Combating Bedtime Procrastination Globally:

A Pretest-Posttest Study on the Effectiveness of an Implementation Intentions Intervention on Bedtime Procrastination and Life Satisfaction and a Cross-Cultural Exploration

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24 June 2024

This manuscript may be made publicly accessible

Abstract

Background. This study investigates bedtime procrastination, defined as delaying sleep without a legitimate reason, and its impact on sleep quality and overall well-being. Despite its significant health effects, bedtime procrastination remains understudied, particularly regarding cultural influences and effective interventions.

Objectives. This study examines the effectiveness of an implementation intentions intervention on reducing bedtime procrastination and increasing life satisfaction. It also explores the relationship between bedtime procrastination and cultural tendencies. It is hypothesized that the intervention will decrease bedtime procrastination and increase life satisfaction, and that there will be a correlation between bedtime procrastination and cultural tendencies.

Methods. In the main study (N=75), a pre-test/post-test design was used to measure the effectiveness of an implementation intention intervention on bedtime procrastination and life satisfaction over three weeks. An exploratory study (N=90) conducted a correlation analysis to study the relationship between bedtime procrastination and cultural tendencies (towards collectivism).

Results. The implementation intentions intervention significantly reduced bedtime procrastination scores. However, there were no significant changes in life satisfaction scores, nor was there a significant correlation between bedtime procrastination and cultural tendencies.

Conclusions. This study is the first to test implementation intentions on bedtime procrastination independently and to investigate the influence of cultural tendencies on bedtime procrastination. These findings underscore the potential of implementation intentions as a strategy to reduce bedtime procrastination and their applicability across cultures.

Keywords: Implementation Intentions, Bedtime Procrastination, Life Satisfaction, Culture

Introduction

Many individuals may relate to late-night activities such as scrolling through social media, binge-watching series, or engaging in deferred chores rather than sticking to a timely bedtime. Yet many of these individuals lack awareness that this phenomenon is called bedtime procrastination. Bedtime procrastination, defined as "going to bed later than intended without any legitimate reason causing the delay" (Kroese et al., 2014, p.2), presents a significant challenge in contemporary society. The terms bedtime procrastination and sleep procrastination are both found in literature and can be used interchangeably. For this study's purpose, the term bedtime procrastination will be used. Consequently, the present study will look closer into the phenomenon through unique angles of bedtime effective interventions for procrastination as well as cultural influences.

Individuals experience disrupted sleep patterns for diverse reasons, with emerging scholarly attention focusing on the phenomenon of bedtime procrastination as a notable contributing factor to poor sleep (Valshtein et al., 2020). The effects of inadequate sleep on a person's health and overall well-being have been studied extensively. Insufficient sleep affects a large range of people's health outcomes (e.g., cardiovascular outcomes; Healy et al., 2024), insulin resistance (Zuraikat et al., 2024), increased disease and mortality risk (e.g., Chung et al., 2024)) as well as attention behavior (e.g., cognitive functioning; Fjell & Walhovd, 2024), working memory and response inhibition (Zimmerman et al., 2024).

Similarly, extensive literature has explored the link between sleep quality and overall well-being, with studies consistently demonstrating associations between sleep quality, variability in sleep duration, and increased life satisfaction (Ness & Saksvik-Lehouillier, 2018; Shin & Kim, 2018). Ness & Saksvik-Lehouillier found that better sleep quality, longer mean sleep duration, less variability in sleep duration and in rise time all impacted greater life satisfaction, with sleep quality and variability of sleep duration being the greatest predictors (2018). Other studies found that sleep quality was a mediator between time perspective and life satisfaction (Rönnlund et al., 2021). While there is a strong background in research regarding the importance fo sleep quality and life satisfaction, there are no studies looking at the direct relationship between bedtime procrastination and life satisfaction.

Despite the detrimental impact on individuals' health and well-being, the phenomenon of bedtime procrastination is still not fully understood, particularly concerning its underlying causes and the variability in individuals' reasons for delaying sleep. Despite the presumed global relevance of research on sleep quality and its effects, there is a notable dearth of

comparative studies exploring cultural influences within the broader domain of sleep health, including bedtime procrastination.

The domain of effective interventions for bedtime procrastination remains relatively unexplored, particularly considering the myriad of reasons underlying bedtime procrastination. A study conducted by Nauts et al. (2019) delved into the underlying rationales behind bedtime procrastination among individuals. The qualitative study found that a typology of bedtime procrastination, using people's reasoning behind the bedtime procrastination in the classification (types found being deliberate procrastinators, mindless procrastinators, and strategic delay) (Nauts et al., 2019). This research opens the door to understanding the intricacies involved in addressing the range of factors contributing to individuals' sleeping problems, particularly when considering how to best target interventions. Having someone who is not getting enough sleep because they are consciously delaying their bedtime, is contextually quite different from someone who is getting poor sleep because they can't organize their time wisely.

The field of sleep hygiene looks at modifiable behaviors and environmental adjustments to implement in promoting sleep quality and sleep duration improvements (De Pasquale et al., 2024). A big challenge in this has been being able to find a universal definition of what exactly this entails and has looked at things like caffeine, alcohol, noise, stress reduction, etc. (De Pasquale et al., 2024). Most sleep hygiene interventions look at single-component interventions such as psychoeducation, as well as ignoring the reasons why people end up delaying their bedtime in the first place (Wilfling et al., 2023). Conventional interventions, often centered around psychoeducation on sleep hygiene, have shown limited effectiveness, necessitating a more nuanced approach tailored to individual needs (Valshtein et al., 2020). Therefore, investigating the efficacy of interventions aimed at the achievement of sleep-related goals requires planning for the role of individual variations.

Implementation intentions as proposed by Gollwitzer (1999), are simple interventions aiming to automatize someone's behavior by using new cues to start action towards someone's specific goal, usually in the form of "if-then" statements. These then specify the when, where, and how the behavior will lead to the achievement of a goal (Gollwitzer, 1999). An example of a typical structure of an implementation intention is 'if situation y arises, then I will perform goal-directed behavior z to achieve goal x'. Implementation intentions enhance the accessibility of situational cues (Webb & Sheeran, 2004) and reinforce the association between anticipated situations and expected behaviors. This facilitates the automatic emergence of goal-relevant behaviors when encountering relevant cues (Sheeran et al., 2005).

In the case of bedtime procrastination, this could include the situational cue of the church bells chiming at 10PM or a sleep alarm going off, which could then reinforce the association between the bell or alarm with the expected behavior of starting the bedtime routine (i.e., brushing your teeth as soon as you are faced with this cue). Ideally, implementation intention is automatizing the behavior of initiating the bedtime routine with the relevant cue of hearing the church bell or setting the sleep alarm at the same time every night. What makes the use of implementation intentions so helpful in considering individual variations in goal setting and routines is that the individual can find that situational cue depending on their own nightly routines. Consequently, implementation intentions reduce the disparity between goals and actions, thereby optimizing goal pursuit.

Implementation intentions have garnered considerable attention in scientific inquiry and have demonstrated effectiveness across broad and diverse behavioral domains including general health contexts (Hagger & Luszczynska, 2014), personal goal achievement (Gollwitzer & Sheeran, 2006), binge eating and healthy eating (Adriaanse et al., 2011; Tanis et al., 2022; Turton et al., 2016), substance use and alcohol consumption (Cooke et al., 2023; Malaguti et al., 2020), smoking (Hagerman et al., 2021; McWilliams et al., 2019), and physical activity (Kompf, 2020). Interestingly, while the breadth of health behaviors in which I.I.s have been tested is sizable, it has not been as thoroughly studied in the sleep hygiene domain. The availability of research on implementation intentions and bedtime procrastination directly is even slimmer.

Additionally, the studies that are available seem to study a combination of motivation and intentional strategies such as mental contrasting-implementation intention-based interventions (Valshtein et al., 2020). Implementation intentions offer a promising approach for tailoring interventions to individuals' specific needs and objectives, rendering them applicable to individuals experiencing bedtime procrastination regardless of the underlying reasons. Implementation intentions facilitates the simultaneous targeting of goal pursuit and implementation, proving beneficial in addressing challenging behaviors such as managing bedtime procrastination (Valshtein et al., 2020), and has demonstrated effectiveness in addressing other complex health behaviors (Webb & Sheeran, 2004). The process of automatizing behavior through implementation intentions serves as a valuable tool in surmounting the barriers inherent in bridging the gap between setting and achieving behavioral intentions (Gollwitzer & Sheeran, 2006). Therefore, the present study aims to address the effectiveness of an implementation intentions intervention as sole strategy in tackling bedtime procrastination. **RQ1:** The main research question guiding this inquiry will be: Is the use of an

implementation intentions intervention that addresses bedtime procrastination effective? In pursuit of this main question, several sub-questions are posed. Firstly, **SRQ1:** Does the intervention decrease bedtime procrastination? Secondly, **SRQ2:** Does the present intervention increase life satisfaction?

Additionally, to our knowledge, there are no studies that look at the relationship between culture and bedtime procrastination directly. Most studies address adaptations of bedtime procrastination scales to diverse languages (e.g., Brando-Garrido et al., 2022; Hazumi et al., 2024). One study compared a Chinese sample to an American sample looking at the impact of smartphone use on bedtime procrastination (Hu et al., 2022). They found both groups had a positive relationship between work-related smartphone use and bedtime procrastination (Hu et al., 2022). Again, what is lacking in the research is studies that compare cultural groups general bedtime procrastination behavior. Based on the article by Nauts et al. (2019), where the distinct types of bedtime procrastination are described, and more specifically deliberate bedtime procrastination in the as "me-time" being needed, it is interesting to consider the potential role culture plays in the reasoning behind individual's bedtime procrastination.

One way to look at this cultural influence is considering at cultural tendencies people have. In Hofstede's distribution of individualistic and collectivistic cultures, it was explained that individualistic cultures value the individual and emphasize autonomy and uniqueness, while collectivist cultures value the group over the individual and emphasize the need for fulfilling group goals (Hofstede, 1980). Due to the lack of studies comparing different cultural tendencies, an exploratory study will look at the differences in bedtime procrastination amongst cultural tendencies through the lens of collectivism tendencies. To my knowledge, this is the first study looking at a comparison specifically between collectivist culture including a sample from South America and individualistic culture including a sample from the Netherlands and the United States. **Exploratory Question:** Is there a correlation between cultural tendency (leaning more towards collectivism or not) and bedtime procrastination scores?

Current Study

Particularly noteworthy is the increasing demand for tailored interventions, accommodating individuals' diverse reasons for procrastinating sleep (Valshtein et al., 2020). Implementation intentions offer a promising avenue for personalized planning, allowing individuals to deploy strategies tailored to their unique circumstances, thereby filling a crucial void in the current understanding of effective sleep intervention strategies. This study aims to address the existing gap in research pertaining to the effectiveness of implementation intention-based interventions as a tool for sleep hygiene interventions.

The first hypotheses *(H1)* proposes that the intervention will be effective, *(H1.1)* decreasing the level of bedtime procrastination in individuals, and *(H1.2)* having a positive impact on satisfaction with life. Regarding the exploratory study, the bedtime procrastination pre-scores of the participants will be used to look at any existing correlations of culture and bedtime procrastination, if any.

By addressing these research questions and hypotheses, this study endeavors to contribute to the understanding of effective interventions for bedtime procrastination. Additionally, the study will expand on the current knowledge of the relationship between sleep and life satisfaction by innovating in studying bedtime procrastination's effect. Furthermore, it will pioneer research in the potential correlation between culture and bedtime procrastination differences. Finally, as practical applications of this study, valuable information on the effectivity of strategies to tackle bedtime procrastination and its role in enhancing individuals' well-being and quality of life.

Methods

Design

Approval from the ethics review committee was received (UU-SER number: 24-0450). In order to calculate the effect of the independent variable of the Implementation Intentions Intervention on the quantitative dependent variables of bedtime procrastination and life satisfaction, a pre-test post-test design without control group was conducted. The study design will be mirroring Valshtein's timeline for baseline, delivery of intervention and follow-up as they studied a mental contrasting-implementation intention intervention on bedtime procrastination and found it effective (2020). As an exploratory study into the variables of culture and bedtime procrastination, a correlation analysis was conducted.

Participants

For both the main and exploratory study, convenience sampling was used via sharing of the questionnaire via social media such as Instagram and Facebook. Snowball sampling was also used by encouraging the spread of the link to others participants might know. There were two exclusion criteria. The first was that anyone under 18 years old was ineligible. The second criteria was being medically diagnosed with a sleeping disorder. Both the age and the medical diagnosis were checked via self-report.

A total of 121 people accessed the initial questionnaire. One person did not consent to participate. Thirty people were excluded for incomplete data and one excluded for having a

sleeping disorder. A total of 90 participants completed the comprehensive initial questionnaire. This number constitutes the baseline sample for the main study and the final sample size for the explorative study and will be described first.

Exploratory Study

An *a priori* power analysis was conducted with the program G*power 3.1 to determine the intended sample size for the exploratory study with a two-tailed approach, assuming a correlation of 0.45 based on a study of culture's effects on sleeping behaviors (Cheung et al., 2021), an alpha of .05 and power of 0.8 and a correlation of 0 for p H0. This yielded a necessary sample size of 36 to find a significant result in a correlation test between cultures and bedtime procrastination.

The sample used for the exploratory studied consisted of the baseline data of the main study. Of this initial sample, 40 (44.4%) identified as male and 50 (55.6%) identified as female. The participants' ages ranged from 18 to 34 with a mean of 26.02 (SD=3.38). There were 21 nationalities represented in the initial questionnaire, with most of the data coming from Ecuador, The Netherlands and the United States. Specifically, seven regions were represented: Eastern Europe, Western Europe, East Asia, Middle East, South America, the Caribbean and North America. **Table 1** contains descriptive statistics for both main study and exploratory study.

Main study

An *a priori* power analysis was conducted with the program G*power 3.1 to determine the intended sample size, assuming an effect size value of 0.35 (between small=0.2 and medium=0.5) (Kang, 2021). This was based on previous literature on the effectiveness of implementation intentions in overall health behaviors which found between small and medium (Adriaanse et al., 2011; Cooke et al., 2023; P. M. Gollwitzer & Sheeran, 2006); as well as the study after which the present experiment is based who found small main effect ($\eta2 = 0.011$) (Valshtein et al., 2020). To achieve an alpha of 0.025 and a power of 0.8, the minimum sample size should be 67 people. Because the design will require data collection at two time points, a modest 25% drop out rate was expected and therefore we will need 90 participants.

A total of 90 participants completed the comprehensive initial questionnaire. For the 3-week follow-up, 75 participants finished the questionnaire. The participants' ages ranged from 18 to 33 with a mean of 25.92 (SD=3.11). The lost to follow-up rate was 16.7%. In the follow-up, 41 (54.7%) participants identified as female and 34 (45.3%) as male. There were 20

countries represented in the follow-up, only losing representation from Czech Republic. Participants represented four continents: North America, South America, Europe and Asia. The majority of the participants were from Ecuador, The Netherlands and the United States.

Table 1.
Descriptive Statistics

Distribution of Participants		**Baseline (*N*=90)**		**Follow-Up (*N*=75)**	
		Frequency	**Percent (%)**	**Frequency**	**Percent (%)**
Gender	*Male*	40	44.4	34	45.3
	Female	50	5.6	41	54.7
Ethnicity	*White*	52	57.8	41	54.7
	Hispanic or Latinx	27	30.0	24	32.0
	Asian	3	3.3	3	4.0
	Biracial or Multicultural	4	4.4	4	5.3
	Other	2	2.2	2	2.7
	Prefer not to Say	2	2.2	1	1.3
Country of Birth	*Ecuador*	22	24.4		
	The Netherlands	17	18.9		
	United Stated	15	16.7		
	Italy	7	7.8		
	Greece	5	5.6		
	Spain	4	4.4		
	Colombia	3	3.3		
	Bulgaria	2	2.2		
	Germany	2	2.2		
	Portugal	2	2.2		
	China	1	1.1		
	Cuba	1	1.1		
	Czech Republic	1	1.1		
	England	1	1.1		
	Finland	1	1.1		
	Ireland	1	1.1		
	Jordan	1	1.1		
	Romania	1	1.1		
	South Korea	1	1.1		
	Turkey	1	1.1		
	United Kingdom	1	1.1		

Materials

Demographic Information

Demographic Information was collected via self-reported questions regarding country of birth, gender and ethnicity.

Bedtime Procrastination

Bedtime procrastination data was collected using Kroese et al.'s validated nine-item scale (Cronbach's α =0.92) (2014). Items were answered using a 5-point Likert scale. The first item, for example is "I go to bed later than intended" and answered from "*Never – 1*" to "*Always – 5*".

Life Satisfaction

Life satisfaction data was collected using the validated five-item Satisfaction with Life Scale (SWLS) developed by Diener et al. (1985). Items were answered using a 7-point Likert scale. The first item is "In most ways my life is close to my ideal" an answered from "*Strongly Disagree – 1*" to "*Strongly Agree – 7*". This scale has been validated across contexts and cultures (Cronbach's α =0.87) (Diener et al., 1985).

Cultural Tendency

This scale measures cultural values by assessing Hofstede's cultural dimensions at the individual level, measuring five cultural values: power distance, uncertainty avoidance, collectivism, masculinity and long term-orientation (Hofstede, 1980). For this study, only cultural tendency towards collectivism was researched using the 6 collectivism items from the original 26-item Cultural Value Scale (CVSCALE) developed by Yoo et al. (2011), with a higher score signifying a higher tendency towards collectivism. The scale showed adequate reliability and validity across samples and has been tested in different cultures and contexts since its development (Cronbach's α =.89 in a Korean sample, .85 in Brazilian sample and .76 in Polish sample) (Yoo et al., 2011; Zotzmann et al., 2019).

Procedure

The procedure was created mirroring Valshtein's design of delivering the intervention after baseline and collecting follow-up data at three weeks (2020). Participants received an electronic informed consent and had to click agree in order to proceed via a Qualtrics questionnaire. At the baseline, participants answered questions regarding their eligibility (age and medical sleep disorder diagnosis). If eligible, participants proceeded to answer demographic information and bedtime. Bedtime procrastination was then assessed, followed

by life satisfaction and cultural tendency questions using the instruments detailed above. This concluded the procedure for data collection for the exploratory study.

Implementation Intention Intervention

For the main study, the implementation intention intervention was delivered electronically to the participants. They received brief psychoeducation on the importance of sleep via the Qualtrics questionnaire space. They were then invited to set a specific goal regarding their ideal bedtime. Consequently, participants were encouraged to enter their personal implementation intention in the form of an if-then statement and to answer the questions "when, where and how they will execute this goal intention". Finally, participants were encouraged to practice for reinforcement if they chose to but were not contacted in the in-between window. See Appendix 2 for intervention.

The inclusion period for the baseline completion was 11 days and closed for data collection as soon as the 90-participant sample was reached. As such, participants started the intervention at different time points and received their respective follow-ups at the three-week mark post their baseline completion. Participants received an email with the follow-up link and received up to three reminder emails if not completed by their due date. Follow-up collection closed one week after the follow-up deadline of the final baseline completed to control for differences due to time elapsing between intervention and follow-up completion. The follow-up included the same questions from the baseline excluding the CVSCALE and adding questions regarding their use of the intervention in the time between the baseline and follow-up.

Data Analysis Plan

Originally, to estimate the effect of the implementation intention intervention, a pre-post-test design was envisioned for analysis with a paired samples t-test. Bedtime procrastination score and life satisfaction score changes were measured from baseline to the follow up and would be compared via t-test. After data collection, assumptions were checked, and a paired samples t-test was conducted for bedtime procrastination comparisons using SPSS. However, after assumptions were checked for the life satisfaction analysis a non-parametric test was required. A Related-Samples Wilcoxon Signed Rank Test was conducted for life satisfaction score comparisons using SPSS. STATA was used for both tests to visualize the distribution of the data.

Originally, a Pearson correlation test was intended for analysis regarding the cultural exploratory study. Ultimately, once assumptions were tested it was discovered the normality

of data and monotonic relationship of data assumptions were both violated and as such Hoeffding's D correlation test was conducted to examine the relationship between the scores on the bedtime procrastination scale and CVSCALE using RStudio (Mirtagioglu & Mendes, 2022).The CVSCALE scores entered by the participants were used where a higher sum of the scores will represent a larger cultural tendency towards collectivism. This scale takes into consideration a significant inter-individual variation within the same country and was created to measure cultural orientation for individuals and not generalized by country (Yoo & Shin, 2017). Because it is measuring collectivism tendency and will only get one score for each participant, the scores were used to directly compare their correlation to the bedtime procrastination scores given at baseline.

Results

Preliminary Analysis

Reliability of Scales

Firstly, the reliability of the scales was measured. All the scales used showed an adequate internal reliability according to Tavakol & Dennick, where an acceptable value of alpha can range from 0.70 to 0.95 (2011). For the exact Cronbach's α per scale in this study, see **Table 2** below.

Table 2
Crohnbach's α per Study Scales

Scale	No. of Items	Cronbach's α
Bedtime Procrastination scale	9	0.89
Satisfaction with life	5	0.88
Cultural Value Scale	5	0.73

Assumptions Check

Using SPSS, the normality of the data was assessed using the Kolmogorov-Smirnov test. The test indicated that for the BPS variable, data was consistent with a normal distribution (D (75) = .978, p =.209), supporting the assumption of normality for subsequent statistical analyses; for the SWLS variable, data significantly deviated from a normal distribution D (75) =.965, p=.035. Conclusions of normality were aided by visual interpretations of distributions (see Appendix 3). Given the violation of the normality assumption for the SWLS variable, the alternative non-parametric test Wilcoxon Signed Ranks Test were used.

Assumptions of symmetry and similar distribution were deemed acceptable visually via histogram and QQ-plots (see Appendix 3). While there were a handful of outliers in the data, the nature of their differences could not be explained by errors or careless answering, and as such were kept in the analysis as part of the nature of the data.

Using SPSS, the assumptions of normality and monotonic relationship of data for the variables of bedtime procrastination at baseline and cultural value scores were tested using a scatter plot visual (see Appendix 4). These assumptions were not met, and as such a non-parametric test that accounts for these characteristics of the data was chosen, namely Hoeffding's D correlation test (Mirtagioglu & Mendes, 2022).

Research Question 1: Is the use of an implementation intentions intervention that addresses bedtime procrastination effective?

Sub-Question 1: Does the present intervention decrease bedtime procrastination?

A paired samples *t*-test was performed using SPSS to evaluate whether there was a difference between the bedtime procrastination scale (BPS) scores before and after the implementation intentions intervention. Using a pre-test/post-test design without control group the BPS scores at follow-up (*M*=26.75, *SD*=6.40) were significantly lower than the BPS scores at baseline (*M*=30.08, *SD*=7.70, *N*=75), $t(74)=5.61$, p=<.001. The effect size, measured by Cohen's d, was 0.648, indicating a medium to large effect size Additionally, Hedges' correction was applied to account for the lack of a control group, yielding a similar effect size of 0.641 (see **Table 3**) (Lakens, 2013). **Figure 1** shows the scores at baseline and follow-up. These findings support the hypothesis (*H1RQ1*) that an implementation intentions intervention will be effective in decreasing the level of bedtime procrastination in individuals
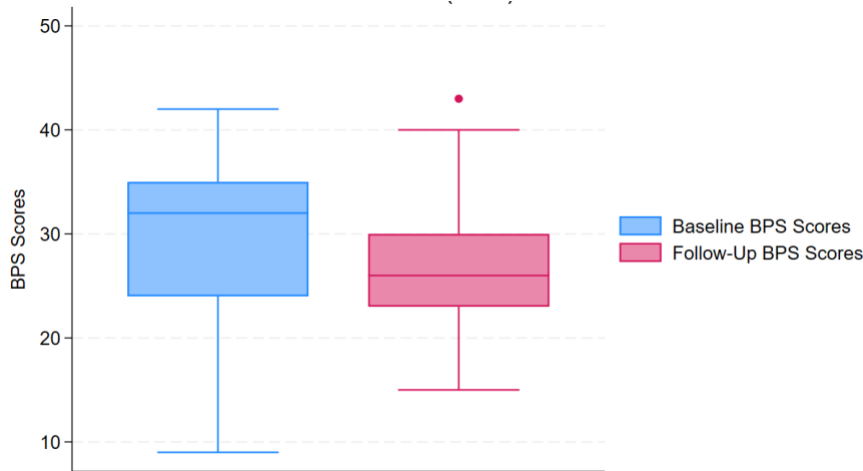
Table 3
Effect Size Calculations Bedtime Procrastination

	Standardizer	Point Estimate	95% Confidence Interval	
			Lower	Upper
Cohen's d	5.147	.648	.397	.895
Hedges' correction	5.200	.641	. 393	.886

Note: Interpret with caution as the intervention is not being compared to a control group (Lakens, 2013).

Figure

Bedtime Procrastination Scale (BPS) Sum Scores Comparison


Sub-Question 2: Does the present intervention increase life satisfaction?

      A Wilcoxon signed-rank test performed using SPSS indicated that there was no significant difference between the satisfaction with life scale scores (SWLS) before and after the implementation intentions intervention ($z = .77$, $p = .440$, $N=75$). The median score for the SWLS was 25, both before the intervention as well as after the intervention. Since the data is not normal, it is standard to look at the median instead. However, just to notice the change in trend seen when looking at the mean scores, the life satisfaction scores were lower at baseline (*M*=23.81, *SD*=6.536) than at follow-up (*M*=24.13, *SD*=6.387). **Figure 2** shows the scores at baseline and follow-up. These findings do not support that an implementation intentions intervention will have a positive impact on satisfaction with life, and as such our hypothesis (*H1SRQ2* is rejected.

Figure 1

Satisfaction with Life Scale (SWLS) Sum Scores Comparison
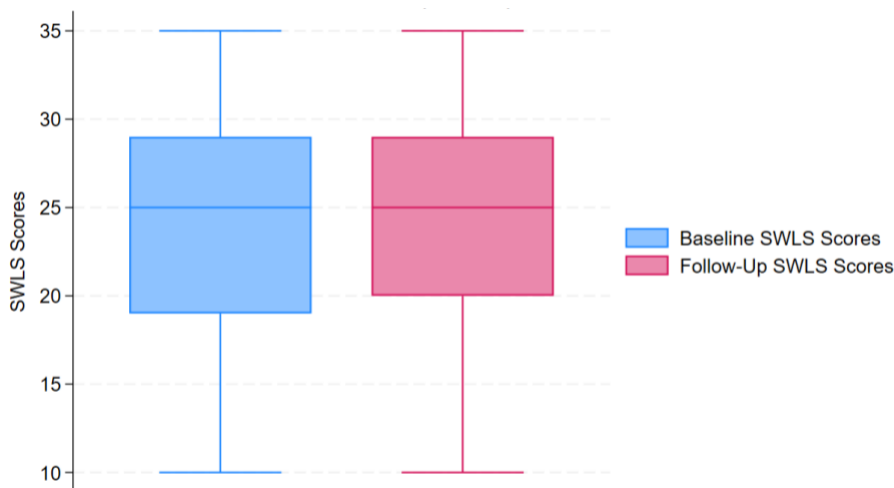
Exploratory Study: Is there a correlation between cultural tendency (leaning more towards collectivism or not) and bedtime procrastination scores?

Hoeffding's D correlation test was conducted to evaluate the relationship between the BPS scores and the collectivist items of the cultural value scale scores. The analysis revealed that there was no statistically significant correlation between the two variables, $D = 0.000$, $p = 0.649$, based on a sample of 90 observations. This findings show there is no correlation between culture and bedtime procrastination scores.

Discussion

The study's main aim was to evaluate the effectiveness of an implementation intentions intervention in reducing bedtime procrastination and enhancing life satisfaction. The results indicated that while the intervention effectively reduced bedtime procrastination, it did not significantly increase participants' life satisfaction. These findings align with previous literature of implementation intentions on bedtime procrastination (Valshtein et al., 2020). However, to our knowledge, this study is the first to use only implementation intentions. This contributes to our understanding of the efficacy of implementation intentions in reducing bedtime procrastination as a sole strategy. While testing with a control group is needed to make a stronger case for it, the medium to large effect size found for a very simple intervention is noteworthy.

Regarding the findings of the intervention on life satisfaction, this partly aligns with previous literature that found that there were no direct quality of life increases when people changed their sleeping habits to increase sleep duration, but they did find that sleep quality over time improved quality of life (Kudrnáčová & Kudrnáč, 2023). Regardless the impact of bedtime procrastination was not investigated, but rather at what changes to bedtime procrastination could imply: sleep quality and sleep duration. The lack of significant improvement in life satisfaction suggests that while sleep quality and duration are linked to life satisfaction (Ness & Saksvik-Lehouillier, 2018), a three-week intervention may be insufficient to impact life satisfaction outcomes needing a longer follow-up period to be able to tell. For example, previous literature followed a sample for five years and found the increase in satisfaction with life with an increase in sleep quality (Kudrnáčová & Kudrnáč, 2023). Another explanation for this could be a ceiling effect as the median score at baseline was 25 which is already considered a high score, and as such the changes on sleep may not have had much of an impact (Diener et al., 1985). Finally, life satisfaction is affected by multiple factors such as

success, work, relationships and family relationships in a person's life that were not controlled for in this study that may have had more of a weight on the participant's life satisfaction scores (Malvaso & Kang, 2022). Sleep has also been researched in other areas of wellbeing such as emotional wellbeing (Vandekerckhove & Wang, 2018) and positive emotions (Parsons et al., 2022). Parson's study looked at the effect of sleep on emotions and emotional regulation over a period of seven days (2022). It would be interesting to investigate bedtime procrastination and its effects on emotions as well, where a shorter follow-up time might also yield more changes.

The second aim of this study was to explore the correlation between cultural tendencies and bedtime procrastination. Results suggest that cultural orientation, specifically collectivism, does not significantly correlate with bedtime procrastination behavior. This was the first study to look into differences in bedtime procrastination across cultural tendencies. Previous literature did not study baseline differences in bedtime procrastination across culture. However, Hu et al. (2022) found that off-time work-related smartphone use influenced bedtime procrastination similarly in American and Chinese samples, albeit more strongly in Americans. This finding, coupled with the lack of significant baseline differences in bedtime procrastination, suggests that such behaviors do not vary significantly across differences in collectivism.

It is important to note the challenges in measuring cultural values for individuals, particularly so via self-reported scales as there may be cultural differences in answering styles through self-reported Likert scales (i.e., acquiescent response style is more prevalent in individualistic cultures than in collectivist) (Kemmelmeier, 2016). Another challenge in classifying people culturally is that groups that display certain cultural traits can also differ in non-cultural characteristics such as ecology, institutional environments, demographic factors and local genetic adaptations that were not necessarily considered (Lonati et al., 2024). This study focused on Hofstede's concept of culture, particularly the collectivism dimension, which, despite its consideration for intra-country variations, remains limited in measuring cultural orientation comprehensively (Yoo & Shin, 2017). Nonetheless, it is surprising that there were no significant differences in bedtime procrastination scores across the 90 individuals studied with different cultural backgrounds.

Previous literature has found that sleep duration and disturbances differ across countries and regions via bedtime routines, sleeping arrangements, and as such this finding signifies that while cultural influence has been seen in sleep behaviors, it may not extend into bedtime procrastination (Jeon et al., 2021). A possible explanation for this could be that factors such as

increased use of social media globally may be having an impact on the reasons behind bedtime procrastination across different cultures regardless of cultural views on sleep (Grandner, 2017). Another challenge arises methodologically of whether it would be better to assess each individual's cultural tendency, or look at the country they were born in, where they grew up in or where they currently live.

Strengths and Limitations

A notable strength of this study is the relatively low dropout rate of 16.7%, which is good for an online intervention with no in-between contact. The study also reached an international audience, with participants from 21 countries, highlighting the global interest in and relevance of this topic. This also entails that the study was able to reach people from both more individualistic and collectivistic cultures, making the findings more generalizable. Further strengths include the approach of using implementation intentions exclusively to address bedtime procrastination, marking a significant contribution to the existing literature. In general, there has been an interest in evaluating multicomponent behavioral interventions, yet in a lot of these cases, it is hard to determine whether all of the major components making up a successful intervention are necessary. As such, testing individual components can optimize necessary parts of interventions when deciding for which interventions to adopt (Collins et al., 2014). The high completion rate indicates strong participant engagement and the feasibility of remote interventions. The ease of implementation and low-cost nature of the intervention make it accessible and scalable to a broad audience which is beneficial because regardless of how large the effect may be, when enough people are reached this has a considerable effect on the population (Bolier, 2015). The individualized nature of the intervention allowed participants to tailor the approach to their specific needs, potentially enhancing its effectiveness. Additionally, it is a noteworthy strength that this is one of the first studies to test for cultural differences in bedtime procrastination in a broad, non-WEIRD (White, Educated, Industrialized, Rich, Democratic) sample. The study's initial exploration of the relationship between culture and bedtime procrastination sets the stage for future research and suggests a potential for generalizable interventions across cultures.

However, the study's limitations must be acknowledged. The absence of a control group makes it difficult to conclusively determine that the changes in scores are due to the intervention itself and not to other factors (Gianicolo et al., 2020). The use of convenience and snowball sampling may have introduced bias, limiting the generalizability of the findings. Furthermore, while the study included participants from many countries, the distribution was

uneven, with a majority from Ecuador, The Netherlands, and the U.S., and minimal representation from other countries. Moreover, non-parametric tests had to be used for some data due to the inability to confirm normality and monotonic relationship of data, which reduces statistical power and complicates interpretation (Nahm, 2016; Politi et al., 2021).

Implications and Future Research

The theoretical implications of this finding add to the literature on the effectivity of implementation intentions as a useful strategy in the reduction of bedtime procrastination. While implementation intentions can be a practical tool for addressing specific behavioral issues, their impact on positive psychological outcomes such as life satisfaction may be limited. Furthermore, the absence of cultural variations at baseline indicates that bedtime procrastination may be a universally shared challenge, unaffected by cultural context. This underscores the potential for universally applicable interventions in this area. For practitioners, it is recommended to consider whether implementation intentions as a strategy to address bedtime procrastination is sufficient before incorporating additional components. Additionally, it is important to consider that bedtime procrastination may be more about personal reasons than culturally informed habits.

Future research should replicate this study with more rigorous scientific methods such as using a randomized control trial (RCT) with a control group to validate these findings. Additionally, employing random sampling techniques and stricter inclusion criteria would help obtain a more representative sample and isolate bedtime procrastination behaviors more effectively. For example, future studies consider certain confounding factors, such as other pre-existing conditions like ADHD, which were not investigated in this study (Uygur & Bahar, 2023). The relationship between sleep and life satisfaction warrants further investigation. Perhaps three weeks was not sufficient time to show the effects that reducing bedtime procrastination has on sleep quality which in turn would increase life satisfaction. Research has found that it can take about 66 days for habits to form, and so it would be better to measure the impact changing bedtime habits on other life areas after at least three months (Arlinghaus & Johnston, 2019).

It would be advisable that future studies look at the use of cost-effective analysis when considering using implementation intentions mixed with other motivational or behavioral components in interventions. The lack of a significant relationship between cultural tendencies and bedtime procrastination suggests that interventions may be broadly applicable across different cultures. Future studies should continue exploring the role of culture in bedtime

procrastination behaviors, particularly in addressing the research gap behind the motivations for people to procrastinate bedtime and the relationship cultural values and routines may have in this. Nauts et al. began researching the motivations behind bedtime procrastination, but it is only one qualitative study that may have it's own biases and did not consider cultural influences in sleep routines such as naps or sharing bedrooms for example (2019).

Conclusion

This study contributes to the understanding of effective interventions for bedtime procrastination and the role of culture in these behaviors, with potential avenues for further research. The implementation intentions intervention significantly reduced bedtime procrastination but did not increase life satisfaction at the three-week follow-up. The lack of a significant correlation between cultural tendencies and bedtime procrastination suggests the potential for generalizable interventions. While the absence of a control group limits conclusions about the intervention's true effectiveness, these findings show the promising nature of using implementation intentions to address bedtime procrastination. Further research, particularly RCTs with more representative samples, is needed to establish the effect of the implementation intentions intervention on bedtime procrastination behaviors across different cultures. This study paves the way for future investigations into the use of implementation intentions as a standalone, easy-to use and cost-effective strategy for reducing bedtime procrastination.

Acknowledgments

I wanted to first of all thank my partner in life, Chris Tomassen, for being a rock throughout this process and everything else. To my family Ruben, Maria, Mateo and Sebastian Useche for everything you have given me to get me to where I am. To my supervisor Laura Weiss, who has gone above and beyond in her role to mentor me and guide me. To Irene Falgas for her continuing mentoring and guidance in the research world. To Milagros Alvarado for her patience and guidance in my statistical analysis. To Emma Bell for her unwavering moral support and encouragement throughout the entire process. And finally, to everyone who has made the completion of this manuscript possible by talking with me about bedtime procrastination, participating in my research, or supported me in any way.

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Appendix

Appendix 1

Scales Used for Questionnaires

Bedtime Procrastination Scale

For each of the following statements, please decide whether it applies to you using a scale from **(1) Never** to **(5) Always.**

Item	(1) Never	(2)	(3)	(4)	(5) Always
SPS1. *I go to bed later than intended*					
*SPS2. *I go to bed early if I have to wake up early in the morning*					
*SPS3. *If it is time to turn off the lights at night, I do it immediately*					
SPS4. *Often, I am doing other things when it is time to go to bed*					
SPS5. *I easily get distracted by things when I actually would like to go to bed*					
SPS6. *I do not go to bed on time*					
*SPS7. *I have a regular bedtime that I keep to*					
SPS8. *I want to go to bed on time, but I just don't*					
*SPS9. *I can easily stop with my activities when it is time to go to bed*					

Satisfaction With Life Scale

Below are five statements that you may agree or disagree with. Using the 1-7 scale below, indicate your agreement with each item. Please be open and honest in your responding

Item	(1) Strongly Disagree	(2) Disagree	(3) Slightly disagree	(4) Neither agree nor ~	(5) Slightly agree	(6) Agree	(7) Strongly Agree
SWLS1. In most ways my life is close to my ideal.							
SWLS2. The conditions of my life are excellent.							
SWLS3. I am satisfied with my life.							
SWLS4. So far, I have gotten the important things I want in life.							
SWLS5. If I could live my life over, I would change almost nothing.							

CVSCALE

Below are six statements that you may agree or disagree with. In each statement a "group" is referenced. This might mean different things to different people. Please interpret the word group in whatever way fits your definition of the word.

Using the 1-5 scale below, indicate your agreement with each item.

Item	(1) Strongly Disagree	(2)	(3)	(4)	(5) Strongly Agree
C1. Individuals should sacrifice self-interest for the group (either at school or the work place).					

C2. Individuals should stick with the group even through difficulties.					
C3. Group welfare is more important than individual rewards.					
C4. Group success is more important than individual success.					
C5. Individuals should only pursue their goals after considering the welfare of the group.					
C6. Group loyalty should be encouraged even if individual goals suffer.					

Appendix 2

Intervention Script

Condition: Implementation Intentions Intervention

"Today we'll explore the importance of sufficient sleep, how sleep procrastination impacts your rest, and ways to set specific goals to improve your bedtime routine.

Brief Psychoeducation

Let's begin with a brief explanation of why sufficient sleep matters. Adequate sleep is crucial for your physical and mental well-being. It helps regulate mood, improves cognitive function, and supports overall health. However, sleep procrastination, or delaying bedtime despite knowing the importance of sleep, can disrupt your sleep schedule and lead to various health issues, affecting your quality of life.

Goal Setting:

Now, regarding your ideal bedtime, what is a realistic goal for you? Please be as **specific as possible** (ex: write down what time you would want to be in bed by, instead of writing down "I want to go to bed earlier").

Implementation Intentions;

Next, we'll create an **"If-Then"** statement to reinforce your bedtime goal. Think about a specific situation and a behavioral reaction that will help you achieve your bedtime goal. Answer the questions: "When, Where, and how will you execute this goal intention?"

For example, if your bedtime goal is to sleep by 10PM, your implementation intention could be"

> "**If** my alarm goes off at 9:45PM, signaling it's time to start preparing for bed, **Then** I will turn off my electronic devices and begin my bedtime routine by brushing my teeth and winding down".

Please note setting an alarm signal is not the only way to set a plan for bedtime goals. Feel free to be as creative as possible and use other situation cues if you'd like.

Practice and Reinforcement:

Now, it's time to practice this strategy daily for the next three weeks. Write down your implementation intention every day to strengthen the link between your trigger and your desired bedtime routine. By consistently reinforcing this connection, you'll gradually establish a healthier sleep pattern.

Remember, consistency is key. Stick to your plan even on weekends or when faced with distractions. Over time, you'll find it easier to adhere to your bedtime goal!

 Thank you for participating in our digital intervention. We're here to support you on your journey to better sleep habits. Don't forget in 3 weeks' time, you will receive an email with a link for a follow-up questionnaire that will help us see the effectiveness of this strategy on your habits.
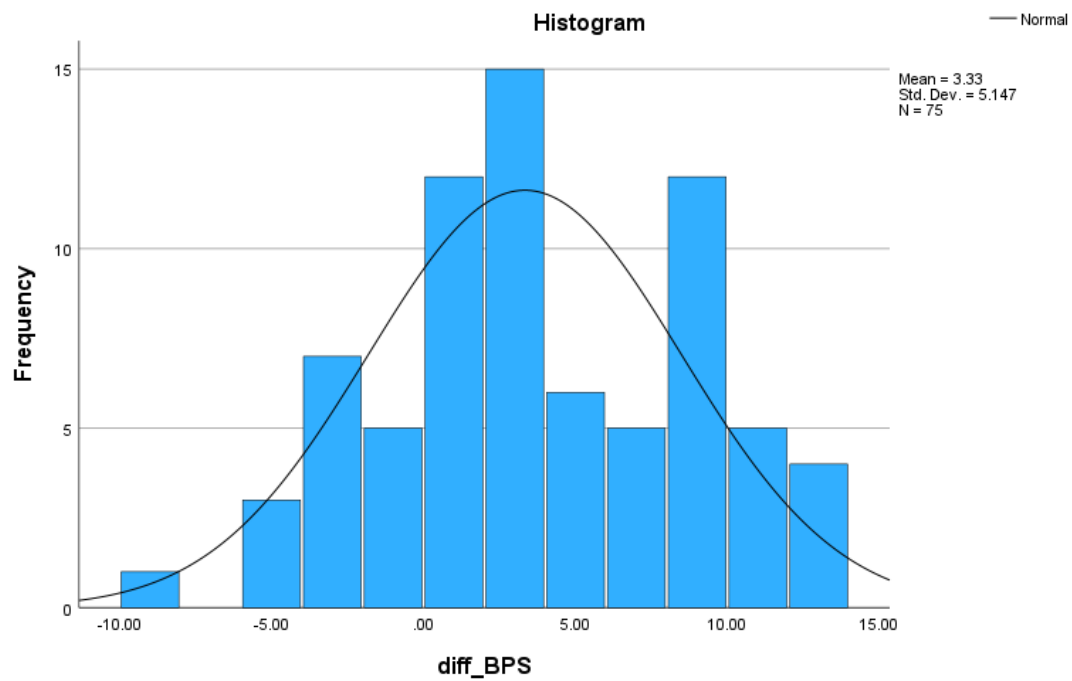
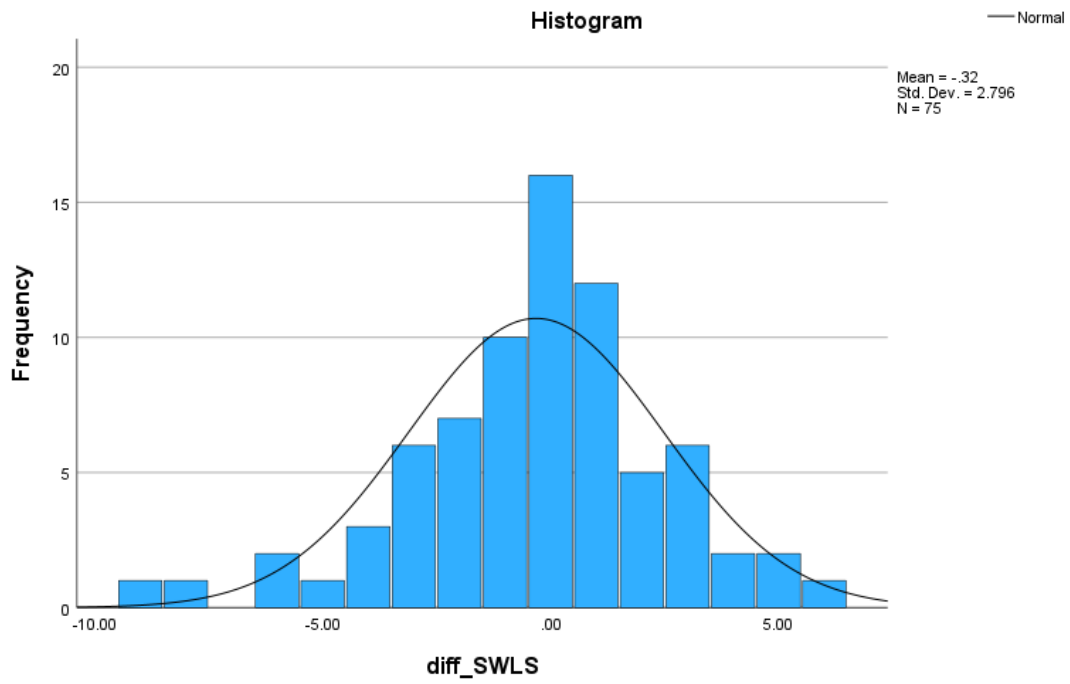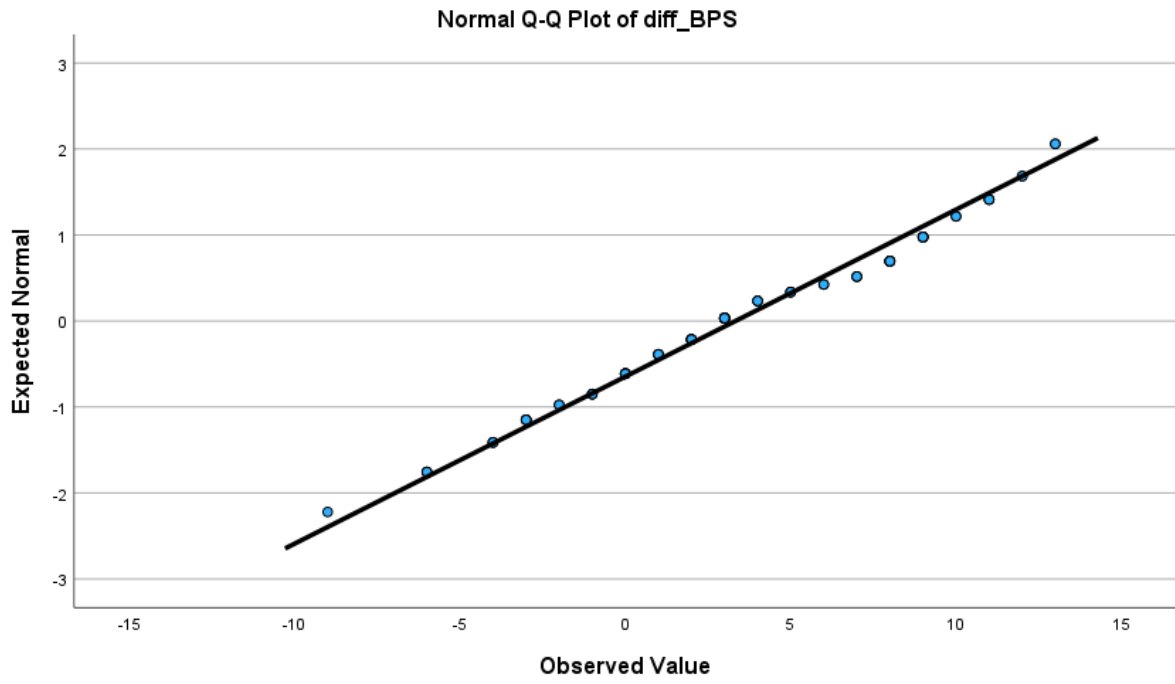Sweet dreams and sleep well!"
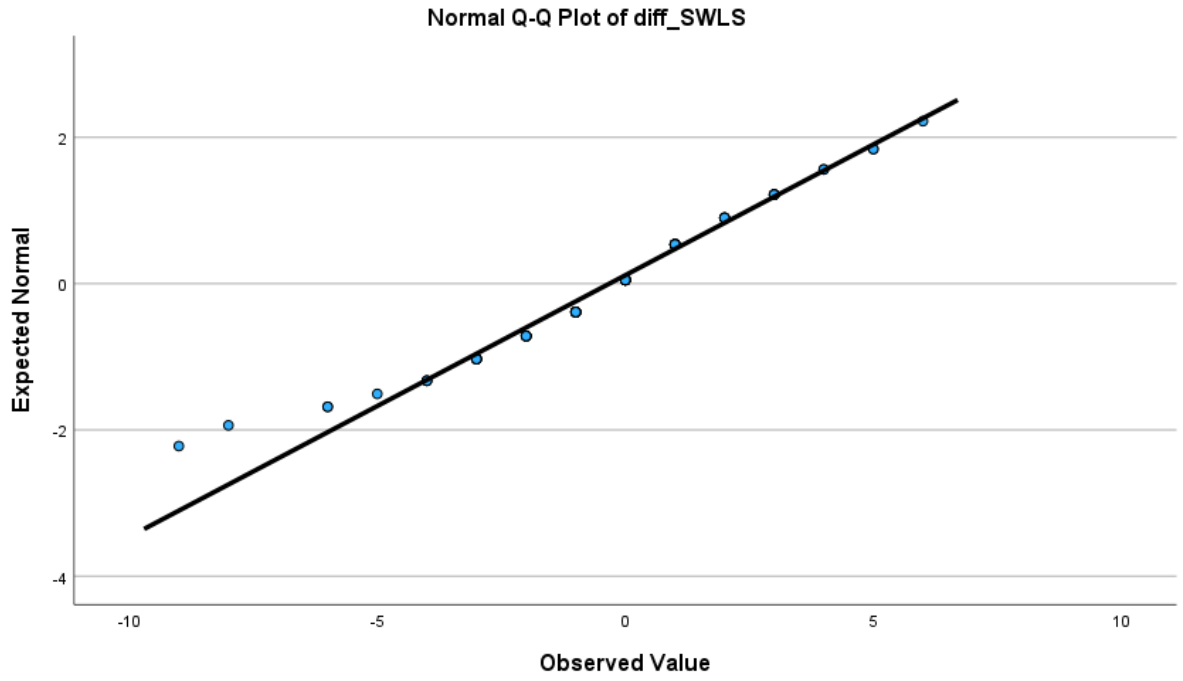
Appendix 3

Tests of Normality for BPS and SWLS

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
diff_BPS	.099	75	.065	.978	75	.209
diff_SWLS	.132	75	.002	.965	75	.035

a. Lilliefors Significance Correction

Histogram

Mean = 3.33
Std. Dev. = 5.147
N = 75

Normal Q-Q Plot of diff_BPS

Histogram

Mean = -.32
Std. Dev. = 2.796
N = 75

Normal Q-Q Plot of diff_SWLS

Appendix 4

Correlation between bedtime procrastination scores and cultural tendency scores