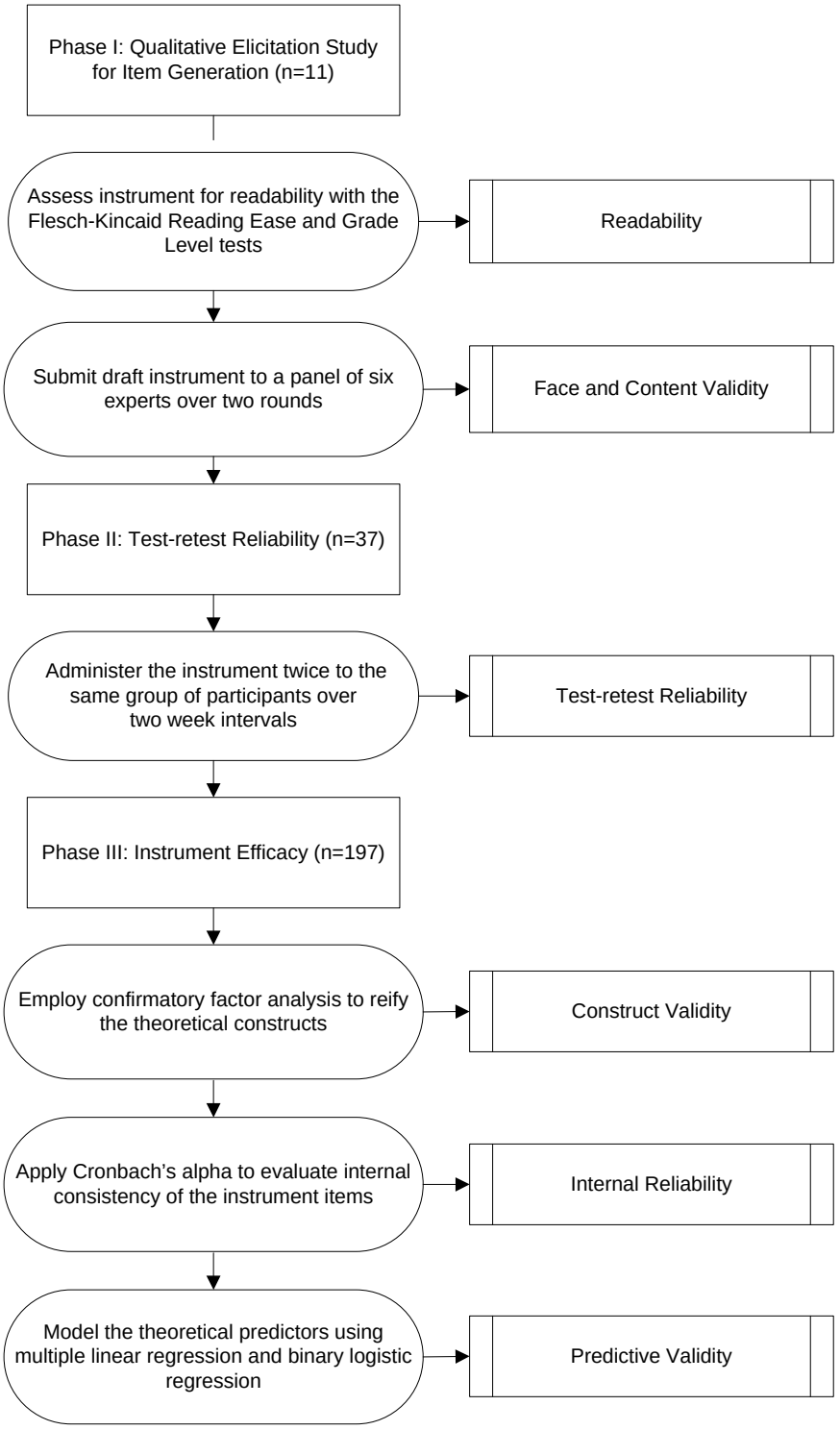
Test-retest reliability coefficients were assessed during phase II, prior to administering the instrument to the full sample. It was determined that if test-retest reliability coefficients failed to meet the *a priori* conditions, the instrument would be refined and once again subjected to the instrumentation process. This process would continue until reliability standards were

satisfied. In the current investigation, each component of the instrument exceeded the acceptable *a priori* condition; thus, it was determined the instrument was prime for delivery to the study population. The Cronbach's alpha coefficient reliability test was calculated for each set of items during phase III of data collection to assess internal consistency of the instrument. Items were grouped together based on the framework of the TpB. The acceptable levels for Cronbach's alphas and test-retest reliability coefficients were set *a priori* at 0.70 (Polit & Beck, 2004).

Construct validity. Factor analysis identifies common dimensions among variables. Confirmatory factor analysis (CFA) confirms a posited structural model hypothesized *a priori*. CFA specifies the number of factors in a given set of indicator variables (i.e. scale items). Model parameters are comprised of factor loadings and error variances. Model parameters are estimated to produce the implied correlation matrix. The maximum likelihood method (MLM) is the preferred extraction method for estimating the parameters of a factor model. An assumption of the MLM is that the data are continuous and satisfy multivariate normality. The MLM is useful as the parameter estimates generated by this technique are a close approximation to the population parameters. In addition, MLM approximates a Chi-square distribution providing a significance test for overall model fit. Accordingly, CFA applying the MLM was employed to confirm the hypothesized factors of the TpB. Scale items which loaded on more than one factor were inspected and considered for removal. Figure 3.1 illustrates the instrument measurement methodology in the context of the three phases of data collection applied in this study.

Figure 3.1

Flow Chart of the Measurement Methodology Underpinning the Instrumentation Process



Procedures

The data collection protocol for this investigation was divided into three phases. Phase I encompassed collecting qualitative data for the purpose of instrument item generation. Phase II entailed collecting data for the purpose of conducting instrumentation test-retest procedures. Phase III included administration of data collection from a quota sample of 197 to assess the efficacy of the instrument to predict the sleep intentions and behaviors of the sample.

Phase I: Elicitation study procedures. ***Overview.*** IRB permission was obtained in January 2010 to conduct the elicitation study (see Appendix A). The questionnaire contained nine, open-ended questions which queried the participants' attitude toward the behavior, subjective norm, and perceived behavioral control towards sleeping 7 to 8 hours a night on a daily basis. A consent form, approved by the IRB, was attached to each questionnaire. The consent form detailed the participants' rights, including the voluntary nature of the study and the option to opt-out of the study at any time. Participants were assured that results would remain confidential and only group data would be reported. Estimated time to complete the questionnaire was set at 20 minutes. All participants were verbally made aware of the consent agreement and, upon signing the consent form, were given a copy for their records.

Data collection. A systematic random sample of every tenth student who came through the main entrance of Union Hall on March 6, 2010 was solicited to participate in the study. For those that agreed, the researcher determined if they met participant inclusion criteria (undergraduate college students between the ages of 18 and 24 enrolled at the University of Cincinnati who did not reside with a parent or legal guardian). After verifying inclusion, consent procedures were verbally administered. Participants were assured of confidentiality and that only group data would be reported. Volunteering participants were provided with a copy of the

questionnaire packet affixed to a clip board. The questionnaire packet included a cover letter, a consent form, and the questionnaire. Participants were requested to sign the consent form and complete the questionnaire. Upon completing the instrument, the researcher offered each participant a copy of the consent form. Participants were informed that completed instruments and consent forms would be stored in a locked filing cabinet for a period of three years.

Data analysis. The template style of qualitative data organization was applied in the elicitation study to assist in the process of item generation. The template style of data organization relies on guidance from a theory, research tradition, pre-existing knowledge, or a summary reading of the text. The data coding process for the template organizing style incorporates a pre-determined code manual to interpret the collected data. Units of data are often behavioral in nature and are refined iteratively during the connecting phase and categorized *a priori* according to a theory's fundamental constructs.

Once the data collection criteria were met, the PI and his committee chair independently analyzed the elicitation questionnaire responses (Francis et al., 2004). The responses were labeled and listed in order of frequency into three categories: attitude towards the behavior, subjective norm, and perceived behavioral control. Items were developed based on the results of the elicitation study and submitted to a panel of experts for assessment of readability, face validity, and content validity over a two-round review process.

Phase II: Instrument test-retest procedures. ***Overview.*** Prior to initiating the test-retest data collection phase, IRB approval was obtained (see Appendix H). For pragmatic purposes it was determined that test-retest participants would be recruited from Health Education and Health, Fitness, and Leisure Studies courses in the Health Promotion and Education Department to increase the likelihood of acquiring retest results. The PI contacted the course instructors and

requested permission to conduct the study. An overview of the research study was provided to the instructors as well as a copy of the instrument.

Phase II data collection. Phase II data were collected over two rounds. Volunteering students registered for Personal Health Behavior (HPE 133) were elicited on Wednesday, November 17, 2010 and again on Wednesday, December 1, 2010. A total of 15 valid samples were acquired during round one. Round two participants were recruited on Tuesday, January 18, 2011 and again on Tuesday, January 25, 2011 from students registered for Lifestyle Health and Fitness (HFL 191). A total of 22 participant samples were acquired during round two. Phase II test-retest participant instrument results were used exclusively to determine the reliability of the instrument and were not factored into the phase III results of this study. The acceptable levels test-retest reliability coefficients were set *a priori* at 0.70 (Polit & Beck, 2004).

Upon entering each classroom, the PI introduced himself to the class, provided a brief biographical sketch, and the purpose of the study. PowerPoint slides provided an outline of phase II procedures for the participants. The instructor referred to the PowerPoint slides throughout the duration of the data collection period. After providing an introduction, the PI described the inclusion criteria for the study and provided volunteering students with a blank ticket, an information sheet, and a copy of the instrument. The information sheet and blank ticket were paper clipped to the instrument. As test-retest was conducted anonymously, the blank ticket was provided to the participants to allow them to generate a self-created identification number. The identification number was used by the PI to compare test-retest results of the participants.

The PI requested the participants remove the blank ticket and to set it on the right hand corner of their desks. The PI then read each section of the information sheet to the participants

and reinforced the voluntary nature of the study and the option to opt-out of the study at any time. Participants were then instructed to remove the information sheet and to keep it for their records. Next, the PI requested participants create a 4 to 10 digit identification number that they would remember and to write it in the appropriate space on the instrument. Participants were then requested to record their self-selected identification number on the blank ticket they had previously removed. Respondents were requested to store the blank ticket on their person and to bring it with them to class during the retest portion of data collection so that they could recall their identification number. Participants were assured that individual results would remain anonymous and only group data would be reported. Estimated time to complete the 43-item questionnaire was set at 15 minutes.

Phase III: Instrument administration procedures. ***Modality.*** During the outset of this study, it was determined the instrument would be delivered electronically to the sample. It was expected that this mode of administration offered the most efficient and cost-effective method for garnering the necessary quota sample. However, electronic data collection is a relatively novel measurement method and possesses noted strengths and limitations. The primary strengths of this conduit are its cost-effectiveness and distribution potential (Cottrell & McKenzie, 2005). Additionally, web-based data collection offers convenience to respondents as they are able to discontinue the instrument at any time and resume the questionnaire at their leisure. Researchers can also benefit from the employment of electronic instruments. For example, if pre-coded, the responses can be imported directly into data analysis software, assisting in reducing data entry errors.

Despite its strengths, electronic data collection has several shortcomings. In general, on-line surveys are known to have lower response rates compared to other survey delivery systems

(Cottrell & McKenzie, 2005). This is likely due to the perception that participants view e-mails from unknown sources as spam or "junk" e-mail. As well, web-based surveys may not appear as intimate as other survey formats. For example, receiving a survey in the mail with a cover letter signed by the researcher is generally perceived as more personal than a request to complete an electronic survey.

With this foreknowledge, the researcher attempted to address the primary barriers associated with electronic surveying. To address the perception of spam, the PI developed a customized sender e-mail identifier. The final format selected for the sender e-mail identifier was: UC Student Adam Knowlden (knowldam@email.uc.edu). This feature would cause the e-mail to appear with the investigator's full name as opposed to only containing an e-mail address. It was assumed that students would perceive an e-mail message from a university student as a legitimate e-mail. To increase the perception of individualization, the researcher developed a survey solicitation cover letter that informed the participants of the importance of the study in developing health promotion programs designed to improve student sleep.

Contact was initiated with the University's Office of the Registrar in December 2009 inquiring about access to the student e-mail database. An in-person meeting was scheduled in which the researcher described the goals of the project. The Registrar agreed to send the solicitation letter and survey link to a sample of the target population with the condition that IRB approval of the study was obtained.

Delivery. The final version of the instrument was programmed into Qualtrics™ (Qualtrics Survey Software, 2010); an on-line, fee-based, survey platform that enables subscribers to create and publish web-delivered surveys. Following analysis of the data collected during phase II, a follow-up meeting was requested with the University Registrar to initiate

formal data collection. Adhering to the researcher's population inclusion criteria, the Registrar's Office employed its e-mail database software to generate an e-mail list of 22,436 students with active university e-mail accounts.

The introductory e-mail message developed by the researcher was entered into the body of the e-mail along (see Appendix I) with a link directing users to the electronic version of the instrument (see Appendix K). The instrument was hosted on an outside server so a special message was included in the e-mail body to assure users they were being directed to a safe web site. Participants were recruited through an electronic invitation delivered via the university e-mail system. Respondents were selected from a sampling frame of 22,436 students on record with the Registrar's electronic mailing list during the time of this study. Participants were delimited by the Registrar's data base software to undergraduate students between 18 and 24 years old. Additional inclusion and exclusion criteria for the study were satisfied by logic criteria integrated into the opening of the instrument. Participation was voluntary and no incentives were offered. As such, a conservative response rate of 1–3% was considered. The web-based version of the instrument was available February 2011. Data collection terminated once the quota sample of 197 was met. It was also determined that if the quota sample was not obtained within two months the electronic survey would close and further attempts to collect data electronically would cease. Given this scenario, it was decided the PI would obtain the remaining data from a convenience sample of undergraduate students.

Instrument structure. Several pre-set options were selected for the on-line survey platform. The researcher set the instrument default to allow the program to enable a cookie on each respondent's computer that tracked the respondent's progress throughout the survey. Using this tool, the respondents were able to fill out a portion of the instrument, save their results, and

complete the remainder of the survey at a later time. It was implicitly understood that for this technique to be effective participants could not delete the cookie from their computer.

A noted advantage of web-based surveys is the ability to require responses to all items through the employment of validation criteria. While this methodology has the potential to deter participants from completing the survey, it was assumed that sleep was a non-sensitive issue and the majority of participants would not hesitate to answer all questions if required to do so. Therefore, the forced response option was incorporated into the instrument structure. For written response items, validation criteria were utilized to ensure pragmatic responses.

Instrument protection protocols included the option to allow only those participants who received an e-mail invitation to participate in the survey. This security feature was employed to maintain the integrity of the sampling process. To further secure sampling reliability, indexing of the survey was blocked to prevent the instrument from populating in search engines. A final security measure, ballot box stuffing, was employed to prevent respondents from completing the instrument more than once.

Participant consent. Before the respondents could attempt the instrument, an information sheet was generated that explained the participants' rights, including the voluntary nature of the study and the option to opt-out of the study at any time (see Appendix J). Respondents were informed that by completing the instrument they were granting permission for their responses to be used in the study. To validate participate consent a forced-response "Yes, I agree that my results may be used for research purposes as described above" and "No, my results may not be used for research purposes as described above" multiple choice question was presented. To indicate compliance, users were instructed to select the "yes" response. A skip logic command was entered to prevent users who selected "no" from participating in the survey.

Participants were assured that results would remain confidential and only group data would be reported. Respondents were notified that the data collected from the completed surveys would be stored in a password protected folder on the researcher's computer for a period of three years. All participants were required to indicate their consent and understanding of the study terms and conditions prior to attempting the actual instrument. A message at the end of the information sheet recommended the participants print the information sheet and retain the form for their records. Contact information for the research team was included in the form. Participants were requested to contact the research team concerning any questions that arose either during or after the survey process.

Participant inclusion. Next, eligibility to participate in the study was determined through a series of logic questions. For the purposes of this study, the target population included undergraduate students between the ages of 18 and 24 who were unmarried and did not reside with a parent or legal guardian. The first inclusion question asked "are you between the ages of 18 and 24?" Participants whom answered "no" were not eligible to participate in the study and were forced to exit the survey. The second inclusion question asked "do you reside with a parent or legal guardian?" Participants whom answered "yes" were not eligible to participate in the study and were forced to exit the survey. The third inclusion question asked "are you married?" Participants whom answered "yes" were not eligible to participate in the study and were forced to exit the survey.

Once consent and eligibility were established, the respondents were able to initiate the data collection process. The electronic version of the instrument was comprised of 43 closed-ended questions which queried the participants' intentions to sleep 7 to 8 hours every night (see Appendix K). Bi-polar matrices were employed to assess items related to the TpB and SHI.

Text entry question-types were used to collect data related to the adequate sleep behavior construct. Multiple choice and text entry question types were used to garner demographic information. Estimated time to complete the questionnaire was set at 20 minutes. Surveys were pre-coded to allow seamless transition from the electronic platform to the data analysis software.

Data Analyses

All data were analyzed using Predictive Analytics Software (PAWS) Statistics Grad Pack 18.0 (PASW, 2009) data analysis software. Data collected during phases II and III were analyzed to establish reliability and validity of the TpB instrument. Descriptive statistics described the characteristics of the sample. Correlation coefficients evaluated the stability and internal consistency of the instrument. Bivariate correlation coefficients assessed the associations between the constructs of the TpB on behavioral intention to obtain adequate sleep. Bivariate correlation coefficients further tested relationships between the behavioral intention, gender, and sleep hygiene on adequate sleep behavior. Multiple linear regression and binary logistic regression modeled the TpB predictors of behavioral intention and sleep behavior. *F* tests evaluated the significance of perceived behavioral control, subjective norm, and attitude toward the behavior as predictors of behavioral intention. The *a priori* criteria of probability of *F* to enter a predictor in the model was less than or equal to 0.05 and for removing a predictor was greater than or equal to 0.10. The Wald Chi-square test assessed the significance of behavioral intention, gender, and sleep hygiene as predictors of sleep behavior. The *a priori* criteria of probability of χ^2 to retain a predictor in the model was less than or equal to 0.05.

Summary

In this chapter, the methods employed to conduct the study were detailed. A cross-sectional research design was utilized in this investigation. Participants included convenience

samples of undergraduate students drawn from a large Midwestern University. A power analysis was calculated to determine a sufficient sample size for phase III data collection. In arriving at the sample size, an alpha of 0.05, a power of 0.80, and a population correlation coefficient of 0.20 were considered. In applying this methodology a sample size of 197 was found to fit the criteria (Polit & Beck, 2004).

Data were collected over three phases. The instrumentation process included a qualitative elicitation study for item generation, Flesch-Kincaid readability test, Cronbach's alpha, test-retest, and confirmatory factor analysis. Validation of the instrument was overseen by a panel of six experts. The acceptable levels for Cronbach's alphas and test-retest reliability coefficients were set *a priori* at 0.70. Confirmatory factor analysis applying the maximum likelihood method reified the latent variables. Guiding criteria for confirmatory factor analysis included Eigen values greater than 1 and factor loadings over 0.36 (Stevens, 1996). Multiple linear regression and binary logistic regression modeled the predictors of behavioral intention to obtain adequate sleep and adequate sleep behavior. The *a priori* criteria of probability of F to enter a predictor in the model was less than or equal to 0.05 and for removing a predictor was greater than or equal to 0.10. The Wald Chi-square test assessed the significance of behavioral intention, gender, and sleep hygiene as predictors of sleep behavior. The *a priori* criteria of probability of χ^2 to retain a predictor in the model was less than or equal to 0.05.

Chapter Four

Results

Sleeping 7 to 8 hours on a daily basis is a critical component of optimal health (Belloc & Breslow, 1972). Despite this, a growing body of evidence suggests voluntary sleep restriction is on the rise in society; both in the general public and in college populations (Lund, Reider, Whiting, & Prichard, 2010; Zee & Turek, 2006). The purpose of this study was to operationalize the constructs of the Theory of Planned Behavior (TpB) (Ajzen, 1991) to predict the sleep intentions and behaviors of undergraduate college students attending a Midwestern University. In addition to the standard TpB constructs, this study also assessed gender and sleep hygiene as supplemental predictor variables of adequate sleep behavior. While a number of studies have examined the sleep behaviors of the general population, college populations have received minimal attention (Buboltz, Brown, & Soper, 2001). The present study represented the first attempt to investigate the sleep behaviors of college students applying the TpB. As well, it was one of the first to employ the Sleep Hygiene Index (SHI) (Mastin et al., 2006). The findings of this study specified a theory-based model for predicting the sleep intentions and behaviors of undergraduate college students. Findings from the SHI aided in identifying sleep-related factors amendable to modification in the study population. Ultimately, the results of this investigation provided a valid and reliable instrument for application in the development and measurement of interventions designed to promote healthy sleep behaviors among undergraduate college student populations.

Chapter four delineates and tabulates the findings of this investigation. All data were analyzed using Predictive Analytics Software (PAWS) Statistics Grad Pack 18.0 (PASW, 2009) data analysis software. Descriptive statistics described the characteristics of the sample.

Correlation coefficients evaluated the stability and internal consistency of the instrument. Pearson correlation coefficients assessed the associations between the constructs of the TpB on behavioral intention to obtain adequate sleep. Pearson correlation coefficients further tested relationships between the TpB constructs of behavioral intention, gender, and sleep hygiene on adequate sleep behavior. Multiple linear regression and binary logistic regression modeled the TpB predictors of behavioral intention and sleep behavior. *F* tests evaluated the significance of perceived behavioral control, subjective norm, and attitude toward the behavior as predictors of behavioral intention. The *a priori* criteria of probability of *F* to enter a predictor in the model was less than or equal to 0.05 and for removing a predictor was greater than or equal to 0.10. The Wald Chi-square test assessed the significance of behavioral intention, gender, and sleep hygiene as predictors of sleep behavior. The *a priori* criteria of probability of χ^2 to retain a predictor in the model was less than or equal to 0.05.

Data Screening and Respondents

Phase III sample. A quota sample of 197 responses was analyzed for phase III data collection. For the purposes of this study, the target population included undergraduate students between the ages of 18 and 24 who were unmarried and did not reside with a parent or legal guardian. Participants were recruited through an electronic invitation delivered through the university e-mail system. Eligibility to participate in the study was determined through a series of inclusionary logic questions. Respondents were selected from a sampling frame of 22,436 undergraduate students between the ages of 18 and 24 on record with the Registrar's electronic mailing list. Data collection terminated once the quota sample of 197 complete responses was satisfied. Responses submitted with missing data were discarded and not considered in the analysis.

Normality of data. Gaussian distributions are assumed by numerous univariate and multivariate statistical procedures. Normality was assessed subjectively by examining construct histograms, box plots, as well as kurtosis and skewness values. Normality was evaluated objectively using the Kolmogorov-Smirnov (K-S) test.

Univariate and multivariate outliers. The first step in normalizing data is to identify and potentially remove influential outliers. Simple outliers are considered extreme values and are traditionally defined as observations more than ±3.3 standard deviations from the mean. *Z* scores as well as visual inspection of histograms and schematic (box-and-whisker) plots can assist in detecting data that are disconnected from the distribution. An examination of the *z* scores and histograms for the theoretical constructs did not uncover univariate outlier observations.

Kurtosis and skewness. After addressing outliers, the distribution of a set of values can be examined through kurtosis and skewness. These two statistics provide information about how widely values are dispersed around their measures of central tendency (mean and standard deviation). Skewness measures the degree of asymmetry exhibited by data. If skewness equals zero, the histogram is symmetric about the mean. If skewness is positive, there are more observations below the mean than above the mean. If skewness is negative, there are a more observations above the mean than below the mean. Kurtosis is based on the size of a distribution's tails and characterizes whether the data are peaked or flat compared to a normal distribution. If kurtosis is negative, the distribution is relatively flat (platykurtic). If kurtosis is positive the distribution is relatively peaked (leptokurtic). It is important to note that many statistical packages such as PASW/SPSS center the normal distribution at zero (Fisher kurtosis). The values for kurtosis and skewness should fall within a range of ±2 range to satisfy the assumption of normality (Garson, 2011). Kurtosis and skewness were inspected for each

theoretical construct to evaluate compliance with the normality assumption. All of the variables aside from attitude toward the behavior were found to meet the ±2 standard for kurtosis and skewness.

K-S Tests. The K-S test evaluates the null hypothesis that a distribution is normally distributed. If $p < 0.050$ the null hypothesis is rejected and it is assumed the data is not normally distributed. Alternatively, if $p > 0.050$ there is insufficient evidence to suggest that the distribution is not normal and the null hypothesis is retained. The K-S test is generally recommended for sample sizes greater than 50 and was applied as an objective measure to evaluate normality of the construct distributions. The K-S failed to reject the null hypotheses that the distributions for the behavioral intention and attitude toward the behavior constructs were normal.

Transformations. Transformations are applied to correct non-normally distributed variables. Behavioral intention and attitude toward the behavior were considered candidates for transformation. Kurtosis and visual inspection of the construct histograms revealed negative skews. Reflection with root-based transformation is applicable for data with a negative skew. Reflection with square root, cube root, and fourth root transformations were applied to both constructs. Evaluation of skewness, kurtosis, and K-S values for behavioral intention and attitude toward the behavior found square root transformation most appropriate. Upon transformation, normality was achieved for both constructs. Table 4.1 summarizes the skewness, kurtosis, and K-S tests statistics for each of the theoretical constructs. As demonstrated by the *p*-values associated with each of the K-S tests, normality was achieved for each construct. Details regarding construct transformations are discussed in the theoretical constructs analyses section of chapter 4.

Table 4.1

Summary of Skewness, Kurtosis, and K-S Statistics for the Theoretical Constructs of Sleep Behavior, Behavioral Intention, Transformed Behavioral Intention, Perceived Behavioral Control, Subjective Norm, Attitude Toward Behavior, Transformed Attitude Toward the Behavior, and Sleep Hygiene for the Sample of Undergraduate Students (n=197)

			K-S Test	
Construct	Skewness	Kurtosis	Value	*p*
Sleep Behavior	0.328	0.269	1.329	0.059
Behavioral Intention	-0.415	-1.101	1.814	0.003
Behavioral Intention: Reflect, Square Root*	-0.071	-1.148	1.336	0.056
Behavioral Intention: Reflect, Cube Root	-0.268	-1.036	1.358	0.050
Behavioral Intention: Reflect, Fourth Root	-0.372	-0.950	1.429	0.034
Perceived Behavioral Control	0.026	-1.008	1.076	0.198
Subjective Norm	-0.544	0.314	1.187	0.119
Attitude Toward Behavior	-1.518	3.907	2.040	0.000
Attitude Toward Behavior: Reflect, Square Root*	0.404	-0.128	1.248	0.089
Attitude Toward Behavior: Reflect, Cube Root	0.093	-0.560	1.463	0.028
Attitude Toward Behavior: Reflect, Fourth Root	-0.053	-0.672	1.555	0.016
Sleep Hygiene	0.129	-0.217	0.595	0.871

Note. *Transformation selected.

Demographic Characteristics of the Sample

Respondents were polled from a sampling frame of 22,436 students on record with the Registrar's electronic mailing list during the time of this study. Respondents were delimited by the Registrar's data base software to undergraduate students between 18 and 24 years old. Additional inclusion criteria for the study were satisfied by logic criteria integrated into the

electronic instrument. Participation was voluntary and no incentives were offered. As such, a conservative response rate of 1–3% was considered. The electronic version of the instrument was made available in February 2011. Data collection for the study ceased once the quota sample of 197 was satisfied.

Age, gender, race/ethnicity. To participate in this study, participants were required to be between the ages of 18 and 24. The mean age of the respondents (n=197) was 20.27 with a range of 18 to 24 years and a standard deviation of 1.537. Concerning age ranges, 23 (11.7%) of the respondents were 18, 54 (27.4%) were 19, 35 (17.8%) were 20, 36 (18.3) were 21, 32 (16.2%) were 22, 15 (7.6%) were 23, and 2 (1.0%) were 24. The respondent pool (n=197) was comprised of 130 (66.0%) females and 67 (34.0%) males. The vast proportion of the participants were Caucasian (n=181, 91.9%). Additional races/ethnicities accounted for in the sample included African American (n=2, 1.0%), Asian (n=5, 2.5%), multi-racial (n=6, 3.0%), Hispanic (n=2, 1.0%), and other (n=1, 0.5%).

Student status and year of student. The majority of the students were of full-time status (n=187, 94.9%). Part-time students accounted for only a small proportion of the sample (n=10, 5.1%). Most respondents were first (n=54, 27.4%) and second year (n=54, 27.4%) students. The remaining portion of the sample was distributed across third (n=31, 15.7%), fourth (n=43, 21.8%), and fifth year and above (n=15, 7.6%) students.

Parental status and employment status. The overwhelming proportion of participants (n=194, 98.2%) did not have any children. Only three (1.5%) individuals reported having children (n=4, M=1.33, SD=0.44). Concerning employment status, most participants held either part-time (n=91, 46.2%) or full-time (n=18, 9.1%) positions. A significant amount of the sample were unemployed (n=88, 44.7%). The mean number of hours worked among respondents whom

indicated they were employed (n=109) was 11.31 (*SD*=13.46). Further analysis revealed the mean hours of respondents who were employed part-time (n=92) was 16.41 (*SD*=7.55) and the mean hours of participants who were employed full-time (n=17) was 42.29 (*SD*=4.83).

College major. Participants represented a variety of college majors with the largest portion of students representing medicine and health (n=39, 19.8%), engineering (n=35, 17.8%), other/undecided (n=26, 13.2), business (n=21, 10.7%), natural science and math (n=17, 8.6%), and design (n=15, 7.6%). Behavioral and social sciences (n=9, 4.6%), architecture (n=8, 4.1%), education (n=8, 4.1%), humanities (n=5, 2.5%), performing arts and music (n=5, 2.5%), and politics (n=4, 2.0%), comprised the next largest proportion of majors in the sample. Law and social justice (n=2, 1.0%), computers and technology (n=1, 0.5%), culture and languages (n=1, 0.5%), and social services were the least represented majors in the total sample. The construction and building trades (n=0, 0.0%) major was not represented in the sample.

Credit hours and GPA. The mean credit hours taken by the sample was 15.47 (*SD*=3.43). The minimum number of credit hours was 1 and the maximum number of credit hours was 23. Overall grade point average of the participants was 3.363 (*SD*=0.45). The minimum grade point average was 1.800 and the maximum grade point average was 4.000. Tables 4.2 and 4.3 summarize the demographic characteristics of the sample.

Table 4.2

Summary of Demographic Frequency Statistics for the Sample of Undergraduate Students (n=197)

Variable	*n*	%	Cumulative %
Age			
18	23	11.7	11.7
19	54	27.4	39.1
20	35	17.8	56.9
21	36	18.3	75.1
22	32	16.2	91.4
23	15	7.6	99.0
24	2	1.0	100.0
Gender			
Female	130	66.0	66.0
Male	67	34.0	100.0
Ethnicity			
Caucasian	181	91.9	91.9
Multi-racial	6	3.0	94.9
Asian	5	2.5	97.4
African American	2	1.0	98.4
Hispanic	2	1.0	99.4
Other	1	0.5	100.0
Student Status			
Full-time	187	94.9	94.9
Part-time	10	5.1	100.0
Year of Student			
First Year	54	27.4	27.4
Second Year	54	27.4	54.8

Third Year	31	15.7	70.6
Fourth Year	43	21.8	92.4
Fifth Year and Above	15	7.6	100.0
Parental Status			
No	194	98.2	98.2
Yes	3	1.5	100.0
Employment Status			
Unemployed	88	44.7	44.7
Part-time	91	46.2	90.9
Full-time	18	9.1	100.0
College Major			
Medicine & Health	39	19.8	19.8
Engineering	35	17.8	37.6
Other/Undecided	26	13.2	50.8
Business	21	10.7	61.5
Natural Science & Math	17	8.6	70.1
Design	15	7.6	77.7
Behavioral & Social Sciences	9	4.6	82.3
Architecture	8	4.1	86.4
Education	8	4.1	90.5
Humanities	5	2.5	93.0
Performing Arts & Music	5	2.5	95.5
Politics	4	2.0	97.5
Law & Social Justice	2	1.0	98.5
Computers & Technology	1	0.5	99.0
Culture & Languages	1	0.5	99.5
Social Service	1	0.5	100.0
Construction	0	0.0	0.0

Table 4.3

Summary of Demographic Descriptive Statistics for the Sample of Undergraduate Students (n=197)

Variable	*n*	Minimum	Maximum	*M*	*SD*
Age	197	18	24	20.27	1.537
Credit Hours	197	1	23	15.47	3.43
Overall Grade Point Average	197	1.800	4.000	3.363	0.45
Parental Status: Number of Children	4	1	2	1.33	0.44
Hours Worked (all employed)	109	1	55	11.31	13.46
Hours Worked (employed part-time)	92	1	40	16.41	7.55
Hours Worked (employed full-time)	17	36	55	42.29	4.83

Instrument Validity and Reliability

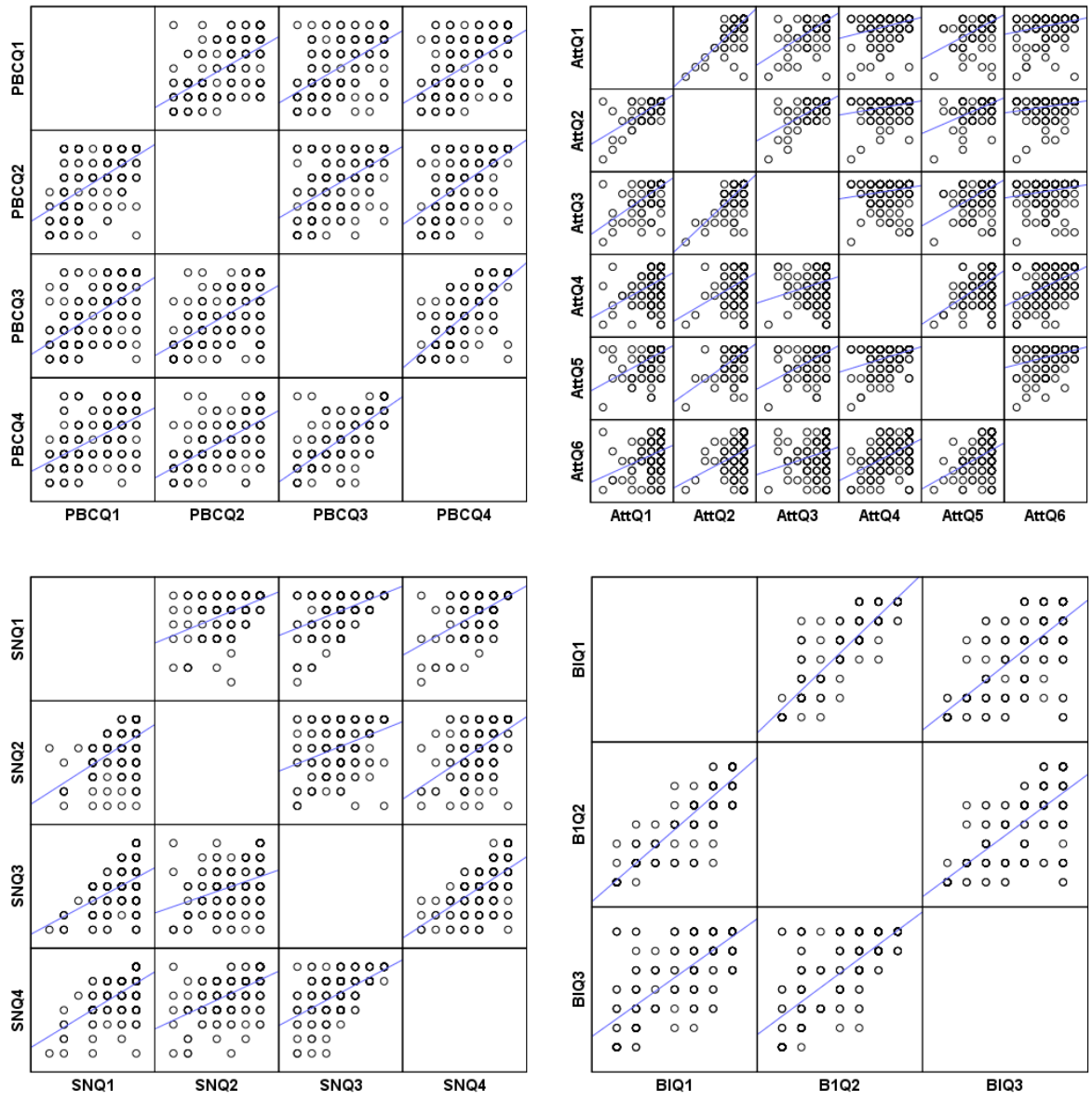
Confirmatory factor analysis. Factor analysis identifies common dimensions among variables. Confirmatory factor analysis (CFA) confirms a posited structural model hypothesized *a priori*. CFA specifies the number of factors in a given set of indicator variables (i.e. scale items). Model parameters are comprised of factor loadings and error variances. Model parameters are estimated to produce the implied correlation matrix. The maximum likelihood method (MLM) is the preferred extraction method for estimating the parameters of a factor model. An assumption of the MLM is that the data are continuous and satisfy multivariate normality. The MLM is useful as the parameter estimates generated by this technique are a close approximation to the population parameters. In addition, MLM approximates a Chi-square distribution providing a significance test for overall model fit. Accordingly, CFA using MLM was employed to confirm the hypothesized factors of the TpB. Scale items which loaded on more than one factor were inspected and considered for removal.

Criteria for factor extraction. Factor extraction was based on Eigenvalue, factor loading significance, communality, and visual inspection of construct scree plots. Eigenvalues describe the total amount of variance explained by each factor. The Kaiser criterion of Eigenvalues greater than 1.00 was applied as the basis for factor extraction. Next, the practical significance of loadings was considered for each factor. According to Stevens (1996), for a sample size of 200 the consideration level for retaining a factor is ±0.36. The third measure involved communality (h^2), or, the percentage of variance explained by the factors. Generally, the percentage of variance explained should exceed 70% (Stevens, 1996). The fourth benchmark included a review of each construct's scree plot. A scree plot is a simple line segment plot that displays the Eigenvalues against the number of factors (Field, 2009).

Diagnostics. Assumptions underlying factor analysis include sufficient sample size, linearity, univariate/multivariate normality, no multivariate outliers, and absence of high multicollinearity. Normality and outlier assumptions were met in advance of conducting the factor analysis. Linearity was addressed through visual inspection of matrix scatterplots. Horizontal lines indicated non-linear relationships between the factor variables. Observation of the scatterplots revealed diagonal lines running through each scatterplot, indicating linearity between the factor variables. Figure 4.1 displays the matrix scatterplots of the initial factor solutions.

Figure 4.1

Matrix Scatterplots of the Initial Factor Solutions for the Sample of Undergraduate Students (n=197)



Multicollinearity was assessed by examining an R matrix of the initial factors. In observing the R matrix, correlations greater than or equal to 0.90 could indicate multicollinearity. Inspection of the R matrix revealed the absence of high multicollinearity assumption was satisfied. A full R matrix is provided in the hypotheses testing section of chapter 4.

Regarding adequacy of sample size, Tabachnick and Fidell (2007) have stated that for solutions with several high loading marker variables (>0.80) sample sizes of 150 are sufficient. The high loading marker variables obtained in the factor analysis satisfied Tabachnick and Fidell's criteria and was considered sufficient for analysis. Finally, the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) was calculated to measure the strength of variable correlation. A KMO value exceeding 0.50 is recommended for factor analysis (Field, 2009). KMO values exceeding 0.73 were found for each factor, thus the assumption of factorability was satisfied.

Based on the results of the analysis, one factor solutions were confirmed for the TpB constructs of behavioral intention, perceived behavioral control, subjective norm, and attitude toward the behavior. Table 4.4 illustrates the unrotated factor loadings, Eigenvalues, and percentage of variance from the CFA using MLM for the TpB constructs under examination. Figure 4.2 displays the scree plots for the one factor solutions.

Table 4.4

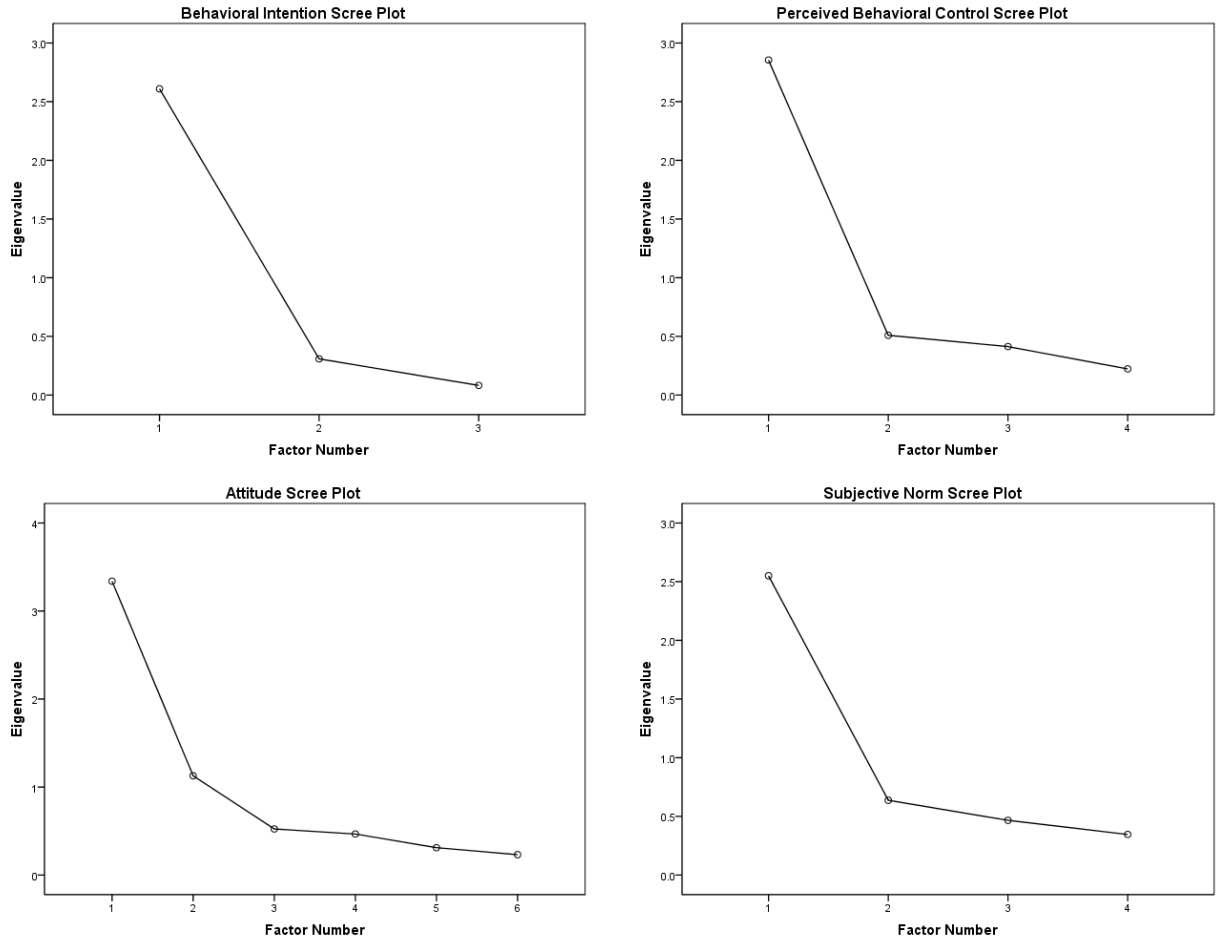
Maximum Likelihood Method Factor Analysis: Unrotated Factor Loadings, Eigenvalues, and Percentages of Variance for Theory of Planned Behavior Construct Items Found in the Student Sleep Behavior Instrument for the Sample of Undergraduate Students (n=197)

Construct	Factor Loadings	Eigenvalue	% of Variance
Behavioral Intention			
1. *Item 15.* In the next 24 hours, I intend to sleep 7 to 8 hours at night time – Completely Disagree : Completely Agree	0.962	2.609	86.983
2. *Item 16.* In the next 24 hours, I intend to sleep 7 to 8 hours at night time – Completely Disagree : Completely Agree	0.954		
3. *Item 17.* In the next 24 hours, I will try to sleep 7 to 8 hours at night time – Completely Disagree : Completely Agree	0.779		
Perceived Behavioral Control			
1. *Item 1.* For me to sleep 7 to 8 hours every night is – Not Practical : Practical	0.695	2.855	71.371
2. *Item 2.* If I wanted to, I am sure I could sleep 7 to 8 hours every night – Completely Disagree : Completely Agree	0.706		
3. *Item 3.* It is up to me whether or not I sleep 7 to 8 hours every night – Completely Disagree : Completely Agree	0.869		
4. *Item 4.* I have complete control over my ability to sleep 7 to 8 hours every night – No Control : Complete Control	0.862		
Attitude Toward the Behavior			
1. *Item 5.* For me to sleep for 7 to 8 hours every night would be – Bad : Good	0.835	3.339	55.649

2.	*Item 6.* For me to sleep for 7 to 8 hours every night would be – Unhealthy : Healthy	0.871		
3.	*Item 7.* For me to sleep for 7 to 8 hours every night would be – Not refreshing : Refreshing	0.788		
4.	*Item 8.* For me to sleep for 7 to 8 hours every night would be – Unnecessary : Necessary	0.514		
5.	*Item 9.* For me to sleep for 7 to 8 hours every night would be – Not enjoyable : Enjoyable	0.687		
6.	*Item 10.* For me to sleep for 7 to 8 hours every night would be – Detrimental to my social life : Beneficial to my social life	0.419		
	Subjective Norm			
1.	*Item 11.* My friend(s) want me to sleep 7 to 8 hours every night– Completely Disagree : Completely Agree	0.705	2.550	63.762
2.	*Item 12.* My parents(s)/guardian(s) want me to sleep 7 to 8 hours every night – Completely Disagree : Completely Agree	0.654		
3.	*Item 13.* My supervisors want me to sleep 7 to 8 hours every night – Completely Disagree : Completely Agree	0.663		
4.	*Item 14.* Most people who are important to me want me to sleep 7 to 8 hours every night – Completely Disagree : Completely Agree	0.856		

Figure 4.2

Scree Plots for the Behavioral Intention, Perceived Behavioral Control, Subjective Norm, and Attitude Toward the Behavior Constructs for the Sample of Undergraduate Students (n=197)



Reliability coefficients for the instrument. *Test-retest reliability.* Pearson's *r* was employed to evaluate test-retest reliability of the constructs. Acceptable stability coefficient values were set *a priori* at 0.70. The constructs of sleep behavior (r (37) = 0.806, $p < 0.01$), behavioral intention (r (37) = 0.833, $p < 0.001$), perceived behavioral control (r (37) = 0.905, $p < 0.01$), subjective norm (r (37) = 0.803, $p < 0.01$), attitude toward the behavior(r (37) = 0.885, $p < 0.01$), and sleep hygiene (r (37) = 0.871, $p < 0.01$) exceeded the acceptable *a priori* condition.

Responses for the item representing the sleep behavior construct were converted from total hours and minutes to total minutes of sleep accrued at night time in the past 24 hours. Table 4.5 summarizes the test-retest reliability coefficients for the theoretical constructs.

Table 4.5

Test-Retest Reliability Coefficients for the Theoretical Constructs of Sleep Behavior, Behavioral Intention, Perceived Behavioral Control, Subjective Norm, Attitude Toward the Behavior, and Sleep Hygiene for the Sample of Undergraduate Students the Sample of Undergraduate Students (n=37)

Construct	Number of items	Pearson *r*
Sleep Behavior	1	0.806**
Behavioral Intention	3	0.833**
Perceived Behavioral Control	4	0.905**
Subjective Norm	4	0.803**
Attitude Toward the Behavior	6	0.885**
Sleep Hygiene	13	0.871**

Note. Sleep behavior total hours and minutes were converted into a single measure representing the total number of minutes participants slept in the past 24 hours at night time.
**Correlation significant at 0.01 level (2-tailed).

Internal consistency. Cronbach's alpha was applied to evaluate internal consistency of the construct items. Acceptable internal consistency coefficients values were established *a priori* at 0.70. The constructs of behavioral intention ($\alpha = 0.925$), perceived behavioral control ($\alpha = 0.865$), subjective norm ($\alpha = 0.803$), attitude toward the behavior ($\alpha = 0.801$), and sleep hygiene ($\alpha = 0.726$) exceeded the acceptable *a priori* criterion. Responses for the item representing the sleep behavior construct were converted from total hours and minutes to total minutes of sleep accrued at night time in the past 24 hours. As the TpB sleep behavior construct was represented

by a single item, testing for internal consistency was not applicable. Table 4.6 summarizes the internal consistency reliability coefficients for the theoretical constructs.

Table 4.6

Internal Consistency Reliability Coefficients for the Theoretical Constructs of Behavioral Intention, Perceived Behavioral Control, Subjective Norm, Attitude Toward the Behavior, and Sleep Hygiene for the Sample of Undergraduate Students the Sample of Undergraduate Students (n=197)

Construct	Number of items	Cronbach's α
Behavioral Intention	3	0.925
Perceived Behavioral Control	4	0.865
Subjective Norm	4	0.803
Attitude Toward the Behavior	6	0.801
Sleep Hygiene	13	0.726

Note. Sleep behavior total hours and minutes were converted into a single measure representing the total number of minutes participants slept in the past 24 hours at night time; subsequently, Cronbach's α was not applicable to the behavior construct.

Theoretical Constructs Analyses

Descriptive statistics for dependent variables. Table 4.7 summarizes the means and standard deviations of the two dependent variable constructs evaluated in this investigation: sleep behavior and behavioral intention. In examining sleep behavior, behavioral intention, sleep hygiene, and gender operated as predictor variables. In assessing behavioral intention, perceived behavioral control, attitude toward the behavior, and subjective norm functioned as the predictor variables. The observed range score for each outcome variable was measured and contrasted against the possible range score. The possible range for adequate sleep behavior was 0 to 1,440. The observed range was 180 to 720 with a mean of 407.34 and a standard deviation of 100.75.

The possible range for behavioral intention to achieve adequate sleep was 3 to 21. The observed range was 3 to 21 with a mean of 13.49 and a standard deviation of 5.89.

Table 4.7

Distribution of Means and Standard Deviations for Sleep Behavior and Behavioral Intention Constructs for the Sample of Undergraduate Students (n=197)

	Range			
Construct	Possible	Observed	*M*	*SD*
Sleep Behavior	0 – 1,440	180 – 720	407.34	100.75
Behavioral Intention	3 – 21	3 – 21	13.49	5.89

Sleep behavior construct analysis. Sleep behavior was assessed through self-report employing 24-hour recall of the previous night's sleep (item 18). Responses for the sleep behavior construct were transformed from total hours and minutes to total minutes of sleep accrued at night time in the past 24 hours. Theoretically, scores for the sleep behavior construct could range from 0 to 1,440 minutes. The mean of the item scores was calculated to provide an overall adequate sleep behavior score. Observations within the range of 420 to 480 total minutes of sleep (equivalent to 7 to 8 hours) were considered to have met this study's operational definition of adequate sleep behavior; alternatively, observations outside of this range were considered to have failed to meet the operational definition of adequate sleep behavior. Expressed as an inequality, adequate sleep behavior was defined as $420 \leq x \leq 480$; where x represents adequate sleep behavior in minutes. Conversely, inadequate sleep behavior was defined as $420 > y > 480$; where y equals inadequate sleep behavior in minutes. For pragmatic purposes, inadequate sleep behavior was dichotomized into two categories; insufficient duration of sleep (<420 minutes; <7 hours) and excessive duration of sleep (>480 minutes; >8 hours).

Table 4.8 summarizes the frequencies and distributions of the adequate sleep behavior construct. In examining adequate sleep behavior, the mean minutes of total sleep at night time of the sample was 407.34 with a standard deviation of 100.75. The mean sleep behavior score of the sample fell below the minimal acceptable score of 420 minutes set forth in this study, indicating a large portion of the sample received an inadequate duration of total sleep. Closer examination of the data revealed only 48 (24.37%) of the participants achieved adequate sleep behavior as defined by this study. Among the pool of participants, 108 (54.80%) received insufficient sleep and 41 (20.81%) obtained excessive sleep.

Table 4.8

Summary of Frequency Distributions and Percentages of the Sleep Behavior Construct for the Sample of Undergraduate Students (n=197)

			Range			
Sleep Behavior Construct	*n*	%	Possible	Observed	*M*	*SD*
Total Construct Score	197	100.0	0 – 1,440	180 – 720	407.34	100.75
Adequate Sleep Behavior	48	24.37	420 – 480	420 – 480	441.25	20.36
Inadequate Sleep Behavior	149	75.63	[0 – 420) ∪ (480 – 1,440]	[180 – 410] ∪ [489 – 720]	391.12	127.06
Insufficient Sleep	108	54.80	0 – 420	180 – 410	336.56	46.63
Excessive Sleep	41	21.64	480 – 1,440	489 – 720	554.24	44.55

Note: All units are in minutes. ∪ = interval notation for union of two number sets; [ ] = endpoint included in set; ( ) = endpoint not included in set.

Graphical presentation of data assists in summarizing a given data set. For the purposes of this study, a variety of tables and figures are presented to illustrate the data associated with the seminal sleep behavior construct. Figure 4.3 depicts a stem-and-leaf plot of the construct. A stem-and-leaf plot is used to conceptualize the impact of frequencies on the shape of the distribution of values. A cursory overview of the shape the stem-and-leaf plot revealed a large cluster of participants fell into the inadequate sleep category. As demonstrated by the frequency column, a substantial portion of the participants fell within the 300 minute range. Within the 400 minute range, most individuals achieved 420 minutes of sleep.

Figure 4.3

Stem-and-Leaf Plot of the Sleep Behavior Construct Measured in Total Minutes of Sleep for the Sample of Undergraduate Students (n=197)

Frequency	Stem	Leaves
1	1 .	9
8	2 .	01114444
11	2 .	56777777777
27	3 .	000000012222333333333334444
51	3 .	666666666666666666677777777888888899999999999999
38	4 .	00000001222222222222222222333333444
23	4 .	55555666778888888889999
19	5 .	0111111111244444444
6	5 .	556677
8	6 .	00000233
3	Extremes	(>=660)

Note: Stem width=100; each leaf=1 case.

As a statistical device, grouped frequency distribution tables assist in organizing large lists of data into quantitative data sets. When constructing a frequency table, observations are grouped into intervals to summarize the distribution of values in the sample. Often, frequency tables can reveal patterns in data that are not readily apparent in a stem-and-leaf plot. Table 4.9 presents a grouped frequency distribution table of the adequate sleep behavior construct. To augment practicality of the data distributions, the table was developed by creating an initial class interval that displayed the data range associated with adequate sleep behavior (420 – 480 minutes). Employing this criterion, the class width for the remaining bins was set at 60 and the number of classes was set at 9. Interval 4 had the greatest number of observations (n=59) followed by interval 5 (n=48). The highest concentration of observations fell within intervals 3 through 6. Overall, the grouped frequency distribution table summarized the dispersion of observations that fell outside the adequate sleep behavior class interval range.

Table 4.9

Grouped Frequency Distribution of the Sleep Behavior Construct Measured in Total Minutes of Sleep for the Sample of Undergraduate Students (n=197)

Interval	Class Interval	*n*	%	Cumulative %
1	176 – 236	7	3.55	3.55
2	237 – 297	15	7.61	11.16
3	298 – 358	27	13.71	24.87
4	359 – 419	59	29.95	54.82
5	**420 – 480**	**48**	**24.37**	**79.19**
6	481 – 541	24	12.18	91.37
7	542 – 602	11	5.58	96.95
8	603 – 663	4	2.03	98.98
9	664 – 723	2	1.02	100
	Total	197		

Note. Row in bold represents adequate sleep behavior class interval.

A box plot reveals the landmarks of the standard normal distribution. Figure 4.4 depicts a box plot of the adequate sleep behavior construct measured in total minutes. The quartiles of the box plot were 352.50 (Q_1), 390.00 (Q_2), and 477.00 (Q_3). The upper whisker value of the box plot was 664.50 ($Q_3 + 1.5(Q_3 – Q_1)$) while the lower whisker value of the box plot was 165.75 ($Q_1 – 1.5(Q_3 – Q_1)$). Typically, 0.7% of the observations lie beyond the whisker points. As evidenced by quartiles one and two, a large proportion of the participants received insufficient sleep. Quartile three illustrated that a considerable quantity of the sample obtained excessive sleep.

Figure 4.4

Box Plot of the Sleep Behavior Construct Measured in Total Minutes of Sleep for the Sample of Undergraduate Students (n=197)

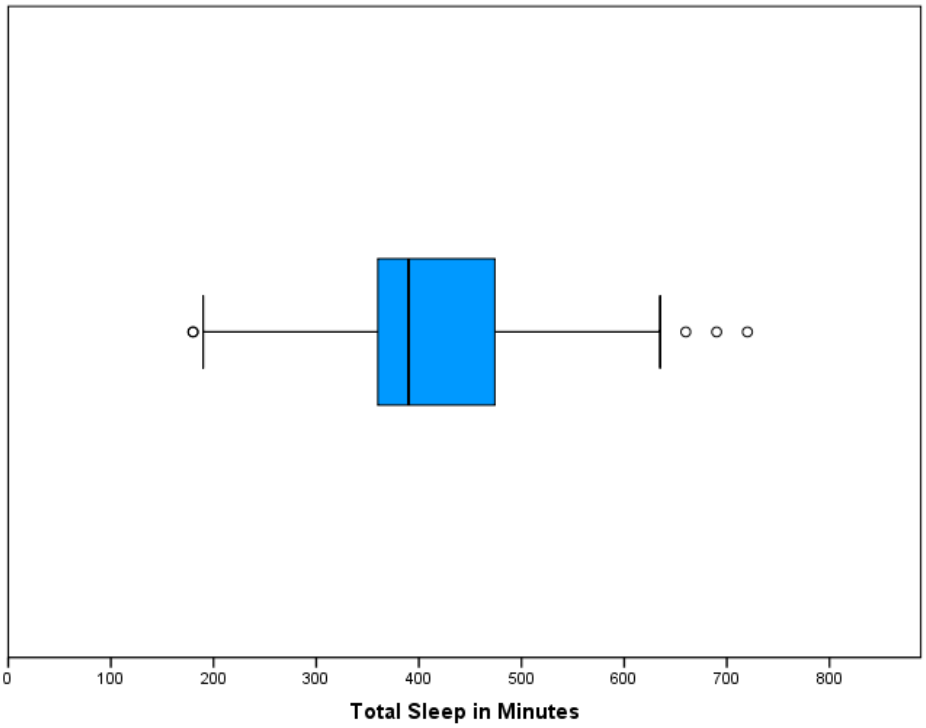
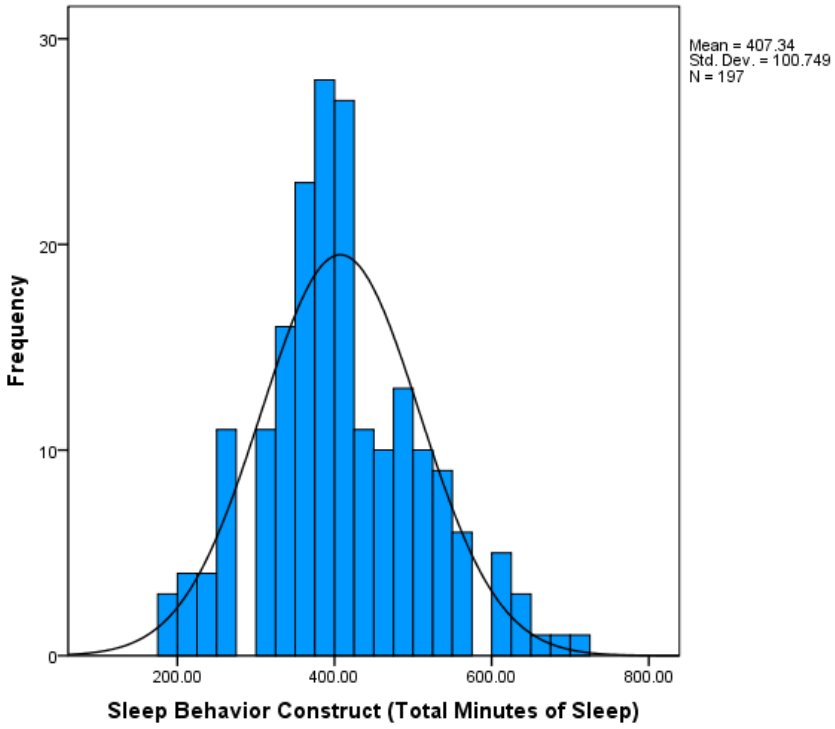


Figure 4.5 displays a histogram with a superimposed normal curve of the adequate sleep behavior construct. A histogram provides a graphical representation of the distribution of a set of data. A standard normal distribution has a kurtosis measure of zero. The high concentration of participants achieving sleep in the 300 minute range resulted in a kurtosis value of 0.269, implying a peaked distribution. The histogram also revealed a skewness of 0.328, indicating a greater quantity of observations below the mean than above the mean. The positive skew uncovered by the distribution affirmed that a greater proportion of the sample received insufficient sleep.

Figure 4.5

Histogram with Normal Distribution Curve of the Sleep Behavior Construct Measured in Total Minutes of Sleep for the Sample of Undergraduate Students (n=197)



Behavioral intention construct analysis. Behavioral intention was operationally defined as the intention to engage in adequate sleep behavior. This construct was assessed in terms of the TACT principle. For the purposes of this study, behavioral intention was defined as undergraduate students (target) intention to sleep (action) for 7 to 8 hours (time) every night (context). This construct was assessed by items 15 through 17 of the instrument and had a score range of 3 to 21. Higher scores reflected a greater intention to achieve sleep behavior. Behavioral intention served as both a predictor and outcome variable in this investigation. In its role as an outcome variable, it was regressed on perceived behavioral control**,** subjective norm, and attitude toward the behavior. As a predictor, behavioral intention was regressed on adequate sleep behavior.

Table 4.10 summarizes the means and standard deviations of the behavioral intention scale items and the behavioral intention total construct score. Behavioral intention was gauged through three items (items 15, 16, and 17). A 7-point semantic differential scale was utilized to measure each item. The possible range for item 15 was 1 to 7. The observed range was 1 to 7 with a mean of 4.44 and a standard deviation of 2.18. The possible range for item 16 was 1 to 7. The observed range was 1 to 7 with a mean of 4.12 and a standard deviation of 2.07. The possible range for item 17 was 1 to 7. The observed range was 1 to 7 with a mean of 4.93 and a standard deviation of 2.07. Summated, the construct had a possible range of 3 to 21 with higher scores reflecting a greater intention to enact the target behavior. The observed score for the construct was 3 to 21 with a mean of 13.49 and a standard deviation of 5.89.

Table 4.10

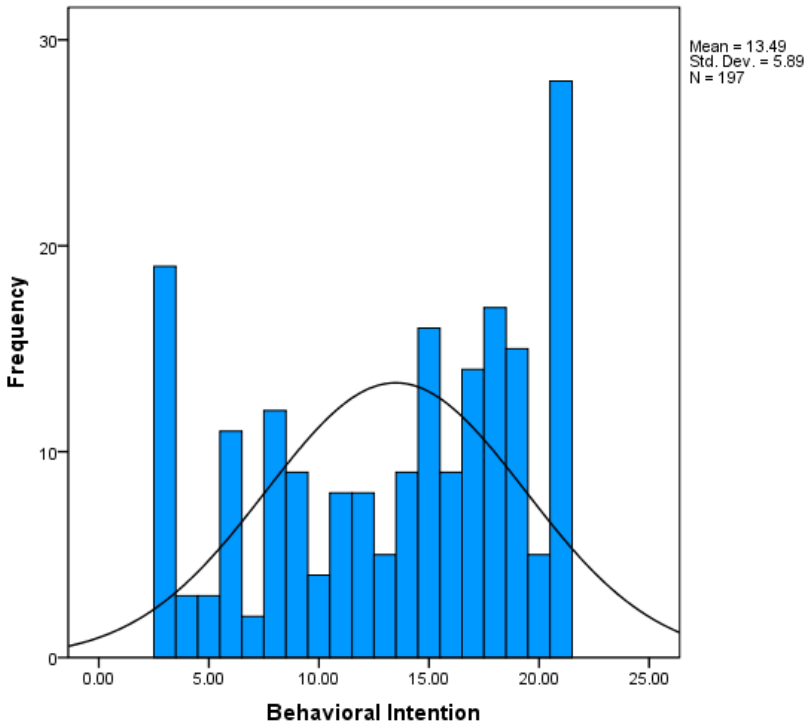
Distribution of Means and Standard Deviations for Behavioral Intention Scale Items and Behavioral Intention Construct for the Sample of Undergraduate Students (n=197)

	Range			
Behavioral Intention	Possible	Observed	*M*	*SD*
4. *Item 15.* In the next 24 hours, I intend to sleep 7 to 8 hours at night time – Completely Disagree : Completely Agree	1 – 7	1 – 7	4.44	2.18
5. *Item 16.* In the next 24 hours, I intend to sleep 7 to 8 hours at night time – Completely Disagree : Completely Agree	1 – 7	1 – 7	4.12	2.07
6. *Item 17.* In the next 24 hours, I will try to sleep 7 to 8 hours at night time – Completely Disagree : Completely Agree	1 – 7	1 – 7	4.93	2.07
Total Construct Score	3 – 21	3 – 21	13.49	5.89

Figure 4.6 displays a histogram with an overlaid normal curve for the behavioral intention construct. The histogram revealed a negative skew in which the mass of the distribution was concentrated on the right of the figure. Closer observation of the histogram demonstrated that a high frequency of individuals (n=28, 14.2%) achieved the maximum construct score of 21; however, a large portion of the respondent pool (n=109, 55.3%) indicated a behavioral intention score less than or equal to15, resulting in a mean total score of 13.49 (*SD*=5.89). The behavioral intention construct histogram revealed a kurtosis value of -1.101 and a skewness value of -0.415. These values implied a flatter distribution with more observations above the mean than below the mean.

Figure 4.6

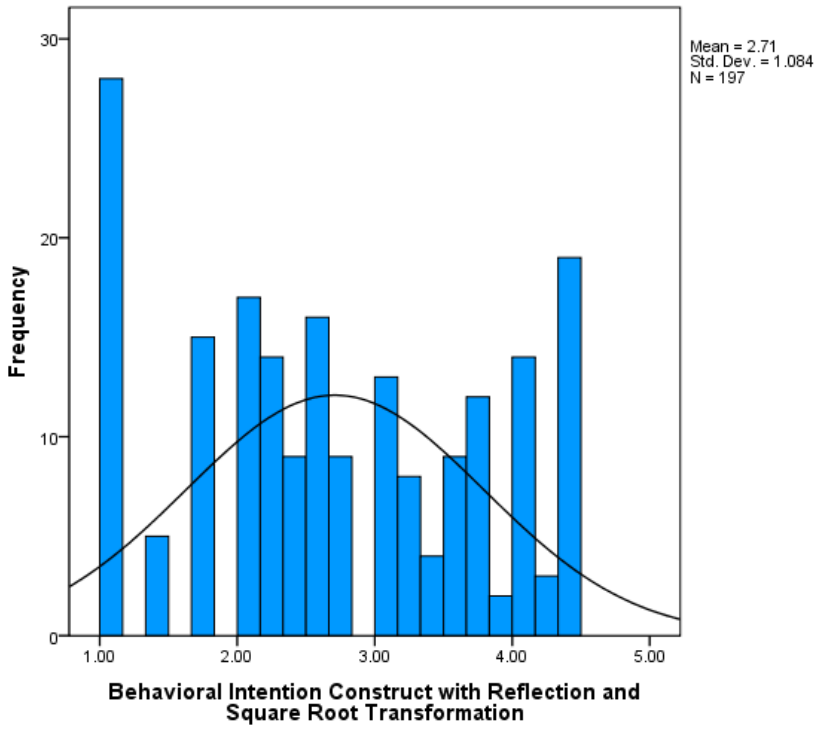
Histogram with Normal Distribution Curve of the Behavioral Intention Construct for the Sample of Undergraduate Students (n=197)



Visual inspection of the behavioral intention construct histogram revealed a negative skew. Square root transformation with reflection was found to slightly increase kurtosis from -1.101 to -1.148 and substantially reduce skewness from -0.415 to -0.071. Figure 4.7 illustrates a histogram with a superimposed normal curve for the behavioral intention construct with reflection and square root transformation.

Figure 4.7

Histogram with Normal Distribution Curve of the Behavioral Intention Construct with Reflection and Square Root Transformation for the Sample of Undergraduate Students (n=197)



Descriptive statistics for independent variables. Table 4.11 summarizes the means and standard deviations of the five independent variable constructs evaluated in this investigation: behavioral intention, perceived behavioral control, subjective norm, attitude toward the behavior, and sleep hygiene. In assessing behavioral intention, perceived behavioral control, subjective norm, and attitude toward the behavior functioned as the predictor variables. In examining sleep

behavior, behavioral intention, sleep hygiene, and gender operated as predictor variables. The observed range score for each predictor variable was measured and contrasted against the possible range score.

The possible range for behavioral intention was 3 to 21. The observed range was 3 to 21 with a mean of 13.49 and a standard deviation of 5.89. The possible range for perceived behavioral control was 4 to 28. The observed range was 4 to 28 with a mean of 17.08 and a standard deviation of 6.56. The possible range for subjective norm was 4 to 28. The observed range was 4 to 28 with a mean of 20.35 and a standard deviation of 4.71. The possible range for attitude toward the behavior was 6 to 42. The observed range was 6 to 42 with a mean of 35.92 and a standard deviation of 5.64. The possible range for sleep hygiene was 13 to 91. The observed range was 28 to 84 with a mean of 51.59 and a standard deviation of 10.93.

Table 4.11

Distribution of Means and Standard Deviations for the Theoretical Constructs of Behavioral Intention, Perceived Behavioral Control, Subjective Norm, Attitude Toward the Behavior, and Sleep Hygiene for the Sample of Undergraduate Students (n=197)

	Range			
Construct	Possible	Observed	*M*	*SD*
Behavioral Intention	3 – 21	3 – 21	13.49	5.89
Perceived Behavioral Control	4 – 28	4 – 28	17.08	6.56
Subjective Norm	4 – 28	4 – 28	20.35	4.71
Attitude Toward the Behavior	6 – 42	6 – 42	35.92	5.64
Sleep Hygiene	13 – 91	28 – 84	51.59	10.93

Perceived behavioral control construct analysis. Table 4.12 summarizes the means and standard deviations of the perceived behavioral control scale items and the perceived behavioral control total construct score. Perceived behavioral control was gauged through four items (items 1, 2, 3, and 4). A 7-point semantic differential scale was utilized to measure each item. The possible range for item 1 was 1 to 7. The observed range was 1 to 7 with a mean of 4.16 and a standard deviation of 1.94. The possible range for item 2 was 1 to 7. The observed range was 1 to 7 with a mean of 4.74 and a standard deviation of 2.02. The possible range for item 3 was 1 to 7. The observed range was 1 to 7 with a mean of 4.10 and a standard deviation of 2.00. The possible range for item 4 was 1 to 7. The observed range was 1 to 7 with a mean of 4.08 and a standard deviation of 1.81. Summated, the construct had a possible range of 4 to 28 with higher scores reflecting a greater level of control over the target behavior. The observed score for the construct was 4 to 28 with a mean of 17.08 and a standard deviation of 6.56.

Table 4.12

Distribution of Means and Standard Deviations for the Perceived Behavioral Control Scale Items and Perceived Behavioral Control Construct for the Sample of Undergraduate Students (n=197)

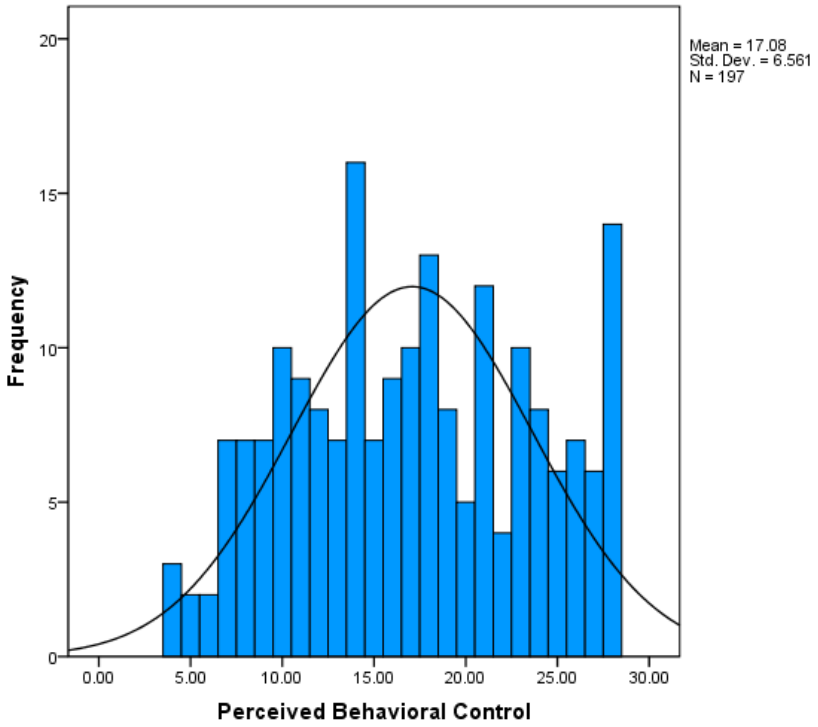
	Range			
Perceived Behavioral Control	Possible	Observed	*M*	*SD*
5. *Item 1.* For me to sleep 7 to 8 hours every night is – Not Practical : Practical	1 – 7	1 – 7	4.16	1.94
6. *Item 2.* If I wanted to, I am sure I could sleep 7 to 8 hours every night – Completely Disagree : Completely Agree	1 – 7	1 – 7	4.74	2.02

7. *Item 3.* It is up to me whether or not I sleep 7 to 8 hours every night – Completely Disagree : Completely Agree	1 – 7	1 – 7	4.10	2.00
8. *Item 4.* I have complete control over my ability to sleep 7 to 8 hours every night – No Control : Complete Control	1 – 7	1 – 7	4.08	1.81
Total Construct Score	4 – 28	4 – 28	17.08	6.56

Figure 4.8 displays a histogram with a superimposed normal curve of the perceived behavioral control construct. Analysis of the histogram revealed a kurtosis value of -1.008 and a skewness value of 0.026. These values implied a flatter distribution with slightly more observations below the mean than above the mean.

Figure 4.8

Histogram with Normal Distribution Curve of the Perceived Behavioral Control Construct for the Sample of Undergraduate Students (n=197)



Subjective norm construct analysis. Table 4.13 summarizes the means and standard deviations of the subjective norm scale items and the subjective norm total construct score. Subjective norm was gauged through four items (items 11, 12, 13, and 14). A 7-point semantic differential scale was utilized to measure each item. The possible range for item 11 was 1 to 7. The observed range was 1 to 7 with a mean of 5.95 and a standard deviation of 1.33. The possible range for item 12 was 1 to 7. The observed range was 1 to 7 with a mean of 5.14 and a standard deviation of 1.66. The possible range for item 13 was 1 to 7. The observed range was 1 to 7 with a mean of 4.04 and a standard deviation of 1.54. The possible range for item 14 was 1 to 7. The observed range was 1 to 7 with a mean of 5.22 and a standard deviation of 1.39. Summated, the construct had a possible range of 4 to 28 with higher scores reflecting a greater social pressure to perform the target behavior. The observed score for the construct was 4 to 28 with a mean of 20.35 and a standard deviation of 4.71.

Table 4.13

Distribution of Means and Standard Deviations for the Subjective Norm Scale Items and Subjective Norm Construct for the Sample of Undergraduate Students (n=197)

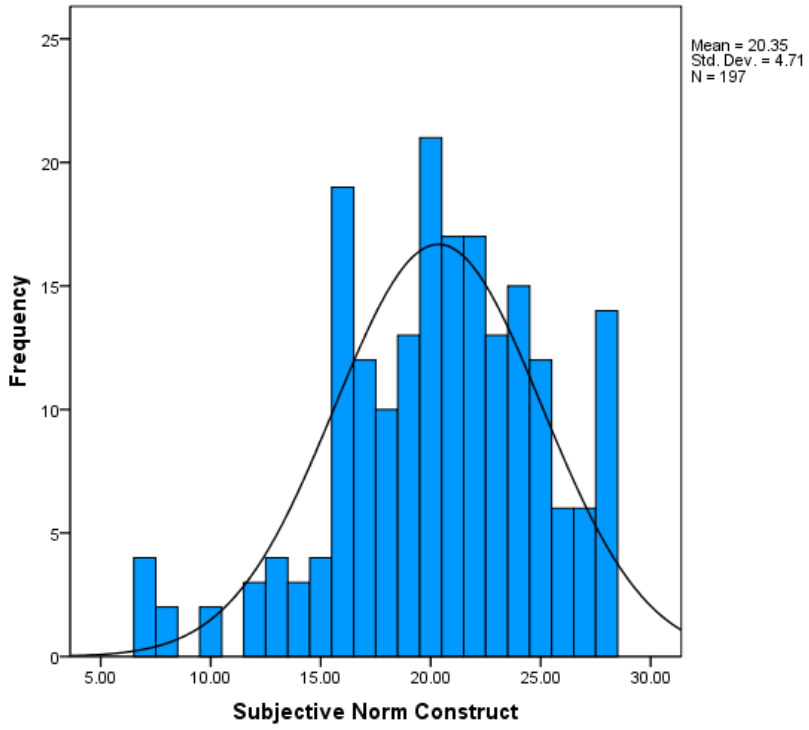
	Range			
Subjective Norm	Possible	Observed	*M*	*SD*
5. *Item 11.* My friend(s) want me to sleep 7 to 8 hours every night– Completely Disagree : Completely Agree	1 – 7	1 – 7	5.95	1.33
6. *Item 12.* My parents(s)/guardian(s) want me to sleep 7 to 8 hours every night – Completely Disagree : Completely Agree	1 – 7	1 – 7	5.14	1.66
7. *Item 13.* My supervisors (e.g. professors/employers) want me to sleep 7 to 8 hours every night – Completely Disagree : Completely Agree	1 – 7	1 – 7	4.04	1.54

8. *Item 14.* Most people who are important to me want me to sleep 7 to 8 hours every night – Completely Disagree : Completely Agree	1 – 7	1 – 7	5.22	1.39
Total Construct Score	4 – 28	4 – 28	20.35	4.71

Figure 4.9 displays a histogram with a superimposed normal curve of the subjective norm construct. Analysis of the histogram revealed a kurtosis value of 0.314 and a skewness value of -0.544. These values suggested a slightly peaked distribution with more observations above the mean than below the mean.

Figure 4.9

Histogram with Normal Distribution Curve of the Subjective Norm Construct for the Sample of Undergraduate Students (n=197)



Attitude toward the behavior construct analysis. Table 4.14 summarizes the means and standard deviations of the attitude toward the behavior scale items and the attitude toward the behavior total construct score. Attitude toward the behavior was gauged through six items (items 5, 6, 7, 8, 9, and 10). Bi-polar adjective were used to evaluate attitude toward the behavior using 7-point scales. The possible range for item 5 was 1 to 7. The observed range was 1 to 7 with a mean of 6.42 and a standard deviation of 1.14. The possible range for item 6 was 1 to 7. The observed range was 1 to 7 with a mean of 6.57 and a standard deviation of 0.90. The possible range for item 7 was 1 to 7. The observed range was 1 to 7 with a mean of 6.38 and a standard deviation of 1.18. The possible range for item 8 was 1 to 7. The observed range was 1 to 7 with a mean of 5.37 and a standard deviation of 1.67. The possible range for item 9 was 1 to 7. The observed range was 1 to 7 with a mean of 6.38 and a standard deviation of 1.15. The possible range for item 10 was 1 to 7. The observed range was 1 to 7 with a mean of 4.81 and a standard deviation of 1.72. Summated, the construct had a possible range of 6 to 42 with higher scores reflecting a more positive attitude towards the target behavior. The observed score for the construct was 6 to 42 with a mean of 35.92 and a standard deviation of 5.64.

Table 4.14

Distribution of Means and Standard Deviations for the Attitude Toward the Behavior Scale Items and Attitude Toward the Behavior Construct for the Sample of Undergraduate Students (n=197)

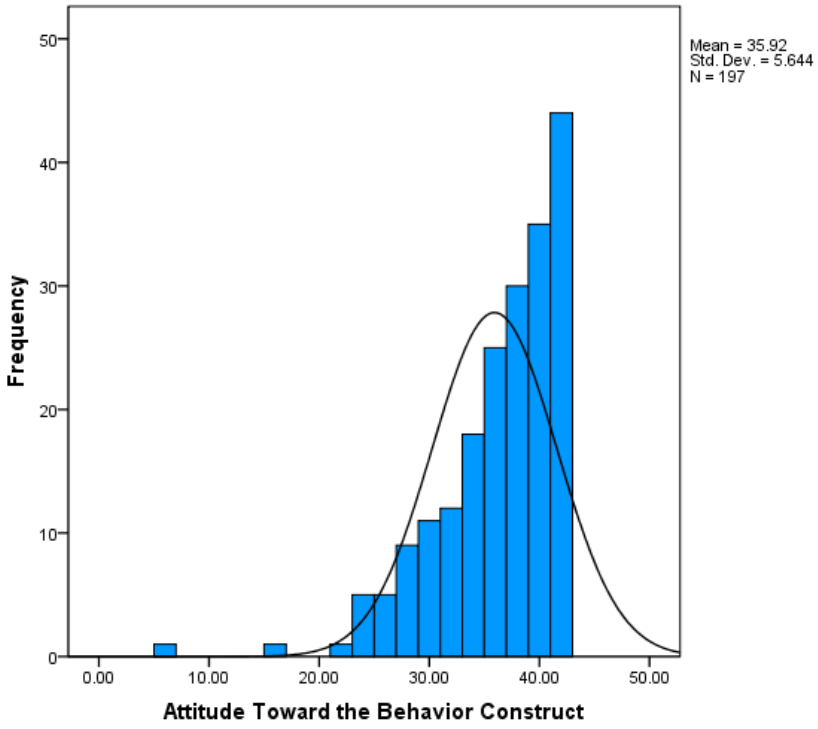
	Range			
Attitude Toward the Behavior	Possible	Observed	*M*	*SD*
1. *Item 5.* For me to sleep for 7 to 8 hours every night would be – Bad : Good	1 – 7	1 – 7	6.42	1.14

2.	*Item 6.* For me to sleep for 7 to 8 hours every night would be – Unhealthy : Healthy	1 – 7	1 – 7	6.57	0.90
3.	*Item 7.* For me to sleep for 7 to 8 hours every night would be – Not refreshing : Refreshing	1 – 7	1 – 7	6.38	1.18
4.	*Item 8.* For me to sleep for 7 to 8 hours every night would be – Unnecessary : Necessary	1 – 7	1 – 7	5.37	1.67
5.	*Item 9.* For me to sleep for 7 to 8 hours every night would be – Not enjoyable : Enjoyable	1 – 7	1 – 7	6.38	1.15
6.	*Item 10.* For me to sleep for 7 to 8 hours every night would be – Detrimental to my social life : Beneficial to my social life	1 – 7	1 – 7	4.81	1.72
Total Construct Score		6 – 42	6 – 42	35.92	5.64

Figure 4.10 displays a histogram with a superimposed normal curve of the attitude toward the behavior construct. Analysis of the histogram revealed a kurtosis value of 3.907 and a skewness value of -1.518. These values implied a more acutely peaked distribution with significantly more observations above the mean than below the mean.

Figure 4.10

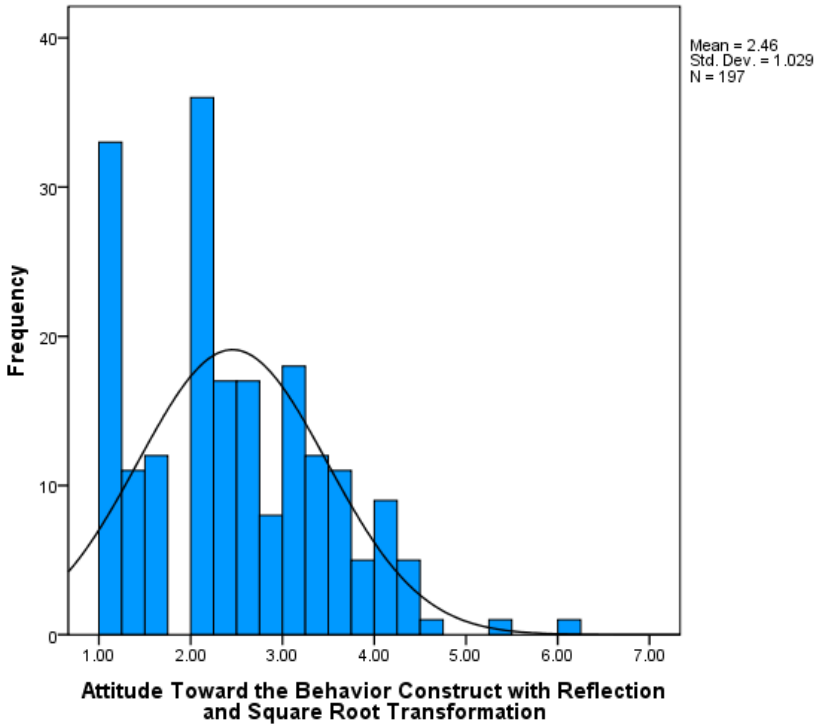
Histogram with Normal Distribution Curve of the Attitude Toward the Behavior Construct for the Sample of Undergraduate Students (n=197)



Visual inspection of the attitude toward the behavior construct histogram revealed a severe negative skew. Square root transformation with reflection was found to reduce kurtosis from 3.907 to -0.128 and skewness from -1.518 to 0.404. Figure 4.11 illustrates a histogram with a superimposed normal curve for the attitude towards the behavior with reflection and square root transformation.

Figure 4.11

Histogram with Normal Distribution Curve of the Attitude Toward the Behavior Construct with Reflection and Square Root Transformation for the Sample of Undergraduate Students (n=197)



Sleep hygiene construct analysis. Table 4.14 summarizes the means and standard deviations of the sleep hygiene scale items and the sleep hygiene total construct score. Sleep hygiene was gauged through 13 items (items 19 through 31). A 7-point semantic differential scale was utilized to measure each item. The possible range for item 19 was 1 to 7. The observed range was 1 to 7 with a mean of 5.27 and a standard deviation of 1.73. The possible range for item 20 was 1 to 7. The observed range was 1 to 7 with a mean of 3.01 and a standard deviation of 1.71. The possible range for item 21 was 1 to 7. The observed range was 1 to 7 with a mean of 3.74 and a standard deviation of 1.81. The possible range for item 22 was 1 to 7. The observed range was 1 to 7 with a mean of 6.13 and a standard deviation of 1.23. The

possible range for item 23 was 1 to 7. The observed range was 1 to 7 with a mean of 4.11 and a standard deviation of 1.97. The possible range for item 24 was 1 to 7. The observed range was 1 to 7 with a mean of 4.39 and a standard deviation of 1.96. The possible range for item 25 was 1 to 7. The observed range was 1 to 7 with a mean of 2.88 and a standard deviation of 1.70. The possible range for item 26 was 1 to 7. The observed range was 1 to 7 with a mean of 3.64 and a standard deviation of 1.64. The possible range for item 27 was 1 to 7. The observed range was 1 to 7 with a mean of 3.39 and a standard deviation of 2.10. The possible range for item 28 was 1 to 7. The observed range was 1 to 7 with a mean of 5.14 and a standard deviation of 1.87. The possible range for item 29 was 1 to 7. The observed range was 1 to 7 with a mean of 4.77 and a standard deviation of 1.77. The possible range for item 30 was 1 to 7. The observed range was 1 to 7 with a mean of 2.52 and a standard deviation of 1.42. The possible range for item 25 was 1 to 7. The observed range was 1 to 7 with a mean of 2.61 and a standard deviation of 1.56. Summated, the construct had a possible range of 13 to 91 with higher scores reflecting a more positive sleep hygiene status. The observed score for the construct was 28 to 84 with a mean of 51.59 and a standard deviation of 10.93.

Table 4.14

Distribution of Means and Standard Deviations for the Sleep Hygiene Scale Items and Sleep Hygiene Construct for the Sample of Undergraduate Students (n=197)

	Range			
Sleep Hygiene	Possible	Observed	*M*	*SD*
1. *Item 19.* I take daytime naps lasting two or more hours – Always : Never	1 – 7	1 – 7	5.27	1.73

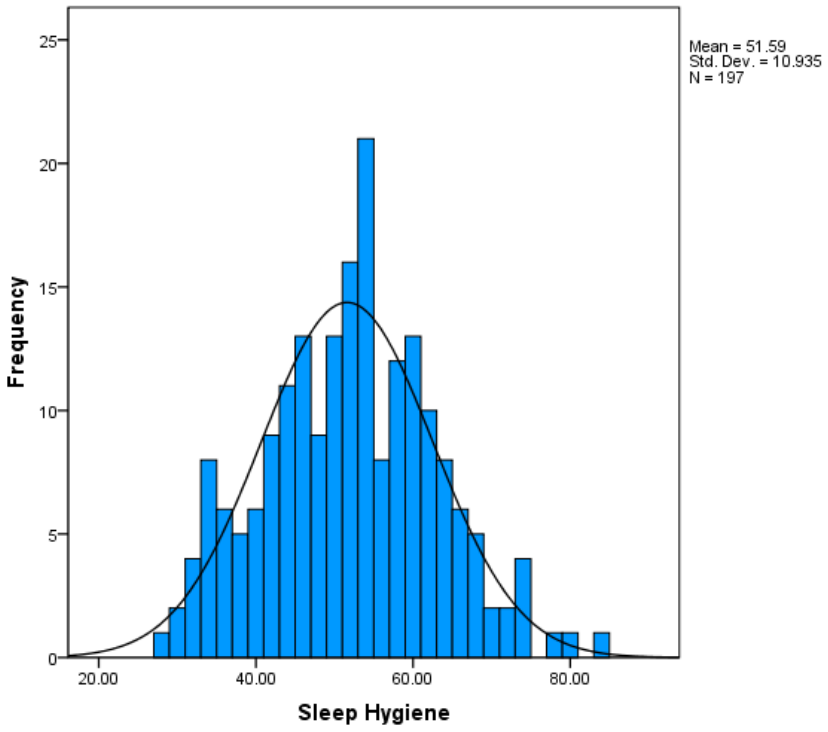
2.	*Item 20.* I go to bed at different times from day to day – Always : Never	1 – 7	1 – 7	3.01	1.71
3.	*Item 21.* I get out of bed at different times from day to day – Always : Never	1 – 7	1 – 7	3.74	1.81
4.	*Item 22.* I exercise to the point of sweating within one hour of going to bed – Always : Never	1 – 7	1 – 7	6.13	1.23
5.	*Item 23.* I stay in bed longer than I should two or three times a week – Always : Never	1 – 7	1 – 7	4.11	1.97
6.	*Item 24.* I use alcohol, tobacco, or caffeine within four hours of going to bed or after going to bed – Always : Never	1 – 7	1 – 7	4.39	1.95
7.	*Item 25.* I do something that may wake me up before bedtime (e.g., play video games, use the internet, or clean) – Always : Never	1 – 7	1 – 7	2.88	1.70
8.	*Item 26.* I go to bed feeling stressed, angry, upset, or nervous – Always : Never	1 – 7	1 – 7	3.64	1.64
9.	*Item 27.* I use my bed for things other than sleeping or sex (e.g., watch television, read, eat, or study) – Always : Never	1 – 7	1 – 7	3.39	2.10
10.	*Item 28.* I sleep on an uncomfortable bed (e.g., poor mattress or pillow, too much or not enough blankets) – Always : Never	1 – 7	1 – 7	5.14	1.87
11.	*Item 29.* I sleep in an uncomfortable bedroom (e.g., too bright, too stuffy, too hot, too cold, or too noisy) – Always : Never	1 – 7	1 – 7	4.77	1.77
12.	*Item 30.* I do important work before bedtime (e.g., pay bills, schedule, or study) – Always : Never	1 – 7	1 – 7	2.52	1.42

13. *Item 31*. I think, plan, or worry when I am in bed – Always : Never	1 – 7	1 – 7	2.61	1.56
Total Construct Score	13 – 91	28 – 84	51.59	10.93

Figure 4.12 displays a histogram with a superimposed normal curve of the sleep hygiene construct. Analysis of the histogram revealed a kurtosis value of -0.217 and a skewness value of 0.126. These values indicated a slightly flatter distribution of values with marginally more observations below the mean than above the mean. As illustrated by the histogram, the sleep hygiene construct displayed a fairly symmetrical distribution.

Figure 4.12

Histogram with Normal Distribution Curve of the Sleep Hygiene Construct for the Sample of Undergraduate Students (n=197)



Hypotheses Testing

Variable association. Pearson's *r* is an index of linear association between two continuous variables, *X* and *Y* (Kleinbaum et al., 2008). As a bivariate measure, *r* can range from -1.00 to 1.00, with 0.00 indicating a complete absence of association. Correlations are generally given qualitative labels based on the degree of association ranging from strong ($| r | \geq 0.70$), moderate ($0.30 < | r | < 0.70$), or weak ($| r | \leq 0.30$) (Field, 2009). Application of Pearson's *r* in gauging the strength of associations between quantitative variables requires that the variables are of an interval/ratio level of measurement, linearly related, and normally distributed.

All constructs were metric in nature and met the first assumption. Visual inspection of scatter plots found linear relationships between the variables (scatterplot matrix provided in the regression diagnostics section of chapter 4). The Pearson correlation coefficient is computed using standardized *z*-scores; therefore, both variables must be normally distributed to conduct significance testing. Initial data screening found behavioral intention and attitude toward the behavior to be non-normally distributed. Transformations of the constructs satisfied the assumption of normality. Prior to examining the variable correlations, the behavioral intention and attitude toward the behavior constructs were re-reflected to assist in interpretation of the findings.

The correlations between the independent variables and dependent variable were positive and ranged from weak to moderate strengths of association. Pearson product-moment correlations calculated on behavioral intention found a significant, moderate positive correlation with perceived behavioral control (r (195) = 0.517, $p < 0.001$) a significant, moderate positive correlation with subjective norm (r (195) = 0.321, $p < 0.001$), and a significant, moderate correlation with attitude toward the behavior (r (195) = 0.357, $p < 0.001$).

Pearson product-moment correlations calculated on adequate sleep behavior found a significant, moderate positive correlation with behavioral intention (r (195) = 0.434, $p < 0.001$), a non-significant weak positive correlation with gender (r (195) = 0.058, $p = 0.209$), and a non-significant weak positive correlation with sleep hygiene (r (195) = 0.078, $p = 0.136$). Table 4.15 summarizes the Pearson product-moment correlation coefficient for the independent and dependent variables.

Table 4.15

Pearson Product-Moment Correlation Coefficients for the Theoretical Constructs of Sleep Behavior, Behavioral Intention, Perceived Behavioral Control, Subjective Norm, Attitude Toward the Behavior, Sleep Hygiene, and Gender for the Sample of Undergraduate Students (n=197)

Variable	1.	2.	3.	4.	5.	6.	7.
1. SBC	–						
2. BIC‡	0.434**	–					
3. PBCC	0.570**	0.517**	–				
4. SNC	0.206**	0.312**	0.151*	–			
5. ATTC‡	0.129	0.357**	0.143*	0.294**	–		
6. GNC	0.058	0.088	0.042	0.254**	0.278**	–	
7. SHC	0.078	0.272**	0.253**	0.036	0.133	0.030	–

Note: SBC=Sleep Behavior Construct; BIC=Behavioral Intention Construct; PBCC=Perceived Behavioral Control Construct; SNC=Subjective Norm Construct; ATTC=Attitude Toward the Behavior Construct; GNC=Gender Construct; SHC=Sleep Hygiene Construct.
‡ = variable re-reflected. * $p < 0.05$. ** $p < 0.01$.

Additional analysis. A correlational matrix, displayed in Table 4.16, was produced to examine relationships between the individual TpB items and TpB theoretical constructs. Observing the matrix, the items comprising the perceived behavioral control scale had the

strongest relationship with behavioral intention. It was also noted that the items comprising behavioral intention had moderate relationships with sleep behavior.

Table 4.16

Correlational Coefficient Matrix of Theory of Planned Behavior Constructs and Items for the Sample of Undergraduate Students (n=197)

	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	SBC	–																					
2	BIC	0.434	–																				
3	PBCC	0.570	0.517	–																			
4	SNC	0.206	0.312	0.151	–																		
5	ATTC	0.053	0.215	0.068	0.200	–																	
6	BHI: 1	0.409	0.94	0.477	0.300	0.220	–																
7	BHI: 2	0.432	0.957	0.529	0.302	0.148	0.918	–															
8	BHI: 3	0.379	0.853	0.398	0.282	0.297	0.749	0.743	–														
9	PBCI: 1	0.525	0.575	0.817	0.134	0.087	0.509	0.576	0.428	–													
10	PBCI: 2	0.520	0.426	0.827	0.152	0.088	0.425	0.416	0.335	0.597	–												
11	PBCI: 3	0.486	0.408	0.872	0.152	0.002	0.379	0.433	0.318	0.604	0.573	–											
12	PBCI: 4	0.386	0.331	0.861	0.065	0.052	0.288	0.356	0.258	0.554	0.609	0.766	–										
13	SNI : 1	0.157	0.196	0.075	0.789	0.131	0.185	0.161	0.199	0.078	0.119	0.048	0.004	–									
14	SNI: 2	0.183	0.256	0.210	0.785	0.160	0.263	0.266	0.157	0.174	0.213	0.200	0.117	0.516	–								
15	SNI: 3	0.123	0.251	0.050	0.764	0.152	0.237	0.261	0.253	0.058	0.008	0.081	0.021	0.463	0.373	–							
16	SNI: 4	0.192	0.287	0.133	0.850	0.192	0.263	0.263	0.298	0.109	0.139	0.141	0.054	0.586	0.558	0.591	–						
17	ATTI: 1	0.061	0.187	0.113	0.156	0.696	0.193	0.124	0.251	0.135	0.116	0.058	0.070	0.050	0.148	0.108	.186	–					
18	ATTI: 2	0.008	0.147	0.093	0.074	0.664	0.141	0.090	0.229	0.078	0.142	0.020	0.072	0.056	0.077	0.048	0.053	0.755	–				
19	ATTI: 3	-0.040	0.074	-0.051	0.085	0.653	0.081	0.019	0.151	-0.031	-0.010	-0.089	-0.043	0.034	0.095	0.096	.035	0.662	0.722	–			
20	ATTI: 4	0.247	0.415	0.247	0.271	0.741	0.428	0.382	0.432	0.276	0.214	0.198	0.142	0.138	0.249	0.232	0.231	0.376	0.317	0.228	–		
21	ATTI: 5	0.131	0.252	0.053	0.205	0.697	0.242	0.195	0.349	0.102	0.049	0.013	0.012	0.161	0.159	0.116	0.221	0.544	0.555	0.544	0.449	–	
22	ATTI: 6	0.114	0.309	0.104	0.306	0.739	0.298	0.287	0.322	0.123	0.097	0.057	0.074	0.206	0.226	0.313	0.222	0.300	0.278	0.232	0.494	0.375	–

Note: SBC=Sleep Behavior Construct; BIC=Behavioral Intention Construct; PBCC=Perceived Behavioral Control Construct; SNC=Subjective Norm Construct; ATTC=Attitude Construct; BHI=Behavioral Intention Item; PBCI=Perceived Behavioral Control Item; SNI=Subjective Norm Item; ATTI: Attitude Item.

Multiple regression. Multiple regression analysis seeks to determine the relationship between a single dependent, or outcome, variable and a set of independent, or predictor, variables. Multiple regression extends upon the concept of r^2 through the multivariate value R^2. R^2, the coefficient of multiple determination, is the percentage of variance in the outcome variable explained uniquely or jointly by the predictor variables. Through significance testing of R^2, multiple regression analysis can confirm that a set of predictors explains a proportion of variance in a dependent variable at a statistically significant level.

Multiple regression diagnostics. Regression analysis operates under several assumptions which, when violated, can result in misleading findings and erroneous interpretations of results (Kleinbaum et al., 2008). Regression diagnostics verify that the underlying assumptions and issues of concern for regression analysis are satisfied. Regression diagnostics were performed to assure the behavioral intention construct satisfied multiple linear regression assumptions.

Assumption 1: continuous variables. For linear regression, all variables in the model must be continuous. Categorical variables, such as gender, can be converted into indicator variables. As well, categorical variables can be assessed using logistic regression. The assumption of continuity of the variables was met for all variables regressed in the TpB-based model.

Assumption 2: normality of the outcome variable residuals. Normality of the errors is necessary for the accuracy of the *t*-test. It is important to note, the *t*-test is robust against departures from normality; normality of the residuals is required for inference only (Kleinbaum et al., 2008). Normality of the outcome variable residuals was evaluated by inspection of the histogram and P-P (probability-probability) plot of the dependent variables' standardized residuals. When examining a histogram, the frequency distribution should closely align with the superimposed normal curve. In inspecting a P-P plot, the residual plot should hold tightly to the

superimposed 45º line. Standardized residuals were also evaluated by the K-S statistic testing the distribution against uniformity.

Inspection of the residual histogram and P-P plot for the outcome variable behavioral intention did not initially satisfy the assumption for normality. Although the construct's residuals did not grossly violate normality, it was decided to incorporate the behavioral intention construct with re-reflection and square root transformation into the model. Reflection assists in normalizing negatively skewed data; however, reflection reverses the original score values which can lead to misinterpretation of the coefficients. Re-reflection aids in interpretation of the coefficients by converting the transformed scores back to their original scale values. Inspection of the residual histogram and P-P plot for the transformed outcome variable behavioral intention were found to meet the assumption for normality. Visual inspection was reinforced by the K-S test which retained the null hypothesis that the standardized residuals of the behavioral intention construct were distributed normally (D (197) = 0.560, p = 0.912).

Figure 4.13 displays the normal P-P plot of the regression standardized residuals for the behavioral intention construct with reflection and square root transformation. As displayed in the figure, the residual plot held tightly to the superimposed 45º line. Figure 4.14 illustrates a histogram with a superimposed normal curve of the standardized residuals for the behavioral intention construct with reflection and square root transformation. The histogram revealed a normal distribution of the standardized residuals. Combined, figures 4.13 and 4.14 displayed satisfaction of the normality of the outcome variable residuals assumption.

Figure 4.13

Normal P-P Plot of the Regression Standardized Residuals for the Behavioral Intention Construct with Re-Reflection and Square Root Transformation for the Sample of Undergraduate Students (n=197)

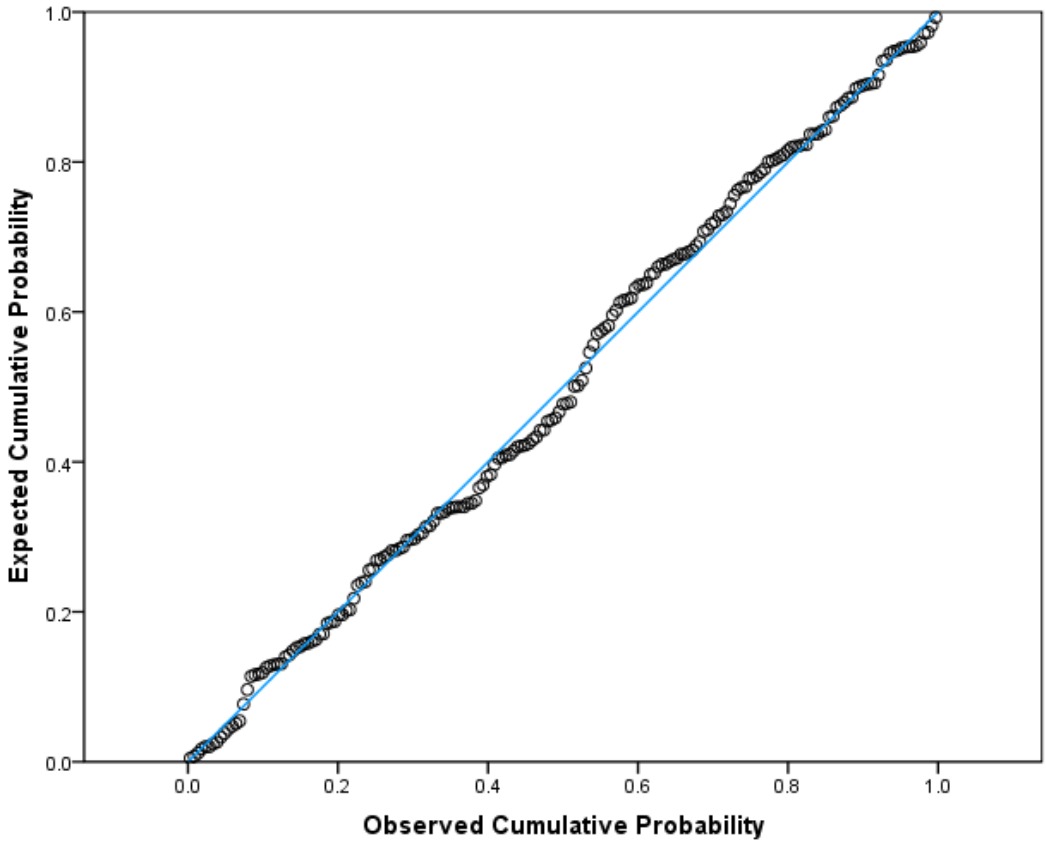
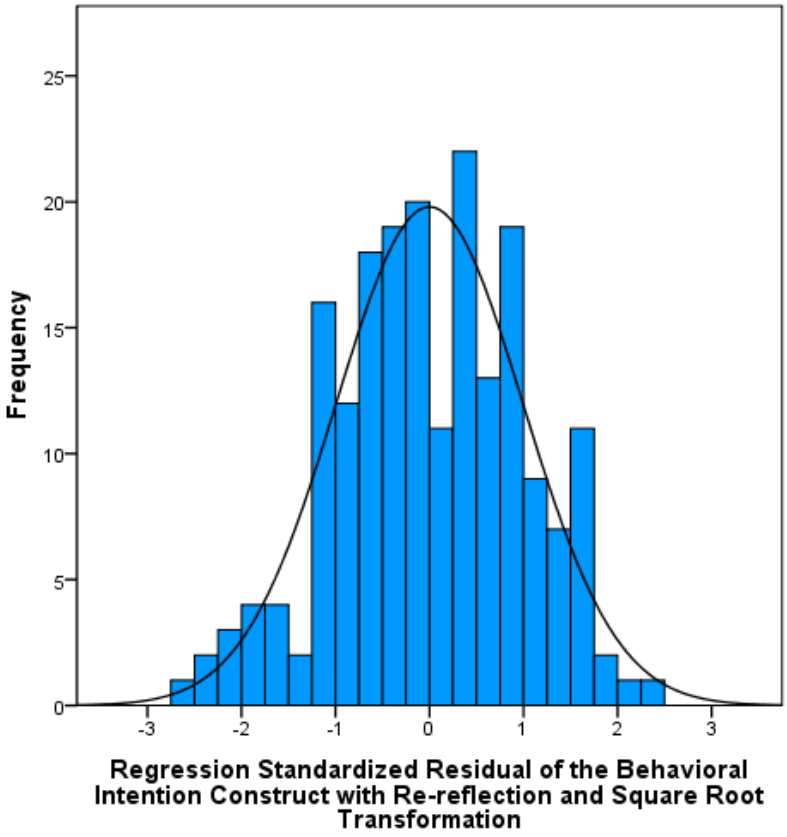


Figure 4.14

Histogram with Normal Distribution Curve of the Standardized Residuals of the Behavioral Intention Construct with Re-Reflection and Square Root Transformation for the Sample of Undergraduate Students (n=197)

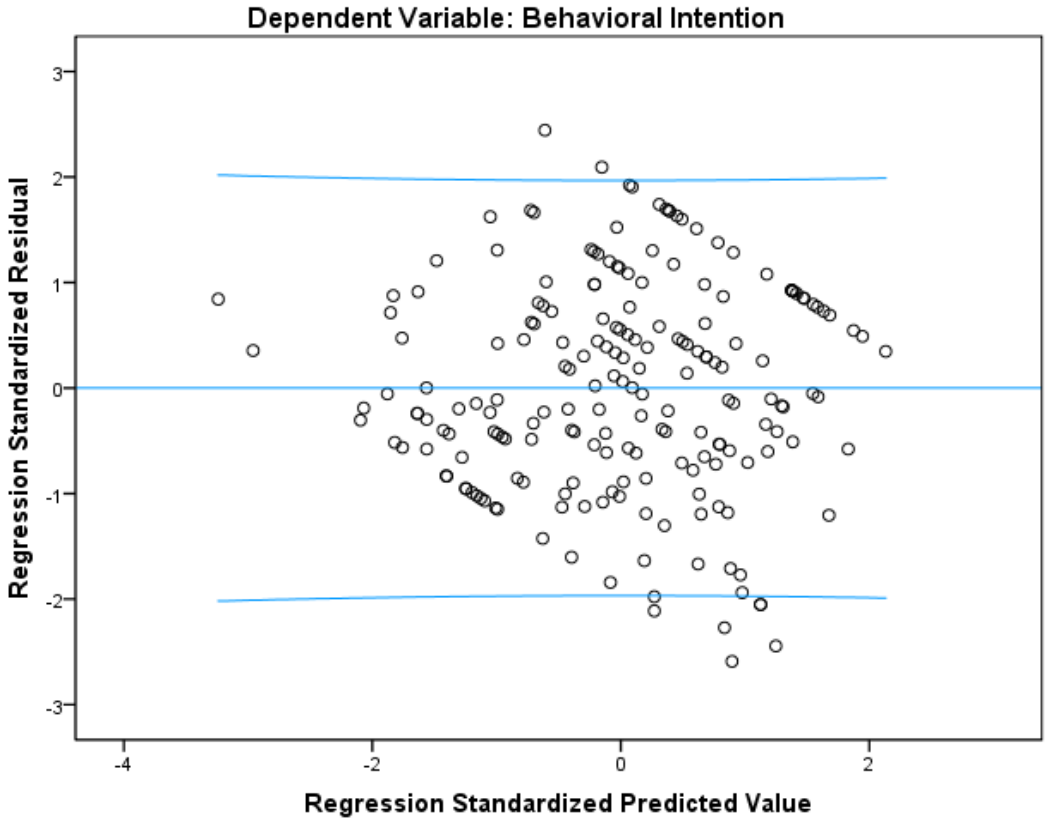


Assumption 3: homoscedasticity of the variance. Variability of the error variance should be constant. The assumption of homoscedasticity is satisfied when the dependent variable exhibits similar amounts of variance across the range of values for an independent variable. The assumption of homoscedasticity was evaluated through consideration of a scatterplot of the standardized predicted values against the standardized residuals. Figure 4.15 presents the scatter plot of the regression standardized residuals for the behavioral intention construct with re-reflection and square root transformation. Inspection of the scatter plot revealed no apparent

funnel pattern or influential outliers; therefore, the assumption of constant variance was met for the variable.

Figure 4.15

Scatter Plot of the Regression Standardized Residuals for the Behavioral Intention Construct with Re-Reflection and Square Root Transformation for the Sample of Undergraduate Students (n=197)

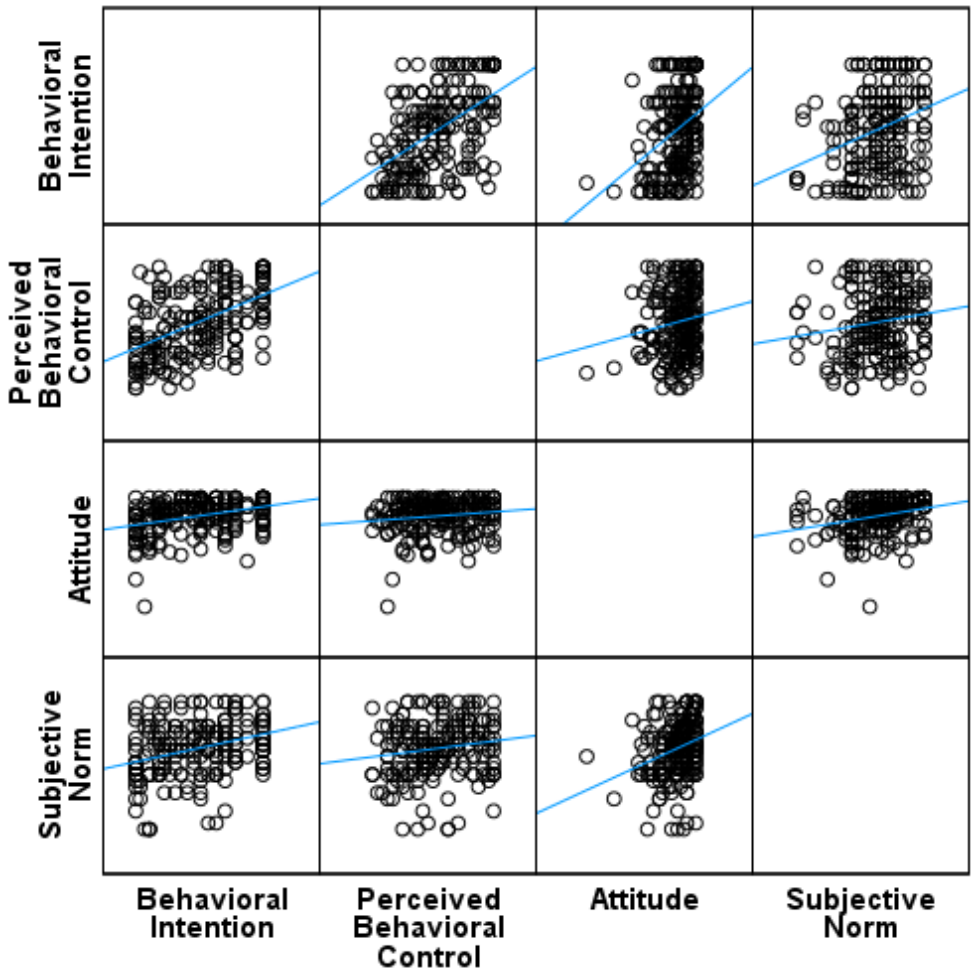


Assumption 4: linearity between the predictors and outcome variable. For regression, the independent variables must have a linear relationship with the dependent variable. Linearity was assessed by inspecting a matrix scatterplot of the variables and through application of the One-way Analysis of Variance deviation from linearity test. In applying the linearity test, if the significance value for deviation from linearity is less than 0.05, the relationship between the

variables is not linear. All predictors exhibited a linear relationship with behavioral intention: perceived behavioral control (F (23) = 0.613, p = 0.916), subjective norm (F (18) = 0.689, p = 0.819), and attitude toward the behavior (F (21) = 1.191, p = 0.264). Figure 4.16 provides a graphical illustration of the matrix scatterplot. Horizontal lines indicated non-linear relationships between the variables. Observation of the scatterplots revealed diagonal lines running through each scatterplot, confirming linearity between the variables.

Figure 4.16

Matrix Scatterplot of the Dependent Variable and Independent Variables for the Sample of Undergraduate Students (n=197)



In addition to underlying assumptions, there are issues of concern with regression analysis which must be remedied to optimize model building.

Issue 1: sample size. In general, the ratio of *n*: *q* greater than 20 is desirable; where, *n* is the sample size and *q* is the number of predictors in the model. The sample size requirement for assessing the regression model was satisfied. A power analysis provided the appropriate sample size for detecting significant effects. In keeping with the desirable ratio, a minimal sample size of 100 was required for the five predictors entered into the model. The sample size of this study (n=197) met these minimal conditions.

Issue 2: multivariate outliers. Influential outliers heavily impact the slope and intercept of the regression line. Cook's Distance (d_i) detects influential outliers in a data set. As a general guideline, d_i greater than 1.0 (or greater than 4/n, where n is equal to the number of coefficients in the model) are recommended for inspection. Values greater than 1.0 suggest an observation is extreme or has a large studentized residual. The maximum d_i found in the data set was .042, indicating an absence of influential multivariate outliers.

Issue 3: multicollinearity and singularity. Strong collinearity (values greater than 0.70) and perfect collinearity among the independent variables can affect the estimation of the regression coefficients as it becomes difficult to determine each variables unique contribution. Multicollinearity among the independent variables can be measured by the tolerance statistic and its reciprocal value, the variance inflation factor (VIF). Tolerance uncovers the proportion of variance in a single predictor that remains unexplained by the remaining predictors. Tolerance values should be close to 1 and less than 0.5. Tolerance for each of the predictors was between 0.911 and 0.966. As a rule of thumb, the VIF should be just over 1 and less than 2 (Kleinbaum

et al., 2008). In the final model the range of VIFs fell between 1.035 and 1.098, further disparaging the presence of multicollinearity among the predictors.

Issue 4: model parsimony. Model specification posits that the final model should include the fewest number of predictors required to explain the greatest contribution of variance in the outcome variable. Variable selection strategies aid in optimizing model specification. In the current study, the backward elimination procedure was employed. The backward elimination procedure begins with the full model and removes the independent variable with the highest p-value. This process continues until all the predictors in the model are significant. In selecting this strategy, the *a priori* criteria of probability of *F* to enter a predictor in the model was less than or equal to 0.05 and for removing a predictor was greater than or equal to 0.10. In gauging predictor relevance, consideration was given not only to statistical significance, but also practical significance. The tested model was theory-driven, confirming its parsimonious nature. In seeking parsimony, it was determined that predictors which contributed little to the model would be considered for removal. Practical significance was gauged by evaluating standardized coefficients of each of the statistically significant predictors.

Multiple regression analysis. A Theory of Planned Behavior based model was built to predict the sleep intentions of a sample (n=197) of undergraduate students. Regression diagnostics confirmed satisfaction of the underlying regression assumptions of normality of the outcome variable residuals, homoscedasticity of the variance, linearity between the predictors and outcome variable, absence of outliers, and absence of multicollinearity.

Multiple linear regression applying the backward elimination strategy modeled the theoretical predictors. The *a priori* criteria of probability of *F* to enter a predictor in the model was less than or equal to 0.05 and for removing a predictor was greater than or equal to 0.10.

Each of the three predictors regressed on behavioral intention were deemed significant: perceived behavioral control (β=0.457, t=7.882, $p < 0.001$), subjective norm (β=0.179, t= 3.000, $p = 0.003$), and attitude toward the behavior (β=0.231, t=3.865, $p < 0.001$). Collectively, the significant predictors produced an $R^2_{adjusted}$ value of 0.362 (F (3, 196) = 38.133, $p < 0.001$), suggesting the model accounted for 36.2% of the variance in the behavioral intention to obtain adequate sleep in the sample of participants. Described as a prediction equation using the standardized coefficients, Behavioral Intention = -1.070 + 0.457(Perceived Behavioral Control) + 0.179 (Subjective Norm) + 0.231(Attitude toward the behavior). Table 4.17 summarizes the parameter estimates for the theoretical predictors regressed on behavioral intention.

Table 4.17

Parameter Estimates for the Theoretical Constructs of Perceived Behavioral Control, Attitude Toward the Behavior, and Subjective Norm Regressed on Behavioral Intention for the Sample of Undergraduate Students (n=197)

Variable	*B*	*SE B*	β	*t*	*p*
Constant	-1.070	0.440		-2.434	0.016
Perceived Behavioral Control	0.076	0.010	0.457	7.882	0.000
Subjective Norm	0.041	0.014	0.179	3.000	0.003
Attitude Toward the Behavior	0.044	0.011	0.231	3.865	0.000

Note: $R^2_{adjusted}$ = 0.362; F (3, 196) = 38.133, $p < 0.001$.

Logistic regression. A variant of multiple regression, logistic regression is a dependence technique that predicts the odds of an occurrence for a category of interest. Logistic regression is suitable for testing hypotheses regarding relationship between a categorical outcome variable and one or more categorical or continuous predictor variables. For the purposes of this study, sleep

behavior was considered a suitable candidate for categorization into two groups: adequate and inadequate sleep. In contrast to other behaviors, acquiring 7 to 8 hours of sleep every night is required to maximize health benefits. Other behaviors, for example physical activity, are not required every day to achieve health benefits.

Logistic regression diagnostics. Logistic regression transforms the outcome variable into a logit variable and applies maximum likelihood estimation to approximate the odds of group membership. As such, logistic regression does not operate under as stringent constraints as multiple regression. However, standard general linear modeling assumptions and issues including adequate sample size, absence of multicollinearity, independence of errors, and absence of outliers do apply in logistic regression. Specific binary logistic assumptions include a binary outcome variable and linearity in the logit. The absence of independence of errors and outliers were confirmed during data screening and theoretical constructs analyses.

Assumption 1: sample size. Discrepancies exist regarding adequate sample size for logistical regression. Long (1997) has devised a formula where p is the smallest of the proportions of positive or negative cases in the population and k the number of covariates in the full model. Given this scenario, N = 10 k / p. In the current study it was found that 48 participants received adequate sleep; therefore, the proportion of adequate sleep cases is 0.24 with three covariates–behavioral intention, sleep hygiene, and gender–resulting in a minimal sample size of 125. The sample size of this study (n=197) met these minimal conditions.

Assumption 2: multicollinearity. Logistic regression assumes an absence of multicollinearity among the predictors. Absence of multicollinearity was verified subjectively through inspection of a correlational matrix and objectively by assessing VIF and tolerance values. Tolerance for each of the predictors was between 0.939 and 0.990. VIF for each of the

predictors fell between 1.010 and 1.065. Combined, VIF and tolerance values indicated a lack of multicollinearity among the predictors. Table 4.18 presents the correlational matrix of the predictor variables entered into the full model. As displayed in Table 4.18, correlations between variables were less than 0.70, indicating a lack of multicollinearity.

Table 4.18

Correlational Coefficients for the Theoretical Constructs of Behavioral Intention, Sleep Hygiene, and Gender for the Sample of Undergraduate Students (n=197)

Construct	1.	2.	3.
1. Behavioral Intention	1		
2. Sleep Hygiene	.229	1	
3. Gender	.100	.030	1

Assumption 3: binary outcome variable. In modeling categorical variables in logistic regression, variables are often dichotomized into to 1's and 0's. Primarily, this coding pattern is preferred as 0 and 1 hold close to the y=0 and y=1 points on the y-axis. Furthermore, the logistic function is bounded by 0 and 1. Sleep behavior was transformed into a binary outcome variable where 0 was equal to inadequate sleep and 1 was equal to adequate sleep. For the purposes of this study, adequate sleep behavior was defined as undergraduate students (target) achieving 420 – 480 minutes [7 to 8 hours] (time) of sleep (action) every night (context). Expressed as an inequality, adequate sleep behavior was defined as $420 \leq x \leq 480$; where x represents adequate sleep behavior in minutes. Conversely, inadequate sleep behavior was defined as $420 > y > 480$; where y is equal to inadequate sleep behavior in minutes.

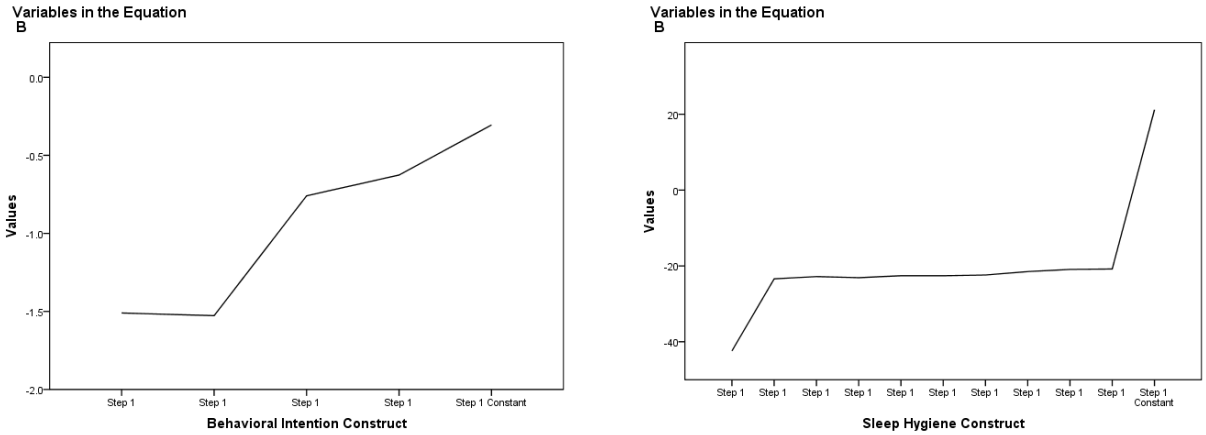
Assumption 4: linearity in the logit. Logistic regression assumes a linear relationship between the continuous predictors and the logit of the outcome variable. To test the assumption

of linearity in the logit, significance tests and logit step tests were performed. Linearity of the logit significance tests were employed by transforming each of the continuous predictors into their natural logarithms. To test the assumption, the continuous predictors and their natural logs were entered into the logistic regression routine as interaction terms (behavioral intention x ln(behavioral intention)) and (sleep hygiene x ln(sleep hygiene)). Behavioral intention ($p >$ 0.421) and sleep hygiene ($p > 0.083$) had significance values greater than 0.05, indicating the assumption of linearity of the logit was satisfied.

The step test routine involved transforming the continuous variables behavioral intention and sleep hygiene into categorical variables and entering the variables as predictors in the logistic regression syntax. A line graph of the beta coefficients was populated to visually inspect linearity. When graphed, an ordinal covariate consistent with linearity in the logit will increase or decrease in a roughly linear fashion without reversals in the direction of the line (Garson, 2011). Figure 4.17 illustrates the logit graphs confirming the assumption of linearity in the logit. The step test line graphs reveal increases with each step without reversals in the direction of the line, satisfying the assumption of linearity in the logit.

Figure 4.17

Logit Step Tests for the Behavioral Intention and Sleep Hygiene Predictor Variables in the Sample of Undergraduate Students (n=197)



Logistic regression analysis. Logistic regression analysis was performed to predict the likelihood of a sample of undergraduate students (n=197) achieving adequate sleep behavior. Adequate sleep behavior was defined as participants' achieving 420 to 480 minutes (equivalent to 7 to 8 hours) of sleep at night time acquired in the past 24 hours. Total minutes outside of this range were operationally defined as inadequate sleep behavior. Total minutes of sleep was converted into a binary variable (inadequate sleep=0; adequate sleep=1) for modeling purposes. The nominal variable gender was converted into an indicator variable for consideration in the logistic model where 0 was equal to female and 1 was equal to male.

Logistic regression applying the direct entry method modeled the theoretical predictors of behavioral intention, sleep hygiene, and gender on adequate sleep behavior. The Wald Chi-square test assessed the significance of behavioral intention, gender, and sleep hygiene as predictors of sleep behavior. The *a priori* criteria of probability of χ^2 to retain a predictor in the model was less than or equal to 0.05. The assumptions of absence of multicollinearity, absence

of outliers, appropriate sample size, and linearity in the logit were satisfied. The Omnibus test of model coefficients, Hosmer and Lemeshow test, classification ratio, likelihood ratio statistic, and Nagelkerke's R^2 were considered in assessing model fit.

Model 1. A test of the full model with all three predictors against a constant-only model was statistically significant, (χ^2 (2) = 21.649, $p < 0.001$) indicating that the predictors, as a set, reliability distinguished between inadequate (n=149) and adequate (n=48) sleep in the sample. The Hosmer and Lemeshow test confirmed goodness of fit for the model (χ^2 (*df*=8, n=197) = 11.465, $p < 0.177$). Classification was satisfactory with the model correctly predicting 97.3% of the sample obtaining inadequate sleep and 22.9% of the sample obtaining adequate sleep predicted correctly, for an overall success rate of 79.2%. The model produced a likelihood ratio statistic of 197.22. The model identified behavioral intention (*B*=0.071, Wald χ^2 (1) = 4.481, p = 0.028) and sleep hygiene (*B*=0.056, Wald χ^2 (1) = 10.001, p = 0.001) as significant predictors. Gender was found to be a non-significant predictor of adequate sleep behavior (*B*= 0.475, Wald χ^2 (1) = 1.670, p = 0.196). Subsequently, the gender variable was removed and the model re-specified.

Model 2. The re-specified model with behavioral intention and sleep hygiene was statistically significant, (χ^2 (2) = 19.992, $p < 0.001$) indicating that the predictors, as a set, reliability distinguished between inadequate (n=149) and adequate (n=48) sleep in the sample. The Hosmer and Lemeshow test confirmed goodness of fit for the model (χ^2 (*df*=8, n=197) = 14.783, $p < 0.064$). Classification was satisfactory with the model correctly predicting 97.3% of the sample obtaining inadequate sleep and 14.6% of the sample obtaining adequate sleep predicted correctly, for an overall success rate of 77.2%. The model produced a likelihood ratio statistic of 198.78. The final model identified behavioral intention (*B*=0.067, Wald χ^2 (1) =

4.440, p = 0.036) and sleep hygiene (B=0.055, Wald χ^2 (1) = 10.006, p = 0.002) as significant predictors.

Behavioral intention. The TpB based predictor, behavioral intention, was found to be a significant predictor of adequate sleep behavior (OR=1.070, 95% CI= [1.004, 1.136]). Results found that for each one unit increase in behavioral intention the odds of obtaining adequate sleep increased by (1.070–1= 0.070) 7.0% when holding all other independent variables constant. More specifically, for every one unit increase in behavioral intention to obtain adequate sleep the logit of adequate sleep behavior increased by 0.067 and the odds ratio increased by a factor of 1.070.

Sleep hygiene. Extending beyond the TpB, Sleep hygiene also emerged as a significant predictor of adequate sleep behavior (OR=1.057, 95% CI= [1.021, 1.093]). Regarding sleep hygiene, for each one unit increase in sleep hygiene the odds of obtaining adequate sleep behavior increased by (1.057–1=0.057) 5.7% when holding all other independent variables constant. Specifically, for each one unit increase in sleep hygiene status, the logit of adequate sleep behavior increased by 0.055 and the odds ratio increased by a factor of 1.057. Collectively, the significant predictors produced a Nagelkerke's R^2 effect size of 0.144. Described as a prediction equation, the odds ratio of Adequate Sleep Behavior = 0.007 + 1.070(Behavioral Intention) + 1.057(Sleep Hygiene). Table 4.19 summarizes the fit statistics and parameter estimates for Models 1 and 2 for the theoretical predictors regressed on sleep behavior.

Table 4.19

Fit Statistics and Parameter Estimates for Models 1 and 2 for the Theoretical Predictors of Behavioral Intention, Sleep Hygiene, and Gender Regressed on Sleep Behavior for the Sample of Undergraduate Students (n=197)

Predictor	Omnibus Model	-2 L-L	H-L Test	%	N-R^2	*B*	*SE*	Wald Statistic	*OR*	95% CI
Model 1	21.649***	197.22	11.465‡	79.2	0.155					
Constant						-5.287	1.035	26.083***	0.005	
Behavioral Intention						0.071	0.032	4.481*	1.074	[1.008, 1.144]
Sleep Hygiene						0.056	0.018	10.100**	1.057	[1.022, 1.094]
Gender						0.475	0.368	1.670‡	1.608	[0.782, 3.306]
Model 2	10.907***	198.779	14.783‡	77.2	0.144					
Constant						-5.033	1.006	25.054***	0.007	
Behavioral Intention						0.067	0.032	4.400*	1.070	[1.004, 1.139]
Sleep Hygiene						0.055	0.017	10.006**	1.057	[1.021, 1.093]

Note. * $p < 0.05$; ** $p < 0.01$; ***$p < 0.001$; ‡ = $p > 0.05$; Omnibus Model = Omnibus Test of Model Coefficients; -2 L-L = -2 Log Likelihood; H-L = Hosmer and Lemeshow Test; % = Classification table overall percentage; N-R^2 = Nagelkerke's R^2 ; CI = Confidence interval for odds ratio (*OR*).

Additional analyses. A series of independent *t*-tests were calculated to evaluate differences in mean scores and effect sizes of behavioral intention, perceived behavioral control, subjective norm, attitude toward the behavior, and sleep hygiene based on inadequate and adequate sleep behavior group membership. Cohen's *d* was calculated to gauge effect size of the differences between groups. In interpreting Cohen's *d*, Cohen's (1988) criteria of: 0.20 = small, 0.50 = moderate, and 0.80 = large effect sizes were considered. Wolf's (1986) criterion of 0.50 concerning practical/clinical significance was also referenced.

Scores of behavioral intention differed significantly between the inadequate and adequate sleep behavior groups (t (195) = -2.978, p = 0.003; Cohen's d = 0.50). Those who obtained adequate sleep reported higher behavioral intention (M=15.65, SD=5.63) than those who did not (M=12.79, SD=5.82). The effect size for behavioral intention between the two groups was moderate (Cohen, 1988) and practically significant (Wolf, 1986).

Scores of perceived behavioral control also differed significantly between the inadequate and adequate sleep behavior groups (t (195) = -5.016, $p < 0.001$; Cohen's d = 0.81). Those who obtained adequate sleep reported higher perceived behavioral control (M=20.98, SD=6.39) than those who did not (M=15.83, SD=6.39). The effect size for perceived behavioral control between the two groups was large (Cohen, 1988) and practically significant (Wolf, 1986).

Finally, scores of sleep hygiene differed significantly between the inadequate and adequate sleep behavior groups (t (195) = -3.991, $p < 0.001$; Cohen's d = 0.63). Those who obtained adequate sleep reported higher sleep hygiene (M=56.88 SD=12.17) than those who did not (M=49.89, SD=9.97). The effect size for sleep hygiene between the two groups was moderate (Cohen, 1988) and practically significant (Wolf, 1986).

Independent *t*-tests calculated for subjective norm found no significant differences based on sleep behavior (*t* (195) = -1.850, *p* = 0.066; Cohen's *d* = 0.31). Those who obtained adequate sleep did not report significantly higher subjective norm (*M*=21.44, *SD*=4.39) than those who reported inadequate sleep (*M*=20.00, *SD*=4.77). Similarly, independent *t*-tests calculated for attitude toward the behavior found no significant differences based on sleep behavior (*t* (195) = -0.408, *p* = 0.107; Cohen's *d* = 0.07). Those who obtained adequate sleep did not report significantly higher attitude toward the behavior (*M*=25.73, *SD*=3.31) than those who reported inadequate sleep (*M*=25.75, *SD*=3.84). Table 4.20 summarizes the means, standard deviations, *t*-test statics, and Cohen's *d* values for each of the five predictor variables. Behavioral intention, perceived behavioral control, and sleep hygiene reported scores were higher for those who obtained adequate sleep compared to those who obtained inadequate sleep. Differences between adequate sleep and inadequate sleep groups were both statistically and practically significant.

Table 4.20

Summary of Means, Standard Deviations, T-test Statistics, and Cohen's d Values for Behavioral Intention, Perceived Behavioral Control, Sleep Hygiene, Subjective Norm, and Attitude Toward the Behavior in the Sample of Undergraduate Students (n = 197)

	Adequate Sleep		Inadequate Sleep			
Predictor	*M*	*SD*	*M*	SD	*t*	Cohen's *d*
Behavioral Intention	15.65	5.63	12.79	5.82	-2.978*	0.50
Perceived Behavioral Control	20.98	6.39	15.83	6.39	-5.016**	0.81
Sleep Hygiene	56.88	12.17	49.89	9.97	-6.98**	0.63
Subjective Norm	21.44	4.39	20.00	4.77	-1.850	0.31
Attitude Toward the Behavior	25.73	3.31	25.75	3.84	0.036	0.01

Note. * $p < 0.01$; ** $p < 0.001$

Summary

Chapter four detailed the outcomes of this investigation. Descriptive statistics described the characteristics of the sample. Factor analysis confirmed construct validity. Correlation coefficients established the stability and internal consistency of the instrument. Theoretical constructs analyses detailed the descriptive statistics of the dependent and independent variables tested in this study. Bivariate correlations identified relationships among the variables. Multiple linear regression and binary logistic regression modeled the TpB predictors of behavioral intention and sleep behavior. The findings of this research provided a valid and reliable instrument for application in the development and measurement of interventions designed to promote healthy sleep among undergraduate student populations.

Chapter Five

Conclusions and Discussion

Sleeping 7 to 8 hours on a daily basis is a critical component of optimal health (Belloc & Breslow, 1972). Despite this, a growing body of evidence suggests voluntary sleep restriction is on the rise in society; both in the general public and in college populations (Lund, Reider, Whiting, & Prichard, 2010; Zee & Turek, 2006). The purpose of this study was to operationalize the constructs of the Theory of Planned Behavior (TpB) (Ajzen, 1991) to predict the sleep intentions and behaviors of undergraduate college students attending a Midwestern University. In addition to the standard TpB constructs, this study also assessed gender and sleep hygiene as supplemental predictor variables of adequate sleep behavior. While a number of studies have examined the sleep behaviors of the general population, college populations have received minimal attention (Buboltz, Brown, & Soper, 2001). The present study represented the first attempt to investigate the sleep behaviors of college students applying the TpB. As well, it was one of the first to employ the Sleep Hygiene Index (SHI) (Mastin et al., 2006). The findings of this study specified a theory-based model for predicting the sleep intentions and behaviors of undergraduate college students. Findings from the SHI aided in identifying sleep-related factors amendable to modification in the study population. Ultimately, the results of this investigation provided a valid and reliable instrument for application in the development and measurement of interventions designed to promote healthy sleep behaviors among undergraduate college student populations.

In this chapter, the hypotheses set forth in this investigation are evaluated. In light of the tested hypotheses, conclusions were drawn and practical implications presented for intervention

measurement and design. Finally, implications for health education and promotion, recommendations for future research, and limitations of the current study are expounded.

Hypotheses Testing Results

Upon examining the statement of the problem a series of research questions emerged. The proposed research questions generated a series of four hypotheses sets for investigating the sleep intentions and behaviors of undergraduate college students. Behavioral intention was operationalized as a continuous variable. The independent variables associated with behavioral intention included perceived behavioral control, subjective norm, and attitude toward the behavior. Sleep behavior was operationalized as a dichotomous variable. The independent variables associated with sleep behavior included behavioral intention, gender, and sleep hygiene. The rationale for the selection of variables was based on the theoretical framework of the TpB as well as factors purported to impact sleep intentions and behaviors identified in the literature. Combined, a total of 8 hypotheses were investigated in this study. Significance levels for rejecting null hypotheses were set *a priori* at $p < 0.05$.

Hypotheses set 1: Tests for relationships among predictor variables on behavioral intention. The first research question asked: *To what extent are the TpB constructs of perceived behavioral, subjective norm, and attitude toward the behavior associated with behavioral intention to obtain adequate sleep in undergraduate students?* Three hypotheses were derived to address this research question:

H_0 1: Perceived behavioral control (PBC) will not have a significant relationship with behavioral intention to obtain adequate sleep (BI) in undergraduate students (H_0: $r_{PBC|BI} = 0$).

A Pearson product-moment correlation coefficient was calculated for the strength of association between perceived behavioral control and behavioral intention. A significant,

moderate positive correlation with behavioral intention was found (r (195) = 0.517, $p < 0.001$). Based on this result, the null hypothesis which stated that there would be no significant relationship between perceived behavioral control and behavioral intention was rejected.

H_0 2: Subjective norm (SN) will not have a significant relationship with behavioral intention to obtain adequate sleep (BI) in undergraduate students (H_0: $r_{SN|\,BI} = 0$).

A Pearson product-moment correlation coefficient was calculated for the strength of association between subjective norm and behavioral intention. A significant, moderate positive correlation with behavioral intention was found (r (195) = 0.321, $p < 0.001$). Based on this result, the null hypothesis which stated that there would be no significant relationship between subjective norm and behavioral intention was rejected.

H_0 3: Attitude Toward the Behavior (ATT) will not have a significant relationship with behavioral intention to obtain adequate sleep (BI) in undergraduate students (H_0: $r_{ATT|\,BI} = 0$).

A Pearson product-moment correlation coefficient was calculated for the strength of association between attitude toward the behavior and behavioral intention. A significant, moderate positive correlation with behavioral intention was found (r (195) = 0.357, $p < 0.001$). Based on this result, the null hypothesis which stated that there would be no significant relationship between attitude toward the behavior and behavioral intention was rejected.

Hypotheses set 2: Tests for relationships among predictor variables on sleep behavior. The second and third research questions asked: *To what extent is the TpB construct of behavioral intention associated with sleep behavior in undergraduate students?* and *To what extent are the constructs of sleep hygiene and gender related to sleep behavior in undergraduate students?* Based on these questions, three hypotheses were developed.

H_0 4: Behavioral intention (BI) will not have a significant relationship with sleep behavior (SB) in undergraduate students (H_0: $r_{BI|SB} = 0$).

A Pearson product-moment correlation coefficient was calculated for the strength of association between behavioral intention and sleep behavior. A significant, moderate positive correlation with sleep behavior was found (r (195) = 0.434, $p < 0.001$). Based on this result, the null hypothesis which stated that there would be no significant relationship between behavioral intention and sleep behavior was rejected.

H_0 5: Gender (GN) will not have a significant relationship with sleep behavior (SB) in undergraduate students (H_0: $r_{GN|SB} = 0$).

A Pearson product-moment correlation coefficient was calculated for the strength of association between gender and sleep behavior. A non-significant, weak positive correlation with sleep behavior was found (r (195) = 0.058, $p = 0.209$). Based on this result, the null hypothesis which stated that there would be no significant relationship between gender and sleep behavior was not rejected.

H_0 6: Sleep hygiene (SH) will not have a significant relationship with sleep behavior (SB) in undergraduate students (H_0: $r_{SH|SB} = 0$).

A Pearson product-moment correlation coefficient was calculated for the strength of association between sleep hygiene and sleep behavior. A non-significant, weak positive correlation with sleep behavior was found (r (195) = 0.078, $p = 0.136$). Based on this result, the null hypothesis which stated that there would be no significant relationship between sleep hygiene and sleep behavior was not rejected.

Hypotheses set 3: Test for significance of TpB predictor variables on behavioral intention. The fourth research question asked: *To what extent do the constructs of perceived*

behavioral, subjective norm, and attitude toward the behavior predict behavioral intention to obtain adequate sleep behavior in undergraduate students? In accordance with the framework of the TpB, the third set of hypotheses tested the significance of perceived behavioral control, subjective norm, and attitude toward the behavior in the prediction of behavioral intention to obtain adequate sleep.

H_0 7: Perceived behavioral control (β_1), subjective norm (β_2), and attitude toward the behavior (β_3), considered together do not significantly predict behavioral intention to obtain adequate sleep in undergraduate students (Y) (H_0: $\beta_1 = \beta_2 = \beta_3 = 0$).

Multiple linear regression modeled the predictors of perceived behavioral control (β_1), subjective norm (β_2), and attitude toward the behavior (β_3) on behavioral intention. Collectively, the significant predictors produced an R^2_{adjusted} value of 0.362 (F (3, 196) = 38.133, $p < 0.001$). Based on this finding, the null hypothesis which stated perceived behavioral control (β_1), subjective norm (β_2), and attitude toward the behavior (β_3), considered together do not explain a significant amount of the variation in behavioral intention to obtain adequate sleep in undergraduate students was rejected.

Hypotheses set 4: Tests for significance of predictors on sleep behavior. Research question five asked: *To what extent do behavioral intention, sleep hygiene, and gender predict sleep behavior in undergraduate students?* Hypothesis set four tested the significance of behavioral intention, sleep hygiene, and gender to predict the likelihood of achieving adequate sleep behavior. Several studies have reported that college women experience more sleep disturbances than college men. Tsai and Li (2004b) observed that women had longer sleep onset latency, more nighttime awakenings, and overall poorer sleep quality than men. Sleep researchers have noted the importance of sleep hygiene in achieving quality sleep (Hicks et al.,

1999; Mastin et al., 2006). Subsequently, the variables gender and sleep hygiene were examined as potential supplementary predictors of sleep behavior.

H_0 8: Behavioral intention (β_1), sleep hygiene (β_2), and gender (β_3) considered together do not significantly predict sleep behavior in undergraduate students (Y) (H_0: $\beta_1 = \beta_2 = \beta_3 = 0$).

Binary logistic regression was employed to model the predictors of behavioral intention, sleep hygiene, and gender on sleep behavior. A test of the full model with all three predictors against a constant-only model was statistically significant, (χ^2 (2) = 21.649, $p < 0.001$) indicating that the predictors, as a set, reliability distinguished between inadequate (n=149) and adequate (n=48) sleep in the sample. A final model including the significant predictors of behavioral intention and sleep hygiene was also significant (χ^2 (2) = 19.992, $p < 0.001$). Based on this finding, the null hypothesis which stated behavioral intention (β_1), sleep hygiene (β_2), and gender (β_3) considered together do not significantly predict sleep behavior in undergraduate students was rejected. Table 5.1 presents a table of the null hypotheses and the results of significance testing investigated in this study.

Table 5.1

Table of Tested Null Hypotheses in the Sample of Undergraduate Students (n=197)

Set	H_0 No.	DV	IV	Test Employed	H_0*	H_0* Rejected/ Not Rejected
1	1	BI	PBC	Correlation Coefficient (r)	H_0: $r_{PBC \mid BI} = 0$	Rejected
	2	BI	SN	Correlation Coefficient (r)	H_0: $r_{SN \mid BI} = 0$	Rejected
	3	BI	ATT	Correlation Coefficient (r)	H_0: $r_{ATT \mid BI} = 0$	Rejected

2	4	SB	BI	Correlation Coefficient (*r*)	H_0: $r_{BI \mid SB} = 0$	Rejected
	5	SB	GN	Correlation Coefficient (*r*)	H_0: $r_{GN \mid SB} = 0$	Not Rejected
	6	SB	SH	Correlation Coefficient (*r*)	H_0: $r_{SH \mid SB} = 0$	Not Rejected
3	7	BI	PBC, ATT, SN	Significance (*F* test)	H_0: $\beta_1 = \beta_2 = \beta_3 = 0$	Rejected
4	8	SB	BI, SH, GN	Significance (χ^2)	H_0: $\beta_1 = \beta_2 = \beta_3 = 0$	Rejected

Note. DV=Dependent variable; IV=Independent variable; BI=Behavioral intention; SB= Sleep Behavior; PBC=Perceived behavioral control; ATT=Attitude Toward the Behavior; SN=Subjective norm; GN=Gender; SH=Sleep hygiene. * Significance levels for all hypotheses set *a priori* at $p < 0.05$.

Conclusions

Instrument reliability and validity. The purpose of this study was to operationalize the TpB to predict the sleep intentions and behaviors of undergraduate students attending a Midwestern University. A methodological instrumentation process led to the development of a reliable and valid instrument for accomplishing this objective. Instrumentation included several procedures spanning three phases of data collection. During phase 1, qualitative data was collected from a sample of undergraduate students (n=11). Data from the elicitation study assisted with item generation. A draft instrument was developed based on the qualitative analysis and subjected to the Flesch Reading Ease test (score = 77.6) and Flesch-Kincaid Grade Level Test (score = 5.7) to assess readability. Next, a panel of six experts confirmed face, content, and readability of the instrument over a two round process. Upon incorporating

feedback from the panel, the revised instrument was evaluated for stability through the application of test-retest reliability.

Phase II data collection included having the same group of participants (n=37) complete the instrument twice at two week intervals. Acceptable stability coefficient values were set *a priori* at 0.70. Reliability coefficients calculated for the instrument's constructs ranged from 0.803 to 0.905 satisfying the *a priori* criterion. During phase III data collection, an invitation was delivered to a sampling frame of 22,436 potential participants to assess the efficacy of the instrument. For phase III, a power analysis was conducted to determine sufficient sample size ($\alpha = 0.05$, $\beta = 0.80$, $\rho = 0.20$). Adhering to the power analysis criteria, a quota sample of 197 participants was sought and obtained.

Instrument refinement during phase III included Cronbach's alpha for internal consistency and confirmatory factor analysis (CFA) for construct validity. Acceptable Cronbach's alpha coefficient values were set *a priori* at 0.70. Each of the theoretical constructs exceeded the acceptable *a priori* condition verifying consistency of instrument items. Significance of factor loadings for CFA was considered in light of Steven's (1996) recommendation of ±0.36 for a sample size of 200. Applying this benchmark resulted in one factor solutions for each of the TpB constructs.

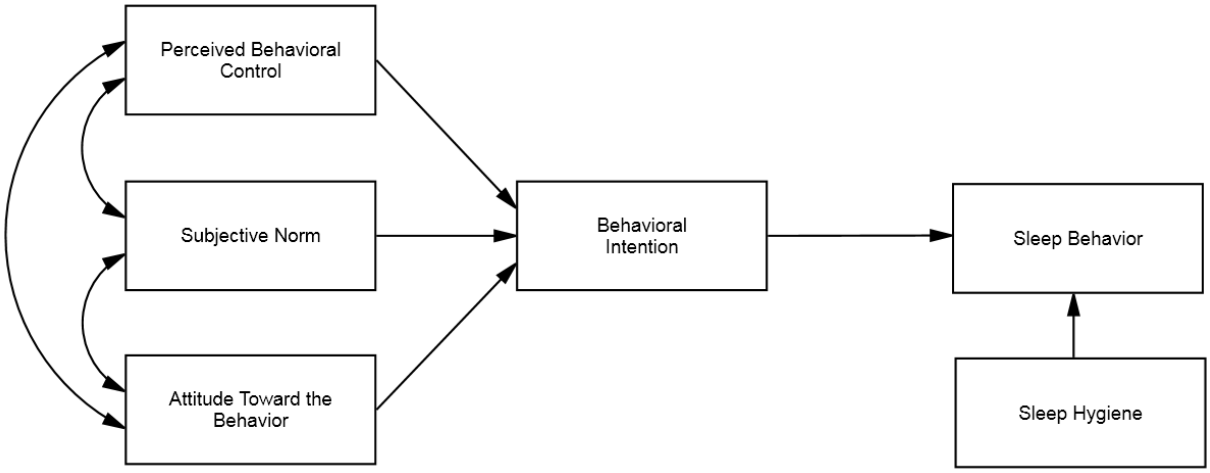
Model specification. Predictive validity of the instrument was tested through multiple linear regression and binary logistic regression. Multiple linear regression modeled the predictors of perceived behavioral control (β=0.457, t=7.882, $p < 0.001$), subjective norm (β=0.179, t= 3.000, $p = 0.003$), and attitude toward the behavior (β=0.231, t=3.865, $p < 0.001$) on behavioral intention. Behavioral intention was reflected and transformed to improve normality of the outcome variable residuals. Behavioral intention was re-reflected prior to

entering the variable into the model to assist with interpretation of the beta coefficients. Combined, the significant predictors produced an $R^2_{adjusted}$ value of 0.362 (F (3, 196) = 38.133, p < 0.001), suggesting the model accounted for 36.2% of the variance in the behavioral intention to obtain adequate sleep in the sample of participants.

Binary logistic regression was employed to model adequate sleep behavior. Behavioral intention (B=0.067, Wald χ^2 (1) = 4.440, p = 0.036) and sleep hygiene (B=0.055, Wald χ^2 (1) = 10.006, p = 0.002) were found to be significant predictors of adequate sleep behavior; conversely, gender was not significant in the prediction of sleep behavior (B=0.475, Wald χ^2 (1) = 1.670, p = 0.196). Analysis revealed that for each one unit increase in behavioral intention the odds of obtaining adequate sleep increased by 7.0%. Similarly, for each one unit increase in sleep hygiene the odds of obtaining adequate sleep behavior increased by 5.7%. The results of this investigation provided a valid and reliable instrument for application in the measurement of TpB based interventions targeting undergraduate sleep health. Figure 5.1 illustrates the final theoretical model for predicting the sleep intentions and behaviors of undergraduate students.

Figure 5.1

Final Theoretical Model for Predicting the Sleep Intentions and Behaviors for Undergraduate College Students



Discussion

Variable assessment. The findings of this study agree with the literature that, as a population, undergraduate college students receive insufficient sleep (Hicks et al., 2001b; Lund et al., 2010). In this investigation, sleep behavior was operationally defined as participants' self-reported total minutes of sleep at night time acquired in the past 24 hours. The mean minutes of total sleep at night time of the sample was 407.3 (*SD*=100.75). Only 48 (24.37%) of the participants achieved adequate sleep behavior, defined as acquiring between 7 to 8 hours of sleep at night time. Among the pool of participants, 108 (54.80%) received insufficient sleep and 41 (20.81%) obtained excessive sleep.

According to the TpB, behavioral intention is the immediate antecedent of behavior. Logistic regression analysis found that for each one unit increase in behavioral intention (score range 3-21) the odds of obtaining adequate sleep increased by 7.4%. A *t*-test evaluating the difference between inadequate and adequate sleep behavior group membership showed that those

who obtained adequate sleep reported higher behavioral intention (*M*=15.65, *SD*=5.63) than those who did not (*M*=12.79, *SD*=5.82) (*t*(195) = -2.978, *p* = 0.003; Cohen's *d* = 0.50). The effect size for behavioral intention between the two groups was moderate (Cohen, 1988) and practically significant (Wolf, 1986). These findings suggest that increasing the sleep intentions of undergraduate students can improve sleep behavior.

In its role as an outcome variable, behavioral intention was comprised of three predictors: perceived behavioral control, subjective norm, and attitude toward the behavior. Combined, the predictors accounted for 36.2% of the variance in the behavioral intention to obtain adequate sleep in the sample of participants. Among the predictors, perceived behavioral control was the strongest (β=0.457, *t*=-7.882, *p* < 0.001), followed by attitude toward the behavior (β=0.231, *t*=3.865, *p* < 0.001) and finally subjective norm (β=0.179, *t*= 3.000, *p* = 0.003).

The variables gender and sleep hygiene were examined as potential supplementary predictors of sleep behavior. While sleep hygiene (*B*=0.055, Wald χ^2 (1) = 10.006, *p* = 0.002) was found to be a significant predictor of behavior, gender was not (*B*=0.475, Wald χ^2 (1) = 1.670, *p* = 0.196). A *t*-test evaluating the difference between inadequate and adequate sleep behavior group membership found scores of sleep hygiene differed significantly between the inadequate and adequate sleep behavior groups (*t*(195) = -3.991, p < 0.001; Cohen's *d* = 0.63). Those who obtained adequate sleep reported higher sleep hygiene (*M*=56.88 *SD*=12.17) than those who did not (*M*=49.89, *SD*=9.97). The effect size for sleep hygiene between the two groups was moderate (Cohen, 1988) and practically significant (Wolf, 1986).

Implications for Health Promotion and Education

The results of this investigation suggest that practitioners should focus intervention efforts on increasing behavioral intentional to obtain adequate sleep primarily through the

channel of perceived behavioral control. As a predictor of behavioral intention, perceived behavioral control considers volitional and non-volitional factors that enable the enactment of a behavior. To maximize modification of this construct, both behavioral and environmental determinants should be addressed. From a behavioral perspective, time management, stress management, and financial management education delivered within the context of sleep health can assist in increasing perceived behavioral control.

Many students underestimate the amount of time university-level work requires and do not properly allot sufficient time to fulfill their academic responsibilities. As sleep is largely considered an expendable requirement by college students, it is often disregarded in favor of homework or social activities. Time management courses can assist students in gaining the necessary skills to increase their perception of control over their sleep behaviors. Assertive communication techniques can be incorporated into intervention sessions to improve perceived behavioral control and subjective norms. To obtain adequate sleep it is imperative that students acquire the ability to communicate their need to engage in adequate sleep behavior to their significant others.

Stress management education can aid in relaxation prior to sleep and decrease sleep onset latency. Lund and colleagues (2010) cited stress as the primary predictor of poor sleep quality among undergraduate students. Sleep inducement strategies such as body temperature regulation through physical activity and passive heating can increase perceived physiological control over sleep behavior. In conjunction with stress management, financial management can minimize the number of work hours students require to meet their financial obligations, allowing more time for academics. Finances are a salient stressor for students and thus should be included in an intervention to help mitigate overall stress.

From an environmental perspective, university campuses should incorporate sleep health education into student orientations. Sleep is required for optimization of learning and should be emphasized to students. For students living in dormitories, dormitory quiet hours, ear plugs, and white noise machines can assist students in overcoming environmental barriers to achieving quality sleep. Furthermore, university mental health counselors should be trained to assist students seeking medical attention for sleep difficulties.

To improve attitude toward sleep, education linking sleep and learning should be emphasized. Sleep research indicates the final two hours of an eight hour sleep epoch as the most critical for memory consolidation (Buboltz et al., 2001). Subsequently, students who habitually receive fewer than 8 hours of sleep per night may be depriving themselves of their maximum learning potential. Students should be cognizant of this fact and understand their need to prioritize sleep.

Two additional constructs–gender and sleep hygiene–were examined for their contribution to sleep behavior. While sleep hygiene was found to be a significant predictor of sleep behavior, gender was not. This outcome suggests that sleep health interventions do not need to be specifically tailored toward gender; instead, programs can remain comprehensive and targeted in a similar fashion to both men and women.

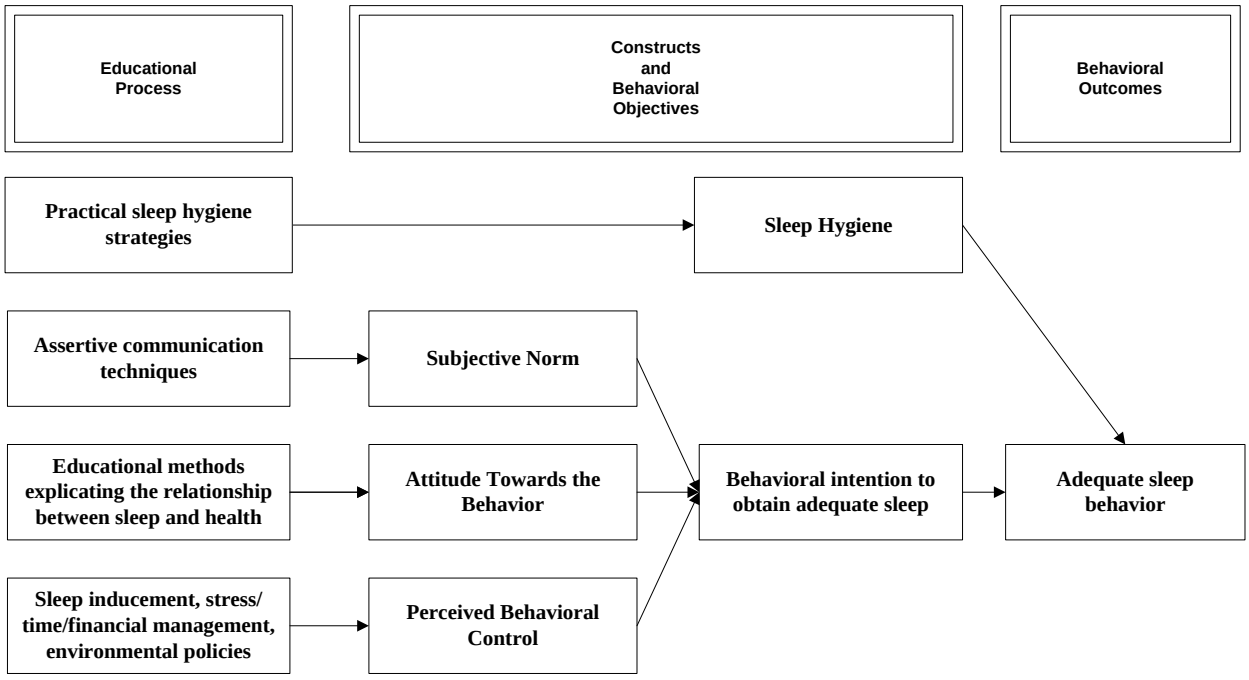
Sleep hygiene can improve behavioral and environmental conditions responsible for inducing the physiological and environmental conditions necessary for quality sleep. In regards to sleep hygiene principles, consistency of sleep-wake time is perhaps the most important; however, it is one of the most difficult for students to adopt. Practical strategies can be incorporated into the intervention to improve upon this area. For example, sleep onset induced within ±2 hours of regular sleep time will not significantly impact habitual circadian oscillations.

The results of this study also show that many students are involved in stressful activities in close proximity to sleep time. Interventions can work with students to replace stimulating stressors (i.e. social media, homework) with relaxing pre-bed routines (i.e. relaxation techniques, religious rituals). Additional stress management tools such as worry lists and journaling can mitigate racing thoughts and prepare the mind for rest.

To overcome feelings of lethargy resulting from sleep deprivation, students often rely on stimulants such as caffeine. Nutrition education and food logs incorporated into a sleep program can assist students in monitoring caffeine consumption, particularly near sleep time. Figure 5.2 illustrates a sample intervention logic model based on the results of this investigation.

Figure 5.2

Sample Intervention Logic Model Based on the Theory of Planned Behavior for Improving Sleep Intentions and Behaviors in Undergraduate Students



Recommendations for Future Research

Although it is one of the three primary pillars of optimal health, sleep has received minimal attention in the health promotion and education literature. Yet, from a behavioral and environmental perspective, there is much room for modification of sleep behaviors through health interventions. The *Healthy People* report has begun to shed light on this critical health topic by establishing a national goal to increase the percentage of adults who receive sufficient sleep from the 2008 baseline level of 69.6% to 70.9% by 2020 (United States Department of Human Services, 2010). To the best of the PI's knowledge, this is the first study exploring sleep behavior from a theory-based perspective. Research investigating the underlying behavioral and social determinants of voluntary sleep restriction is strongly encouraged.

Longitudinal research examining sleep behavior change across the life span would considerably increase the capacity of primary prevention interventions. In the current context, there is a need to understand the changes students go through from high school to college that lead to the degradation of healthy sleep patterns. Currently, much of this transition is based on speculation which makes intervention development difficult. There is also a need to determine if unhealthy sleeping patterns garnered during college years continue into students' professional lives.

A need exists for more studies that explore the attitudes, opinions, and beliefs underlying sleep health. Past evidence has found that most college students view sleep as an expendable requirement and that they underestimate the impact sleep deprivation has on their neurocognitive performance and psychomotor vigilance. Research exploring this phenomenon could augment the ability of interventions to result in behavior modification.

To reduce measurement error, objective methods for monitoring sleep behaviors should be incorporated in future research. In the present study, self-report was utilized; however, the accuracy of this method is suspect (Magee et al., 2008). Furthermore, the types of self-report items used by sleep researchers are inconsistent, confounding the ability to conduct meta-analyses. Actigraphs are relatively inexpensive, non-invasive, portable devices which can monitor and record sleep-wake patterns. Employment of objective measurement tools such as actigraphs would strengthen the findings of future sleep health research initiatives.

The advancement of sleep health from a health promotion and education perspective could benefit tremendously from qualitative research. Understanding the lived experiences of college students could bolster interventionists' ability to increase perceived behavioral control and identify additional factors that impact sleep behavior. Finally, due to the complexity and multi-factorial nature of sleep health, advanced modeling techniques, such as structural equation modeling, are recommended to provide more comprehensive models of sleep behavior.

Limitations

There are limitations to this study which should be considered when evaluating the findings of this report. Participants were pooled from convenience samples of students at a Midwestern University. Therefore, outcomes cannot be generalized beyond the study participants. A cross-sectional study design was utilized in this investigation thereby inhibiting the ability to establish cause-and-effect relationships between variables. The findings of this study were based on the self-reporting accuracy, integrity, and honesty of the participants. Concurrently, misinterpretation of instrument items may have skewed participant responses.

The present study considered sleep within the context of voluntary sleep restriction. The instrument did not contain items querying medically diagnosed sleep disorders. In addition,

sleep behavior was operationalized in accordance with the TpB TACT (time, action, context, and target) principle; however, sleep is a highly complex behavior which cannot be fully reified through a single variable. Sleep behavior data was collected through self-report. Sleep researchers have questioned the accuracy of this data collection method for measuring sleep behavior.

There are a multitude of knowledge gaps in the relationship between sleep and health. As a field of science, the study of sleep health is in its infancy. As sleep science advances, the assumptions of sleep health presented in this report may become outdated. For example, some researchers argue that the traditional 7 to 8 hours of sleep considered necessary for optimal health is an average duration and that sleep length need is normally distributed in the population (Ferrara & De Gennaro, 2001). Horne (1988) has contended that humans require only 5 to 6 hours of sleep per night and that additional sleep is optimal; alternatively, Bonnet and Arand (1995) have maintained that humans require 9 to 10 hours each night. As it stands, many of the basic elements of sleep health have not been resolved among prominent sleep researchers.

There are limitations inherent to the TpB. Primarily, the TpB does not explain affective processing. An underlying assumption of the TpB is that humans base behavior-related decisions on rational thought processes; however, unhealthy behaviors are often rooted in irrationality. For example, it is well known that sleep deprivation impairs mental capacity; yet, research has demonstrated that college students frequently underestimate the cognitive ramifications of sleep restriction.

S**ummary**

In this chapter, the conclusions, implications for practice, recommendations for future research and limitations of the study were discussed. Based upon the results of the tested

hypotheses, conclusions were drawn leading to specification of a final theory-based model for predicting the sleep intentions and behaviors of undergraduate college students. An assessment of the theoretical variables comprising the proposed model served as the basis for the practical implications of this analysis. Suggestions for developing an intervention based on the findings of this study resulted in a sample intervention logic model. Recommendations for future research described the need for additional research as well as a general direction for advancement of sleep health research efforts. Finally, the limitations inherent to this investigation were delineated.

The TpB was found to be a valid framework for predicting sleep intentions and behaviors in a sample of undergraduate students. Perceived behavioral control, subjective norm, and attitude are significant determinants in the behavioral intentions of undergraduate students to obtain adequate sleep behavior. As antecedents of sleep behavior, behavioral intention and sleep hygiene play an important role in the engagement of adequate sleep behavior among undergraduate students. Gender was not a significant predictor of sleep behavior. Therefore, comprehensive health promotion programs can be implemented on university campuses without gender-specific targeting. Each of the identified predictors is amendable to modification in the population of interest and should be incorporated in interventions designed to improve the sleep health of undergraduate populations.

References

Albarracin, D., Johnson, B. T., Fishbein, M., & Muellerleile, P. A. (2001). Theories of Reasoned Action and Planned Behavior as models of condom use: A meta-analysis. *Psychological Bulletin, 127*(1), 142-161. doi: 10.1037/0033-2909.127.1.142

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211. doi: 10.1016/0749-5978(91)90020-T

Ajzen, I. (2002). Constructing a TpB questionnaire: Conceptual and methodological considerations. Retrieved from http://people.umass.edu/aizen/pdf/tpb.measurement.pdf

Ajzen, I. (2010, July). The theory of planned behavior: A bibliography. Retrieved from http://www.people.umass.edu/aizen/tpbrefs.html

American Academy of Sleep Medicine. (2001). *The international classification of sleep disorders, revised* [Adobe Digital Editions version]. Retrieved from http://www.esst.org/adds/ICSD.pdf

American College Health Association, National College Health Assessment. (2008). *Reference group data report: Fall 2008.* Retrieved from http://www.acha-ncha.org/docs/ACHA-NCHA_Reference_Group_Report_Fall2008.pdf

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text rev.) [Web version]. doi: 10.1176/appi.books.9780890423349

Aserinsky, E., & Kleitman, N. (1953). Regularly occurring periods of eye motility and concomitant phenomena during sleep. *Science, 118,* 273-274.

Attarian, H. P., Schenck, C. H., & Mahowald, M. W. (2000). Presumed REM sleep behavior disorder arising from cataplexy and wakeful dreaming. *Sleep Medicine, 1*(2), 131-133. doi: 10.1016/S1389-9457(99)00013-1

Ayas, N. T., White, D. P., Manson, J. E., Stampfer, M. J., Speizer, F. E., Malhotra, A., & Frank, H. (2003). A Prospective study of sleep duration and coronary heart disease in women. *Archives of Internal Medicine, 163*(2), 205-209. doi: 10.1001/archinte.163.2.205

Balkin, T. J., Bliese, P. D., Belenky, G., Sing, H., Thorne, D. R., Thomas, M.,…Wesensten, N. J. (2004). Comparative utility of instruments for monitoring sleepiness-related performance decrements in the operational environment. *Journal of Sleep Research, 13*(3), 219-227. doi: 10.1111/j.1365-2869.2004.00407.x

Banks, S., & Dinges, D. F. (2007). Behavioral and physiological consequences of sleep restriction. *Journal of Clinical Sleep Medicine 3*(5), 519-528. Retrieved from http://www.ncbi.nlm.nih.gov

Belenky, G., Wesensten, N. J., Thorne, D. R., Thomas, M. L., Sing, H. C., Redmond, D. P.,… Balkin, T. J. (2003). Patterns of performance degradation and restoration during sleep restriction and subsequent recovery: a sleep dose-response study. *Journal of Sleep Research, 12*(1), 1-12. doi: 10.1046/j.1365-2869.2003.00337.x

Belloc, N. B., & Breslow, L. (1972). Relationship of physical health status and health practices. Preventive Medicine, 1(3), 409-421. doi: 10.1016/0091-7435(72)90014-X

Benington, J. H. (2000). Sleep homeostasis and the function of sleep. *Sleep, 23*(7), 960. Retrieved from http://web.sbu.edu/

Bennett, L., Langford, B., Stradling, J., & Davies, R. (1998). Sleep fragmentation indices as predictors of daytime sleepiness and nCPAP response in obstructive sleep apnea. *American Journal of Respiratory and Critical Care Medicine, 158*(3), 778. Retrieved from http://highwire.stanford.edu/

Berger, H. (1929). Über das Elektroenkephalogramm des Menschen. I. Mitteilung. Archiv für *Psychiatrie und Nervenkrankheiten, 87,* 527-570. doi: 10.1007/BF01797193

Bixler, E. (2009). Sleep and society: An epidemiological perspective. *Sleep Medicine, 10*(Supplement 1), S3-S6. doi: 10.1016/j.sleep.2009.07.005

Bjorvatn, B., & Pallesen, S. (2009). A practical approach to circadian rhythm sleep disorders. *Sleep Medicine Reviews, 13*(1), 47-60. doi: 10.1016/j.smrv.2008.04.009

Bonnet, M. H. & Arand, D. (1995). We are chronically sleep deprived. *Sleep, 18,* 908-911.

Bonnet, M. H. (1991). The effect of varying prophylactic naps on performance, alertness and mood throughout a 52-hour continuous operation. *Sleep, 14*(4), 307-315. Retrieved from http://sleepresearch.tripod.com

Bonnet, M. H., Dinges, D. F., Roehrs, T., Rogers, N. L., & Wesensten, N. J. (2005). The use of stimulants to modify performance during sleep loss: a review by the sleep deprivation and stimulant task force of the American Academy of Sleep Medicine. *Sleep, 28*(9), 1144-1168. Retrieved from http://sleepresearch.tripod.com

Borbély, A. A. (1982). A two process model of sleep regulation. *Human Neurobiology, 1*(3), 195-204. Retrieved from http://www.ncbi.nlm.nih.gov

Borbély, A. A., & Achermann, P. (1999). Sleep homeostasis and models of sleep regulation. *Journal of Biological Rhythms, 14*(6), 559-570. doi: 10.1177/074873099129000894

Breslau, N., Roth, T., Rosenthal, L., & Andreski, P. (1996). Sleep disturbance and psychiatric disorders: A longitudinal epidemiological study of young Adults. *Biological Psychiatry, 39*(6), 411-418. doi: 10.1016/0006-3223(95)00188-3

Brown, F. C., & Buboltz, W. C., Jr. (2002). Applying sleep research to university students: Recommendations for developing a student sleep education program. *Journal of College Student Development, 43*(3), 411-416.

Brown, F. C., Buboltz, W. C., Jr., & Soper, B. (2002). Relationship of sleep hygiene awareness, sleep hygiene practices, and sleep quality in university students. *Behavioral Medicine, 28*(1), 33-33. Retrieved from http://vnweb.hwwilsonweb.com

Brown, F. C., Buboltz, W. C., Jr., & Soper, B. (2006). Development and evaluation of the sleep treatment and education program for students (STEPS). *Journal of American College Health, 54*(4), 231-237. doi: 10.3200/JACH.54.4.231-237

Brown, F. C., Soper, B., & Buboltz, W. C., Jr. (2001). Prevalence of delayed sleep phase syndrome in university students. *College Student Journal, 35*(3), 472. Retrieved from http://web.ebscohost.com

Buboltz, W. C., Jr., Brown, F., & Soper, B. (2001). Sleep habits and patterns of college students: A preliminary study. *Journal of American College Health, 50*(3), 131-135. Retrieved from http://web.ebscohost.com/

Buysse, D. J., Reynolds Iii, C. F., Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index: A new instrument for psychiatric practice and research. *Psychiatry Research, 28*(2), 193-213. doi: 10.1016/0165-1781(89)90047-4.

Caldwell, J. A., Caldwell, J. L., & Schmidt, R. M. (2008). Alertness management strategies for operational contexts. *Sleep Medicine Reviews, 12*(4), 257-273. doi: 10.1016/ j.smrv.2008.01.002

Carskadon, M. A. (2004). Sleep deprivation: Health consequences and societal impact. *Medical Clinics of North America, 88*(3), 767-776. doi: 10.1016/j.mcna.2004.03.001

Casper, E. S. (2007). The theory of planned behavior applied to continuing education for mental health professionals. *Psychiatric Services, 58*(10), 1324-1329. doi: 10.1176/appi.ps.58.10.1324

Caton, R. (1875). The electric currents of the brain. *British Medical Journal, 2*, 278. Retrieved from http://journals.lww.com

Centers for Disease Control and Prevention. (2011). Unhealthy Sleep-Related Behaviors—12 States, 2009. *Morbidity & Mortality Weekly Report,* 66(SS-08), 233-266. Retrieved from http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6008a2.htm

Chen, M. Y., Wang, E., & Jeng, Y.-J. (2006). Adequate sleep among adolescents is positively associated with health status and health-related behaviors. *BMC Public Health, 6*(1), 59. doi: 10.1186/1471-2458-6-59

Cohen, J. (1988). *Statistical power analysis for behavioral sciences* (2nd ed.). Hillsdale: NJ: Lawrence Erlbaum Associates Inc.

Cottrell, R.R., & McKenzie, J.F. (2005). *Health promotion & education research methods: Using the five-chapter thesis/dissertation model*. Sudbury, MA: Jones & Bartlett.

Crabtree, B. F., & Miller, W. L. (Eds.). (1999). *Doing qualitative research in primary care: Multiple strategies* (pp. 163-177). Newbury Park, CA: Sage Publications.

Crosby, R. A., DiClemente, R. J., & Salazar, L. F. (2006). *Research methods in health promotion.* San Francisco: Jossey-Bass.

Curcio, G., Ferrara, M., & De Gennaro, L. (2006). Sleep loss, learning capacity and academic performance. *Sleep Medicine Reviews, 10*(5), 323-337. doi: 10.1016/j.smrv.2005.11.001

Dawson, D., & Reid, K. (1997). Fatigue, alcohol and performance impairment. *Nature, 388*(6639), 235. Retrieved from http://www.dwitrialprep.com

Deak, M., & Epstein, L. J. (2009). The history of polysomnography. *Sleep Medicine Clinics, 4*(3), 313-321. doi: 10.1016/j.jsmc.2009.04.001

Digdon, N. L., & Rhodes, S. (2009). Methods used to cope with sleepiness may perpetuate sleepiness in college students with an evening type circadian preference. *Biological Rhythm Research, 40*(2), 129-144. doi: 10.1080/09291010801987700

Dijk, D. J., Duffy, J. F., & Czeisler, C. A. (2000). Contribution of circadian physiology and sleep homeostasis to age-related changes in human sleep. *Chronobiology International, 17*(3), 285-311. doi: 10.1081/CBI-100101049

Dinges, D., Orne, M., & Orne, E. (1985). Assessing performance upon abrupt awakening from naps during quasi-continuous operations. *Behavior research methods, instruments & computers, 17*(1), 37-45.

Driver, H. S., & Taylor, S. R. (2000). Exercise and sleep. *Sleep Medicine Reviews, 4*(4), 387-402. doi: 10.1053/smrv.2000.0110

Espie, C., & Kyle, S. (2009). Primary insomnia: An overview of practical management using cognitive behavioral techniques. *Sleep Medicine Clinics, 4*(4) doi: 10.1016/j.jsmc.2009.07.009

Fan, J., McCandliss, B. D., Fossella, J., Flombaum, J. I., & Posner, M. I. (2005). The activation of attentional networks. *NeuroImage, 26*(2), 471-479. doi: 10.1016/j.neuroimage.2005.02.004

Ferrara, M., & De Gennaro, L. (2001). How much sleep do we need? *Sleep Medicine Reviews, 5*(2), 155-179. doi: 10.1053/smrv.2000.0138

Field, A. (2009). *Discovering statistics using SPSS* (3rd ed.). London: Sage Publications.

Flesch, R. (1948). New readability yardstick. *Journal of Applied Psychology, 32*, 221–223. doi: 10.1037/h0057532

Francis, J. J., Eccles, M.P., Johnson, M., Walker, A., Grimshaw, J., Foy, R.,…Bonetti, D. (2004). Constructing questionnaires based on the theory of planned behavior: A manual for health services researchers. Newcastle upon Tyne, UK: Centre for Health Services Research, University of Newcastle. Retrieved from http://people.umass.edu/aizen/pdf/Francis%20etal.TPB%20research%20manual.pdf

Friedman, E. M., Hayney, M. S., Love, G. D., Urry, H. L., Rosenkranz, M. A., Davidson, R. J.,…Ryff, C. D. (2005). Social relationships, sleep quality, and interleukin-6 in aging women. *Proceedings of the National Academy of Sciences of the United States of America, 102*(51), 18757-18762. doi: 10.1073/pnas.0509281102

Friedman, L., Benson, K., Noda, A., Zarcone, V., Wicks, D. A., O'Connell, K.,…Yesavage, J. A. (2000). An actigraphic comparison of sleep restriction and sleep hygiene treatments for insomnia in older adults. *Journal of Geriatric Psychiatry and Neurology, 13*(1), 17-27. doi: 10.1177/089198870001300103

Fuller, P. M., Gooley, J. J., & Saper, C. B. (2006). Neurobiology of the sleep-wake cycle: Sleep architecture, circadian regulation, and regulatory feedback. *Journal of Biological Rhythms, 21*(6), 482-493. doi: 10.1177/0748730406294627

Gais, S., & Born, J. (2004). Declarative memory consolidation: Mechanisms acting during human sleep. *Learning and Memory, 11*, 679-685. doi: 10.1101/lm.80504

Gangwisch, J. E., Heymsfield, S. B., Boden-Albala, B., Buijs, R. M., Kreier, F., Pickering, T. G.,…Malaspina, D. (2007). Sleep duration as a risk factor for diabetes incidence in a large US sample. *Sleep, 30*(12), 1667-1673.

Garfinkel, D., Laudon, M., Nof, D., & Zisapel, N. (1995). Improvement of sleep quality in elderly people by controlled-release melatonin. *The Lancet, 346*(8974), 541-544. doi: 10.1016/S0140-6736(95)91382-3

Garson, G. D. (2011). *Logistic regression: Assumptions*. Retrieved from http://faculty.chass.ncsu.edu/garson/PA765/logistic.htm#assume

Grandner, M. A., & Kripke, D. F. (2004). Self-reported sleep complaints with long and short sleep: a nationally representative sample. *Psychosomatic Medicine, 66*(2), 239–241. Retrieved from http://www.psychosomaticmedicine.org

Hall, M. H., Muldoon, M. F., Jennings, J. R., Buysse, D. J., Flory, J. D., & Manuck, S. B. (2008). Self-reported sleep duration is associated with the metabolic syndrome in midlife adults. *Sleep, 31*(5), 635-643. Retrieved from http://www.ncbi.nlm.nih.gov/

Harrison, Y., & Horne, J. A. (2000). The impact of sleep deprivation on decision making. *Journal of Experimental Psychology: Applied, 6*(3), 236-249. doi: 10.1037//1076-898X.6.3.236

Hauri, P. J. (1991). *Sleep hygiene, relaxation therapy, and cognitive intervention*. In P. J. Hauri (Ed.), Case Studies in Insomnia (pp. 65-84). New York: Plenum Medical Book Company.

Hicks, R. A., Lucero-Gorman, K., Bautista, J., & Hicks, G. (1999). Ethnicity, sleep hygiene knowledge, and sleep hygiene practices. *Perceptual and Motor Skills, 88*, 1095-1096.

Hicks, R. A., Fernandez, C., & Pellegrini, R. J. (2001a). Striking changes in the sleep satisfaction of university students over the last two decades. *Perceptual and Motor Skills, 93*(3), 660. doi: 10.2466/pms.93.7.660-660

Hicks, R. A., Fernandez, C., & Pellegrini, R. J. (2001b). The changing sleep habits of university students: An update. *Perceptual and Motor Skills, 93*(3), 648.

Hirshkowitz, M. (2004). Normal human sleep: An overview. *Medical Clinics of North America, 88*(3), 551-565. doi:10.1016/j.mcna.2004.01.001

Horne, J., & Reid, A. (1985). Night-time sleep EEG changes following body heating in a warm bath. *Electroencephalography and clinical neurophysiology, 60*(2), 154-157.

Horne, J. A., & Staff, L. H. (1983). Exercise and sleep: Body-heating effects. *Sleep, 6*(1), 36-46. Retrieved from http://psycnet.apa.org/

Horne J. A. (1988). *Why we sleep: The functions of sleep in humans and other mammals.* Oxford: Oxford University Press, 1988.

Hublin, C., Partinen, M., Koskenvuo, M., & Kaprio, J. (2007). Sleep and mortality: A population-based 22-year follow-up study. *Sleep, 30*(10), 1245-1253. Retrieved from http://www.ncbi.nlm.nih.gov

Iber, C., Ancoli-Israel, S., Chesson, A., & Quan, S. F. (Eds.). (2007). *The AASM manual for the scoring of sleep and associated events: Rules, terminology and technical specifications.* Westchester: American Academy of Sleep Medicine.

Irwin, M., McClintick, J., Costlow, C., Fortner, M., White, J., & Gillin, J. (1996). Partial night sleep deprivation reduces natural killer and cellular immune responses in humans. *The Federation of American Societies for Experimental Biology,10*(5), 643-653. Retrieved from http://www.fasebj.org/

Jacobs, G. D., Pace-Schott, E. F., Stickgold, R., & Otto, M. W. (2004). Cognitive behavior therapy and pharmacotherapy for insomnia: A randomized controlled trial and direct comparison. *Archives of Internal Medicine, 164*(17), 1888-1896. doi: 10.1001/

archinte.164.17.1888

Jean-Louis, G., von Gizycki, H., Zizi, F., & Nunes, J. (1998). Mood states and sleepiness in college students: influences of age, sex, habitual sleep, and substance use. *Perceptual and Motor Skills, 87*(2), 507-512. Retrieved from http://www.ncbi.nlm.nih.gov

Jenni, O. G., & O'Connor, B. B. (2005). Children's sleep: An interplay between culture and biology. *Pediatrics, 115*(1), 204-216. doi: 10.1542/peds.2004-0815B

Jensen, D. R. (2003). Understanding sleep disorders in a college student population. *Journal of College Counseling, 6*(1), 25. Retrieved from http://www.questia.com

Jouvet, M., Michel, F., & Courjon, J. (1959). *Comptes Rendus des Seances de la Societe de Biologie et de ses Filiales, 153*, 1024-1028. Retrieved from http://www.archive.org

Kendall, A., Kautz, M., Russo, M., & Killgore, W. D. S. (2006). Effects of sleep deprivation on lateral visual attention. *International Journal of Neuroscience, 116*(10), 1125-1138. doi: 10.1080/00207450500513922

Kilduff, T. S., Lein, E. S., de la Iglesia, H., Sakurai, T., Fu, Y., & Shaw, P. (2008). New developments in sleep research: Molecular genetics, gene expression, and systems neurobiology. *Journal of Neuroscience, 28*(46), 11814-11818. doi: 10.1523/jneurosci.3768-08.2008

Kim, D. J., Lee, H. P., Kim, M. S., Park, Y. J., Go, H. J., Kim, K. S.,…Lee C. T. (2001). The effect of total sleep deprivation on cognitive functions in normal adult male subjects. *The International Journal of Neuroscience, 109*(1-2), 127-137. doi: abs/10.3109/ 00207450108986529

Kleinbaum, D. G., Kupper, L. L., Nizam, A. Miller, K. E. (2008). *Applied regression analysis and other multivariable methods* (4th ed.). Belmont, CA: Thomas Learning, Inc.

Knutson, K. L., Spiegel, K., Penev, P., & Van Cauter, E. (2007). The metabolic consequences of sleep deprivation. *Sleep Medicine Reviews, 11*(3), 163-178. doi: 10.1016/ j.smrv.2007.01.002

Kronholm, E., Partonen, T., Laatikainen, T., Peltonen, M., Harma, M., Hublin, C.,…Sutela, H. (2008). Trends in self-reported sleep duration and insomnia-related symptoms in Finland from 1972 to 2005: A comparative review and re-analysis of Finnish population samples. *Journal of Sleep Research, 17*(1), 54-62. doi: 10.1111/ j.1365- 2869.2008.00627.x

Krueger, P. M., & Friedman, E. M. (2009). Sleep duration in the United States: A cross-sectional population-based study. *American Journal of Epidemiology, 169*(9), 1052-1063. doi: 10.1093/aje/kwp023

Lack, L. (1986). Delayed sleep and sleep loss in university students. *Journal of American College Health, 35*(3), 105-110. Retrieved from http://eric.ed.gov

Lacks, P., & Rotert, M. (1986). Knowledge and practice of sleep hygiene techniques in insomniacs and good sleepers. *Behaviour Research and Therapy, 24*(3), 365-368. doi: 10.1016/0005-7967(86)90197-X

Landolt, H. P., Roth, C., Dijk, D. J., & Borbely, A. A. (1996). Late-afternoon ethanol intake affects nocturnal sleep and the sleep EEG in middle-aged men. *Journal of Clinical Psychopharmacology, 16*(6), 428-436.

Leger, D. (1994). The cost of sleep-related accidents: a report for the National Commission on Sleep Disorders Research. *Sleep, 17*(1), 84-93. Retrieved from http://ovidsp.tx.ovid.com

Liao, W. C. (2002). Effects of passive body heating on body temperature and sleep regulation in the elderly: A systematic review. *International Journal of Nursing Studies, 39*(8), 803-810. doi: 10.1016/S0020-7489(02)00023-8

Liu, X., Uchiyama, M., Kim, K., Okawa, M., Shibui, K., Kudo, Y.,…Ogihara, R. (2000). Sleep loss and daytime sleepiness in the general adult population of Japan. *Psychiatry Research, 93*(1), 1-11. doi: 10.1016/S0165-1781(99)00119-5

Lockley, S. W., Cronin, J. W., Evans, E. E., Cade, B. E., Lee, C. J., Landrigan, C. P.,… Czeisler, C. A. (2004). Effect of reducing interns' weekly work hours on sleep and attentional failures. *New England Journal of Medicine, 351*(18), 1829-1837. doi: 10.1056/NEJMoa041404

Loomis, A., Harvey, E., & Hobart, G. (1937). Cerebral states during sleep as studied by human brain potentials. *Journal of Experimental Psychology, 21*(1), 127-144. Retrieved from http://psycnet.apa.org

Lund, H. G., Reider, B. D., Whiting, A. B., & Prichard, J. R. (2010). Sleep patterns and predictors of disturbed sleep in a large population of college students. *Journal of Adolescent Health, 46*(2), 124-132. doi: 10.1016/j.jadohealth.2009.06.016

Machado, E. E. R. S., Varella, V. V. B. R., & Andrade, M. M. M. M. (1998). The influence of study schedules and work on the sleep–wake cycle of college students. *Biological Rhythm Research, 29*(5), 578-584. doi: 10.1076/brhm.29.5.578.4827

Mackiewicz, M., Shockley, K., Romer, M., Galante, R., Zimmerman, J., Naidoo, N.,…Pack A. (2007). Macromolecule biosynthesis: a key function of sleep. *Physiological Genomics, 31*(3), 441. doi: 10.1152/physiolgenomics.00275.2006

Magee, C. A., Iverson, D. C., Huang, X. F., & Caputi, P. (2008). A link between chronic sleep restriction and obesity: Methodological considerations. *Public Health, 122*(12), 1373-1381. doi: 10.1016/j.puhe.2008.05.010

Markov, D., & Goldman, M. (2006). Normal sleep and circadian rhythms: Neurobiologic mechanisms underlying sleep and wakefulness. *Psychiatric Clinics of North America, 29*(4), 841-853.

Marshall, N. S., Glozier, N., & Grunstein, R. R. (2008). Is sleep duration related to obesity? A critical review of the epidemiological evidence. *Sleep Medicine Reviews, 12*(4), 289-298. doi: 10.1016/j.smrv.2008.03.001

Mastin, D. F., Bryson, J., & Corwyn, R. (2006). Assessment of sleep hygiene using the Sleep Hygiene Index. *Journal of Behavioral Medicine, 29*(3), 223-227. doi: 10.1007/s10865-006-9047-6

Meier-Ewert, H. K., Ridker, P. M., Rifai, N., Regan, M. M., Price, N. J., Dinges, D. F., & Mullington, J. M. (2004). Effect of sleep loss on C-Reactive protein, an inflammatory marker of cardiovascular risk. *Journal of the American College of Cardiology, 43*(4), 678-683. doi: 10.1016/j.jacc.2003.07.050

Mercer, P. W., Merritt, S. L., & Cowell, J. M. (1998). Differences in reported sleep need among adolescents. *Journal of Adolescent Health, 23*(5), 259-263. doi: 10.1016/S1054-139X(98)00037-8

Mignot, E. (2008). Why we sleep: The temporal organization of recovery. *Public Library of Science Biology 6*(4), e106. doi: 10.1371/journal.pbio.0060106

Minkel, J. D., Banks, S., & Dinges, D. F. (2009). Sleep deprivation: Neurobehavioral changes. In R. S. Larry (Ed.), *Encyclopedia of Neuroscience* (pp. 997-1004). Oxford: Academic Press.

Mirmiran, M., Maas, Y. G. H., & Ariagno, R. L. (2003). Development of fetal and neonatal sleep and circadian rhythms. *Sleep Medicine Reviews, 7*(4), 321-334. doi: 10.1053/smrv.2002.0243

Monk, T., Buysse, D., Rose, L., Hall, J. A., & Kupfer, D. (2000). The sleep of healthy people: A diary study. *Chronobiology International: The Journal of Biological and Medical Rhythm Research, 17*(1), 49. Retrieved from http://informahealthcare.com

Munhall, P. A. (2010). *Nursing research: A qualitative perspective* (5th ed.). Sudbury, MA: Jones and Bartlett.

Murphy, M., & Archer, J. (1996). Stressors on the college campus: A comparison of 1985 and 1993. *Journal of College Student Development, 37*(1), 20-28.

National Institutes of Health, National Heart, Lung, and Blood Institute, National Center on Sleep Disorders Research, National Highway Traffic Safety Administration. (1998). *Drowsy Driving and Automobile Crashes: Report and recommendation*. Retrieved from http://www.nhlbi.nih.gov/health/prof/sleep/drsy_drv.pdf

National Sleep Foundation [NSF]. (2005). *2005 sleep in America poll: Summary of findings.* http://www.sleepfoundation.org/sites/default/files/2005_summary_of_findings.pdf

National Sleep Foundation [NSF]. (2009). *2009 sleep in America poll: Summary of findings.* Retrieved from http://www.sleepfoundation.org/sites/default/files/2009%20Sleep%20in%20America%20SOF%20EMBARGOED.pdf

National Sleep Foundation [NSF]. (2010). *2010 sleep in America poll: Summary of findings.* Retrieved from http://www.sleepfoundation.org/sites/default/files/nsaw/NSF%20Sleep%20in%20%20America%20Poll%20%20Summary%20of%20Findings%20.pdf

Nehlig, A. (1999). Are we dependent upon coffee and caffeine? A review on human and animal data. *Neuroscience & Biobehavioral Reviews, 23*(4), 563-576. doi: 10.1016/S0149-7634(98)00050-5

Ohayon, M. M. (2002). Epidemiology of insomnia: What we know and what we still need to learn. *Sleep Medicine Reviews, 6*(2), 97-111. doi: 10.1053/smrv.2002.0186

Ohayon, M. M., Carskadon, M. A., Guilleminault, C., & Vitiello, M. V. (2004). Meta-analysis of quantitative sleep parameters from childhood to old age in healthy individuals: Developing normative sleep values across the human lifespan. *Sleep, 27*(7), 1255-1273. Retrieved from http://psycnet.apa.org

Pack, A., Pack, A., Rodgman, E., Cucchiara, A., Dinges, D., & Schwab, C. (1995). Characteristics of crashes attributed to the driver having fallen asleep. *Accident Analysis and Prevention*, 27(6), 769. Retrieved from http://journals.ohiolink.edu

Panossian, L. A., & Avidan, A. Y. (2009). Review of sleep disorders. *The Medical Clinics of North America, 93*(2), 407. Retrieved from 10.1016/j.mcna.2008.09.001

Patel, M., Tran, D., Chakrabarti, A., Vasquez, A., Gilbert, P., & Davidson, T. (2008). Prevalence of snoring in college students. *Journal of American College Health, 57*(1), 45-52.

Patel, S. (2007). Social and demographic factors related to sleep duration. *Sleep, 30*(9), 1096-1103. Retrieved from http://www.ncbi.nlm.nih.gov

Patel, S., Ayas, N., Malhotra, M., White, D., Schernhammer, E., & Speizer, F.,…Hu, B. (2004). A prospective study of sleep duration and mortality risk in women. *Sleep, 27*(3), 440-444. Retrieved from http://www.journalsleep.org

Patel, M., Tran, D., Chakrabarti, A., Vasquez, A., Gilbert, P., & Davidson, T. (2008). Prevalence of snoring in college students. Journal of American College Health, 57(1), 45-52.

Pigeau, R., Naitoh, P., Buguet, A., McCann, C., Baranski, J., Taylor, M.,…Mack, I. (1995). Modafinil, d-amphetamine and placebo during 64 hours of sustained mental work. Effects on mood, fatigue, cognitive performance and body temperature. *Journal of Sleep Research, 4*(4), 212-228. doi: 10.1111/j.1365-2869.1995.tb00172.x

Pilcher, J. J., Ginter, D. R., & Sadowsky, B. (1997). Sleep quality versus sleep quantity: Relationships between sleep and measures of health, well-being and sleepiness in college students. *Journal of Psychosomatic Research, 42*(6), 583-596. doi: 10.1016/S0022-3999(97)00004-4

Pilcher, J. J., & Walters, A. S. (1997). How sleep deprivation affects psychological variables related to college students' cognitive performance. *Journal of American College Health, 46*(3), 121-126. Retrieved from http://web.ebscohost.com

Polit, D. F., & Beck, C. T. (2004). *Nursing research: Principles and methods.* (7th ed.). Hagerstown, Maryland: Lippincott Williams & Wilkins.

Porkka-Heiskanen, T., Alanko, L., Kalinchuk, A., & Stenberg, D. (2002). Adenosine and sleep. *Sleep Medicine Reviews, 6*(4), 321-332. doi: 10.1053/smrv.2001.0201

Predictive Analytics Software (PASW). (2009). PASW Statistics. Chicago, Illinois: SPSS, Inc. Headquarters. Retrieved from http://www.spss.com/statistics/

Qualtrics Survey Software. (2010). Qualtrics. Provo, Utah. Retrieved from http://www.qualtrics.com/

Rauchs, G., Desgranges, B., Foret, J., & Eustache, F. (2005). The relationships between memory systems and sleep sages. *Journal of Sleep Research, 14*(2), 123-140. Retrieved from http://www.sciencesleep.org

Rechtschaffen, A. & Kales, A. (Eds.). (1968). *A manual of standardized terminology, techniques and scoring system for sleep stages of human subjects* (NIH Publication No. 204). U.S. Government Printing Office: Washington DC.

Reid, K. J., & Burgess, H. J. (2005). Circadian Rhythm Sleep Disorders. *Primary care: Clinics in office practice, 32*(2), 449-473. doi: 10.1016/j.pop.2005.02.002

Roffwarg, H. P., Muzio, J. N., & Dement, W. C. (1966). *Ontogenetic development of the human sleep-dream cycle* (pp. 604-619) [Web version]. Retrieved from http://www.jstor.org/stable/1718980

Rosa, R. R., & Bonnet, M. H. (1993). Performance and alertness on 8 h and 12 h rotating shifts at a natural gas utility. *Ergonomics, 36*(10), 1177-1193. doi: 10.1080/ 00140139308967987

Scott, L., Hwang, W., Rogers, A., Nysse, T., Dean, G., & Dinges, D. (2007). The relationship between nurse work schedules, sleep duration, and drowsy driving. *Sleep, 30*(12), 1801-1807. Retrieved from http://www.ncbi.nlm.nih.gov

Sharma, M., & Romas, J. A. (2008). *Theoretical foundations of health education and health promotion* (pp. 115-136). Sudbury, MA: Jones and Bartlett Publishers.

Shirakawa, S., Inoue, K., Uchida, S., Kuwahara, H., Kousaka, M., Kobayashi, T.,…Fukada, N. (2001). Proposed supplements and amendments to ‘A Manual of Standardized

Terminology, Techniques and Scoring System for Sleep Stages of Human Subjects', the Rechtschaffen & Kales (1968) standard. *Psychiatry and clinical neurosciences, 55*, 305-310. Retrieved from http://web.ebscohost.com

Siegel, J. (2001). The REM sleep-memory consolidation hypothesis. *Science, 294*(5544), 1058. doi: 10.1126/science.1063049

Sinton, C. M., & McCarley, R. W. (2004). Neurophysiological mechanisms of sleep and wakefulness: A question of balance. *Seminars in Neurology, 24*(3), 211-223. doi: 10.1055/s-2004-835067

Sousa, I., Araújo, J., & Azevedo, C. (2007). The effect of a sleep hygiene education program on the sleep-wake cycle of Brazilian adolescent students. S*leep and Biological Rhythms, 5*(4), 251-258. doi: 10.1111/j.1479-8425.2007.00318.x

Spiegel, K., Leproult, R., L'Hermite-Baleriaux, M., Copinschi, G., Penev, P. D., & Van Cauter, E. (2004). Leptin levels are dependent on sleep duration: Relationships with sympathovagal balance, carbohydrate regulation, cortisol, and thyrotropin. *The Journal of Clinical Endocrinology and Metabolism, 89*(11), 5762-5771. doi: 10.1210/jc.2004-1003

Spiegel, K., Leproult, R., & Van Cauter, E. (1999). Impact of sleep debt on metabolic and endocrine function. *The Lancet, 354*(9188), 1435-1439. doi: 10.1016/S0140-6736(99)01376-8

Stepanski, E. J., & Wyatt, J. K. (2003). Use of sleep hygiene in the treatment of insomnia. *Sleep Medicine Reviews, 7*(3), 215-225. doi: 10.1053/smrv.2001.0246

Steptoe, A., Peacey, V., & Wardle, J. (2006). Sleep duration and health in young adults. *Archives of Internal Medicine, 166*(16), 1689-1692. doi: 10.1001/archinte.166.16.1689

Stevens, J. (1996). *Applied multivariate statistics for the social sciences*. (3rd ed.). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Stickgold, R., Hobson, J. A., Fosse, R., & Fosse, M. (2001). Sleep, learning, and dreams: Off-line memory reprocessing. *Science, 294*(5544), 1052-1057. doi: 10.1126/science.1063530

Strine, T. W., & Chapman, D. P. (2005). Associations of frequent sleep insufficiency with health-related quality of life and health behaviors. *Sleep Medicine, 6*(1), 23-27. doi: 10.1016/j.sleep.2004.06.003

Szentkirályi, A., Madarász, C. Z., & Novák, M. (2009). Sleep disorders: Impact on daytime functioning and quality of life. *Expert Review of Pharmacoeconomics & Outcomes Research, 9*(1), 49-64. doi: 10.1586/14737167.9.1.49

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Boston, MA: Allyn & Bacon.

Tamakoshi, A., & Ohno, Y. (2004). Self-reported sleep duration as a predictor of all-cause mortality: Results from the JACC study, Japan. *Sleep, 27*(1), 51-54. Retrieved from http://www.journalsleep.org

Taub, J. M., & Berger, R. J. (1974). Acute shifts in the sleep-wakefulness cycle: Effects on performance and mood. *Psychosomatic Medicine, 36*(2), 164-173. Retrieved from http://www.psychosomaticmedicine.org

Teran-Santos, J., Jimenez-Gomez, A., & Cordero-Guevara, J. (1999). The association between sleep apnea and the risk of traffic accidents. *New England Journal of Medicine, 340*(11), 847-851. doi: 10.1056/nejm199903183401104

Thompson Reuters. (2009). Endnote (X3). [Reference management software package]. Retrieved from http://www.endnote.com

Tochikubo, O., Ikeda, A., Miyajima, E., & Ishii, M. (1996). Effects of insufficient sleep on blood pressure monitored by a new multibiomedical recorder. *Hypertension, 27*(6), 1318-1324. Retrieved from http://hyper.ahajournals.org

Tomasi, D., Wang, R. L., Telang, F., Boronikolas, V., Jayne, M. C., Wang, G. J.,…Volkow, N. D. (2009). Impairment of attentional networks after 1 night of sleep deprivation. *Cerebral Cortex, 19*(1), 233-240. doi: 10.1093/cercor/bhn073

Tononi, G., & Cirelli, C. (2006). Sleep function and synaptic homeostasis. *Sleep Medicine Reviews, 10*(1), 49-62. doi: 10.1016/j.smrv.2005.05.002

Tsai, L. L., & Li, S. P. (2004a). Sleep education in college: A preliminary study. *Perceptual and Motor Skills, 99*(3), 837-848.

Tsai, L. L., & Li, S. P. (2004b). Sleep patterns in college students: Gender and grade differences. *Journal of Psychosomatic Research, 56*(2), 231-237. doi: 10.1016/ S0022-3999(03)00507-5

Tudor, M., Tudor, L., & Tudor, K. (2005). Hans Berger (1873-1941)-The history of electroencephalography. *Academy of Medical Sciences of Croatia, 59*(4), 307-313.

Tulving, E., & Markowitsch, H. J. (1998). Episodic and declarative memory: Role of the hippocampus. *Hippocampus, 8*(3), 198-204. doi: 10.1002/(SICI)1098-1063(1998)8:3<198::AID-HIPO2>3.0.CO;2-G

Umberson, D. (1987). Family status and health behaviors: Social control as a dimension of social integration. *Journal of Health and Social Behavior, 28*(3), 306-319. Retrieved from http://www.jstor.org

University of Cincinnati. (2010). Programs by general interest. Retrieved from http://www.uc.edu/degreeprograms/searchPrograms.aspx University of Cincinnati Diversity Initiative.

University of Cincinnati Diversity Initiative. (2010). Diversity presentation. Retrieved from http://www.uc.edu/degreeprograms/searchPrograms.aspx

University of Cincinnati UC Facts. (2010). Enrollment (2009-2010). Retrieved from http://www.uc.edu/about/ucfactsheet.html#ratio

U.S. Department of Health and Human Services, National Institutes of Health, National Heart, Lung, and Blood Institute, National Center on Sleep Disorders Research. (2003). *National sleep disorders research plan*. Retrieved from http://www.nhlbi.nih.gov/health/prof/sleep/res_plan/sleep-rplan.pdf

U.S. Department of Health and Human Services. (2010). *Healthy people 2020: The road ahead.* Retrieved from http://www.healthypeople.gov/2020/topicsobjectives2020/overview.aspx?topicid=38

Van Cauter, E., Leproult, R., & Plat, L. (2000). Age-related changes in slow wave sleep and REM sleep and relationship with growth hormone and cortisol levels in healthy men. *Journal of the American Medical Association, 284*(7), 861-868. doi: 10.1001/ jama.284.7.861

Van Dongen, H. P. A., Maislin, G., Mullington, J. M. & Dinges, D. F. (2003). The cumulative cost of additional wakefulness: Dose-response effects on neurobehavioral functions and sleep physiology from chronic sleep restriction and total sleep deprivation. *Sleep, 26*(2), 117-126. Retrieved from http://web.med.upenn.edu

Vela-Bueno, A., Fernandez-Mendoza, J., & Olavarrieta-Bernardino, S. (2009). Sleep patterns in the transition from adolescence to young adulthood. *Sleep Medicine Clinics, 4*(1), 77-85. doi: 10.1016/j.jsmc.2008.12.003

Vela-Bueno, A., Fernandez-Mendoza, J., Olavarrieta-Bernardino, S., Vgontzas, A. N., Bixler, E. O., de la Cruz-Troca, J. J.,… Oliván-Palacios, J. (2008). Sleep and behavioral correlates of napping among young adults: a survey of first-year university students in Madrid, Spain. *Journal of American College Health, 57*(2), 150-158.

Vranesh, J. G., Madrid, G., Bautista, J., Ching, P., & Hicks, R. A. (1999). Time perspective and sleep problem. *Perceptual and Motor Skills, 88*(1), 23-24. doi: 10.2466/pms.88.1.23-24

Vyazovskiy, V., Cirelli, C., Pfister-Genskow, M., Faraguna, U., & Tononi, G. (2008). Molecular and electrophysiological evidence for net synaptic potentiation in wake and depression in sleep. *Nature, 11*(2), 200-208. doi: 10.1038/nn2035

Walker, M. P., & Stickgold, R. (2006). Sleep, memory, and plasticity. *Annual Review of Psychology, 57*(1), 139-166. doi: doi:10.1146/annurev.psych.56.091103.070307

Weinger, M. B., & Ancoli-Israel, S. (2002). Sleep deprivation and clinical performance. *Journal of the American Medical Association, 287*(8), 955-957. doi: 10.1001/jama.287.8.955

Wolf, F. M. (1986). *Meta-analysis: Quantitative methods for research synthesis*. Beverly Hills, CA: Sage.

Wong, J. G. W. S., Cheung, E. P. T., Chan, K. K. C., Ma, K. K. M., & Tang, S. W. (2006). Web-based survey of depression, anxiety and stress in first-year tertiary education students in Hong Kong. *Australian and New Zealand Journal of Psychiatry, 40*(9), 777-782. doi: 10.1080/j.1440-1614.2006.01883.x

Woodmansey, R. (2010). Readability of educational materials for endodontic patients. *Journal of Endodontics, 36*(10), 1703-1706. doi: 10.1016/j.joen.2010.07.005

Yoo, S.-S., Gujar, N., Hu, P., Jolesz, F. A., & Walker, M. P. (2007). The human emotional brain without sleep-a prefrontal amygdala disconnect. *Current Biology, 17*(20), R877-R878. doi: 10.1016/j.cub.2007.08.007

Youngstedt, S. D. (2005). Effects of exercise on sleep. *Clinics in Sports Medicine, 24*(2), 355-365. 10.1016/j.csm.2004.12.003

Youngstedt, S. D., & Kripke, D. F. (2004). Long sleep and mortality: Rationale for sleep restriction. *Sleep Medicine Reviews, 8*(3), 159-174. doi: 10.1016/j.smrv.2003.10.002

Zee, P. C. & Turek, F. W. (2006). Sleep and health: Everywhere and in both directions. *Archives of Internal Medicine, 166*(16). doi: 1686-1688. 10.1001/archinte.166.16.1686

Appendix A

Copy of the Approval Letter from the Institutional Review Board at University of Cincinnati to Conduct the Qualitative Elicitation Study

UNIVERSITY OF Cincinnati

Institutional Review Board - Social/Behavioral Sciences
University of Cincinnati
PO Box 210567
Cincinnati, OH 45221-0567

51 Goodman Drive
University Hall, Suite 300
(513) 558-5784 Phone
(513) 558-4111 Fax

January 19, 2010

Adam Knowlden, MS
Dept. of Health Promotion and Education

RE: IRB # 10-01-06-03E "Elicitation questionnaire to assess sleeping behaviors of college students"

The University of Cincinnati Institutional Review Board – Social and Behavioral Sciences (UC IRB-S) has reviewed your research project and has granted approval under Expedited category 45 CFR 46.110.

APPROVAL DATE: January 19, 2010
EXPIRATION DATE: January 19, 2011

The following document versions are included in this approval.
Protocol v. 1-19-10
Consent v. 1-19-10
Recruitment v. 1-19-10

The research MUST be conducted EXACTLY as approved. You must report to the Chair of the UC IRB-S any changes affecting the protocol upon which this certification is based. No changes may be made without prior approval by the Board except those necessary to eliminate immediate hazards.

Attached you will find some or all of the following:
1. APPROVED consent(s): document is locked and shows the IRB approved/expires date stamp. You MUST use this version (with IRB approved / expires date stamp) with your participants.
2. Investigator Responsibilities: these apply to all UC research team members involved with human subject research.

Should your project extend beyond the expiration date, you must submit a Progress Report form A MONTH BEFORE THE EXPIRATION DATE indicating that the project is continuing. You will need to attach to the Progress Report a copy of the first signed consent (with IRB approved / expires date stamp) to document use of the approved versions.

IT IS YOUR RESPONSIBILITY to keep track of your project's expiration date and to submit a Progress Report either to continue or to close your study. If the IRB-S does not reapprove your research by the specified expiration date, ALL research activities MUST STOP, including recruitment and enrollment of participants, interventions and interactions with current participants, collection of data, and data analysis.

Julie Waltz-Gerlach, BSN, MPH, CIP
Chair, UC IRB-S

Statement regarding International Conference on Harmonisation and Good Clinical Practices
The University of Cincinnati Institutional Review Board is duly constituted (fulfilling FDA requirements for diversity), has written procedures for initial and continuing review of clinical trials: prepares written minutes of convened meetings, and retains records pertaining to the review and approval process; all in compliance with requirements defined in 21 CFR Parts 50, 56 and 312 Code of Federal Regulations. This institution is in compliance with the ICH GCP as they correspond to FDA/DHHS regulations.

Appendix B

Panel of Experts Juror Profiles

1. Manoj Sharma, MBBS, CHES, Ph.D.

   Professor of Health Promotion & Education

   University of Cincinnati

   Teachers College 527 C

   P.O. Box 210068

   Cincinnati, OH 45221

   (Expertise: Population Expert/Instrument Development)

2. Amy Bernard, CHES, Ph.D.

   Associate Professor of Health Promotion & Education

   University of Cincinnati

   Teachers College 526 D

   P.O. Box 210002

   Cincinnati, OH 45221

   (Expertise: Population Expert/Instrument Development)

3. David F. Mastin, Ph.D.

   Associate Professor of Psychology

   University of Arkansas at Little Rock

   Department of Psychology

   2801 South University Avenue

   Little Rock, AR 72204-1099

   (Expertise: Sleep Behaviors)

4. Roxanne Prichard, Ph.D.

   Assistant Professor of Psychology

   St. Thomas University

   Department of Psychology

   St. Paul, MN 55105

   (Expertise: Sleep Behaviors)

5. Tavis Glassman Ph.D., MPH, CHES

   Assistant Professor of Health Education & Public Health

   University of Toledo

   College of Health Science and Human Services

   Department of Health & Recreation Professions

   Mail Stop # 119, Office # 1006

   Toledo, OH 43606

   (Expertise: Theory of Planned Behavior)

6. Karen Pielak, RN, MSN

   Nurse Epidemiologist

   Epidemiology Services

   B.C. Centre for Disease Control

   655 W 12th Avenue

   Vancouver, BC V5Z 4R4

   (Expertise: Theory of Planned Behavior)

Appendix C

Letters to Panel of Experts

(Round 1)

Dear Panel of Expert Jurors:

Thank you for agreeing to assist me in the development of the instrument I conceptualized as part of my master's degree thesis project. As you may recall, I am a graduate student majoring in Health Promotion and Education at the University of Cincinnati. For my thesis, I am researching the sleeping behaviors of undergraduate students using the Theory of Planned Behavior (TpB). The tentative title of my thesis is, "TpB Based Predictors of Sleep Intentions and Behaviors in Undergraduate College Students at a Midwestern University." Based on your expertise in at least one of the following areas 1) undergraduate college students, 2) sleeping behaviors, 3) the TpB, or 4) instrument development you have been identified as an expert to assist me in establishing the content validity of the instrument.

The instrument I have developed is comprised of three sections. The first section contains 20 items designed to assess the salient constructs of the TpB. The second section of the instrument provides a global score of the respondents' sleep hygiene status using the Sleep Hygiene Index (SHI). The final section is designed to collect demographic information about the population. Attached, you will find a copy of my draft instrument along with an instrument assessment form for you to provide feedback and comments. Please comment on the subscales and items in regard to the following:

- Readability: Is the meaning of each item clear and at an appropriate reading level for undergraduate college students?
- Face validity: Does each item appear to measure the intended construct as operationally defined?
- Content validity: Do the items in Section 1 adequately assess each TpB construct within the universe of content as operationally defined?

I am requesting that you please complete the assessment form and return it to me by June 27, 2010. After incorporating the changes you have recommended a revised draft of the instrument will be delivered to you for a second round of review. If you would prefer hardcopies of the draft instrument and assessment form, please provide me with the appropriate postal address and I will mail the forms to you. If you have any questions I can be reached at knowldam@email.uc.edu. I am extremely grateful for your time and would like to convey my anticipatory gratitude for your valuable comments on my instrument.

Sincerely,

Adam P. Knowlden

Advisor: Dr. Manoj Sharma, MBBS, Ph.D.

(Round 2)

Dear Panel of Expert Jurors:

Thank you very much for providing feedback on the instrument I am developing to predict the sleep intentions and behaviors of undergraduate college students using the Theory of Planned Behavior (TpB). Based on your suggestions, I have made numerous modifications to the instrument. A summary of those changes include:

Section I: Theory of Planned Behavior Subscale

Section 1 Instructions:

- Re-worded: The questions in this section make use of rating scales with seven (7) place response options. Please indicate where you fall on the scale. For each question, please **circle** one number that is true for you. Please do not leave any questions blank.

Perceived Behavior Control construct (items 1, 2, 3, and 4):

- Item 1 endpoints: changed from "not feasible/feasible" to "not practical/practical"
- Item 2 readability: replaced the word "confident" with "sure"
- Item 4: Re-formatted from third person to first person

Attitude construct (items 5, 6, 7, 8, 9, and 10):

- Item 7 endpoints: changed from "not relaxing/relaxing" to "not refreshing/refreshing"
- Item 10: changed from "unsociable /sociable" to "detrimental to my social life/beneficial to my social life"

Subjective norm construct (items 11, 12, 13, 14, 15):

- Eliminated item 16 "My roommate(s) want me to sleep 7 to 8 hours every night"
- Combined items 13 "My professor(s)/instructor(s) want me to sleep 7 to 8 hours every night" and 14 "My employer(s) want me to sleep 7 to 8 hours every night" to "Those those in supervisory positions over me (i.e. professors, employers) want me to sleep 7 to 8 hours every night"

Behavioral Intention construct (items 16, 17, and 18):

- Added "at night time" at the end of all Behavioral Intention construct items "In the next 24 hours I intend/plan/will try to sleep 7 to 8 hours at night time"

Behavior construct (items 19):

- Provided space for participants to indicate both hours and minutes of total nocturnal sleep duration
- Added "at night time" at the end of item 19

Section 3: Demographic Data

- Item 35: "What is your current grade level" changed to "What year student are you?
- Modified response options to: First year, Second year, Third year, Fourth year, Fifth year and above

Due to the nature of the TpB, there were suggestions made by the panel which I was unable to incorporate into the instrument:

- Changing the type of scale: Icek Ajzen (developer of the TpB) has recommended the use of 7-point semantic differential scales for the TpB to increase its predictive validity.

- Removing the *good–bad* item under the attitude sub-scale: Ajzen strongly recommends using the *good–bad* scale to capture overall evaluation.
- Similar verbiage for the behavioral intention sub-scale: Parallel verbiage (i.e. intend/plan/try) is incorporated to ensure the items have a strong internal consistency.
- Including "not applicable" options to certain items: In terms of a "not applicable" option, each item must be applicable to all participants in order for the item to contribute to the predictability of the given construct. For those items that the panel suggested an "n/a" option be included, I re-structured or eliminated the item to make it inclusive for all participants.

Attached, you will find a copy of the revised instrument along with an instrument assessment form for you to provide feedback and comments. Please comment on the subscales and items in regard to the following:

- Readability: Is the meaning of each item clear and at an appropriate reading level for undergraduate college students?
- Face validity: Does each item appear to measure the intended construct as operationally defined?
- Content validity: Do the items in Section 1 adequately assess each TpB construct within the universe of content as operationally defined?

I am requesting that you please complete the assessment form and return it to me by August 8, 2010. If you would prefer hardcopies of the instrument and assessment form, please provide me with the appropriate postal address and I will mail the forms to you. If you have any questions I can be reached at knowldam@email.uc.edu. I am extremely grateful for your time and would like to convey my anticipatory gratitude for your valuable comments on my instrument.

Sincerely,

Adam P. Knowlden

Advisor: Dr. Manoj Sharma, MBBS, Ph.D.

Appendix D

Panel of Experts Round Two Instrument Assessment Form

Section 1: Theory of Planned Behavior Subscale

Section one of this instrument will employ the Theory of Planned Behavior (TpB) to assess the participants' intention to sleep 7 to 8 hours a night on a daily basis. The TpB (Azjen, 1991) posits that the intention to perform a behavior is a proximal measure of actual behavior. Behavioral intention, in turn, is the function of three latent variables: attitude, subjective norm, and perceived behavioral control. Attitude towards a behavior refers to the overall feeling of like or dislike toward a given behavior. Subjective norms encompass the individual's perception of the social pressure to perform or not perform a given behavior. Perceived behavioral control examines the extent to which an individual believes they are able to perform the behavior in question.

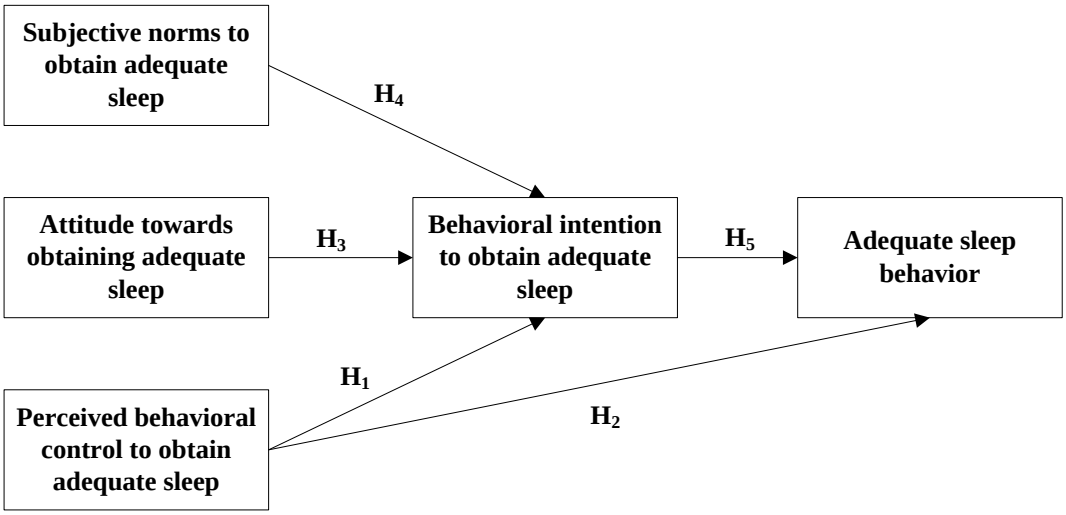


Figure 1. Section 1 research model based on the TpB.

(Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211. doi: 10.1016/0749-5978(91)90020-T)

- *Section 1 Instructions:* The questions in this section make use of rating scales with seven (**7)** place response options. Please indicate where you fall on the scale. For each question, please **circle** one number that is true for you. Please do not leave any questions blank.

(1) Are the instructions readable?		(2) Comments on instructions:
yes_____	no_____	

Section 1, Part A: Measuring Perceived Behavioral Control to Achieve Adequate Sleep

Universal Definition: The construct of perceived behavioral control refers to people's perceptions of their ability to perform a given behavior.

Operational Definition: The first set of questions in section one of the instrument are designed to assess the respondent's perceived behavioral control to obtain adequate sleep. For the purpose of this study, perceived behavioral control is operationally defined as how much the individual believes they are in control of obtaining 7 to 8 hours of sleep on a daily basis. A total of four items will be used to assess this construct (items 1, 2, 3, and 4). A 7-point semantic differential scale will be used to measure each item. A range of scores from 4 to 28 are possible for this construct. The mean of the item scores will be calculated to provide an overall perceived behavioral control score. A higher score will reflect a greater level of perceived control over the target behavior.

- *Section 1, Part A Instructions:* In this first set of questions, please consider how much control you feel you have over your sleeping habits.

(1) Are the instructions readable?		(2) Comments on instructions:
yes_____	no_____	

- *Section 1, Part A Items Measuring Perceived Behavioral Control to Achieve Adequate Sleep*

1. For me to sleep 7 to 8 hours every night is

not practical: 1 : 2 : 3 : 4 : 5 : 6 : 7 : practical

(1) Is the item readable?		(2) Are the endpoints adequate?		(3) Is the item face valid?	
yes_____	no_____	yes_____	no_____	yes_____	no_____
Comments on item or response endpoints:					

2. If I wanted to, I am sure I could sleep for 7 to 8 hours every night

completely disagree: 1 : 2 : 3 : 4 : 5 : 6 : 7 : completely agree

(1) Is the item readable?		(2) Are the endpoints adequate?		(3) Is the item face valid?	
yes_____	no_____	yes_____	no_____	yes_____	no_____
Comments on item or response endpoints:					

3. It is up to me whether or not I sleep 7 to 8 hours every night

completely disagree: 1 : 2 : 3 : 4 : 5 : 6 : 7 : completely agree

(1) Is the item readable?		(2) Are the endpoints adequate?		(3) Is the item face valid?	
yes_____	no_____	yes_____	no_____	yes_____	no_____
Comments on item or response endpoints:					

4. I have complete control over my ability to sleep 7 to 8 hours every night

no control : 1 : 2 : 3 : 4 : 5 : 6 : 7 : complete control

(1) Is the item readable?		(2) Are the endpoints adequate?		(3) Is the item face valid?	
yes_____	no_____	yes_____	no_____	yes_____	no_____
Comments on item or response endpoints:					

Section 1, Part B: Measuring Attitude Towards Obtaining Adequate Sleep

Universal Definition: Attitude toward a behavior is the degree to which performance of the behavior is positively or negatively valued.

Operational Definition: The second set of questions in section one of the instrument are designed to assess the respondent's attitude toward obtaining adequate sleep. For the purpose of this study, attitude toward obtaining adequate sleep is operationally defined as the individual's overall feeling of like or dislike towards obtaining adequate sleep behavior. A total of six items will be used to assess this construct (items 5, 6, 7, 8, 9, and 10). A 7-point attitudinal scale will be used to measure each item. A range of scores from 6 to 42 are possible for this construct. The mean of the item scores will be calculated to provide an overall attitude score. A higher score is indicative of a more positive attitude toward the target behavior.

- *Section 1, Part B Instructions:* In this next set of questions, please consider how you feel about sleeping for 7 to 8 hours every night.

(1) Are the instructions readable?		(2) Comments on instructions:
yes_____	no_____	

- *Section 1, Part B Items Measuring Attitude Towards Obtaining Adequate Sleep*

For me to sleep for 7 to 8 hours each night would be (stem question)

(1) Is the stem item readable?		(2) Comments on stem item:
yes_____	no_____	

5. bad: 1 : 2 : 3 : 4 : 5 : 6 : 7 : good

(1) Is the item readable?		(2) Are the endpoints adequate?		(3) Is the item face valid?	
yes_____	no_____	yes_____	no_____	yes_____	no_____
Comments on item or response endpoints:					

6. unhealthy: 1 : 2 : 3 : 4 : 5 : 6 : 7 : healthy

(1) Is the item readable?		(2) Are the endpoints adequate?		(3) Is the item face valid?	
yes_____	no_____	yes_____	no_____	yes_____	no_____
Comments on item or response endpoints:					

7. not refreshing: 1 : 2 : 3 : 4 : 5 : 6 : 7 : refreshing

(1) Is the item readable?		(2) Are the endpoints adequate?		(3) Is the item face valid?	
yes_____	no_____	yes_____	no_____	yes_____	no_____
Comments on item or response endpoints:					

8. unnecessary: 1 : 2 : 3 : 4 : 5 : 6 : 7 : necessary

(1) Is the item readable?		(2) Are the endpoints adequate?		(3) Is the item face valid?	
yes_____	no_____	yes_____	no_____	yes_____	no_____
Comments on item or response endpoints:					

9. not enjoyable: 1 : 2 : 3 : 4 : 5 : 6 : 7 : enjoyable

(1) Is the item readable?		(2) Are the endpoints adequate?		(3) Is the item face valid?	
yes_____	no_____	yes_____	no_____	yes_____	no_____
Comments on item or response endpoints:					

10. detrimental to my social life: 1 : 2 : 3 : 4 : 5 : 6 : 7 : beneficial to my social life

(1) Is the item readable?		(2) Are the endpoints adequate?		(3) Is the item face valid?	
yes_____	no_____	yes_____	no_____	yes_____	no_____
Comments on item or response endpoints:					

Section 1, Part C: Measuring Subjective Norm to Obtain Adequate Sleep

Universal Definition: Subjective norms are the perceived social pressures to engage or not to engage in a behavior.

Operational Definition: The third set of questions in section one of the instrument are designed to assess the respondent's subjective norms toward obtaining adequate sleep. For the purpose of this study, subjective norms to obtain adequate sleep is operationally defined an individual's belief that most of the significant others in their lives think they should or should not obtain adequate sleep. A 7-point semantic differential scale will be used to measure each item. A total of four questions will be used to assess this construct (questions 11, 12, 13, and 14). A range of scores from 4 to 28 are possible for part C. The mean of the item scores will be calculated to provide an overall subjective norms score. Higher scores will reflect a greater social pressure to perform the target behavior.

- *Section 1, Part C Instructions:* In this next set of questions, please consider those individuals whose opinions you value most.

(1) Are the instructions readable?		(2) Comments on instructions:
yes_____	no_____	

- *Section 1, Part C Items Measuring Subjective Norms to Obtain Adequate Sleep*

11. Most people who are important to me think that I should sleep 7 to 8 hours every night

completely disagree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : completely agree

(1) Is the item readable?		(2) Are the endpoints adequate?		(3) Is the item face valid?	
yes_____	no_____	yes_____	no_____	yes_____	no_____
Comments on item or response endpoints:					

12. My parent(s)/guardian(s) want me to sleep 7 to 8 hours every night

completely disagree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : completely agree

(1) Is the item readable?		(2) Are the endpoints adequate?		(3) Is the item face valid?	
yes_____	no_____	yes_____	no_____	yes_____	no_____
Comments on item or response endpoints:					

13. My supervisors (e.g. professors/employers) want me to sleep 7 to 8 hours every night

completely disagree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : completely agree

(1) Is the item readable?		(2) Are the endpoints adequate?		(3) Is the item face valid?	
yes_____	no_____	yes_____	no_____	yes_____	no_____
Comments on item or response endpoints:					

14. My friend(s) want me to sleep 7 to 8 hours every night

completely disagree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : completely agree

(1) Is the item readable?		(2) Are the endpoints adequate?		(3) Is the item face valid?	
yes_____	no_____	yes_____	no_____	yes_____	no_____
Comments on item or response endpoints:					

Section 1, Part D: Subscale Measuring Behavioral Intention to Obtain Adequate Sleep

Universal Definition: Intention is an indication of a person's readiness to perform a given behavior and it is considered to be the immediate antecedent of behavior.

Operational Definition: Behavioral intention to obtain adequate sleep will be gauged through three items (questions 15, 16, and 17). This construct will be assessed in terms of the target, action, context, and time (TACT) principle. For the purposes of this study, intention to obtain adequate sleep behavior is operationally defined as undergraduate students (target) intention to sleep (action) for 7 to 8 hours (time) at night time (context). A 7-point semantic differential scale will be used to measure each item. Scores for part D can range from 3 to 21. The mean of the item scores will be calculated to provide an overall behavioral intention score. Higher scores will reflect a greater intention to perform the target behavior.

- *Section 1, Part D Instructions:* In this next set of questions, please consider your personal sleeping habits.

(1) Are the instructions readable?		(2) Comments on instructions:
yes_____	no_____	

- *Section 1, Part D Items Measuring Behavioral Intention to Obtain Adequate Sleep*

15. In the next 24 hours, I intend to sleep 7 to 8 hours at night time

completely disagree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : completely agree

(1) Is the item readable?		(2) Are the endpoints adequate?		(3) Is the item face valid?	
yes_____	no_____	yes_____	no_____	yes_____	no_____
Comments on item or response endpoints:					

16. In the next 24 hours, I plan to sleep 7 to 8 hours at night time

completely disagree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : completely agree

(1) Is the item readable?		(2) Are the endpoints adequate?		(3) Is the item face valid?	
yes_____	no_____	yes_____	no_____	yes_____	no_____
Comments on item or response endpoints:					

17. In the next 24 hours, I will try to sleep 7 to 8 hours at night time

completely disagree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : completely agree

(1) Is the item readable?		(2) Are the endpoints adequate?		(3) Is the item face valid?	
yes_____	no_____	yes_____	no_____	yes_____	no_____
Comments on item or response endpoints:					

Section 1, Part E: Subscale Measuring Adequate Sleep Behavior

Universal Definition: Behavior is the manifest, observable response in a given situation with respect to a given target. Behavior is defined in terms of the target, action, context, and time (TACT) principle.

Operational Definition: Adequate sleep behavior will be gauged by one item. This construct will be assessed in terms of the target, action, context, and time (TACT) principle. For the purposes of this study, adequate sleep behavior is defined as undergraduate students (target) achieving 7 to 8 hour (time) of sleep (action) on a daily basis (context). The sleep behavior variable will be assessed through self-report.

- *Section 1, Part E Instructions:* In this next set of questions, please consider your personal sleeping habits (same instructions as part D).

(1) Are the instructions readable?		(2) Comments on instructions:
yes_____	no_____	

- *Section 1, Part E Item Measuring Adequate Sleep Behavior*

18. In the past 24 hours, how many hours/minutes did you sleep at night time? (please **write in** the appropriate response)

_____ Hours and _____ Minutes

(1) Is the item readable?		(2) Is the self-report measure adequate?		(3) Is the item face valid?	
yes_____	no_____	yes_____	no_____	yes_____	no_____
Comments on item or response endpoints:					

- **Section 1: Content Validity**

Is the TpB subscale content valid (the items of the subscale adequately assess each Theory of Planned Behavior construct within the universe of content as operationally defined)?

(1) Is the subscale content valid (the items of the subscale adequately assess each Theory of Planned Behavior construct within the universe of content as operationally defined)?	yes_____	no_____
(2) Additional comments on Section 1		

Section 2: Sleep Hygiene Index Subscale

Section 2 employs the Sleep Hygiene Index developed by Mastin, Bryson, and Corwyn (2006). Sleep hygiene assesses behavioral and environmental factors that can be modified to enhance sleep quality. The items in Section 2 will not be modified in this study. However, for the purpose of this study, the original 5-point Likert scales have been converted to 7-point Likert scales for instrument consistency.

(Mastin, D. F., Bryson, J., & Corwyn, R. (2006). Assessment of sleep hygiene using the Sleep Hygiene Index. *Journal of Behavioral Medicine, 29*(3), 223-227. doi: 10.1007/s10865-006-9047 6)

- *Section 2 Instructions:* The questions in this section make use of rating scales with seven **(7)** places. Please indicate on which end of the scale you mostly agree. For each question, please **circle** one number that is true for you. Please do not leave any questions blank.

(1) Are the instructions readable?		(2) Comments on instructions:
yes_____	no_____	

- *Section 2, Part A Instructions:* In this set of questions, please consider your daily sleeping habits.

(1) Are the instructions readable?		(2) Comments on instructions:
yes_____	no_____	

Section 3: Demographic Data

- *Section 3 Instructions:* For this last section, please place an **"X"** next to the appropriate response. <u>All responses will be kept confidential and private. Only group data will be reported.</u>

(1) Are the instructions readable?		(2) Comments on instructions:
yes_____	no_____	

32. What is your gender?

_____ Male _____ Female

(1) Is the item readable?		(2) Comments on item:
yes_____	no_____	

33. What is your age? (please **write** your response)

_____ Years

(1) Is the item readable?		(2) Comments on item:
yes_____	no_____	

34. What year student are you?

_____ First Year _____ Third Year _____ Fifth Year and above
_____ Second Year _____ Fourth Year

(1) Is the item readable?		(2) Comments on item:
yes_____	no_____	

35. Are you enrolled as a part-time or full-time student?

_____ Part-time _____ Full-time

(1) Is the item readable?		(2) Comments on item:
yes_____	no_____	

36. What is your college major?

_____ Architecture
_____ Behavioral & Social Sciences
_____ Business
_____ Computers & Technology
_____ Humanities
_____ Law & Social Justice
_____ Medicine & Health
_____ Natural Science & Math

_____ Construction & Building Trades
_____ Culture & Languages
_____ Design
_____ Education
_____ Engineering
_____ Performing Arts & Music
_____ Politics
_____ Social Service
_____ Other

(1) Is the item readable?		(2) Comments on item:
yes_____	no_____	

37. What is your race/ethnicity?

_____ African American
_____ Asian
_____ Caucasian
_____ Hispanic
_____ Multi-racial
_____ Other

(1) Is the item readable?		(2) Comments on item:
yes_____	no_____	

38. What is your current Grade Point Average? (please **write** your response)

_____/ 4.0

(1) Is the item readable?		(2) Comments on item:
yes_____	no_____	

Appendix E

Permission to Use Sleep Hygiene Index

From: Knowlden, Adam (knowldam)
Sent: Tuesday, February 02, 2010 4:03 PM
To: dfmastin@ualr.edu
Subject: Permission to use Sleep Hygiene Index

Dear Dr. Mastin:

Hello, my name is Adam Knowlden. I am a graduate student at the University of Cincinnati working towards my MS in Health Promotion and Education. For my thesis, I am researching the sleeping behaviors of undergraduate students using the Theory of Planned Behavior. As part of my literature review I came across the Sleep Hygiene Index. As the developer of this instrument, I wanted to ask permission to use it in my study. If you agree I would be happy to give you and your colleagues' full-credit for development of the scale. If there is a cost to use the scale would you kindly let me know the price and provide payment details?

Thank you,
Adam Knowlden

From: David Mastin [dfmastin@ualr.edu]
Sent: Wednesday, February 03, 2010 11:39 AM
To: Knowlden, Adam (knowldam)
Subject: RE: Permission to use Sleep Hygiene Index

Hi Adam,

No permission is required. Not cost is incurred. I imagine a reference to the publication/authors is appropriate. I have attached the original manuscript and formatted instrument. Let me know how I can help.

David

David F. Mastin, PhD
Associate Professor
Department of Psychology
University of Arkansas at Little Rock
2801 South University Avenue
Little Rock, AR 72204-1099

Appendix F

Original Version of the Sleep Hygiene Index

Sleep Hygiene Index University of Arkansas at Little Rock • Biobehavioral Laboratory

Sleep Hygiene Index						
Please rate all of the following statements using the scale below.						
5 Always 4 Frequently 3 Sometimes 2 Rarely 1 Never						
						1=Never
					2=Rarely	
				3=Sometimes		
			4=Frequently			
		5=Always				
Sleep Hygiene Index						
Please circle the letters or blacken the box by using the scale above.						
1.	I take daytime naps lasting two or more hours.	5	4	3	2	1
2.	I go to bed at different times from day to day.	5	4	3	2	1
3.	I get out of bed at different times from day to day.	5	4	3	2	1
4.	I exercise to the point of sweating within one hour of going to bed.	5	4	3	2	1
5.	I stay in bed longer than I should two or three times a week.	5	4	3	2	1
6.	I use alcohol, tobacco, or caffeine within four hours of going to bed or after going to bed.	5	4	3	2	1
7.	I do something that may wake me up before bedtime (for example: play video games, use the internet, or clean).	5	4	3	2	1
8.	I go to bed feeling stressed, angry, upset, or nervous.	5	4	3	2	1
9.	I use my bed for things other than sleeping or sex (for example: watch television, read, eat, or study).	5	4	3	2	1
10.	I sleep on an uncomfortable bed (for example: poor mattress or pillow, too much or not enough blankets).	5	4	3	2	1
11.	I sleep in an uncomfortable bedroom (for example: too bright, too stuffy, too hot, too cold, or too noisy).	5	4	3	2	1
12.	I do important work before bedtime (for example: pay bills, schedule, or study).	5	4	3	2	1
13.	I think, plan, or worry when I am in bed.	5	4	3	2	1

Appendix G

Hardcopy Version of Instrument (reformatted to fit page)

UNIVERSITY OF CINCINNATI STUDENT SLEEP BEHAVIOR SURVEY

Consent and Directions: Participation in this survey is voluntary. You may choose to stop this survey at any time. The results of this survey will be used to develop health promotion programs to improve the quality of college students' sleep. Please rest assured that your responses and any information that could be used to identify you will remain strictly confidential. Your participation in this survey implies your consent.

Please answer the following questions to ensure you are eligible to participate in this survey. Please place an **"X"** next to the appropriate response:

Are you between the ages of 18 and 24?

_____ Yes
_____ No **(If you answered NO, you are not eligible to participate in this study)**

Do you reside with a parent or legal guardian?

_____ Yes **(If you answered YES, you are not eligible to participate in this study)**
_____ No

Are you currently married?

_____ Yes **(If you answered YES, you are not eligible to participate in this study)**
_____ No

SECTION 1

The questions in this section make use of rating scales with seven (**7)** answers. Please indicate where you fall on the scale. For each question, please **circle** one number that is true for you. Please do not leave any questions blank.

- *In this first set of questions, please consider how much control you feel you have over your sleeping habits.*

5. For me, to sleep 7 to 8 hours every night is

not practical : 1 : 2 : 3 : 4 : 5 : 6 : 7 : practical

6. If I wanted to, I am sure I could sleep for 7 to 8 hours every night

   completely disagree: 1 : 2 : 3 : 4 : 5 : 6 : 7 : completely agree

7. It is up to me whether or not I sleep 7 to 8 hours every night

   completely disagree: 1 : 2 : 3 : 4 : 5 : 6 : 7 : completely agree

8. I have complete control over my ability to sleep 7 to 8 hours every night

   no control : 1 : 2 : 3 : 4 : 5 : 6 : 7 : complete control

- *In this next set of questions, please consider how you feel about sleeping for 7 to 8 hours every night.*

For me to sleep for 7 to 8 hours every night would be

(5) bad: 1 : 2 : 3 : 4 : 5 : 6 : 7 : good

(6) unhealthy: 1 : 2 : 3 : 4 : 5 : 6 : 7 : healthy

(7) not refreshing: 1 : 2 : 3 : 4 : 5 : 6 : 7 : refreshing

(8) unnecessary: 1 : 2 : 3 : 4 : 5 : 6 : 7 : necessary

(9) not enjoyable: 1 : 2 : 3 : 4 : 5 : 6 : 7 : enjoyable

(10) detrimental to my social life: 1 : 2 : 3 : 4 : 5 : 6 : 7 : beneficial to my social life

- *In this next set of questions, please consider those individuals whose opinions you value most.*

(11) My friend(s) want me to sleep 7 to 8 hours every night

completely disagree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : completely agree

(12) My parent(s)/guardian(s) want me to sleep 7 to 8 hours every night

completely disagree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : completely agree

(13) My supervisors (e.g. professors/employers) want me to sleep 7 to 8 hours every night

completely disagree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : completely agree

(14) Most people who are important to me want me to sleep 7 to 8 hours every night

completely disagree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : completely agree

- *In this next set of questions, please consider your personal sleeping habits.*

(15) In the next 24 hours, I intend to sleep 7 to 8 hours at night time

completely disagree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : completely agree

(16) In the next 24 hours, I plan to sleep 7 to 8 hours at night time

completely disagree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : completely agree

(17) In the next 24 hours, I will try to sleep 7 to 8 hours at night time

completely disagree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : completely agree

(18) In the past 24 hours, how many hours and minutes did you sleep at night time? (please **write in** the appropriate response)

_____ Hours and _____ Minutes

SECTION 2

The questions in this section make use of rating scales with seven **(7)** places. Please indicate on which end of the scale you mostly agree. For each question, please **circle** one number that is true for you. Please do not leave any questions blank.

- *In this set of questions, please consider your daily sleeping habits.*

(19) I take daytime naps lasting two or more hours

always: 1 : 2 : 3 : 4 : 5 : 6 : 7 : never

(20) I go to bed at different times from day to day

always: 1 : 2 : 3 : 4 : 5 : 6 : 7 : never

(21) I get out of bed at different times from day to day

always: 1 : 2 : 3 : 4 : 5 : 6 : 7 : never

(22) I exercise to the point of sweating within one hour of going to bed

always: 1 : 2 : 3 : 4 : 5 : 6 : 7 : never

(23) I stay in bed longer than I should two or three times a week.

always: 1 : 2 : 3 : 4 : 5 : 6 : 7 : never

(24) I use alcohol, tobacco, or caffeine within four hours of going to bed or after going to bed.

always: 1 : 2 : 3 : 4 : 5 : 6 : 7 : never

(25) I do something that may wake me up before bedtime (e.g., play video games, use the internet, or clean)

always: 1 : 2 : 3 : 4 : 5 : 6 : 7 : never

(26) I go to bed feeling stressed, angry, upset, or nervous

always: 1 : 2 : 3 : 4 : 5 : 6 : 7 : never

(27) I use my bed for things other than sleeping or sex (e.g., watch television, read, eat, or study)

always: 1 : 2 : 3 : 4 : 5 : 6 : 7 : never

(28) I sleep on an uncomfortable bed (e.g., poor mattress or pillow, too much or not enough blankets)

always: 1 : 2 : 3 : 4 : 5 : 6 : 7 : never

(29) I sleep in an uncomfortable bedroom (e.g., too bright, too stuffy, too hot, too cold, or too noisy)

always: 1 : 2 : 3 : 4 : 5 : 6 : 7 : never

(30) I do important work before bedtime (e.g., pay bills, schedule, or study)

always: 1 : 2 : 3 : 4 : 5 : 6 : 7 : never

(31) I think, plan, or worry when I am in bed

always: 1 : 2 : 3 : 4 : 5 : 6 : 7 : never

SECTION 3

- *For this last section, please place an* **"X"** *next to the appropriate response. All responses will be kept confidential and private. Only group data will be reported.*

(32) What is your gender?

_____ Male _____ Female

(33) What is your age? (please **write** your response)

_____ Years

(34) What year student are you?

_____ First Year _____ Third Year _____ Fifth Year and above
_____ Second Year _____ Fourth Year

(35) Are you enrolled as a part-time or full-time student?

_____ Part-time _____ Full-time

(36) How many credit hours are you currently taking?

_____ Credit hours (please **write** your response)

(37) Do you have a part-time or full-time job?

_____ Unemployed _____ Part-time _____ Full-time

(38) If you indicated you have a part-time or full-time job, how many hours do you work per week? ***If you are unemployed, please enter "0".*

_____ **Average** number of hours per week (please **write** your response as a single number and not a range)

(39) Do you have any children?

_____ Yes _____ No

(40) If you indicated you have children, how many children do you have? ****If you have no children, please enter "0".*

_____ Number of children (please **write** your response)

(41) What is your race/ethnicity?

_____ African American
_____ Asian
_____ Caucasian
_____ Hispanic
_____ Multi-racial
_____ Other

(42) What is your college major?

_____ Architecture
_____ Behavioral & Social Sciences
_____ Business
_____ Computers & Technology
_____ Construction & Building Trades
_____ Culture & Languages
_____ Design
_____ Education
_____ Engineering
_____ Humanities
_____ Law & Social Justice
_____ Medicine & Health
_____ Natural Science & Math
_____ Performing Arts & Music
_____ Politics
_____ Social Service
_____ Other/Undecided

(43) What is your current *overall* Grade Point Average? (please **write** your response using a 4.0 scale)

_____/ 4.0

Thank you for your time and participation!

Appendix H

Copy of the Approval Letter from the Institutional Review Board at University of Cincinnati to Collect Data

UNIVERSITY OF Cincinnati

Institutional Review Board - Social/Behavioral Sciences
University of Cincinnati
PO Box 210567
Cincinnati, OH 45221-0567

51 Goodman Drive
University Hall, Suite 300
(513) 558-5784 Phone
(513) 558-4111 Fax

November 12, 2010

Adam Knowlden, MBA
Department of Health Promotion and Education
ML # 0068

RE: IRB # 10-10-13-03E "Theory of Planned Behavior Based Predictors of Sleep Intentions and Behaviors in Undergraduate Students Attending a Midwestern University"

The University of Cincinnati Institutional Review Board – Social and Behavioral Sciences (UC IRB-S) has reviewed your research project and has granted approval under Expedited category 45 CFR 46.110.

APPROVAL DATE: November 11, 2010
EXPIRATION DATE: November 11, 2011

The following document versions are included in this approval.
Protocol v.11-11-10
Consents (phase 1 and 2) v. 11-11-10
Recruitment v. 11-11-10

The research MUST be conducted EXACTLY as approved. You must report to the Chair of the UC IRB-S any changes affecting the protocol upon which this certification is based. No changes may be made without prior approval by the Board except those necessary to eliminate immediate hazards.

Attached you will find some or all of the following:
1. APPROVED consent(s): document is locked and shows the IRB approved/expires date stamp. You MUST use this version (with IRB approved / expires date stamp) with your participants.
2. Investigator Responsibilities: these apply to all UC research team members involved with human subject research.

Should your project extend beyond the expiration date, you must submit a Progress Report form A MONTH BEFORE THE EXPIRATION DATE indicating that the project is continuing. You will need to attach to the Progress Report a copy of the first signed consent (with IRB approved / expires date stamp) to document use of the approved versions.

IT IS YOUR RESPONSIBILITY to keep track of your project's expiration date and to submit a Progress Report either to continue or to close your study. If the IRB-S does not reapprove your research by the specified expiration date, ALL research activities MUST STOP, including recruitment and enrollment of participants, interventions and interactions with current participants, collection of data, and data analysis.

Please note, this approval is through the U.C. IRB only. You may be responsible for reporting to other regulatory officials (e.g., VA Research and Development Office, UC Health- University Hospital). Please check with your Institution and Department to ensure you have met all reporting requirements.

Julie Waltz-Gerlach, BSN, MPH, CIP
Chair, UC IRB-S

Statement regarding International Conference on Harmonisation and Good Clinical Practices
The University of Cincinnati Institutional Review Board is duly constituted (fulfilling FDA requirements for diversity), has written procedures for initial and continuing review of clinical trials: prepares written minutes of convened meetings, and retains records pertaining to the review and approval process; all in compliance with requirements defined in 21 CFR Parts 50, 56 and 312 Code of Federal Regulations. This institution is in compliance with the ICH GCP as they correspond to FDA/DHHS regulations.

An affirmative action/equal opportunity institution

Appendix I

Solicitation E-mail to Participants

Dear Fellow Student:

I am a graduate student at the University of Cincinnati pursuing my Master's degree in Health Promotion & Education. I am conducting an investigation on the sleeping patterns of undergraduate students attending our university. As students, sleep deprivation has a profound impact on our health and ability to learn. I am interested in investigating this topic further so I can develop health promotion programs designed to enhance the sleep quality of UC college students. I am writing to request that you share your opinion about this important health issue by completing a brief survey about your sleeping patterns.

Please note that to participate in this study you must be:

- Of Undergraduate status
- Between 18 and 24
- Not reside with a parent or legal guardian
- Be unmarried

By clicking on the link below, you will be re-directed to a brief electronic survey that asks a variety of questions about your opinion of sleeping for seven to eight hours each night.

<LINK>

Please be rest assured that the web site you will be directed to is completely safe and used regularly by universities for academic research. If you choose to participate, please agree to allow your answers to be included in this study by pressing the "yes" button at the bottom of the first screen. Please note there is no right or wrong answer to any of the questions in this survey. This survey will take about 10 minutes to complete.

The survey is anonymous and no personal information will be collected about you from the web site. Only group data will be reported. Thank you in advance for your assistance in my research project. If you have any questions, please feel free to contact me at any time. My contact information can be found at the bottom of this letter.

Sincerely,

Adam Knowlden

_____

Adam Knowlden
Graduate Student
Health Promotion & Education
University of Cincinnati
Teacher's College
P.O. Box 210002
Cincinnati, OH 45221-0002

Appendix J

Information Sheet for Electronic Instrument

UNIVERSITY OF Cincinnati
Institutional Review Board – Social & Behavioral Sciences
IRB # 10-10-13-03
APPROVED 11-11-10
EXPIRES 11-11-11

Information Sheet for Research
University of Cincinnati
Department: Health Promotion and Education
Principal Investigator: Adam Knowlden
Faculty Advisor: Manoj Sharma

Title of Study: Theory of Planned Behavior Based Predictors of Sleep Intentions and Behaviors in Undergraduate Students Attending a Midwestern University.

What is the purpose of this research study?
The purpose of this research study is to develop a theoretical framework to predict the sleep intentions and behaviors of undergraduate college students. Ultimately, the results of this study will be used to develop health education programs designed to promote healthy sleeping habits among undergraduate college students.

Who will be in this research study?
Approximately 197-263 students will be participating in this phase of the research study. You may be in this study if you are a student of undergraduate status currently enrolled at the University of Cincinnati, are between the ages of 18 and 24, are unmarried, and do not reside with a parent or guardian.

What will you be asked to do in this research study, and how long will it take?
You will be asked to complete a set of questions which will take approximately 10-15 minutes.

Are there any risks to being in this research study?
There are no anticipated risks for being in this research study.

Are there any benefits from being in this research study?
There will be no direct benefit to you as a result of this study. However, your responses will be used to help better understand how to educate students on the importance of receiving seven to eight hours of sleep each night.

Will you have to pay anything to be in this research study?
You will not be compensated for participating in this research study.

What will you get because of being in this research study?
You will not be given anything for participating in this research study.

Do you have choices about taking part in this research study?
If you do not want to take part in this research study you may stop at any time.

How will your research information be kept confidential?
Because this is an online survey that can be done at your convenience, your privacy is protected. Data collected electronically will be kept in a password protected folder for three years. After that it will be deleted. Agents of the University of Cincinnati may inspect study records for audit or quality assurance purposes.

Appendix J

Information Sheet for Electronic Instrument (cont.)

UNIVERSITY OF Cincinnati
Institutional Review Board – Social & Behavioral Sciences
IRB # 10-10-13-03
APPROVED 11-11-10
EXPIRES 11-11-11

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

What if you have questions about this research study?
If you have any questions or concerns about this research study, you should contact Adam Knowlden at: knowldam@email.uc.edu or Dr. Manoj Sharma at: manoj.sharma@uc.edu.

The UC Institutional Review Board – Social and Behavioral Sciences (IRB-S) reviews all non-medical research projects that involve human participants to be sure the rights and welfare of participants are protected.

If you have questions about your rights as a participant or complaints about the study, you may contact the Chairperson of the UC IRB-S at (513) 558-2086. Or, you may call the UC Research Compliance Hotline at (800) 889-1547, or write to the IRB-S, 300 University Hall, ML 0567, 51 Goodman Drive, Cincinnati, OH 45221-0567, or email the IRB office at irb@ucmail.uc.edu.

Do you HAVE to take part in this research study?
No one has to be in this research study. Refusing to take part will NOT cause any penalty or loss of benefits that you would otherwise have. You may start and then change your mind and stop at any time. To stop being in the study, you should close out of your Internet browser.

**BY SELECTING YES BELOW, YOU INDICATE CONSENT FOR YOUR ANSWERS TO BE USED IN THIS RESEARCH STUDY.

(Forced reply; in order to proceed to the survey, the participant must select either yes or no. If they select yes, they are allowed to proceed with the survey. If they select no, they are automatically exited from the survey)

PLEASE PRINT THIS INFORMATION SHEET FOR YOUR RECORDS.

(Print button will be provided)

Appendix K

Electronic Version of Instrument

Screen 1

University of Cincinnati Student Sleep Behavior Survey

IRB # 10-10-13-03
APPROVED 11-11-10
EXPIRES 11-11-11

Information Sheet for Research
University of Cincinnati
Department: Health Promotion and Education
Principal Investigator: Adam Knowlden
Faculty Advisor: Manoj Sharma

Title of Study: Theory of Planned Behavior Based Predictors of Sleep Intentions and Behaviors in Undergraduate Students Attending a Midwestern University.

What is the purpose of this research study?
The purpose of this research study is to develop a theoretical framework to predict the sleep intentions and behaviors of undergraduate college students. Ultimately, the results of this study will be used to develop health education programs designed to promote healthy sleeping habits among undergraduate college students.

Who will be in this research study?

Up to 300 students will be participating in this research study. You may be in this study if you are a student of undergraduate status currently enrolled at the University of Cincinnati, are between the ages of 18 and 24, are unmarried, and do not reside with a parent or guardian.

What will you be asked to do in this research study, and how long will it take?
You will be asked to complete a set of questions which will take approximately 10-15 minutes.

Are there any risks to being in this research study?
There is no apparent risk.

Are there any benefits from being in this research study?

There will be no direct benefit to you as a result of this study. However, your responses will be used to help better understand how to educate students on the importance of receiving seven to eight hours of sleep each night.

You will not be compensated for participating in this research study.

What will you get because of being in this research study?
There will be no direct benefit to you as a result of this study.

Do you have choices about taking part in this research study?
If you do not want to take part in this research study you may stop at any time.

How will your research information be kept confidential?
Data collected electronically will be kept in a password protected folder for three years. After that it will be deleted. Agents of the University of Cincinnati may inspect study records for audit or quality assurance purposes.

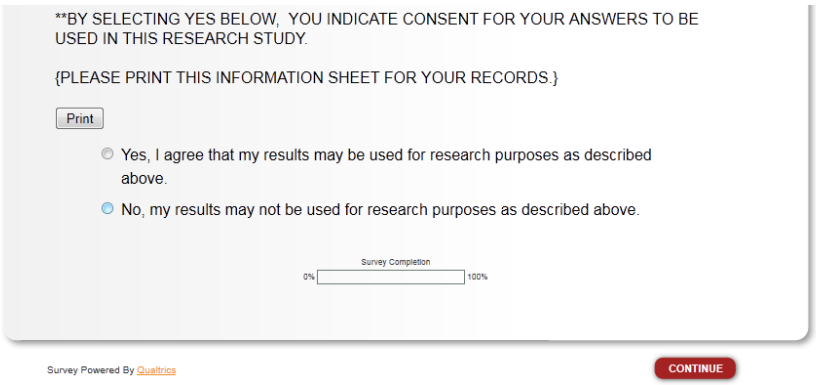
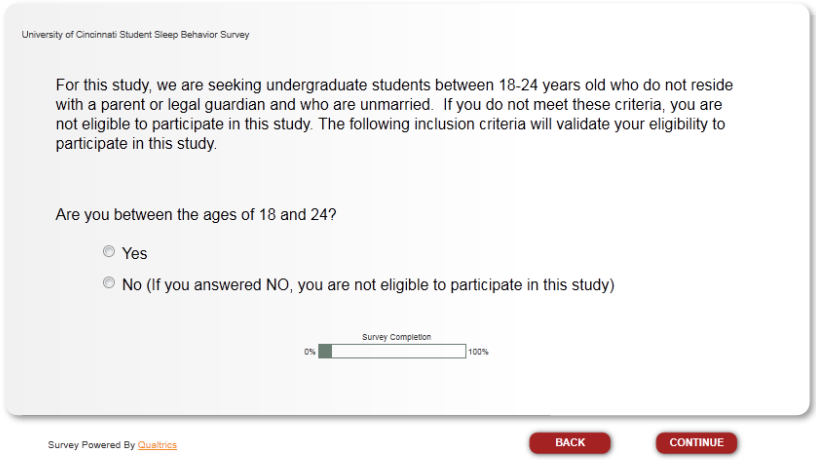
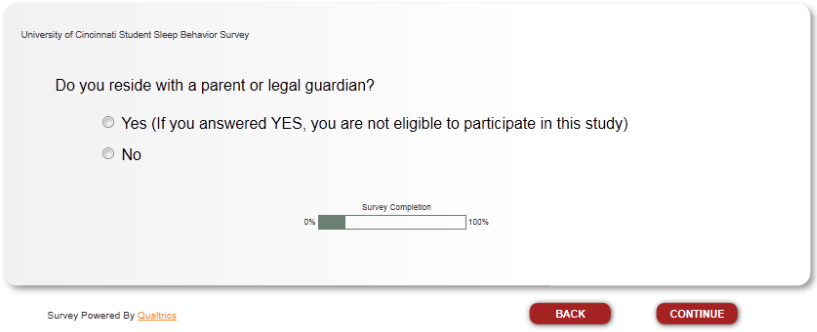
What are your legal rights in this research study?
Nothing in this consent form waives any legal rights you may have. This consent form also does not release the investigator, the institution, or its agents from liability for negligence.

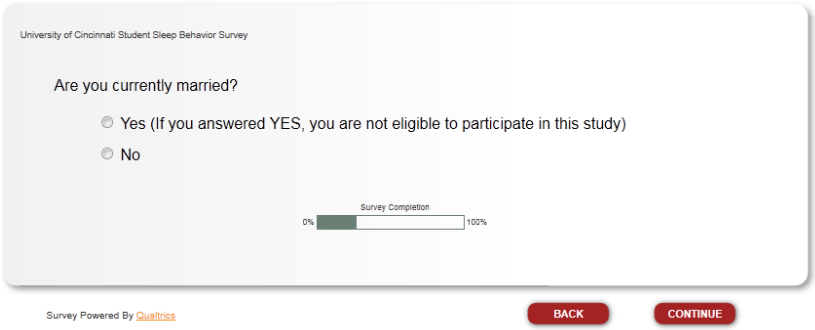
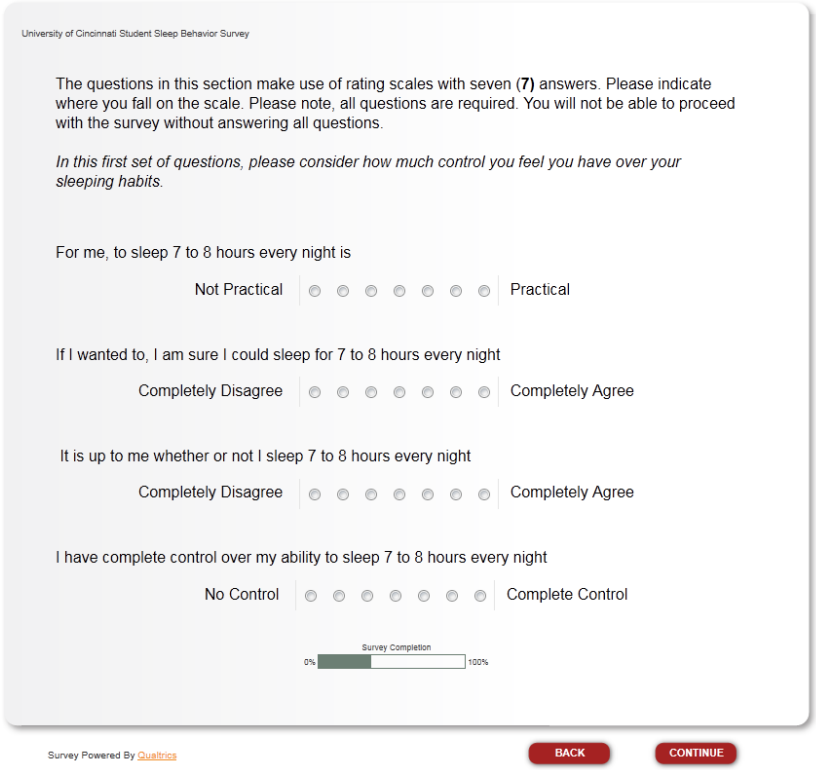
What if you have questions about this research study?
If you have any questions or concerns about this research study, you should contact Adam Knowlden at: knowldam@email.uc.edu or Dr. Manoj Sharma at manoj.sharma@uc.edu.

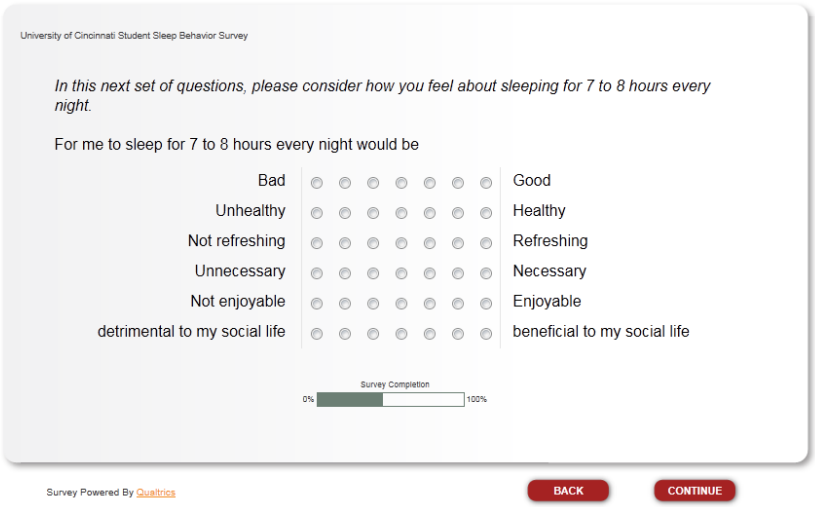
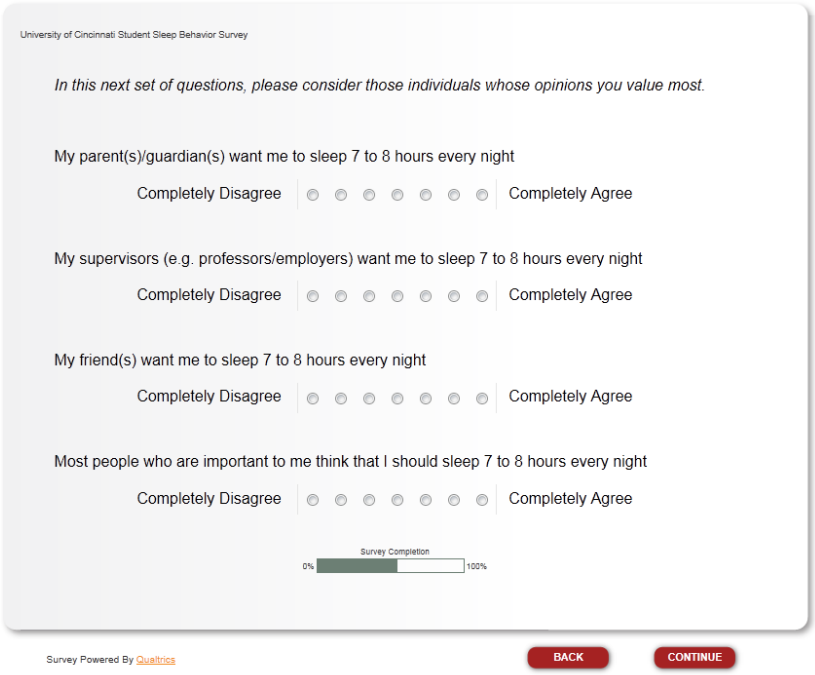
The UC Institutional Review Board – Social and Behavioral Sciences (IRB-S) reviews all non-medical research projects that involve human participants to be sure the rights and welfare of participants are protected.

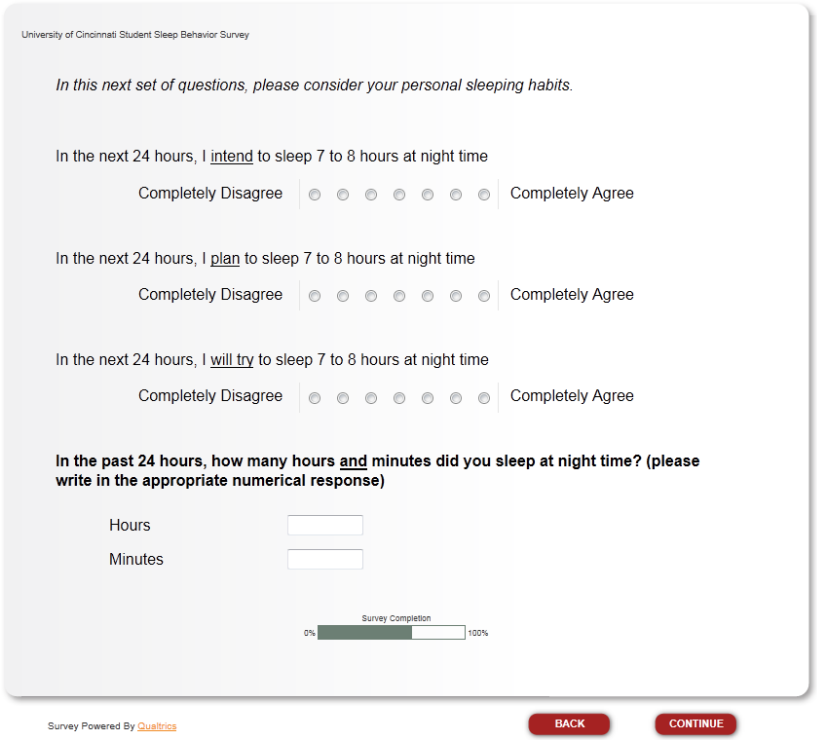
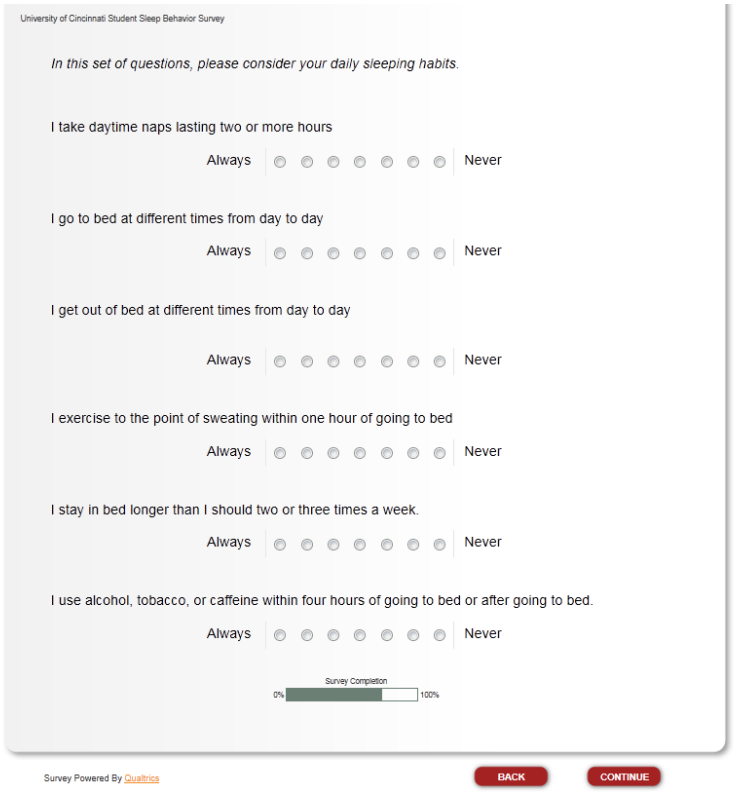
If you have questions about your rights as a participant or complaints about the study, you may contact the Chairperson of the UC IRB-S at (513) 558-5784. Or, you may call the UC Research Compliance Hotline at (800) 889-1547, or write to the IRB-S, 300 University Hall, ML 0567, 51 Goodman Drive, Cincinnati, OH 45221-0567, or email the IRB office at irb@ucmail.uc.edu.

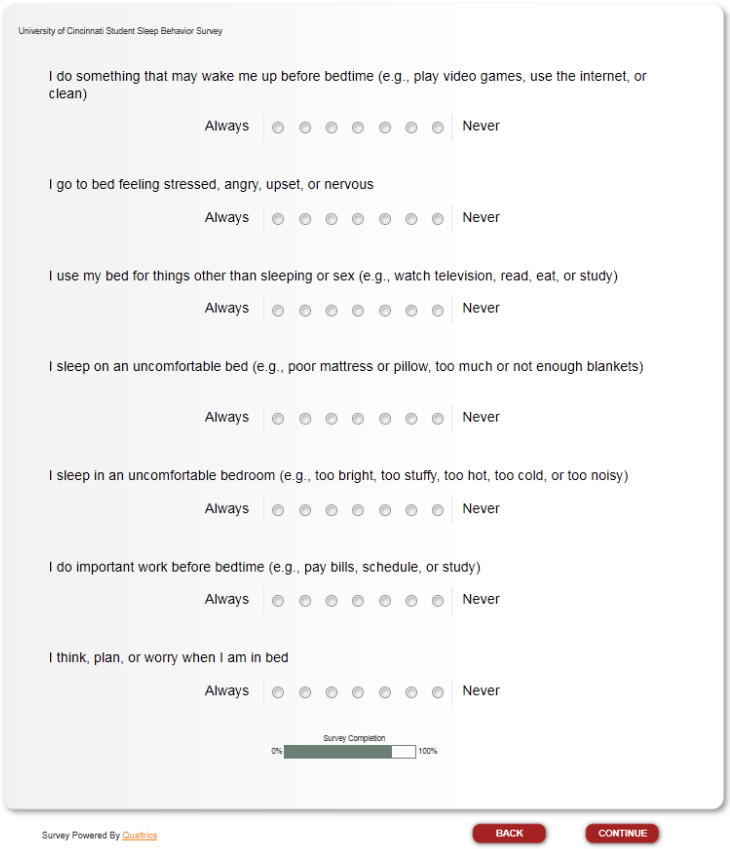
Do you HAVE to take part in this research study?
No one has to be in this research study. Refusing to take part will NOT cause any penalty or loss of benefits that you would otherwise have. You may start and then change your mind and stop at any time. To stop being in the study, you should tell Adam Knowlden.

	
Screen 2	
Screen 3	

Screen 4	
Screen 5	

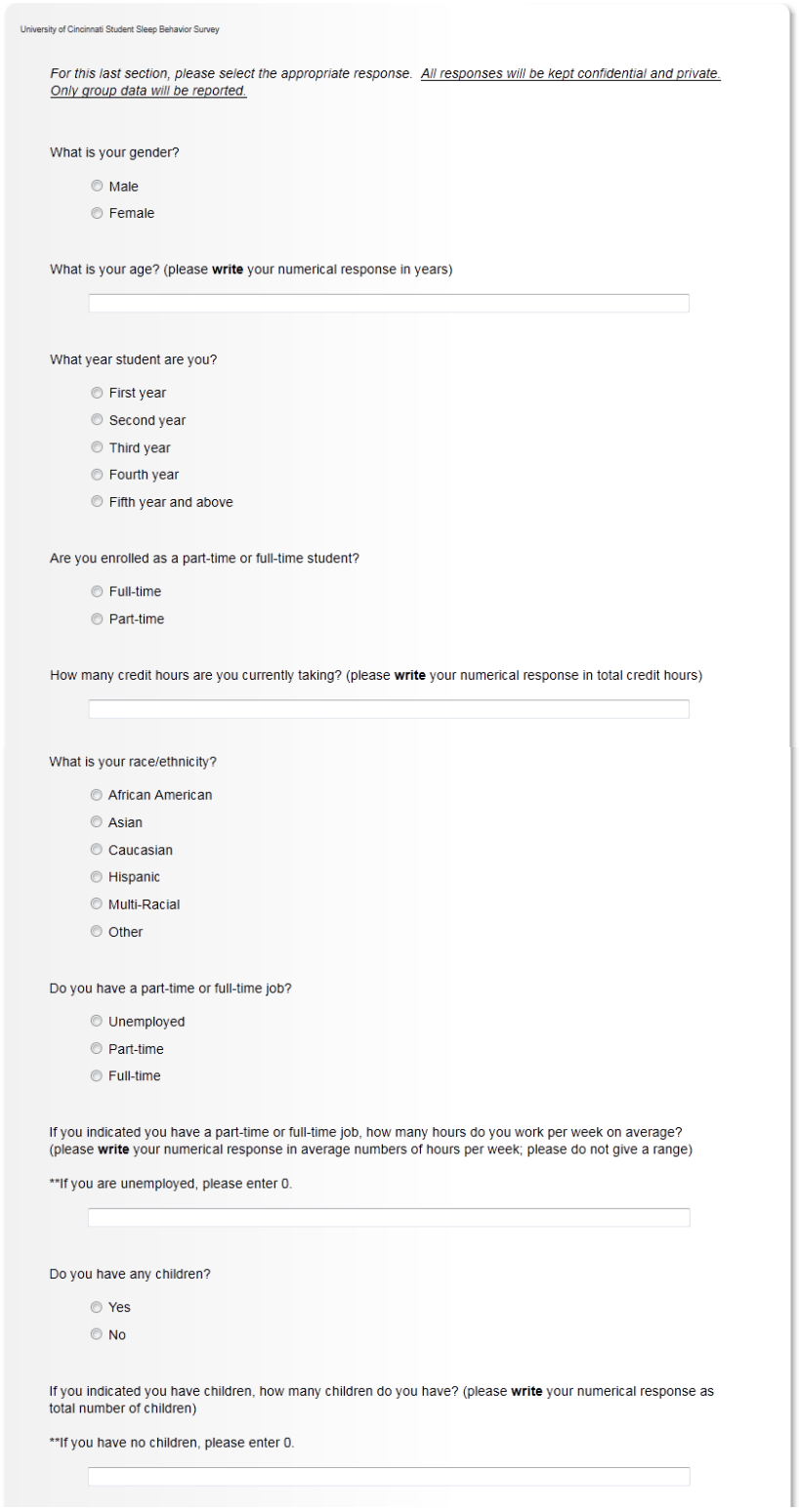
Screen 6	
Screen 7	

Screen 8	
Screen 9	

Screen 10	

University of Cincinnati Student Sleep Behavior Survey
I do something that may wake me up before bedtime (e.g., play video games, use the internet, or clean)
Always
Never
I go to bed feeling stressed, angry, upset, or nervous
Always
Never
I use my bed for things other than sleeping or sex (e.g., watch television, read, eat, or study)
Always
Never
I sleep on an uncomfortable bed (e.g., poor mattress or pillow, too much or not enough blankets)
Always
Never
I sleep in an uncomfortable bedroom (e.g., too bright, too stuffy, too hot, too cold, or too noisy)
Always
Never
I do important work before bedtime (e.g., pay bills, schedule, or study)
Always
Never
I think, plan, or worry when I am in bed
Always
Never
Survey Completion
0%
100%
Survey Powered By Qualtrics
BACK
CONTINUE

Screen 11



University of Cincinnati Student Sleep Behavior Survey

For this last section, please select the appropriate response. All responses will be kept confidential and private. Only group data will be reported.

What is your gender?

- Male
- Female

What is your age? (please **write** your numerical response in years)

What year student are you?

- First year
- Second year
- Third year
- Fourth year
- Fifth year and above

Are you enrolled as a part-time or full-time student?

- Full-time
- Part-time

How many credit hours are you currently taking? (please **write** your numerical response in total credit hours)

What is your race/ethnicity?

- African American
- Asian
- Caucasian
- Hispanic
- Multi-Racial
- Other

Do you have a part-time or full-time job?

- Unemployed
- Part-time
- Full-time

If you indicated you have a part-time or full-time job, how many hours do you work per week on average? (please **write** your numerical response in average numbers of hours per week; please do not give a range)

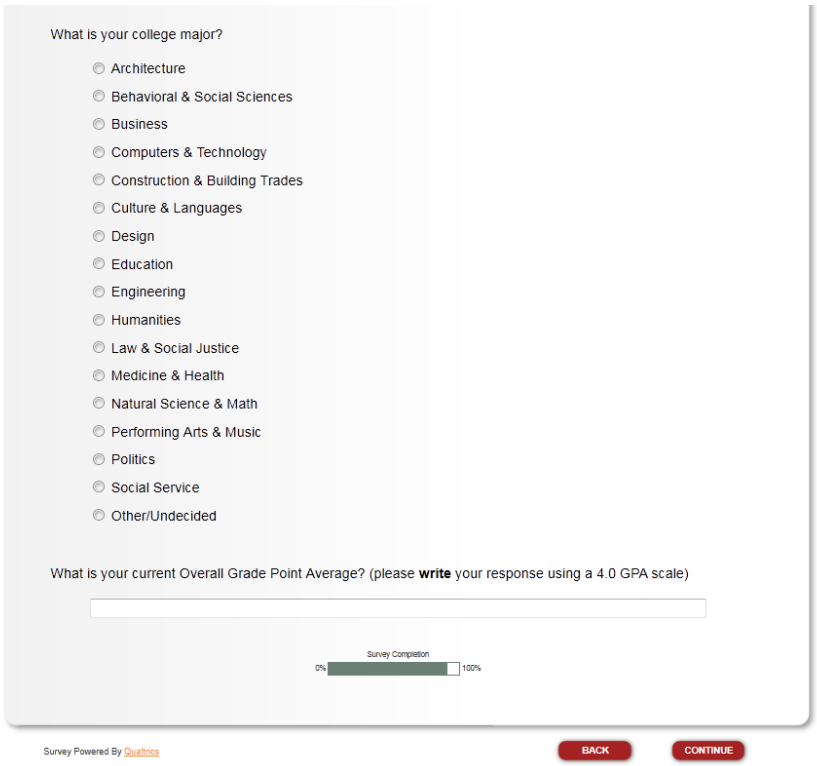
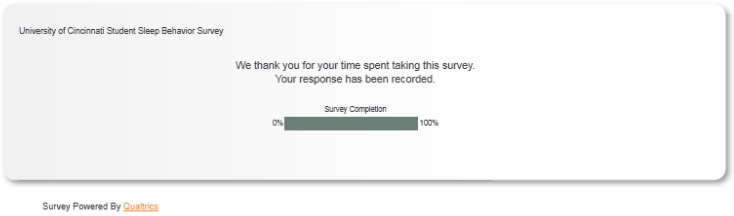
**If you are unemployed, please enter 0.

Do you have any children?

- Yes
- No

If you indicated you have children, how many children do you have? (please **write** your numerical response as total number of children)

**If you have no children, please enter 0.

	 What is your college major? Architecture Behavioral & Social Sciences Business Computers & Technology Construction & Building Trades Culture & Languages Design Education Engineering Humanities Law & Social Justice Medicine & Health Natural Science & Math Performing Arts & Music Politics Social Service Other/Undecided What is your current Overall Grade Point Average? (please **write** your response using a 4.0 GPA scale) Survey Completion 0% 100% Survey Powered By Qualtrics BACK CONTINUE
Screen 12	 University of Cincinnati Student Sleep Behavior Survey We thank you for your time spent taking this survey. Your response has been recorded. Survey Completion 0% 100% Survey Powered By Qualtrics