A Pilot Study of a Single-Session, Internet-Based Insomnia Intervention for College Students
with Insomnia Symptoms and History of Suicide Ideation

by

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Abstract

Insomnia is a particularly promising avenue for suicide prevention efforts because it is amenable to treatment, and insomnia treatment is relatively lower in stigma than treatment specifically targeting suicide ideation (Downs & Eisenberg, 2012; Trockel et al., 2015). Cognitive-behavioral therapy for insomnia (CBT-I) is an evidence-based treatment for insomnia (Geiger-Brown et al., 2015) that reduces suicide ideation at post-treatment (Batterham et al., 2017; Manber et al., 2014; Pigeon at el., 2017; Trockel et al., 2015). However, current formats of CBT-I (i.e., traditional face-to-face, internet-based, and brief CBT-I) are time-intensive (i.e., six to eight weekly sessions; Batterham et al., 2017), require a trained treatment provider (Pigeon at el., 2017), or both (Manber et al., 2014; Trockel et al., 2015). Thus, the goal of the current study is to establish the feasibility and acceptability of a single session, self-guided, internet-based insomnia treatment among college students with a lifetime history of suicide ideation and current insomnia symptoms. Participants ($N = 38$) completed seven daily sleep diaries before being administered self-report surveys and Sleep Scholar, a single session, self-guided, internet-based insomnia intervention. Immediately after the intervention, participants completed post-treatment measures of acceptability and feasibility. One week and one month after the insomnia treatment, participants completed follow-up self-report surveys and were given personalized suggestions for improving their sleep derived from their daily sleep diaries. Results showed that approximately 33 students could be recruited per semester, an attrition rate of 47% from pre-treatment to one-month follow-up, the mean duration of time to complete the Sleep Scholar was approximately 30 minutes, and the majority of the information in Sleep Scholar was retained. Participants were found the treatment acceptable and were satisfied, and approximately half of participants adhered

to their prescribed time in bed recommendations. Most clinical measures had adequate variability

and internal consistency. Implications for a future randomized controlled trial are discussed.

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Fatal suicide attempts are a serious public health concern and global challenge accounting for almost one million deaths worldwide each year, which amounts to a suicide death every 40 seconds (World Health Organization [WHO], 2017). Over the past 50 years, there has been an increase in knowledge about suicidal thoughts and behaviors; however, the rates of suicide and suicide ideation have not substantially declined (Centers for Disease Control and Prevention [CDC], 2018; Franklin et al., 2017; Kessler, Berglund, Borges, Nock, & Wang, 2005). There are some risk factors for suicide ideation that have been identified (e.g., sleep disturbance; Pigeon, Pinquart, & Conner, 2012), but have not been subjected to as much investigation as other risk factors (e.g., hopelessness). Sleep disturbance is a particularly promising avenue for suicide prevention efforts because it is amenable to treatment, and this treatment is relatively lower in stigma compared to specifically engaging in treatment for suicide ideation (Downs & Eisenberg, 2012; Stinson, Tang, & Harvey, 2006; Trockel, Karlin, Taylor, Brown, & Manber, 2015). However, dissemination of effective treatments for sleep disturbance are hindered by the limited number of trained professionals and the time-intensive treatment process (Lamberg, 2008; Manber et al., 2012). The goal of the current study is to establish the feasibility and acceptability of a single-session, self-guided, internet-based insomnia intervention among college students with at least current subclinical insomnia symptoms and a lifetime history of suicide ideation.

Insomnia as a Transdiagnostic Factor

Previously, insomnia symptoms could be diagnosed either as primary insomnia (i.e., insomnia not due to another disorder) or insomnia related to a primary psychiatric disorder (e.g., major depressive disorder). In the current *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition* (DSM-5), there is a single diagnosis, insomnia disorder, which can either occur as an independent condition or comorbidly with another disorder (American

Psychiatric Association [APA], 2013). According to the *DSM-5*, insomnia disorder is defined as dissatisfaction with sleep quantity or quality and is associated with difficulty initiating sleep, maintaining sleep, and/or early morning awakenings with an inability to return to sleep. These difficulties must persist for at least three nights per week and for at least three months despite adequate opportunity for sleep, and the symptoms must cause clinically significant distress or impairment (APA, 2013). Approximately 10% of college students meet criteria for insomnia disorder (Taylor, Bramoweth, Grieser, Tatum, & Roane, 2013). Subclinical insomnia can be classified as insomnia symptoms that do not necessarily meet full *DSM-5* diagnostic criteria (i.e., difficulty initiating or maintaining sleep or sleep that is not restorative regardless of duration and consequences; APA, 2013; Ohayon, 2002). Approximately one-third of college students have subclinical insomnia symptoms (Taylor et al., 2013).

Insomnia and Other Psychiatric Conditions. Aside from being a diagnosable disorder, insomnia symptoms are also a descriptive (i.e., concurrent with other psychiatric disorders) and mechanistic (i.e., causally or bidirectionally related to psychiatric disorders) transdiagnostic process for other psychiatric conditions (Dolsen, Asarnow, & Harvey, 2014) that are fairly common in college students. Specifically, approximately 7% of college students meet criteria for major depressive disorder (Blanco et al., 2008), 12% experience anxiety symptoms (Blanco et al., 2008), and 12% endorse symptoms of PTSD (Smyth, Hockemeyer, Heron, Wonderlich, & Pennebaker, 2008). There is also evidence that treating insomnia also improves depression (Morawetz, 2003; Taylor, Lichstein, Weinstock, Sanford, & Temple, 2007; Thorndike et al., 2013), anxiety (Belleville, Cousineau, Levrier, and St-Pierre-Delorme, 2011), and PTSD symptoms (Margolies, Rybarczyk, Vrana, Leszczyszyn, & Lynch, 2013; Ulmer, Edinger, & Calhoun, 2011).

Insomnia and Suicide Ideation. Among individuals with insomnia disorder, 32% report

having suicide ideation (Trockel et al., 2015). Pigeon et al.'s (2012) meta-analysis of 11

longitudinal studies and 28 cross-sectional studies investigating the relationship between sleep

disturbances (i.e., insomnia, nightmares, and other sleep disturbances [e.g., sleep apnea, poor

sleep quality, short sleep duration]) and suicidal outcomes (i.e., suicide ideation, nonfatal suicide

attempt, suicide) showed that insomnia was significantly associated with suicide ideation in both

adjusted (i.e., those that controlled for confounding variables; depression, anxiety, and

demographic variables) and unadjusted studies. Pigeon et al. (2012) also examined moderators,

finding that across various populations, among cross-sectional and longitudinal designs, and

while controlling for covariates, insomnia was associated with suicide ideation. Moreover, out of

the examined sleep disturbances, insomnia displayed the strongest and most consistent

relationship with suicide ideation.

Since the Pigeon et al. (2012) meta-analysis, there have been further investigations of the

relationship between insomnia and suicide ideation. In cross-sectional studies, insomnia

symptoms have been positively associated with suicide ideation in adult (Chakravorty et al.,

2015; Pigeon, Woosley, & Lichstein, 2014), clinical (Bernert et al., 2017; McCall et al., 2013),

and college student samples (Bozzay, Karver, & Verona, 2016; Chu et al., 2016). Moreover,

although the majority of the literature regarding the relationship between insomnia and suicide

ideation has been cross-sectional, there have been some longitudinal investigations supporting

the relationship between insomnia and suicide ideation (Bryan et al., 2015; McCall et al., 2010;

Ribeiro et al., 2012; Zuromski et al., 2017). The most comprehensive of the longitudinal studies

was Zuromski et al., (2017), which used latent difference score modeling to examine the

prospective relationship between insomnia symptoms and suicide ideation in a community

sample of adults who had experienced lifetime suicidal thoughts or behavior. A key finding of this study was that severity of insomnia symptoms predicted increases in subsequent suicide ideation, but the reverse was not true.

Five recent studies have found that insomnia treatment reduces suicide ideation at post-treatment (Batterham et al., 2017; Christensen et al., 2016; Manber, Bernert, et al., 2014; Pigeon, Funderburk, Bishop, & Crean, 2017; Trockel et al., 2015). Among these, one study (Trockel et al., 2015) showed this effect occurred independently of depression and another showed this effect persisted three months post-treatment (Pigeon et al., 2017). However, these insomnia treatments involved a time-intensive process (Batterham et al., 2017; Christensen et al., 2016), trained treatment professionals (Pigeon et al., 2017; Trockel et al., 2015), or both (Manber et al., 2014; Trockel et al., 2015). Furthermore, when the impact of an insomnia intervention on suicide ideation has been examined, it was in a small pilot study that explored post-hoc descriptive statistics of the effect on suicide ideation (Pigeon et al., 2017), Veterans (Pigeon et al., 2017; Trockel et al., 2015), or adults that are typically older than college students (Batterham et al., 2017; Christensen et al., 2016; Manber, Bernert, et al., 2014; Pigeon et al., 2017; Trockel et al., 2015). Thus, it is unclear if insomnia treatments are effective for reducing suicide ideation among college students.

Insomnia Interventions

Two common modes of insomnia treatment include pharmacological and non-pharmacological interventions. Common pharmacological treatments for insomnia include hypnotics (e.g. flurazepam), non-hypnotic benzodiazepines (e.g. zolpidem), and antidepressants (e.g. trazadone; Lie, Tu, Shen, & Wong, 2015; Walsh & Schweitzer, 1999). Non-pharmacological treatments consist of psychological (e.g., cognitive therapy, relaxation) and

behavioral treatments (e.g., stimulus control therapy, sleep restriction therapy, sleep hygiene) or a combination of both modalities (i.e. cognitive-behavior therapy; Morin, LeBlanc, Daley, Gregoire, & Merette, 2006). The literature has shown that pharmacological and non-pharmacological treatments for insomnia are approximately equivalent in efficacy (Smith et al., 2002). However, when considering patients' acceptance of interventions for insomnia, non-pharmacological treatment is preferred and is viewed as a more effective long-term solution, more likely to improve daytime functioning, as well as, less likely to produce negative side effects compared to pharmacological treatment (Bluestein, Healey, & Rutledge, 2011; Vincent & Lionberg, 2001).

Cognitive-behavioral therapy for insomnia (CBT-I) is a non-pharmacological, evidence-based treatment shown to improve quality and quantity of sleep (Geiger-Brown et al., 2015; Okajima, Komada, & Inoue, 2011; Trauer, Qian, Doyle, Rajaratnam, & Cunnington, 2015). As mentioned previously, there is also some evidence that CBT-I improves suicide ideation (Batterham et al., 2017; Christensen et al., 2016; Manber, Bernert, et al., 2014; Pigeon, Funderburk, Bishop, & Crean, 2017; Trockel et al., 2015). There are several forms of CBT-I including: traditional face-to-face CBT-I (Trockel et al., 2015), internet-based CBT-I (Batterham et al., 2017), and brief CBT-I (Pigeon et al., 2017). Traditional, face-to-face CBT-I consists of six to eight sessions lasting 50-90 minutes in duration and can be conducted in individual or group formats (Manber, Friedman, et al., 2014; Rybarczyk, Lopez, Benson, Alsten, & Stepanski, 2002; Trockel et al., 2015). Although CBT-I is an efficacious treatment for improving insomnia symptoms, there are a limited number of professionals trained in CBT-I, resulting in difficulty accessing effective treatment for insomnia (Manber et al., 2012). As such, internet-based interventions have been examined to increase access and portability of mental health services.

Internet-based Insomnia Interventions. An internet-based intervention is a mostly self-guided, prescriptive program that is executed through a website and is used by clients who are seeking resources for health or mental health difficulties (Barak, Klein, & Proudfoot, 2009). There have been two meta-analyses examining the effectiveness of internet-based interventions in general (Barak, Hen, Boniel-Nissim, & Shapira, 2008; Davies, Morriss, and Glazebrook, 2014). Among the studies included in these meta-analyses, the internet-based interventions varied from one to six sessions (Davies et al., 2014). Overall, internet-based interventions were effective at reducing psychological problems (i.e., managing emotions, thoughts, and behaviors; Barak et al., 2008; Davies et al., 2014). Furthermore, when comparing internet-based interventions to face-to-face treatment with the same problem there was not a significant difference in effectiveness (Barak et al., 2008; Davies et al., 2014).

More specific to the current study, there are several forms of internet-based CBT-I, including: Sleep Healthy Using the Internet (SHUTi) – administered through six weekly modules (Thorndike, Saylor, Bailey, Gonder-Frederick, Morin, & Ritterband, 2008) and Sleepio – administered through six weekly modules (Espie et al., 2012). A recent meta-analysis of 11 randomized controlled trials examined the efficacy of internet-based CBT-I (Zachariae, Lyby, Ritterband, & O'Toole, 2016). Among the included studies, four did not involve human support, three involved the possibility of contacting staff and receiving individualize responses, three involved personal contact as an essential part of treatment, and one compared treatment with and without staff telephone support. Treatments ranged from two to nine weeks in duration and included four to six modules to be completed at the participant's own pace on a weekly basis over the intervention period. The average post-treatment assessment was conducted after two weeks, and follow-up ranged from four to 48 weeks. Internet-based CBT-I was found to

significantly improve insomnia symptoms at post-treatment and follow-up. In addition, when the effect sizes for internet-based CBT-I were compared to effect sizes in meta-analyses of face-to-face CBT-I and group CBT-I, there was not a significant difference for insomnia symptoms. Importantly, degree of human support and number of CBT-I modules were not statistically significant moderators of the effectiveness of treatment (Zachariae et al., 2016). Although internet-based CBT-I has been found to improve suicide ideation post-treatment in two studies (Batterham et al., 2017; Christensen et al., 2016), internet-based CBT-I, like traditional CBT-I, remains a time-consuming process for patients.

Brief Insomnia Interventions. Only 36% of college students with psychiatric symptoms used mental health services in the prior year (Eisenberg, Hunt, Speer, & Zivin, 2011), less than half (42%) of individuals with insomnia disorder consulted with a healthcare professional about sleep problems in their lifetime (Morin, LeBlanc, Daley, Gregoire, & Merette, 2006), and only 32% of individuals who died by suicide used mental health services in the prior year (Luoma, Martin, & Pearson, 2002). In addition, approximately 33% of college students report not having enough time as a barrier to treatment (Yorgason, Linville, & Zitzman, 2008). Face-to-face, brief therapy typically ranges from a single session to nine sessions (Draper, Jennings, Baron, Erdur, & Shankar, 2002; Hazlett-Stevens & Craske, 2002) and has been found to be comparable in effectiveness to face-to-face, time-unlimited therapy (Bloom, 2001; Orlinsky, Rønnestad, & Willutzki, 2004).

More relevant to the current study, brief insomnia interventions consist of one to five sessions that are 15-90 minutes in duration. These treatments can be administered in individual or group formats and may include supplemental materials and/or brief follow-up phone calls or sessions (Boullin, Ellwood, & Ellis, 2016; Currie, Clark, Hodgins, & El-Guebaly, 2004; Edinger

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& Sampson, 2003; Ellis, Cushing, & Germain, 2015; Germain et al., 2006; Germain, Shear, Hall, & Buysse, 2007; Lovato, Lack, Wright, & Kennaway, 2014; Pigeon et al., 2017).

Brief insomnia interventions have been shown to improve insomnia symptoms immediately post-treatment among clinical (Pigeon et al., 2017), psychiatric (Currie et al., 2004), and primary insomnia samples (Edinger & Sampson, 2003; Ellis et al., 2015; Falloon, Elley, Fernando, Lee & Arroll, 2015; Fernando III, Arroll, & Falloon, 2013; Germain et al., 2006; Lovato et al., 2014). Moreover, there is evidence that these effects persist up to six months after treatment in psychiatric (Currie et al., 2004) and primary insomnia samples (Falloon, Elley, Fernando, Lee & Arroll, 2015). As previously noted, brief CBT-I reduces suicide ideation both immediately post-treatment and three months after treatment (Pigeon et al., 2017). CBT-I consisting of one session, two sessions, four sessions, and eight sessions with a therapist have been compared to determine the optimal dose of therapy for individuals with primary insomnia (Edinger, Wohlgemuth, Radtke, Coffman, & Carney, 2007). Results showed that only the one- and four-session groups showed significant improvement in insomnia symptoms throughout the eight-week treatment phase compared to a control group. Of note, the singular session of CBT-I saw greater improvement in sleep efficiency (i.e., proportion of the time in bed that one is sleep), time awake after sleep onset, and total time awake during sleep period at post-treatment compared to four sessions of CBT-I, as assessed by sleep diary. In addition, participants who received either one or four sessions of CBT-I saw comparable significant improvement in insomnia symptoms from baseline to six-month follow-up (Edinger et al., 2007). However, these forms of brief CBT-I are not internet-based and therefore still require a trained treatment provider.

Thus, there is initial evidence that single session insomnia therapy improves insomnia symptoms, and one session of CBT-I may engender greater improvement in sleep variables (e.g., time awake after sleep onset) compared to extended insomnia treatment. However, there are relatively few studies examining single-session insomnia therapies, and those that exist are not internet-based and instead involve a face-to-face session with a trained professional. Given the limitations of the previous literature, developing a single-session, self-guided, internet-based, intervention would decrease the need for trained professionals and the time involved in insomnia treatment.

Current Study

Insomnia symptoms have been identified as a risk factor for suicide ideation (e.g., Zuromski et al., 2017), and the treatment of insomnia through CBT-I has been found to improve suicide ideation (Batterham et al., 2017; Christensen et al., 2016; Trockel et al., 2015). Although insomnia symptoms are a promising avenue for treating suicide ideation, the dissemination of CBT-I is hindered by the limited number of trained professionals and the time intensive treatment process (Lamberg, 2008; Manber et al., 2012). Single-session, internet-based insomnia interventions would be a particularly useful treatment alternative for university counseling centers because 31.50% of university and college counseling centers having a waitlist during the year (Mistler, Reetz, Krylowicz, & Barr, 2012), and some college students with suicide ideation are mandated to attend treatment (Downs & Eisenberg, 2012).

A single-session, internet-based insomnia intervention is a complex intervention (i.e., an intervention with several interconnected components); therefore, the Medical Research Council's complex intervention framework advises using a stepwise approach to treatment development that includes conducting a pilot study before implementing a large-scale randomized controlled

trial (Craig et al., 2008). A pilot study is a small study to test the methods and procedures of a protocol, determining the feasibility of recruitment, retention, assessment procedures; and degree of treatment adherence to inform a main study (Leon, Davis, & Kraemer, 2011; Thabane et al., 2010). Accordingly, the current study addresses gaps in the literature by piloting the use of a single-session, self-guided, internet-based insomnia intervention among college students with current insomnia symptoms and a history of suicide ideation. Results from this study will inform a future randomized controlled trial that will test the effectiveness of this intervention.

The current study aims to add to the current literature by testing the feasibility and acceptability of a single-session, self-guided, internet-based, insomnia intervention among college students with at least subclinical levels of insomnia and a lifetime history of suicide ideation. All participants were administered a single-session, self-guided, internet-based insomnia intervention that was approximately 30 minutes in duration. All participants were assessed pre-treatment, immediately post-treatment, one week post-treatment, and one month post-treatment.

A pilot study is not intended to test hypotheses, as pilot studies are typically not adequately powered for this purpose; therefore, inferential statistics should not be utilized to examine the efficacy of the intervention (Leon et al., 2011). Thus, the objectives of the current study are to (Lancaster, Dodd, & Williamson, 2004; Leon et al., 2011):

1. Examine the screening rate and recruitment rate.
2. Examine the attrition rates at the follow-up assessments.
3. Examine the duration of time to complete the intervention and the assessments at each timepoint.

4. Examine the participants' willingness to utilize the intervention at post-treatment, knowledge acquisition and retention at post-treatment, level of satisfaction with the intervention at post-treatment and one-month follow-up, as well as, adherence to the intervention at the one-week and one-month follow-up.

5. Examine the variability in clinical outcome measures at each timepoint.

Method

Participants

Figure 1 shows the flow of participants through the study. Undergraduate students were recruited using the SONA Human Subject Pool Software. Potential participants completed an eligibility screener with inclusion criteria of at least subclinical insomnia (i.e., score of eight or above on the Insomnia Severity Index [ISI]; Bastien, Vallières, Morin, 2001) and a lifetime history of suicide ideation as determined by a single item (i.e., *Have you ever had thoughts of killing yourself?*; Nock, Holmberg, Photos, & Michel, 2007). The screener also assessed the following exclusion criteria: under age 18, shift work, untreated sleep apnea, untreated restless leg syndrome, untreated chronic pain, and current engagement in insomnia treatment, along with other questions (i.e., PROMIS Scale v1.2 - Global Health; Hays, Bjorner, Revicki, Spritzer, & Cella, 2009) to distract the participant from the aim of the study. Before participating in the laboratory session, eligible participants received daily text messages in order to complete seven daily sleep diaries (Carney et al., 2012). Participants only completed the laboratory session after completing at least five of the seven daily sleep diaries (i.e. if they had not completed five diaries prior to their laboratory session, the session was rescheduled for a later point in time).

Among the eligible participants, 40 students participated in the laboratory session. However, data from two participants were excluded from the final analysis because technical

difficulties prevented them from receiving personalized feedback on how to adjust their time in bed window from their sleep diaries completed before the one-week follow-up assessment. Thus, the final sample consisted of 38 students. The mean age of the sample was 19.24 (S.D. = 1.55; range = 18-24). Most participants were female (84%; $n = 32$), while the remaining participants were male (13%; $n = 15$), and genderqueer female (3%; $n = 1$). The majority of participants identified as Hispanic or Latino (90%; $n = 34$) and Caucasian (90%; $n = 34$), while the remaining participants identified as non-Hispanic or Latino (11%; $n = 4$), Black or African-American (5%; $n = 2$), Asian (3%; $n = 1$), and American Indian/Alaska Native (3%; $n = 1$). Regarding sexual orientation, participants identified as heterosexual (87%; $n = 33$) and bisexual (13%; $n = 5$). Participants were undergraduate first-years (63%; $n = 24$), second-years (8%; $n = 3$), third-years (13%; $n = 5$), and fourth-years (16%; $n = 6$).

Procedure

Once participants arrived to the laboratory, they provided informed consent, completed the pre-treatment assessment, and a single-session, self-guided, internet-based insomnia intervention. After completion of the insomnia treatment, participants immediately completed the post-treatment assessment of acceptability and satisfaction. Each laboratory session was scheduled to be completed in 1.5 hours.

After completion of the post-treatment assessment, to protect participant safety, all participants were debriefed and given local mental health resources. Participants who were at elevated risk for suicide completed a semi-structured suicide risk assessment interview with a clinical psychology graduate student, then followed procedures designed to ensure participant safety. Six risk assessments were conducted with participants after the post-treatment assessment

and all participants were all deemed to be low risk according to the Chu et al. (2015) risk assessment framework.

Follow-up assessments were completed online one week and one month after the intervention. In addition, participants completed seven daily sleep diaries before each follow-up assessment. Participants received daily text message reminders at 9:00 AM in order to complete the daily sleep diaries and a text reminder at 10:00 AM reminding them to complete the one-week and one-month follow-up assessments when applicable. Procedures were in place to review participant responses to measures of current suicide ideation during the follow-up assessments and to contact participants for additional risk assessment if deemed appropriate. Of note, no additional risk assessments were needed during the follow-up period.

Following participation at each assessment timepoint, participants were provided SONA credit hours that fill a course requirement or can be used for extra credit in their respective courses. In addition, because the one-month follow-up assessment and the seven daily sleep diaries before this follow-up assessment may have occurred outside the boundaries of the academic semester, all participants were financially compensated $10 for the completion of one-month follow-up assessment and $5 for the completion of seven daily sleep diaries that occurred immediately before this follow-up assessment.

Intervention

Sleep Scholar

Participants were administered Sleep Scholar, a single-session, self-guided, internet-based insomnia intervention (see Appendix A). Sleep Scholar consisted of three text-based modules that were read on a web browser. The content of the modules was adapted from Ellis et al.'s (2015), Morin, Barlow, & Dement's (1993), and Perlis, Jungquist, Smith, & Posner's (2006)

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protocols for traditional face-to-face sessions. New content (e.g., vignettes and quizzes) was created to tailor the intervention to be specific to college students and none was copied word for word from previous treatment manuals. Modules of the current intervention included: sleep psychoeducation, stimulus control therapy, and sleep quality enhancement. Modules were sequential so that previous modules could not be accessed after they were completed. In addition, before the three modules were presented, there was a brief introduction that included a description of the evidence base for CBT-I and an overview of the text-based modules.

Sleep Psychoeducation. First, the sleep psychoeducation module was presented. Sleep psychoeducation consisted of the definition of insomnia symptoms (i.e., difficulties falling asleep, difficulty staying asleep, and early morning awakenings; Ohayon, 2002), a description of how insomnia symptoms are developed and maintained using the "3-P Model" (Spielman, Caruso, & Glovinsky, 1987) based on the diathesis-stress framework, and an explanation of how sleep is regulated using the two-process model of sleep regulation (i.e., a sleep dependent process [sleep drive] and a sleep independent process [circadian rhythm]; Borbély, 1982). In addition, individual differences in sleep were discussed, focusing on sleep changes that occurred between adolescence and young adulthood. Psychoeducation was expected to modify participants' beliefs about sleep and sleep interfering cognitions (e.g., *I need eight hours of sleep to function well during the day*). It was also used as a basis to discuss how sleep hygiene (i.e., amount and timing of substances, medication, food, and exercise) is related to sleep regulation.

Stimulus Control Therapy. Next, the stimulus control therapy module was presented. The stimulus control therapy module (Bootzin & Nicassio, 1978) was based on idea that among individuals with sleep difficulties, the bed/bedroom has become associated with arousal (e.g., frustration, wakefulness), rather than sleep. The goal of this module was to alter this association

by associating the bed/bedroom with sleep, rather than arousal. This conditioned arousal (i.e., the bed/bedroom being associated and arousal) was explained as the body learning that the bed/bedroom was a place to be aroused (e.g., awake) through repeated pairing of the bed and sleep-interfering activities (e.g., anxiety, frustration, activities on phone) without an individual's knowledge. To change this conditioned arousal, participants were taught the difference between being sleepy (i.e., inability to stay awake) and tired (i.e., fatigued), then instructed to only be in bed when sleepy (i.e., getting out of bed if they had difficulty sleeping and only returning to bed once they became sleepy again), only use the bed for sleep and sexual activity, keep a consistent wake time, and avoid daytime napping/dozing.

Sleep Quality Enhancement. Finally, the sleep quality enhancement module was presented. The sleep quality enhancement module was based in sleep restriction therapy (Spielman et al., 1987). Sleep restriction therapy is a behavioral strategy that restricts duration of time in bed to duration of total sleep time. The goal of this strategy is to increase sleep drive (i.e., sleepiness) through prolonged wakefulness. To accomplish sleep restriction therapy, participants' average total sleep time from the seven daily sleep diaries that were completed before the laboratory session were used to set their initial prescribed time in bed duration. Next, participants choose a wake time based on the earliest time they typically needed to be awake for their responsibilities (e.g., class or work). After choosing a wake time, participants' prescribed total time in bed window was calculated by starting at their chosen wake time and counting backwards their prescribed time in bed duration (i.e., participants' average total sleep time before the intervention). For example, if a participant was sleeping from 12:00am to 7:00am (i.e., seven hours asleep) before the intervention, their prescribed time in bed duration was seven hours. If the participant was waking up earlier than desired and wanted a wake time of 8:00am, their new

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bedtime was 1:00am (i.e., seven hours before 8:00am) and their prescribed time in bed window was 1:00am to 8:00am.

Intervention Implementation. When implementing both stimulus control therapy and sleep restriction therapy, if the participant is not sleepy at their bedtime (e.g., 1:00am), the participant is instructed to not get into bed until they become sleepy. Therefore, their bedtime is the earliest time the participant can get into bed. The goal of these combined strategies is that participants increase their sleep drive (i.e., sleepiness) through prolonged wakefulness, then once sleepy, get into bed and quickly fall asleep; thus, the body learns to associate the bed/bedroom with sleep again.

After each week of implementing the strategies from the sleep quality enhancement module (i.e., prescribed time in bed window) and stimulus control module (e.g., only being in bed if sleepy), participants' sleep efficiency (i.e., proportion of the time in bed that one is sleep) was to be calculated using seven daily sleep diaries. Based on participants' average total sleep time from that week, participants adjusted their time in bed duration by keeping their wake time consistent and adjusting their bedtime. Specifically, a 15-minute reduction in their time in bed duration was recommended for a sleep efficiency < 85%, no change in time in bed duration was recommended for a sleep efficiency between 85% and 90%, and a 15-minute expansion of time in bed duration was recommended for a sleep efficiency > 90% (Ellis et al., 2015). In addition, to protect participant safety, participants were advised to never restrict their time in bed duration below five hours. Thus, although participants initially have less time in bed than typical and may initially receive less sleep than typical, the first prescribed time in bed window is only temporary and if participants frequently fall asleep quickly while in bed and only use the bed for sleep (and

sexual activity), their sleep efficiency will increase, allowing increases to their time in bed duration and thus gradually working toward more sleep.

Importantly, since participants were only provided one session of Sleep Scholar, and after the intervention only received daily text message reminders to complete seven daily sleep diaries in the week after intervention and the week before the one-month follow-up assessment, individual sleep efficiencies were only given at the one-week and one-month follow-up assessment for independently adjusting one's time in bed duration. As such, participants were encouraged, but not required to complete sleep diaries and adjust their time in bed duration in the two weeks before the one-month follow-up assessment.

Intervention Interactivity. The main mode of delivery for Sleep Scholar was text; however, interactivity was enhanced by using animations, graphics, vignettes (e.g., the consequences of ineffective sleep strategies and the benefits of the Sleep Scholar's strategies for college students). In addition, an interactive checklist was used where participants identified perceived barriers to strategies from a list of common barriers (e.g., difficulty staying up until sleepy) and selected possible solutions to address their identified barriers (e.g., activities that can be completed until becoming sleepy). Also, after each module, short multiple choice or true/false quizzes of the main concepts of the module were administered to assess participants' knowledge acquisition and retention. For example, after the stimulus control therapy module, vignettes were provided depicting college students implementing stimulus control strategies, and participants were asked to determine the characteristics of being sleepy and when to get in and get out of bed at night. Similarly, after the sleep quality enhancement module, based on a vignette, participants were asked to select the correct time in bed window and how to adjust time in bed duration. After each item was answered on the quizzes there was text providing feedback on the correct or

incorrect answer choice. To enhance motivation to retain the material, participants were encouraged to pay close attention to the intervention to obtain a high score on the quizzes and receive additional SONA credit; however, all participants were ultimately given this additional SONA credit regardless of their score.

After completion of the post-treatment assessment, all participants were sent a summary reminder email of the information from the intervention including: (1) their prescribed time in bed window with brief instructions of how to adjust the window, (2) a brief description of the difference of being tired versus sleepy with information about when to get in and get out of bed, (3) their identified barriers and selected solutions to barriers, (4) a list of possible questions and answers about following Sleep Scholar's recommendations (e.g., *Can I nap?, What should I do if I can't sleep?*), and (5) a link to the daily sleep diary (see Appendix B). In addition, this email was sent again approximately halfway between the two follow-up assessment timepoints; however, it did not include participants' prescribed time in bed window (see Appendix C).

Measures

See Table 1 for a schedule of measures administered at each timepoint.

Demographics

Information about the participants age, race, ethnicity, gender identity, year in college, and sexual orientation were collected at the pre-treatment assessment.

Bogus items

Bogus items (Meade & Craig, 2012) were administered to determine if participants were randomly responding to surveys. Bogus items and length of time to complete surveys were used as methods of screening data for analysis at all assessment timepoints.

Acceptability

Insomnia Treatment Acceptability Scale—Behavioral Subscale (ITAS-B; Morin, Barlow, & Dement, 1993) is an 8-item measure assessing willingness to utilize a hypothetical, non-pharmacological treatment for insomnia. This measure was modified in the current study so that participants would not be provided a hypothetical description of insomnia treatment. Instead, participants would respond to the items based on Sleep Scholar. Participants used an electronic slider on a visual analog scale from 0 to 100 to indicate their agreement with questions (e.g., *How acceptable do you consider this treatment for your insomnia?*) regarding their acceptability of Sleep Scholar. Each statement has descriptive anchors typically ranging from *not at all acceptable* to *very acceptable* or *not at all suitable* to *very suitable*. Total score is the average of the items with higher scores indicating greater likelihood of using the treatment. The scale has shown strong internal consistency ($\alpha = .80$) in adult patients with insomnia (Vincent & Lionberg, 2001). The ITAS-B was administered at the post-treatment assessment and showed adequate internal consistency ($\alpha => .84$) in our sample.

Satisfaction

Client Satisfaction Questionnaire-8 (CSQ-8; Larsen, Attkisson, Hargreaves, & Nguyen, 1979) is an 8-item scale measuring satisfaction with health and human services. Items are on a 4-point scale ranging from 1 to 4 and total score ranges from 0 and 32. The overall score is the sum of the items with higher score indicating higher satisfaction. Participants were asked to rate statements (e.g., *In an overall, general sense, how satisfied are you with the service you received?*). The CSQ-8 has shown strong internal consistency in adult outpatients ($\alpha = .92$). It was administered at the post-treatment and one-month follow-up assessment and showed adequate internal consistency ($\alpha s => .84$) at both timepoints in our sample.

In addition, satisfaction was assessed with four open-ended questions written for the purpose of this study: (1) *What were the most helpful aspects of the intervention?* (2) *What were the least helpful aspects of the intervention?* (3) *What aspects of the intervention were difficult to understand?* (4) *What aspects of the intervention would you change?* The open-ended questions were administered at the post-treatment and one-month follow-up assessments. To evaluate the open-ended responses, the first author reviewed the participants' open-ended responses to each question, aggregated across both timepoints. These responses were then categorized according to Sleep Scholar's modules (i.e., sleep psychoeducation, stimulus control, and sleep quality enhancement) or other comments. This method prevented similar responses at the post-treatment and one-month follow-up assessment from being double counted.

Adherence

The Consensus Sleep Diary (Carney et al., 2012) is an 9-item measure for daily prospective self-monitoring of sleep disturbance severity, variability, and patterns. Participants are asked about bedtime, time they tried to sleep, sleep onset latency, number of nocturnal awakenings, duration of awakening after sleep onset, wake time, duration of early morning awakenings, and rise time. In addition, sleep quality was rated on 5-point scale from *very poor* to *very good*. From these variables, total time in bed (i.e., rise time minus time to bed), total sleep time (i.e., time in bed minus sleep onset latency minus wake after sleep onset), and sleep efficiency (i.e., total sleep time divided by time in bed then multiplied by 100) were calculated. These were used to determine adherence (i.e., being within 15 or 30 minutes of time in bed recommendations on average; Ellis et al., 2015). Sleep diaries are considered the gold standard for assessment of sleep, producing a reliable and valid index of insomnia symptoms (Buysse, Ancoli-Israel, Edinger, Lichstein, & Morin, 2006). The Consensus Sleep Diary was administered

for seven days before the laboratory session, one-week follow-up assessment, and one-month follow-up assessment.

Insomnia

The Insomnia Severity Index (ISI; Bastien, Vallières, Morin, 2001) is a self-report measure used to report the severity of insomnia. There are seven items rated on a 0 to 4 scale with total scores ranging from 0 to 28 and higher scores indicating greater severity of insomnia. The ISI has been shown to have a strong internal consistency in a community sample with a presenting problem of insomnia ($\alpha = .90$) and to detect clinical cases of insomnia, corresponding with a diagnosis with a semi-structured interview or self-report (Morin, Belleville, Bélanger, & Ivers, 2011). The ISI has also been shown to be sensitive to detect changes related to insomnia treatment from baseline to eight weeks after treatment (Bastien et al., 2001). The ISI was administered during the eligibility screening, pre-treatment assessment, one-week follow-up assessment, and one-month follow-up assessment. The ISI gathers information from the previous two weeks; thus, for the one-week and one-month follow-up assessment, the instructions were changed to ask participants about their symptoms over the past week. The ISI showed adequate internal consistency at all timepoints ($\alpha s = > .74$) in our sample.

Suicide Ideation

Depression Symptom Inventory—Suicide Subscale (DSI-SS; Joiner, Pfaff, & Acres, 2002) is a four-item self-report measure assessing frequency and intensity of suicide ideation and impulses. Items are on a 0 to 3 scale and total scores range from 0 to 12. Higher scores indicate greater intensity of suicide ideation. The scale has shown a strong internal consistency in a sample of adolescents and young adults ($\alpha = .90$; Joiner et al., 2002) and adequate test-retest reliability over the course of ten weeks in college students ($r = .38$; Joiner & Rudd, 1996). The

DSI-SS was administered at the pre-treatment, one-week follow-up, and one-month follow-up assessment. The DSI-SS gathers information from the previous two weeks; thus, during one-week follow-up assessment, the instructions were changed to ask participants about their symptoms in the past week. Scores were monitored during follow-up assessments, and participants were contacted by phone for a semi-structured suicide risk assessment interview if necessary. The DSI-SS showed an adequate internal consistency at all timepoints (αs = > .76) in our sample. At the pre-treatment assessment, 13 out of 38 (34%) participants endorsed some degree of suicide ideation in the past two weeks. At the one-week follow-up assessment, 11 of the remaining 33 (33%) participants endorsed some degree of suicide ideation in the past week, and at the one-month follow-up assessment, four of the remaining 20 (20%) participants endorsed some degree of suicide ideation in the past week.

Sleep Quality

The Pittsburgh Sleep Quality Index (PSQI; Buysse, Reynolds, Monk, Berman, & Kupfer, 1989) is a 19-item self-report measure assessing sleep quality and disturbance. Items are on a 4-point scale ranging from 0 to 3 and total score ranges from 0 and 21. Higher scores indicate worse sleep quality. The PSQI total score cutoff of > 5 differentiates adults with primary insomnia from controls (Backhaus, Junghanns, Broocks, Riemann, & Hohagen, 2002). The PSQI was found to have good internal consistency (α =.83) and test-retest reliability over the course of 18 months in adults with and without insomnia symptoms (r = .85). The PSQI was administered at the pre-treatment, one-week follow-up, and one-month follow-up assessment. The PSQI asks about symptoms over the past month; thus, for the one-week and one-month follow-up assessment, the instructions were changed to ask participants about symptoms in the past week. At all timepoints, the PSQI did not show adequate internal consistency (αs = < .70) in our sample

(see Table 2). The inadequate internal consistency may have been due to an administration error where the middle two points were combined, resulting in only a 3-point scale (i.e. 0, 1, 3 instead of 0, 1, 2, 3) for items 5,7,8, and 9.

Fatigue

The Multidimensional Fatigue Inventory (MFI-20; Smets, Garssen, Bonke, & De Haes, 1995) is a 20-item self-report measure. It produces an overall score of fatigue and includes subscales of general fatigue, physical fatigue, reduced activity, reduced motivation, and mental fatigue on a 5-point scale. The total score ranges from 20 to 100 and scores on each subscale range from 4 to 20 with higher scores indicating greater level of fatigue. The MFI-20's overall fatigue score internal consistency was excellent (α = .93) and the internal consistency of its subscale scores (α = .71–.86) were acceptable in a community sample (Lin et al., 2009). It also has demonstrated adequate test-retest reliability over the course of six to eight weeks in clinical patients (r = .60 –.70; Stein, Martin, Hann, & Jacobsen, 1998). The MFI-20 was administered at the pre-treatment, one-week follow-up, and one-month follow-up assessments. Regarding the MFI-20's internal consistencies, there was an adequate internal consistency at all timepoints in our sample for overall fatigue (αs = > .83), reduced activity subscale (αs = > .70), and mental fatigue subscale (αs = > .85). However, the general fatigue, physical fatigue, and reduced motivation subscales did not show adequate internal consistency (αs = < .70) at some timepoints in our sample (see Table 2).

Beliefs and Attitudes About Sleep

The Dysfunctional Beliefs and Attitudes about Sleep (DBAS-16; Morin, Vallières, & Ivers, 2007) is a 16-item self-report measure assessing sleep related beliefs, attitudes, expectations, appraisals, attributions. Participants used an electronic slider on a scale from 0 to

10 anchored by *strongly disagree* at one end and *strongly agree* at the other end to indicate their agreement with statements (e.g., *I need 8 hours of sleep to feel refreshed and function during the day*). Total scores are based on the average of all items with higher scores indicating more dysfunctional beliefs and attitudes about sleep. The DBAS-16 was found to have acceptable internal consistency (α =.77) and test-retest reliability over the course of two weeks (r = .83) in adults with insomnia symptoms. The DBAS-16 was administered at the pre-treatment, one-week follow-up, and one-month follow-up assessments. The DBAS-16 showed adequate internal consistency at all timepoints (αs = > .75) in our sample.

Depression and Anxiety

The Depression Anxiety Stress Scale (DASS-21; Lovibond, & Lovibond, 1995) is a 21-item self-report measure with three subscales assessing depression, anxiety and stress. The depression and anxiety subscales were used to examine depressive and anxiety symptom severity. Each subscale contains seven items. Items are on a 4-point scale ranging from 0 to 3 and total score ranges from 0 to 63 with higher scores indicating greater symptom severity. It was found to have good internal consistency for the depression (α =.85) and anxiety (α =.81) subscales among college students (Osman et al., 2012). It also demonstrated good test-retest reliability over the course of two weeks for depression (r = .71) and anxiety (r = .78) among psychiatric patients (Page, Hooke, & Morrison, 2007). The DASS was administered at the pre-treatment, one-week follow-up, and one-month follow-up assessments. The DASS depression (αs = > .83) and anxiety subscales (αs = > .77) showed adequate internal consistency at all timepoints in our sample.

Posttraumatic Stress

The Life Events Checklist for *DSM-5* (LEC-5; Weathers, Blake, Schnurr, Kaloupek, Marx, & Keane, 2013) is a 16-item self-report measure assessing lifetime traumatic events. It provides a detailed assessment of Criterion A (i.e., trauma exposure) for PTSD by asking participants indicated levels of exposure to each potentially traumatic event. Items are on a 6-point scale ranging from *Happened to me* to *Doesn't apply*. This was used to establish Criterion A for PTSD. The LEC-5 was administered at the pre-treatment assessment.

The Posttraumatic Stress Disorder Checklist for *DSM-5* (PCL-5; Weathers, Litz, Keane, Palmieri, Marx, & Schnurr, 2013) is a 20-item self-report measure assessing PTSD severity. Items are on a 4-point scale ranging from 0 to 4 and total score ranges from 0 to 80 with high scores indicating greater severity for symptom clusters and whole disorder. It was found to have strong internally consistency ($\alpha =.94$) and adequate test-retest reliability over the course of one week in college students ($r = .82$; Blevins, Weathers, Davis, Witte, & Domino, 2015). The PCL-5 was administered at the pre-treatment, one-week follow-up, and one-month follow-up assessments. Among the participants who were determined to have experienced a Criterion A event based on the LEC-5 (see below), the PCL-5 showed an adequate internal consistency ($\alpha s = > .94$) at all timepoints.

To assess *DSM-5* PTSD Criterion A, participants completed The Life Events Checklist for *DSM-5* (LEC-5). Next, participants identified the worst event from The Life Events Checklist for *DSM-5* and responded to The Posttraumatic Stress Disorder Checklist (PCL-5) based on this event. Participants' responses to the LEC-5 and the narrative of the worst event were reviewed by the first author. If participants' worst event happened directly to them or they witnessed it and during the event their or someone else's life was in danger or was threatened with physical harm or they experienced serious injury/death or there was sexual violence, the event was considered a

Criterion A event. In addition, if participants' worst event included learning about an event happening to a close friend or family member and it included an accident or violence, the event was considered a Criterion A event. If a participant's response did not follow this pattern it was not considered a Criterion A event. From the LEC-5, there were 20 participants (52.60%) whose worst event was consistent with a Posttraumatic Stress Disorder Criterion A event. The PCL-5 was only scored for the participants whose worst event was determined to meet Criterion A according to the LEC-5.

Data Analytic Strategy

Feasibility

In a pilot study, inferential statistics are not computed; thus, descriptive statistics were provided for the screening rate, recruitment rate, acceptability, treatment satisfaction, adherence, Sleep Scholar's duration, assessment duration, and scores on quizzes taken during Sleep Scholar. The feasibility outcomes of the current study will inform the study design for a future randomized controlled trial (RCT).

Clinical Outcome Variability

The variability of clinical outcomes was assessed descriptively for the all measures at the pre-treatment, one-week, and one-month follow-up assessments to examine the data for floor and ceiling effects.

Sample Size

According to Leon et al. (2011), power analyses should not be presented in a pilot study that does not utilize inferential statistics. Due to the exploratory nature of the study, a pilot study sample size should be representative of the target population, logically based on the recruitment methods (e.g., available population size, range of population exposed to recruitment system,

length of time for recruitment), and should be sufficient to examine feasibility of the study (Leon

et al., 2011; Thabane et al., 2010). Although social science literature has relatively few sample

size recommendations for pilot studies, Hill (1998) and Isaac & Michael (1995) recommended

10 to 30 participants; however, more recently, The Medical Research Council suggests larger

sample sizes to ensure sufficient variability in outcome variables (Craig et al., 2008). In addition,

up to 12% of undergraduates have been found to respond carelessly on questionnaire measures

(Meade & Craig, 2012); therefore, we aimed to recruit 40 participants for the current study, but

ultimately included 38 in our analyses.

Results

All percentages have been rounded to the nearest whole number.

Screening and Recruitment Rate

Screening and recruitment of potential participants began approximately half-way through

the Spring semester in March 2019, continued throughout the Summer semester, and completed

at the end of the Fall semester in November of 2019 (see Figure 1). There were 822 responders

to the eligibility screener. Of these, 822 students, 812 (99%) agreed to participate in the screener.

Of the 812 students who agreed to participate in the screener, 771 (95%) provided adequate

information to determine eligibility for inclusion. Thus, in total, 771 students were screened for

the current study across all three semesters, resulting in a screening rate of 234 (30%) during

Spring semester, 4 (1%) during Summer semester, and 533 (70%) during Fall semester.

Among the 771 students who were screened for the current study, 347 (45%) were excluded

for not endorsing a lifetime history of suicide ideation, 41 (5%) were excluded for not endorsing

at least subclinical insomnia symptoms, and 242 (31%) were excluded for endorsing neither

inclusion criteria. Of the 141 students meeting the inclusion criteria, 28 (20%) students were

excluded for endorsing at least one of the exclusion criteria (i.e., current shift work [$n = 10$; 7%],
a current alternative insomnia treatment [$n = 5$; 4%], untreated chronic pain [$n = 5$; 4%],
untreated restless leg syndrome [$n = 2$; 1%], untreated sleep apnea [$n = 0$], or a combination of
exclusion criteria [$n = 6$; 4%]). Among the 113 eligible students, 40 (35%) participants enrolled
in current study, resulting in a recruitment rate of 7 (18%) during Spring semester, none during
Summer semester, and 33 (83%) during Fall semester. Two enrolled participants from Spring
semester were excluded from the final analysis due to technical difficulties with their sleep
diaries. Therefore, 38 of the 40 students enrolled were included in our analyses.

Assessment and Sleep Diary Attrition Rates

The overall attrition rate from the pre-treatment assessment ($n = 38$) to the one-month
follow-up assessment was 47% ($n = 18$); however, attrition rates varied as participants
progressed through the protocol (See Figure 2). Specifically, there was a low attrition rate, less
than 15% of participants ($n = 5$), from the pre-treatment assessment through the one-week
follow-up assessment; however, there was a high attrition rate, over one-third of participants (39
%; $n = 13$), between the one-week follow-up assessment and the one-month follow-up
assessment. Most of these participants ($n = 9$) completed neither the one-month daily sleep
diaries nor the one-month follow-up assessment.

Due to the higher than expected attrition rate, we calculated post-hoc t-tests to compare
pre-treatment assessment scores, treatment knowledge acquisition and retention quiz scores,
treatment duration, and post-treatment acceptability and satisfaction scores for participants who
dropped out of the study at any point to those who did not (see Table 3). Compared with
participants who completed the protocol, participants who dropped out of the study reported a
later bedtime (t[35] = -2.41, $p = .02$), greater overall fatigue (t[36] = -2.07, $p = .04$), greater

activity fatigue (t[36] = -3.43, *p* < .01), and greater treatment acceptability (t[35] = -2.18, *p* = .03). Conversely, those who completed the protocol did not differ from those who dropped out on any other pre-treatment measures, treatment quiz scores, treatment duration or post-treatment satisfaction scores (all *t*'s < 1.85; all *p*'s > .10).

In addition, to determine if the timing of assessments contributed toward dropout, we examined whether participation was consistent before and after classes were completed for the semester. Specifically, among the 22 participants who were asked to complete the one-month follow-up assessment during the regular semester, approximately half (55%; *n* = 12) completed this assessment, while among the remaining 16 participants who were asked to complete the one-month follow-up assessment after classes were completed, exactly half (50%; *n* = 8) completed this assessment. Similarly, among the 26 participants who were asked to complete all or the majority of the one-month seven daily sleep diaries during the regular semester, most (62%; *n* = 16) completed at least five daily sleep diaries, while among the remaining 12 participants who were asked to complete all or the majority of the one-month seven daily sleep diaries after classes were completed, most (67%; *n* = 8) completed at least five daily sleep diaries. Thus, the high attrition rates between the one-week and one-month follow-up assessment does not appear to be attributable to the timing of the assessment.

Completion Time of Sleep Scholar and Survey Assessments

As can be seen in Table 4, the overall mean duration of time to complete the treatment was 32.94 minutes (S.D. = 11.02; median = 40.28; range = 13.83-54.05; *n* = 38). The duration of time to complete each module varied. Specifically, the shortest duration of time was the stimulus control module (*M* = 5.75; median = 5.59; S.D. = 2.63; range = 0.59-10.95). The longest duration of time was the sleep quality enhancement module (*M* = 10.16; S.D. = 4.61; median = 10.39;

range = 1.32-19.81). Overall, there was a small minority of participants (approximately 5%; $N =$ 2) who spent fewer than 16 minutes on the entire treatment and likely were not attending carefully to the material.

In addition, the duration of time to complete the survey assessments varied (See Table 4). Specifically, as expected, given that the post-treatment assessment contained a smaller number of surveys, it took the shortest duration of time (M = 5.40; S.D. = 2.09; range = 2.17-12.73). The remaining three assessments, which were nearly identical in number of surveys to one another, were approximately equivalent in duration and distribution of time. During all survey assessments, all participants answered the bogus questions with 75% or greater accuracy and completed the surveys within an adequate amount of time for the completed number of surveys. Thus, no participants were removed from these time-points.

Sleep Scholar Knowledge Acquisition and Retention

Participants' knowledge acquisition and retention of the information in Sleep Scholar was examined with quizzes for the sleep psychoeducation module, stimulus control therapy module, and sleep quality enhancement module, which were presented immediately after each respective module (see Table 5). Across all quizzes, participants answered a mean of 17.03 out of 20 questions correctly (85%; S.D. = 1.35; range = 14-20; n = 38); however, scores varied across each quiz. Specifically, participants scored highest on the sleep psychoeducation module quiz, followed by the stimulus control therapy quiz, and scored lowest on the sleep quality enhancement quiz. Importantly, the items on the sleep quality enhancement quiz with which participants had the most difficulty involved calculating the appropriate time in bed.

Acceptability of Sleep Scholar

Overall acceptability ($M = 76.80$; S.D. = 14.17; range = 43.00-97.44; $n = 37$) is the average of the eight acceptability items (see Table 6). At the item level, the mean scores were all in a positive direction (i.e. above 50 on a 0-100 scale); however, there was there was some variability. Willingness to adhere to the treatment was the highest rated item, and extent of treatment side effects was the lowest rated item. Taking all of the acceptability items into account, although participants reported they were quite willing to adhere to Sleep Scholar's strategies, they viewed the treatment as more effective in the long-term than in the short-term. In addition, participants viewed the treatment as more effective for difficulties falling asleep and daytime functioning (e.g., alertness, performance, mood) than for difficulties staying asleep. Treatment acceptability for oneself was rated similarly to treatment acceptability for others.

Treatment Satisfaction

At the post-treatment assessment, participants' mean overall satisfaction rating was 28.22 out of 32 (S.D. = 3.07; range = 21-32; $n = 37$), but satisfaction ratings differed across individual items (see Table 7). Specifically, more than 90% of participants rated the treatment quality as good or excellent, indicated that the treatment was the service they wanted, stated that the treatment met most or almost all of their needs, reported that they would recommend the treatment to a friend, stated that they were very or mostly satisfied with the amount of help they received, reported that they were helped by the treatment, and stated they were very or mostly satisfied with the treatment, and a similar proportion of participants (87%) stated that they would return to the treatment if they were to seek help again. At the one-month follow-up assessment, the pattern of results was nearly identical to the one-week follow-up assessment (see Table 7).

Participants also completed open-ended questions assessing what aspects of the treatment were most helpful, least helpful, difficult to understand, and needed to be changed at the post-

treatment and one-month follow-up assessment. Due to the similarity in responses between the post-treatment and one-month follow-up assessment, the responses were aggregated, and the percentages shown represent the percent out of the total sample ($N = 38$), which is conservative estimate, given that not all participants completed these questions. Note that some participants commented that multiple aspects of the treatment were helpful; thus, the percentages do not add up to 100%. Also, if participants mentioned the same aspect of treatment during both timepoints, we did not double count it in the forthcoming percentages.

Regarding the psychoeducation module, some participants (16%; $n = 6$) commented that this module was the most helpful aspect of the treatment, while others (8%; $n = 3$) stated that it was the least helpful aspect of the treatment. In addition, some participants (11%; $n = 4$) reported that the module was difficult to understand, but no participants reported that it needed to be changed.

Regarding the stimulus control module, almost half of participants (47%; n = 18) commented that this module was the most helpful aspect of the treatment. Within this group of 18 participants, approximately one half (56%; $n = 10$) specifically mentioned that the activities to do when one cannot fall asleep was the most helpful aspect and over one-third (39%; $n = 7$) mentioned that not getting into bed until one was sleepy was the most help aspect. These reports are consistent with participants rating the treatment as more suitable for difficulties falling asleep then for difficulties staying asleep. However, three participants (8%) reported that the stimulus control module was the least helpful aspect, two participants (5%) mentioned that the module was difficult to understand, and one (3%) participant stated that they would change the module to have further discussion of the activities to do when one cannot sleep.

Regarding the sleep quality enhancement module, half of participants (50%; $n = 19$) stated that this module was the most helpful aspect of the treatment. Within this group of 19 participants, nearly three-fourths (74%; $n = 14$) specifically mentioned that receiving a time in bed window was the most helpful aspect of the sleep quality enhancement module. However, a substantial minority of participants (21%; $n = 8$) reported that the limited information on how to implement the time in bed window consistently (e.g., adjusting time in bed window when staying up later or waking up earlier to study, or staying out later than expected) was the least helpful aspect of the treatment. An even larger number of participants (39%; $n = 15$) mentioned that calculating and adjusting the time in bed window was difficult to understand. Consequently, some participants (18%; $n = 7$) reported that they would change the treatment to allow more flexibility when choosing their time in bed window or to include more information on how to implement of the time in bed window consistently. Participants' reports about aspects of the time in bed window being least helpful, difficult to understand, and needing change are consistent with the items that were incorrect on the sleep quality enhancement module quiz and the lower mean score for this quiz compared to other module quizzes.

Beyond the individual treatment modules, some participants (11%; $n = 4$) stated that the most helpful aspect was the content of the treatment being explained clearly and thoroughly or it being applied to real-life situations during the module quizzes, but a similar number of participants (11%; $n = 4$) reported the least helpful aspect was the length of readings. In addition, participants noted that they would change the treatment to be more concise (13 %; $n = 5$), interactive (13%; $n = 5$; e.g., audio, video, or graphs), or to have more support between the one-week and one-month follow-up assessment (8%; $n = 3$; e.g., use of sleep diaries or access to readings).

Objective Adherence to Time in Bed Duration Recommendations

Adherence to the prescribed time in bed duration recommendations was determined with the seven daily sleep diaries completed in the week after the treatment and in the week before the one-month assessment. Participants who did not complete at least five daily sleep diaries were automatically considered non-adherent with the time in bed duration recommendations. In the week after the treatment, six participants (16%) did not complete at least five daily sleep diaries and were therefore considered non-adherent. Among those who completed at least five daily sleep diaries, adherence to the time in bed duration recommendations was based on participants' time in bed being within 15 to 30 minutes (Ellis et al., 2015) of their restricted time in bed duration recommendation (i.e., their total sleep time determined from the pre-treatment sleep diaries). Among the participants who completed at least five daily sleep diaries, less than half of participants (42%; $n = 16$) were adherent within 30 minutes of their restricted time in bed duration recommendation, and within this group, 13 (34%) were adherent within 15 minutes of their restricted time in bed duration recommendation. Among the participants who completed at least five daily sleep diaries, but were not adherent within 30 minutes of their restricted time in bed duration recommendation (42%; $n = 16$), nine (24%) participants restricted their time in bed duration below the 30 minute range of their prescribed time in bed duration recommendation (i.e. spent *less* time in bed than was recommended), further decreasing excessive time in bed, and seven (18%) participants expanded their time in bed above the 30 minute range of their restricted time in bed duration recommendation (i.e. spent *more* time in bed than was recommended), increasing excessive time in bed. Thus, in total, 25 (66%) participants were either adherent within 30 minutes of their prescribed time in bed duration recommendation (42%; $n = 16$) or restricted their time in bed more than 30 minutes below their recommendation (24%; $n = 9$),

while the remaining 13 (34%) participants were non-adherent because they either expanded their time in bed more than 30 minutes above their recommendation (18%; $n = 7$) or they failed to complete at least five daily sleep diaries (16%; $n = 6$).

In the week before the one-month follow-up, 14 (37%) participants did not complete at least five daily sleep diaries and were therefore considered non-adherent. Among the participants who completed at least five daily sleep diaries, approximately one-fourth of participants (24%; $n = 9$) were adherent within 30 minutes of their new restricted time in bed duration recommendation, and within this group, two (5%) were adherent within 15 minutes of their new restricted time in bed duration recommendation. Of the participants who completed at least five daily sleep diaries, but were not adherent within 30 minutes of their restricted time in bed duration recommendation (40%; $n = 15$), three participants (8%) restricted their time in bed below the 30 minute range of their restricted time in bed duration recommendation (i.e. spent *less* time in bed than was recommended), further decreasing excessive time in bed, and 12 participants (32%) expanded their time in bed above the 30 minute range their restricted time in bed recommendation (i.e. spent *more* time in bed than was recommended), increasing excessive time in bed. Therefore, in total, 12 participants (32%) were either adherent within 30 minutes of their prescribed time in bed duration recommendation (24%; $n = 9$) or restricted their time in bed more than 30 minutes below the recommendation (8%; $n = 3$), while the remaining 26 (68%) participants were non-adherent because they either expanded their time in bed more than 30 minutes above their recommendation (32%; $n = 12$) or they failed to complete at least five daily sleep diaries (37%; $n = 14$).

Of note, participants' sleep diaries were not completed between the one-week and one-month follow-up assessment; therefore, it is possible that participants may have appropriately

adjusted their time in bed window during this time, but it would not be reflected in the adherence rates.

Clinical Outcome Measures

The internal consistency and variability differed by each clinical outcome measure (see Table 2). All measures had an acceptable internal consistency, except the Multidimensional Fatigue Inventory (MFI-20) general fatigue, physical fatigue, and reduced motivation subscales, and the Pittsburgh Sleep Quality Index (PSQI). For the PSQI, the poor internal consistency may be applicable to an administration error of the measure; thus, the PSQI is better described descriptively at the item level. Descriptively, at the pre-treatment assessment, the majority of participants reported difficulty falling and staying asleep, poor quality sleep, and problems with daytime enthusiasm three or more times per week, while less than half of participants reported medications for sleep, physical disturbances (e.g., pain, difficulty breathing), or other sleep disturbances (e.g., inability to shut off mind) three or more times per week (see Table 8).

As can be seen in Table 2, there was adequate variability (i.e. no pronounced floor or ceiling effects) on all clinical measures across all timepoints, except the Depression Symptom Inventory—Suicide Subscale. Specifically, for the Depression Symptom Inventory—Suicide Subscale (DSI-SS), although the total possible score ranges from 0 to 12, observed scores in our sample only ranged from 0 to 4, and the majority of participants (66%; $n = 25$) scored zero or less at the pre-treatment assessment.

<center>**Discussion**</center>

This study aimed to establish the feasibility and acceptability of Sleep Scholar, a single-session, self-guided, internet-based insomnia intervention for college students with at a lifetime history of suicide ideation and at least current subclinical insomnia symptoms. To our

knowledge, this is the first study to examine a single-session, internet-based, insomnia intervention. There were five main findings that are relevant for planning a future randomized controlled trial in the current setting: (1) approximately 33 students could be recruited per semester in an future study using the current eligibility criteria; (2) almost half of participants (47%) were lost from the pre-treatment assessment to the one-month follow-up assessment; (3) the mean duration of time to complete Sleep Scholar was 32.94 minutes and the mean duration of time to complete each survey assessment was under 20 minutes; (4) the majority (85%) of the knowledge in Sleep Scholar was acquired and retained, all intervention acceptability item scores were above 50 (out of 100), the majority of participants (> 80%) were satisfied with Sleep Scholar at the post-treatment and one-month follow-up assessment, and approximately half of participants adequately adhered to their prescribed time in bed recommendation in the week after and approximately half of these participants maintained their adherence in the week before the one-month follow-up assessment; (5) there was adequate variability (i.e. no pronounced floor or ceiling effects) and internal consistency in all clinical outcome measures, except the Depression Symptom Inventory—Suicide Subscale (DSI-SS), Pittsburgh Sleep Quality Index (PSQI), and Multidimensional Fatigue Inventory (MFI-20). These findings will be discussed in more detail in the following sections.

Screening and Recruitment Rate

Our results provide support for the feasibility of conducting a randomized controlled trial investigating the effectiveness of Sleep Scholar in our setting. Specifically, we were able to recruit a similar number of participants compared with previous trials examining internet-based (*N's* = 28-45; Ritterband et al., 2009; Ritterband, Bailey, Thorndike, Lord, Farrell-Carnahan, & Baum, 2011; Suzuki, Tsuchiya, Hirokawa, Taniguchi, Mitsuhashi, & Kawakami, 2008) and

single-session insomnia interventions (*N's* = 10-40; Boullin et al., 2017; Ellis et al., 2015; Germain et al., 2006; Germain et al., 2007). Moreover, we were able to screen and recruit participants over a shorter time period than other trials that investigated internet-based insomnia interventions (10-12 months; Espie et al., 2012; Ritterband et al., 2011) or single session or brief insomnia interventions (14-32 months; Edinger & Sampson, 2003; Germain et al., 2006; Lovato et al., 2014). Our results suggest that in our setting, there are an adequate number of college students with insomnia symptoms and suicide ideation that are open to participating in a single-session, internet-based insomnia intervention. Therefore, in our setting with the current eligibility criteria, recruitment of two groups for a randomized controlled trial would take approximately two academic semesters to complete.

Attrition Rates

Almost half of participants were lost from the pre-treatment to one-month follow-up assessment. This rate of attrition is consistent with at least two internet-based insomnia interventions treatment arms (41-57%; Ho, Chung, Yeung, Ng, & Cheng, 2014; Vincent, & Lewycky, 2009), but inconsistent with the lower rates in single-session insomnia intervention treatment arms (0-30%; Ellis et al., 2015; Boullin, et al., 2016; Germain et al., 2006; Germain et al., 2007) with a similar follow-up assessment interval (i.e., four to six weeks). However, to our knowledge, the current study is the only single-session insomnia intervention that did not include interaction with a trained professional. As such, a single-session insomnia intervention with a trained professional may have allowed participants to become invested by spending time building rapport or encouraged participants to be more responsive and accountable throughout the treatment process. Given the significant portion of participants lost in the current study, future research examining single-session, internet-based insomnia interventions should consider

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including additional support throughout the follow-up intervals. Additional support could come in the form of access to a website where participants can regularly review the treatment concepts (Espie et al., 2012; Ritterband et al., 2011), daily sleep diaries throughout the protocol and regular personalized sleep recommendations (Espie et al., 2012; Ritterband et al., 2011), and asking participants if they are willing to commit to the study protocol after the intervention is completed (Espie et al., 2012).

Consistent with previous trials investigating internet-based (Lancee et al., 2012; Vincent, & Lewycky, 2009) and brief insomnia interventions (Currie et al., 2004), sleep variables, sleep disorders, and depressive symptoms were not significantly associated with attrition, and neither was treatment satisfaction. However, those who dropped out of the current study had a later bedtime, greater fatigue symptoms, and viewed the treatment as more acceptable than those who were retained. To our knowledge, no other internet-based or brief insomnia intervention trials have found similar predictors of attrition. However, a trial investigating a traditional face-to-face insomnia intervention (Arnedt, Conroy, Armitage, & Brower, 2011) found that participants with greater physical fatigue scores on the MFI-20 were more likely to drop out. In the current study, participants who dropped out may have had a later bedtime and slept until their typical rise time. Once these participants were out of bed, they may have had a limited amount time before class or work, or been too fatigued to respond to the morning text message reminders for the study. Another explanation of attrition is that participants with elevated acceptability scores may have been more likely to implement the treatment, have positive effects, and discontinue the follow-up assessments; thus, it is possible that those who dropped out were equally as satisfied as those who completed the protocol. Future researchers should consider sending multiple reminders

(e.g., morning, afternoon, evening), and integrating brief questions into the intervention that enhance participants' motivation (Espie et al., 2012;Thiart, Lehr, Ebert, Berking, & Riper, 2015).

Completion Time of Sleep Scholar and Survey Assessments

The duration of time taken to complete Sleep Scholar was consistent with other individual sessions of brief insomnia interventions with a trained professional (20-40 minutes; Edinger & Sampson, 2003; Pigeon et al., 2017), but was shorter than a single module of another internet-based insomnia intervention (45-60 minutes; Ritterband, Bailey, Thorndike, Lord, Farrell-Carnahan, & Baum, 2012) and other single-session insomnia interventions with a trained professional (45-90 minutes; Ellis et al., 2015; Germain et al., 2006; Germain et al., 2007). However, to our knowledge, this is the first internet-based insomnia intervention that delivered all the modules in a single session and the first single-session insomnia intervention that was conducted without a trained professional. Regarding internet-based insomnia interventions, it is unclear how much content is needed to produce behavior change; therefore, it has been suggested that researchers implement "short form" internet interventions (Ritterband, Thorndike, Cox, Kovatchev, & Gonder-Frederick, 2009). In addition, concerning single-session insomnia interventions with a trained professional, the speaking rate in conversations (193 words per minute; Yuan, Liberman, & Cieri, 2006) may be slightly slower than the silent reading rate of college students (approximately 230 words per minute; Lewandowski, Codding, Kleinmann, & Tucker, 2003), which may allow for more information to be reviewed in a somewhat shorter amount of time. Future research should consider using brief, self-guided, text-based, internet interventions to decrease the time it takes to deliver an intervention. Overall, results from this pilot study indicate that future researchers with a similar protocol should plan for participants to complete the laboratory session in a similar amount of time as the current study (i.e., 1.5 hours).

Sleep Scholar Knowledge Acquisition and Retention

The elevated scores on Sleep Scholar's quizzes are consistent with at least one other internet-based insomnia intervention indicating that the information was understandable (Ritterband et al., 2011; Thorndike et al., 2008). However, to our knowledge, the current study is the first brief insomnia intervention to examine the knowledge gained from the intervention. This may be due to trained professionals in brief insomnia interventions checking for understanding while delivering the treatment. Our results suggest that a self-guided, internet-based intervention delivered in a single session is a sufficient and efficient delivery method of CBT-I content for college students.

Acceptability of Sleep Scholar

Participants rating Sleep Scholar as generally acceptable for their lifestyle and effective for their insomnia symptoms is consistent with previous internet-based insomnia interventions (Ho et al., 2014; Ritterband et al., 2011; Ström, Pettersson, & Andersson, 2017; Thorndike et al., 2008). Although the majority of clinical trials specifically examining brief insomnia interventions do not report acceptability ratings, the results in the current study are consistent with qualitative reports in a trial examining a brief insomnia intervention (Pigeon & Funderburk, 2014) and a lower proportion of participants in a single-session insomnia intervention asking for traditional CBT-I treatment compared to the control group after study completion (Ellis et al., 2015). Our results suggest that Sleep Scholar's brief format and internet-based delivery method did not notably impact acceptability compared with longer format or in-person treatment delivery methods.

Treatment Satisfaction

The elevated satisfaction ratings and most helpful aspects of the treatment identified by participants were similar to other investigations of internet-based insomnia interventions (Ritterband et al., 2011; Thiart et al., 2015). Similar to acceptability ratings in brief insomnia interventions, satisfaction ratings are seldom reported. However, the satisfaction ratings in the current study are consistent with at least one other brief insomnia intervention (Loring, Johnston, Gray, Goldman, & Malow, 2016). In addition, although participants were generally satisfied with Sleep Scholar, some participants reported difficulties with the prescribed time in bed recommendations and the intervention's interactivity. This may be because there was a limited amount of regular feedback and a fewer number of interactive modules in the current study compared to other internet-based insomnia interventions (e.g., Ritterband et al., 2011). In addition, Sleep Scholar did not include a trained professional to help with adjusting their time in bed window compared to other brief insomnia interventions (Germain et al., 2006; Germain et al., 2007) and college students' lifestyles (e.g., staying up all night to study; staying out later with friends; sharing sleeping space with roommates) may be more complex than the adults who have typically participated in other single-session insomnia interventions (Boullin et al., 2017; Ellis et al., 2015). Our findings suggest that although participants are generally satisfied with a single-session, self-guided, internet-based insomnia intervention, future researchers may want to consider providing additional support through the protocol (e.g., regular completion of sleep diaries, which would allow more opportunities for feedback).

Objective Adherence

Adherence to the prescribed time in bed recommendations was partially maintained throughout the protocol. The proportion of adherent participants in the week after the treatment, was consistent with an internet-based insomnia intervention (52%; Vincent, & Lewycky, 2009),

but below other single-session insomnia interventions (65-92%; Boullin et al., 2017; Ellis et al., 2015). The proportion of adherent participants in the week before the one-month follow-up was approximately half of those adherent in the week after the treatment. Insomnia interventions typically report adherence as a dichotomous variable (i.e., adherent or non-adherent), limiting the ability to fully describe adherence to various aspects of the treatment (Matthews, Arnedt, McCarthy, Cuddihy, & Aloia, 2013; Lovato et al., 2014). In addition, in internet-based and single-session insomnia trials, adherence is typically assessed in the week after the strategies are provided (e.g., Boullin et al., 2017; Ellis et al., 2015; Vincent, & Lewycky, 2009), limiting the ability to describe long-term adherence. The substantial decrease in adherence across the protocol may have been due to the difficulty in accurately assessing individual changes in the prescribed time in bed recommendations or participants' low self-efficacy in adjusting their time in bed window. Providing additional support over the course of the follow-up period, in addition to adding materials designed to enhance motivation for enacting Sleep Scholar's recommended strategies may improve adherence in future studies.

Importantly, the goal of the time in bed recommendation for sleep restriction is to reduce excessive time in bed, a factor believed to perpetuate insomnia symptoms (Spielman et al., 1987), and, in the week after Sleep Scholar, almost a quarter of participants restricted their time in bed *below* our adherence guidelines (but not below 5 hours per night). This finding is unexpected given that participants implementing sleep restriction therapy often have difficulty adhering to the prescribed schedule due to the strategy's counter-intuitiveness (i.e., time in bed decreased rather than increased to improve sleep) and the difficulty of staying up until their scheduled bedtime (Riedel & Lichstein, 2001; Spielman et al., 1987). Of note, when these participants were included as being adherent to the time in bed recommendation, the proportion

of adherent participants in the current study (66%) slightly exceeded other internet-based and single-session insomnia interventions (Ellis et al., 2015; Vincent, & Lewycky, 2009). Moreover, in the aforementioned studies that examined adherence, adherence did not impact the treatment outcome (Boullin et al., 2017; Ellis et al., 2015; Vincent, & Lewycky, 2009). Boullin and colleagues (2017) suggest that this may be because there is not a standard measure of adherence that is used for sleep restriction therapy and that the definition used in their study, similar to the definition in current study, may be too stringent. In addition, Boullin and colleagues (2017) suggest that sleep restriction may not be essential for individuals with acute insomnia, which also may be the case for college students who may not have experienced insomnia symptoms for an extended duration. Although participants may not have been completely adherent to the prescribed time in bed recommendations, they may have been adherent to other strategies of Sleep Scholar (e.g., stimulus control) and it is possible that participants still saw improvement in their insomnia symptoms. Improvement in sleep variables and sleep disorders should be examined in a future clinical trial.

Clinical Outcome Measures

The observed variability and internal consistency of the clinical outcome measures were sufficient, with some exceptions. First, the poor variability in the DSI-SS (i.e. a floor effect) was likely due to broad inclusion criteria of lifetime history of suicidal thoughts and behaviors. These findings suggest that when the effect of the intervention is tested in a larger trial that the inclusion criteria of lifetime history of suicide ideation will need to be narrowed (e.g., requiring a recent history of suicide ideation) to obtain more elevated symptoms on this measure at the pre-treatment assessment, thereby allowing for the possibility of improvement on this variable over

the course of treatment. This change of inclusion criteria may extend the screening and recruitment time for a future trial examining the effect of Sleep Scholar.

To our knowledge, the inadequate internal consistency of the PSQI in the current study has not been reported in other trials investigating internet-based (Suzuki et al., 2008) and single-session insomnia interventions (Germain et al., 2006; Germain et al., 2007). The inadequate internal consistency in the current study may be due to the administration error that occurred. However, other studies have found similarly inadequate internal consistency even when there was not an administration error (e.g., Exelmans, & Van den Bulck, 2014; Spira et al., 2011). These findings suggest that before implementing a larger trial with the PSQI as a primary outcome measure, this measure should be piloted in a similar sample to the current one to determine if acceptable internal consistency is observed when the measure is administered without the error in its scaling.

Unlike the PSQI, the MFI-20 did not have an administration error and nevertheless exhibited inadequate internal consistency for some subscales. The inadequate internal consistency of the MFI-20 subscales has not been reported when involved with other internet-based insomnia intervention with adults (Vincent, & Lewycky, 2009; Vincent & Walsh, 2013) or traditional face-to-face insomnia interventions with college students (Taylor et al., 2014) that used a similar sample size as the current study in their treatment arms, and, to our knowledge, the inadequate internal consistency has not been reported in other trials examining brief insomnia interventions. However, the initial validation of the MFI-20 also found inadequate internal consistency on some subscales in certain samples (range: 0.53-0.93; Smets et al., 1995). As such, future researchers should consider using a different fatigue measure with more consistent psychometric properties (e.g., Fatigue Severity Scale; Krupp, 1989; Whitehead, 2009).

Clinical Implications and Future Directions

In the current study, we demonstrated that a single-session, self-guided, internet-based insomnia intervention for college students with insomnia symptoms and a history of suicide ideation was viewed as acceptable, and overall, our study procedure was demonstrated to be feasible in the current setting. This provides a firm foundation for a future clinical trial investigating its efficacy. Ultimately, if we are able to demonstrate that this treatment impacts insomnia symptoms and/or suicide ideation, this would result in increased access to mental health treatment due to the brief and widely portable nature of the intervention. This is especially important because of the ubiquitous nature of insomnia symptoms (Taylor et al., 2013) and their association with suicide ideation (Zuromski et al., 2017). For example, in the current study, almost half of the potential participants (45%) endorsed having current insomnia symptoms without a history of suicide ideation, and approximately 20% of students endorsed a history of suicide ideation with current insomnia symptoms; and, both insomnia symptoms (Pigeon et al., 2012) and suicide ideation (Franklin et al., 2017) are associated with increased risk for fatal suicide attempts.

Limitations

First, the participants in the current study consisted of a small sample that self-selected into the study and were mostly female and Caucasian. Therefore, the current sample may not be a comprehensive representation of college students with suicide ideation and insomnia symptoms. Second, the definition and method used for adherence resulted in only examining adherence in reference to the prescribed time in bed recommendations and only clearly examining adherence in the week after the intervention. Although our definition and method are similar to other single-session insomnia interventions (Boullin et al., 2017; Ellis et al., 2015), it is

unclear if participants adhered to all aspects of the intervention and for how long college students will adhere to the recommendations made by a single-session, internet-based insomnia intervention. Third, the administration error that occurred with the PSQI or other factors may have resulted in the poor internal consistency and limited the utility of the measure in the current study. Finally, the current study examined the feasibility and acceptability, and not the efficacy of a single-session, internet-based insomnia intervention. Therefore, it remains to be seen whether Sleep Scholar actually has an impact on insomnia symptoms or suicide ideation.

Conclusion

The current study aimed to examine the feasibility and acceptability of a single-session, self-guided, internet-based insomnia intervention among college student with insomnia symptoms and a history of suicide ideation. We found that it was feasible to screen and recruit participants and to implement the intervention; however, there was difficulties with attrition over the follow-up period. In addition, participants understood the intervention, accepted and were satisfied with the intervention's format and strategies, and moderately adhered to the intervention. Lastly, we found that most measures used in this pilot were acceptable for use in a large trial. To our knowledge, this is the first study to implement a single-session, internet-based insomnia intervention. Now, with the intervention's feasibility and acceptability established in college students, the efficacy of the intervention and its effect on other psychiatric conditions can be examined.

References

Arnedt, J. T., Conroy, D. A., Armitage, R., & Brower, K. J. (2011). Cognitive-behavioral therapy for insomnia in alcohol dependent patients: A randomized controlled pilot trial. *Behaviour Research and Therapy*, *49*(4), 227–233. https://doi.org/10.1016/j.brat.2011.02.003

Backhaus, J., Junghanns, K., Broocks, A., Riemann, D., & Hohagen, F. (2002). Test–retest reliability and validity of the Pittsburgh Sleep Quality Index in primary insomnia. *Journal of psychosomatic research*, *53*(3), 737-740.

Barak, A., Hen, L., Boniel-Nissim, M., & Shapira, N. A. (2008). A comprehensive review and a meta-analysis of the effectiveness of internet-based psychotherapeutic interventions. *Journal of Technology in Human services*, *26*(2-4), 109-160.

Barak, A., Klein, B., & Proudfoot, J. G. (2009). Defining Internet-Supported Therapeutic Interventions. *Annals of Behavioral Medicine*, *38*(1), 4–17. https://doi.org/10.1007/s12160-009-9130-7

Bastien, C.H., Vallières, A., Morin, C.M. (2001). Validation of the Insomnia Severity Index as an outcome measure for insomnia research. *Sleep Med*. 2 (4), 297–307.

Batterham, P. J., Christensen, H., Mackinnon, A. J., Gosling, J. A., Thorndike, F. P., Ritterband, L. M., ... & Griffiths, K. M. (2017). Trajectories of change and long-term outcomes in a randomised controlled trial of internet-based insomnia treatment to prevent depression. *British Journal of Psychiatry Open*, *3*(5), 228-235.

Belleville, G., Cousineau, H., Levrier, K., & St-Pierre-Delorme, M. È. (2011). Meta-analytic review of the impact of cognitive-behavior therapy for insomnia on concomitant anxiety. *Clinical Psychology Review*, *31*(4), 638-652.

Bernert, R. A., Hom, M. A., Iwata, N. G., & Joiner, T. E. (2017). Objectively Assessed Sleep

    Variability as an Acute Warning Sign of Suicidal Ideation in a Longitudinal Evaluation

    of Young Adults at High Suicide Risk. *The Journal of Clinical Psychiatry*, *78*(06), e678–

    e687. https://doi.org/10.4088/jcp.16m11193

Blanco, C., Okuda, M., Wright, C., Hasin, D. S., Grant, B. F., Liu, S. M., & Olfson, M. (2008).

    Mental health of college students and their non–college-attending peers: results from the

    national epidemiologic study on alcohol and related conditions. *Archives of general*

    psychiatry, *65*(12), 1429-1437.

Blevins, C. A., Weathers, F. W., Davis, M. T., Witte, T. K., & Domino, J. L. (2015). The

    posttraumatic stress disorder checklist for DSM-5 (PCL-5): Development and initial

    psychometric evaluation. *Journal of Traumatic Stress*, *28*(6), 489-498.

Blevins, C. A., Weathers, F. W., Davis, M. T., Witte, T. K., & Domino, J. L. (2015). The

    posttraumatic stress disorder checklist for DSM-5 (PCL-5): Development and initial

    psychometric evaluation. *Journal of Traumatic Stress*, *28*(6), 489-498.

Bloom, B. L. (2001). Focused single-session psychotherapy: A review of the clinical and

    research literature. *Brief treatment and crisis intervention*, *1*(1), 75.

Bootzin, R. R., & Nicassio, P. M. (1978). Behavioral treatments for insomnia. In *Progress in*

    behavior modification (Vol. 6, pp. 1-45). Elsevier.

Borbély, A. A. (1982). A two process model of sleep regulation. *Hum neurobiol*, *1*(3), 195-204.

Boullin, P., Ellwood, C., & Ellis, J. G. (2016). Group vs. Individual Treatment for Acute

    Insomnia: A Pilot Study Evaluating a "One-Shot" Treatment Strategy. *Brain sciences*,

    7(1), 1.

Bozzay, M. L., Karver, M. S., & Verona, E. (2016). Linking insomnia and suicide ideation in

college females: The role of socio-cognitive variables and depressive symptoms in

suicide risk. *Journal of Affective Disorders*, *199*, 106–113.

https://doi.org/10.1016/j.jad.2016.04.012

Bryan, C. J., Gonzales, J., Rudd, M. D., Bryan, A. O., Clemans, T. A., Ray-Sannerud, B., ... &

Etienne, N. (2015). Depression mediates the relation of insomnia severity with suicide

risk in three clinical samples of US military personnel. *Depression and anxiety*, *32*(9),

647-655.

Buysse, D. J., Ancoli-Israel, S., Edinger, J. D., Lichstein, K. L., & Morin, C. M. (2006).

Recommendations for a standard research assessment of insomnia. *Sleep*, *29*(9), 1155-

1173.

Buysse, D. J., Reynolds, 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.

Carney, C. E., Buysse, D. J., Ancoli-Israel, S., Edinger, J. D., Krystal, A. D., Lichstein, K. L., &

Morin, C. M. (2012). The consensus sleep diary: standardizing prospective sleep self-

monitoring. *Sleep*, *35*(2), 287-302.

Centers for Disease Control and Prevention, National Center for Injury Prevention and Control.

Web-based Injury Statistics Query and Reporting System (WISQARS) [online]. (2005)

[2018 Apr 24]. Available from URL: www.cdc.gov/injury/wisqars

Chakravorty, S., Siu, H. K., Lalley-Chareczko, L., Brown, G. K., Findley, J. C., Perlis, M. L., &

Grandner, M. A. (2015). Sleep duration and insomnia symptoms as risk factors for

suicidal ideation in a nationally representative sample. *The primary care companion for CNS disorders*, *17*(6).

Christensen, H., Batterham, P. J., Gosling, J. A., Ritterband, L. M., Griffiths, K. M., Thorndike, F. P., … Mackinnon, A. J. (2016). Effectiveness of an online insomnia program (SHUTi) for prevention of depressive episodes (the GoodNight Study): a randomised controlled trial. *The Lancet Psychiatry*, *3*(4), 333–341. https://doi.org/10.1016/s2215-0366(15)00536-2

Chu, C., Hom, M. A., Rogers, M. L., Ringer, F. B., Hames, J. L., Suh, S., & Joiner, T. E. (2016). Is insomnia lonely? Exploring thwarted belongingness as an explanatory link between insomnia and suicidal ideation in a sample of South Korean university students. *Journal of clinical sleep medicine: JCSM: official publication of the American Academy of Sleep Medicine*, *12*(5), 647.

Chu, C., Klein, K. M., Buchman-Schmitt, J. M., Hom, M. A., Hagan, C. R., & Joiner, T. E. (2015). Routinized Assessment of Suicide Risk in Clinical Practice: An Empirically Informed Update. *Journal of Clinical Psychology*, *71*(12), 1186–1200. https://doi.org/10.1002/jclp.22210

Craig, P., Dieppe, P., Macintyre, S., Michie, S., Nazareth, I., & Petticrew, M. (2008). Developing and evaluating complex interventions: the new Medical Research Council guidance. *Bmj*, *337*, a1655.

Currie, S. R., Clark, S., Hodgins, D. C., & El-Guebaly, N. (2004). Randomized controlled trial of brief cognitive–behavioural interventions for insomnia in recovering alcoholics. *Addiction*, *99*(9), 1121-1132.

Davies, E. B., Morriss, R., & Glazebrook, C. (2014). Computer-delivered and web-based
interventions to improve depression, anxiety, and psychological well-being of university
students: a systematic review and meta-analysis. *Journal of medical Internet research*.

Diagnostic and statistical manual of mental disorders: DSM-5. (2013). Washington: American
Psychiatric Publishing.

Dolsen, M. R., Asarnow, L. D., & Harvey, A. G. (2014). Insomnia as a transdiagnostic process in
psychiatric disorders. *Current psychiatry reports*, *16*(9), 471.

Downs, M. F., & Eisenberg, D. (2012). Help seeking and treatment use among suicidal college
students. *Journal of American College Health*, *60*(2), 104-114.

Draper, M. R., Jennings, J., Baron, A., Erdur, O., & Shankar, L. (2002). Time-limited counseling
outcome in a nationwide college counseling center sample. *Journal of College
Counseling*, *5*(1), 26-38.

Edinger, J. D., & Sampson, W. S. (2003). A primary care "friendly" cognitive behavioral
insomnia therapy. *Sleep*, *26*(2), 177-182.

Eisenberg, D., Hunt, J., Speer, N., & Zivin, K. (2011). Mental health service utilization among
college students in the United States. *The Journal of nervous and mental disease*, *199*(5),
301-308.

Ellis, J. G., Cushing, T., & Germain, A. (2015). Treating acute insomnia: a randomized
controlled trial of a "single-shot" of cognitive behavioral therapy for
insomnia. *Sleep*, *38*(6), 971-978.

Espie, C. A., Kyle, S. D., Williams, C., Ong, J. C., Douglas, N. J., Hames, P., & Brown, J. S. L.
(2012). A Randomized, Placebo-Controlled Trial of Online Cognitive Behavioral

Therapy for Chronic Insomnia Disorder Delivered via an Automated Media-Rich Web

    Application. *Sleep*, *35*(6), 769–781. https://doi.org/10.5665/sleep.1872

Exelmans, L., & Van den Bulck, J. (2014). The Use of Media as a Sleep Aid in

    Adults. *Behavioral Sleep Medicine*, *14*(2), 121–133.

    https://doi.org/10.1080/15402002.2014.963582

Falloon, K., Elley, C. R., Fernando, A., Lee, A. C., & Arroll, B. (2015). Simplified sleep

    restriction for insomnia in general practice: a randomised controlled trial. *Br J Gen*

    Pract, *65*(637), e508-e515.

Fernando III, A., Arroll, B., & Falloon, K. (2013). A double-blind randomised controlled study

    of a brief intervention of bedtime restriction for adult patients with primary

    insomnia. *Journal of primary health care*, *5*(1), 5-10.

Franklin, J. C., Ribeiro, J. D., Fox, K. R., Bentley, K. H., Kleiman, E. M., Huang, X., ... & Nock,

    M. K. (2017). Risk factors for suicidal thoughts and behaviors: A meta-analysis of 50

    years of research. *Psychological Bulletin*, *143*(2), 187.

Geiger-Brown, J. M., Rogers, V. E., Liu, W., Ludeman, E. M., Downton, K. D., & Diaz-Abad,

    M. (2015). Cognitive behavioral therapy in persons with comorbid insomnia: a meta-

    analysis. *Sleep medicine reviews*, *23*, 54-67.

Germain, A., Moul, D. E., Franzen, P. L., Miewald, J. M., Reynolds, C. F., Monk, T. H., &

    Buysse, D. J. (2006). Effects of a brief behavioral treatment for late-life insomnia:

    preliminary findings. *Journal of Clinical Sleep Medicine*, *2*(04), 407-408.

Germain, A., Shear, M. K., Hall, M., & Buysse, D. J. (2007). Effects of a brief behavioral

    treatment for PTSD-related sleep disturbances: a pilot study. *Behaviour Research and*

    Therapy, *45*(3), 627-632.

Hays, R. D., Bjorner, J. B., Revicki, D. A., Spritzer, K. L., & Cella, D. (2009). Development of

   physical and mental health summary scores from the patient-reported outcomes

   measurement information system (PROMIS) global items. *Quality of Life*

   Research, *18*(7), 873–880. https://doi.org/10.1007/s11136-009-9496-9

Hazlett-Stevens, H., & Craske, M. G. (2002). Brief Cognitive-Behavioral Therapy: Definition

   and Scientific Foundations. *Handbook of brief cognitive behaviour therapy*, 1-20.

Hill, R. (1998). What sample size is "enough" in internet survey research. *Interpersonal*

   Computing and Technology: An electronic journal for the 21st century, *6*(3-4), 1-10.

Ho, F. Y.-Y., Chung, K.-F., Yeung, W.-F., Ng, T. H.-Y., & Cheng, S. K.-W. (2014). Weekly

   brief phone support in self-help cognitive behavioral therapy for insomnia disorder:

   Relevance to adherence and efficacy. *Behaviour Research and Therapy*, *63*, 147–156.

   https://doi.org/10.1016/j.brat.2014.10.002

Isaac, S., & Michael, W. B. (1995). *Handbook in research and evaluation: A collection of*

   principles, methods, and strategies useful in the planning, design, and evaluation of

   studies in education and the behavioral sciences. Edits publishers.

Joiner, T. E., & Rudd, M. D. (1996). Disentangling the interrelations between hopelessness,

   loneliness, and suicidal ideation. *Suicide and Life-Threatening Behavior*, *26*(1), 19-26.

Joiner, T. E., Pfaff, J. J., & Acres, J. G. (2002). A brief screening tool for suicidal symptoms in

   adolescents and young adults in general health settings: Reliability and validity data from

   the Australian National General Practice Youth Suicide Prevention Project. *Behaviour*

   Research and Therapy, 40, 471–481. http://dx.doi.org/10.1016/s0005-7967 (01)00017-1

Kessler, R. C., Berglund, P., Borges, G., Nock, M., & Wang, P. S. (2005). Trends in suicide

ideation, plans, gestures, and attempts in the United States, 1990-1992 to 2001-

2003. *Jama*, *293*(20), 2487-2495.

Krupp, L. B. (1989). The Fatigue Severity Scale. *Archives of Neurology*, *46*(10), 1121.

https://doi.org/10.1001/archneur.1989.00520460115022

Lamberg, L. (2008). Despite effectiveness, behavioral therapy for chronic insomnia still

underused. *Jama*, *300*(21), 2474-2475.

Lancaster, G. A., Dodd, S., & Williamson, P. R. (2004). Design and analysis of pilot studies:

recommendations for good practice. *Journal of evaluation in clinical practice*, *10*(2),

307-312.

Lancee, J., van den Bout, J., van Straten, A., & Spoormaker, V. I. (2012). Internet-delivered or

mailed self-help treatment for insomnia? A randomized waiting-list controlled

trial. *Behaviour Research and Therapy*, *50*(1), 22–29.

https://doi.org/10.1016/j.brat.2011.09.012

Larsen, D. L., Attkisson, C. C., Hargreaves, W. A., & Nguyen, T. D. (1979). Assessment of

client/patient satisfaction: development of a general scale. *Evaluation and program

planning*, *2*(3), 197-207.

Leon, A. C., Davis, L. L., & Kraemer, H. C. (2011). The role and interpretation of pilot studies in

clinical research. *Journal of psychiatric research*, *45*(5), 626-629.

Lewandowski, L. J., Codding, R. S., Kleinmann, A. E., & Tucker, K. L. (2003). Assessment of

reading rate in postsecondary students. *Journal of Psychoeducational Assessment*, *21*(2),

134-144.

Lie, J. D., Tu, K. N., Shen, D. D., & Wong, B. M. (2015). Pharmacological treatment of

insomnia. *Pharmacy and Therapeutics*, *40*(11), 759.

Lin, J. M. S., Brimmer, D. J., Maloney, E. M., Nyarko, E., BeLue, R., & Reeves, W. C. (2009).

Further validation of the Multidimensional Fatigue Inventory in a US adult population

sample. *Population health metrics*, *7*(1), 18.

Loring, W. A., Johnston, R., Gray, L., Goldman, S., & Malow, B. (2016). A brief behavioral

intervention for insomnia in adolescents with autism spectrum disorders. *Clinical

Practice in Pediatric Psychology, 4*(2), 112–124. https://doi.org/10.1037/cpp0000141

Lovato, N., Lack, L., Wright, H., & Kennaway, D. J. (2014). Evaluation of a brief treatment

program of cognitive behavior therapy for insomnia in older adults. *Sleep*, *37*(1), 117-

126.

Lovibond, P. F., & Lovibond, S. H. (1995). The structure of negative emotional states:

Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression

and Anxiety Inventories. *Behaviour research and therapy*, *33*(3), 335-343.

Luoma, J. B., Martin, C. E., & Pearson, J. L. (2002). Contact with mental health and primary

care providers before suicide: a review of the evidence. *American Journal of

Psychiatry*, *159*(6), 909-916.

Manber, R., Bernert, R. A., Suh, S., Nowakowski, S., Siebern, A. T., & Ong, J. C. (2014). CBT

for insomnia in patients with high and low depressive symptom severity: adherence and

clinical outcomes. *FOCUS*, *12*(1), 90-98.

Manber, R., Carney, C., Edinger, J., Epstein, D., Friedman, L., Haynes, P. L., ... & Trockel, M.

(2012). Dissemination of CBTI to the non-sleep specialist: protocol development and

training issues. *Journal of clinical sleep medicine: JCSM: official publication of the American Academy of Sleep Medicine*, *8*(2), 209.

Manber, R., Friedman, L., Siebern, A.T., Carney, C., Edinger, J., Epstein, D., Haynes, P., Pigeon, W., & Karlin, B. E., (2014). Cognitive Behavioral Therapy for insomnia in Veterans: Therapist manual. Washington, DC: U.S. Department of Veterans Affairs.

Margolies, S. O., Rybarczyk, B., Vrana, S. R., Leszczyszyn, D. J., & Lynch, J. (2013). Efficacy of a cognitive-behavioral treatment for insomnia and nightmares in Afghanistan and Iraq veterans with PTSD. *Journal of Clinical Psychology*, *69*(10), 1026-1042.

Matthews, E. E., Arnedt, J. T., McCarthy, M. S., Cuddihy, L. J., & Aloia, M. S. (2013). Adherence to cognitive behavioral therapy for insomnia: A systematic review. *Sleep Medicine Reviews*, *17*(6), 453–464. https://doi.org/10.1016/j.smrv.2013.01.001

McCall, W. V., Batson, N., Webster, M., Case, L. D., Joshi, I., Derreberry, T., … Farris, S. R. (2013). Nightmares and Dysfunctional Beliefs about Sleep Mediate the Effect of Insomnia Symptoms on Suicidal Ideation. *Journal of Clinical Sleep Medicine*. https://doi.org/10.5664/jcsm.2408

McCall, W. V., Blocker, J. N., D'Agostino Jr, R., Kimball, J., Boggs, N., Lasater, B., & Rosenquist, P. B. (2010). Insomnia severity is an indicator of suicidal ideation during a depression clinical trial. *Sleep medicine*, *11*(9), 822-827.

Meade, A. W., & Craig, S. B. (2012). Identifying careless responses in survey data. *Psychological methods*, *17*(3), 437.

Mistler, B. J., Reetz, D. R., Krylowicz, B., & Barr, V. (2012). The association for university and college counseling center directors annual survey. *Retrieved from Association for*

University and College Counseling Center Directors website: http://files. cmcglobal. com/Monograph_2012_AUCCCD_Public. pdf.

Morawetz, D. (2003). Insomnia and depression: which comes first. *Sleep Res Online*, *5*(2), 77-81.

Morin, C. M. (1993). *Treatment manuals for practitioners. Insomnia: Psychological assessment and management.* Guilford Press.

Morin, C. M., Belleville, G., Bélanger, L., & Ivers, H. (2011). The Insomnia Severity Index: Psychometric Indicators to Detect Insomnia Cases and Evaluate Treatment Response. *Sleep*, *34*(5), 601–608. https://doi.org/10.1093/sleep/34.5.601

Morin, C. M., LeBlanc, M., Daley, M., Gregoire, J. P., & Merette, C. (2006). Epidemiology of insomnia: prevalence, self-help treatments, consultations, and determinants of help-seeking behaviors. *Sleep medicine*, *7*(2), 123-130.

Morin, C. M., Vallières, A., & Ivers, H. (2007). Dysfunctional beliefs and attitudes about sleep (DBAS): validation of a brief version (DBAS-16). *Sleep*, *30*(11), 1547-1554.

Nock, M. K., Holmberg, E. B., Photos, V. I. , & Michel, B. D. (2007). The Self-Injurious Thoughts and Behaviors Interview: Development, reliability, and validity in an adolescent sample. *Psychological Assessment*, 19, 309-317.

Ohayon, M. M. (2002). Epidemiology of insomnia: what we know and what we still need to learn. *Sleep medicine reviews*, *6*(2), 97-111.

Okajima, I., Komada, Y., & Inoue, Y. (2011). A meta-analysis on the treatment effectiveness of cognitive behavioral therapy for primary insomnia. *Sleep and Biological Rhythms*, *9*(1), 24-34.

Orlinsky, D. E., Rønnestad, M. H., & Willutzki, U. (2004). Fifty years of psychotherapy process-outcome research: Continuity and change. In M. J. Lambert (Ed.), *Bergin and Garfield's handbook of psychotherapy and behavior change* (5th ed., pp. 307–390). New York: Wiley.

Osman, A., Wong, J. L., Bagge, C. L., Freedenthal, S., Gutierrez, P. M., & Lozano, G. (2012). The depression anxiety stress Scales—21 (DASS-21): further examination of dimensions, scale reliability, and correlates. *Journal of clinical psychology*, *68*(12), 1322-1338.

Page, A. C., Hooke, G. R., & Morrison, D. L. (2007). Psychometric properties of the Depression Anxiety Stress Scales (DASS) in depressed clinical samples. *British Journal of Clinical Psychology*, *46*(3), 283-297.

Perlis, M. L., Jungquist, C., Smith, M. T., & Posner, D. (2006). *Cognitive behavioral treatment of insomnia: A session-by-session guide* (Vol. 1). Springer Science & Business Media.

Pigeon, W. R., & Funderburk, J. (2014). Delivering a Brief Insomnia Intervention to Depressed VA Primary Care Patients. *Cognitive and Behavioral Practice*, *21*(3), 252–260. https://doi.org/10.1016/j.cbpra.2013.10.007

Pigeon, W. R., Funderburk, J., Bishop, T. M., & Crean, H. F. (2017). Brief cognitive behavioral therapy for insomnia delivered to depressed veterans receiving primary care services: a pilot study. *Journal of affective disorders*, *217*, 105-111.

Pigeon, W. R., Pinquart, M., & Conner, K. (2012). Meta-Analysis of Sleep Disturbance and Suicidal Thoughts and Behaviors. *The Journal of Clinical Psychiatry*, 73(09). doi:10.4088/jcp.11r07586

Pigeon, W. R., Woosley, J. A., & Lichstein, K. L. (2014). Insomnia and hypnotic medications are associated with suicidal ideation in a community population. Archives of suicide

research, 18(2), 170-180.

Ribeiro, J. D., Pease, J. L., Gutierrez, P. M., Silva, C., Bernert, R. A., Rudd, M. D., & Joiner Jr, T. E. (2012). Sleep problems outperform depression and hopelessness as cross-sectional and longitudinal predictors of suicidal ideation and behavior in young adults in the military. *Journal of affective disorders*, *136*(3), 743-750.

Riedel, B. W., & Lichstein, K. L. (2001). Strategies for evaluating adherence to sleep restriction treatment for insomnia. *Behaviour Research and Therapy*, *39*(2), 201–212. https://doi.org/10.1016/s0005-7967(00)00002-4

Ritterband, L. M., Bailey, E. T., Thorndike, F. P., Lord, H. R., Farrell-Carnahan, L., & Baum, L. D. (2011). Initial evaluation of an Internet intervention to improve the sleep of cancer survivors with insomnia. *Psycho-Oncology*, *21*(7), 695–705. https://doi.org/10.1002/pon.1969

Ritterband, L. M., Thorndike, F. P., Cox, D. J., Kovatchev, B. P., & Gonder-Frederick, L. A. (2009). A Behavior Change Model for Internet Interventions. *Annals of Behavioral Medicine*, *38*(1), 18–27. https://doi.org/10.1007/s12160-009-9133-4

Ritterband, L. M., Thorndike, F. P., Gonder-Frederick, L. A., Magee, J. C., Bailey, E. T., Saylor, D. K., & Morin, C. M. (2009). Efficacy of an Internet-Based Behavioral Intervention for Adults With Insomnia. *Archives of General Psychiatry*, *66*(7), 692. https://doi.org/10.1001/archgenpsychiatry.2009.66

Rybarczyk, B., Lopez, M., Benson, R., Alsten, C., & Stepanski, E. (2002). Efficacy of two behavioral treatment programs for comorbid geriatric insomnia. *Psychology and aging*, *17*(2), 288.

Smets, E. M. A., Garssen, B., Bonke, B. D., & De Haes, J. C. J. M. (1995). The

   Multidimensional Fatigue Inventory (MFI) psychometric qualities of an instrument to

   assess fatigue. *Journal of psychosomatic research*, *39*(3), 315-325.

Smith, M. T., Perlis, M. L., Park, A., Smith, M. S., Pennington, J., Giles, D. E., & Buysse, D. J.

   (2002). Comparative meta-analysis of pharmacotherapy and behavior therapy for

   persistent insomnia. *American Journal of Psychiatry*, *159*(1), 5-11.

Smyth, J. M., Hockemeyer, J. R., Heron, K. E., Wonderlich, S. A., & Pennebaker, J. W. (2008).

   Prevalence, type, disclosure, and severity of adverse life events in college

   students. *Journal of American College Health*, *57*(1), 69-76.

Spielman, A. J., Caruso, L. S., & Glovinsky, P. B. (1987). A behavioral perspective on insomnia

   treatment. *The Psychiatric Clinics of North America*, *10*(4), 541–553.

Spira, A. P., Beaudreau, S. A., Stone, K. L., Kezirian, E. J., Lui, L.-Y., Redline, S., … Stewart,

   A. (2011). Reliability and Validity of the Pittsburgh Sleep Quality Index and the Epworth

   Sleepiness Scale in Older Men. *The Journals of Gerontology Series A: Biological

   Sciences and Medical Sciences*, *67A*(4), 433–439. https://doi.org/10.1093/gerona/glr172

Stein, K. D., Martin, S. C., Hann, D. M., & Jacobsen, P. B. (1998). A multidimensional measure

   of fatigue for use with cancer patients. *Cancer practice*, *6*(3), 143-152.

Stinson, K., Tang, N. K. Y., & Harvey, A. G. (2006). Barriers to treatment seeking in primary

   insomnia in the United Kingdom: a cross-sectional perspective. *Sleep*, *29*(12), 1643-

   1646.

Ström, L., Pettersson, R., & Andersson, G. (2017). Internet-based treatment for insomnia : A

   controlled evaluation. *Journal of Consulting and Clinical Psychology*, *72*(1), 113–120.

   DOI: 10.1037/0022-006X.72.1.113

Suzuki, E., Tsuchiya, M., Hirokawa, K., Taniguchi, T., Mitsuhashi, T., & Kawakami, N. (2008). Evaluation of an Internet-Based Self-Help Program for Better Quality of Sleep among Japanese Workers: A Randomized Controlled Trial. *Journal of Occupational Health*, *50*(5), 387–399. https://doi.org/10.1539/joh.l7154

Taylor, D. J., Bramoweth, A. D., Grieser, E. A., Tatum, J. I., & Roane, B. M. (2013). Epidemiology of insomnia in college students: relationship with mental health, quality of life, and substance use difficulties. *Behavior therapy*, *44*(3), 339-348.

Taylor, D. J., Lichstein, K. L., Weinstock, J., Sanford, S., & Temple, J. R. (2007). A pilot study of cognitive-behavioral therapy of insomnia in people with mild depression. *Behavior Therapy*, *38*(1), 49-57.

Taylor, D. J., Zimmerman, M. R., Gardner, C. E., Williams, J. M., Grieser, E. A., Tatum, J. I., … Ruggero, C. (2014). A Pilot Randomized Controlled Trial of the Effects of Cognitive-Behavioral Therapy for Insomnia on Sleep and Daytime Functioning in College Students. *Behavior Therapy*, *45*(3), 376–389. https://doi.org/10.1016/j.beth.2013.12.010

Thabane, L., Ma, J., Chu, R., Cheng, J., Ismaila, A., Rios, L. P., ... & Goldsmith, C. H. (2010). A tutorial on pilot studies: the what, why and how. *BMC medical research methodology*, *10*(1), 1.

Thiart, H., Lehr, D., Ebert, D. D., Berking, M., & Riper, H. (2015). Log in and breathe out: interne-tbased recovery training for sleepless employees with work-related strain – results of a randomized controlled trial. *Scandinavian Journal of Work, Environment & Health*, *41*(2), 164–174. doi: 10.5271/sjweh.3478

Thorndike, F. P., Ritterband, L. M., Gonder-Frederick, L. A., Lord, H. R., Ingersoll, K. S., & Morin, C. M. (2013). A randomized controlled trial of an internet intervention for adults

with insomnia: effects on comorbid psychological and fatigue symptoms. *Journal of clinical psychology*, *69*(10), 1078-1093.

Thorndike, F. P., Saylor, D. K., Bailey, E. T., Gonder-Frederick, L., Morin, C. M., & Ritterband, L. M. (2008). Development and Perceived Utility and Impact of an Internet Intervention for Insomnia. *E-Journal of Applied Psychology : Clinical and Social Issues*, *4*(2), 32–42. https://doi.org/10.7790/ejap.v4i2.133

Trauer, J. M., Qian, M. Y., Doyle, J. S., Rajaratnam, S. M., & Cunnington, D. (2015). Cognitive behavioral therapy for chronic insomnia: a systematic review and meta-analysis. *Annals of internal medicine*, *163*(3), 191-204.

Trockel, M., Karlin, B. E., Taylor, C. B., Brown, G. K., & Manber, R. (2015). Effects of cognitive behavioral therapy for insomnia on suicidal ideation in veterans. *Sleep*, *38*(2), 259-265.

Ulmer, C. S., Edinger, J. D., & Calhoun, P. S. (2011). A multi-component cognitive-behavioral intervention for sleep disturbance in veterans with PTSD: a pilot study. *Journal of clinical sleep medicine: JCSM: official publication of the American Academy of Sleep Medicine*, *7*(1), 57.

van Straten, A., Emmelkamp, J., de Wit, J., Lancee, J., Andersson, G., van Someren, E. J. W., & Cuijpers, P. (2013). Guided Internet-delivered cognitive behavioural treatment for insomnia: a randomized trial. *Psychological Medicine*, *44*(7), 1521–1532. https://doi.org/10.1017/s0033291713002249

Vincent, N., & Lewycky, S. (2009). Logging on for Better Sleep: RCT of the Effectiveness of Online Treatment for Insomnia. *Sleep*, *32*(6), 807–815. https://doi.org/10.1093/sleep/32.6.807

Vincent, N., & Lionberg, C. (2001). Treatment preference and patient satisfaction in chronic

insomnia. *Sleep*, *24*(4), 411-417.

Vincent, N., & Walsh, K. (2013). Stepped Care for Insomnia: An Evaluation of Implementation

in Routine Practice. *Journal of Clinical Sleep Medicine*, *09*(03), 227–234.

https://doi.org/10.5664/jcsm.2484

Walsh, J.K., & Schweitzer, P.K. (1999). Ten-year trends in the pharmacological treatment of

insomnia. *Sleep*, *22*(3), 371-375.

Weathers, F. W., Blake, D. D., Schnurr, P. P., Kaloupek, D. G., Marx, B. P., & Keane, T. M.

(2013). The life events checklist for DSM-5 (LEC-5). *Instrument available from the*

National Center for PTSD at www. ptsd. va. gov.

Weathers, F.W., Litz, B.T., Keane, T.M., Palmieri, P.A., Marx, B.P., & Schnurr, P.P. (2013).

The PTSD Checklist for *DSM-5* (PCL-5). Scale available from the National Center for

PTSD at www.ptsd.va.gov.

Whitehead, L. (2009). The Measurement of Fatigue in Chronic Illness: A Systematic Review of

Unidimensional and Multidimensional Fatigue Measures. *Journal of Pain and Symptom*

Management, *37*(1), 107–128. https://doi.org/10.1016/j.jpainsymman.2007.08.019

World health statistics 2017: monitoring health for the SDGs, Sustainable Development Goals.

Geneva: World Health Organization; 2017. License: CC BY-NC-SA 3.0 IGO.

Yorgason, J. B., Linville, D., & Zitzman, B. (2008). Mental health among college students: do

those who need services know about and use them?. *Journal of American College*

Health, *57*(2), 173-182.

Yuan, J., Liberman, M., & Cieri, C. (2006). Towards an integrated understanding of speaking

rate in conversation. In Ninth International Conference on Spoken Language Processing.

Zachariae, R., Lyby, M. S., Ritterband, L. M., & O'Toole, M. S. (2016). Efficacy of internet-delivered cognitive-behavioral therapy for insomnia–a systematic review and meta-analysis of randomized controlled trials. *Sleep medicine reviews*, *30*, 1-10.

Zuromski, K. L., Cero, I., & Witte, T. K. (2017). Insomnia symptoms drive changes in suicide ideation: A latent difference score model of community adults over a brief interval. *Journal of Abnormal Psychology, 126*(6), 739-749. doi:10.1037/abn0000282

Appendix

Tables

Table 1

Measure Administration Schedule

Timepoints	Measures
Eligibility Screening	Insomnia Severity Index (8 or higher) Lifetime history of suicide ideation Self-report exclusion criteria PROMIS Scale v1.2 - Global Health
Pre-treatment Sleep Diaries	Seven daily sleep diaries
Pre-treatment Assessment	Demographics Insomnia Severity Index (ISI) Depression Symptom Inventory—Suicide Subscale (DSI-SS) The Pittsburgh Sleep Quality Index (PSQI) The Multidimensional Fatigue Inventory (MFI-20) Dysfunctional Beliefs and Attitudes about Sleep Scale (DBAS-16) Depression Anxiety Stress Scales (DASS) Life Events Checklist (LEC-5) The Posttraumatic Stress Disorder Checklist (PCL-5)
Post-treatment Assessment	Insomnia Treatment Acceptability Scale—Behavioral Subscale (ITAS-B) Client Satisfaction Questionnaire-8 (CSQ-8) Open-Ended Satisfaction Questions
Post-treatment Sleep Diaries	Seven daily sleep diaries
One-week Follow-up Assessment	Insomnia Severity Index (ISI) Depression Symptom Inventory—Suicide Subscale (DSI-SS) The Pittsburgh Sleep Quality Index (PSQI) The Multidimensional Fatigue Inventory (MFI-20) Dysfunctional Beliefs and Attitudes about Sleep Scale (DBAS-16) Depression Anxiety Stress Scales (DASS) The Posttraumatic Stress Disorder Checklist (PCL-5)
One-month Follow-up Sleep Diaries	Seven daily sleep diaries
One-Month Follow-up Assessment	Insomnia Severity Index (ISI) Depression Symptom Inventory—Suicide Subscale (DSI-SS) The Pittsburgh Sleep Quality Index (PSQI) The Multidimensional Fatigue Inventory (MFI-20) Dysfunctional Beliefs and Attitudes about Sleep Scale (DBAS-16) Depression Anxiety Stress Scales (DASS) The Posttraumatic Stress Disorder Checklist (PCL-5) Client Satisfaction Questionnaire-8 (CSQ-8) Open-Ended Satisfaction Questions

Table 2

Clinical Outcome Measures

Measure	Measure Range	Actual Range	Pre-Treatment					One-Week Follow-up						One-Month Follow-up					
			M (S.D)	α	Skew	Kurtosis	n	Actual Range	M (S.D)	α	Skew	Kurtosis	n	Actual Range	M (S.D)	α	Skew	Kurtosis	n
ISI	0-28	8-26	15 (4.40)	.74	.43	0.05	38	1-18	9.27 (4.13)	.78	-0.09	-0.28	33	1-18	7.20 (4.48)	.86	0.56	-0.00	20
DSI-SS	0-12	0-4	0.84 (1.35)	.85	1.36	0.45	38	0-4	0.67 (1.14)	.76	1.67	1.74	33	0-4	0.50 (1.15)	.87	2.33	4.61	20
PSQI	0-21	3-15	8.68 (2.44)	.28	-0.47	1.56	37	2-12	6.13 (2.79)	.52	0.15	-0.87	31	1-13	4.55 (2.80)	.64	1.47	2.45	20
MFI-20 – Overall Fatigue	20-100	44-87	66.82 (11.21)	.83	0.12	-0.71	38	38-87	63.13 (13.06)	.85	-0.02	-056	32	33-75	56.10 (12.69)	.87	-0.30	-1.01	20
MFI-20 – General Fatigue	4-20	12-20	16.24 (2.33)	.54	-0.06	-1.09	38	10-20	14.72 (3.50)	.71	0.26	-1.47	32	6-17	12.65 (3.41)	.75	-0.33	-1.07	20
MFI-20 – Physical Fatigue	4-20	5-19	12.32 (3.56)	.69	-0.05	-0.68	38	5-18	11.56 (3.48)	.72	-0.16	-0.79	32	7-20	11.20 (3.79)	.80	0.92	0.47	20
MFI-20 – Reduced Activity	4-20	5-19	10.84 (3.54)	.71	0.54	-0.53	38	5-20	10.84 (3.92)	.82	0.63	-0.51	32	5-15	9.95 (3.07)	.70	0.00	-0.87	20
MFI-20 – Reduced Motivation	4-20	6-20	12.58 (3.10)	.49	0.15	-0.53	38	5-18	11.50 (3.46)	.69	-0.01	-0.54	32	5-14	9.55 (2.68)	.62	-0.10	-1.17	20
MFI-20 – Mental Fatigue	4-20	8-20	14.84 (3.76)	.85	-0.45	-0.40	38	5-20	14.50 (3.66)	.88	-0.76	0.13	32	6-17	12.75 (3.18)	.86	-0.96	0.34	20
DBAS-16	0-10	2-7.94	4.98 (1.47)	.75	-0.13	-0.45	37	1.56-7.44	3.94 (1.40)	.81	0.30	-0.06	32	0.81-6.06	3.38 (1.51)	.85	-0.4	-0.97	20
DASS – Depression	0-42	4-40	15.68 (9.50)	.86	0.79	-0.15	37	0-32	12.93 (8.88)	.85	0.27	-0.97	30	0-22	6.90 (6.37)	.83	1.20	0.30	20
DASS – Anxiety	0-42	0-32	12.97 (8.94)	.77	0.57	-0.76	37	0-30	9.93 (8.33)	.79	0.78	-0.16	30	0-30	7.40 (6.96)	.80	1.87	5.06	20
PCL-5	0-80	0-51	23.90 (18.86)	.95	0.51	-1.64	20	0-52	16.31 (14.95)	.94	1.12	0.67	16	0-36	13.33 (12.90)	.94	1.25	0.15	9

Note: ISI = Insomnia Severity Index; DSI-SS = Depression Symptom Inventory—Suicide Subscale; PSQI = The Pittsburgh Sleep Quality Index; MFI-20 = The Multidimensional Fatigue Inventory; DBAS-16 = The Dysfunctional Beliefs and Attitudes about Sleep; DASS = The Depression Anxiety Stress Scale; PCL-5 = The Posttraumatic Stress Disorder Checklist for DSM-5. The PCL-5 scores only include participants who met criteria for Posttraumatic Stress Disorder Criterion A. Percentages have been rounded to the nearest whole number.

Table 3

Post-hoc t-test comparing those who completed the protocol to those who dropped out on pre-treatment and post-treatment assessments.

| Measure | Completed Treatment | | Dropped from Treatment | | | |
	M	S.D.	M	S.D.	df	t-test
ISI	15.15	4.44	14.83	4.480	36	0.22
DSI-SS	0.55	1.19	1.17	1.47	36	-1.43
PSQI	8.65	2.43	8.22	3.19	36	0.47
PSQI - Bedtime (in hours)	11:53 PM	1.18	12:49 AM	1.18	35	-2.41*
PSQI - Sleep Onset Latency (in minutes)	44.23	45.89	48.53	34.05	35	-0.32
PSQI - Rise time (in hours)	7:57 AM	1.32	8:31 AM	1.57	35	-1.21
PSQI - Total Sleep Time (in hours)	6.88	1.78	7.03	1.44	35	-0.36
MFI-20 – Overall Fatigue	63.40	10.69	70.61	10.80	36	-2.07*
MFI-20 – General Fatigue	16.10	2.07	16.39	2.64	36	-0.38
MFI-20 – Physical Fatigue	12.10	3.32	12.56	3.88	36	-0.39
MFI-20 – Reduced Activity	9.20	2.61	12.67	3.60	36	-3.43**
MFI-20 – Reduced Motivation	12.10	3.32	13.11	2.83	36	-1.00
MFI-20 – Mental Fatigue	13.90	15.89	15.89	3.10	36	-1.67
DBAS-16	4.80	1.01	5.21	1.87	35	-0.84
DASS – Depression	13.10	6.70	18.71	11.49	35	-1.85
DASS – Anxiety	11.80	18.31	14.35	9.70	35	-0.86
PCL-5	25.33	18.44	22.73	20.02	18	0.30
Treatment Module Quizzes Total	16.75	1.37	17.33	1.28	36	-1.35
Treatment Duration	33.85	10.10	31.92	11.28	36	-0.54
ITAS-B	72.34	15.77	82.05	10.10	35	-2.18*
CSQ-8	28.15	3.12	28.29	3.12	35	-1.10

Note: ISI = Insomnia Severity Index; DSI-SS = Depression Symptom Inventory—Suicide Subscale; PSQI = The Pittsburgh Sleep Quality Index; MFI-20 = The Multidimensional Fatigue Inventory; DBAS-16 = The Dysfunctional Beliefs and Attitudes about Sleep; DASS = The Depression Anxiety Stress Scale; PCL-5 = The Posttraumatic Stress Disorder Checklist for DSM-5; ITAS-B = Insomnia Treatment Acceptability Scale—Behavioral Subscale; CSQ-8 = Client Satisfaction Questionnaire-8. The PCL-5 scores only include participants who met criteria for Posttraumatic Stress Disorder Criterion A. *$p< .05$. **$p< .01$.

Table 4

Duration of Time to Complete Treatment and Assessments

Assessment Timepoint or Treatment Module	*M*	*S.D.*	Range	5th percentile	25th percentile	50th percentile	75th percentile	95th percentile
Pre-Treatment (*n* = 38)	17.18	5.38	3.02-34.38	8.34	13.40	17.65	20.30	25.15
Treatment (*n* = 38)	32.93	11.02	13.83-54.05	15.73	23.13	40.28	40.28	52.39
Sleep Psychoeducation	7.61	2.89	2.50-13.66	2.73	4.82	7.98	10.01	11.95
Stimulus Control Therapy	5.75	2.63	0.59-10.95	0.93	4.07	5.59	7.70	10.54
Sleep Quality Enhancement	10.16	4.61	1.32-19.81	1.64	6.84	10.39	13.80	18.02
Post-Treatment (*n* = 37)	5.40	2.09	2.17-12.73	2.23	3.82	5.50	6.51	8.95
One-Week Follow-up (*n* = 33)	16.48	9.19	5.72-37.08	7.12	9.69	13.30	24.52	36.28
One-Month Follow-up (*n* = 20)	17.16	8.77	7.33-44.25	7.37	11.22	14.65	20.38	43.56

Note: Time is in minutes.

Table 5

Treatment Knowledge Acquisition and Retention Quizzes (*n* = 38)

Module Quizzes	*M* No. Items Correct (% Correct)	*S.D.*	Range
All Quizzes (20 items)	17.03 (85)	1.35	14-20
Sleep Psychoeducation Quiz (7 items)	6.58 (94)	0.68	4-7
Stimulus Control Therapy Quiz (5 items)	4.26 (85)	0.55	3-5
Sleep Quality Enhancement Quiz (8 items)	6.18 (77)	0.90	4-8

Note: Score is the average number of items answered correctly.

Table 6

Post-Treatment Acceptability Ratings (n = 37)

Acceptability Items	*M*	*S.D.*	Range
Overall acceptability	76.80	14.17	43-97.44
1. Acceptability for self	81.00	20.63	35-100
2. Acceptability for others	82.12	16.86	34-100
3. Willingness to adhere	85.73	15.67	40-100
4a. Suitability for difficulties falling asleep	84.35	18.14	47-100
4b. Suitability for difficulties staying asleep	76.59	26.80	1-100
5. Short-term Effectiveness	60.92	26.98	14-100
6. Long-term Effectiveness	78.68	16.30	30-100
7. Effectiveness for daytime functioning	79.00	20.91	25-100
8. Extent of side-effects	59.84	27.38	9-100

Note: Higher ratings indicate a more acceptable or effective treatment. Overall acceptability is the average across all items. Items 1 and 2 anchors ranged from not at all acceptable (0) to very acceptable (100), item 3 anchors ranged from not at all willing (0) to very willing (100), items 4a and 4b anchors ranged from not at all suitable (0) to very suitable (100), items 5-7 anchors ranged from not at all effective (0) to very effective (100), item 8 anchors ranged from very strong side effects (0) to no side effects (100).

Table 7

Post-Treatment and One-month Follow-up Satisfaction Ratings

Satisfaction Items	Post-Treatment (*n* = 37)		One-Month Follow-up (*n* = 20)	
	n	(%)	*n*	(%)
Quality of treatment				
Fair	0	(0)	1	(5)
Good	10	(27)	5	(25)
Excellent	27	(73)	14	(70)
Received treatment they wanted				
No	0	(0)	1	(5)
Yes, Generally	14	(38)	10	(50)
Yes, Definitely	23	(62)	9	(45)
Treatment needs met				
None	0	(0)	1	(5)
Only a Few	2	(5)	3	(15)
Most	15	(41)	8	(40)
Almost all	20	(54)	8	(40)
Recommend to friend				
No	1	(3)	1	(5)
Yes, generally	14	(37)	9	(45)
Yes, definitely	22	(60)	10	(50)
Satisfied with amount of help				
Indifferent or mildly dissatisfied	2	(5)	2	(10)
Mostly Satisfied	13	(35)	10	(50)
Very Satisfied	22	(60)	8	(40)
Treatment helped				
No	1	(3)	1	(5)
Yes, somewhat	20	(54)	10	(50)
Yes, a great deal	16	(43)	9	(45)
General satisfaction				
Indifferent or mildly dissatisfied	1	(3)	1	(5)
Mostly satisfied	11	(30)	9	(45)
Very satisfied	25	(67)	10	(50)
Return to treatment				
No	5	(14)	4	(20)
Yes, I think so	19	(51)	9	(45)
Yes, definitely	13	(35)	7	(35)

Table 8

Description of the Pittsburgh Sleep Quality Index (PSQI)

Sleep Pattern Items	Pre-treatment (*n* =37)			One-week Follow-up (*n* =31)			One-month Follow-up (*n* =20)		
	M	S.D.	Range	*M*	S.D.	Range	*M*	S.D.	Range
Bedtime	12:19 a.m.	1.25	10:15 p.m. – 3:00 a.m.	12:23 a.m.	1.32	9:00 p.m. – 2:00 a.m.	12:14 a.m.	1.12	10:00 p.m. – 2:30 a.m.
Sleep Onset Latency (in minutes)	46.20	40.39	5-182.50	17.35	15.11	2-80	15.50	13.00	2-60
Rise time	8:13 a.m.	1.45	6:15 a.m. – 11:45 a.m.	8:11 a.m.	1.30	5:35 a.m. – 10:30 a.m.	8:13 a.m.	1.30	5:45 a.m.– 11:00 a.m.
Total Sleep Time (in hours)	6.95	1.29	5-9.93	6.91	1.09	4.50-9	7.26	1.12	5.50-9.50

Sleep Disturbance/ Quality Items	Pre-treatment (*n* =37)		One-week Follow-up (*n* =31)		One-month Follow-up (*n* =20)	
	n	(%)	*n*	(%)	*n*	(%)
Cannot get to sleep within 30 minutes						
Not during the past month (week)	2	(5)	13	(42)	11	(55)
Less than once or twice a week	15	(40)	13	(42)	5	(25)
Three or more times a week	20	(55)	5	(16)	4	(20)
Wake up in the middle of the night or early morning						
Not during the past month (week)	3	(8)	8	(26)	2	(10)
Less than once or twice a week	9	(24)	13	(42)	15	(75)
Three or more times a week	25	(68)	10	(32)	3	(15)
Have to get up to use the bathroom						
Not during the past month (week)	12	(32)	15	(48)	12	(60)
Less than once or twice a week	16	(43)	12	(39)	6	(30)
Three or more times a week	9	(24)	4	(13)	2	(10)
Cannot breathe comfortably						
Not during the past month (week)	23	(64)	22	(71)	16	(80)
Less than once or twice a week	8	(22)	6	(19)	3	(15)
Three or more times a week	5	(14)	3	(10)	1	(5)
Cough or snore loudly						
Not during the past month (week)	28	(76)	27	(87)	18	(90)
Less than once or twice a week	6	(16)	4	(13)	0	(0)
Three or more times a week	3	(8)	0	(0)	2	(10)
Feel too cold						
Not during the past month (week)	16	(43)	20	(65)	12	(60)

Sleep Disturbance/	Pre-treatment (*n* =37)		One-week Follow-up (*n* =31)		One-month Follow-up (*n* =20)	
Quality Items	*n*	(%)	*n*	(%)	*n*	(%)
Feel to cold						
Less than once or twice a week	13	(35)	8	(25)	7	(35)
Three or more times a week	8	(22)	3	(10)	1	(5)
Feel too hot						
Not during the past month (week)	3	(8)	12	(39)	9	(45)
Less than once or twice a week	18	(49)	11	(36)	9	(45)
Three or more times a week	16	(43)	8	(26)	2	(10)
Have bad dreams						
Not during the past month (week)	8	(27)	16	(52)	13	(65)
Less than once or twice a week	15	(41)	12	(38)	7	(35)
Three or more times a week	14	(38)	3	(10)	0	(0)
Have pain						
Not during the past month (week)	26	(70)	19	(61)	18	(90)
Less than once or twice a week	10	(27)	10	(32)	1	(5)
Three or more times a week	1	(3)	2	(7)	1	(5)
Other reasons (e.g., anxiety/stress due to school)						
Not during the past month (week)	11	(36)	22	(85)	15	(94)
Less than once or twice a week	6	(19)	1	(4)	1	(6)
Three or more times a week	14	(45)	3	(11)	0	(0)
Sleep Quality						
Very good	1	(3)	3	(10)	5	(25)
Fairly good	17	(46)	20	(65)	14	(70)
Fairly bad	16	(43)	8	(25)	3	(5)
Very bad	3	(8)	0	(0)	0	(0)
Medications for sleep						
Not during the past month (week)	21	(57)	27	(87)	16	(80)
Less than once or twice a week	13	(35)	2	(6)	2	(10)
Three or more times a week	3	(8)	2	(7)	2	(10)
Difficulty with daytime activities						
Not during the past month (week)	16	(43)	14	(45)	12	(60)
Less than once or twice a week	19	(52)	9	(28)	7	(35)
Three or more times a week	2	(5)	8	(26)	1	(5)

Sleep Disturbance/	Pre-treatment (*n* =37)		One-week Follow-up (*n* =31)		One-month Follow-up (*n* =20)	
Quality Items	*n*	(%)	*n*	(%)	*n*	(%)
Difficulty with enthusiasm						
Not during the past month (week)	2	(5)	9	(29)	9	(45)
Less than once or twice a week	14	(38)	13	(42)	7	(35)
Three or more times a week	21	(57)	9	(29)	4	(20)

Note: Percentages have been rounded to the nearest whole number. The pre-treatment assessment asked if sleep disturbances did not occur during the past month, and the one-week and one-month follow-up assessment asked if sleep disturbances did not occur during the in the past week.

Figures
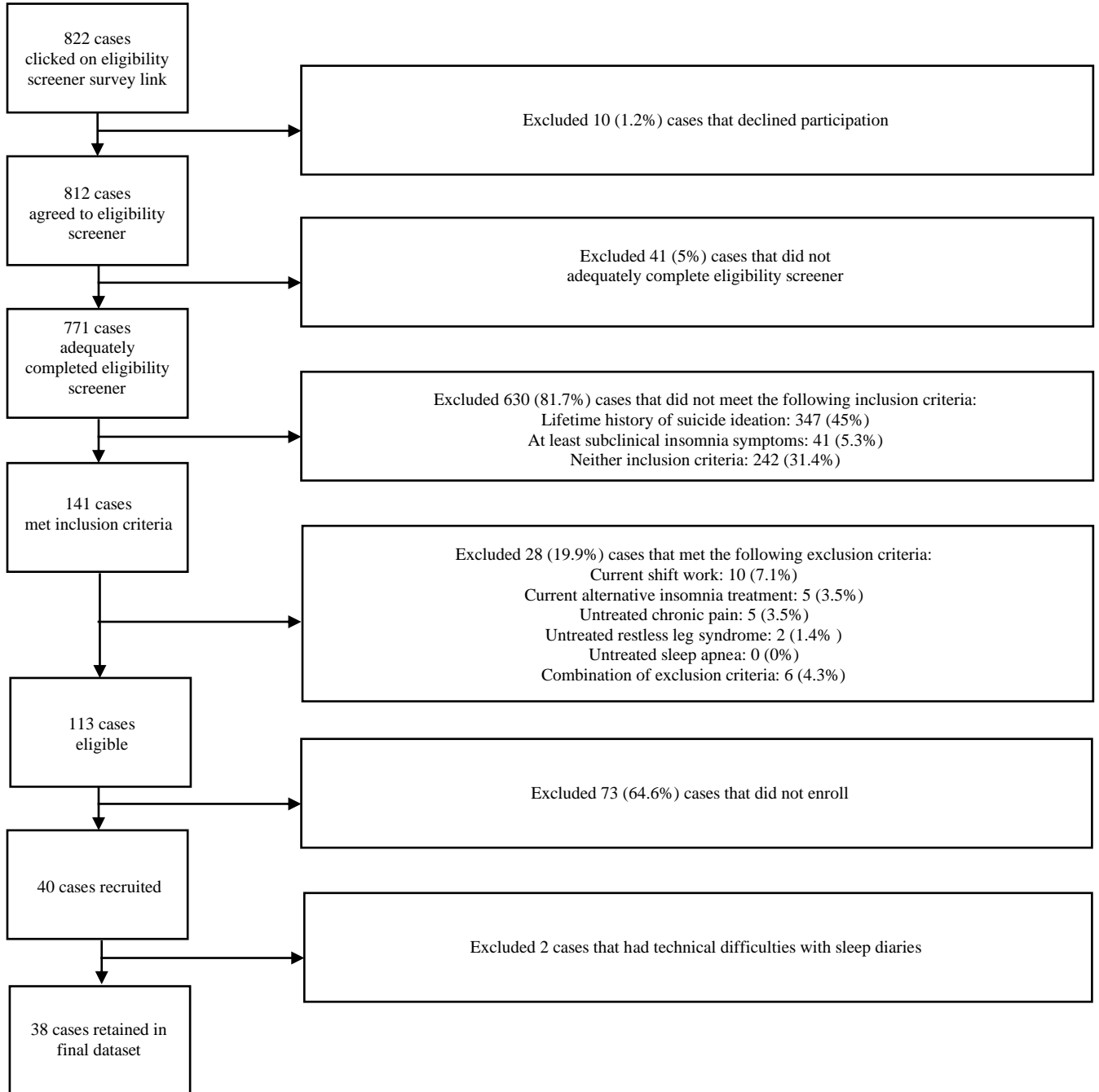
Figure 1. Diagram indicating selection, inclusion, and exclusion of cases from March 2019 to November 2019 to be used for assessing the feasibility and acceptability of a single-session, internet-based insomnia treatment for college students with at least subclinical insomnia symptoms and lifetime suicide ideation.

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┌─────────────────────────────────┐
│ 38 completed pre-treatment      │
│ sleep diaries and pre-treatment │
│ assessment                      │
│                                 │
└─────────────────────────────────┘
               │                        ┌─────────────────────────────────┐
               ├───────────────────────▶│ 1 (2.63%) missed post-treatment │
               │                        │ assessment                      │
               ▼                        └─────────────────────────────────┘
┌─────────────────────────────────┐
│ 37 completed post-treatment     │
│ assessment                      │
│ (38 retained)                   │
│                                 │
└─────────────────────────────────┘
               │                        ┌─────────────────────────────────┐
               ├───────────────────────▶│ 2 (5.26%) missed one-week sleep │
               │                        │ diaries                         │
               │                        │ 4 (10.53%) missed one-week      │
               ▼                        │ sleep diaries and dropped out   │
┌─────────────────────────────────┐    │ from study                      │
│ 32 completed one-week sleep     │    └─────────────────────────────────┘
│ diaries                         │
│ (34 retained)                   │
│                                 │
└─────────────────────────────────┘
               │                        ┌─────────────────────────────────┐
               ├───────────────────────▶│ 1 (2.94%) missed one-week       │
               │                        │ assessment and dropped out from │
               │                        │ study                           │
               ▼                        └─────────────────────────────────┘
┌─────────────────────────────────┐
│ 33 completed one-week           │
│ assessment                      │
│ (33 retained)                   │
│                                 │
└─────────────────────────────────┘
               │                        ┌─────────────────────────────────┐
               ├───────────────────────▶│ 9 (27.27%) missed one-month     │
               │                        │ sleep diaries and dropped out   │
               │                        │ from study                      │
               ▼                        └─────────────────────────────────┘
┌─────────────────────────────────┐
│ 24 completed one-month sleep    │
│ diaries                         │
│ (24 retained)                   │
│                                 │
└─────────────────────────────────┘
               │                        ┌─────────────────────────────────┐
               ├───────────────────────▶│ 4 (16.67%) missed one-month     │
               │                        │ assessment                      │
               ▼                        └─────────────────────────────────┘
┌─────────────────────────────────┐
│ 20 completed one-month          │
│ assessment                      │
│                                 │
└─────────────────────────────────┘
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Figure 2. Diagram depicting the number of participants and the attrition rates at each timepoint from March 2019 to December 2019 for assessing the feasibility and acceptability of a single-session, internet-based insomnia treatment for college students with subclinical insomnia symptoms and lifetime suicide ideation. For sleep diaries, participants were only counted as retained if they completed at least five daily sleep diaries for that timepoint. Percent missing or dropped is the proportion of the number of retained participants from the previous timepoint.

Appendix A
Note: Black lines indicate footers, light grey lines indicate page breaks, and bolded answers
indicate the correct answer on quizzes.

Welcome to Sleep Scholar
An internet-based, single-session insomnia program for college students

Introduction

During this guide, you will learn strategies of Cognitive Behavior Therapy for Insomnia (CBT-I).

CBT-I is a non-medication, evidence-based treatment shown to improve sleep quantity and sleep quality (i.e., restful sleep)[1-3]. In college students, CBT-I has been found to show greater improvements in sleep duration, sleep onset latency, sleep efficiency, and time awake after sleep onset compared to sleep hygiene, relaxation/mindfulness, and other therapeutic approaches (e.g., imagery rehearsal therapy)[4]. It is also considered a first-line treatment for chronic insomnia in adults by professional medical associations and sleep research organizations, including the American College of Physicians[5] and National Institutes of Health[6].

Not only does non-medication-based insomnia treatment engender objective improvements in sleep and professional recommendations, but individuals with insomnia typically prefer nonmedication-based insomnia treatment because it is seen as a more effective long-term solution, more likely to improve daytime functioning, and less likely to produce negative side effects compared to medication-based insomnia treatments[7-8].

This guide will consist of three text-based modules:
1. Sleep Psychoeducation (5 min)
2. Stimulus Control Therapy (10 min)
3. Sleep Quality Enhancement (10 min)

It will also include short quizzes after each module to check your knowledge and to practice implementing the described strategies. If you perform well on these quizzes, you can earn up to 0.5 extra SONA credit hours. You are <u>strongly encouraged</u> to use the strategies to improve your sleep and complete a daily sleep diary until the end of your participation in the study.

It is expected to take approximately 30 minutes to learn and practice these strategies today; however, more time can be taken if needed.

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[1]Geiger-Brown et al., 2015; [2]Okajima, Komada, & Inoue, 2011; [3]Trauer, Qian, Doyle, Rajaratnam, & Cunnington, 2015; [4]Friedrich & Schlarb, 2018; [5]American College of Physicians, 2016; [6]National Institutes of Health, 2005; [7]Bluestein, Healey, & Rutledge, 2011; [8]Vincent & Lionberg, 2001

Sleep Psychoeducation

What is insomnia? [9]

Insomnia symptoms can be classified into 3 categories:
- Difficulty falling asleep
- Difficulty staying asleep (i.e., multiple brief awakenings, extended duration of awakening(s)
- Waking up earlier than intended and not being able to fall back asleep

How are insomnia symptoms developed and maintained? [10]

There are *predisposing*, *precipitating*, and *perpetuating* factors that contribute to the development and maintenance of insomnia.

Predisposing factors: Some individuals are naturally vulnerable to having insomnia symptoms due to biological (e.g., a sensitive sleep system) or psychological (e.g., tendency to worry) factors.

Precipitating events: Stressful life events (e.g., exams, presentations, break-ups, family issues, financial struggles) often trigger sleep difficulties. However, these stress-induced sleep difficulties are typically short-lived and decrease in severity after the stressful life event has ended.

Perpetuating factors: Ineffective behaviors that an individual has adopted to compensate for or cope with sleep difficulties. Three categories of perpetuating factors include: engaging in non-sleep activities in the bed, staying in bed while awake, and spending excessive amounts of time in bed. Although these strategies are intended to improve sleep, they actually worsen sleep.

Some examples of ineffective sleep behaviors include:
- Non-sleep activities in the bed: doing homework, watching tv, playing video games, spending time on phone/tablet
- Staying in bed while awake: during difficulty falling asleep, during the middle of the night awakenings, after final awakening in the morning
- Excessive amounts of time in bed: going to bed earlier, getting out of bed later, extended napping, hanging out in bed, using the bed as you would a couch/chair in a living room

Individuals who adopt these behaviors wish to increase their opportunity for sleep, thinking that by being in bed, sleep will come soon thereafter. They have increased sleep effort; *they are trying too hard to sleep*. The ineffective sleep strategies adopted to cope with their sleep problems create a cycle by worsening the very problem they are attempting to solve. The goal of Sleep Scholar is to change ineffective sleep stratagies that are maintaining insomnia symptoms.

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[9]Ohayon, 2002; [10]Perlis, Shaw, Cano, Espie, 2011;

In this graph, we demonstrate how predisposing, precipitating, and perpetuating factors are related to insomnia symptoms. We also show the difference between acute, early, and chronic insomnia.

Insomnia Development and Maintenance[10]
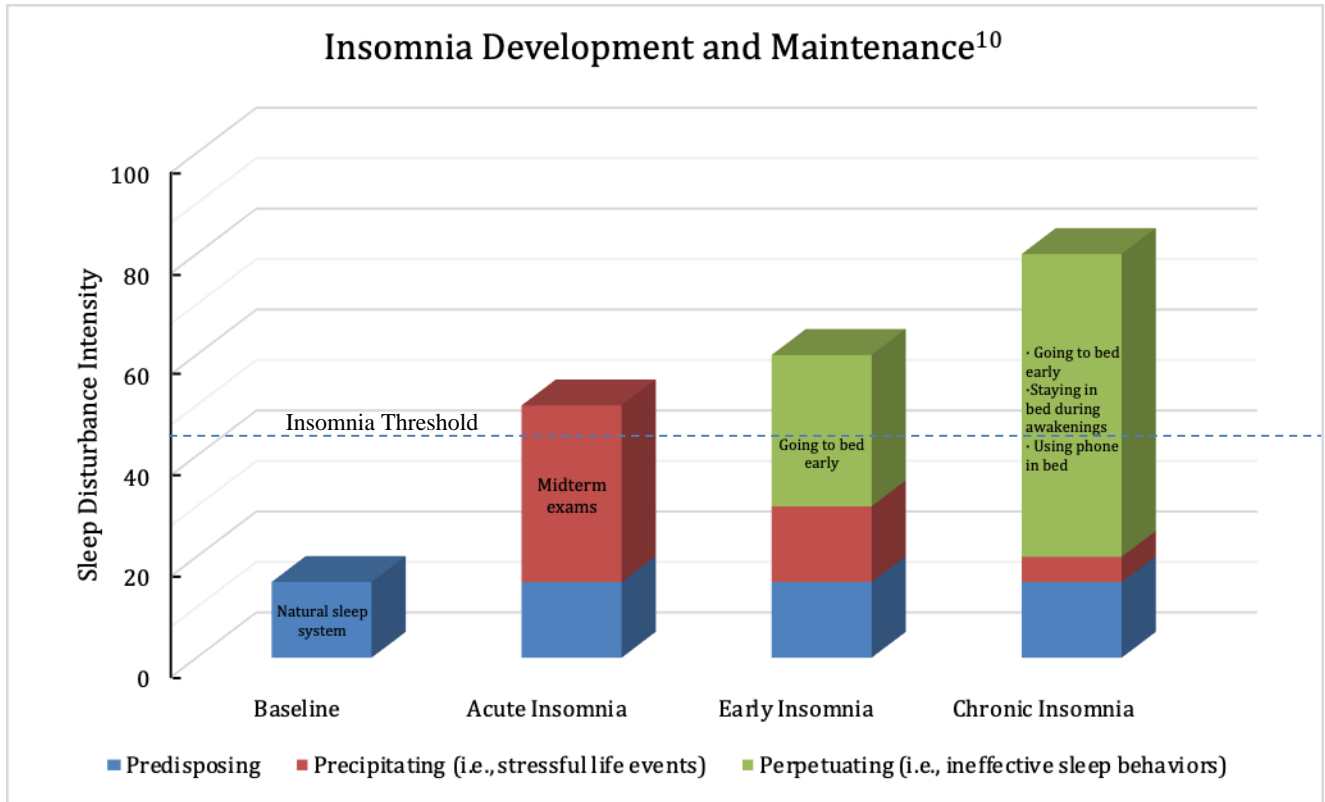
Baseline: Your natural sleep system may make you prone to having insomnia symptoms.

Acute Insomnia: Stressful life events (e.g., midterm exams) may cause you to initially develop insomnia symptoms, but as the stressful life event is resolved insomnia symptoms typically decrease.

Early Insomnia: During the time of the stressful life event, you may develop ineffective strategies to gain more sleep (e.g., going to bed early), further maintaining insomnia symptoms.

Chronic Insomnia: When the stressful life events does not have large contribution to insomnia symptoms, insomnia symptoms are maintained by further implementing ineffective sleep strategies (e.g., going to bed early, staying in bed when you cannot fall asleep, using phone in bed when you cannot return to sleep).

[10]Perlis, Shaw, Cano, Espie, 2011

How is sleep regulated?[11]

There are two opposing drives that regulate sleep: *sleep drive* and circadian alerting signal, hereafter referred to as the *alerting signal*. Sleep drive is the body's drive to go to sleep, while your alerting signal is the body's drive to stay awake. Here's how they work together:

Sleep Drive

Once you wake up, your *sleep drive* begins to build, and the longer you are awake, the higher your sleep drive becomes. In other words, the longer you're awake the more the body needs to sleep, and your drive for sleep increases.

Once you fall asleep, your drive for sleep keeps the body asleep, slowly decreasing throughout the night until it is at a low enough level for the body to wake up.

A nap decreases your sleep drive. An extended nap will decrease your sleep drive such that your drive to sleep isn't high enough at night to feel sleepy.

However, if we only had a sleep drive, during the day our sleep drive would build, we would fall asleep, then wake up after the sleep drive has decreased. We would repeatedly fall asleep and wake up throughout the day.

In this figure, we show how your sleep drive works throughout the day and night. As you can see, your sleep drive increases the longer you are awake. Then, once you go to sleep, it gradually decreases throughout the night.
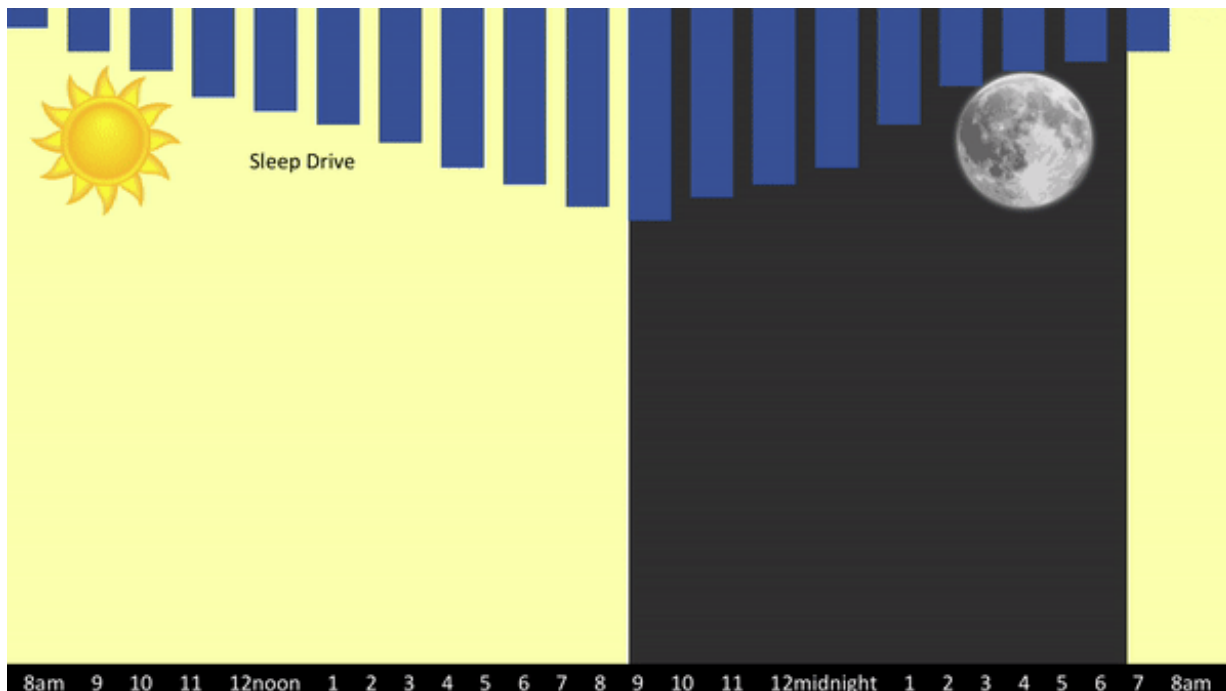
[11]Borbély, A. A. (1982).

Alerting Signal

This is why we have the *alerting signal*. We have an alerting signal that works against the sleep drive, helping to keep us awake.

Have you ever experienced having to regularly wake up at an early time (e.g., for class or work), then, when you are able to sleep to a later time (e.g., during semester breaks) you still wake up at the earlier time?

This is your body's alerting signal, which is an internal clock that alerts the body when to be awake and when to sleep. The alerting signal begins when we wake up, working against the sleep drive, building throughout the day to keep the body awake. At night, the alerting signal decreases, allowing us to sleep throughout the night.

It is important to set the body's internal clock by keeping a consistent wake time to improve insomnia symptoms, so that your body knows when to be awake and when to sleep.

(Fun Fact: Have you ever experienced becoming sleepy after lunch? Many people think that this mid-afternoon drowsiness is due to the lunch they recently ate. However, this sleepiness occurs because our alerting signal briefly decreases during the afternoon and our body can feel a stronger effect of the sleep drive [see animation below]. After the afternoon decrease in the alerting signal, the alerting signal increases again before decreasing throughout the evening).
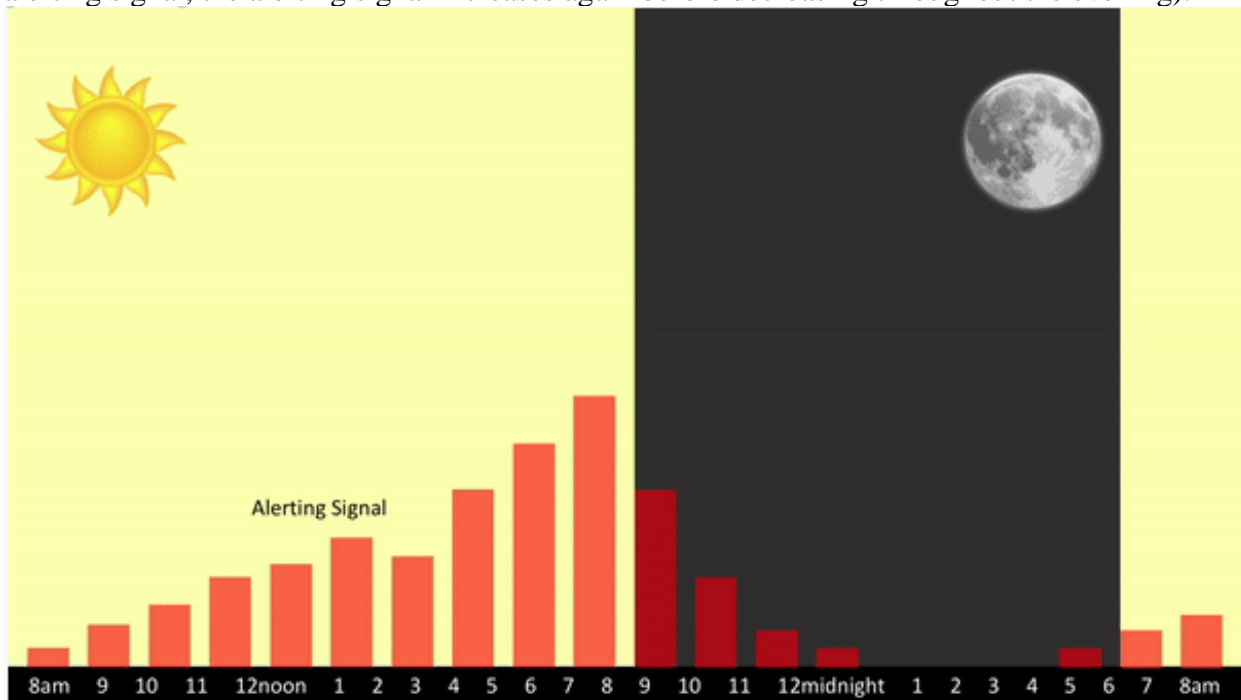
[11]Borbély, A. A. (1982).

In this figure, we show how your sleep drive and alerting signal work together during the day and night. As you can see, your sleep drive increases the longer you are awake. Then, once you go to sleep, it gradually decreases throughout the night. Your alerting signal also generally

95

increases throughout the day, with a slight dip in the late afternoon. Once you get close to bedtime, your alerting signal decreases, allowing you to fall asleep and stay asleep throughout the night. Each individual's pattern will be slightly different, based on their natural sleep system and habits he/she has developed over time.

Sleep Drive

Alerting Signal

| 8am | 9 | 10 | 11 | 12noon | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12midnight | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8am |
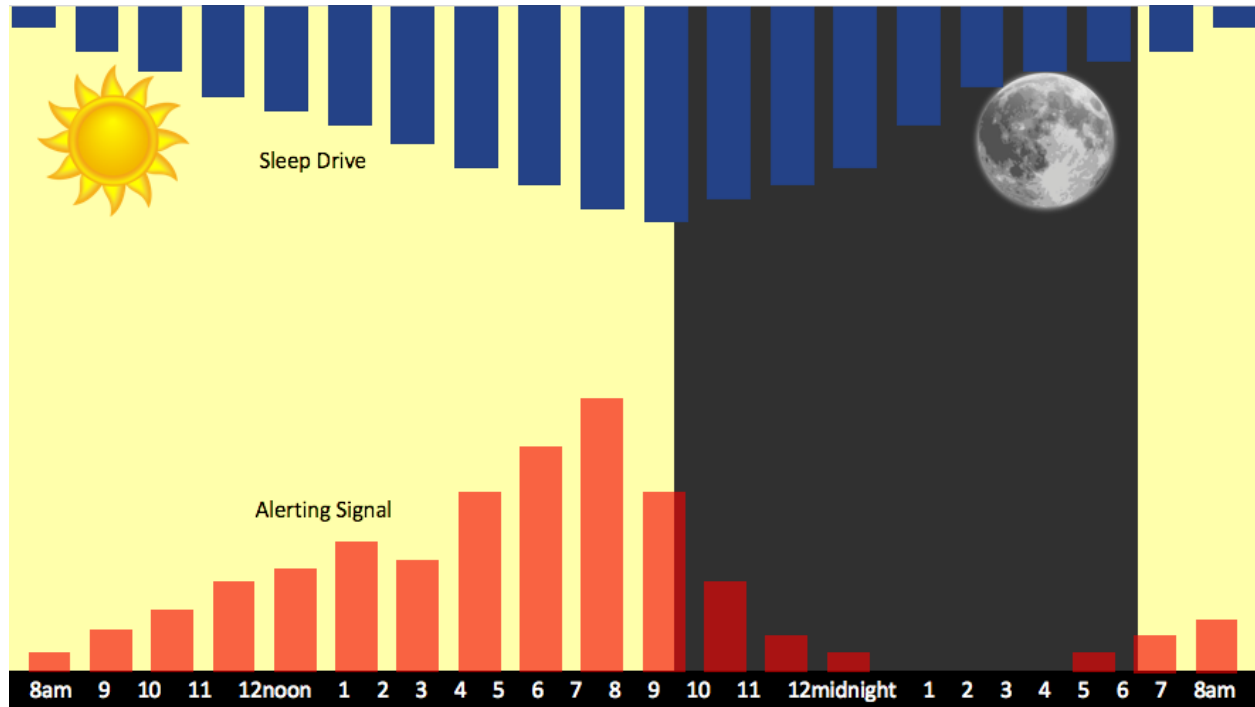
[11]Borbély, A. A. (1982).

How does sleep change across the life span?[12]

Over the lifespan, sleep patterns evolve. There is less time spent sleeping each day as we get older. Whereas newborn babies sleep for about 16 hours per day, during adulthood, individuals sleep approximately eight hours per day.

Sleep duration and sleep timing also change throughout the lifespan. During adolescence and early adulthood, the preferred time for sleeping is typically shifted later than what it is during childhood and adulthood (i.e., later bedtime and later wake time). This results in many high school and college students going to bed later and having to wake up earlier than desired to attend school the next morning. Many adolescents and young adults try to catch up on missed sleep during the weekends by sleeping in later; however, this shifts their alerting signal out of phase with their weekday schedule.

There are also individual differences for total sleep duration and the number of times that each person may wake up during the night. Although most adults need approximately eight hours of sleep to feel rested, some adults may only need seven hours or may need 9 hours of sleep to feel rested. Attempting to sleep more or less than what your body needs may result in insomnia symptoms. In addition, everyone wakes up at least once during the night, even if for brief, non-memorable moments. Infrequent, brief awakenings (i.e., less than 30 total minutes awake at night) during the sleep cycle are not considered to be a problem with maintaining sleep.

Infrequent, brief awakenings are typical during the sleep cycle and occur even in the sleep cycle of good sleepers.

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[12]Division of Sleep Medicine at Harvard Medical School, 2007

<u>How do lifestyle and environmental factors affect sleep?[12]</u>
Some lifestyle choices and environmental factors may negatively affect falling and staying asleep.

Caffeine (e.g., coffee, soda, energy drinks, tea), nicotine (e.g., Juul, cigarettes, chewing tobacco), alcohol, diet, as well as, medications (e.g., ADHD medication) and illicit substances (e.g., cocaine) play a role in the falling and staying asleep.

- Caffeine is a stimulant and is used to promote alertness. As such, caffeine intake can cause an increase in duration of time to fall asleep or number of awakenings; thus, caffeine should be limited during the six hours before bedtime.

- Nicotine is also a stimulant, producing similar effects as caffeine. Although nicotine use may initially help you to relax, its overall effect is stimulation, leading to problems with initiating or maintaining sleep. Therefore, nicotine should be avoided near bedtime and during middle of the night awakenings.

- Although alcohol is a depressant and drinking alcohol before bedtime may help initiate sleep quickly, withdrawal symptoms occur as alcohol is broken down in the body, resulting in multiple awakenings and a decrease in total sleep time. Therefore, while you're trying to get your sleep back on track, it's a good idea to reduce or eliminate alcohol in the hours prior to bedtime.

- Diet also plays a role in sleep. A pre-bedtime snack may help induce sleep; however, a large meal is likely to disrupt sleep as digestions occurs throughout the night. Therefore, large meals should be avoided close to bedtime and during the middle of the night.

- Stimulant medications, such as medication for attention-deficit/hyperactivity disorder (ADHD), also promote alertness. In addition, illicit substances (e.g., cocaine) can have unpredictable effects on sleep; thus, illicit substances should be avoided and medications should only be taken as prescribed by a medical professional.

Environmental factors also influence sleep and may contribute to insomnia symptoms. Some environmental factors that may affect sleep include: noise, light, and temperature.
- Loud noises, bright light, and extreme temperatures are likely to disrupt good sleep. Therefore, you can limit noise with earplugs or a "white noise" machine, use window blinds or curtains to avoid bright lighting, and use air conditioning or an electric blanket to maintain a comfortable temperature. Temperature should be kept reasonably cool for sleep, between 60- and 75-degrees Fahrenheit.

Now it's time to test your knowledge about what you just learned.

Module 1 Quiz: Psychoeducation

1. The _____ time you are awake, the more your drive for sleep (i.e., sleep drive) _____.
   a. Less; increases
   b. More; increases
   c. More; decreases
      i. Correct: That's right! The body's drive to sleep begins to build when you wake up and continues to increase the longer you are awake.)
      ii. Incorrect: That not quite right. The body's drive to sleep begins to build when you wake up and continues to increase the longer you are awake. The more time you are awake the more the sleep drive increases.)
2. Napping during the day _____ your drive for sleep.
   a. Increases
   b. Decreases
   c. Maintains
   d. Does not affect
      i. Correct: Great job! Napping during the day will decreases your sleep drive, making it more difficult to sleep at night. It is ideal to allow your sleep drive build during the day while awake and decrease while sleeping to maintain sleep throughout the night.
      ii. Incorrect: That's not quite right, napping for an extended amount of time during the day will decrease your sleep drive, making it more difficult to sleep at night. It is ideal to allow your sleep drive to build during the day while awake and decrease while sleeping to maintain sleep throughout the night.
3. True or false: The alerting signal is your body's internal clock telling the body when it's time to wake up and go to sleep.
   a. True
   b. False
      i. Correct: Excellent! The body's alerting signal is the internal clock indicating when to be awake and when to sleep.
      ii. Incorrect: That's not quite right, the body's alerting signal is the internal clock indicating when to be awake and when to sleep.
4. True or false: Keeping a consistent wake-up time will help your body know when it's time to be alert and when it's time for sleep.
   a. True
   b. False
      i. Correct: Nice job! The alerting signal works opposite to the sleep drive to keep the body awake. It begins to build when we wake up and decreasing

at night. <u>Keeping a consistent wake up time helps the body know when to send the alerting signal and when to decrease the signal.</u>

  ii. Incorrect: That's not quite right, the alerting signal works opposite to the sleep drive to keep the body awake. It begins to build when we wake up and decreasing at night. <u>Keeping a consistent wake up time helps the body know when to send the alerting signal and when to decrease the signal.</u>

5. True or false: It is typical to wake up during the middle of the night.
    a. **True**
    b. False
        i. Correct: Great! Yes, it is typical to wake up during the sleep cycle. These awakenings occur even if the individual does not remember. The goal of treatment is to decrease the frequency and duration of awakenings (less than 30 minutes awake during the night); however, they will not be completely eliminated.
        ii. Incorrect: That's not quite right, it is typical to wake up during the sleep cycle. These awakenings occur even if the individual does not remember. The goal of treatment is to decrease the frequency and duration of awakenings; however, they will not be completely eliminated.

6. Please select the factors that may affect sleep (select all that apply).
    a. **Caffeine**
    b. **Nicotine**
    c. **Alcohol**
    d. **Medications/illicit drugs**
    e. **Diet**
    f. **Light**
    g. **Noise**
    h. **Temperature**
        i. Correct: That's right! All of these factors influence sleep and may contribute to insomnia symptoms. Consider how these factors may affect your sleep.
        ii. Incorrect: That's not quite right, ALL of these factors influence sleep and may contribute to insomnia symptoms. Consider how these factors may affect your sleep.

7. True or false: It's a good idea to sleep in late on the weekends to catch up on the sleep you missed during the week.
    a. True
    b. **False**
        i. Correct: You should not sleep in late on weekends to catch up on sleep. If you sleep in too late, your sleep drive will not be strong enough at the end of the day to fall asleep easily, and the cycle will continue the next night. Keeping a consistent wake up time helps the body know when to be alert for the day and give the body adequate time to build its sleep drive, helping you fall asleep quickly at night.
        ii. Incorrect: That's not right. You should not sleep in late on weekends to catch up on sleep. If you sleep in too late, your sleep drive will not be strong enough at the end of the day to fall asleep easily, and the cycle will

continue the next night. Keeping a consistent wake up time helps the body know when to be alert for the day and give the body adequate time to build its sleep drive, helping you fall asleep quickly at night.

Would you like to know the strategies to improve your sleep?
Poor sleepers should follow the strategies we're going to talk about next to establish good sleep practices. However, good sleepers do not always have to follow these strategies, and after a poor sleeper establishes good sleep practices, these strategies can be relaxed.

Some individuals may have difficulty following the prescribed strategies. So, when completing the strategies, remember: short-term pain, for long-term gain!

Stimulus Control Therapy[13]

The goal of stimulus control strategies is (a) to change this association, teaching the body the bed is a place for sleep and not for activities that interfere with sleep and (b) to set your body's alerting signal, teaching your body when it is time to be awake and time to fall asleep.

This is done in four ways:
1. Only going to bed when sleepy
2. Only using the bed for sleep and sexual activity
3. Keeping a consistent wake-up time
4. Avoiding daytime naps and dozing

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[13]Bootzin & Nicassio, 1978

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<u>1. Only go to bed when sleepy</u>

Do you know the difference between being tired and being sleepy?

Tiredness is being fatigued or having low energy. For example, a person may be tired after physical activity, learning difficult materials in class, studying, or a difficult conversation with a friend/family member. After these events you may feel worn out or drained, but this does necessarily mean that your body is ready to fall asleep. Thus, if you go to bed when you are tired, but not sleepy, you may struggle to fall asleep. You should not get into bed if you are only tired.

Being tired/fatigued is different from being sleepy.

Sleepiness is the inability to stay awake. Some symptoms of sleepiness include: not being able to keep their eyes open, head nodding, rubbing your eyes, or constant yawning. Symptoms may vary, but you can tell if you are sleepy if you say to yourself 'I cannot stay awake any longer.' You should only get into bed when you are sleepy. When you go to bed when you are sleepy, your body will begin to associate the bed with sleep, teaching the body that the bed is only a place for sleep. Alternatively, if you are in the bed when you are tired, drained, or worn out and you do not sleep (i.e., you are not sleepy), it teaches the body the bed is a place to be awake. By repeatedly going to bed when you are sleepy, the association between sleepiness and the bed are established, and thereafter when you get into bed you will quickly fall asleep.

But what happens if you go to bed when sleepy and can't fall asleep?

If you are struggling to fall asleep (i.e., you are putting effort into falling sleep) you should get out of bed and go to another room (e.g., lounge area, living room, extra bedroom), <u>only returning to bed once you are sleepy</u>.

If you are not able to fall asleep after returning to bed, repeat this process. Go to another room and only return to bed once you are sleepy. It will take some time for your body to pair the bed with sleepiness, rather than with being awake. By repeatedly going to bed when you are sleepy, you strengthen the association between the bed and sleepiness and, eventually, the association will become automatic and you will quickly fall asleep when in bed. This process should also be completed when you are having difficulty falling asleep at the beginning of the night or if you

have difficulty maintaining sleep throughout the night. Continue as often as necessary until you *quickly* fall asleep in bed. Remember, short-term pain for long-term gains!

What should I do when I am in another room and waiting to become sleepy?
If you wake up in the middle of the night and you are having difficulty falling back to sleep (i.e., you are putting effort into falling sleep or after 15 minutes of tossing and turning) you should get out of bed and go to another room (e.g., lounge area, living room, extra bedroom), only <u>returning to bed once you are sleepy</u>.

If you are not able to fall asleep after returning to bed, repeat this process. Go to another room and only return to bed once you are sleepy. It will take some time for your body to pair the bed with sleepiness, rather than with being awake. By repeatedly going to bed when you are sleepy, you strengthen the association between the bed and sleepiness and, eventually, the association will become automatic and you will quickly fall asleep when in bed.

This process should also be completed both when you are having difficulty falling asleep at the beginning of the night or if you have difficulty staying asleep throughout the night. Continue as often as necessary until you quickly fall asleep in bed. Remember, short-term pain for long-term gains!

What should I do when I am in another room and waiting to become sleepy?
When you are in another room waiting to become sleepy you should be doing calm, relaxing, or boring activities. Some activities include: doing laundry, meditation, calling a friend in another time zone, cleaning, or reading. These activities are NOT meant to make you sleepy, but are intended to put you in a relaxed state as your sleep drive builds, setting the stage for you to fall asleep.

Watching T.V. can be a relaxing/calming activity; however, certain precautions should be taken so that you do not become stimulated. Most T.V.s release a light that is stimulating. Therefore, if you are watching T.V. while waiting to become sleepy, you should ensure that there is adequate space between you and the T.V. For example, it's not a good idea to watch TV on a tablet device or phone that is held really close to your face. This may be difficult for some college students if they live in a small dorm or there is limited space in their living room. In addition, some T.V. programs or movies genres may be naturally stimulating to watch (e.g., politics, drama, suspense, thrillers, or even comedies). You should refrain from watching this type of content if you are watching T.V. while waiting to become sleepy. If you are watching this type of content, your body may begin to learn that this is a time to alert and entertained rather than to relax and fall asleep. Sometime people think they are doing a relaxing activity, but it is actually stimulating. While using the T.V. as a relaxing activity you should watch content that you find boring and/or relaxing. Other individuals with insomnia symptoms have suggested: infomercials, children's shows, golf, silent auctions, or the History Channel. If you are watching T.V. while waiting to fall asleep and you are having a lot of difficulty becoming sleepy, you should try a different relaxing activity (e.g., deep breathing, counting backwards from 1000).

Some activities are NOT recommended while waiting to become sleepy, for example, watching the clock, doing/reviewing homework, studying, playing video games, checking locks, checking appliances. You should also avoid bright lights and stimulating content (e.g., politics, dramas, horror, games) associated with watching T.V., phones, tablets, or computers. All of these activities can be arousing. Remember, we want to set the stage for you to quickly fall asleep. Certain thoughts can also be arousing and are not recommended while waiting to become sleepy. For example, when individuals with insomnia symptoms watch the clock, they often think about how much time has passed and how much sleep they are missing. These thoughts bring frustration and anxiety, further arousing the body and limiting its ability to be in relaxed state to fall asleep. Similarly, thoughts about life problems (e.g., worrying about a test, relationships, or financial problems) can be arousing and should be avoided while waiting to become sleepy. By planning for stressful events, worrying, and thinking about irritating topics while you want to be sleeping, the body is taught that this is a time for arousal, rather than sleep. Your thoughts should remain calm and relaxed to help your body prepare to become sleepy.

Once you begin to feel sleepy (e.g., not being able to keep their eyes open, head nodding) while doing calm and relaxing activity, you should go to bed so that your body begins to associate the bed with sleepiness. If you repeatedly fall asleep in another room while waiting to become sleepy your body will begin to associate this room and its features (e.g., the couch in the lounge area) with sleep instead of your bed. Remember, we want to pair the bed with sleepiness.

Ultimately, you will have to decide what is stimulating or not. If you are having difficulty falling asleep while doing your calm/relaxing activity, you should try a more calming or boring activity (e.g., looking out the window, counting the stars).

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2. The bed is only for sleep and sexual activity

The bed should only be used for sleep and sexual activity. Do NOT watch TV, study, eat, play video games, hangout, etc. while in bed. After sexual activity, the aforementioned instructions about going to bed when sleepy should be followed. This will help build a strong association between the bed and sleep. By doing these other activities in bed, you are weakening the association between the bed and sleep. For example, if a student was spending time on social media while in bed, they will be exposed to bright screens and experience a variety of emotions by engaging in this activity (e.g., excitement about an upcoming event, anxiety when comparing themselves to peers, or frustration by a post from a friend). These emotions are incompatible with sleep.

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3. Keep a consistent wake up time

You should set an alarm to get up at the same time every day, regardless of amount of sleep you receive. This should be followed both during the week and weekends. Some people try to "catch up on" lost sleep by sleeping in; however, this can be counterproductive and negatively impact your alerting signal over time. If you sleep in too late, your sleep drive will not be strong enough at the end of the day to fall asleep easily, and the cycle will continue. By keeping a consistent wake up time your body will establish a consistent sleep rhythm, knowing when to wake up and

when to fall asleep. At first, you will feel more tired during the day because your total sleep time is shorter, but by keeping a consistent wake-up time every day, you will eventually feel sleepy enough at the end of the day to fall asleep at a reasonable bedtime. Remember, short-term pain for long-term gains!

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4. Avoid naps and dozing

Naps and dozing during the day should be avoided. Napping and dozing decrease the body's sleep drive, making it more difficult to fall asleep at night. Although it might feel really good in the moment to take a nap in the afternoon, you run the risk of sabotaging your ability to fall asleep later that night. This can lead to a cycle of struggling to fall asleep at night, resulting in poor sleep quality and daytime sleepiness, which leads to more naps, which leads to poor sleep at night. To break this cycle, you will need to push through the daytime sleepiness and avoid napping. Again, remember, short-term pain for long-term gain!

If you feel a nap is absolutely necessary to ensure safety (e.g., while driving a vehicle) or to complete needed tasks (e.g., staying awake in class), the nap should be taken as early as possible (i.e., before 12 noon) and should be a brief as possible (i.e., under 30 minutes). Remember to set an alarm or you won't have enough sleep drive to fall asleep later in the evening. In addition, you should continue to follow stimulus control strategies if you are having difficulty falling asleep while taking brief naps early in the day.

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[13]Bootzin & Nicassio, 1978

Module 2 Quiz: Stimulus Control Therapy

1. Identify some factors that maintain insomnia symptoms according to stimulus control therapy.
    a. Not enough exercise during the day to tire yourself out
    b. Watching T.V in bed
    c. Studying in bed
    d. Not getting good sleep the previous night
    e. Hanging out with a significant other in bed
    f. A chemical imbalance in my body
    g. Not getting out of bed once you wake up
    h. You cannot predict what maintains insomnia
        i. Correct: That's right! You should NOT do these activities in bed, they maintain insomnia symptoms. Spending excessive time in bed (i.e., time in bed not spent sleeping) and doing arousing activities (e.g., studying, watching tv) in bed teaches your body that the bed is a place for things other than sleep; thus, perpetuating insomnia symptoms.
        ii. Incorrect: That's not quite right, you should NOT do these activities in bed. spending excessive time in bed (i.e., time in bed not spent sleeping) and doing arousing activities (e.g., studying, watching tv) in bed teaches your body that the bed is a place for things other than sleep; thus, perpetuating insomnia symptoms.

2. What is the difference between being sleepy and being tired?
   a. There is no difference.
   b. Being tired is when you are ready for bed, being sleepy is having low energy and being fatigued.
   c. **Being sleepy is when you have the inability to stay awake and when you should go to bed; being tired is when you have low energy, but should not necessarily go to bed.**
      i. Correct: Yes! Being sleepy is when you are not able to stay awake any longer, including symptoms like: heavy eyes or head nodding and this is when you go to bed. Being tired is having low energy and being fatigued.
      ii. Incorrect: That not quite right, being sleepy is when you are not able to stay awake any longer, including symptoms like: heavy eyes or head nodding and this is when you go to bed. Being tired is having low energy and being fatigued.
3. When implementing stimulus control strategies, you should get out of bed when you find that you are putting effort into sleeping and return to bed only once you are sleepy, repeating the process as many times as necessary.
   a. **True**
   b. False
      i. Correct: That's right! To help re-associate the bed with sleep you should get out of bed when you cannot fall asleep (i.e., you are putting effort into falling asleep). You should only return to bed when are sleepy (i.e., the inability to stay awake). This process should be repeated until you fall asleep quickly in bed.
      ii. Incorrect: That's no quite right, to help re-associate the bed with sleep you should get out of bed when you cannot fall asleep (i.e., you are putting effort into falling asleep). You should only return to bed when are sleepy (i.e., the inability to stay awake). This process should be repeated until you fall asleep quickly in bed.

4. When following stimulus control strategies, what would you do if you are tossing and turning or putting effort into falling asleep, at the beginning, middle, or end of the night?
   a. Watch the clock, thinking about how much time has passed
   b. Think about the argument with your friend that made you angry
   c. Stay in bed; you will fall asleep eventually
   d. **Get out of bed, go to another room, and do a calm/relaxing activity**
   e. Play a game on your phone
      i. Correct: Great job! When you are putting effort into falling asleep you should get out of bed, go to another room, and do a clam/relaxing activity. This activity is not meant to make you feel sleepy, but sets the stage so when do feel sleepy, you can fall asleep quickly.
      ii. Incorrect: No, you should not do that. When you are putting effort into falling asleep you should get out of bed, go to another room, and do a clam/relaxing activity. This activity is not meant to make you feel sleep, but sets the stage so when do feel sleepy, you can fall asleep quickly.
5. When should you keep a consistent wake-up time?

a. Only during weekdays
b. Only during weekends
c. Only when you have received 8 hours of sleep
d. **Every day, including weekday and weekends, regardless of how much sleep you received**
    i. Correct: You are correct! <u>You should keep a consistent wake-up time every day, including weekdays and weekends, no matter how much sleep you received the previous night</u>. Keeping a consistent time helps set a sleep rhythm, so your body knows when to fall asleep and be awake.
    ii. Incorrect: That's not correct, <u>you should keep a consistent wake-up time every day, including weekdays and weekends, no matter how much sleep you received the previous night</u>. Keeping a consistent time helps set a sleep rhythm, so your body knows when to fall asleep and be awake.

Sleep Enhancement Therapy[14]

It is more important to get good quality of sleep that it is to get the correct quantity of sleep. This is because consolidated (i.e., quickly falling asleep with infrequent, brief middle-of-night awakenings) sleep feels more restful than interrupted (i.e., extended time to fall asleep, long awakenings in the middle of the night) sleep for an extended period of time.

Remember the body's sleep drive and alerting signal? We want to create a time in bed window that maximizes your sleep drive, allowing you to quickly fall asleep and stay asleep. We also want to maintain a consistent wake time to strengthen your alerting signal, so the body knows when to fall asleep and when to be awake.

Creating a time in bed window to maximize your sleep drive and alerting signal work together with the previous module, Stimulus Control, to help you quickly fall asleep once in bed. Without the stimulus control strategies, the body's sleep drive may be high and you may be very sleepy at bedtime. However, if you haven't used stimulus control strategies to link your bed with sleepiness, when you get into bed, you will become alert because your body has associated the bed with being awake. Thus, you will not fall asleep quickly and stay asleep during the middle of the night. It is important to use both the stimulus control strategies in combination with strategies described next.

Here's how it works:
1. First, you determine your time in bed duration. To create a time in bed window that allows for consolidated sleep, we will reduce your total time in bed to your current total sleep time. For example, if are typically in bed from 11pm to 7am (i.e., 8 hours), but only sleeping 12am to 6am (i.e., 6 hours), this means that your time-in-bed window would be 6 hours in duration.

   This may sound like you're getting less sleep. Although this will likely happen at first, it is only temporary. This is another example of short-term pain for the sake of long-term gain. Once you are able to achieve consolidated sleep (i.e. quickly falling asleep and having minimal brief awakenings), you will slowly expand your time in bed window to get that quantity of sleep your body desires.

2. Next, you will choose your wake-up time. Individuals' wake times are typically based on the earliest time they have to be awake during the week for activities (e.g., class, work, meetings). For example, if you have class at 8:00am on Mondays and Wednesdays, but don't have class until 10:00am on Tuesdays and Thursdays, you might choose 7:00am as you wake time to have adequate time to prepare for the day (e.g., shower). You would wake up 7:00am every day, even on the days when you have class at a later time and on the weekends.

3. Next, you will determine your bedtime. After choosing your wake time, you count backwards from your wake time based on your total sleep time (item 1 above). For example, if you chose 7:00am as your wake time, and your total sleep time is 6 hours, you would count backwards 6 hours from 7:00am to determine your bedtime. Your

bedtime would therefore be 1:00am. This might sound really late for a bedtime, but remember that this is only temporary. As you start to gain more consolidated sleep, you will gradually move your bedtime earlier to increase the duration of sleep.

4. In total, your time in bed window would be 1:00am to 7:00am. However, 1:00am is the earliest you should go to bed. You should continue stimulus control strategies and only go to bed when sleepy. Thus, if it is 1:00 am, and you are not sleepy, you should not go to bed until you feel sleepy. Also, even if you don't fall asleep until much later than 1:00 am, it's very important that you still get up at 7:00am for the day. This will set you up for success the next night, as you will likely be very sleepy and fall asleep more quickly.

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[14]Spielman, Saskin & Thorpy, 1987

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How long do I have to keep my time in bed window to get short, consolidated sleep?
You should maintain your new sleep schedule for at least one week to gain restful sleep.

What do I do after a week of keeping my new sleep schedule?
After 1 week of maintaining your time in bed window you will calculate your sleep efficiency. Your sleep efficiency is the proportion of the time that you spend in bed that you are actually sleep. Good sleepers typically have at sleep efficiency between 85% and 90%, meaning that at least 85% of the time they are in bed, they are asleep.

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There is a simple formula to calculate your sleep efficiency: total sleep time (TST) divided by total time in bed (TIB) times 100. (TST/TIB) x 100 = Sleep Efficiency%

- If your sleep efficiency for the week is *under 85%*, you should <u>decrease</u> your time in bed by 15 minutes (i.e., go to be 15 minutes later) to get more consolidated sleep.
- If your sleep efficiency for the week is *between 85% and 90%*, do not change your time in bed.
- If your sleep efficiency for the week is *over* 90%, you should <u>increase</u> your time in bed by 15 minutes (i.e., go to bed 15 minutes earlier) to gain more quantity of sleep.

Good quality and quantity sleep are both based on your sleep efficiency, not the number of hours that you are sleep at a time. For example, if your sleep efficiency is below 85% a large portion of the time you spend in bed is not spent sleeping (i.e., insomnia symptoms); therefore, by decreasing your time in bed you reduce the excess time that you are not sleeping. On the other hand, if your sleep efficiency is above 90% your body is attempting to sleep as much as possible during your time in bed (i.e., you are not getting enough quantity of sleep). Increasing your time in bed allows more time for your body to sleep. You should aim for a sleep efficiency between 85% and 90%. This indicates that you are getting both an adequate amount of sleep and good quality sleep. When you achieve a sleep efficiency between 85% and 90%, you should stop adjusting your time in bed window.

At the end of this module, we will help you determine you time in bed window. You will choose your wake-up time and enter your total sleep time that was provided the research assistant. After you enter this information, you will be presented your new time in bed window based on the provided information. In addition, you will be asked to submit sleep diaries for seven days after today's session and for seven days approximately one month from today's session. After you have completed each of these sleep diaries, you will be provided your sleep efficiency and given guidelines on how to adjust your time in bed window. To adjust your time in bed, you should keep your wake time consistent and adjust your bedtime by 15-minute increments. After adjusting your time in bed window, you should maintain your new sleep schedule for another week. After a week of your new sleep schedule, calculate your sleep efficiency again to determine what adjustments, if any, need to be made. However, you should **NEVER** schedule a time in bed window under 5 hours. Sleeping under 5 hours on a regular basis can be detrimental to you physical, cognitive, emotional, and social functioning. In addition, sleep under 5 hours on a regular basis can also endanger your life or the lives of others while operating a vehicle. If your current total sleep time is less than 5 hours, your total time in bed should be set to 5 hours to allow you to have an adequate amount of sleep.

What should I do while waiting for my earliest bedtime or during an early morning awakening?
While waiting for your earliest bedtime, you should do calming and relaxing activities. This will help as your sleep drive builds, setting the stage to fall asleep when your bedtime comes. Remember, the bedtime in your sleep schedule is the earliest time you can go to bed. If you are not sleepy at this time, continue to do calm and relaxing activities until you become sleepy.

What should I do if I become sleepy before my earliest bedtime?
If you become sleepy before your earliest bedtime, you should stay up until your bedtime. During this time, you should do calm/relaxing activities. In other words, regardless of whether you are sleepy before your bedtime, the earliest time you should go bed is your designated bedtime. This will help your sleep drive build for a longer period of time. Thus, when it is your bedtime you will quickly fall asleep and stay asleep because your drive for sleep is very high. If you get into bed when you are sleepy, but before your bedtime, you will likely fall asleep quickly; however, you are likely to wake up in the middle of the night because your sleep drive was not high enough to allow to sleep through the night. Remember, your drive for sleep keeps building the longer your are awake. If you are sleepy before your earliest bedtime, your bedtime arrives, and you are not sleepy anymore (i.e., you become more alert), you should stay out of bed until you become sleepy again. You should only get into bed when you are sleepy.

Putting it all together – sleep enhancement/stimulus control therapy:
Jamie is a college student that lives off campus. She has problems with falling asleep, middle of the night awakenings, and early morning awakenings. She is typically in bed from 12:00am to 9:00am. She is implementing sleep quality enhancement and stimulus control.

First, Jamie determines her total sleep time from sleep diary information. She determines that it typically takes her 1 hour to fall asleep, she is up 1 hour in the middle of the night, and she

wakes up 1 hours before her alarm and is not able to go back to sleep. Although she is currently in bed for 9 hours per night, she is only sleeping 6 hours.

Next, she chooses her wake up time. Jamie has class during the week around 10:00am and work on Fridays and Saturdays at 9:00am, so she chooses a wake time of 8:00am to give her enough time to prepare in the mornings.

Then Jamie calculates her time in bed window by counting backwards from her chosen wake time the number of hours she is currently sleeping. She chose a wake time of 8:00am and is currently sleeping 6 hours, so her time in bed window is from 2:00am to 8:00am. However, she reminds herself that this is her earliest bedtime. If she is not sleepy at this time she must stay up until she becomes sleepy. In addition, she only uses the bed for sleep and sexual activity and avoids daytime napping. She maintains this schedule for one week.

Week 1: After one week of implementing her new sleep schedule, Jamie is only in bed during her time in bed window (2:00am to 8:00am), but still has some insomnia symptoms, so she is only sleeping for 5 hours during that period. Jamie calculates her sleep efficiency for the week. She divides her total sleep time (i.e., 5 hours) by her time in bed (i.e., 6 hours) and multiplies by 100 ([5 hours/6 hours] X 100 = sleep efficiency%). Her sleep efficiency is at 83%, so she decreases her time in bed window by 15 minutes (2:15am to 8:00am). She maintains this schedule for one week.

Week 2: After one week of implementing her sleep schedule (2:15am to 8:00am), Jamie calculates her sleep efficiency again. Jamie is only in bed during her time in bed window, 5.75 hours (2:15am to 8:00am), and her insomnia symptoms have decreased, so she is sleeping for 5.5 hours during that period. Her sleep efficiency ([5.5 hours/5.75 hours] X 100 = sleep efficiency%) is at 96% so she increases her time in bed window. Her new time in bed window is 2:00am to 8:00am. She maintains this new schedule for one week.

Jamie calculates her sleep efficiency on a weekly basis and adjusts her time in bed as needed based on the prescribed guidelines.

Week 6: After a few weeks of calculating and adjusting her bedtime as needed Jamie is in bed from 12:00am to 8:00am, 8 hours. She is sleeping 7 hours during this time period. Jamie calculates her sleep efficiency ([7 hours/8 hours] X 100 = sleep efficiency%). Her sleep efficiency is at 87% so she maintains her time in bed window. Her new time in bed window is 12:00am to 8:00am. Based on her sleep efficiency, Jamie is getting good quality and a good duration of sleep.

Remember, both good quality and quantity sleep are based on your sleep efficiency, not the number of hours that you are sleep. When your sleep efficiency is between 85% and 90% you should stop making adjustments to time in bed window. This indicates that most of the time that you are in bed you are sleep (i.e., over 85% of the time) and that your body is not hungry for more sleep while you are in bed (i.e., needing 90%+ of the time you are in bed for sleep).

Module 3 Quiz: Sleep Quality Enhancement

1. What is the purpose of sleep enhancement therapy?
    a. To get good quantity of sleep, then get good quality of sleep
    b. To go sleep when you are not sleepy
    c. To wake up to different times each day
    d. **To increase sleep drive and set your alerting signal**
        i. Correct: Yes! The purpose of sleep enhancement therapy is to increase your body's sleep drive so that you fall asleep quickly and stay asleep, while setting your alerting signal with a consistent wake-up time so your body knows when to fall asleep and stay awake. First you get quality sleep, then work on duration of sleep.
        ii. Incorrect: That's not quite right, the purpose of sleep enhancement therapy is to increase your body's sleep drive so that you fall asleep quickly and stay asleep, while setting your alerting signal with a consistent wake-up time so your body knows when to fall asleep and stay awake. First you get quality sleep, then work on duration of sleep.
2. Jeff is currently in bed from 11:15pm to 9am. However, it takes him 1 hour to fall asleep. What should Jeff use as his time in bed duration when applying sleep enhancement strategies?
    a. 8 hours and 30 minutes
    b. **8 hours and 45 minutes**
    c. 9 hours and 15 minutes
    d. 9 hours and 45 minutes
        i. Correct: Great! Jeff's new time in bed duration is **8** hours and 45 minutes. This is because Jeff is only sleeping **8** hours and 45 minutes at night. When implementing sleep enhancement strategies, you set your time in bed duration to match your current total sleep time.
        ii. Incorrect: That's not right, Jeff's new time in bed duration is **8** hours and 45 minutes. This is because Jeff is only sleeping **8** hours and 45 minutes at night. When implementing sleep enhancement strategies, you set your time in bed duration to your current total sleep time.
3. How do you choose your wake-up time when applying sleep enhancement strategies?
    a. Wake up based on what you need to do that day
    b. **Choose the earliest time you have to be awake during the week**
    c. Always wake up between 6:00am and 9:00am
    d. Wake up when your body wakes you up
        i. Correct: Yes! You should choose the earliest time that you have to be awake during the week. This will help you keep a consistent wake-up time every day.
        ii. Incorrect: That's not quite right, you should choose the earliest time that you have to be awake during the week. This will help you keep a consistent wake-up time every day.
4. Lucy is applying sleep enhancement strategies, she has chosen a wake-up time of 9:00am and is currently sleeping 4 hours at night. What is her time in bed window?

a. **4:00am to 9:00am**
b. 5:00am to 9:00am
c. 12:00am to 9:00am
d. 10:00pm to 9:00am
    i. Correct: Amazing! Lucy's time in bed window in from 4:00am to 9:00am. Although she is sleeping 4 hours a night, you should never schedule a time in bed window for under 5 hours. To determine your time in bed window count backwards from your chosen wake-up time your total sleep time to determine your bedtime.
    ii. Incorrect: This is incorrect. Lucy's time in bed window in from 4:00am to 9:00am. Although she is sleeping 4 hours a night, you should never schedule a time in bed window for under 5 hours. To determine your time in bed window count backwards from your chosen wake-up time your total sleep time to determine your bedtime.

5. Tim is currently in bed from 10pm to 7am, but he is only sleeping 6 hours during this time. What is his sleep efficiency? Sleep efficiency = total sleep time (TST) divided by total time in bed (TIB) times 100. (TST/TIB) x 100 = Sleep Efficiency%
a. 88%
b. 93%
c. **66%**
d. 50%
    i. Correct: That's right! To calculate sleep efficiency, you divide total sleep time (6 hours) by time in bed (9 hours, 10pm to 7am) and multiple by 100. Therefore, Tim's sleep efficiency is 66%.
(6/9) X 100 = 66%
    ii. Incorrect: You calculated incorrectly, to calculate sleep efficiency, you divide total sleep time (6 hours) by time in bed (9 hours, 10pm to 7am) and multiple by 100. Therefore, Tim's sleep efficiency is 66%. (6/9) X 100 = 66%

6. You stay up until your bedtime at 1am, but do not get into bed until you are sleepy at 3am. You have set your wake time and alarm to 7am. What should you do at 7am when you alarm goes off?
a. Stay in bed, it's the weekend
b. Stay in bed, you only received 4 hours of sleep
c. **Get out of bed and start your day, you should keep a consistent wake time**
d. Get out of bed to check the time and return to bed
    i. Correct: Right! You should keep a consistent wake time regardless of how much sleep you have received and what day it is (i.e., weekday or weekend). This will help set you alerting signal and build your sleep drive for the following night so you can fall asleep quickly and stay asleep.
    ii. Incorrect: This is not right. You should keep a consistent wake time regardless of how much sleep you have received and what day it is (i.e., weekday or weekend). This will help set you alerting signal and build your sleep drive for the following night so you can fall asleep quickly and stay asleep.

7. Chris's time in bed window is from 11:00pm to 5:00am. However, at 11:00pm Chris is not sleepy. What should he do?
    a. Go to bed anyway, he will fall asleep eventually
    b. Do a calm and relaxing activity until he feels sleepy
    c. Exercise to tire himself out
    d. Think about all the work he has to do tomorrow and the sleep he is missing
        i. Correct: Nice! Chris should do a calm and relaxing activity. Chris's bedtime is his earliest bedtime. However, if he is not feeling sleepy at that time, he should do a calm and relaxing activity until he becomes sleepy.
        ii. Incorrect: That not right. Chris should do a calm and relaxing activity. Chris's bedtime is his earliest bedtime. However, if he is not feeling sleepy at that time, he should do a calm and relaxing activity until he becomes sleepy.
8. You your bedtime is set for 12am, midnight, and it 10pm and you already feel sleepy. What time should you get into bed?
    a. Now, you are sleepy
    b. At 12am, midnight, this is your bedtime
    c. At 11pm this is close to your bed time
    d. At 12am, midnight, but only if you are sleepy at this time
        i. Correct: Yes! Your bedtime is your earliest bedtime. Therefore, you should not get into bed before your bedtime. In addition, if you are not sleepy at your bedtime you should stay up until you become sleepy. Staying up until your bedtime and only getting into bed when you are sleepy will allow your sleep drive to build longer. Therefore, when you get into bed, you will fall asleep quickly and stay asleep longer throughout the night.
        ii. Incorrect: Incorrect, your bedtime is your earliest bedtime. Therefore, you should not get into bed before your bedtime. In addition, if you are not sleepy at your bedtime you should stay up until you become sleepy. Staying up until your bedtime and only getting into bed when you are sleepy will allow your sleep drive to build longer. Therefore, when you get into bed, you will fall asleep quickly and stay asleep longer throughout the night.

Intervention Barriers/Solutions

Below are some common barriers that individuals have when following the recommendations. Which ones apply to you?

☐ Finding calming and relaxing activities to do when you cannot fall asleep

☐ Finding calming and relaxing activities to do in the middle of the night

☐ Finding calming and relaxing activities to do when waking up too early

☐ Feeling tired during the day and wanting to take a nap

☐ Noisy roommates when trying to sleep

☐ Keeping a consistent wake up time

☐ Not going to bed at the same time as your partner

☐ Uncomfortable sleep environment

☐ I can't stop thinking about something stressful while I'm trying to sleep

☐ I keep looking at the clock and stressing about how little sleep I'm going to get tonight.

☐ I will never feel sleepy

☐ Other (please specify)

_____

_____

_____

_____

What should you do if you want to nap during the day?

Avoiding day time napping will increase your sleep drive so that you fall asleep and staying asleep at night. If you feel like you need a nap, napping should be limited to under 30 minutes a day and should be taken before 12 noon. Remember, you do not have to practice these strategies forever, once you are getting better sleep these strategies can be relaxed, it is short-term pain for a long-term gain.

What should you do if your roommates are too noisy?
You can try speaking with your roommates about your new sleep schedule to help to come to an agreement about the noise level. You can also try using ear plugs at night or a white noise machine to decrease the noise level.

What should you do to keep a consistent wake time?
You can try using an alarm clock instead of your phone and placing the alarm clock across the room. This will make it easier to get up for the day when your alarm goes off because you will have to get out of bed to turn off the alarm.
You can also plan a pleasurable activity in the morning to motivate you to get out of bed. Some pleasurable activity may include: watching your favorite tv show, playing video games, reading a book, making breakfast.

What should you do if you find it difficult to not go to bed at the same time as your partner?
You can try speaking with your partner about your new sleep schedule to help to come to help build support for yourself. Remember, you do not have to practice these strategies forever. Once you are getting better sleep these strategies can be relaxed,. Again, it is short-term pain for a long-term gain.

What should you do if you have an uncomfortable sleep environment?
Try adjusting the temperature, lighting, or pillows until you are comfortable. The ideal sleep temperature is between 60- and 75-degrees Fahrenheit. You can also consider getting curtains or blinds to reduce light in your room. In addition, you can also consider a mattress topper or extra pillow to make your bed more comfortable.

What should you do if you can't stop thinking of stressful things while you are trying to sleep?
Create a time before bed to wind down and prepare the body for bed. During this time, activities may include: taking a shower, brushing your teeth, making your lunch for the next day, reading a book, or practicing deep breathing. A video on how to practice deep breathing will be included in the Q&A of the reminder email about the Sleep Scholar program, which you will receive after today's session. You could also consider keeping a notebook in which you jot down worries and/or things you need to do the next day so that you are less likely to be preoccupied with them while trying to fall asleep.

If this is a recurring problem, you can set up a scheduled worry time: Set aside 15-30 minutes each day in the morning or in the middle of the day to plan for the next day or consider your worries and develop solutions. After this time period is over, delay your worries until the next scheduled worry time.

<u>What should I do if I</u> keep looking at the clock and stressing about how little sleep I'm going to get tonight?

> Place your phone or alarm clock on the other side of the room and turn them so that you cannot see the time. This will help you better identify what being sleepy feels like and place less focus on the time. You should not be concerned about your ability to track your sleep time for the sleep dairy. It is more important to avoid the stress of watching the clock to promote sleep. During the sleep diary entry, you can just give your best estimates of the time spent awake during the middle of the night.

> In addition, this can help you keep a consistent wake time in the morning because you will have to get out of bed to turn off your alarm. Remember, that sleep is a natural process that everyone needs and, eventually, your body will feel sleepy. Do not try to force or put effort into falling asleep. Ultimately, if you are having difficulty falling asleep and you are following the prescribed Sleep Scholar strategies, this will only help your fall asleep more quickly the next night because the longer you are awake the higher your drive for sleep.

What solutions do you have for barriers that you have identified?

_____
_____
_____
_____

Below are some calm/relaxing activities that may be helpful for you when out of bed. Please choose the ones you are most likely to implement.

- [ ] Count Backwards from 1000

- [ ] Deep breathing

- [ ] Create a calming Visualization (e.g., a beach)

- [ ] Close Your Eyes

- [ ] Do a puzzle

- [ ] Brush Your Hair

- [ ] Make your lunch for the day

- [ ] Listen to calm music

- [ ] Listen to white noise

- [ ] Look Out the Window

- [ ] Write a letter

- [ ] Stretch/Yoga

- [ ] Take a shower/bath

- [ ] Draw/Paint/ Color/ Doodle

- [ ] Read a book

- [ ] Sing

- [ ] Look at the stars

- [ ] Pet an animal

- [ ] Wash dishes

- [ ] Watch the sun rise

☐ Play a board game

☐ Listen to birds

☐ Give Yourself a Hand Massage

☐ Art and crafts

☐ Squeeze a Stress Ball

☐ Clean the house

☐ Decorate a room

☐ Drink non-caffeinated tea

☐ Call a friend/family member in another time zone

☐ Rub Your Feet Over a Golf Ball

☐ Smell a candle

☐ Do laundry

☐ Meditate

Now it is time to determine your time in bed window for the next week.

What is the earliest time that you need to wake up during the week (e.g., for class or work)?

▼ 12:00 AM (1) ... 11:50 PM (144)

What is your total sleep time provided by the research assistant?

_____

Your time in bed window for the next week is:

XX:XX to XX:XX

Please note your new time in bed window. Your new time in bed window will be included in the reminder email about the intervention that you will receive after today's session.

Along with following the time in bed window listed above remember to:
1. Only get into bed when you're sleepy, but not before your earliest bedtime
2. Wake up at your chosen wake time listed above, regardless of how much sleep you have received the night before and the day (i.e., weekday or weekend)
3. Get out of bed when you cannot sleep
4. Only use the bed for sleeping and sexual activity
5. Avoid daytime napping

Now, you have learned the skills to improve your insomnia symptoms, you are a sleep scholar! Over the next month, you should implement the strategies that you have learned today to improve your insomnia symptoms. Thank you for your participation!

As a reminder, after today's session you will receive an email that summarizes the information presented in Sleep Scholar. It will include your time in bed window, identified barriers and solutions, answers to common questions about insomnia treatment, and provide you with a tool to track your sleep efficiency outside of the study requirements. In addition, after today's session you will be asked to complete seven daily sleep diaries. You will then be provided information about how to adjust your time in bed window. Approximately one week from today you will be asked to complete a follow-up survey battery. Approximately 23 days from now, you will be asked to complete seven daily sleep diaries and will be provided information about how to adjust your time in bed window. After completing these daily sleep diaries, you will be asked to complete a one-month follow-up survey battery.

Appendix B. First Reminder Email

Subject: Reminder for research study titled "Single-Session Insomnia Treatment, Part 2"

Hi,

This email is in regard to the research study titled "Single-Session Insomnia Treatment, Part 2" in which you recently participated and about which you agreed to receive information. I am emailing you a summary of the information contained in the intervention, which will assist you in following the recommendations that were provided.

1. Below is your initial time in bed window (i.e., the earliest time to go to bed and your chosen wake up time) with brief instructions of how to adjust the window

Your initial time in bed window is: XX:XX to XX:XX

After 1 week of maintaining your time in bed window, you will calculate your sleep efficiency. Your sleep efficiency is the proportion of the time that you spend in bed that you are actually sleep. Good sleepers typically have at sleep efficiency between of 85% and 90%, meaning that at least 85% of the time they are in bed they are asleep.

There is a simple formula to calculate your sleep efficiency: total sleep time (TST) divided by total time in bed (TIB) times 100. (TST/TIB) x 100 = Sleep Efficiency%

- If your sleep efficiency for the week is under 85%, you should decrease your time in bed by 15 minutes to get more consolidated sleep.
- If your sleep efficiency for the week is between 85% and 90%, do not change your time in bed.
- If your sleep efficiency for the week is over 90%, you should increase your time in bed by 15 minutes to gain more quantity of sleep.

2. You should also follow stimulus control strategies:

This is done in four ways:
    a) Only get into bed when sleepy
    b) Only use the bed for sleep and sexual activity
    c) Keep a consistent wake up time
    d) Avoid daytime naps and dozing

Sleepiness is the inability to stay awake. Some symptoms of sleepiness include: not being able to keep your eyes open, head nodding, rubbing your eyes, or constant yawning. Symptoms may vary, but you can tell if you are sleepy if you say to yourself, 'I cannot stay awake any longer.' By only going to bed when you are sleepy it teaches the body that the bed is only a place for sleep.

The bed should only be used for sleep and sexual activity. Do NOT watch TV, study, eat, play video games, hangout, etc. while in bed. After sexual activity, the aforementioned instructions about going to bed when sleepy should be followed.

3. Below are your identified barriers and selected solutions to barriers.
   [Input will be inserted from intervention identified barriers and selected solutions questionnaire in Appendix C7]

4. Below is a list of possible questions and answers about following the insomnia treatment recommendations
   a. Can I nap?
      i. Naps and dozing during the day should be avoided. Napping and dozing decrease the body's sleep drive, making it more difficult to fall asleep at night. If naps are needed, they should be done before 3pm and limited to 30 minutes.
   b. What should I do if I can't sleep?
      i. If you are struggling to fall asleep (i.e., you are putting effort into falling sleep) you should get out of bed and go to another room (e.g., lounge area, living room, extra bedroom), ~~only returning to bed once you are sleepy~~. If you are not able to fall asleep after returning to bed, repeat this process.
   c. What if I never feel sleepy?
      i. You will eventually feel sleepy. The longer you are awake the more your drive for sleep increases. Put your body in a calm state by doing relaxing activities.
   d. How can I wake up at the same time every day?
      i. Some strategies to wake up at the same time everyday include:
         1. Use an alarm - get out of bed within 10 minutes of your alarm
         2. Moving your alarm clock to the other side of the room so you have to get up to turn it off
         3. Plan an activity in the morning to encourage yourself to get out of bed
   e. Should I watch the clock to complete the sleep diary?
      i. Watching the clock may add stress and inhibit your ability to sleep. When completing the sleep diary, the times do not have to exact. Just use your best estimates.
   f. What if I can't turn off my mind while in bed?
      i. Go to another and do a calm/relaxing activity until your feel sleepy, then return to bed. If this is recurring problem, you can set up a scheduled worry time: Set aside 15-30 minutes each day in the morning or in the middle of the day to plan for the next day or consider your worries and

develop solutions. After this time period is over, delay your worries until the next schedule worry time.

   ii. Practice deep breathing to help relax:
https://www.youtube.com/watch?v=EYQsRBNYdPk

  iii. Create a time before bed to wind down and prepare the body for bed. During this time, activities may include: taking a shower, brushing your teeth, making your lunch for the next day, reading a book.

Here is a sleep diary tool that can used to track your sleep efficiency outside of the study requirements.
Android: https://play.google.com/store/apps/details?id=info.bdslab.android.sleep.demo.full
Apple iOS: https://itunes.apple.com/no/app/sleep-diary/id1333684925?l=nb&mt=8
Please be sure to complete your sleep diaries when you receive your reminder texts.

Appendix C. Second Reminder Email

Subject: Reminder for research study titled "Single-Session Insomnia Treatment, Part 2"

Hi,

This email is in regard to the research study titled "Single-Session Insomnia Treatment, Part 2" in which you recently participated and about which you agreed to receive information. I am emailing you a summary of the information contained in the intervention which will assist you in following the recommendations that were provided.

1. Please continue to calculate your sleep efficiency on a weekly basis and adjusting your time in bed window based on the information below. Your sleep efficiency is the proportion of the time that you spend in bed that you are actually sleep. Good sleepers typically have at sleep efficiency between of 85% and 90%, meaning that at least 85% of the time they are in bed they are asleep.

There is a simple formula to calculate your sleep efficiency: total sleep time (TST) divided by total time in bed (TIB) times 100. (TST/TIB) x 100 = Sleep Efficiency%

- If your sleep efficiency for the week is under 85%, you should decrease your time in bed by 15 minutes to get more consolidated sleep.
- If your sleep efficiency for the week is between 85% and 90%, do not change your time in bed.
- If your sleep efficiency for the week is over 90%, you should increase your time in bed by 15 minutes to gain more quantity of sleep.

2. You should also follow stimulus control strategies:

This is done in four ways:
a) Only get into bed when sleepy
b) Only use the bed for sleep and sexual activity
c) Keep a consistent wake up time
d) Avoid daytime naps and dozing

Sleepiness is the inability to stay awake. Some symptoms of sleepiness include: not being able to keep your eyes open, head nodding, rubbing your eyes, or constant yawning. Symptoms may vary, but you can tell if you are sleepy if you say to yourself, 'I cannot stay awake any longer.' By only going to bed when you are sleepy it teaches the body that the bed is only a place for sleep.

The bed should only be used for sleep and sexual activity. Do NOT watch TV, study, eat, play video games, hangout, etc. while in bed. After sexual activity, the aforementioned instructions about going to bed when sleepy should be followed.

3. Below are your identified barriers and selected solutions to barriers.
   [Input will be inserted from intervention identified barriers and selected solutions questionnaire in Appendix C7]

4. Below is a list of possible questions and answers about following the insomnia treatment recommendations
   a. Can I nap?
      i. Naps and dozing during the day should be avoided. Napping and dozing decrease the body's sleep drive, making it more difficult to fall asleep at night. If naps are needed, they should be done before 3pm and limited to 30 minutes.
   b. What should I do if I can't sleep?
      i. If you are struggling to fall asleep (i.e., you are putting effort into falling sleep) you should get out of bed and go to another room (e.g., lounge area, living room, extra bedroom), only returning to bed once you are sleepy. If you are not able to fall asleep after returning to bed, repeat this process.
   c. What if I never feel sleepy?
      i. You will eventually feel sleepy. The longer you are awake the more your drive for sleep increases. Put your body in a calm state by doing relaxing activities.
   d. How can I wake up at the same time every day?
      i. Some strategies to wake up at the same time everyday include:
         1. Use an alarm - get out of bed within 10 minutes of your alarm
         2. Moving your alarm clock to the other side of the room so you have to get up to turn it off
         3. Plan an activity in the morning to encourage yourself to get out of bed
   e. Should I watch the clock to complete the sleep diary?
      i. Watching the clock may add stress and inhibit your ability to sleep. When completing the sleep diary, the times do not have to exact. Just use your best estimates.
   f. What if I can't turn off my mind while in bed?
      i. Go to another and do a calm/relaxing activity until your feel sleepy, then return to bed. If this is recurring problem, you can set up a scheduled worry time: Set aside 15-30 minutes each day in the morning or in the middle of the day to plan for the next day or consider your worries and develop solutions. After this time period is over, delay your worries until the next schedule worry time.
      ii. Practice deep breathing to help relax:
          https://www.youtube.com/watch?v=EYQsRBNYdPk

    iii. Create a time before bed to wind down and prepare the body for bed. During this time, activities may include: taking a shower, brushing your teeth, making your lunch for the next day, reading a book.

Here is a sleep diary tool that can used to track your sleep efficiency outside of the study requirements.
Android: https://play.google.com/store/apps/details?id=info.bdslab.android.sleep.demo.full
Apple iOS: https://itunes.apple.com/no/app/sleep-diary/id1333684925?l=nb&mt=8
Please be sure to complete your sleep diaries when you receive your reminder texts.