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PP452: APPLYING BEHAVIOURAL ECONOMICS FOR SOCIAL
IMPACT: DESIGN, DELIVERY, EVALUATION AND POLICY

SCROLL LESS, SLEEP MORE:

The Effectiveness of MCII on Digital Media
Induced Bedtime Procrastination among
LSE Students

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Executive Summary

This research was undertaken as summative coursework for the module *PP452: Applying Behavioural Economics for Social Impact: Design, Delivery, Evaluation and Policy*. Over the course of Autumn Term 2023, our team designed and conducted a randomized control trial to help LSE students overcome the irrational behaviour of “bedtime procrastination” whereby they delay going to sleep by using digital media despite being aware of the negative consequences of a delayed bedtime for their future selves.

We began our research by consulting academic studies to define the concept of bedtime procrastination and to learn about the behavioural economic theories that underpin this irrational behaviour. We then conducted qualitative research through focus groups and interviews to better understand our end user’s journey that leads to this undesirable behaviour. Through speaking with students, we identified 3 positive deviants who had suffered from bedtime procrastination but found a successful strategy to overcome it. Ultimately, we identified two potential interventions: one from our literature review called Mental Contrasting with Implementation Intentions (MCII) and one inspired by a positive deviant, that we coined as the “Charles Method”.

We ran a pilot to test the effectiveness of the two interventions that provided us with first-hand feedback, which was later incorporated into the design of our final intervention. We decided to scale-up the MCII intervention, which seeks to mitigate time inconsistency bias, or the tendency to overvalue the present benefits of an action and discount its future costs. We also realised from the pilot that the Charles Method can be adapted into the larger MCII framework, allowing us to combine an academically proven method with insights from positive deviants in our focus groups.

For our intervention, we offered 8 MCII training sessions in total – 5 for the treatment group and 3 for the control group. The trainings for the control group were conducted after the study period to reduce endline survey attrition in the control group. For the training to be effective, participants must set a goal for themselves and visualise the positive outcomes associated with succeeding at their goal. Then they must identify all the obstacles that may stand in the way of them meeting that goal and create if-then plans for overcoming those obstacles. To test the efficacy of our treatment, we collected baseline and endline data from our treatment and control groups.

The results indicate that MCII is a promising intervention for overcoming bedtime procrastination: We found that individuals in the treatment group significantly decreased their bedtime procrastination compared to the control group, as measured by the Kroese et al. (2014) Bedtime Procrastination Scale. Individuals who received treatment also significantly decreased their digital media use before bed and went to sleep earlier than non-participants. Finally, satisfaction with digital media use before bed was significantly higher for the treatment group than the control group. Certain limitations of our research method as well as directions for future research are discussed at the end of the report.

Introduction and Methodology

This research was undertaken as summative coursework for the module *PP452: Applying Behavioural Economics for Social Impact: Design, Delivery, Evaluation and Policy*. For the course, we were asked to diagnose a behavioural puzzle, design an intervention using behavioural economics theory, execute an experiment and disseminate the results in a project report.

Inspired in part by our own experiences, our team chose to study why LSE students delay their bedtime by using digital media before going to sleep. This behaviour struck us as puzzling because we realised that most of the LSE students we spoke to are aware of the importance of getting an adequate amount of sleep as well as the negative impacts of excessive digital media consumption, especially on the quality of sleep when consumed right before bed. Yet, many students spend hours mindlessly scrolling Instagram and TikTok or watching YouTube before falling asleep.

Our research methodology can be broadly divided into five stages described below:

1. Define the problem, behavioural puzzle and end user:

- Conducted an extensive literature review of previous work on topics associated with digital media use as a means of procrastination, late bedtime habits and revenge procrastination.
- Collected insights from our peers and other LSE students to understand their relationship with digital media use and bedtime procrastination through an information survey.
- Identified target population for the intervention and defined the behavioural puzzle.

2. Diagnose:

- Organised focus group discussions and key personnel interviews among students to discuss their digital media use and bedtime habits to understand the user journey of our potential end user.
- Mapped the various emotions and feelings described by the subjects in their process of delaying their bedtime with digital media use.
- Identified positive deviant experiences among the participants.

3. Design, deliver and implement:

- Presented our behavioural puzzle, diagnosis and implementation plan to our peers and module convenors to gain feedback on next steps.
- Defined outcome measures and designed a data collection and measurement plan for our project.
- Rolled out our pilot intervention to test two identified implementation plans and gain insights on the effectiveness of our intervention.
- Recruited for our final intervention by broadcasting messages among different departments at LSE, university accommodation group chat and via in-person outreach.
- Incorporated findings from our pilot to develop and design our final intervention that was rolled out the weeks following the completion of the pilot.

4. Test and evaluate:

- Conducted relevant trainings for the treatment group and control group based on their respective allocation for the intervention.
- Evaluated the impact of our intervention against our theory of change with key outcome measures including the Bedtime Procrastination Scale by Kroese et al. (2014), digital media use before sleep, the gap between participants' ideal and actual bedtimes, and participants' feeling of control over their bedtime procrastination.

5. Results and reflection:

- Measured the Intention to Treat and Treatment Effect on the Treated.
- Reported results of the intervention for all outcome measures, mentioned above.
- Discussed limitations and potential ideas for future research.

The methodology has been explained in detail for each stage in the relevant sections in this report.

Stage 1: Define the Problem, Behavioural Puzzle and End User

The first stage of our research consisted of conducting a literature review to pinpoint the precise behavioural puzzle we wished to explore over the term. In our initial research, we came across various trends associated with procrastination and media consumption. One such term is “doom-scrolling,” which is the persistent consumption of negative and depressing information on social media newsfeeds about crises, disasters, and tragedies (Sharma et al., 2022; Satici et al., 2022). We also explored concepts like social media bingeing and “revenge procrastination” which originated from overworked employees in China who wanted to gain a sense of ownership of their time after being deprived of this control during their working hours (Liang, 2020).

On concluding the literature review, we identified the key construct of “**bedtime procrastination due to digital media use**” as the problem we wished to study due to its broad scope and relevance to our most accessible sample groups i.e., students. In addition, our literature review provided insight into the behavioural economics theories that explain bedtime procrastination as well as interventions that have been successfully employed to help individuals overcome this behaviour. A summary of our literature review is provided below.

Defining the Problem: Literature Review

What is bedtime procrastination?

Kroese et al. (2014) coined the term bedtime procrastination and defined it as “going to bed later than intended while no external circumstances are accountable for doing so.” It is important to note that while Kroese et al. defined going to bed as the act of getting into bed, we will define it in this paper as the act of going to sleep (not falling asleep, but purposefully setting aside all other actions/intentions except for that of sleeping). The key concept is that going to sleep is a behaviour that can be postponed (in our case, procrastinated).

What is the link between bedtime procrastination and digital media?

Several studies confirm that there is a strong relationship between bedtime procrastination and digital media use. Chung et al. (2020) found that individuals who were classified as having a high bedtime procrastination score (i.e., who scored above the median of the Bedtime Procrastination Scale) used their smartphones 451% (79.48 minutes) more than those who had a low bedtime procrastination score (17.60 minutes) three hours prior to bedtime.

A survey ran by the American Academy of Sleep Medicine (2022) found that 80% of US adults responded that they lost sleep or were awake past bedtime so that they could engage with social media. This result was starker among the generation Z age range i.e., those born between 1997 and 2012 (aged from 11 to

26 years), of whom 93% confirmed the reason they were going to sleep late was related to social media use.

A study conducted by Santiago Correa-Iriarte et al. (2023) shows a significant correlation between what they called Problematic Smartphone Use (PSU), sleep quality and bedtime procrastination. In this study, the authors define PSU as “any use of a smartphone associated with at least some element of dysfunctional use, such as anxiety when the smartphone is not available or neglect of other activities due to smartphone use” (Correa-Iriarte et al., 2023). Under this definition, any form of smartphone use, irrespective of the content consumed, that distracts the user from engaging with other routine activities of the day, including going to sleep on time, is considered a form of PSU and thus is correlated with lower sleep quality.

What are the consequences of bedtime procrastination for students?

Bedtime procrastination due to digital media use has been shown to have negative consequences for young adults’ and students’ mental health. For instance, one study conducted by Sushanth Bhat et al. (2018) shows that consuming “electronic social media” while in bed was correlated with general dysfunction in sleep and mood. In another study on Swedish students conducted by Fred Johansson et al. (2023), clear correlations were found between bedtime procrastination and negative mental effects, likes depression and stress. In a study of problematic smartphone use and its outcomes on Chinese students’ mental health, Guanghui Cui et al. (2021) found a significant relationship between PSU, bedtime procrastination and depression.

Other studies have shown that there is a strong link between sleep deprivation and negative outcomes for students such as concentration, attention and memory problems at times even leading to a lower GPA and decreased chances of graduation (Rose & Ramanan, 2017; Chen & Chen, 2014). Considering that high quality and sufficient sleep is an indisputable and critical basis for mental health and academic performance, we can clearly assume any interruption to sleep time, regarding length or quality, will negatively affect the individual’s cognitive behaviour. This is a consequential issue for students when we consider that cognitive ability is typically integral to success in school.

What behavioural economics theories explain bedtime procrastination?

According to the behavioural economics literature, bedtime procrastination can be categorised as a self-control issue. This can be tackled by a tool that conquers strong impulses. Baumeister et al. (1998) found that self-regulation is a limited resource that gets depleted when this resource is utilised for one action; as a result, self-control is reduced for subsequent actions. Given that bedtime procrastination has a unique feature that it occurs at the end of the day, it is unlikely that strategies that focus solely on willpower are likely to succeed (Kroese et al, 2014). This idea supports the Ego Depletion Theory which purports that volitional acts that individuals must make result in a depletion of their self-control capacities (Hu et al., 2022). Procrastination is further reinforced by people’s own beliefs about self-control as a limited resource which results in even more bedtime procrastination after a stressful day (Bernecker and Job, 2019). Hence, lower self-control is associated with a higher likelihood of bedtime procrastination (Exelmans and Van den Bulck, 2017). This further impairs one’s ability to prioritise the future benefits of sufficient sleep over the short-term benefits of media entertainment.

Bedtime procrastination also plays into the Paradox Theory that hypothesises that leisure and health are distinct and competing needs (Yan, 2023). While leisure needs are important for people's well-being, engaging in leisure activities late at night can trigger cognitive dissonance because the leisure needs are being fulfilled at a health expense (delayed sleep) (Kuykendall et al., 2015; Festinger, 1957). This creates a discrepancy between what one wants to do and what one is expected to do, which can build negative emotions in individuals because of an attitude-behaviour disconnect. These negative emotions can be harder to manage for people who are less self-compassionate and are unable to use effective healthy emotion regulation strategies (Sirois et al., 2018). Additionally, people want to satisfy the hedonic needs of both leisure and health at the same time which creates tensions between the two and explains the resource conflicts, where the existence of one comes at the expense of the other (Riediger et al., 2004). Bedtime procrastination can also be described as a "time inconsistency problem" where individuals overvalue the present benefits of an action and discount the future costs (Breig et al., 2019).

What behavioural economics interventions have been tested on bedtime procrastination?

Motivational interviewing, information provision and Mental Contrasting with Implementation Intentions (MCII) are techniques that have been tested as interventions for bedtime procrastination. Motivational interviewing involved a weekly three-session intervention, with an additional psychological intervention through which people talked through the reasons why they bedtime procrastinated and set themselves goals or contracts for each week (Suh et al., 2021). The intervention viewed bedtime procrastination as a health behaviour and wanted to encourage participants to choose instead a health action (i.e., sleep) which can be described as promoting the co-creation of a health outcome. The study measured bedtime procrastination using the scale developed by Kroese et al. (2014). Participants also kept sleep diaries to track their bedtime procrastination duration (in minutes), sleep onset latency, wake after sleep onset, total sleep time, time in bed, bedtime, wake time, sleep efficiency and feeling refreshed upon awakening (scale 1–5). The outcome was measured through a change in the bedtime procrastination score and the minutes of bedtime procrastination which was calculated by subtracting the initial time planned to go to sleep from the lights off time. The results showed that there was a 64% reduction in bedtime procrastination time, but the study was unable to measure the longevity of this behaviour as it did not last more than one month.

Another intervention consisted of providing information about the importance of sleep and sleep hygiene (Irish et al., 2015). Sleep hygiene can be defined as "recommendations [that] are generally aimed at having the individual avoid behaviour that interferes with a normal sleep pattern, or to engage in behaviour that promotes good sleep" (Stepanski & Wyatt, 2003). However, this intervention was not found to be conclusively effective for a non-clinical modern-day audience (Irish et al., 2015).

MCII or mental contrasting with implementation intentions is a self-regulatory mechanism that can be used to reduce the inconsistencies that exist between the present and future self (Gollwitzer et al., 2018). It consists of "mental contrasting" where the participant will think about a desired future and the obstacles that they expect to face. This is followed by "implementation intentions" which requires them to create "if-then" plans with details on how they aim to overcome the obstacles, for example "if I am unable to sleep when I am in bed then I will read a chapter of my book." An important element is to reframe current actions, such as watching a funny video, to viewing it as an obstacle that hinders them from achieving a desirable goal. The purpose of MCII is to encourage the participant to self-modify their behaviour by

influencing their belief systems. A part of that process involves making them more conscious about the actions they perform instinctively, such as reaching for their phone immediately whenever a phone notification flashes.

The fantasy realisation model highlights three forms of self-regulatory thought (Oettingen, 2012). These consist of indulging, dwelling and mental contrasting. MCII differs from the first two because indulging consists of thinking about a future and its benefits but not about considering the obstacles. Dwelling requires one to reflect on the present reality and how it can stand in the way of one's desired future but does not involve a necessity to act. MCII, on the other hand, is a tool that can be used for self-regulated behaviour change for sustained goal pursuit. It also builds on the identity-based motivation theory which highlights individual's tendencies to maintain their present-focused actions if they do not consider their future self and place a low value on the difficulties of taking future-focused action (Oyserman and Horowitz, 2023). Instead, their future-focused actions are considered if their future self is relevant to their current choices.

MCII has been used to explore whether healthcare professionals can down-regulate their workplace stress and develop autonomous control through mental imagery (Gollwitzer et al., 2018). Gollwitzer et al. (2018) used a randomised 3*2 factorial design and looked at dependent variables such as perceived stress, current physical symptoms and work engagement (at the beginning and end of 3 weeks). Participants filled out three questionnaires for baseline measurement of perceived stress, physical symptoms of stress and the potential consequences of having a lot of stress. The MCII intervention required the participants to repeatedly engage in mental exercises that involved detailing a specific wish they had that was related to reducing stress. They were then required to identify their most desired positive outcomes and use strong imagery to consolidate these thoughts. Following this, participants detected and imagined the obstacles that held them back from achieving this potential outcome and created if-then plans for each of the obstacles on how to overcome them. The results of the study showed that MCII reduced the healthcare professionals' overall stress compared to the control group and improved their work engagement.

MCII has also proven to be effective in settings such as education to improve student performance and health behaviours to improve physical activity (see Duckworth et al., 2013; Marquardt et al., 2017). Valshtein et al., (2019) showed that MCII created positive and significant results within the context of bedtime procrastination. The treatment group received the MCII exercise and created if-then plans for overcoming their identified obstacles to less bedtime procrastination. This study shows that MCII is a cost-effective and simple self-regulation tool that we can use within our study to reduce bedtime procrastination among LSE students.

Defining the Behavioural Puzzle and End User

The literature we read on the topic of bedtime procrastination, specifically among young people and students, supported our hypothesis that this is a common affliction for our population of interest. Further, a prior survey conducted by a group of PP452 students in 2021 confirmed that sleep deprivation is indeed a problem that affects School of Public Policy (SPP) students at LSE. They found that 92% of their 54 survey respondents agreed that poor sleep had negative effects on their daily life. Perhaps most importantly, they found that there was an appetite for change - with 80% of the students who were dissatisfied with their sleep pattern wanting to change.

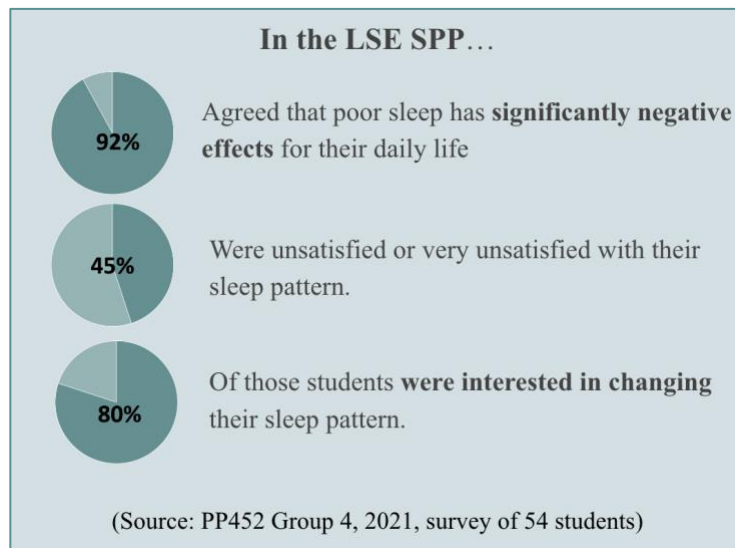


Figure 1: Survey of LSE SPP Students, 2021

In the beginning of our project, we had identified LSE SPP students as our target population and end users due to their proximity and accessibility as well as the relevance of such a problem among these students. For reasons that will be detailed below, our intervention was conducted on the wider LSE student population including students from outside the SPP. This does not discount our stance that bedtime procrastination remains to be a problem and is relevant to a broader population of students at the LSE.

In the end, we defined our behavioural puzzle as:

Why do LSE students **delay** their **bedtime** by **using digital media** despite being aware of how **damaging** it is to their **well-being**?

Stage 2: Diagnose

Having defined the end user and behavioural puzzle, we were keen to understand the journey that our typical end user undergoes before they decide to procrastinate their sleep. We recruited SPP students to participate in personal interviews and focus group discussions by circulating a short survey sent to the SPP WhatsApp group chat. The survey consisted of just 1 substantive question: “Do you go to bed later than you think you should because you spend time on technology/ digital media” that could be answered three ways: yes/ I used to, but I got over it/ no. This question was designed to help us distinguish our end-users (who answered yes) from “positive deviants” (who answered, “I used to, but I got over it”).

Focus group discussions

We conducted 5 focus group discussions that were attended by 13 participants. These discussions lasted 45 minutes and involved using open-ended questions to prompt participants to share their experiences with bedtime procrastination and build on insights from one another. Some of the common themes discussed during these focus groups were different perceptions of bedtime procrastination, experiences with cutting down digital media use, emotions associated with delaying the bedtime and reflection on feelings from the morning after a delayed bedtime night (Please refer to Appendix 1.1 for the questions used in these conversations and Appendix 2 for key takeaways).

Personal interviews

We also conducted 7 personal interviews among participants that were either unable to make it to the larger focus groups due to timetable clashes or wanted to speak on the matter privately. The duration of the interview ranged from 15 to 30 minutes depending on the subject’s responses and availability. Like the focus groups, the interviews aimed at better understanding the bedtime habits and user journeys of the participants (Please refer to Appendix 1.2 for the questions used in these conversations and Appendix 2 for key takeaways).

These focus groups and interviews provided us with three key pieces of information. The discussions with our end users i.e., students who are struggling with bedtime procrastination, helped us create a **user journey** to identify the **key decision points** leading up to the act of bedtime procrastination. The discussions with “positive deviants,” i.e., individuals who used to struggle with bedtime procrastination but had found successful approaches to overcoming this behaviour, provided us with ideas for **potential interventions**.

User Journey

Definition of User Journey

A user journey, first used in the field of Marketing, has been adopted by the social impact sector. While the two sectors have significant differences in purpose, the know-how of creating a user journey remains the same i.e., to understand key decisions and actions taken by the end user in a specific setting. As researchers, we asked open-ended questions to learn how our end users felt and thought at every stage of

the process leading up to their bedtime procrastination. Mapping out the user journey was an important step to ensure that our planned intervention was user-centric, effective, and sustainable in the long run.

Mapping the User Journey

Based on our focus groups and interviews, we gained a more thorough understanding of individuals' behaviour. A summary of the focus group and interview content can be found in Appendix 2. We distilled the information into the following user journey chart, which has three different dimensions:

- **Time frame** – the timeline between when a user finishes their last task of the day and prepares to enter their bed to go to sleep until they wake up the following morning.
- **Feelings and emotions** – the emotional journey of the end user and various feelings associated with their actions in this time frame.
- **Decision points** – the decision points of an end user from when they decide to prepare for bed to when they sleep.

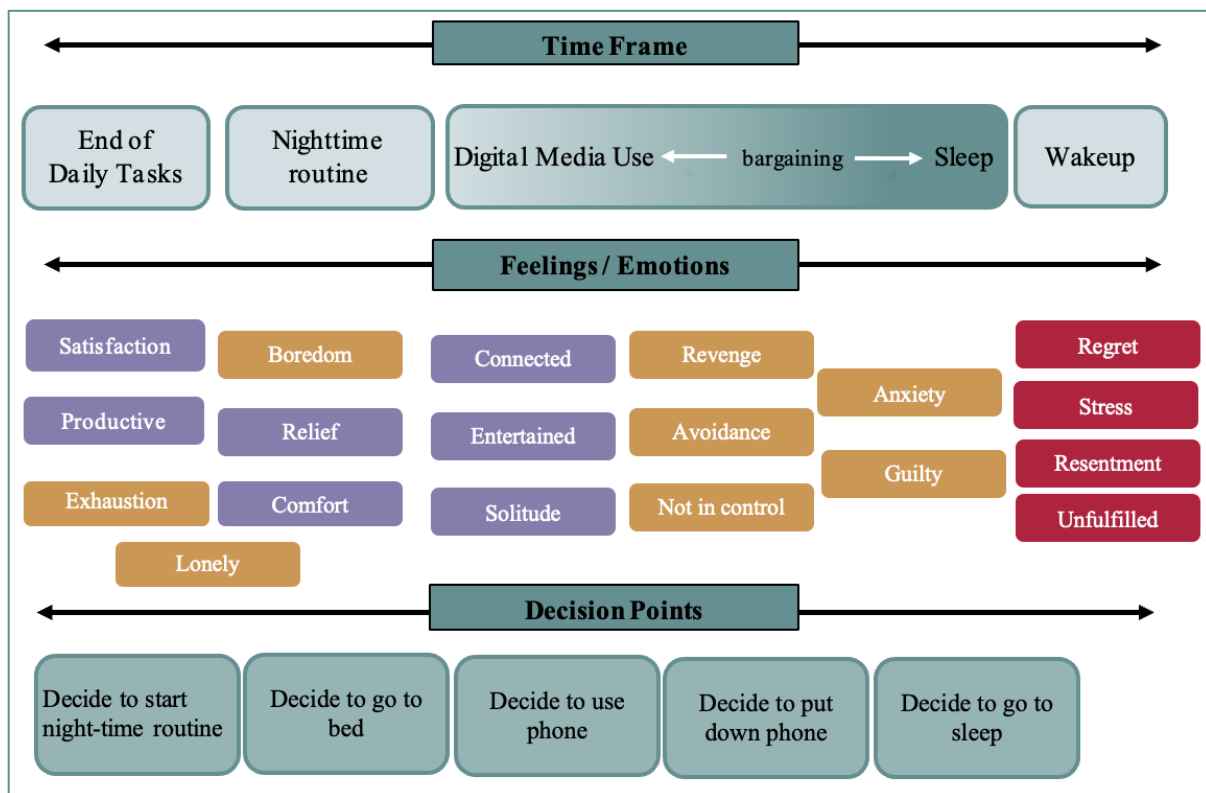


Figure 2: User Journey

Time Frame

The time frame for the user journey begins when the individual stops their daily tasks and prepares to go to sleep by completing their “night-time routine.” The time frame carries on through when they are asleep and finishes the following morning once they wake up to start the next day. Since there is a finite number of hours between when an individual completes their night-time routine and when they must wake up the following morning, we decided to display these hours as one period, split between using digital media and

sleeping. There is a trade-off for the end user wherein hours used for digital media consumption during this window are hours that are not being used for sleep.

Feelings Involved

The discussions in our focus group meetings revealed that there are many feelings at play during this time frame and all of them are likely to influence an individuals' behaviour. Some of these feelings were common among all the participants while others were unique to a smaller sub-set of individuals, or in some cases only associated with one person. We compiled the most frequently mentioned emotions and included them in our user journey. One interesting observation was that users typically expressed more positive feelings at the start of the journey and ended with the most negative ones. For instance, when individuals first got into bed and started using their digital media, they often expressed that they felt “entertained” and “connected” with friends and family and that they relished this time as “me-time.” However, the following morning, most participants expressed that they felt regret for staying up too late and sacrificing their hours of sleep.

Decision points

A decision point refers to a specific moment or stage where an end-user makes a critical choice that influences their path forward. During the initial interviews within the focus groups, we discovered that for most of the interviewees, there was a set of common decision points that are involved in their bedtime procrastination. We identified 5 key decision points:

- 1) When the end user decides to start their night-time routine
- 2) When they decide to get into their bed
- 3) When they decide to use their phone
- 4) When they decide to put their phone away
- 5) When they decide to go to sleep

These decision points were later used to decide at which stage we should implement our intervention.

Positive Deviants

From our focus groups, we identified three positive deviants who used to struggle with bedtime procrastination but have now found methods to help them overcome it. Each preferred a different type of digital media and had different motivations for change, summarised in Figure 3 below. Additionally, each subject employed a unique strategy to reduce their bedtime procrastination.

Subject A and B both employed methods that targeted their lack of self-control while using digital media and employed methods to interrupt themselves mid-use. Subject A used a timer on their iPhone that would shut down their app after their allotted time was up. Whereas Subject A was able to go to sleep when this happened, Subject B felt that they needed a stronger mechanism for self-control and opted for an app that cannot be overridden once it is set. They also went “cold turkey” and completely deleted their Twitter account rather than just deleting the app that they could easily re-download.

Subject C managed to drastically cut their screen time from about 10 hours per day when they were working in an unhappy job to about 4 to 5 hours per day while they were in school. Rather than implementing a method that disrupted them during use, they used a “plan ahead” model to schedule a time that was dedicated to catching up on Instagram reels that their friends had sent them throughout the day or week. Interestingly, they found that that when their day was productive and filled with enjoyable activities, they were less likely to use digital media and procrastinate their bedtime.

Reflecting on these three different methods proved useful for the next stage when we identified possible interventions to tackle bedtime procrastination.

	Subject A	Subject B	Subject C
Preferred digital media	<ul style="list-style-type: none"> - YouTube 	<ul style="list-style-type: none"> - Twitter - Reddit 	<ul style="list-style-type: none"> - Instagram
Motivation for change	<ul style="list-style-type: none"> - Used to fall asleep while watching videos and would have to wake up to turn off their device - Wanted to build a healthier habit 	<ul style="list-style-type: none"> - Felt like digital media use was “chipping away at life” - Got frequent headaches - Had exams around the corner 	<ul style="list-style-type: none"> - When working at a job they didn’t like, they would stay up until 3 or 4am on social media and felt tired/unproductive the next day
Method used to reduce digital media use	<ul style="list-style-type: none"> - Sets a 20-minute timer on iPhone that shuts down the app in use when the time is up 	<ul style="list-style-type: none"> - Self-control computer app that cannot be bypassed - Went “cold turkey” and deleted Twitter account 	<ul style="list-style-type: none"> - Consciously schedule a time to “catch up” on Instagram reels on a night when they don’t need to wake early the next day

Figure 3: Positive Deviants

Stage 3: Design, Deliver and Implement

Upon consulting the literature and learning from our positive deviants, our team identified two specific interventions that we believed would be most effective in helping our end users reduce their bedtime procrastination:

1. **“The Charles Method,”** inspired by Subject A in Figure 3, is an intervention we created to help individuals who have trouble with *self-control*. The “Charles Method” begins by completing a night-time ritual, such as having warm tea, completing one’s skincare and other pre-bed habits. The intervention inserts a decision point after the individual has gotten into bed and decides to use their phone. Instead of mindlessly scrolling until one decides to go to sleep, the intervention requires the participant to make a conscious decision about how long they would like to consume media for that evening. The individual is asked to set their morning alarm for the next day as well as a timer on their phone for the amount of time they would like to permit themselves to consume digital media that evening to get their desired number of hours of sleep. iPhone users are shown a simple alarm setting that turns off their phone at the end of the timer.
2. **The Mental Contrasting with Implementation Intention (MCII) Method**, described in detail in the Literature Review of the report, is a method that can be used to help individuals who have a *time inconsistency* bias. MCII aims to reduce the inconsistency between an individual’s view of their present and future selves through the process of goal formation. MCII is delivered to participants via a one-time training where they are first asked to identify a feasible wish about getting to bed on time. They are then asked to write down and visualise the positive outcomes of realising their goal in as much sensory detail as possible, including smell, touch, feeling, sounds and visuals associated with waking up after a night of good and lengthy sleep. Next, the individuals are asked to identify the critical obstacles which stand in the way of them fulfilling their goal. Finally, individuals prepare “if-then” strategies to overcome each obstacle (“If I encounter X obstacle, then I will perform Y strategy”). Whereas the “Charles Method” aimed to redirect the user in one of the key decision points in our user journey above, MCII is an intervention that occurs before any of the decision points i.e., it is a prudential measure.

During this stage, we had the opportunity to present our findings and proposed interventions to our peers and module convenors, who provided us with valuable feedback and certain points to reflect on. After incorporating the feedback from this session, we conducted a pilot for both our proposed interventions to test the effectiveness and receptivity of the intervention among participants.

The Pilot Design

Our pilot ran for one week among three participants. The participants were all current LSE students. Of these, two participants were trained with the MCII method while one participant was treated with the “Charles Method.”

We conducted a one-hour pilot session to trial the MCII intervention. The aim of the pilot was not necessarily to collect data on the impact of the intervention, but more to gain an understanding of the end-user's experience with the training. We also aimed to get feedback on the ease of filling out the baseline survey. Our baseline survey included collecting the screen time data of the participants and through the pilot, we were able to understand how difficult such data collection is for Android phone users vs. iPhone users. The baseline survey collected information on the subject's ideal bedtime, typical/actual bedtime, types of apps used before bedtime, and typical screen time before bed. We used the Bedtime Procrastination Scale (BPS) created by Kroese et. al (2014) as a measure of the participant's level of self-control and their motivation to change their behaviour. Participants were provided with a notebook and a pen to record their responses, alongside a copy of the slides that they could refer to for the MCII questions.

Pilot participants discussed their relationships with digital media and their use of specific apps at night. They also provided examples of techniques that they had tried in the past that did not prove to be effective, such as in-app reminders. Following this, the researchers introduced the participants to the MCII technique. They communicated a general explanation of the intervention and highlighted its success in recent studies. Then, the participants took the following steps:

- 1) First, they named an important and feasible wish, such as getting to bed on time.
- 2) Then, they were asked to identify their best outcome and elaborate on this outcome by creating vivid mental imagery of its achievement, such as feeling well-rested or getting more hours of sleep.
- 3) Participants were then asked to identify events and experiences related to that positive outcome through similar mental imagery, such as visualising themselves feeling awake enough to make coffee or a healthy breakfast for themselves in the morning.
- 4) Then, they were asked to identify and vividly imagine the key obstacles standing in the way of attaining that wish, such as social media notifications from an app or the urge to watch a video. They detailed examples of when and where they are likely to encounter these obstacles.
- 5) Participants detailed implementation intentions to overcome the specified obstacles. This was done by creating if-then plans in the following format: If I encounter X, then I will perform Y. For example, if they noticed that they received a notification, they would flip their phone to its other side. If any physical contact with their device creates an urge for them to consume digital media, then they will create distance by charging their phone on the other side of the room away from their bed. Participants were encouraged to create personalised solutions of if-then(s) that they think would work best for them.
- 6) Lastly, they were asked to set a daily time when they would practice this technique and answer the following questions as part of their daily exercise.
 - a) What is the best possible outcome today of my wish to have less stress?
 - b) What is the main obstacle today to fulfilling this wish?
 - c) How can I act to overcome this obstacle?
 - d) What is my if-then plan today?

Reflections from the Pilot

Overall, the MCII pilot participants engaged positively with the intervention. At the end of the training, the pilot participants highlighted that they found it useful to break down some of the more unconscious decisions that they had not much thought about before and appreciated having a space to discuss their

imageries or if-then plans. One week later, we followed up with the participants to learn how the training influenced them that week. Both participants reported that they actively thought about the intervention and created MCII goals on 4 days during the past week. Both participants reported trying new methods for controlling their digital media use: one tried putting their phone away from their bed, turning off the lights, and not listening to a podcast to fall asleep while the other tried reminding themselves about the promise that they made before going to the bedroom from their kitchen. Both reflected that they could see the intervention being effective going forward. However, one participant reported that they were sick with a cold and could not fully focus on the intervention that week and the other reported that they were under a lot of stress that week and felt it would work better when they were less stressed.

We gleaned two important takeaways for the logistics of running the training sessions, which were then incorporated into our final intervention design. The first takeaway was that we realised it is better to collect the screenshots from the participants at the end of the training instead of right at the beginning so that trust could be established first. We also realised that it is difficult to get comparable hourly data on an Android phone, as the hourly data is only visible on an app-by-app basis. As a result, we created different instructions for Android users to submit screen time data for the app that they most frequently use before bed in the final baseline survey.

Ultimately, we decided to proceed with the MCII intervention for our final experiment. In part, this is because we soon recognised that as facilitators, we could recommend the “Charles Method” to participants as one of the if-then strategies they can employ if their core obstacle has to do with self-control issues. Given the heterogeneity of end user journeys we encountered, we liked the bespoke nature of the MCII intervention, which allows participants to reflect on what would work best for them in general as well as on a given night.

Stage 4: Test and Evaluate

Following our insights from the pilot, we proceeded to recruit participants to test our MCII intervention.

Recruitment

As mentioned above, our initial end-user was defined as students from the SPP at LSE. As such, we began by recruiting participants by messaging in SPP-wide WhatsApp chats (See the message in Appendix 3). The message included a link to complete baseline survey for the intervention, which consisted of questions such as the respondents' actual and ideal bedtimes, the Bedtime Procrastination Scale, the apps that they tended to use most often before bed, and their demographic information (Refer to Appendix 4.1). We collected this baseline data to be able to ensure that our randomisation worked as well as to assess whether there were systematic differences in attrition between the treatment and control groups once we analysed the data.

We only received 13 respondents to our recruitment survey sent to the SPP. To increase our sample size, we decided to expand our recruitment to all LSE departments and to undergraduates as well as post-graduates. We emailed all LSE departments with a message asking them to advertise our study to their students via email or to include it in their next weekly newsletter. In addition, we sent a message in an LSE student accommodation WhatsApp group chat. In total, we recruited 46 participants for the intervention over the course of 10 days.

Experimental Design

We randomised the respondents into treatment and control groups with 23 participants in each group. Because we were wary of the possibility of high levels of attrition in our control group, we decided to conduct our experiment with a phase-in design. The total duration of the experiment was 2 weeks, with one week of pre-intervention data collected in the baseline survey. Participants who were randomly assigned to treatment were invited to a training in the week of November 13, 2023 (Week 8 of the Autumn term). Participants in the control group were invited to receive training in the week of November 27, 2023 (Week 10 of Autumn Term). All participants were asked to complete an endline survey in Week 10 (See Appendix 4.2).

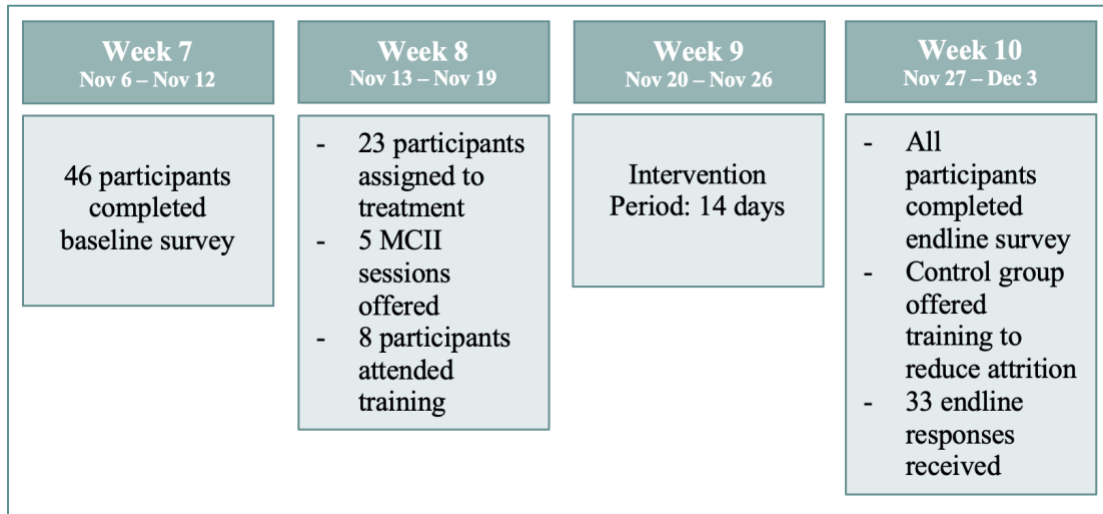


Figure 4: Experimental Timeline

Treatment participants were emailed a week prior to their training to assign them to a treatment session based on the availability they provided in their baseline survey. An email reminder was sent the night before. We tracked who attended the trainings and followed up with the “no shows” to offer them other sessions. In total 8 of the 23 participants who were randomly assigned to treatment attended the MCII trainings in Week 8.

Final Intervention

We conducted 8 one-hour long trainings in total, 5 for treatment groups and 3 for control after the intervention period ended. Each researcher facilitated three trainings and there were two researchers present at each training. We used the same slides and followed a similar script (see the training slides in Appendix 5). There was a slight deviation in the examples used as we asked participants to share personal examples.

The sessions were led by two facilitators who communicated to the participants their flexibility in shaping the intervention because of their role as end-users. Then, they were provided with materials such as a copy of the MCII training slides, a pocket-sized notebook and a pen, which they could use to record their responses to the goal-setting questions (see Appendix 6). Participants were also encouraged to keep the notebooks and use them to remind themselves to practice the MCII technique daily.

The facilitators started the session by thanking the participants for their time and acknowledged that their presence was valuable, given the busy term-time period. They briefly described MCII and explained that it is a sustained goal-setting mechanism that is self-regulatory and would require the participants to visualise and use creative imagery to explore all five senses. Previous successes of MCII were shared so that participants could be reassured that the technique may be useful to them. After this, the facilitators put forward the MCII questions and asked the participants to share their experiences and examples for each of them. It was especially important to ask leading questions because the participants did not always understand the level of descriptiveness that was required of them. The facilitators were able to nudge them

to expand on their goals and experiences with more details and truly visualise the smells, touch or noises associated with those experiences.

Some of the participants kindly consented to their notes being shared for research purposes, which have been included below alongside their relevant questions.

Question 1. Please write down your most important personal wish for less bedtime procrastination in the next 2 weeks.

- a. P1: I would like to put my phone down 15-20 minutes earlier to leave time for other things like reading and eventually build better sleep habits.
- b. P2: I would like to be more productive and meet self-imposed deadlines. I would like to wake up feeling refreshed.
- c. P3: I would like to start my day earlier and get more done in the morning.

Question 2. Please think about the best outcome of fulfilling your wish for less BP and take notes of your thoughts by writing down one or two sentences.

- a. P1: I would like to wake up without having to hit snooze and feel awake right as I get out of bed. I would like to enjoy quiet time in the morning with a coffee and not feel rushed. I would like to watch the sunrise over my back garden and be fully present. I would like to not crave coffee in the afternoon and feel energised enough in the evening to go to the gym and do other fun activities.
- b. P2: I want to wake up feeling not drowsy. I want to have time to exercise and regularly meditate. I want to start the day making good food resulting in a more productive day. I don't want to feel tired towards the end of the day.
- c. P3: I want to meditate and prime my mind for the day. I want to catch up on the news and be more aware of what is going on. I don't want to press snooze. I want to brush my teeth, get dressed, go upstairs, get a fresh breath of air, practice breathing and meditating.

Question 3. Think of obstacles to wish being fulfilled.

- a. P1: The algorithm is designed to provide me with content that I like and short videos make it easy to feel like "one more video" isn't a big deal. Funny and interesting content makes me want to keep watching. My phone is right by my bed while charging which makes it easy to pick up and use it before bed.
- b. P2: I don't get time to use social media during the day, especially for LinkedIn opportunities and this is not something that just happens, but I actively pursue this. I call friends in the US and watch YouTube videos in between work. I sometimes wake up people back home.
- c. P3: My main obstacle is that I don't have a set bedtime. I pick up my phone because it's on my bed right next to me. I am curious about whether my friends are online. I get
- d. notifications from Instagram and also YouTube but this is less significant.

Question 4. My action to fulfil my wish in the next weeks by overcoming my obstacle is...

- a. P1: I will log out of Instagram or use the alarm setting to "stop playing". I will put the phone below the shelf or place it at the back of the night table instead.
- b. P2: My daily commitment is to think of my future self.

The participants were given approximately five minutes to write down their responses to the questions after which the facilitators opened the space for discussion. This gave them the opportunity to verbalise their reflections and gain comfort as other members at the training could also relate to their experiences, creating a safe environment to be vulnerable. It was useful for participants to get greater clarity of their if-then plans by being able to talk about them out loud. At the end of the session, participants were reminded that they were eligible for a giveaway with a chance of winning one of three Christmas-themed prizes. They then scanned the QR code on the slides to upload their daily screenshots and were reminded to remove any personally identifiable information from the screenshots.

A difficulty that we encountered during this process was that most of the participants did not know how to access the screen time that we requested. However, we included a video in the slides and provided in-person guidance by using our own phones as examples to clarify the specific type of screenshots we needed. We also told them that we would be in touch with them again after two weeks to hear about their thoughts on the experiment.

Theory of Change

Our theory of change summarises the measurement framework that we have employed to assess the impact of our intervention.

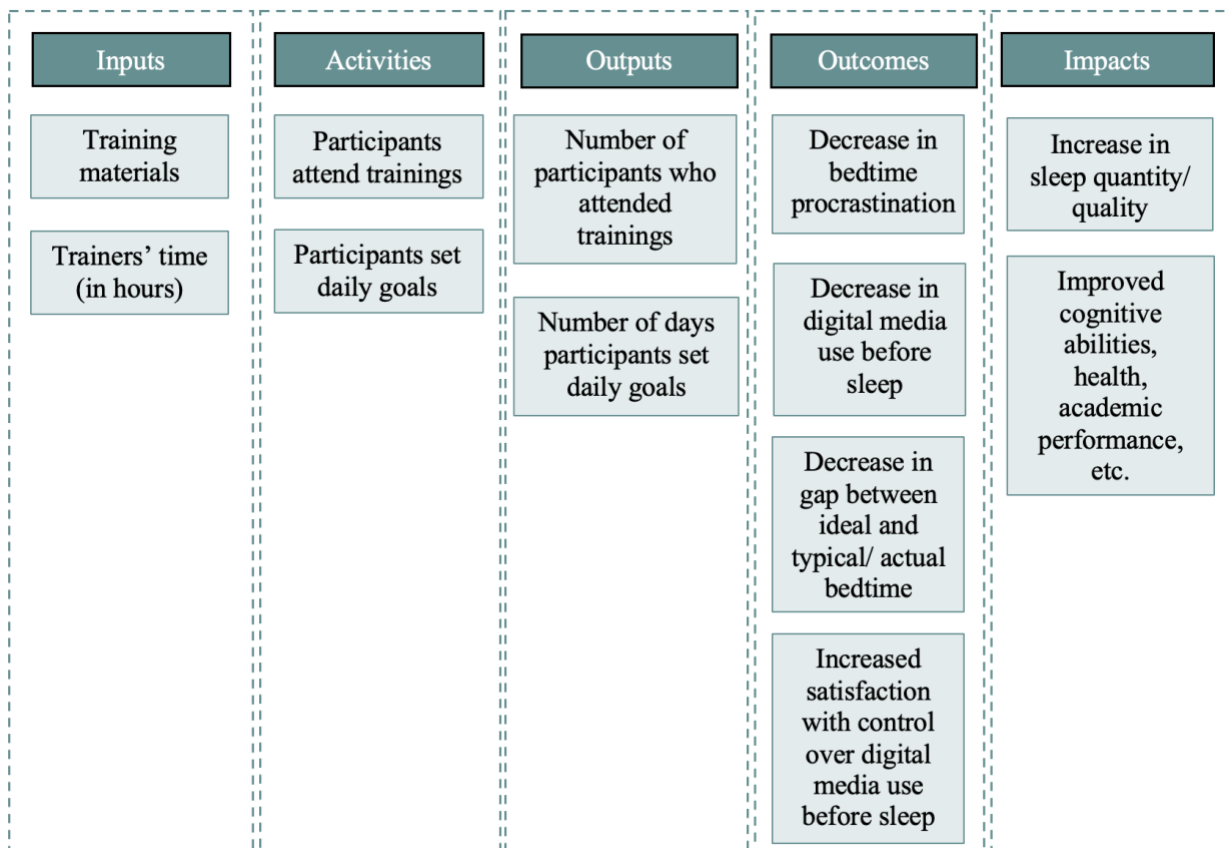


Figure 5: Theory of Change

The **inputs** for this study include:

1. Training materials

- a. This slideshow was used to train participants on the steps of employing the MCII method to address their individual challenges with bedtime procrastination. The slides can be found in Appendix 5 and were adapted from the study conducted by Gollwitzer et al. (2018).

2. The trainers' time (reported in hours)

- a. In total, the trainers delivered 8 1-hour training sessions across the treatment and control groups.

The **activities** include:

1. Participants **attending the trainings**
2. Participants **setting goals daily**

The **outputs** include:

1. The number of participants who attended the trainings

- a. This was measured by taking attendance at each of the sessions.
- b. In total, 8 out of the 23 participants assigned to treatment attended the training.

2. The number of days that individuals thought about their MCII goals

- a. This was measured in the endline survey via a question that asks “How many days did you think about your MCII goal over the past two weeks?” (Never, 1-3 days, 4-6 days, 7-9 days, 10-12 days, 13-14 days)
- b. Only two respondents answered this question in the endline survey as it was not mandatory. One answered “7-9 days” and the other answered “10-12” days.

For the following **outcomes**, we compared the mean values of the treatment and control groups in the endline survey controlling for the baseline value of the outcome:

1. Bedtime procrastination

- a. This was measured using the Bedtime Procrastination scale created by Kroese et al. (2014) which asks participants to rate on a Likert scale from 1 to 5 whether the following statements apply to them. A value of 1 indicates “never,” 2 “rarely,” 3 “sometimes,” 4 “often” and 5 “always.” For the purposes of calculating the average bedtime procrastination score, statements with (R) are reverse coded so that a value of 1 is re-assigned to a 5, a value of 2 is re-assigned to 4, and vice-versa.

- I go to bed later than I had intended.
- I go to bed early if I have to get up early in the morning (R).
- If it is time to turn off the lights at night I do it immediately (R).
- Often I am still doing other things when it is time to go to bed.
- I easily get distracted by things when I actually would like to go to bed.
- I do not go to bed on time.
- I have a regular bedtime which I keep to (R).
- I want to go to bed on time but I just don't.
- I can easily stop with my activities when it is time to go to bed (R).

2. Digital media use before sleep

- a. Participants self-reported how long they typically spend on digital media before sleep (less than 30 minutes, 30 minutes - 1 hour, 1-2 hours, 2-3 hours, or 3+ hours).

3. The difference or gap between participants' ideal bedtime and their typical bedtime.

- a. Participants self-reported their "ideal bedtime" in the baseline survey defined as "a realistic time you aim to go to sleep by that would maximise your wellbeing."
- b. Participants self-reported the time they typically go to sleep in the baseline and endline surveys.

4. The difference or gap between participants' ideal bedtime and their actual bedtime.

- a. Again, "ideal bedtime" is the self-reported measure described in the previous outcome measure.
- b. Actual bedtime was approximated by observing the last bar of screen time data. Participants submitted their screen time data for 3 weeks (the week prior to the intervention serving as the baseline period). This measure relies on the assumption that once individuals have put their phone down, then they have decided to go to sleep. This measure was used as an objective comparator to the self-reported data.

5. Satisfaction with control over digital media use before sleep.

- a. Participants self-reported their satisfaction with their digital media use before sleep on a 5-point Likert scale ranging from "very dissatisfied" to "very satisfied".

The **impacts** of this study aren't directly measurable as they are long-term and beyond the scope of the given experiment. However, we anticipate that if individuals decrease their digital media induced bedtime procrastination, both the quality and quantity of their sleep will improve. As we have discussed in the literature review, sleep deprivation has negative consequences for students' mental health, cognitive abilities, and academic performance (Bhat, 2018; Johansson, 2023; Rose & Ramanan, 2017; Chen & Chen, 2014). As such, we anticipate that by improving the quantity and quality of sleep, individuals will experience improvements to their mental health, concentration, attention, and memory and even their academic performance.

Stage 5: Results and Reflection

Descriptive Statistics

We recruited 46 LSE students to be a part of this study. Out of the participants, 63% were postgraduates. The departmental breakdown is shown in Figure 6. We had 31 female and 15 male participants. The age breakdown is shown in Figure 7 with 67% of the sample falling into the 18-24 category.

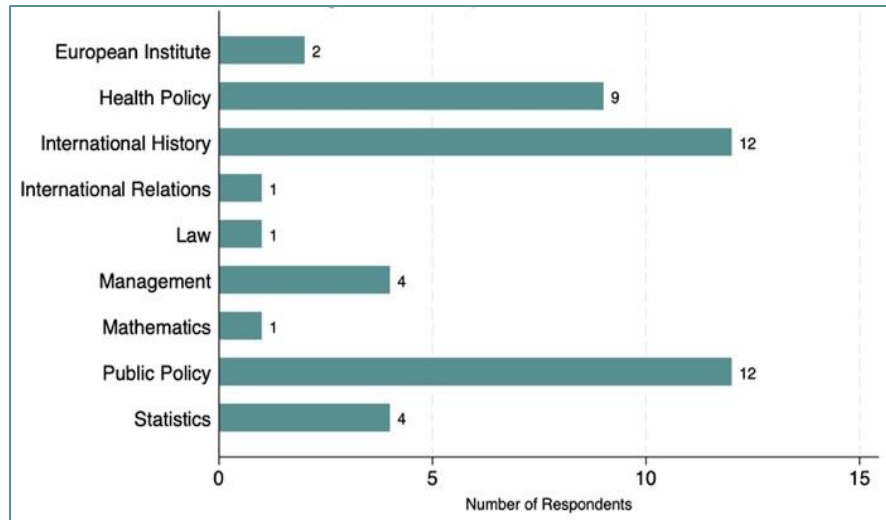


Figure 6: Department-wise breakdown of participants

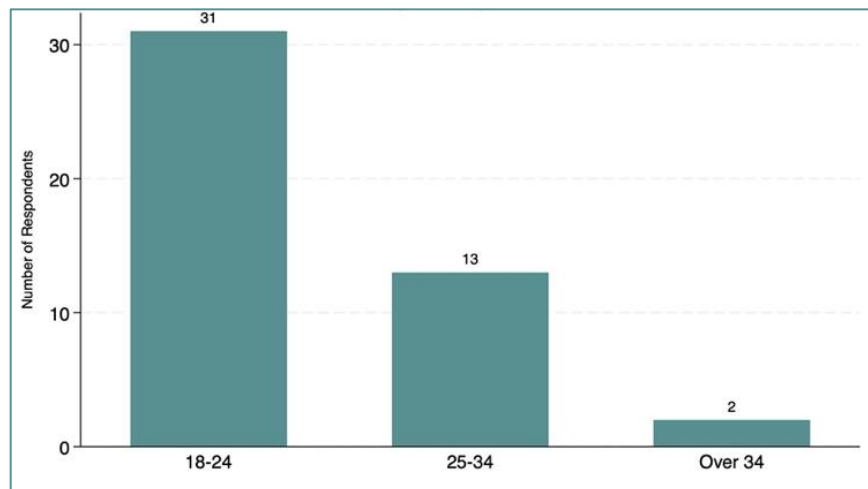


Figure 7: Age-wise breakdown of participants

The types of digital media most used at bedtime was predominantly split between social media and video streaming with only a few respondents indicating messaging or music streaming as their top category (see Figure 8 for details and Appendix 5 for full survey questions and answer categories). Of those who indicated social media as their top category, 15 said that Instagram was their most used app at bedtime, 7 said TikTok, and 1 said X (Twitter).

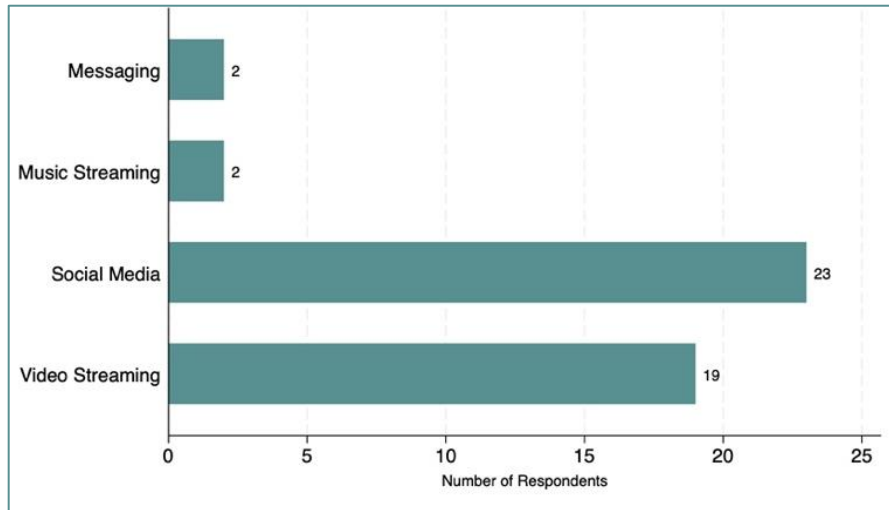


Figure 8: Type of digital media used at bedtime

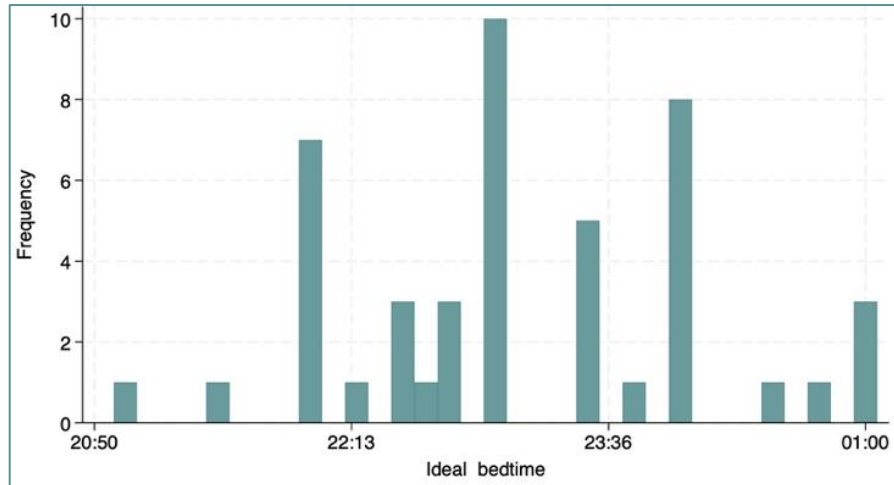


Figure 9: Distribution of ideal bedtimes among respondents

Figure 9 presents the distribution of ideal bedtimes among respondents with an average answer around 23:00. The average value for the question, “How interested are you in changing your digital media use before you sleep?” was 4.43 (standard deviation 0.6) on a scale from 1-5, indicates a high desire to change. On average, participants spent 75 minutes on digital media right before bed and had 2.2 (out of 5) satisfaction with their current use. The average bedtime procrastination score in this sample is 3.8 (5 indicating very high bedtime procrastination). Lastly, on average participants were going to bed about 100 minutes later than their realistic ideal bedtime.

Randomisation Check

Table 1 shows a t-test of baseline characteristics between treatment and control groups. It does not show any statistically significant differences between the two groups. Since the sample size is small, statistically significant differences would be unlikely to be found even if they were truly there. However, the row point differences are small which adds support that the two groups are very similar at baseline. Some

differences, although statistically insignificant, indicate that our treatment group may have had slightly less bedtime procrastination at baseline.

Table 1. Two-sample t test of baseline characteristics between treatment and control

	Control N	Treatment N	Control Mean	Treatment Mean	Difference	Standard Error	p value
Difference between ideal and self-reported typical bedtime (minutes)	23	23	114.46	94.565	19.892	18.431	.287
Difference between ideal and actual bedtime	10	9	90.116	87.501	2.615	27.945	.926
Interest in changing digital media use before bed	23	23	4.391	4.479	-.087	.195	.657
Time spent on digital media before bed (minutes)	23	23	79.130	73.087	6.043	15.008	.689
Satisfaction with digital media use before bed	23	23	2.392	2.043	.348	.322	.286
Bedtime Procrastination Score	23	23	3.865	3.809	.056	.181	.761
Proportion Female	23	23	0.565	.782	-.217	.138	.121
Proportion Postgrad	23	23	0.739	.521	.217	.142	.133
Age (proportions)							
24 and under	23	23	0.652	.696	-.044	.141	.76
25 to 34	23	23	0.261	.304	-.044	.136	.75
35 and over	23	23	0.087	0	.087	.06	.155

*p-value < 0.1 **p-value < 0.05 ***p-value < 0.01

Attrition

We experienced attrition in both take-ups of treatment after randomisation and in endline survey responses. From our initial 46 recruited participants, 23 were randomly allocated to treatment and 23 to control. In treatment, 8 out of the 23 participants attended the training (about a 35% take up rate). Out of the 23 participants assigned treatment, 15 filled out the endline survey. We received endline responses from 18 out of the 23 control participants.

Although it does not matter for our results, it is interesting to note that the control group had a higher attendance rate at the MCII sessions than the treatment group (13 vs 8). This is surprising since the control

group waited 2 weeks longer to receive treatment than the treatment group. The training sessions were also held during Week 10 of the term, which usually has more academic deadlines than Week 8 when treatment training sessions were held. We sent the same reminder emails at similar times to both groups. The only difference in communication was that we included a calendar invite to the control group's emails. This may not be what made the difference (we could have just been unlucky to have randomly put more committed people into our control group), but it might be useful to note for future similar research.

Some respondents indicated why they were not able to attend a session in the endline survey (Table 2). It appears that the treatment group had more conflicts than the control group. This is unlikely to be the full reason for the discrepancy in session attendance since participants were asked in the recruitment survey to pick specific session times that they had free in their schedules. However, it gives us some insight.

Table 2. Please indicate why you were unable to attend a session

	Control	Treatment
Conflict in schedule	2	4
Forgot	0	1
Not on campus that day	1	0
Other	1	1
Sick	0	1
Total	4	7

We tested for non-random take-up attrition using a two-sample t-test of all baseline variables between those who attended treatment and the rest of the sample. Table 3 presents the results (See Appendix 7). We did not find statistically significant differences between these two groups on any variables. The point differences are minor, but some may suggest that those who attended had slightly less bedtime procrastination than those that who did not. Given that our sample size is small, there may be noise obscuring truly significant differences, however, there is not sufficient evidence for attrition bias.

We tested to see if attrition in endline survey response differed between treatment and control by regressing an indicator variable for endline survey non-response on an indicator variable for assigned treatment. The coefficient was not statically significant (t-value 0.97; see Table 4 in Appendix 7). These findings lower the possibility of attrition bias from non-responses.

Missing Screen Time Data

We collected baseline screen time data from 19 participants, 10 from control and 9 from treatment. We collected endline screen time data from 21 participants, 11 from control and 10 from treatment. Because we are missing this key outcome from many of our participants (as a result of them leaving the question blank or incorrectly filled out on the surveys), we explore how correlated it is with typical bedtime (which we have for all respondents at baseline and endline) to see how appropriate typical bedtime is as a proxy for actual bedtime. We find a correlation of 0.79 (Figure 10) between these two variables. This supports the assumption that self-reported typical bedtime is a reasonable proxy for actual bedtime.

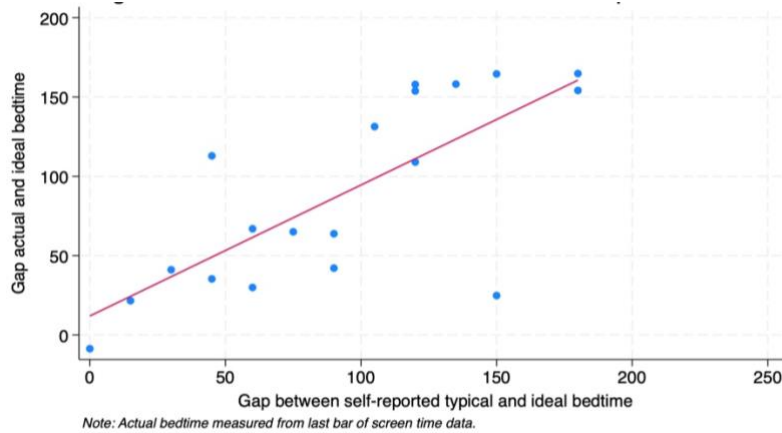


Figure 10: Correlation between actual and self-reported bedtime

Analysis

We analysed our results using an intention-to-treat model because of imperfect compliance around the treatment group taking up the treatment. Equation (1) shows the model we used to identify the ITT causal effect of MCII on bedtime procrastination. The main outcome variable is the Bedtime Procrastination Score (BPS) as measured by Kroese et al. (2014)’s scale. This is regressed on a dummy variable for being assigned treatment status. BPS at baseline is added in as a control variable to reduce noise around the estimate and increase statistical power. We repeated the same model for the five key outcomes detailed in the Theory of Change section above: time spent on digital media before bed, the difference between ideal and self-reported typical bedtimes, the difference between ideal and actual bedtimes, and satisfaction with control over digital media use before bed.

$$BPS_{post_i} = \alpha + \beta_1 Treat_i + \beta_2 BPS_{pre_i} + \varepsilon_i \quad - (1)$$

Table 5 shows the results of equation (1) for all the key outcomes specified. Overall, the results support our hypothesis that MCII decreases bedtime procrastination and digital media use before bed. After controlling for baseline differences in BPS, we found that the mean BPS decreased by 0.60 points in the treatment group relative to the control group. This was significant at the 1% level. The standard deviation on BPS is 0.69 in our data so this represents nearly a standard deviation decrease in bedtime procrastination. The mean BPS in the treatment group is now 3.3 compared to a mean score of 3.9 in the control group.

We also found that the treatment group spent 30 minutes less on digital media before bed than the control group after controlling for baseline differences. This represents a 40% decrease from the average time spent on digital media across the whole sample (81 minutes). We find no statistically significant difference in the gap between ideal bedtime and self-reported typical bedtime. However, we do find a significant 56-minute decrease in this gap when using actual bedtime and controlling for baseline differences. This means that treatment participants are going to bed an hour closer to their ideal bedtime on average. Finally, we

find that satisfaction with digital media use before bed significantly improved by 1.34 points on the 5-point scale controlling for baseline differences. This represents more than a standard deviation (1.15) increase in satisfaction.

Our results suggest that MCII is effective in both changing actual bedtime behaviour (i.e., inducing people to go to bed closer to their ideal bedtime and reducing the amount of time they spend on digital media before bed) and participants' feelings of control and satisfaction around it.

Table 5. ITT Estimate

Variable	Coefficient on Treatment	Constant	N
Bedtime Procrastination Scale	-0.60*** (.19)	1.39**	33
Time spent on digital media before bed (minutes)	-30.58** (12.12)	63.44***	33
Difference between ideal and self-reported typical bedtime (minutes)	7.94 (17.87)	20.74	33
Difference between ideal and actual bedtime (minutes)	-56.811** (21.92)	27.01	17
Satisfaction with control over digital media use before bed	1.34*** (.33)	0.82**	33

Note: All models include the baseline values of the outcome as control. Robust standard errors in parentheses. Treatment is an indicator for random assignment to treatment group. Key outcome variables described in the text (see Theory of Change section).

****p-value < 0.01; **p-value < 0.05; *p-value < 0.1*

We also analysed the effect of MCII using an instrumental variable to explore the effect of the treatment on the treated since we had a low take-up of the actual training. The instrument variable model will give us the effect of treatment on the treated rather than the local average treatment effect since we only gave the treatment to the treatment group during the study period and have no “always takers.”

We used random assignment to the treatment group as the instrument to isolate the causal effect of attending a session (i.e., receiving the treatment). The model is shown in the equation (2) below. The correlation between treatment assignment and receiving the treatment is 0.62. The treatment assignment was random, and we have no evidence that it is correlated with anything in the error term. Finally, it is very unlikely that assignment to treatment itself changed behaviour since both treatment and control were

given the same information about the study at recruitment. Exactly like the ITT model above, we repeated this model with all 5 of our key outcomes in place of BPS in the second equation (2).

$$\begin{aligned} \text{Attended}_i &= \alpha + \beta_1 \text{Treat}_i + \varepsilon_i \\ \text{BPS}_{\text{post}i} &= \alpha + \gamma_1 \widehat{\text{Attended}}_i + \varepsilon_i \end{aligned} \quad - (2)$$

Table 6 shows the results of equation (2). The results reflect those of the ITT regression above for the most part. The IV regression output shows a slightly larger effect on BPS score than ITT with a 1-point decrease in BPS score for those who received MCII training. Notably, the effect of MCII on digital media before bed for those who attended a session is nearly double the effect size found in ITT at a 54-minute decrease (slightly less statistically significant here). The difference between ideal and typical bedtime remains insignificant. The difference between ideal and actual bedtime also shows a larger effect size with a 100-minute decrease on average for those who attended the training. Lastly, satisfaction with digital media use before bed increased by 2.2 points on the 5-point Likert scale, significant at the 1% level.

These results strengthen the conclusions drawn from the ITT model and show strong evidence supporting the effectiveness of MCII in reducing digital-media-driven bedtime procrastination.

Table 6. 2SLS Estimate of attending the MCII Training

Variable	Coefficient on Attended	Constant	N
Bedtime Procrastination Scale	-1.09*** (.405)	3.87***	33
Time spent on digital media before bed (minutes)	-54.375* (27.86)	10.138***	33
Difference between ideal and self-reported typical bedtime (minutes)	-21.25 (41.598)	108.333***	33
Difference between ideal and actual bedtime (minutes)	-100.013** (42.471)	134.083***	21
Satisfaction with digital media use before bed	2.229*** (.595)	1.944***	33

Note: Robust standard errors in parentheses. Assignment to treatment (dummy) was used as the instrumental variable. Attended is an indicator for if the participant attended an MCII training during study. Key outcome variables described in the text (see Theory of Change section).

Limitations

Following the implementation of the intervention and analysing the results, we have identified five main limitations of our experiment.

The first limitation of the intervention design is that our final sample consisted of a broader category of LSE students, who were not surveyed as part of our focus group discussions and the pilot. The initial end-users that we chose to experiment on were students from the School of Public Policy at the university. We recruited SPP students, mainly from the Master of Public Administration Program, to participate in focus groups to get their perspectives on their relationship with digital media at bedtime. Our pilot participants were also from the same course, which is not representative of our final sample for the experiment, which consisted of a total of 9 departments with both undergraduate and postgraduate students. This could end up being an issue if it so happens that MPA students are systematically different from other students to the point where they tend to use digital media more often than those from other departments. However, we have found no evidence that one's educational degree has a causal link to the amount of digital media-related bedtime procrastination. There could be other factors that come into play where undergraduate students may use certain addictive apps more than postgraduates who tend to be older. However, we hope to have resolved this issue of systematic differences by randomising participants into treatment and control. As the balance check showed, there were no statistically significant differences between the groups based on observable characteristics.

The second limitation, which may be a threat to the internal validity of the study, is the measurement error of bedtimes. We attempted to measure the construct of bedtime procrastination as the gap between an individual's ideal bedtime and their actual bedtime. To do this, we collected self-reported data on the participant's ideal and typical bedtimes and calculated the difference between the two. We are assuming that the discrepancy in bedtime was entirely due to digital media and that the ideal bedtime remains constant nightly. However, this may not be very accurate as participants can over or underestimate their self-reported typical bedtime and they may have used the time for other purposes than digital media consumption. Additionally, some nights an ideal bedtime may be infeasible due to constraints other than bedtime procrastination and may change depending on the night of the week (i.e., ideal bedtime on Friday may be later than on Monday).

To counter the lack of objectivity from self-reported data, we collected screenshots from participants that showed the amount of time that they had used their phones for that day. We used this as a proxy for the actual time participants go to sleep. We assumed that when a participant puts their phone down and their screen time data shows no more active use, it means that they are going to sleep. While we do feel that this was a promising way to collect objective digital media use and bedtime, we acknowledge that it has limitations as well. For instance, if participants listened to music or a podcast, this background activity is not measured by screen time. Further, this measure may not be entirely accurately recorded because the iPhone report does not generate a minute-by-minute detailed estimation. Because the time bars are only broken into segments of 0, 15, 30, 45, and 60 minutes, we chose to use the average of the range. In other words, if the peak of the bar is between 0 and 15 minutes, we considered that the device was used for 8 minutes, which may not be the most representative amount of time spent on digital media (See Appendix 8 for a full description of the data cleaning procedure). As such, the screen time data was primarily used to check the accuracy of the self-reported bedtimes. Overall, we found a strong correlation of .79 between

the self-reported typical bedtimes and actual bedtimes, deduced from the screen time data, which suggests that the self-reported data is a pretty good approximation of the actual time individuals go to sleep.

The third limitation that we faced was our small sample size. Initially, we believe this was due to the difficulty in filling out the baseline survey which required respondents to log into their Microsoft Forms account and do the survey on a laptop as the formatting made it complicated to do on a phone. As a result of the design, we were only able to collect a total of one response during this first recruitment period. We edited the formatting of the survey to greatly improve ease of access (especially on smartphones) then decided to expand to all LSE students and emailed each of the Departments, including both their undergraduate and postgraduate divisions. This helped us bump up our responses from 1 to 46 in one week, which after randomisation were split into 23 each in the control and treatment groups.

The fourth limitation we encountered was attrition. We offered participants a choice of 5 availabilities for MCII sessions that were conducted in-person at LSE which we hoped would make it easier for participants to come in between classes when they had a spare 45 minutes. We anticipated that there would be some attrition as to who showed up for the training. To minimise this, we sent reminder emails to all participants the evening before. However, the Tuesday and Thursday slots proved to be more popular, and only one participant showed up for the Friday slot. We figured that this may be because many people do not have classes on Fridays and it meant that the only reason that they would have to be on campus would have to be to attend our session, which may not have been a strong enough reason for them to attend. This gave us a total of 9 attendees out of the 23 participants that were chosen for treatment which resulted in an attrition rate of 61%. This led to another worry that those who did end up attending one of our sessions did so because they were systematically different than those who did not attend, in a way that meant that maybe they were more motivated to resolve their issue of bedtime procrastination because of digital media which may lead to an overestimation of the results. However, this may not necessarily be the case since when we asked the singular Friday participant who showed up why they chose to attend, they very kindly highlighted the difficulty in gathering survey responses and attended our session out of pity and not because they felt an extra sense of motivation to resolve their bedtime procrastination issues. Future research could explore online or less time intensive versions of the intervention to address attrition.

We also may have faced the issue of spill overs as those from the treatment group may have exposed the intervention to the control group. While we took every effort not to specify the details of the intervention to those who were in control, such as by not naming the MCII technique in our communications and using vague terms such as “promising intervention”, we acknowledge that some of our participants are from the very class for which we have undertaken this project (i.e. PP452) and may have been aware of the intervention from class discussions and presentations.

Conclusion and Proposals for Further Research

Despite having a sample size of 46 participants, the MCII proved to be effective at improving many outcome measures for the treatment group in our study. Two weeks after receiving training, our treatment group on average exhibited decreased bedtime procrastination and digital media use before bed. The participants who received treatment also had a smaller gap between their ideal and actual bedtimes than the control participants. Finally, the treatment group reported increased feelings of control over their

bedtime procrastination compared with the control group. These findings indicate that the MCII can be an effective intervention for overcoming bedtime procrastination.

Due to the time constraints of our study, we were unable to learn more about the mechanisms driving these improved outcomes. If we had more time, we would have liked to have followed up with the training participants for another set of qualitative interviews to learn more about what they were doing differently because of their experience with the training. Future research should focus on better understanding *why* the MCII is effective and leveraging that understanding to make the training even more effective.

Again, due to time constraints, we were unable to measure the impact of the intervention over the long run (beyond the 2 week intervention period). Given that MCII is supposed to be a sustained self-regulatory measure, we could not test whether this was successfully practiced over longer periods such that this goal-setting process eventually became a habit for our participants. It would be interesting to conduct research evaluating whether the effectiveness of MCII can be sustained over a longer period or whether the effectiveness dissipates over time.

Finally, our intervention delivered trainings in-person as we assumed that this would be the most engaging format for delivering the sessions. However, given the high levels of attrition, future research may consider whether other means of delivering the training (via video or Zoom) may be just as effective and less time-intensive for participants.

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Appendix

Appendix 1. Interview & Focus Group Questions

1.1 Focus Group Questions

1. How did you feel when staying up late or the next morning?
2. How do you feel about waking up the next day?
3. Tell us about your bedtime routine yesterday.
 - Did you find yourself staying up later than necessary and spending time on your phone/technology?
 - What apps are you using? How are you spending your time?
4. Why do you think you stayed up too late?
 - Revenge?
 - Do you feel regret/guilt for staying up late?
5. Have you tried to change this behaviour in the past?
 - What worked?
 - What didn't?
6. What gets you up in the morning?

1.2 Exploratory Interview Questions

1. How did you feel on mornings you stayed up too late?
2. Why do you think you want to be on your phone at night?
3. What sucks you in? What keeps you going?
4. Typical routine?
5. Have you heard of revenge scrolling? Ever done that?
6. What is the environment in your room when you sleep (light on/light off)?
7. What do you feel when you go to bed about the next day?

Appendix 2. Focus Group Insights

Notes taken during focus group based on discussion:

Before Bedtime

<u>Actions</u>	<u>Responses</u>
Exercises late at night	Exhaustion → Too tired = Do not go on device
Awareness of an early morning meeting/wake-up time	Lack of time → Prioritise sleep = Do not go on device
Switch on alarms for the next day	Phone is nearby → Goes on device
Socially active day	Needs me time → Goes on device
Day has been packed with productive activities that are enjoyable	Exhaustion → Too tired = Do not go on device
Feels bored but seeks activities unrelated to academics	Needs something to look forward to → Goes on device
No one at home	Feels alone → Goes on device

During Bedtime

<u>Actions</u>	<u>Responses</u>
Sets an ideal bedtime	Uses phone → Delays bedtime
Gets in bed → Phone is nearby → Resists urge to pick it up → Negotiates by setting a self-timer on how long device can be used → Justify using device for the self-set time → Opens app (TikTok, Instagram, YouTube Shorts)	Watches short video → Receives burst of information/content → Feels reward/stimulation → Scrolls/Auto-scroll → Next video plays
Online daily limits have been met	Dismisses alert → Feels momentarily guilty → Continues to stay on device
Puts phone away	Gets anxious
Eyes are tired from watching device	Continues watching → But eventually a

	nudge to put phone away OR Falls asleep while device is still playing
Seek background noise	Watch Netflix
Fear of missing out on a message → Feelings of anxiousness → Picks up phone → Sees that friends have shared videos or posts	Replies to messages → Contributes by sharing more videos and posts
Plays podcast	Passive + Educational → Less guilt than actively staying on device → Eventually falls asleep
Watches longer videos on YouTube/Netflix	YouTube/Netflix autoplay next video → no need to consciously make a decision to stop watching as the device makes default choice of continuing → Keeps watching
Feels tired → Thinks “I should go to bed” → Seeks something comforting to help sleep	Watches something on a device → Might feel energised after consuming content → Spends more time
Surrounded by own thoughts → Wants to avoid thoughts	Seeks comfort → Picks up phone
Wants to pick up phone but also feel productive	Uses apps like Reddit/Twitter (seems more productive/informational)

Morning After

<u>Actions</u>	<u>Emotions</u>
Goes on phone to listen to music	Feels less lethargic
Sleeps in Late	Gets mad at oneself
Uses mindfulness app	Delays picking up phone
Lack of Time → Rushes → Realisation that there is not enough time to walk to destination → Spends money on bus	Regret on not getting enough sleep → Not waking up on time → Economic cost by spending money
Switches off alarm on phone → Continues to hold phone → Open app → Spend time on device	Feels like time was wasted

Wants to check messages from family abroad → Picks up phone	Gets distracted → Feels guilty on spending more time on device
Reduced ability to prepare for the day	Not as ready for seminars → Feels stressed and regretful

Appendix 3. Recruitment Message

Do you scroll mindlessly until 3 am on Instagram? 🙄

Have you lost track of how many Netflix episodes you've watched before bed? 🙄

Do you regret staying up late when you are rushing to get to your 9am lecture/seminar? 🙄

Us tooo! We have designed a **promising intervention** that can help you gain control of your digital media use AND your sleep.

Please fill in the quick form (literally 3 mins) below if you want to participate. As a bonus, you get free stationery AND a chance to win one of the following for you and a plus one!:

- 🎟 Ice Skating Tickets
- ❄ Winter Wonderland Entry Tickets
- 🍫 Knoop's Hot Chocolate

Appendix 4. Surveys

4.1 Baseline Survey

Q1: Would you like to be a part of our bedtime procrastination study? (Yes, No)

- This will entail this survey, one 45 minute training session, and an end-line survey sent 2 weeks after training.
- The surveys will collect data on your sleep and digital media use habits as well as uploading screenshots of your daily screen time use.
- To be eligible for the prizes you must attend the training and fill out both surveys.
- Your data will be anonymized and used only for our final report in PP452.

Q2: Please indicate your general availability to join an in-person training session at LSE. The trainings will take place over the next two weeks. Select all that apply, you will be invited to just one session. If none of the listed times work, please give a few times you are available in the "Other" option. (Multiple choice options)

Q3: Please enter your email address. We will contact you with the time and location of your session. Thank you! (Text response)

Q4: Please enter your student ID number. This will be used to anonymously link your responses to the baseline and end line survey and will be deleted after data collection. (Text response)

Q5: What time do you typically go to sleep? (Text response)

Q6: What is your ideal bedtime? An ideal bedtime is a realistic time you aim to go to sleep by that would maximize your wellbeing.

Q7: How interested are you in changing your digital media use before you sleep? (Extremely interested, somewhat interested, neutral, somewhat not interested, extremely not interested)

Q8: How long do you typically spend on digital media before going to sleep? (Less than 30 minutes, 30 minutes – 1 hour, 1- 2 hours, 2 – 3 hours, 3 or more hours)

Q9: How satisfied are you with your digital media use just before you go to sleep? (Very satisfied, somewhat satisfied, neither satisfied nor dissatisfied, somewhat dissatisfied, very dissatisfied)

Q10: For each of the following statements, please decide whether it applies to you using a scale from 1 (almost) never to 5 (almost) always.

- I go to bed later than I had intended.
- I go to bed early if I have to get up early in the morning.
- If it is time to turn off the lights at night I do it immediately.
- Often I am still doing other things when it is time to go to bed.
- I easily get distracted by things when I actually would like to go to bed.
- I do not go to bed on time.
- I have a regular bedtime which I keep to.
- I want to go to bed on time but I just don't.
- I can easily stop with my activities when it is time to go to bed.

Q11: Please select your gender. (Woman, man, non-binary, prefer not to say, other)

Q12: What department are you in? (Text response)

Q13: What degree level are you? (Undergrad, postgrad)

Q14: Please select your age range. (18-24, 25-34, over 34)

Q15: Which of the following categories of digital media do you use **most** at bedtime?

- Social Media (TikTok, Instagram, X/Twitter, etc)
- Video Streaming (YouTube, Netflix, Amazon Prime Video, etc.)
- Music Streaming (Spotify, Apple Music, etc.)
- Messaging (iMessage, WhatsApp, WeChat, Snapchat, etc.)
- News and Information (FT, BBC, The New York Times, etc.)
- Gaming

Q16: Last question! Which of these apps do you use the **most** at bedtime?

- TikTok
- Instagram
- Facebook

- Reddit
- X (Twitter)
- Other

4.2 Endline Survey

Q1: Please enter your student ID number. This will be used to anonymously link your responses to the baseline and end line survey and will be deleted after data analysis. (Text response)

Q2: What has been your typical bedtime over the past two weeks (term weeks 9 and 10)? (Multiple choice options – every half hour from 20:00 to 3:00)

Q3: How long have you typically spent on digital media before going to sleep over the past two weeks (term weeks 9 and 10)? (Less than 30 minutes, 30 minutes – 1 hour, 1- 2 hours, 2 – 3 hours, 3 or more hours)

Q4: How satisfied are you with your digital media use just before you go to sleep? (Very satisfied, somewhat satisfied , neither satisfied nor dissatisfied, somewhat dissatisfied, very dissatisfied)

Q5: For each of the following statements, please decide whether it applies to you using a scale from 1 (almost) never to 5 (almost) always.

- I go to bed later than I had intended.
- I go to bed early if I have to get up early in the morning.
- If it is time to turn off the lights at night I do it immediately.
- Often I am still doing other things when it is time to go to bed.
- I easily get distracted by things when I actually would like to go to bed.
- I do not go to bed on time.
- I have a regular bedtime which I keep to.
- I want to go to bed on time but I just don't.
- I can easily stop with my activities when it is time to go to bed.

Q6: What day did you attend a bedtime procrastination training session? (Multiple choice for training dates or unable to attend; survey architecture then directed individuals to different questions to prompt them to provide screenshots for the appropriate days).

Q7: Upload screenshots of your screen time from [**X to X date**]. This will serve as a baseline bedtime measure. Instructions below if needed.

iPhone Instructions for taking screen time screenshots:

1. Enter the "Settings" app
2. Click on "Screen Time" (has a purple icon)
3. Click on "See All Activity" directly underneath the blue bar chart.
4. Swipe right on the smaller bar chart on the bottom until you reach the dates indicated in bold above.
5. Take a screenshot of the data on this page. Remember to crop your device name out of image before

you save it.

6. Repeat step 4 and 5 for the days indicated.

Non-iPhone instructions:

1. Find screen time in "Settings" app. In Android it is called "Digital wellbeing and parental controls"
2. Select the app you use most before bed.
3. Screenshot the hour-by-hour breakdown for the days indicated in bold above.

Q8: (For individuals who did not attend a session) Please indicate why you were unable to attend a session. (Conflict in schedule, not on campus that day, forgot, no longer wanted to attend, sick, other)

Q9: (For treated individuals) How many days did you think about your MCII goal over the past two weeks? (Never, 1-3 days, 4-6 days, 7-9 days, 10-12 days, 13-14 days)

Q10: (For treated individuals) Please rate your agreement to the following statements. (Strongly disagree, disagree, neutral, agree, strongly agree)

- MCII (setting a goal) helped me go to sleep earlier.
- I see my new bedtime becoming a long-term habit.

Q11: Last question! If you would like to leave a comment about your experience, please do so here. Thank you again for participating. (Text response)

Appendix 5. MCII Slides

Slides used to conduct MCII training:

Bedtime Procrastination Training: MCII

Based on Gollwitzer, P. M., Mayer, D., Frick, C., & Oettingen, G. (2018)

Mental contrasting with implementation intentions (MCII)

Assumption: Students are delaying their sleep by using digital media due to the gap between their present and future goals i.e. **time inconsistency problem**.

Behavioural target: Reduce inconsistency between future self and present actions by goal formation

Mental Contrasting

- Participants write down a **feasible wish** about getting to bed on time
- Write down the most **positive outcome** of realising this wish as well as events and experiences related to that positive outcome.
- Envision a **critical obstacle** standing in the way of attaining that wish, followed by an elaboration of the events and experiences they associated with it

Implementation Intention

- Ask themselves 'When and where will the obstacle occur next?' and 'What can I do to overcome the obstacle?'
- Link answers with **if-then statement**: If I encounter X, then I will perform Y!

Please write down your most important personal wish for less bedtime procrastination in the next 2 weeks.

What does bedtime procrastination mean for me?

What does *less* bedtime procrastination mean for me?

Why do I want *less* bedtime procrastination?

My wish for *less* bedtime procrastination: _____

Please think about the best outcome of fulfilling your wish for less BP and take note of your thoughts by writing down one or two sentences.

The best outcome of fulfilling my wish in the next 2 weeks is: _____

Now imagine the best outcome in your thoughts. Imagine the events and experiences you associate with the best outcome. Please take as much time as you need to imagine it as fully as you can.

Now please write down all the thoughts and images you had regarding the best outcome: _____

Think of obstacles to wish being fulfilled

(1) What is your main obstacle? Please write it down in one or two sentences.

My main obstacle to fulfilling my wish in the next 2 weeks is: _____

2) Now please imagine this main obstacle. What are the events and experiences that could hold you back? Please take as much time as you need to imagine it as fully as you can.

Now please write down all the thoughts and images you had regarding your main obstacle: _____

If...[enter your obstacle here] occurs, then I will...[enter wish-fulfilling action here]!

How can you act to fulfill your wish? Please briefly describe this wish-fulfilling action.

My action to fulfill my wish in the next weeks by overcoming my obstacle is: _____

Now imagine this if-then plan and go through it in your mind

Daily Commitment for the next 2 weeks

- ❑ What is the best possible outcome today of my wish to have less bedtime procrastination?
- ❑ What is the main obstacle today to fulfilling this wish?
- ❑ How can I act to overcome this obstacle?
- ❑ What is my if-then plan today?

Set a daily reminder on your phone.

We will send you another survey during Week 10! Complete this to be eligible to win the prizes.



Follow up: Scroll Less, Sleep More!



Login with your LSE email and password

Thank You!

We wish you the best of luck!

Appendix 6. MCII Training Materials

Material provided to subjects during MCII training:

- A notebook
- Print out of the slides
- Pen



Appendix 7. Tables and Figures

Table 3. Two-sample t test of baseline characteristics between those who attended treatment and the rest of the sample

	Did not Attend N	Attended N	Did not Attend Mean	Attended Mean	Difference	Standard Error	p value
Difference between ideal and self-reported typical bedtime (minutes)	38	8	108.75	84.375	24.375	24.358	.323
Difference between ideal and actual bedtime (minutes)	12	7	90.074	86.826	3.248	28.923	.912
Interest in changing digital media use before bed	38	8	4.394	4.625	-.231	.256	.372
Time spent on digital media before bed (minutes)	38	8	76.316	75.125	1.191	19.834	.953
Satisfaction with digital media use before bed	38	8	2.263	2	.263	.428	.542
Bedtime Procrastination Score	38	8	3.785	4.083	-.298	.236	.212
Proportion Female	38	8	0.658	.75	-.092	.186	.623
Proportion Postgrad	38	8	0.606	.75	-.144	.191	.452
Age (proportions)							
24 and under	38	8	0.711	.5	.21	.183	.258
25 to 34	38	8	0.237	.5	-.263	.175	.139
35 and over	38	8	0.052	0	.052	.081	.518

*p-value < 0.1 **p-value < 0.05

Table 4. Linear regression of non-response to endline survey on treatment status

No Response	Coef.	St.Err.	t-value	p-value	[95% Conf Interval]	Sig
Treat	.13	.134	0.97	.337	-.14 .401	
Constant	.217	.088	2.47	.017	.04 .395	**
Mean dependent var		0.283	SD dependent var		0.455	
R-squared		0.021	Number of obs		46	
F-test		0.943	Prob > F		0.337	
Akaike crit. (AIC)		60.159	Bayesian crit. (BIC)		63.816	

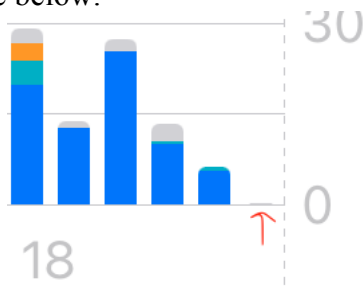
*** $p < .01$, ** $p < .05$, * $p < .1$

Appendix 8. Data Cleaning Procedure

Steps taken to transform the data from Microsoft Forms (excel sheet) for data analysis in Stata:

1. Deleted survey meta-data, emails, and recruitment information (meeting time)
 - a. Deleted ID, start time, completion time, Email, Name, Last Modified Time, please indicate your general availability, please enter your email
2. Reordered so that ID number was first row
3. Typical/Idea bedtime data
 - a. Converted all inputs into 24-hour time in Stata. Added 24 hours to responses that were past 00:00 so that Stata knew these values were on the next day.
 - b. Took midpoint of range if presented (i.e. 10-11 recoded as 10:30)
4. How interested are you in changing
 - a. 1- Extremely Uninterested
 - b. 5 - Extremely Interested
5. How long do you typically spend on digital media before bed?
 - a. Recoded as minutes (less than 30 = 30, took midpoint of other categories, 3 or more = 180)
6. How satisfied are you with your digital media use just before going to sleep?
 - a. Coded so that higher values indicate more bedtime procrastination
 - i. 1- Very dissatisfied
 - ii. 5 - Very satisfied
7. Bedtime Procrastination Scale questions: Text deleted but the number kept the same except for questions indicated with “(R)” which were reverse coded (5 became 1 and 1 became 5, etc.)
 - a. I go to bed later than I had intended.
 - b. I go to bed early if I have to get up early in the morning (R).
 - c. If it is time to turn off the lights at night I do it immediately (R).
 - d. Often I am still doing other things when it is time to go to bed.
 - e. I easily get distracted by things when I actually would like to go to bed.
 - f. I do not go to bed on time.
 - g. I have a regular bedtime which I keep to (R).
 - h. I want to go to bed on time but I just don't.
 - i. I can easily stop with my activities when it is time to go to bed (R).
8. Created a new “Bedtime Procrastination Scale” variable that is the mean of questions 1-9 above.
9. Gender
 - a. Created a dummy variable called “female” that is 1 if female
10. Department
 - a. Grouped by department (replaced some spelling) and assigned arbitrary numbers
11. Degree level
 - a. Created a dummy variable called “postgrad” that is 1 if post graduate student
12. Age
 - a. Generated a categorical variable called “age” that increases with categories (1= under 24, 3 = over 34)

- b. Generated dummy variables for each category (under24, age_25-34, and over34)
- 13. Which of the following categories of digital media do you use most at bedtime?
 - a. Converted into arbitrary categories
- 14. Which of these apps do you use the most at bedtime?
 - a. Converted into arbitrary categories
- 15. Screen time: Estimated bedtime by looking where the last bar of the day fell (check that it isn't on the next day).
 - a. Recorded in 24hr time format.
 - b. If the bar fell directly on the line it was recorded as that time (ex. bar ended right on 30 min, coded with minutes :30).
 - c. If the top of the last bar fell between 15 min bars it was coded as the midpoint of the time
 - 0-15m = :08
 - 15-30m = :23
 - 30-45m = :38
 - 45-60M = :53
 - d. If the bar was so small it looked like less than 1-2 min, it was ignored. Example in graphic below.



- i.
- e. Data recorded under variables called “read_bed1-7”
 - i. Real_bed1: bedtime day before intervention (checking screenshot from day of treatment for bedtime past 00:00).
 - 1. If participant attended workshop on 13 Nov then this would be the bedtime on 12 Nov (checking that the last bar could be on 13 Nov)
 - ii. Real_bed7 = one week before treatment (i.e. oldest screenshot)
- f. Finally, in Stata 24 hours were added to times past 00:00 to indicate to Stata that these times were on the next day.

Variables only in endline survey:

- 1. What day did you attend the session?
 - a. Created categorical variable
 - i. 0 = Unable to attend
 - ii. 1 = Tuesday 14 November
 - iii. 2 = Thursday 16 November
 - iv. 3 = Friday 17 November
 - v. 4 = Thursday 30 November
 - vi. 5 = Friday 1 December
- 2. Please indicate why you were unable to attend a session.
 - a. Converted into arbitrary categories
- 3. How many days did you think about your MCII goal over the past two weeks?

- a. Recoded into days using the midpoint mostly. Exact numbers shown below.
 - i. 0 = Never
 - ii. 2 = 1-3 days
 - iii. 5 = 4-6 days
 - iv. 8 = 7-9 days
 - v. 11 = 10-12 days
 - vi. 13 = 13-14 days
4. MCII (setting a goal) helped me go to sleep earlier.
 - a. Recoded numerically: 1= Strongly Disagree, 5= Strongly Agree
5. I see my new bedtime becoming a long-term habit.
 - a. Recoded numerically: 1= Strongly Disagree, 5= Strongly Agree
6. Screenshots
 - a. Coded using same process as in point 15 above under variables “bed1-14”
 - b. bed1 = day after intervention
 - c. bed14 = most recent day (usually Nov 29 or 30)