PREDICTING SLEEP DURATION IN COLLEGE STUDENTS:

A REASONED ACTION APPROACH

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Predicting Sleep Duration in College Students: A Reasoned Action Approach

The negative consequences of poor sleep and sleep deprivation are well documented. Poor quality and insufficient sleep affect both physiological and cognitive processes and are linked to many chronic illnesses (Division of Adult and Community Health, 2008; National Sleep Foundation, 2011). Importantly, the prevalence of chronic, partial sleep deprivation is high among both clinical and non-clinical populations and is most likely the most prevalent form of sleep disturbance. A telephone survey of 24,600 participants, 15 years and older from six populations (France, the UK, Germany, Italy, Portugal, and Spain), revealed that 27.2% reported chronic difficulty falling asleep, 18% had disrupted sleep, and another 8.9% experienced non-restorative sleep several nights a week (Ohayon & Roth, 2001). People who experience sleep deprivation are more likely to have depression and anxiety and report more illness than those who get adequate sleep. Additionally, poor sleepers (those with sleep deprivation or interrupted sleep cycles) tend to have impaired speech and vision and often experience tremors or fatigue while carrying out daily activities (Murphey & Delanty, 2007). Hall and colleagues (2008) recently found that adults who reported sleeping less than 7-8 hours nightly were 45% more likely to have metabolic syndrome. They also found that shortened sleep duration was associated with abdominal obesity and elevated glucose levels, which is linked to hypertension. Similarly, Ayas and colleagues (2003) found that people who reported sleeping only 5-6 hours nightly had a moderately increased risk of coronary heart disease-related events, some leading to mortality.

In addition to physical health risks, several lines of research have documented cognitive and emotional impairments associated with sleep deprivation and poor sleep
quality. A recent meta-analyses revealed that chronic short-term sleep deprivation is correlated with decreased performance on many cognitive tasks including attention, processing speed, working memory and reasoning skills (Lim & Dinges, 2010). The largest deficits were observed for tasks requiring simple attention. This has important safety implications for many industrial jobs and those that require time spent driving, especially for those that require late-night and early morning shift work. There is also evidence that sleep deprivation leads to dysfunction in emotional regulation. Analyses of fMRI scans show that for sleep deprived participants who view emotionally negative stimuli there is 60% more activity in the amygdala, the region of the brain known to regulate negative emotions. Moreover, there is also a neural disconnect between the amygdala and cortical areas in the brain that regulate top-down processing of emotions (Yoo, Gujar, Hu, Jolesz, & Walker, 2007). This provides preliminary evidence for a causal relationship between sleep deprivation and mood disorders such as depression.

Though sleep dysfunction has negative physical and cognitive consequences across several populations, a particular group of interest is traditionally-aged college students (18-24 years old). Relatively few sleep studies, however, have examined the sleep habits of college students. By comparison, a relatively large literature has emerged focusing on the sleep habits of younger adolescents (11-17 years old). Although young adolescents require more sleep than older age groups, they are consistently one of the most sleep-deprived groups (e.g., Carskadon, Harvey, & Dement, 1981; Hansen, Janssen, Schiff, Zee, & Dubocovich, 2005; Roberts, Roberts, & Duong, 2009). Importantly, there is emerging evidence that this pattern of sleep deprivation continues into the college years (Lund, Reider, Whiting, & Prichard, 2010). College students experience a new freedom from
supervision allowing them more flexibility in their sleep schedules but likely encounter environments where regular and adequate sleep becomes difficult. They may have to deal with roommates, noisy neighbors, and the pressure to stay out late for social functions or to frequently use alcohol and recreational drugs. It is estimated that 75% of college students have occasional sleep problems and that around 13% experience chronic poor sleep quality (Buboltz, Soper, Brown, & Jenkins, 2002; Val-Smith, Felts, & Becker, 2009). Sleep deprivation and disturbance has also been linked to increased performance of health-risk behaviors in college students. Specifically, students who self-report poor sleep quality engage in fighting, smoking, alcohol use, and suicide ideation significantly more often than peers who receive adequate sleep (Val-Smith, et al., 2009).

**Changing Sleep Habits**

Providing good sleep hygiene information is a commonly proposed, but unfortunately minimally effective technique to increase quantity and quality of sleep. Such efforts typically provide educational information about the importance of sleep and good “sleep hygiene” behaviors. Recommended behaviors commonly include maintaining consistent sleep-wake times, getting an appropriate duration of sleep (e.g., at least 8 hours per day), avoiding caffeine, and other lifestyle practices that contribute to good sleep habits (Buboltz et al., 2002). While such educational interventions have good intentions, there is at best mixed support for effectiveness. Whereas some studies of adults with insomnia report gains in overall sleep time and quality (Lichstein & Riedel, 1994; Morin & Wootin, 1996; Murtagh & Greenwood, 1995), other studies report that increasing knowledge about sleep hygiene does not translate into behavioral change. Gallasch and Gradisar (2007) administered the Sleep Knowledge Questionnaire, the Sleep Behavior Self-Rating Scale, and
the Pittsburgh Sleep Quality Index to a large sample of college students who were
categorized as either good or poor sleepers. They found that even though there was a
significant relationship between sleep behavior and sleep quality, there was no
relationship between sleep knowledge and sleep hygiene practices. In fact, very poor
sleepers typically exhibited more knowledge about sleep hygiene than good sleepers, but
were seemingly unable to apply it to their own lives. This indicates that mere knowledge
about sleep and sleep hygiene is not sufficient for the successful carrying out of good sleep
practices.

The high prevalence of poor sleep and its consequent negative outcomes have led to
the search for effective treatments and interventions. One approach is the use of
pharmacological aids such as barbiturates and benzodiazepines. These medications act on
GABA receptors in the brain to reduce neural activity, resulting in drowsiness or a calming
effect (Nutt & Malizia, 2001). A meta-analysis of sleep studies using benzodiazepine
revealed that patients taking the drug had an increased overall sleep time of 61.8 minutes
compared to placebo groups. However, treatment groups also reported a range of negative
side effects including dizziness, daytime drowsiness, and memory difficulties (Holbrook,
Crowther, Lotter, Cheng, & King, 2000). Additionally, several other studies have reported
on the addictive properties of benzodiazepine as well as withdrawal symptoms and
intolerability in some patients (Maczaj, 1993; Morin & Wooten, 1999; Vincent & Lionberg,
2001). Given the high number of costs relative to benefits, it is not surprising that clinicians
have also employed nonpharmacological treatments for insomnia.

Psychological techniques for improving sleep have focused on cognitive and
behavioral factors in an attempt to change how people think about sleep as well as the
behaviors that directly affect sleep quality (for a review, see Murtagh & Greenwood, 1995). Specific treatment techniques vary but some have achieved a moderate level of success in improving sleep. A recent internet-based study administered a treatment package to adults with diagnosed insomnia and sleep difficulty (Ritterband, et al., 2009). The package included sleep restriction and stimulus control (providing rules about sleep time and bedroom environment), sleep hygiene (behaviors to perform and avoid to improve sleep), cognitive restructuring (changing thoughts about sleep), and relapse prevention. They found that those who participated in the treatment had significant improvements for insomnia severity, reduced waking after sleep onset, and improved sleep efficiency compared to a control group. However, because the treatments were administered as a package, it is not possible to determine their individual contributions or degree of effectiveness. Other studies have found that sleep quality can be improved through exercise and stretching (Tworoger et al., 2003), writing about experiences to facilitate emotional processing that can interfere with sleep (Harvey & Farrell, 2003), and teaching and practicing good sleep hygiene (Shoicket, Bertelson, & Lacks, 1988).

Most sleep intervention studies have focused on adults with clinical insomnia who were often referred to treatment by a physician and therefore were probably highly motivated to comply with and complete treatment. To the best of the authors’ knowledge, there is only one study that administered a sleep hygiene intervention to college students. Brown, Buboltz, and Soper (2006) developed the Sleep Treatment and Education Program for Students (STEPS) in an attempt to change sleep hygiene behaviors and improve sleep quality in an undergraduate sample. In support of the interventions, students who received the STEPS training had higher scores on the Sleep Hygiene Awareness and Practice Scale.
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(SHS) and lower scores on the Pittsburgh Sleep Quality Index (indicating better quality sleep), relative to a control group. However, it is important to note that effect sizes for sleep quality were significantly lower than those for sleep hygiene awareness, again, indicating that more knowledge about sleep hygiene does not necessarily lead to direct improvements in sleep quality.

**The Theory of Planned Behavior**

The varying degrees of success of current interventions to improve sleep leave room for additions and improvement. A key step in making these improvements may be to gain a better understanding of the factors that distinguish between people who do tend to perform or not perform good sleep hygiene behaviors. One method to acquire this information is to apply the Theory of Planned Behavior (Fishbein & Ajzen, 2010) to sleep hygiene.

The Theory of Planned Behavior (TPB) is a well-established social cognitive framework based on the premise that although any number of variables can lead to the performance of a specific behavior, only a very limited set are needed to accurately predict the intentions to perform that behavior. Specifically, attitudes, perceived normative pressure, and perceived behavioral control are thought to be the best predictors of the intention to perform a behavior. In turn, the TPB posits that behavioral intentions are the direct antecedents of actual behavior (Ajzen, 1985). Therefore, if we are able to adequately predict behavioral intentions then we should be able to predict actual behavior with reasonable accuracy.

The current conceptualization of the TPB was born from the Theory of Reasoned Action (TRA; see Ajzen & Fishbein, 1980), which included only 2 of the 3 TPB antecedents.
Specifically, TRA included attitudes and perceived norms (but not behavioral control) as predictors of behavioral intention. In both models, attitudes are the function of the behavioral beliefs one holds toward a particular object or behavior. Likewise, perceived normative pressure is the function of beliefs about what others think and do as well as how they expect us to think and act.

However, attitudes and perceived norms may not be sufficient for predicting behavioral intentions and behaviors. It is generally recognized that people’s perceptions of their volitional control over events influences their desire and ability to act on their intentions (e.g. Bandura, 1989; Fiske & Taylor, 1991; Rodin, 1986). Therefore, Ajzen (1985) proposed an extension to the TRA that includes perceived behavioral control (PBC; see Figure 1). Just as attitudes and perceived norms are derived from behavioral and normative beliefs, PBC is derived from the beliefs one holds about his or her ability to perform a behavior and the environmental circumstances that do or do not allow for the behavior. In all three cases these beliefs arise from a considerably large number of background factors such as personality traits, gender, political views, socioeconomic status, level of education, knowledge, etc. However, PBC is a unique factor of the theory because in addition to contributing to the prediction of intentions, it also directly predicts behavior. That is, PBC generally adds predictive validity above and beyond what is accounted for by intentions alone. This prediction is based on the idea that even if people hold favorable intentions, they are less likely to successfully perform a behavior if they do not have the necessary skills or if there are situational factors that prevent them from doing so.

Reasonably, we would only expect people to be able to act on their intentions if they have sufficient control to do so. Thus, to the degree that people hold accurate perceptions of
their skills and situational constraints, PBC should serve as a proxy measure of actual control and thus directly predict behavior.

Research has supported the effectiveness of the TPB for predicting a variety of intentions and behaviors. In a meta-analytic review, Armitage and Conner (2001) reported that the TPB accounted for an average 39% of the variance in intentions to perform a wide variety of behaviors. Similarly, Godin and Kok (1996) reviewed a large number of studies using the TPB and reported an average $R^2$ of .41 for the prediction of intentions. Furthermore, the prediction of behavior from intentions has resulted in correlations ranging from .47 to .62 (Fishbein, 2008).

**TPB and Sleep Habits**

Though its efficacy has been demonstrated in a broad variety of behavioral domains, there is limited research that applies the Theory of Planned Behavior to sleep hygiene. The research that has explored sleep hygiene in the TPB framework has produced interesting but somewhat limited results. In a study designed to compare the TPB with the earlier TRA approach, Madden, Ellen and Ajzen (1992) asked college students to list behaviors they anticipated performing over the next two-week period. The behaviors varied in level of control such that some were high in controllability (e.g. renting a videocassette) and others were lower (e.g. exercising regularly). Interestingly, “getting a good night’s sleep” was perceived as the behavior lowest in control. The TPB predicts that for behaviors perceived as having low control, the inclusion of PBC as a predictor will significantly increase the explained variance in the target behavior. The results of this study supported this hypothesis. Including PBC in the prediction of intentions increased the average $R^2$ from .48 to .59 across all behaviors, and, notably, from .08 to .17 for getting a good night’s sleep. For
predicting behavior, the addition of PBC increased the average $R^2$ from .28 to .38 for all behaviors and from .13 to .41 for getting a good night’s sleep, indicating that perceived control is a particularly important variable for predicting sleep behavior (also see Yzer, 2012).

However, “getting a good night’s sleep” is not a well-defined, volitional behavior. According to Fishbein and Ajzen (2010), the accurate prediction of a behavior requires that it be carefully defined by four elements: Target, action, context, and time (TACT). For example, “going to class” could be specifically defined as students (target) attending (action) all class periods for which they are registered (context) during the following week (time). Given this framework, it is clear that “getting a good night's sleep” does not meet the TACT requirement. Rather, “getting a good night’s sleep” is more accurately described as a behavioral goal that, in terms of the specific behaviors required to achieve the goal, is likely interpreted differently by different participants and in different contexts. Thus, from an applied research standpoint with an eye toward the design of future behavioral interventions to improve sleep quality, a likely more productive approach is the examination of specific sleep hygiene behaviors. An additional weakness of the Madden et al. (1992) study is that the behavioral measure relied exclusively on participant recall of the total frequency of the target behavior after the specified 2-week period. Because participants were not asked to record their behavior during the 2 weeks it is possible that there were significant errors in recall.

Rather than examining a goal, Sheeran, Trafimow, Finlay, and Norman (2002) examined the sleep of a sample of UK undergraduates using a behavioral definition that met TACT requirements. Specifically, they asked participants to report their attitudes,
subjective norms, PBC, and intentions toward “getting at least 7 hours’ sleep over the next two weeks” (p.259). They found that the TPB accounted for 33% of the variability in intentions, a notably higher proportion than reported by Madden et al. (1992).

Interestingly, whereas Sheeran et al. found both subjective norms and PBC to be significant predictors of intentions, attitudes toward getting at least 7 hours of sleep was not an independent predictor.

More recently, there has been some specific applied interest in the efficacy of the complete TPB model for predicting sleep hygiene intentions and behavior. Kor and Mullan (2011) found that the TPB significantly predicted both sleep hygiene intentions ($R^2 = 0.13$) and behavior ($R^2 = 0.07$) in a college student population. However, only perceived norms and perceived behavioral control were significant predictors. In contrast, Knowlden, Sharma, and Bernard (2012) reported that attitudes, perceived norms and PBC all significantly predicted obtaining 7-8 hours of sleep nightly. In this case, the TPB accounted for 36% of the variability in intentions and 18.5% of the variability in self-reported behavior. However, both of these studies are limited by the nature of their behavioral measurements. In the latter, measurement of sleep hygiene consisted solely of asking participants to recall how many hours they slept during the previous 24 hours, which technically constitutes a measure of past behavior rather than a prediction of future behavior. Kor and Mullan administered a questionnaire to measure sleep habits one week after the TPB measurements, when participants were required to recall, without aid, their behavior over the previous week.

In an attempt to better understand the relationship between sleep and the TPB Tagler and Stanko (in preparation) tested the model using a more comprehensive
definition of good sleep hygiene, based on recommendations from the National Sleep Foundation (www.sleepfoundation.org). Their definition consisted of six distinct behaviors: obtaining 8 hours of sleep nightly, maintaining consistent sleep/wake times, avoiding caffeine close to bedtime, avoiding alcohol close to bedtime, exercising regularly, and avoiding large meals close to bedtime. When participants were instructed to consider these behaviors collectively, the TPB explained a significant and very large amount of the variance in the intention to perform these behaviors \( (R^2 = .71) \). The relative contributions of attitudes, perceived norms, and PBC were similar in magnitude (standardized regression coefficients equal to 35, .28, and .37, respectively). Next, in a series of studies Tagler and Stanko separately examined each of the six sleep hygiene behaviors. Significant and large proportions of variance in behavioral intentions for all six behaviors were accounted for by the TPB constructs. However, the relative contribution of predictors varied across the behaviors. For example, all predictors were significant for intentions to get 8 hours of sleep and for keeping consistent sleep/wake times, but intentions to avoid caffeine and alcohol were predicted by attitudes only.

Taken together, the TPB appears to be a promising approach toward the prediction of sleep hygiene behaviors. However, additional studies are needed to examine the relationship between specific sleep hygiene intentions and actual behavior. Toward this goal, the current study focused on the specific behavior of sleeping 7-8 hours per night. The objective was to replicate previous results for the prediction of intentions and to extend them by also predicting behavior. College students completed TPB measures and then participated in a weeklong sleep study. Both self-reported sleep duration (with the aid of a
sleep diary) and an objective measure of sleep duration (as measured by wrist actigraphy) were obtained from each participant.

First, it was hypothesized that direct measures of attitudes, perceived norms, and PBC would collectively account for a significant proportion of the variability in intentions to obtain 7-8 hours of sleep nightly. Meta-analyses have found that attitudes, norms, and perceived control all tend to emerge as statistically significant predictors of various behaviors with effect sizes interpretable as at least small but not trivial (Armitage & Connor, 2001; Godin & Kok, 1996). Additionally, Knowlden et al. (2012) found that all three variables made significant and unique contributions to the prediction of intentions to obtain 7-8 hours of sleep. Finally, the current study included a sample drawn from the same population of college students as a previous study in which attitudes, perceived norms, and PBC all emerged as significant predictors of intentions (Tagler & Stanko, in preparation). Therefore, it is reasonable to expect similar results. However, conflicting results can be found in the literature on sleep and the TPB. As previously mentioned, Sheeran, Trafimow, Finlay, and Norman (2002) found that perceived norms and PBC, but not attitudes, significantly predicted getting at least 7 hours sleep. Kor and Mullan (2011) also found that attitudes were not a significant predictor of several sleep hygiene behaviors. Thus, if attitudes do not emerge as a significant predictor in the current study, the results could add support to the possibility that attitudes are not as important as perceived norms and PBC for predicting sleep duration.

Next, it was predicted that intentions to obtain 7-8 hours of sleep a night would significantly predict sleep duration. Also, because there is evidence that getting adequate sleep is perceived as difficult to control (Knowlden, et al., 2012; Kor & Mullan 2011,
Madden, et al., Ellen, & Ajzen, 1992; Sheeran et al., 2002; Tagler & Stanko, in preparation; Yzer, 2012) it was predicted that PBC would account for significant additional variability in sleep duration beyond what is predicted by intentions. Next, there has been mixed evidence for the validity of self-reported sleep as compared to objective measures of sleep, such as wrist actigraphy. Some studies have found no significant difference between self-reported sleep time and time recorded by actigraph monitors (e.g. Wolfson, et al., 2003) while others have found discrepancies (e.g. Lauderdale, Knutson, Yan, Liu, & Rathouz, 2008). Therefore, no specific prediction was made about the possibility of significant differences between the sleep duration measures, but it was expected that self-reported sleep durations and actigraph sleep duration would be significantly correlated. Lastly, because there is evidence that intentions are better predictors of self-reported behavior than objective behavior (Armitage & Conner, 2001) it is possible that intentions will account for a greater proportion of variability in sleep diaries than in wrist actigraphy.

Method

Participants

A total of 57 participants from a Midwestern university completed the full seven-day study. They were recruited from introductory psychology courses via an online sign-up system and received course credit in return for participation. However, three participants failed to wear the actigraph for at least four nights and were thus excluded from analyses, resulting in a sample size of 54. Of these participants 26 (48.1%) were female and 28 (51.9%) were male. The sample consisted primarily of participants who identified as White/Anglo-American (N = 43, 79.6%). Remaining participants identified as Black/African-American (N = 8, 14.8%), Asian/Pacific Islander (N = 2, 3.7%), and Hispanic
(N = 1, 1.9%). The mean age for the sample was 19.67 years ($SD = 1.53$) with a range of 18-26 years.

**Measures**

All predictor variables were measured using the questionnaire format outlined by the Theory of Planned Behavior (Fishbein & Ajzen, 2010). Participants were asked to respond to questions about obtaining 7-8 hours of sleep nightly. With regard to performing this behavior, questions assessed participants’ attitudes, perceived normative pressure, PBC, and intentions (see Appendix A). To assess internal reliability, Cronbach’s alpha was calculated for each measure.

**Attitudes.** Before beginning, participants read: “Please answer each of the following questions by selecting the interval that best describes your opinion toward “getting 7-8 hours of sleep each night during the following week.” Participants rated their attitudes by responding to a series of 12, 7-point semantic differential scales. The bipolar adjectives were selected to represent both instrumental and experiential components of attitudes. The instrumental component generally involves cognitive dimensions of the construct such as bad/good and valuable/worthless, while the experiential component involves affective dimensions such as pleasant/unpleasant and enjoyable/unenjoyable (Fishbein & Ajzen, 2010). Attitude scores were calculated by averaging responses across all items. Cronbach’s $\alpha$ for the 12 items was 0.89.

**Perceived Norms.** Participants read instructions to answer the following questions by selecting the interval that best described their opinion. Next, they responded to nine statements regarding the normative pressure they felt to obtain 7-8 hours of sleep nightly during the following week. They rated each statement on a 7-point Likert-Type scale. This
scale consisted of items measuring both injunctive and descriptive components of subjective norms. Injunctive norm items consisted of those assessing what others believe should or ought to be done (e.g., I feel social pressure to get 7-8 hours of sleep nightly. Strongly agree/Strongly disagree). In contrast, descriptive norm items assessed participants’ perceptions that others are or are not performing the target behavior (e.g., Most people who are important to me get 7-8 hours of sleep each night. Definitely true/Definitely false; Fishbein & Ajzen, 2010). A perceived norms score was calculated by averaging responses across all eight items. Cronbach’s $\alpha$ for this scale was 0.65.

**Perceived Behavioral Control.** Participants responded to eight statements assessing their perceived level of behavioral control toward getting 7-8 hours of sleep each night during the following week. All statements were rated using 7-point Likert-type scales. The measure was comprised of items to measure both capacity and autonomy components of PBC. Capacity items assessed perceived ability to perform the target behavior (e.g., I am confident that I can get 7-8 hours of sleep each night during the following week. Definitely true/Definitely false), and autonomy items assessed participants’ perceived control over the behavior, or how much it was “up to me.” (e.g., It is mostly up to me whether or not I to get 7-8 hours of sleep each night during the following week. Strongly Agree/Strongly Disagree; Fishbein & Ajzen, 2010). A PBC score was calculated by averaging across all items. Cronbach’s $\alpha$ for this scale was 0.88.

**Intentions.** Intentions were measured with seven statements rated on 7-point semantic differential scales (e.g., I plan to obtain 7-8 hours of sleep a night during the following week. Strongly agree/Strongly disagree, I expect to get 7-8 hours of sleep each
night during the following week. Strongly agree/Strongly disagree). An intention score was calculated by averaging across all items. Cronbach’s α for this scale was 0.88.

**Sleep Diary.** Sleep diaries have been a commonly used method for recording sleep habits both in and out of laboratories (Carney, et al., 2012; Ustinov, et al., 2010; Rogers, Caruso, & Aldrich, 1993). They are especially useful when direct measures of sleep cannot be obtained or when it would be impractical to do so, such as when a large sample is needed. Moreover, sleep diaries collected outside of the lab have the advantage of ecological validity. That is, unlike sleep lab studies, sleep diaries are designed to capture real-world sleep behavior with minimal intrusion to participants’ normal routines. In the present study, participants completed both a sleeptime (in-bed) and a waketime (out-of-bed) diary for one week (7 days). Waketime questions related to the previous night’s sleep such as the time the participant went to bed, how long it took them to fall asleep, sleep disturbances, time they woke up, and subjective total sleep duration. Sleeptime questions related primarily to the preceding day’s activities such as physical activity, caffeine and alcohol intake, and naps taken (see Appendix B).

**Actigraphy.** Wrist actigraph monitors (ActiSleep Monitor, ActiGraph, Inc., Pensacola, FL) were used to record participant sleep / wake times. The use of wrist actigraphy in conjunction with self-report measures has become increasingly popular in sleep research (Chung & Tso, 2010; Saksvik, et al., 2011; Wolfson et al., 2003). The monitor, which is roughly the size of a wristwatch, is relatively unobtrusive to wearers and is able to capture accurate sleep data in the convenience of the participant’s usual sleep domain. The actigraph operates by recording activity based on an epoch-to-epoch measurement and is analyzed using a specific algorithm known as the Cole-Kripke method.
(see Cole, Kripke, Gruen, Mullaney, & Gillin, 1992) that scores each 60-second epoch as either “Wake” or “Sleep”. Actigraphy validity has been established against sleep lab polysomnography, a type of sleep study that involves comprehensive recording of physiological changes occurring during sleep (Kushida, et al., 2001; Sadeh, Sharkey, & Carskadon, 1994; Souza et al., 2003). Actilife™ software version 6 (ActiGraph, Inc., Pensacola, FL) was used to manage the data from the actigraphs and to obtain sleep reports on each participant. The reports contain sleep/wake times, latency (the time elapsed between full consciousness and sleep onset: Sadeh et al., 1994), nighttime awakenings, sleep duration, and sleep efficiency (total sleep time divided by amount of time in bed; Cole et al., 1992).

**Procedure**

Students who consented to participate attended two 1-hour meetings scheduled one week (7 days) apart. During the initial meeting, participants first completed the Theory of Planned Behavior questionnaires assessing attitudes, perceived norms, perceptions of behavioral control, and behavioral intentions toward obtaining 7-8 hours of sleep each night. Next, they were introduced to the sleep diary and directed to complete a sleeptime portion before going to bed and a waketime portion upon awakening, everyday for the following seven days. They were then introduced to the actigraph and instructed to wear it for the proceeding week except when the device may get wet or undergo physical shock (e.g., during a shower, while playing football). The participant returned to the lab one week later to return their sleep diary and the actigraph, and to be debriefed.
Results

Descriptive Statistics and Bivariate Correlations

Sleep Duration. Average nightly sleep duration as measured by participants’ self-report and recorded by actigraphy were very strongly correlated, $r(46) = .87, p < .01$. Whereas the average nightly self-reported sleep duration was just under 8 hours (477.78 minutes) with a standard deviation of 62.20 minutes, the average duration recorded by actigraphy was considerably shorter: 6 hours and 44 minutes ($SD = 60.06$ minutes). A paired-samples t-test confirmed that participants reported sleeping significantly longer (>70 minutes) than what was objectively recorded by actigraphy, $t(53) = 17.51, p < .01, d = 2.38$.

Theory of Planned Behavior Constructs. Scores for the TPB constructs were calculated such that higher scores indicate more favorable attitudes, perceived normative pressure, PBC, and behavioral intentions toward obtaining 7-8 hours of sleep. The mean score for intention was 5.07 ($SD = 1.24$), indicating that on average students had relatively positive intentions to obtain 7-8 hours of sleep each night. All predictors of intentions were also relatively to moderately favorable; the highest mean score was attitude ($M = 6.00, SD = 0.71$), followed by PBC ($M = 4.74, SD = 1.33$) and perceived norms ($M = 4.70, SD = 0.77$).

Correlations between sleep duration and TPB constructs. Bivariate correlations between all measures are displayed in Table 1. As expected, the intercorrelations between TPB predictor variables were generally moderate ($rs = .28-.33$) with a somewhat stronger relationship between perceived norms and PBC ($r = .51$). Also as expected, the correlations between each predictor and intentions were significant, with perceived norms and PBC most strongly predictive of behavioral intentions. Intentions were positively correlated
with both sleep duration measures, but only statistically significant for self-reported sleep duration. However, PBC significantly predicted both self-reported and actigraph sleep durations. Consistent with the TPB model, correlations between attitudes and sleep duration, and perceived norms and sleep duration, were weaker and not significant.

**Predicting Intentions**

To test the hypothesis that attitudes, perceived norms, and PBC would combine to significantly predict intentions to obtain 7-8 hours of sleep nightly, all predictors were entered simultaneously into a multiple regression analysis. Despite significant bivariate correlations between TPB constructs, multicolinearity statistics were acceptable. Standardized and unstandardized beta coefficients can be seen in Table 2. The overall model was significant, $F(3, 50) = 27.90, p < .001$. Together the predictors accounted for 62.6% of the variance in intentions. However, only perceived norms and PBC were significant predictors; attitudes were not significant.

**Predicting Sleep Duration**

To test the hypothesis that intentions and PBC significantly predict sleep duration separate hierarchical multiple regressions were performed for self-reported and actigraph-measured sleep duration. As outlined by TPB guidelines (Fishbein & Ajzen, 2010), intentions were entered in step 1 and PBC was added in step 2. This allowed us to test the prediction that PBC will add significant predictive validity beyond what is accounted for by intentions. Results are displayed in Tables 3 and 4.

In the first analysis, intentions alone accounted for 8.8% of the variability in total self-reported sleep duration, a significant contribution, $F(1, 52) = 5.03, p < .05$. The inclusion of PBC in step 2 accounted for an additional 9.1% predicted variability, a
significant increase, $F(1, 51) = 5.64, p < .05$. Intentions became non-significant in the second step.

In the second analysis, actigraph-recorded total sleep duration was regressed onto intentions and PBC, again, in two steps. Intentions alone did not significantly predict sleep duration, $F(1, 52) = 2.90, p = .09, R^2 = .05$. However, the overall model became significant when PBC was added, accounting for 14.4% of the total variability in sleep duration, $F(1, 51) = 4.30, p < .05$. PBC uniquely predicted 9.1% of the variability, a significant increase, $F(1, 51) = 5.45, p < .05$. Intentions remained non-significant in the second step. Tests for multicollinearity did not reveal high levels of multicollinearity in either regression.

**Discussion**

The purpose of this study was to further the investigation of sleep hygiene in college students within the TPB framework. Because there is evidence that attitudes, perceived norms, and PBC may differentially relate to specific sleep hygiene behaviors (Tagler & Stanko, in preparation), the goal of the present study was to determine how the model applies specifically to obtaining between 7-8 hours of sleep nightly. I sought to replicate previous findings that TPB constructs significantly predict intentions to engage in this behavior (Knowlden et al., 2012). Furthermore, the study was designed to extend previous research by investigating the predictive relationship between intentions and behavior, as well as the direct relationship between PBC and behavior, using both self-report and objective measures.

The first hypothesis, that attitudes, perceived norms, and PBC would account for a significant and large proportion of the variability in intentions, was clearly supported. Together, these variables predicted 63% of the variability in intentions. This proportion is
notably higher than the average 39-41% variability explained in studies using the TPB across a variety of behaviors (Armitage & Conner, 2001; Godin & Kok, 1996) as well as what has been reported when explicitly investigated getting 7-8 hours of sleep (Knowlden, et al. 2012). Unlike some other studies, the current study had strict compatibility between measures, a specific and well-defined behavior, and scales with multiple items assessing each construct. This may have resulted in improved predictive validity relative to some previous studies using the TPB.

Although the overall model predicting intentions was significant, the prediction that attitudes, perceived norms, and PBC would each emerge as a significant and unique predictor was not supported; only perceived norms and PBC were significant when entered simultaneously into the multiple regression. This is inconsistent with recent work suggesting that all three would be significant (Tagler & Stanko, in preparation) and with other studies using the TPB, which have generally found attitudes to be the strongest predictor and perceived norms to be the weakest (Armitage & Connor, 2001; Fishbein & Ajzen, 2010).

Notably, Kor and Mullan (2011) and Sheeran et al. (2002) also reported non-significant results for attitudes. Kor and Mullan suggested two possible explanations for these results; incongruence between time elements of their attitude and intention measures, and a lack of distinction between cognitive (instrumental) and affective (experiential) aspects of attitudes. In contrast, the measures in the present study were designed to have strict compatibility of time elements (both attitude and intention measures made reference to “the following week”). Additionally, the attitude measure in the present study included both instrumental and experiential attitude components and
had high internal consistency. It is possible that attitudes were not a significant predictor of intentions to get 7-8 hours of sleep because participants were already anticipating the difficulties they could experience when actually carrying out the behavior. In other words, although participants held rather favorable attitudes toward the behavior, their intentions were weakened by a relatively lower perceived lack of control over being able to successfully obtain 7-8 hours of sleep per night. Furthermore, it is important to note the relative lack of variability in participants’ attitudes. Scores on this construct ranged from 4.17 to 7.00 on a 7-point scale, a finding that is somewhat inconsistent with recent studies by Tagler and Stanko (in preparation). Specifically, in a study with a larger sample \((N = 112)\) of college students, Tagler and Stanko found attitudes toward obtaining at least 8 hours of sleep was more variable, ranging from 1.67 to 7.00. It is possible that the sample size in the present study was not large enough to capture adequate variability in attitudes (i.e., individuals who have negative attitudes) to fully detect the attitude-intention relationship.

However, even if sample size were increased enough for attitudes to reach statistical significance, it appears that most college students report rather favorable attitudes toward obtaining 7-8 hours of sleep. As such, holding positive attitudes may be a necessary, but not sufficient factor in forming intentions to sleep 7-8 hours per night. In other words, at present attitudes do not appear to be an effective target for persuasive appeals and interventions designed to increase sleep duration intentions and behavior. However, further studies are needed to replicate the present findings and test this interpretation.

In the TPB framework, intentions serve as both an outcome variable (predicted by attitudes, perceived norms, and PBC) and also as the most proximal predictor variable for
actual behavior (Ajzen, 1985). Consistent with the model, it was expected that a significant portion of the variability in sleep duration would be predicted by intentions. Furthermore, because sleep behaviors are likely perceived as difficult, it was predicted that PBC would add additional predictive power over intentions (Madden, Ellen, & Ajzen, 1992). These predictions were largely confirmed with the exception that intentions alone did not significantly predict actigraph-recorded sleep duration. For self-reported sleep duration, intentions alone predicted 8.8% of the variability in sleep time and PBC explained an additional 9.1%. The overall model accounted for 17.9%, an amount that is similar to what has been found in previous research using self-report measures for sleep duration (Knowlde et al., 2012).

A particular strength of this study was that it was the first to use objective measures of sleep behavior within the TPB framework. Although sleep diaries are a common method for studying sleep, there are concerns over the accuracy of self-reports. It is possible that self-reported sleep duration is impacted by social desirability or response consistency biases. While some studies have found no significant differences between self-report and actigraph-recorded sleep habits (e.g. Wolfson, et al., 2003), others have found discrepancies between self-report and objective measures (e.g. Lauderdale, Knutson, Yan, Liu, & Rathouz, 2008). Although Fishbein and Ajzen (2010) have argued that self-reports are generally sufficient for most behaviors, they still recommend obtaining both self-reports and objective behavioral measures when feasible. This is particularly important under circumstances when it may be difficult for participants to accurately recall behavior (e.g. over long periods of time; for infrequent behavior) or when social desirability or self-presentation biases are a concern. Because, by definition, sleep involves a marked
reduction in consciousness, it is likely difficult for participants to accurately recall sleep behavior.

Actigraph results indicated that 14.4% of the variability in sleep duration was accounted for by the TPB; intentions alone accounted for 5.3% of the variability in actigraph-recorded sleep time and PBC explained an additional 9.1%. The total is somewhat smaller than the average 27% of variability explained by the TPB when using objective measures across a variety of behaviors (Armitage & Conner, 2001). However, Fishbein and Ajzen note that behaviors can differ widely in terms how much variability in behavior is explained by intentions. Some of the potential factors they cite as affecting the intention-behavior gap are measurement compatibility, temporal stability of intentions (i.e. if intentions change after measurement but prior to the performance of behavior), and accuracy of memory for intentions. Because the current study is the first to use objective measures of sleep behavior within the TPB, we cannot directly compare the magnitude of variability explained to what is typical or reasonably possible for this behavior. As a result, future studies on sleep habits should continue to employ both self-report and objective measures. Additionally, potential concerns about the intention-behavior gap should be examined. For example, temporal stability of intentions could be assessed by administering TPB measures both before and after performance of sleep hygiene behavior and examining for potential inconsistencies. Moreover, the degree to which sleep duration intentions are salient (activated and brought to awareness in relevant situations), elaborated on (considered in detail prior to carrying out the behavior), and are actually viable (under volitional control) should be investigated in future studies. The research literature on
implementation intentions (Gollwitzer & Sheeran, 2006) provides a strong theoretical framework for better understanding the intention–behavior relationship.

The difference in variability accounted for in self-reported and objective sleep duration in this study (18% and 14%, respectively) is notable, but not unexpected. Armitage and Conner (2001) found that when behavioral measures were self-reports, the TPB accounted for 31% of variance but only 21% when measures were objective or observed. This discrepancy could be an indication of social-desirability response bias, whether participants were trying to protect a favorable image of themselves (Johnson & Fredrich, 2005) or if they self-deceptively believed the information they presented (King & Brunner, 2000). Only two studies have directly examined the effects of social desirability on TPB constructs. Beck and Ajzen (1991) assessed the contribution of a measure of socially desirable responding to the prediction of dishonest actions and found that it accounted for 5% of the total variability. In contrast, Armitage & Conner (1999) found that social desirability did not mediate the relationship between TPB constructs and intentions to eat a low-fat diet. Future research on the TPB and sleep might consider whether social-desirability response bias is a validity threat by incorporating measures to detect such effects into regression analyses.

No specific predictions were made about the relative validity of the self-reported and actigraph-recorded sleep duration measures. However, as expected there was a significant and large correlation between the two measures. The average total self-reported sleep duration was more than one hour longer than what was recorded by actigraphy, indicating that participants consistently over-estimated the amount of sleep they obtained each night. The literature on sleep estimation provides mixed results such that some
samples have significantly overestimated (Lakshminarayana Tadimeti, Caruana-Montaldo, Wallace, & Mendelson, 2000; Rotenberg, Indursky, Kayumov, Sirota, & Melamed, 2000) and others have significantly underestimated (Trajanovic, Radivojevic, Kaushansky, & Shapiro, 2007) total sleep time. However, much of this research has been conducted on clinical populations with various mood and sleep disorders (e.g. depression, sleep apnea) and little is known about sleep estimation in non-clinical populations. Although, I did not screen participants for potential mood disorders or clinical sleep disturbances in the present study, Buboltz et al., (2002) estimate that up to 75% of college students experience only occasional sleep disturbance. Therefore, it is likely that the non-clinical sample in the present study consisted of participants who report occasional sleep disturbance. Moreover, it appears that sleep time overestimation but actual chronic partial sleep deprivation may be a normal feature of this population. Future studies may attempt to replicate the present TPB findings both in other non-clinical, college samples and also in clinical samples. If research consistently finds that college students overestimate total sleep duration then it would be beneficial to explore potential explanations for this phenomenon. For example, it is possible that people may have a tendency to largely underestimate the number and duration of intermittent sleep-time awakenings and therefore overestimate total sleep time (Schneider-Helmert, & Kumar, 1995).

Several limitations were present in the current study. For example, although the use of sleep diaries add an element of ecological validity and are an important supplement to objective measures of behavior, they are most effective when completed as close to the performance of the target behavior as possible. Participants were instructed to complete the waketime portion of the diary as soon after waking as possible and the bedtime diary as
close to falling asleep as possible. Additionally, reminder emails were sent each morning and evening in an attempt to ensure the timely completion of the diaries. However, there was no method to objectively ensure that participants were completing the measures as instructed. In future studies, in may be beneficial to employ an online/computerized version of the diaries so that electronic time verification of completion can be obtained.

A number of directions can be taken with future investigation of sleep and the TPB. Fishbein and Ajzen (2010) note that a full application of the TPB involves soliciting the salient modal beliefs that cause people to hold their attitudes, perceived norms, and perceptions of behavioral control towards the target behavior. For example, Knowlden et al. (2012) asked participants open-ended questions regarding their behavioral, normative, and control beliefs (e.g., “list the advantages and disadvantages of getting 7-8 hours of sleep”). Unfortunately, responses to these questions were used only to construct items for a TPB questionnaire. More thoroughly, identifying salient modal beliefs in future studies would also make it possible to identify the critical beliefs needed to target in interventions to improve sleep duration.

In the current study, PBC was a significant factor for predicting sleep duration even after intentions were accounted for. This indicates that it may be especially beneficial to identify the control beliefs that discriminate between performers and non-performers of sleep behaviors. Such information could be used to design targeted interventions aimed at increasing PBC for getting between 7-8 hours of sleep. Interventions for a variety of health behaviors have involved providing appropriate information about the behavior or attempting to change peoples’ attitudes about the behavior by highlighting its benefits. However, these types of interventions often fail or have limited success (e.g. Buboltz et al.,
2002). Fishbein and Ajzen (2010) suggest a possible explanation that providing relevant information or attempting to change attitudes will be ineffective for people who already have favorable attitudes and intend to carry out the target behavior. Under these circumstances successful interventions should more logically aim to change PBC, actual control, or both.

Because the current study is one of the first to investigate sleep duration using the TPB, future research should involve similar studies on sleep duration and other measures of sleep timing such as latency and consistency. However, another important question to address is which sleep hygiene behaviors are most important to target. Sleep duration is only one of several recommendations for practicing good sleep hygiene (National Sleep Foundation, 2011). Good sleep hygiene also consists of avoiding caffeine before bedtime, avoiding large meals before bedtime, regular exercise, and others (National Sleep Foundation, 2011). It is likely that some of these behaviors are correlated (e.g., people who sleep 7-8 hours per night are more likely to avoid caffeine before bedtime) but it is important to determine which of these are most important to target toward the goal of improving sleep quantity and quality, especially in a college population.

**Conclusion**

In conclusion, the findings from this study are consistent with previous research using the TPB to study health behavior and support the use of this theoretical framework to predict sleep hygiene behaviors. The results were generally consistent with previous research demonstrating that intentions to engage in sleep-related behaviors can be predicted from a combination of attitudes, perceived norms, and perceived control, with the notable exception that attitudes alone were not a significant predictor. Additionally, the
findings have added to the limited body of research on sleep hygiene that has predicted behavior from intentions and PBC. These results supported the theoretical prediction that intentions can reasonably predict observed behavior. Moreover, the finding that PBC significantly predicted intentions and contributed a significant portion of additional variance in behavior beyond intentions indicates that control beliefs are of particular importance for sleep duration. As such, the present results suggest that interventions to improve sleep duration should focus on PBC. However, future research is first needed to confirm the present findings, to examine additional sleep hygiene behaviors, and to identify the salient modal beliefs that best differentiate between those who do and do not engage in good sleep hygiene.
References


Table 1. Bivariate Correlations for TPB Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Attitudes</td>
<td>-</td>
<td>.280*</td>
<td>.328*</td>
<td>.315*</td>
<td>.179</td>
<td>.103</td>
</tr>
<tr>
<td>2. Norms</td>
<td>-</td>
<td>.511**</td>
<td>.661**</td>
<td>.209</td>
<td>.176</td>
<td></td>
</tr>
<tr>
<td>3. PBC</td>
<td>-</td>
<td>.710**</td>
<td>.415**</td>
<td>.350*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Intentions</td>
<td>-</td>
<td>.307*</td>
<td></td>
<td>.208</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. SR-Sleep</td>
<td>-</td>
<td></td>
<td>.871**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Act-Sleep</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Self-reported sleep duration (SR-Sleep); Actigraph-recorded sleep duration (Act-Sleep)

*p<.05  **p<.01
<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE B</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitudes</td>
<td>.074</td>
<td>.160</td>
<td>.042</td>
</tr>
<tr>
<td>Subjective Norms</td>
<td>.642</td>
<td>.165</td>
<td>.396**</td>
</tr>
<tr>
<td>PBC</td>
<td>.459</td>
<td>.096</td>
<td>.484**</td>
</tr>
</tbody>
</table>

$R^2$ 0.626

$F$ 27.898**

Note: *p < .05, **p < .01.
Table 3. Summary of Hierarchical Regression Analyses for Variables Predicting Self-Reported Sleep Duration

<table>
<thead>
<tr>
<th>Variable</th>
<th>Step 1</th>
<th></th>
<th></th>
<th>Step 2</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE B</td>
<td>B</td>
<td>SE B</td>
<td>B</td>
<td>SE B</td>
</tr>
<tr>
<td>Intentions</td>
<td>14.777</td>
<td>6.587</td>
<td>.297*</td>
<td>- .346</td>
<td>8.968</td>
<td>-.007</td>
</tr>
<tr>
<td>PBC</td>
<td></td>
<td></td>
<td>19.786</td>
<td>8.335</td>
<td></td>
<td>.428*</td>
</tr>
<tr>
<td>$R^2$</td>
<td>.088</td>
<td></td>
<td></td>
<td>.179</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$F$</td>
<td>5.032*</td>
<td></td>
<td></td>
<td>5.558**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$F$ for $R^2$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5.636*</td>
</tr>
<tr>
<td>Change</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: *p < .05, **p < .01.
Table 4. Summary of Hierarchical Regression Analyses for Variables Predicting Actigraph Recorded Sleep Duration

<table>
<thead>
<tr>
<th>Variable</th>
<th>Step 1</th>
<th></th>
<th>Step 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>SE B</td>
<td>B</td>
<td>SE B</td>
</tr>
<tr>
<td>PBC</td>
<td></td>
<td></td>
<td>19.132</td>
<td>8.192</td>
</tr>
<tr>
<td></td>
<td>.230</td>
<td></td>
<td>-.075</td>
<td></td>
</tr>
<tr>
<td>R²</td>
<td>.053</td>
<td></td>
<td>.144</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>2.903</td>
<td></td>
<td>4.303*</td>
<td></td>
</tr>
<tr>
<td>F for R²</td>
<td></td>
<td></td>
<td>5.454*</td>
<td></td>
</tr>
</tbody>
</table>

Note: *p < .05.
Figure 1. Conceptual model of The Theory of Planned Behavior. This figure illustrates the relationship among TPB variables. Attitudes, perceived norms, and perceived behavioral control directly predict intentions and intentions predict behavior. Additionally, perceived behavioral control can also directly predict behavior.
Appendix A. Theory of Planned Behavior Questionnaire

Instructions

Many questions in this survey make use of rating scales with 7 intervals; you are to select the interval that best describes your opinion. For example, if you were asked to rate “The Weather in Muncie” on such a scale, the 7 intervals should be interpreted as follows:

<table>
<thead>
<tr>
<th>good</th>
<th>extremely</th>
<th>quite</th>
<th>slightly</th>
<th>neither</th>
<th>slightly</th>
<th>quite</th>
<th>extremely</th>
</tr>
</thead>
</table>

The Weather in Muncie is:

If you think the weather in Muncie is extremely good, then you would respond as follows:

The Weather in Muncie is:

If you think the weather in Muncie is quite bad, then you would respond as follows:

The Weather in Muncie is:

If you think the weather in Muncie is neither good nor bad, then you would respond as follows:

The Weather in Muncie is:

When responding, please remember the following:

• Place your marks in the middle of the spaces, not on the boundaries.
• Be sure to mark every scale – please don’t omit any.
• Don’t put more than one mark on a single scale.
• Some of the questions will appear similar, but they do address somewhat different issues.
• Please read each question carefully.
Please answer each of the following questions by selecting the interval that best describes your opinions toward getting 7-8 hours of sleep each night during the following week.

For me to get 7-8 hours of sleep each night during the following week is:

- bad :____:____:____:____:____:____:____: good
- positive :____:____:____:____:____:____:____: negative
- valuable :____:____:____:____:____:____:____: worthless
- unpleasant :____:____:____:____:____:____:____: pleasant
- nice :____:____:____:____:____:____:____: awful
- enjoyable :____:____:____:____:____:____:____: unenjoyable
- harmful :____:____:____:____:____:____:____: beneficial
- wonderful :____:____:____:____:____:____:____: awful
- boring :____:____:____:____:____:____:____: appealing
- important :____:____:____:____:____:____:____: unimportant
- necessary :____:____:____:____:____:____:____: unnecessary
- foolish :____:____:____:____:____:____:____: wise
- productive :____:____:____:____:____:____:____: unproductive
- sick :____:____:____:____:____:____:____: healthy
- detrimental :____:____:____:____:____:____:____: constructive
Please answer each of the following questions by selecting the interval that best describes your opinions toward **getting 7-8 hours of sleep each night during the following week**.

---

For me to get 7-8 hours of sleep each night during the following week would be:

|------------|-----------------|----------|

I plan to get 7-8 hours of sleep each night during the following week.

|-------------------|--------------|---------------|

Most people who are important to me get 7-8 hours of sleep each night.

|-----------------|-------------------|-----------------|

How much control do you believe you have over getting 7-8 hours of sleep each night during the following week?

|------------|-------------------|------------------|

I will get 7-8 hours of sleep each night during the following week.

|-------------------|-------------------|------------------|

I expect to get 7-8 hours of sleep each night during the following week.

|----------------|---------------------|-------------------|

Most people who are important to me think that I should get 7-8 hours of sleep each night during the following week.

|-----------------|-------------------------|------------------|

It would be

|-----------|------------------------|----------------|

The people in my life whose opinions I value would

|---------|------------------------|------------|

of me getting 7-8 hours of sleep each night during the following week.

Most people I respect and admire think that I should not

|------------|------------------------|-------|

get 7-8 hours of sleep each night during the following week.

I feel social pressure to get 7-8 hours of sleep each night during the following week.

|-------------------|-----------------|---------------|

I am willing to get 7-8 hours of sleep each night during the following week.

|------------------|------------------------|----------------|
Please answer each of the following questions by selecting the interval that best describes your opinions toward **getting 7-8 hours of sleep each night during the following week.**

<table>
<thead>
<tr>
<th>Question</th>
<th>Strongly Agree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is mostly up to me whether or not I get 7-8 hours of sleep each night during the following week.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I will try to get 7-8 hours of sleep each night during the following week.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Most people I respect and admire get 7-8 hours of sleep each night.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Most people like me get 7-8 hours of sleep each night.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I intend to get 7-8 hours of sleep each night during the following week.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The people in my life whose opinions I value do get 7-8 hours of sleep each night.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If I wanted to I could get 7-8 hours of sleep each night during the following week.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am confident that I can get 7-8 hours of sleep each night during the following week.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>It is expected of me that I get 7-8 hours of sleep each night during the following week.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For me to get 7-8 hours of sleep each night during the following week is not at all under my control.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The number of events outside my control which could prevent me from getting 7-8 hours of sleep each night during the following week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I will make an effort to get 7-8 hours of sleep each night during the following week.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Strongly agree :                      :                      :                      : strongly disagree
### Appendix B. Sleep Log

#### WAKE-UP LOG

<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What day is today? [check the corresponding box]</td>
<td>S ☐ M ☒ T ☐ W ☒ T ☐ F ☒ S ☐</td>
</tr>
<tr>
<td>2. What time did you go to bed last night? (write in response and mark AM or PM)</td>
<td>AM[after midnight] ☐ PM[before midnight] ☐</td>
</tr>
<tr>
<td>3. Did you feel ready for sleep when you went to bed?</td>
<td>YES ☒ NO ☐</td>
</tr>
<tr>
<td>4. Did you take anything to help you sleep?</td>
<td>YES ☒ NO ☐</td>
</tr>
<tr>
<td>5. How long did it take you to fall asleep?</td>
<td>Hours: ☐ 1 ☒ 2 ☐ 3 ☒ 4 ☒ More than 4</td>
</tr>
<tr>
<td></td>
<td>Minutes: ☐ 0 ☒ 5 ☐ 10 ☐ 15 ☐ 20 ☒ 25</td>
</tr>
<tr>
<td></td>
<td>☐ 30 ☐ 35 ☒ 40 ☒ 45 ☒ 50 ☒ 55 ☒ 60</td>
</tr>
<tr>
<td>6. How many times did you wake up during the night?</td>
<td>☐ 1 ☒ 2 ☒ 3 ☒ 4 ☒ 5 ☒ 6 ☒ 7 ☒ 8 ☒ 9 ☒ More than 9</td>
</tr>
<tr>
<td>7. Altogether, how long were you awake during the night after you initially fell asleep?</td>
<td>Hours: ☐ 1 ☒ 2 ☒ 3 ☒ 4 ☒ More than 4</td>
</tr>
<tr>
<td></td>
<td>Minutes: ☐ 0 ☒ 5 ☒ 10 ☒ 15 ☒ 20 ☒ 25</td>
</tr>
<tr>
<td></td>
<td>☐ 30 ☒ 35 ☒ 40 ☒ 45 ☒ 50 ☒ 55 ☒ 60</td>
</tr>
<tr>
<td>8. Rate the quality of your sleep last night. (1 = excellent; 5 = poor)</td>
<td>☐ 1 ... ☐ 2 ... ☐ 3 ... ☐ 4 ... ☐ 5 ... poor</td>
</tr>
<tr>
<td>9. What time did you wake up to start your day? (write in response and mark AM or PM)</td>
<td>AM[before noon] ☐ PM[afternoon] ☐</td>
</tr>
<tr>
<td>10. How long did you sleep last night?</td>
<td>Hours: ☐ And (example: 8 hours, 15 minutes) Minutes:</td>
</tr>
<tr>
<td>11. How difficult was it to wake up? (1 = very easy; 5 = very hard)</td>
<td>Very easy ☐ 1 ... ☐ 2 ... ☐ 3 ... ☐ 4 ... ☐ 5 ... very hard</td>
</tr>
<tr>
<td>12. How rested/refreshed do you feel now?</td>
<td>Very rested ... ☐ 1 ... ☐ 2 ... ☐ 3 ... ☐ 4 ... ☐ 5 ... not at all</td>
</tr>
<tr>
<td>13. Comments:</td>
<td></td>
</tr>
</tbody>
</table>

#### BEDTIME LOG

<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What day is today?</td>
<td>S ☐ M ☒ T ☐ W ☒ T ☐ F ☒ S ☐</td>
</tr>
<tr>
<td>2. Did you experience physical discomfort today? Mark all that apply.</td>
<td>☐ Headache ☐ Upset stomach ☐ Cold/allergy symptoms ☐ Menstrual cramps</td>
</tr>
<tr>
<td></td>
<td>☐ Muscle/joint pain ☐ Other:</td>
</tr>
<tr>
<td>3. Did you take any medications today (including over-the-counter medications)?</td>
<td>YES ☒ NO ☐ If yes, specify:</td>
</tr>
<tr>
<td>4. How many caffeine drinks did you consume today? (e.g. Coke, tea, coffee, etc.)</td>
<td>☐ ☐ ☐ ☐ ☐ ☐ 5+</td>
</tr>
<tr>
<td></td>
<td>☐ ☐ ☐ ☐ ☐ ☐ 5+</td>
</tr>
<tr>
<td></td>
<td>☐ ☐ ☐ ☐ ☐ ☐ 5+</td>
</tr>
<tr>
<td></td>
<td>☐ ☐ ☐ ☐ ☐ ☐ 5+</td>
</tr>
<tr>
<td>5. How many drinks of alcohol did you have today?</td>
<td>☐ NONE ☐ ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☒ 7 ☒ 8 ☒ 9 ☐ More than 9</td>
</tr>
<tr>
<td>6. How many naps did you have today?</td>
<td>NONE ☐ 1 ☐ 2 ☐ 3 ☒ 4 ☒ More than 4</td>
</tr>
<tr>
<td>7. Altogether, how much time did you nap today?</td>
<td>☐ 1 ☒ 2 ☒ 3 ☒ 4 ☒ More than 4</td>
</tr>
<tr>
<td></td>
<td>☐ 0 ☒ 5 ☒ 10 ☒ 15 ☒ 20 ☒ 25</td>
</tr>
<tr>
<td></td>
<td>☐ 30 ☒ 35 ☒ 40 ☒ 45 ☒ 50 ☒ 55 ☒ 60</td>
</tr>
<tr>
<td>8. If you had vigorous physical activity for at least 15 minutes today, circle below every hour this occurred.</td>
<td>☐ NONE</td>
</tr>
<tr>
<td></td>
<td>12(Noon) 1 2 3 4 5 6 7 8 9 10 11 am</td>
</tr>
<tr>
<td></td>
<td>12(Midnight) 1 2 3 4 5 6 7 8 9 10 11 pm</td>
</tr>
<tr>
<td>9. Comments:</td>
<td></td>
</tr>
</tbody>
</table>