The effects of short-term sleep extension on emotion regulation in chronically sleep-deprived individuals

By

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Abstract

Objectives: Chronic sleep deprivation is a prevalent public health concern that impairs emotional functioning. This study investigated whether a two-week behavioral sleep extension intervention (combining psychoeducation, motivational interviewing, and actigraphy feedback) could (a) increase sleep duration in young adults habitually sleeping ≤6.5 hours/night, (b) improve emotion regulation strategies, and (c) reduce subjective reactivity to negative stimuli. **Methods:** Eleven participants (aged 18–29) completed Baseline, Sleep Hygiene, and Sleep Extension phases in a within-subject repeated-measures design. Sleep was measured objectively with actigraphy and subjectively through daily diaries; emotion regulation strategies were tracked via Ecological Momentary Assessments. Emotional reactivity was assessed pre- and post-intervention using valence (1 = pleasant, 9 = unpleasant) and arousal (1 = calm, 9 = excited) ratings of negative images in a lab-based Emotion Regulation Task. **Results:** H1 (Sleep Duration Increase) was supported, with objectively measured sleep rising from $M = 5.15$ hr at Baseline to $M = 6.67$ hr in the Extension phase ($p < .001$), and subjectively reported sleep from $M = 5.65$ hr to $M = 7.37$ hr ($p < .001$). Regression analyses (H2) showed that greater increases in sleep predicted significantly lower rumination ($\beta = –.358$, $p = .016$) and higher reappraisal ($\beta = .317$, $p = .044$), whereas suppression and acceptance did not significantly change. Emotional reactivity (H3) trended toward reductions in unpleasantness ($p = .077$) and arousal ($p = .169$) for negative stimuli, though these effects did not reach statistical significance. **Conclusions:** A brief behavioral intervention increased both objective and subjective sleep, and selectively improved emotion regulation strategies—particularly rumination and reappraisal. Although reductions in emotional reactivity in the emotion regulation task were not statistically significant, consistent directional improvements suggest that extended sleep may beneficially influence responses to negative stimuli. Future research with larger samples and longer interventions is needed to fully clarify the impact of sleep extension on emotional reactivity.

Keywords: Sleep Extension; Chronic Sleep Deprivation; Emotion Regulation

Thesis Submission Declaration Form

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Thesis Submission Declaration Form

Student Name: Akira Basa Okabe

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Chapter 1

1. INTRODUCTION

Chronic sleep deprivation affects approximately 17.1% of adults in China and is closely associated with lifestyle factors such as increased digital device use and long working hours (Yan et al., 2024). This issue represents a significant public health concern, linked to elevated risks for conditions such as heart disease, stroke, diabetes, hypertension, and obesity. Alarmingly, over 60% of Chinese adults sleep less than eight hours per night, contributing not only to widespread physical health problems but also to increased healthcare costs and years of life lost due to insufficient sleep (Yan et al., 2024). At the neurobiological level, insufficient sleep disrupts communication between brain regions involved in managing emotional responses, making it more difficult to regulate mood effectively (Palmer & Alfano, 2017). While this connection is well-established, less is known about how extending sleep might alter individuals' ability to manage their emotions, particularly in ways that promote more adaptive and reduce maladaptive emotional responses.

Therefore, the present study explores whether a short-term behavioral sleep extension intervention can increase sleep duration in chronically sleep-deprived individuals, and whether such increases are associated with shifts in the way individuals respond to emotional challenges. In particular, it examines whether improvements in sleep may facilitate the use of more adaptive emotional responses and reduce tendencies that contribute to emotional difficulties. The study also investigates whether changes in sleep are accompanied by a reduction in emotional sensitivity to negative stimuli, helping to clarify sleep's role in shaping daily emotional experience.

1.1 Literature review

Chronic Sleep Deprivation

Chronic sleep deprivation, defined as obtaining less than 6 hours of sleep per night, impairs neurobehavioral performance and leads to emotional disturbances (Yan et al., 2024). It heightens the risk of engaging in risky behavior, enhances impulsivity, and compromises cognitive functions such as problem-solving. Mood regulation, particularly emotion regulation, becomes more difficult in the context of sleep deprivation (Chattu et al., 2019). Specifically, sleep deprivation diminishes emotional reactivity by reducing positive emotions and amplifying negative emotions, such as anxiety, irritability, and stress. This emotional impairment suggests that sleep deprivation disrupts the neurobiological mechanisms that underlie emotion regulation (Palmer et al., 2023).

Sleep and Emotion Interaction

Sleep deprivation disrupts critical neural interactions vital for emotional regulation. It leads to increased emotional reactivity, particularly in response to negative stimuli. Research shows that sleep deprivation impairs connectivity between the medial prefrontal cortex (PFC) and the amygdala—two brain regions crucial for emotional processing and regulation. The medial PFC helps modulate emotional responses, while the amygdala plays a key role in emotional reactivity. When this connection weakens, individuals struggle to regulate their emotions effectively (Palmer & Alfano, 2017). Additionally, sleep deprivation reduces the efficacy of emotion regulation strategies, such as cognitive reappraisal and attention deployment, leading to heightened emotional sensitivity (Palmer & Alfano, 2017).

Almondes et al. (2021) also found that sleep deprivation exacerbates emotional reactivity by impairing PFC-amygdala connectivity. This disruption leads to greater emotional instability and increased susceptibility to stress and negative stimuli. Circadian rhythm disturbances, often linked with sleep deprivation, further aggravate emotional dysregulation, creating a vicious cycle that amplifies emotional reactivity (Almondes et al., 2021).

Emotion Regulation

Emotion regulation involves managing and modifying emotional responses to internal or external stimuli using various strategies, such as situation selection, attentional control, and cognitive reappraisal. Sleep deprivation impairs the ability to use these strategies effectively. For example, sleep-deprived individuals may avoid rewarding situations and social interactions due to fatigue, reducing their ability to engage in positive emotional experiences (Palmer & Alfano, 2017).

Cognitive Reappraisal

In the context of the emotion regulation task, cognitive reappraisal involves reinterpreting a situation to alter its emotional impact. Sleep deprivation impairs cognitive flexibility, making it more difficult for individuals to reframe negative situations in a less emotionally charged way (Palmer & Alfano, 2017). This task-based use of reappraisal often involves active cognitive processes aimed at regulating immediate emotional reactions to stimuli presented in controlled environments.

Distraction

Distraction involves shifting attention away from emotional stimuli. However, sleep deprivation hinders this ability, making individuals more vigilant to negative stimuli and reducing the effectiveness of distraction as an emotion regulation strategy (Palmer & Alfano, 2017).

Maladaptive Emotion Regulation

Maladaptive emotion regulation strategies are typically characterized by ineffective emotional management. These strategies often involve attempts to suppress emotional expression or engage in repetitive focus on negative emotions.

Suppression

Suppression involves inhibiting emotional expression, which may reduce short-term emotional expression but increases physiological responses and worsens emotional outcomes in the long term. This strategy is commonly linked to poorer mental health and ineffective emotional regulation (Kozubal et al., 2023). Although suppression might provide temporary relief from emotional expression, it often leads to greater emotional dysregulation and increased distress over time.

Rumination

Rumination refers to the repetitive focus on negative emotions, which prolongs negative feelings and increases emotional intensity. Rumination is associated with poor emotional processing and contributes significantly to anxiety and depression (Sahib et al., 2024). This strategy undermines problem-solving abilities and hinders effective emotional processing, further exacerbating emotional difficulties

(Kozubal et al., 2023; Sahib et al., 2024). By fixating on negative emotions, individuals who engage in rumination tend to reinforce their emotional distress, making it more difficult to manage or resolve.

Both suppression and rumination reflect maladaptive attempts to regulate emotions that ultimately lead to poorer emotional outcomes, especially when amplified by factors like sleep deprivation.

Adaptive Emotion Regulation

Adaptive emotion regulation strategies, such as cognitive reappraisal and acceptance, are linked to improved emotional stability and long-term psychological well-being.

Cognitive Reappraisal

Cognitive Reappraisal involves reinterpreting a situation to change its emotional impact. It is widely recognized as an effective emotion regulation strategy associated with numerous psychological benefits, including reduced negative emotions and enhanced positive emotions. Research indicates that habitual use of reappraisal is linked to better emotional well-being, with individuals who frequently use this strategy experiencing more stable moods and fewer emotional disturbances (Troy et al., 2017). Cognitive reappraisal is particularly effective in minimizing distressing emotions by altering one's interpretation of a situation, thereby reducing the emotional intensity and fostering a more balanced emotional response. Long-term use of reappraisal has been shown to contribute to sustained psychological health and emotional resilience.

Acceptance

Acceptance refers to the non-judgmental engagement with emotions, where individuals acknowledge their emotional experiences without attempting to alter or suppress them. Acceptance is associated with reduced negative affect, improved psychological health, and more adaptive physiological responses to stress (Troy et al., 2017). It plays a crucial role in promoting emotional resilience by encouraging emotional recovery, self-awareness, and reducing emotional avoidance. Acceptance fosters a balanced approach to managing emotions by allowing individuals to experience and process emotions in a healthy, adaptive way, rather than attempting to control or dismiss them. Empirical evidence supports that acceptance enhances long-term emotional stability and well-being, helping individuals navigate stress more effectively (Alawadhi et al., 2024). Additionally, cognitive reappraisal and acceptance contribute to emotional recovery by promoting a flexible, adaptive approach to handling emotions, fostering emotional resilience, and supporting long-term psychological health (Troy et al., 2017; Alawadhi et al., 2024).

Impact of Sleep Deprivation on Emotion Regulation

Sleep deprivation profoundly disrupts the brain's ability to regulate emotions, particularly through impairments in the connectivity between the medial prefrontal cortex (PFC) and the amygdala—two regions integral to emotional regulation (Palmer & Alfano, 2017). This disruption reduces prefrontal cortex activity, which in turn enhances emotional reactivity and increases vulnerability to stress (Tomaso et al., 2021). Moreover, sleep deprivation amplifies amygdala activity, especially in response to negative stimuli, exacerbating emotional responses and further impairing emotion regulation (Yoo et al., 2007, as cited in Goldstein & Walker, 2014).

Tomaso et al. (2021) also demonstrated that sleep restriction diminishes the capacity to engage in adaptive emotion regulation strategies like cognitive reappraisal. This deficit results from weakened top-down regulation from the prefrontal cortex, leading individuals to rely more on maladaptive strategies such as rumination or suppression, which can exacerbate emotional distress.

Emotional Reactivity

Sleep deprivation reduces prefrontal cortex activity and impairs amygdala signaling, leading to inappropriate emotional reactions and heightened vulnerability to stress. The disrupted connection between the PFC and the amygdala increases emotional reactivity, particularly in response to negative stimuli, resulting in exaggerated emotional responses. This phenomenon supports the concept of a "negativity bias," in which individuals are more likely to react intensely to negative events, fostering emotional instability (Simon et al., 2021, as cited in Tomaso et al., 2021).

Sleep Extension and Emotion Regulation

Research indicates that sleep extension interventions can effectively increase sleep duration and improve emotional regulation. Typically, sleep extension involves behavioral and educational strategies that promote consistent sleep schedules and calming pre-sleep routines, which in turn enhance both sleep quality and emotional well-being (Baron et al., 2021). A meta-analysis by Baron et al. (2021) revealed that sleep extension increased sleep duration by approximately 45 minutes on average, leading to significant improvements in emotional regulation and psychological well-being. These interventions have also been linked to enhanced cognitive performance and better mood regulation (Baron et al., 2021). Furthermore, studies have shown that sleep extension can improve PFC-amygdala connectivity, helping to recover from chronic sleep deprivation and mitigate negative emotional responses (Motomura et al., 2017). Notably, sleep extension was found to reduce resting-state amygdala activity, which may explain the improvements in mood regulation. These findings suggest that sleep extension could counteract the emotional dysregulation often caused by chronic sleep deprivation (Motomura et al., 2017).

1.2 Research Gaps

Mixed evidence on sleep deprivation and emotional reactivity

Despite significant findings, research on sleep deprivation's impact on emotional reactivity and regulation presents mixed results. Some studies suggest sleep loss exacerbates emotional reactivity, while others show no significant changes (Tempesta et al., 2018). The conflicting results may stem from differences in sleep quality, duration, and emotional stimuli used in the studies. This ambiguity underlines the need for further research to clarify how sleep influences emotional processing in real-world settings (Tempesta et al., 2018).

Lack of Research on Short-Term Sleep Extension and Emotion Regulation

Most studies focus on the negative effects of sleep deprivation, with limited research on the potential benefits of short-term sleep extension for emotion regulation in chronically sleep-deprived individuals (Palmer & Alfano, 2017). While sleep deprivation disrupts neural circuits involved in emotional regulation, particularly by reducing connectivity between the PFC and the amygdala, the effects of short-term sleep extension on these circuits remain largely unexplored.

Limited Objective Measures of Sleep Duration and Emotion Regulation Strategies

Few studies have used objective measures, like actigraphy, to assess how changes in sleep duration affect emotion regulation strategies (Boon et al., 2023; Parsons et al., 2021). Most research relies on subjective sleep reports or focuses on sleep deprivation protocols rather than manipulating sleep duration experimentally. This gap in the literature highlights the need for more research using objective sleep measures to understand how fluctuations in sleep duration impact emotion regulation strategies.

Additional Experimental Research Needed on Sleep and Affect Regulation

Straus et al. (2024) call for experimental studies to explore how sleep influences the implementation of affect regulation strategies. Inducing emotional responses and instructing participants to use specific regulation strategies would provide valuable insights into how sleep affects the use and effectiveness of these strategies. Comparing emotional responses between conditions where regulation strategies are either used or not would help clarify the role of sleep in emotion regulation (Straus et al., 2024).

1.3 Hypotheses

The following hypotheses will be tested in this study:

- **H1**: Sleep duration will increase progressively across intervention stages, from baseline through sleep hygiene to sleep extension (DV1).

- **H2**: Improvements in sleep duration during the sleep extension phase predict improved emotion regulation strategies post-intervention, including:
  - (a) Reduced use of maladaptive emotion regulation strategies (suppression and rumination) (DV2)
  - (b) Enhanced use of adaptive emotion regulation strategies (acceptance and reappraisal) (DV3)
- **H3**: After the sleep extension intervention, participants will show improved subjective emotional reactivity to negative stimuli, as measured by:
  - (a) Lower valence ratings (DV4)
  - (b) Lower arousal ratings (DV5)

CHAPTER 2

2. METHODOLOGY

2.1 Participants

A total of 11 healthy young adults (aged 18–29 years) were recruited through flyers and email. Although an initial sample size of 28 was planned, practical constraints and pilot study limitations restricted the final sample to 11 participants. Eligibility required participants to habitually obtain ≤6.5 hours of sleep per night, confirmed via screening questionnaires and self-report. Exclusion criteria included regular daytime napping (defined as more than 2x per week, and each nap exceeding 45 minutes), shift work, left-handedness, and any diagnosed medical or psychiatric conditions potentially affecting sleep or emotion regulation. An incentive of HKD 800, payable in cash or electronically, was provided upon study completion.

Participants meeting any of the following criteria were excluded from the current study:

- Regular daytime napping habits.
- Current shift work schedules (e.g., night-shift workers).
- Left-handedness.
- Any diagnosed medical or psychiatric conditions or disorders that could potentially affect sleep or emotion regulation processes.

2.2 Materials

Emotion Regulation Task

Participants completed an Emotion Regulation Task adapted from prior protocols. They viewed neutral and negative images from the International Affective Picture System (IAPS; Lang et al., 2008), each presented for 5 seconds. Before each image, a cue instructed one of three regulation strategies:

- **Maintain:** Let natural emotional responses occur without modification.
- **Distract:** Redirect attention to unrelated or neutral content.
- **Reappraise:** Reinterpret the image in a less negative or more neutral way.

After each trial, participants rated their responses using the Self-Assessment Manikin (SAM; Bradley & Lang, 1994):

- **Valence:** 1 = pleasant, 9 = unpleasant
- **Arousal:** 1 = calm, 9 = excited

Questionnaires

Pittsburgh Sleep Quality Index (PSQI)

The Pittsburgh Sleep Quality Index (PSQI; Buysse et al., 1989) is an 18-item self-report questionnaire that assesses sleep quality over the past month by generating a global score ranging from 0 to 21 (with higher scores indicating poorer quality). It was administered only during screening to ensure participants habitually slept ≤6.5 hours per night, and those meeting this criterion were included in the study.

Global Sleep Assessment Questionnaire (GSAQ)

The Global Sleep Assessment Questionnaire (GSAQ; Roth et al., 2002) is an 11-item self-report tool that identifies symptoms of common sleep disorders such as insomnia, sleep apnea, and restless leg syndrome. It was only used during screening to exclude participants reporting any symptoms indicative of sleep disorders, ensuring that only healthy individuals without diagnosed sleep-related conditions were included.

Daily measurements

Objective Measures

Actigraphy Watch

Each participant wore an actigraphy watch throughout the study to track their sleep-wake patterns and provide daily data on total sleep time as a measure of objective sleep duration. Subjective sleep duration estimates from PRO-Diary which is an electronic device for capturing subjective data were then compared with the objective recordings to ensure the final sleep duration values accurately reflected participants' sleep experience.

Subjective Measures

Consensus Sleep Diary (CSD)

Participants completed two question items from the Consensus Sleep Diary (CSD-M; Carney et al., 2012) each morning to record their subjective sleep experience. Data were collected from the PRO-Diary watch, which has been shown to yield reliable subjective sleep data (Jungquist, 2015).

- **Subjective Sleep Duration** was captured via CSD-M Question 8: "In total, how long did you sleep?" (open numerical input)
- **Sleep Quality** was taken using CSD-M Question 9: "How would you rate the quality of your sleep?" on a 5-point scale from 1 = Very Poor to 5 = Very Good.

Ecological Momentary Assessment (EMA)

Daily EMA surveys via PRO-Diary tracked participants' use of emotion regulation strategies on a 5 point scale from 1 = Strongly Disagree to 5 = Strongly Agree, this is adapted by the SENA research team:

- **Acceptance:** "I accept my feelings without judgment." (SENA_EMA_ER_acceptance)
- **Reappraisal:** "I change my perspective on things." (SENA_EMA_reappraise)
- **Suppression:** "I suppress and avoid expressing my feelings." (SENA_EMA_suppression)
- **Rumination:** "I can't stop thinking about my feelings." (SENA_EMA_rumination)

These items assessed day-to-day fluctuations in emotion regulation strategy use.

2.3 Intervention Components

Sleep Hygiene

Participants were educated on sleep hygiene practices, which included behavioral adjustments such as maintaining a consistent sleep schedule (regular bedtimes and wake-up times), establishing relaxing pre-sleep routines, and avoiding stimulants such as caffeine or nicotine prior to bedtime.

Sleep Extension Intervention

Participants were instructed to extend their habitual nightly sleep duration by 90 minutes during the final intervention phase. This sleep extension directive was reinforced through psychoeducation, daily actigraphy reminders, and motivational interviewing. Adherence of ≥80% to the prescribed sleep extension was required.

Psychoeducational Videos

Psychoeducational materials and motivational interviewing techniques were utilized as primary intervention components to enhance sleep behaviors. Psychoeducational videos (Wood, 2019) provided participants with detailed education on sleep hygiene practices and the importance of adequate sleep for emotional well-being.

Motivational Interviews (MI)

Motivational Interviews (Wood, 2019) were conducted at two key points in the intervention to reinforce adherence, enhance motivation, and address potential barriers to achieving recommended sleep goals.

2.4 Study Procedure and Design

Operationalisation of IVs and DVs

This study used a within-subject repeated-measures design over a 14-day period, comprising three sequential intervention phases:

Baseline (T1–T2; 3 days): Participants maintained their habitual short sleep (≤6.5 hours/night), verified by actigraphy and sleep diaries.

Sleep Hygiene (T2–T3; 4 days): Participants received psychoeducational videos and motivational interviews to promote consistent bedtime routines and sleep hygiene practices.

Sleep Extension (T3–T4; 7 days): Participants were instructed to extend nightly sleep by 90 minutes, with adherence monitored via actigraphy.

Independent Variables (IVs)

Categorical IV (Intervention Stages; Hypothesis 1): Intervention Stage (Baseline, Sleep Hygiene, Sleep Extension).

Continuous IV (H2): Change in sleep duration (ΔSleep) from T1–T2 to T3–T4.

Covariates for H2: Mid-phase (T2–T3) mean scores for maladaptive and adaptive strategies.

Categorical IV (Time; Hypothesis 3): Time (Pre vs. Post) for examining emotional reactivity changes from Pre-intervention (T2) to Post-intervention (T4).

Dependent Variables (DVs)

DV1 (H1): Objective and subjective sleep duration, averaged across phases.

DV2 (H2a): EMA scores for suppression and rumination at T4.

DV3 (H2b): EMA scores for acceptance and reappraisal at T4.

DV4 (H3a): Valence ratings of negative stimuli (scale: 1 = pleasant to 9 = unpleasant).

DV5 (H3b): Arousal ratings of negative stimuli (scale: 1 = calm to 9 = excited).

Statistical Approach

H1: Sleep duration increases across intervention stages from baseline through sleep hygiene to sleep extension

To address Hypothesis 1 (H1) which posits a progressive increase in sleep duration across the three intervention stages (Baseline, Sleep Hygiene, Sleep Extension) -- a repeated measures ANOVA will be conducted to test whether mean sleep duration differs significantly across these stages. If the main effect is significant, post hoc comparisons will identify specific stage differences.

It is anticipated that mean sleep duration will progressively increase across stages, reflecting the effectiveness of the interventions educational videos, motivational interviewing, and the 90-minute extension recommendation in increasing overall sleep.

H2: Improvements in sleep duration during the sleep extension phase predict improved emotion regulation strategies at post-intervention, including

(a) reduced maladaptive strategies (suppression and rumination)

(b) improved adaptive strategies (acceptance and reappraisal)

This hypothesis posits that participants who increase sleep duration from Baseline (T1–T2) to Sleep Extension (T3–T4) will demonstrate greater improvements in emotion regulation—specifically, reduced use of maladaptive strategies and increased use of adaptive strategies at T4.

A multiple linear regression approach will be used to test this hypothesis across four separate models—one for each emotion regulation subscale. The primary predictor will be the change in sleep duration (T3–T4 minus T1–T2), while the outcome variable will be the post-intervention (T3–T4) EMA score for each strategy. Mid-phase (T2–T3) scores will serve as covariates to control for individual differences at the midpoint.

A negative relationship between ΔSleep and maladaptive strategy scores (e.g., rumination) would suggest that participants who gained more sleep subsequently reduced those behaviors. Conversely, a positive relationship with adaptive strategy scores (e.g., reappraisal) would indicate that greater sleep increases were associated with more frequent use of those strategies. Each model will be evaluated for statistical significance ($p < .05$) and tested for standard regression assumptions, including normality of residuals, homoscedasticity, and absence of outliers. If significant after adjusting for mid-phase covariates, these results would support the role of increased sleep in enhancing emotion regulation.

H3: After the sleep extension intervention, participants will show improved subjective emotional reactivity to negative stimuli, as measured by:

(a) **lower valence ratings** (scored 1 = pleasant to 9 = unpleasant)
(b) **lower arousal ratings** (scored 1 = calm to 9 = excited)

To test this, a 2 (Time: Pre vs. Post) × 3 (Condition: Maintain, Reappraise, Distract) repeated-measures ANOVA will be conducted separately for each dependent variable (valence and arousal). The analysis will assess:

Main Effect of Time: Overall changes in ratings from Pre (T2) to Post (T4).

Main Effect of Condition: Differences in regulation strategies across all time points.

Time × Condition Interaction: Whether certain strategies are more effective in reducing emotional reactivity over time.

Additionally, a 2 (Time) × 2 (Condition) ANOVA comparing Neutral Maintain and Negative Maintain will confirm whether negative images elicit greater arousal and unpleasantness than neutral stimuli.

This analysis includes 11 participants, with one excluded due to outlier responses from a rating-scale misunderstanding. Planned comparisons will be followed by pairwise or simple effects analyses, applying Bonferroni correction as appropriate.

Protocol

The intervention spanned 14 days, divided into four stages (T1–T4), with continuous assessments of sleep, emotion regulation, and emotional reactivity.

Days 1–3 (T1: Baseline)

Participants completed initial screening via qualtrics using the PSQI and GSAQ, administered by the SENA research team. Participants then began wearing actigraphy watches to record nightly sleep duration, maintained their habitual short sleep schedule (≤6.5 hours/night), and completed daily EMAs on emotion regulation, along with the Consensus Sleep Diary (CSD) to track subjective sleep quantity and quality.

Day 4 (T2: Pre-Test)

On Day 4, participants attended the first in-lab session and received a motivational interview on sleep behaviors. They were instructed to continue their short sleep schedule for stabilization. They then completed the Emotion Regulation Task (ERT), providing valence (1 = pleasant to 9 = unpleasant) and arousal (1 = calm to 9 = excited) ratings in response to negative stimuli. Daily EMAs and sleep diaries continued throughout this phase.

End of Day 8

Participants were instructed to begin extending their sleep by 90 minutes per night. A second motivational interview was conducted to reinforce compliance and address any barriers. Actigraphy data were reviewed to confirm adherence.

Days 9–15 (T3–T4: Sleep Extension Phase)

Participants followed the sleep extension protocol for seven nights, adjusting bedtime to increase sleep duration by approximately 90 minutes relative to baseline. Compliance was monitored via actigraphy and supported through automated reminders. Participants continued daily EMAs tracking usage of rumination, suppression, reappraisal, and acceptance, and completed the CSD each morning.

Day 15 (T4: Post-Test)

Participants returned for the final lab session. They repeated the ERT and rated valence and arousal in response to negative stimuli. Final questionnaires were completed, and all remaining EMAs and sleep diaries were submitted.

This protocol ensured continuous measurement of both objective and subjective indicators of sleep and emotion regulation, supporting a detailed analysis of intervention effects. All details, measures, and procedures outlined above were designed to comprehensively assess the impact of extended sleep on emotion regulation strategy usage and subjective emotional reactivity. Data obtained from actigraphy, daily surveys, and laboratory tasks provided objective and self-reported metrics, allowing for thorough investigation of the hypotheses.

CHAPTER 3

3. RESULTS

3.1 Overview of Sleep Outcomes (H1)

Hypothesis 1 is expected to progressively increase in actual sleep (DV1) from Baseline → Hygiene → Extension

Objective Sleep Duration

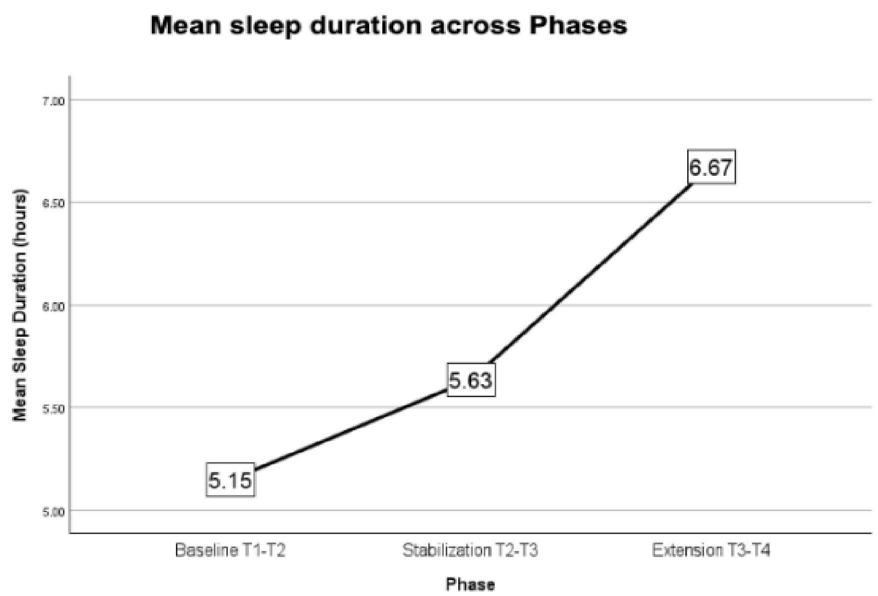

Figure 3.1: Objective Sleep Duration Across Intervention Phases

Figure 3.1 illustrates participants' objectively measured nightly sleep duration across the intervention phases—Baseline, Stabilization, and Extension. The figure clearly reveals a progressive increase in mean sleep duration from 5.15 hours in Baseline phase to 6.67 hours in Extension phase, consistent with the expected outcome (Hypothesis 1).

Intervention Phase	Mean (SD)	n	Repeated-Measures ANOVA	Pairwise Comparisons (Bonferroni p)
Baseline (T1–T2)	5.15 (0.79)	11	$F(2,20)=18.60$, $p<.001$, $\eta^2=.650$	Baseline vs. Stabilization: p=.012
Stabilization (T2–T3)	5.63 (0.74)	11		Baseline vs. Extension: p=.002
Extension (T3–T4)	6.67 (0.90)	11		Stabilization vs. Extension: p=.010

Table 3.1 Objective Sleep Duration (hours)

Participants significantly increased their nightly sleep duration over the intervention phases, clearly supporting Hypothesis 1. **Shapiro-Wilk tests** confirmed that **objective sleep duration** was normally distributed across all intervention phases—**Baseline (W = .887, p = .129), Stabilization (W = .931, p = .426), and Extension (W = .950, p = .641)**—satisfying the **normality assumption** for repeated-measures ANOVA. Objective sleep measurements recorded through actigraphy revealed a significant progressive increase (**$F(2,20) = 18.60$, $p < .001$, partial $\eta^2 = .650$**). Specifically, sleep duration increased significantly from **Baseline (M = 5.15 hours, SD = 0.79)** to **Stabilization (M = 5.63 hours, SD = 0.74, p = .012)**. During the **Extension phase (M = 6.67 hours, SD = 0.90)**, sleep duration further increased significantly compared to Baseline (**p = .002**) and Stabilization (**p = .010**). Overall, participants improved their nightly sleep duration by approximately 1.5 hours from Baseline to Extension, demonstrating that the sleep extension intervention effectively and incrementally increased participants' objectively measured sleep duration.

Subjective Sleep Duration

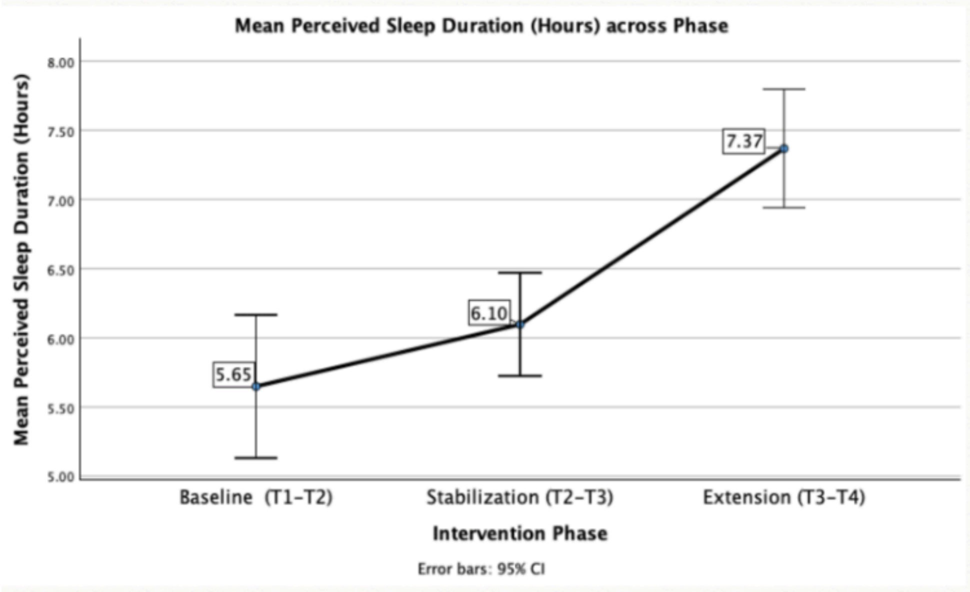

Figure 3.2: Subjective sleep duration across intervention stages

Figure 3.2 illustrates participants' subjectively reported nightly sleep duration across the intervention stages. Participants reported increases in perceived nightly sleep duration from Baseline (**M = 5.65 hours**) to Stabilization (**M = 6.10 hours**) and further increased during the Extension phase (**M = 7.37 hours**). The error bars (95% CI) visually indicate consistent increases across phases, aligning with the objective sleep duration data.

Intervention Phase	Mean (SD)	n	Repeated-Measures ANOVA	Pairwise Comparisons (Bonferroni p)
Baseline (T1–T2)	5.65 (0.77)	11	$F(2,20)=22.41$, $p<.001$, $\eta^2=.691$	Baseline vs. Stabilization: p=.199 (ns)
Stabilization (T2–T3)	6.10 (0.56)	11		Baseline vs. Extension: p=.002
Extension (T3–T4)	7.37 (0.64)	11		Stabilization vs. Extension: p<.001

Table 3.2: Subjective Sleep Duration (hours)

Subjectively reported sleep duration mirrored the objective findings, lending further support to Hypothesis 1. Participants perceived a substantial improvement in their sleep across the intervention phases (**$F(2,20) = 22.41$, $p < .001$, partial $\eta^2 = .691$**). Specifically, subjective sleep duration showed a slight increase from **Baseline (M = 5.65 hours, SD = 0.77)** to **Stabilization (M = 6.10 hours, SD = 0.56)**, but this difference was not statistically significant (**$p = .199$**). However, during the **Extension phase (M = 7.37 hours, SD = 0.64)**, subjective sleep duration significantly increased compared to both Baseline (**$p = .002$**) and Stabilization (**$p < .001$**). These results indicate that participants not only objectively increased their sleep but also clearly recognized this improvement, particularly after the sleep extension intervention was implemented.

Subjective Sleep Quality

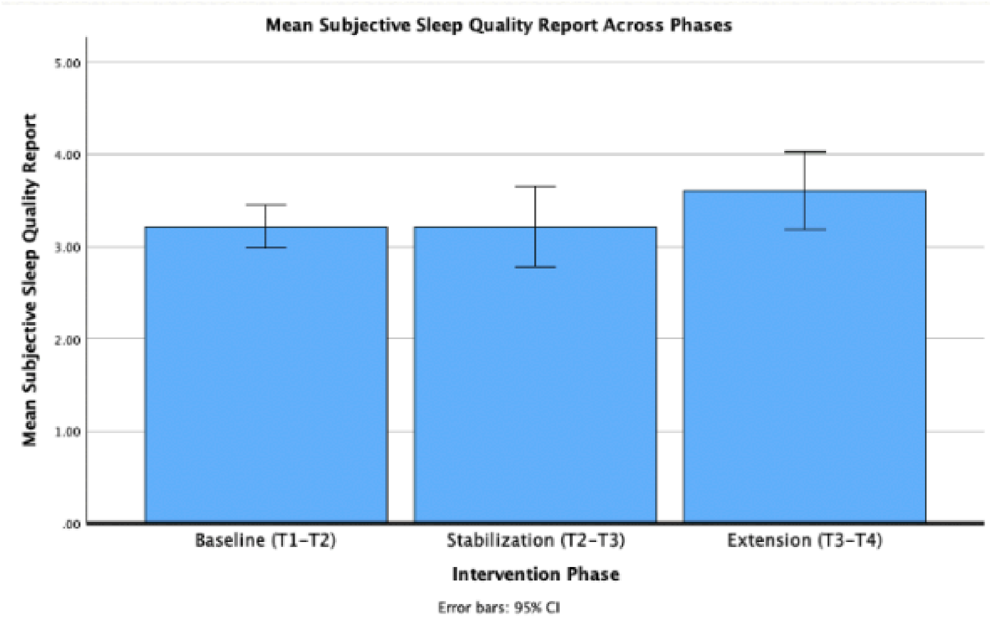

Figure 3.3: Subjective Sleep Quality

Figure 3.3 depicts participants' average subjective sleep quality ratings (scale: 1 = Very Poor, 5 = Very Good). The figure illustrates relatively stable sleep quality ratings from Baseline (**M = 3.21**) to Stabilization (**M = 3.22**), followed by a modest increase during the Extension phase (**M = 3.61**). The confidence intervals suggest the increase from earlier phases to Extension was consistent, although modest.

Intervention Phase	Mean (SD)	n	Repeated-Measures ANOVA	Pairwise Comparisons (Bonferroni p)
Baseline (T1–T2)	3.21 (0.35)	11	F(2,20)=3.14, p=.065, η^2=.239 (ns)	Baseline vs. Stabilization: p=1.000 (ns)
Stabilization (T2–T3)	3.22 (0.65)	11		Baseline vs. Extension: p=.111 (ns)
Extension (T3–T4)	3.61 (0.63)	11		Stabilization vs. Extension: p=.205 (ns)

Table 3.3: Subjective Sleep Quality (1=Very Poor, 5=Very Good)

Subjective sleep quality ratings indicated an upward trend over the course of the intervention, though this did not reach statistical significance (**$F(2,20) = 3.14$, $p = .065$, partial $\eta^2 = .239$**). Participants rated their sleep quality similarly during **Baseline (M = 3.21, SD = 0.35)** and **Stabilization (M = 3.22, SD = 0.65; p = 1.000, ns)**, with a modest increase during **Extension (M = 3.61, SD = 0.63)**. However, this improvement during Extension was not statistically significant compared to either Baseline (**p = .111, ns**) or Stabilization (**p = .205, ns**). These results suggest participants perceived modest improvements in sleep quality as sleep duration increased, but the intervention's short duration or limited sample size may have reduced statistical power, preventing these improvements from reaching significance.

Comparison of Objective vs. Subjective Sleep

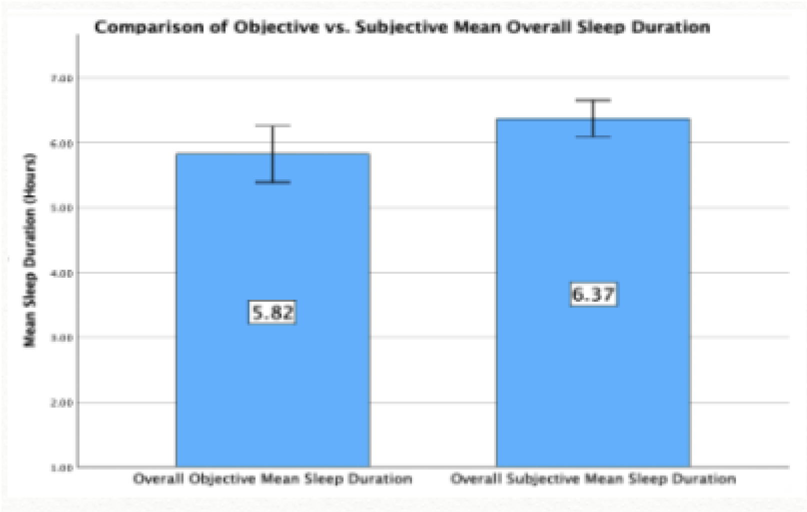

Figure 3.4: Comparison of Objective vs. Subjective Mean Overall Sleep Duration

Figure 3.4 compares overall **objective** and **subjective** mean sleep duration across all the phases. As illustrated by the bar chart, the **objective** measure (5.82 hours) was consistently lower than the **subjective** estimate (6.37 hours), suggesting a modest tendency for individuals to **overestimate** their total nightly sleep.

Comparison	Pearson r	p-value	95% CI
Objective vs. Subjective Sleep	.368	.265 (ns)	[–0.297, 0.793]

Table 3.4: Objective vs. Subjective Sleep Correlation

Correlation analyses (**Table 3.4**) further examined this observed discrepancy between objective and subjective sleep durations, revealing a positive but moderate and nonsignificant correlation (**r = .368, p = .265, 95% CI [–0.297, 0.793]**). Although participants' subjective sleep reports generally corresponded to actual sleep duration, the non significant correlation and wide confidence interval (crossing zero) indicate considerable variability and likely reflect limited statistical power due to the small sample size. Overall, these results highlight the importance of supplementing subjective reports with objective sleep measures.

3.2 Emotional Regulation Outcomes (H2)

It is expected for Hypothesis 2 to predict that increased nightly sleep duration (ΔSleep; calculated as Extension minus Baseline) would correlate with reductions in maladaptive emotion regulation strategies (negative slope) and increases in adaptive emotion regulation strategies (positive slope).

Rumination: Partial Regression Analysis

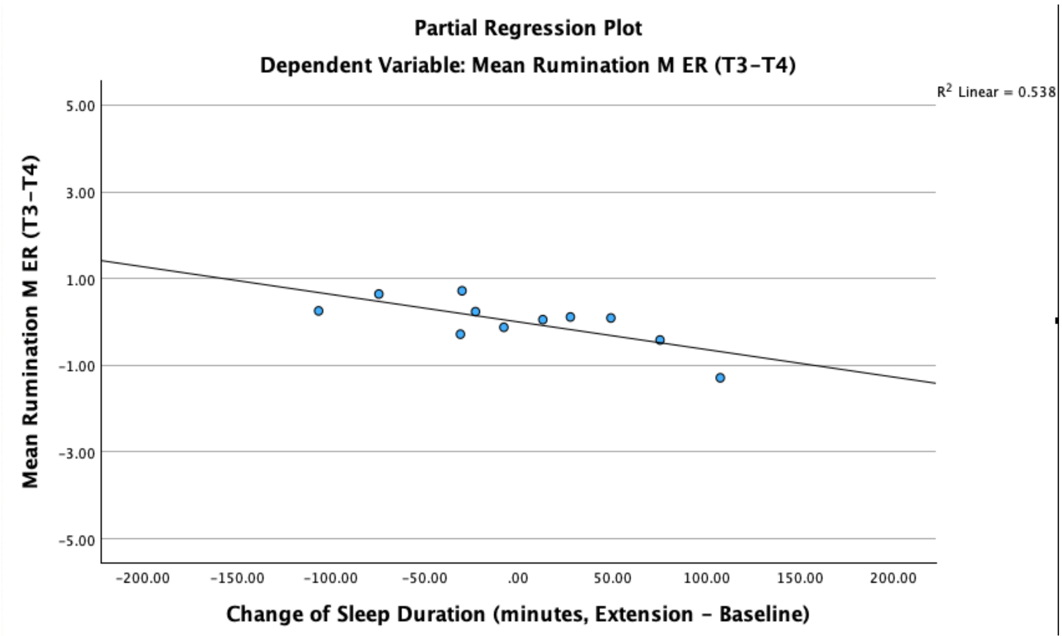

Figure 3.5: Partial Regression Plot for Mean Rumination M (Maladaptive) ER (T3–T4) as a Function of ΔSleep

As seen in Figure 3.5 , is the partial regression plot for Mean Rumination (T3–T4) as a function of ΔSleep (Extension minus Baseline), controlling for mid-intervention rumination (T2–T3). Consistent with H2, the negative slope indicates greater sleep increases were correlated with lower rumination at T3–T4, explaining approximately 53.8% of variance ($R^2 = .538$).

Suppression: Partial Regression Analysis

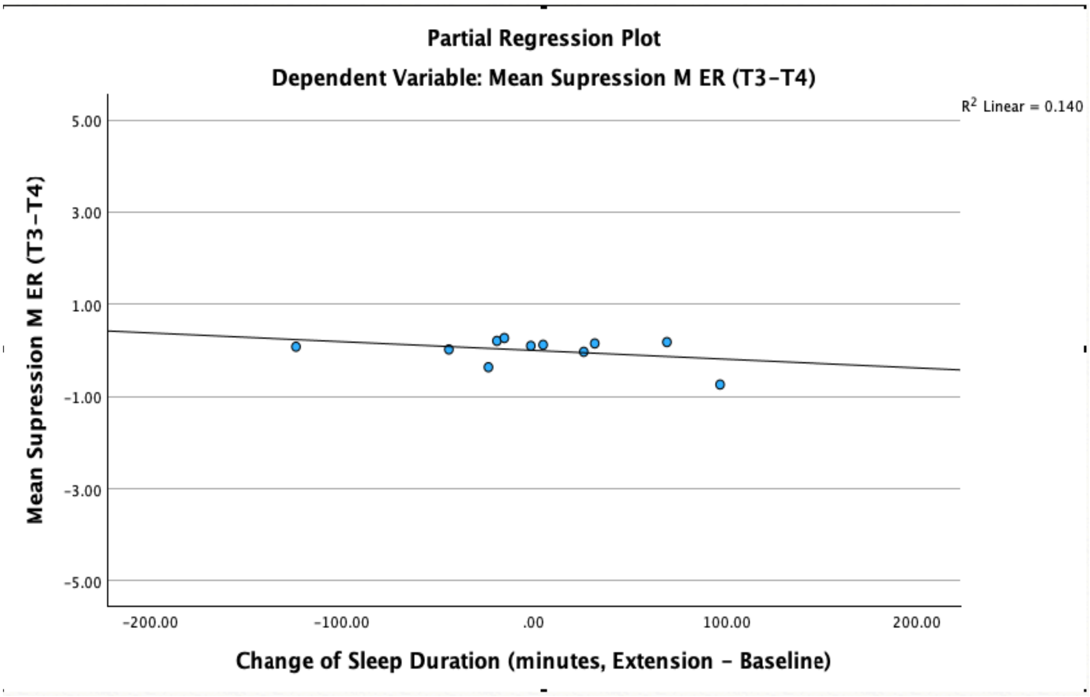

Figure 3.6: Partial Regression Plot for Mean Suppression M ER (T3–T4) as a Function of ΔSleep

Figure 3.6 illustrates the partial regression plot for Mean Suppression (T3–T4) as a function of ΔSleep, controlling for mid-intervention suppression. The negative slope suggests a modest relationship, where increased sleep was correlated with lower suppression at T3–T4, though variance explained was limited ($R^2 = .140$).

Acceptance: Partial Regression Analysis

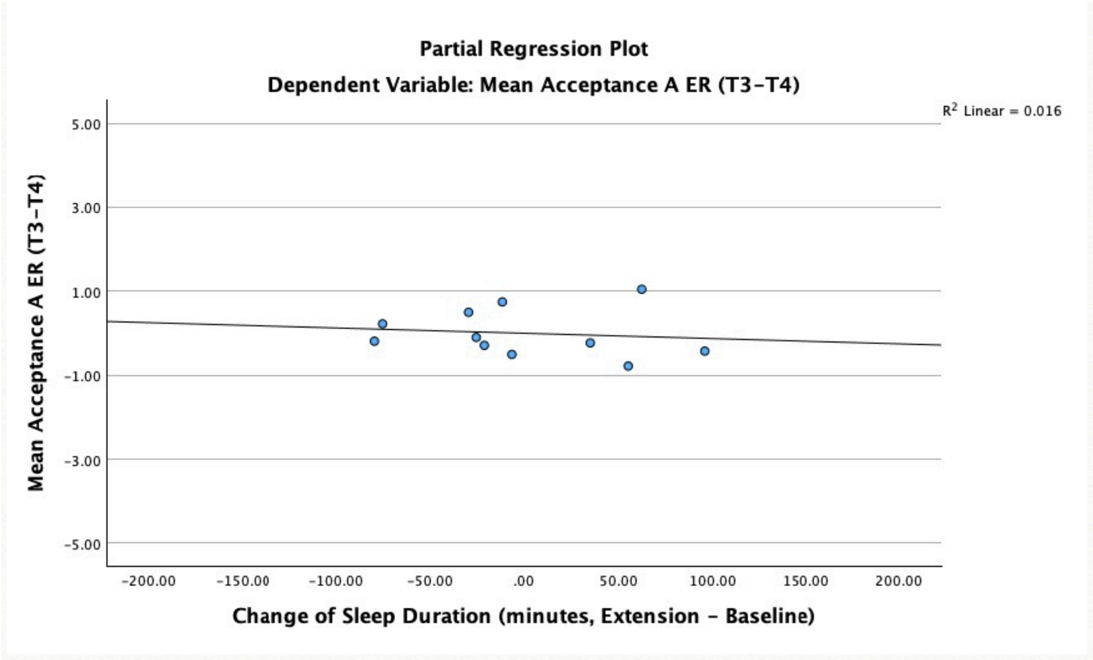

Figure 3.7: Partial Regression Plot for Mean Acceptance A (Adaptive) ER (T3–T4) as a Function of ΔSleep

Figure 3.7 shows the partial regression plot for mean acceptance (T3–T4) as a function of ΔSleep, controlling for mid-intervention acceptance. The slope is slightly negative, suggesting marginally lower acceptance correlated with increased sleep, though the explained variance is small ($R^2 = .016$); this direction was unexpected and may reflect individual variability rather than a consistent trend.

Reappraisal: Partial Regression Analysis

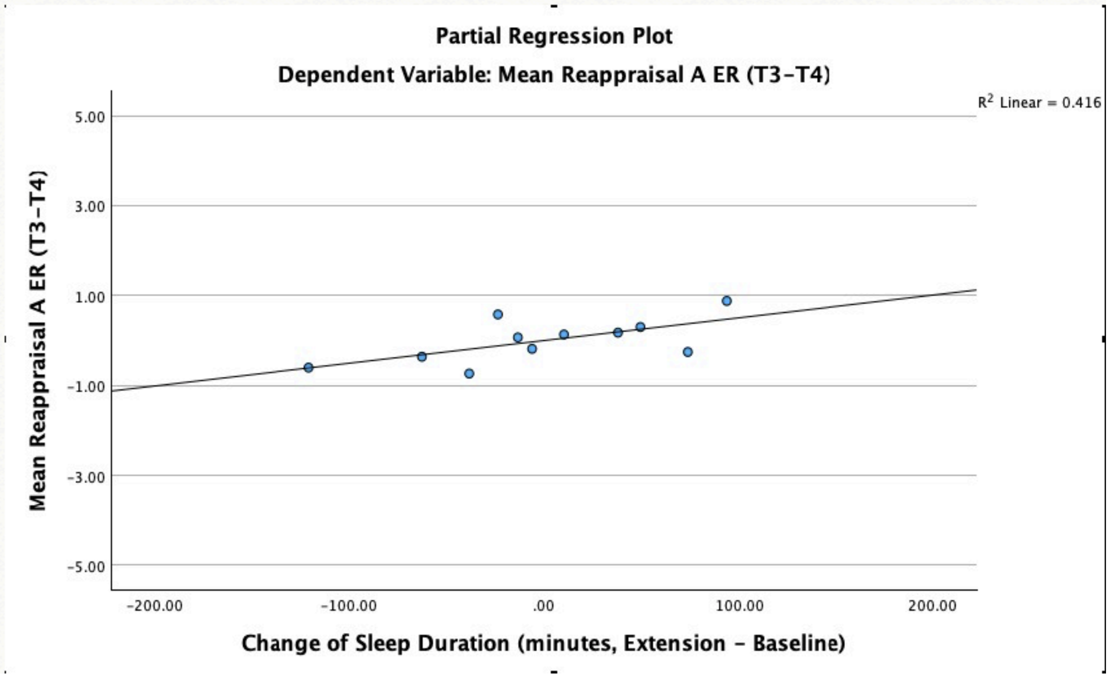

Figure 3.8: Partial Regression Plot for Mean Reappraisal A ER (T3–T4) as a Function of ΔSleep

Figure 3.8 shows the partial regression plot indicating that increased nightly sleep duration positively predicts T3–T4 reappraisal, controlling for mid-intervention reappraisal. The positive slope and $R^2 = .416$ suggest increased sleep explains a substantial portion of variance in reappraisal.

Descriptive and Correlational Results for Emotion Regulation Strategies

Strategy	Mean T2–T3 (SD)	Mean T3–T4 (SD)	r with ΔSleep	p (one-tailed)
Rumination	1.77 (0.99)	1.55 (1.14)	–.498	.059 (ns)
Suppression	1.94 (1.24)	1.67 (1.19)	–.481	.067 (ns)
Acceptance	3.13 (0.89)	3.23 (0.72)	–.388	.119 (ns)
Reappraisal	2.65 (1.12)	2.63 (1.02)	.094	.392 (ns)

Table 3.5 Emotion Regulation Strategies: Descriptive Statistics and Correlations with ΔSleep (N = 10 Participants)

Correlational analyses examined whether increased sleep duration (**ΔSleep**, calculated as the increase from Baseline to Extension) was associated with changes in emotion regulation strategies. Increased sleep duration was moderately, though nonsignificantly, correlated with reductions in maladaptive emotion regulation strategies, including rumination (**T2–T3: M = 1.77, SD = 0.99; T3–T4: M = 1.55, SD = 1.14; r = –.498, p = .059, ns**) and suppression (**T2–T3: M = 1.94, SD = 1.24; T3–T4: M = 1.67, SD = 1.19; r = –.481, p = .067, ns**). In contrast, adaptive strategies showed weaker and nonsignificant correlations with increased sleep: acceptance had a slight negative correlation (**T2–T3: M = 3.13, SD = 0.89; T3–T4: M = 3.23, SD = 0.72; r = –.388, p = .119, ns**), whereas reappraisal displayed a negligible positive correlation (**T2–T3: M = 2.65, SD = 1.12; T3–T4: M = 2.63, SD = 1.02; r = .094, p = .392, ns**). These initial correlational findings provide partial support for Hypothesis 2, suggesting that increasing sleep may modestly help reduce maladaptive emotion regulation strategies. However, the nonsignificant results highlight the need for cautious interpretation, likely reflecting limited statistical power due to the small sample size.

Hierarchical Regression Model Summaries

Strategy	Model 1 R^2	Model 2 R^2	ΔR^2	F-change	p-value
Rumination	.771	.894	.123	9.303	.016
Suppression	.938	.947	.009	1.301	.287 (ns)
Acceptance	.391	.401	.010	0.128	.729 (ns)
Reappraisal	.771	.867	.095	5.694	.044

Table 3.6 Hierarchical Regression Model Summaries: Model 1 includes mid-intervention emotion regulation as predictor; Model 2 adds sleep extension (ΔSleep) to evaluate incremental predictive value.

Regression analyses tested whether sleep extension (ΔSleep from Baseline to Extension) significantly predicted changes in emotion regulation strategies beyond initial levels, using hierarchical regression models. Results indicated that adding sleep extension significantly improved the model predicting reductions in rumination (**Model 1 R^2 = .771; Model 2 R^2 = .894; ΔR^2 = .123; F-change = 9.303, p = .016**) and increases in reappraisal (**Model 1 R^2 = .771; Model 2 R^2 = .867; ΔR^2 = .095; F-change = 5.694, p = .044**). In contrast, sleep extension did not significantly enhance prediction for suppression (**Model 1 R^2 = .938; Model 2 R^2 = .947; ΔR^2 = .009; F-change = 1.301, p = .287, ns**) or acceptance (**Model 1 R^2 = .391; Model 2 R^2 = .401; ΔR^2 = .010; F-change = 0.128, p = .729, ns**). These findings provide strong support for Hypothesis 2 specifically regarding rumination and reappraisal, highlighting that improved sleep selectively impacted these emotion regulation strategies while showing no significant predictive effects on suppression or acceptance.

Final Regression Coefficients

Strategy	Predictor	β	t-value	p-value
Rumination	T2–T3 Rumination	.779	5.82	<.001
Rumination	ΔSleep	–.358	–3.05	.016
Suppression	T2–T3 Suppression	.927	10.36	<.001
Suppression	ΔSleep	–.102	–1.14	.287 (ns)
Acceptance	T2–T3 Acceptance	.571	1.83	.105 (ns)
Acceptance	ΔSleep	–.112	–0.36	.729 (ns)
Reappraisal	T2–T3 Reappraisal	.953	7.17	<.001
Reappraisal	ΔSleep	.317	2.39	.044

Table 3.7 Final Regression Coefficients (Model 2): Results show standardized coefficients (β) for predictors (T2–T3 emotion regulation and ΔSleep) predicting T3 – T4 emotion regulation outcomes.

Final regression coefficients confirmed that increased sleep duration (ΔSleep from Baseline to Extension) significantly predicted less rumination (**β = –.358, t = –3.05, p = .016**), even after controlling for earlier rumination levels (**β = .779, t = 5.82, p < .001**). Similarly, greater sleep extension significantly predicted increased use of reappraisal (**β = .317, t = 2.39, p = .044**), controlling for earlier reappraisal (**β = .953, t = 7.17, p < .001**). In contrast, increased sleep duration did not significantly predict changes in suppression (**β = –.102, t = –1.14, p = .287, ns**), despite strong predictive effects of earlier suppression (**β = .927, t = 10.36, p < .001**). Likewise, increased sleep duration also did not significantly predict changes in acceptance (**β = –.112, t = –0.36, p = .729, ns**), with baseline acceptance itself also being nonsignificant (**β = .571, t = 1.83, p = .105, ns**). These regression findings further support Hypothesis 2, clearly demonstrating selective intervention benefits whereby increased sleep duration specifically predicted reduced rumination and enhanced reappraisal, while having no significant predictive effects on suppression or acceptance.

3.3 Overview of In-Lab Emotion Regulation Task Ratings (H3)

- **DV4 (Valence)**: **Lower** ratings from pre to post (less unpleasant).
- **DV5 (Arousal)**: **Lower** ratings from pre to post (less excited).

If both valence and arousal systematically move downward, this suggests a global effect of sleep extension on subjective reactivity.

Valence ratings

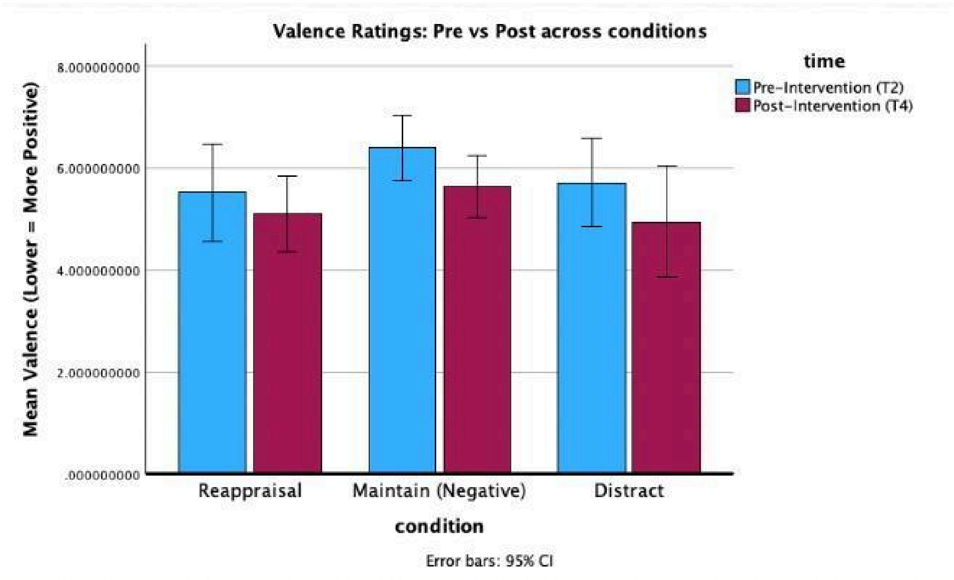

Figure 3.9: Mean valence ratings, with lower ratings indicating more pleasant emotional states (1 = pleasant, 9 = unpleasant)

Figure 3.9 presents mean valence ratings (1 = pleasant, 9 = unpleasant) for the Reappraisal, Maintain (negative), and Distract conditions at two time points: pre-intervention (T2) and post-intervention (T4). The bars illustrate how each condition’s ratings changed after one participant was excluded for unreliable, outlier responses, resulting in a **final sample of ten participants** providing ratings across all three emotion-regulation conditions. Among these three conditions, Reappraisal shows a slight decrease (from roughly 5.52 at T2 to 5.09 at T4), Maintain (negative) exhibits a moderate decline (from about 6.39 to 5.63), and Distract demonstrates the largest drop (from approximately 5.71 to 4.95). Collectively, these mean ratings indicate that, after the intervention phase, participants in all conditions reported more “pleasant” (i.e., lower) valence levels, with Distract yielding the most pronounced shift.

Condition	Pre Mean (SD)	Post Mean (SD)	n	Repeated-Measures ANOVA	Pairwise Comparisons (Bonferroni p)
Reappraisal	5.52 (1.34)	5.09 (1.04)	10	Time: $F(1,9)=3.995$, $p=.077$(ns); Condition: $F(2,18)=10.485$, $p<.001$	Maintain>Reappraisal: $p=.001$; Maintain>Distract: $p=.016$
Maintain (Negative)	6.39 (0.91)	5.63 (0.86)	10	Interaction: $F(2,18)=0.506$, $p=.611$(ns)	Reappraisal vs. Distract: $p=1.000$ (ns)
Distract	5.71 (1.20)	4.95 (1.53)	10		

Table 3.8 Mean Valence Ratings (1=pleasant, 9=unpleasant)

Participants reported lower valence ratings (indicating reduced unpleasantness) from pre- to post-intervention across all three emotion regulation conditions: Reappraisal (**Pre: M = 5.52, SD = 1.34; Post: M = 5.09, SD = 1.04**), Maintain (Negative) (**Pre: M = 6.39, SD = 0.91; Post: M = 5.63, SD = 0.86**), and Distract (**Pre: M = 5.71, SD = 1.20; Post: M = 4.95, SD = 1.53**). These analyses were conducted on a final sample of **10 participants**, as data from one participant were excluded due to misunderstanding instructions for answering the rating scale, resulting in outlier responses at pre-test. Although the overall decrease in valence ratings across time did not reach statistical significance (**Time effect: $F(1,9) = 3.995$, $p = .077$, ns**), this effect approached significance, indicating a notable trend toward improved subjective emotional responses following the intervention.

A significant main effect emerged for emotion regulation conditions (**Condition effect: $F(2,18) = 10.485$, $p < .001$**). Specifically, the Maintain (Negative) condition elicited significantly higher negative ratings compared to both the Reappraisal (**$p = .001$**) and Distract (**$p = .016$**) conditions, while Reappraisal and Distract conditions did not differ significantly from each other (**$p = 1.000$, ns**). The nonsignificant interaction (**Interaction effect: $F(2,18) = 0.506$, $p = .611$, ns**) indicates that pre-to-post intervention changes were similar in magnitude across all three conditions.

These results provide partial support for Hypothesis 3, suggesting improvements in subjective emotional responses following sleep extension. However, statistical significance for the overall time effect was likely limited by the small sample size (**$n = 10$**), further constrained by the exclusion of data from one participant. Additionally, distinct and consistent differences in valence ratings between emotion regulation strategies were observed independently of intervention effects, underscoring clear strategy-specific effectiveness.

Arousal Ratings

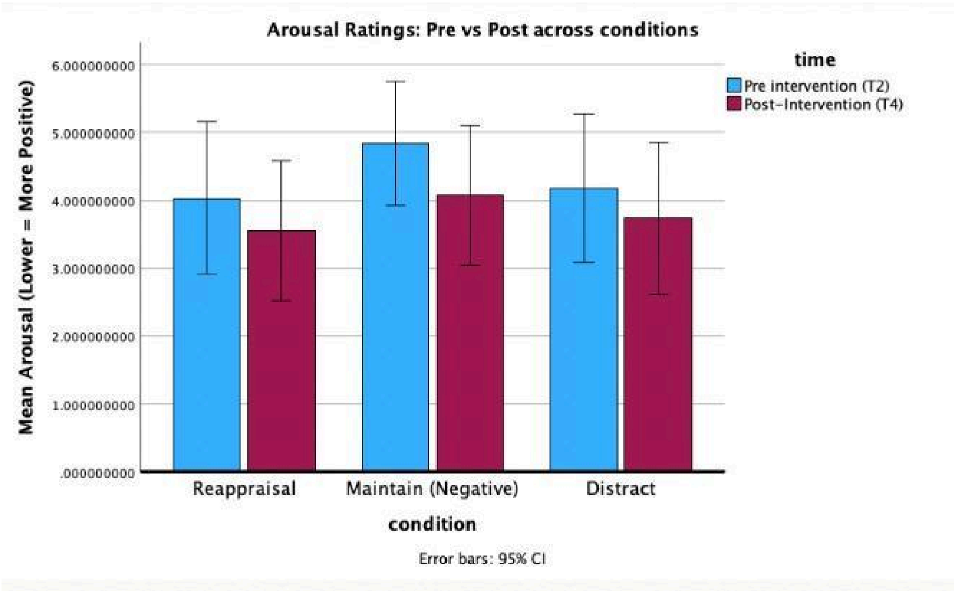

Figure 3.10: Mean arousal ratings, with lower scores indicating calmer (less excited) emotional states (1 = calm, 9 = excited).

Figure 3.10 shows mean arousal ratings (lower = more positive) for three emotion‑regulation strategies—Reappraisal, Maintain (Negative), and Distract—measured at pre‑intervention (T2) and post‑intervention (T4), with a final sample size of 10 per condition. As depicted, **Reappraisal** shifts from about 4.03 pre‑intervention to 3.55 post‑intervention, **Maintain (Negative)** moves from roughly 4.84 to 4.08, and **Distract** goes from around 4.18 to 3.74. All three conditions trend toward lower (i.e., more positive) arousal ratings, although Maintain (Negative) starts and remains at a relatively higher level compared to the other two.

Condition	Pre Mean (SD)	Post Mean (SD)	n	Repeated-Measures ANOVA	Pairwise Comparisons (Bonferroni p)
Reappraisal	4.03 (1.58)	3.55 (1.43)	10	Time: F(1,9)=2.235, p=.169(ns); Condition: F(2,18)=13.619, p<.001	Maintain>Reappraisal: p=.003; Maintain>Distract: p=.020
Maintain (Negative)	4.84 (1.27)	4.08 (1.44)	10	Interaction: F(2,18)=0.761, p=.481(ns)	Reappraisal vs. Distract: p=.524 (ns)
Distract	4.18 (1.53)	3.74 (1.55)	10		

Table 3.9 Mean Arousal Ratings (1=calm, 9=excited)

Participants similarly reported reductions in arousal ratings (indicating calmer emotional responses) from pre- to post-intervention across all three emotion-regulation conditions: Reappraisal (**Pre: M = 4.03, SD = 1.58; Post: M = 3.55, SD = 1.43**), Maintain (Negative) (**Pre: M = 4.84, SD = 1.27; Post: M = 4.08, SD = 1.44**), and Distract (**Pre: M = 4.18, SD = 1.53; Post: M = 3.74, SD = 1.55**). As previously noted, analyses included data from **10 participants** following the exclusion of one participant due to rating-scale response misunderstanding. Despite the overall favorable trend toward calmer subjective emotional responses, the reductions in arousal ratings across time did not reach statistical significance (**Time effect: F(1,9) = 2.235, p = .169, ns**), again likely reflecting limitations in statistical power due to the small sample size.

Nevertheless, a significant main effect emerged for the emotion-regulation conditions (**Condition effect: F(2,18) = 13.619, p < .001**). Specifically, the Maintain (Negative) condition elicited significantly higher arousal ratings compared to both the Reappraisal (**p = .003**) and Distract (**p = .020**) conditions. The Reappraisal and Distract conditions did not differ significantly from each other (**p = .524, ns**). The nonsignificant interaction effect (**Interaction effect: F(2,18) = 0.761, p = .481, ns**) indicated that the magnitude of pre-to-post intervention changes in arousal ratings did not differ significantly between conditions.

These results partially align with Hypothesis 3, demonstrating consistent directional (though nonsignificant) improvements in subjective emotional arousal ratings following the sleep intervention. Additionally, clear and consistent differences between emotion-regulation strategies emerged independently of intervention effects, highlighting meaningful differences in their relative effectiveness at managing emotional arousal, irrespective of sleep improvements.

Baseline Checks: Neutral vs. Negative Maintain

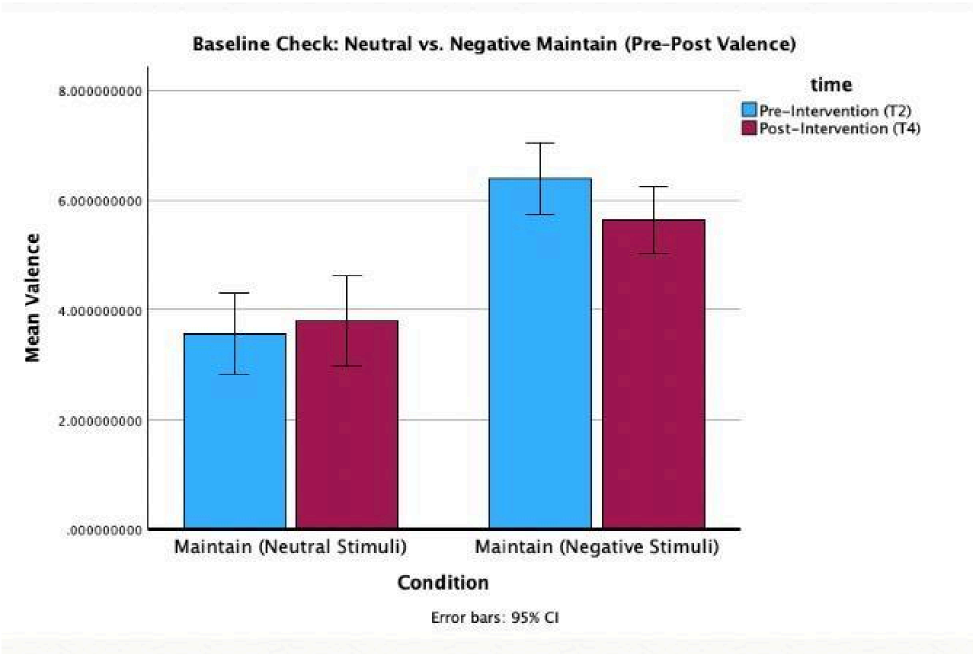

Figure 3.11: Baseline Check—Neutral vs. Negative Maintain (Pre–Post Valence)

Figure 3.11 compares mean valence ratings (1 = pleasant, 9 = unpleasant) for two conditions—Maintain (Neutral) and Maintain (Negative)at two time points: pre-intervention (T2) and post-intervention (T4). As shown by the bars, the **Maintain (Neutral)** group starts at about **3.56** at T2 and shifts slightly to **3.79** by T4, whereas the **Maintain (Negative)**group is initially higher at roughly **6.39** and then decreases to around **5.63**. These patterns suggest that, overall, *maintaining* a negative stimulus is associated with more negative (higher) valence ratings compared to maintaining a neutral stimulus, though both conditions show relatively modest changes from pre to post.

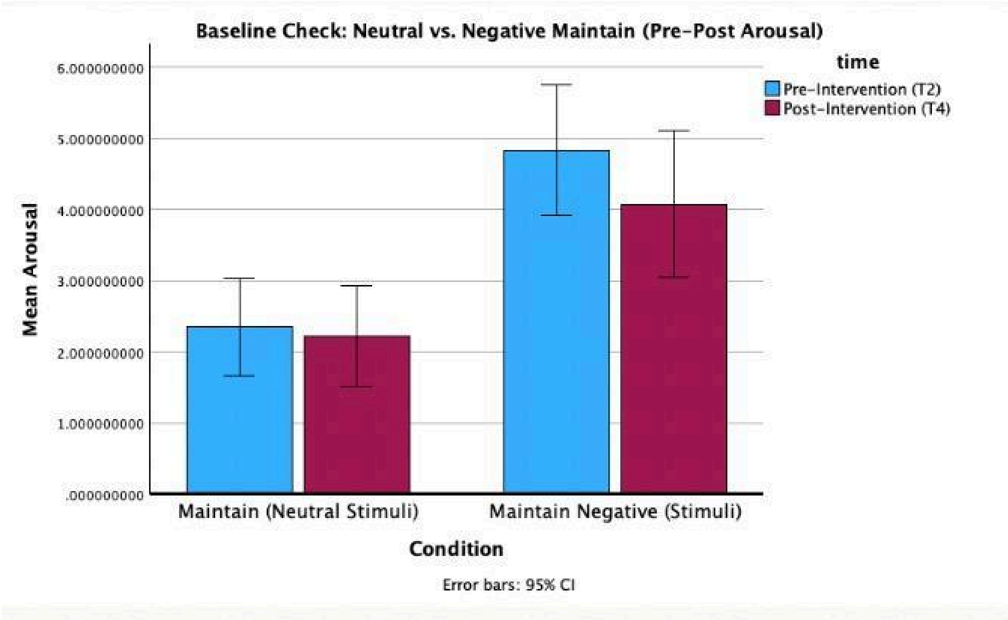

Figure 3.12: (Baseline Check: Neutral vs. Negative Maintain, Pre–Post Arousal)

As shown in Figure 3.12, participants instructed to *maintain neutral stimuli* demonstrate relatively low arousal levels (around 2.0–2.4), showing only a small decrease from pre-intervention (T2) to post-intervention (T4). By contrast, those maintaining *negative* stimuli start at a substantially higher arousal level (exceeding 4.8) and still remain higher post-intervention (around 4.1) despite a modest reduction. Thus, the valence of the maintained stimulus (neutral vs. negative) has a pronounced impact on arousal, with negative stimuli eliciting greater and more persistent arousal but exhibiting some downward shift over time.

Measure	Condition (Baseline)	Mean (SD)	F-value	p-value	Partial η^2	Pairwise Comparisons (Bonferroni adjusted)
Valence	Maintain Neutral	3.56 (1.03)	F(1,9) = 46.176	< .001	.837	Negative > Neutral, p < .001
	Maintain Negative	6.39 (0.91)				
Interaction Valence (Time × Condition)	Neutral vs. Negative	-	F(1,9) = 12.924	.006	.589	-
Arousal	Maintain Neutral	2.35 (0.95)	F(1,9) = 38.566	< .001	.811	Negative > Neutral, p < .001
	Maintain Negative	4.84 (1.27)				
Interaction Arousal (Time × Condition)	Neutral vs. Negative	-	F(1,9) = 6.894	.028	.434	-

Table 3.10 Baseline Checks (Valence and Arousal)

Baseline checks confirmed that negative emotional stimuli reliably elicited significantly higher negative valence ratings (**Negative Maintain: M = 6.39, SD = 0.91**) compared to neutral stimuli (**Neutral Maintain: M = 3.56, SD = 1.03**), as evidenced by a significant main effect of condition (**$F(1,9) = 46.176$, $p < .001$, partial $\eta^2 = .837$**). Additionally, negative stimuli induced significantly higher emotional arousal (**Negative Maintain: M = 4.84, SD = 1.27**) compared to neutral stimuli (**Neutral Maintain: M = 2.35, SD = 0.95**), also confirmed by a significant condition effect (**$F(1,9) = 38.566$, $p < .001$, partial $\eta^2 = .811$**). Crucially, repeated-measures ANOVAs revealed significant interactions between time (pre- vs. post-intervention) and condition for both valence (**$F(1,9) = 12.924$, $p = .006$, partial $\eta^2 = .589$**) and arousal (**$F(1,9) = 6.894$, $p = .028$, partial $\eta^2 = .434$**), indicating that differences between negative and neutral stimuli varied across the two time points. These significant interactions validate the emotional regulation task, ensuring that negative stimuli effectively induced more unpleasant and aroused emotional states compared to neutral stimuli at baseline, meeting a necessary condition for testing Hypothesis 3.

CHAPTER 4

4. DISCUSSION

The present study examined whether a brief behavioral sleep extension intervention could increase sleep duration, improve emotion regulation strategies, and reduce subjective emotional reactivity in young adults who habitually slept less than 6.5 hours per night. The two-week intervention combined psychoeducation, motivational interviewing, and actigraphy-supported adherence monitoring. Three hypotheses were tested:

H1: Sleep duration would significantly increase across the Baseline, Sleep Hygiene/Stabilization, and Sleep Extension phases.

H2: Greater increases in sleep (ΔSleep) would predict improved emotion regulation—reflected by reduced maladaptive strategies and enhanced adaptive responses.

H3: Participants would show reduced emotional reactivity to negative stimuli, as indicated by lower unpleasantness and arousal ratings.

Findings supported H1, with objective sleep increasing from 5.15 hours at Baseline to 6.67 hours during the Extension phase, and subjective sleep reaching 7.37 hours. Regression analyses provided partial support for H2; increased sleep was significantly associated with lower rumination and higher reappraisal, while suppression and acceptance did not show significant changes. For H3, ratings of negative stimuli trended toward lower unpleasantness and arousal after the intervention, although these changes did not reach statistical significance likely due to the small sample size. Overall, the findings suggest that modest improvements in sleep are associated with selective enhancements in emotion regulation, specifically, reduced rumination and increased reappraisal and may be linked to a trend toward decreased emotional reactivity.

4.1 Sleep Extension Intervention Effectiveness (H1)

The data demonstrate a robust ($\eta^2 = .650$) and progressive increase in sleep duration across the Baseline, Stabilization/Hygiene, and Extension stages. Although some participants continued to sleep less than the recommended 7–9 hours, the improvement from 5.15 to 6.67 hours represents a clinically meaningful shift. Similar short-term behavioral interventions have reported comparable gains (Baron et al., 2023; Tasali et al., 2022), though effect sizes vary based on adherence and protocol intensity.

Several factors likely contributed to the observed improvements:

Structured Psychoeducation and Motivational Interviewing:

Participants received active coaching aimed at challenging maladaptive sleep beliefs, emphasising realistic bedtime adjustments and personal motivators for better rest. Research indicates that individualized or small-group intervention formats outperform the mere distribution of “sleep tips” (Bendall et al., 2024). Baron et al. (2023) similarly noted that prescribing explicit bedtimes plus personalized feedback yields larger effects than general education alone. The structured protocol consisting of psychoeducation, motivational interviewing, and actigraphy likely contributed to reshaping sleep patterns in this chronically sleep‑deprived population, supporting the potential of brief behavioral support to foster healthier sleep routines.

Actigraphy and Prompt Feedback:

Ongoing reviews of actigraphy data likely maintained participant accountability and provided real-time insight into their actual sleep patterns, reinforcing newly adopted habits (Reynolds et al., 2024). While 6.67 hours still falls short of ideal recommendations, it can yield benefits in cognitive and emotional functioning (Reynolds et al., 2024). The parallel rise in subjective sleep ratings suggests participants experienced not only more sleep but also greater perceived restfulness. This alignment between subjective and objective measures supports the intervention's impact on daily routine and awareness on sleep habits.

Multi-Component Approach:

Beyond simple hygiene advice (e.g., consistent bedtimes, reduced device use), the intervention incorporated psychoeducation on the emotional and cognitive benefits of adequate rest. Research shows that participants respond more positively when aware of tangible gains (Tasali et al., 2022). Real-world studies, such as Chan et al. (2025), report sustained but modest improvements when behavioral tools and reminders are used. Although external factors such as academic demands may constrain further gains, even modest increases have been associated with meaningful improvements in mood, cognition, and health. Tasali et al. (2022) further noted that individualized counseling may yield larger benefits, yet even the modest improvements observed here offer important physiological and emotional advantages.

While participants slightly overestimated their sleep, both subjective and objective data trended similarly. This convergence implies that sleep behavior and sleep awareness both improved, reinforcing the utility of combining actigraphy with self-monitoring tools.

4.2 Emotion Regulation Strategies (H2)

Consistent with H2, the data show that greater increments in nightly sleep predicted more adaptive emotion regulation—specifically, lower rumination and higher reappraisal—but did not significantly influence acceptance or suppression. This contrast suggests that certain strategies, especially those relying on greater cognitive flexibility (like reappraisal) or those that manifest as repetitive negative thought cycles (like rumination), may respond more readily to sleep improvements (Goldstein & Walker, 2014; Zhang et al., 2019).

These findings reinforce the view that improved sleep benefits strategies relying on cognitive control and working memory. Prior research links short sleep with elevated rumination, while experimental studies show that restoring sleep enhances reappraisal by strengthening amygdala–prefrontal connectivity (Zhang et al., 2019; Walker & van der Helm, 2009). Even modest sleep gains can shift maladaptive patterns, though strategies like acceptance or suppression may require more targeted or extended interventions.

Reappraisal

Reappraisal involves reframing negative events and relies heavily on executive functioning, including working memory and inhibitory control. Its improvement here aligns with the idea that longer, more stable sleep restores prefrontal capacity for regulating emotion (Zhang et al., 2019). Adequate sleep appears to enable participants to reinterpret emotionally charged situations more adaptively (Troy et al., 2017). Li et al. (2025) found that a single night of total sleep deprivation impairs reappraisal and intensifies emotional responses to negative images. When fatigued, reappraisal often fails due to diminished prefrontal control. The present trend suggests that extended sleep helps restore this prefrontal–limbic balance.

Motomura et al. (2017) further demonstrated that mild sleep debt impairs medial prefrontal–amygdala connectivity, but these connections recover following sleep restoration. The improved reappraisal capacity observed here may stem from the same mechanism—restored top-down regulation of emotional responses.

Rumination

Rumination decreased significantly with extended sleep—an important finding given rumination's automatic and often resistant nature. It is marked by repetitive, negative self-referential thought patterns (Nolen-Hoeksema et al., 2008). Chronic sleep deprivation amplifies these tendencies, impairing attentional disengagement and increasing default mode network activity associated with self-focused rumination (Bendall et al., 2024). Improved sleep may enhance attentional control, allowing participants to interrupt or redirect these loops more effectively.

Suppression

Suppression showed no significant change. As a response-focused strategy, suppression often operates automatically and is reinforced by cultural norms, particularly under stress (Troy et al., 2017). It involves masking emotional expression without altering inner experience and is typically deployed unconsciously. Small sleep improvements may be insufficient to alter such ingrained behaviors, which likely require interventions directly addressing emotional expressivity and social context (Bendall et al., 2024).

Acceptance

Acceptance was also unaffected by increased sleep. Though it is considered adaptive, acceptance tends to function more like a dispositional stance or mindfulness-related trait than a flexible, state-based strategy. Unlike reappraisal, it is less effortful and more passive (Kobylińska & Kusev, 2019). While better sleep may reduce reactivity and foster openness, true shifts in acceptance may require longer-term interventions, such as mindfulness training.

Overall, these findings emphasize that improvements in sleep do not uniformly influence all emotion regulation strategies. Gains were prominent for reappraisal and rumination, both of which hinge on cognitive reorganization or the interruption of automatic thought patterns. In contrast, strategies that operate outside conscious control (suppression) or that reflect relatively stable dispositions (acceptance) appear less sensitive to modest, short-term increases in sleep. Tailoring interventions to target specific regulatory processes most likely to benefit from improved sleep may therefore yield the most robust outcomes.

4.3 Emotional Reactivity in Experimental Task (H3)

H3 proposed that participants would report reduced unpleasantness (valence) and arousal in response to negative stimuli after the sleep extension intervention.

Although the pre-to-post differences were not statistically significant, the observed trends followed the expected direction—lower unpleasantness and decreased arousal across regulation conditions.

These trends align with broader findings linking sustained sleep loss to heightened negative affect (Goldstein & Walker, 2014). Even modest sleep gains have been associated with calmer emotional responses (Zhang et al., 2019). While effect sizes were small, the uniformity of directional change suggests a shift toward a less reactive emotional baseline.

Possible Explanations for Non-significant findings:

Small Sample and Limited Statistical Power

With only ten valid participants contributing to this analysis, the study may have been underpowered to detect small effects. Emotional self-report measures often require larger samples for reliable inference (Lipinska et al., 2022). As Button et al. (2013) note, underpowered studies are prone to false negatives, potentially masking true effects.

Measurement Noise

Daily emotional states are inherently variable and may obscure subtle changes. The reliance on subjective ratings, while ecologically valid, is susceptible to mood fluctuations and response inconsistencies. Palmer et al. (2024) synthesized decades of findings, reporting that while sleep loss consistently reduces positive affect and reward sensitivity, its effects on negative affect are more variable. In this context, using only negative images may have limited emotional contrast, masking potential gains. Similarly, Pilcher et al. (2015) observed that sleep deprivation decreases arousal and valence responses more strongly for positive than negative stimuli, especially when sample sizes are small.

Stimulus Limitation

Because only negative stimuli were used, the range of detectable change may have been limited. Palmer et al. (2024) argue that positive emotional responses are more sensitive to sleep changes, and including both positive and neutral stimuli could have clarified the emotional scope of sleep's effect. Despite these limitations, the consistently downward shift in both valence and arousal ratings across conditions—including Maintain-Negative, Reappraise, and Distract—suggests a general trend toward reduced emotional reactivity. Rather than reflecting a strategy-specific effect, this pattern implies a baseline reduction in the intensity of emotional responses, as also found by Davidson and Pace-Schott (2021).

Although the changes did not reach statistical thresholds, the consistent downward trend supports the idea that improved sleep may produce subtle emotional recalibrations, reflecting a foundational shift in emotional tone rather than a targeted response to specific regulatory cues. Therefore, the results offer partial support for H3. While not statistically robust, the uniform decrease in valence and arousal ratings suggests that short-term sleep extension may promote a less reactive affective state. These findings warrant further investigation with larger samples and multimodal methods to clarify how improved sleep shapes subjective emotional responses.

4.4 Implications and Future Directions

The present findings offer preliminary support for a brief behavioral sleep extension protocol in selectively improving emotion regulation, particularly through reduced rumination and enhanced cognitive reappraisal. These effects followed a structured two-week intervention combining psychoeducation, motivational interviewing, and actigraphy-guided feedback—without pharmacological support. This aligns with existing evidence that behavioral approaches can enhance both sleep and emotional functioning while minimizing medication use (Burton et al., 2016).

In Hong Kong, sleep deprivation remains a significant public health concern. Data show that 17.2% of Chinese adults sleep under six hours per night, and over 61% report at least one insomnia symptom (Zhao et al., 2019). These sleep issues are independently linked to reduced happiness, even after accounting for mental health symptoms, underscoring the need to integrate sleep-focused interventions into wellness programs targeting young adults at high risk of chronic restriction.

Scalable, evidence-based interventions demonstrate that low-intensity behavioral programs can be effective. A structured behavioral protocol with a digital interface has been shown to increase sleep duration and quality, reduce presenteeism, and lower mental health service utilization (Robbins et al., 2022). These outcomes support public health applications, particularly when digital tools provide real-time feedback to reinforce behavior change.

Design features are critical to intervention success. Workplace-based, non-pharmacological programs that include institutional messaging and self-monitoring have improved both sleep and mental health outcomes, with minimal impact on medication usage (Burton et al., 2016). Interactive formats involving goal setting and personalized feedback consistently outperform passive education (Redeker et al., 2019; Illingworth et al., 2019). The current protocol mirrors these elements and demonstrates strong potential for use in educational or occupational settings.

Future research should examine whether longer interventions can shift more stable or dispositional emotion regulation patterns, such as suppression or acceptance. Evidence suggests these strategies are less likely to shift through brief interventions, even when sleep improves (Redeker et al., 2019; Illingworth et al., 2019). Including a broader emotional range—especially positive affect—could clarify whether sleep benefits regulation of specific affective domains.

Mechanistically, improved sleep may enhance regulation through increased daytime alertness and self-control (Wang et al., 2024). Future studies should incorporate physiological indices such as EEG oscillations, ERPs, or heart rate variability to detect regulatory changes not captured via self-report.

Lastly, widespread implementation will require institutional backing. Environmental constraints like academic or work schedules can hinder long-term change. Digital infrastructure and personalized feedback systems may enable sustained gains (Illingworth et al., 2019). Embedded in such systems, behavioral sleep interventions could provide a cost-effective way to improve emotion regulation and reduce vulnerability in chronically sleep-deprived populations.

4.5 Limitations

Several limitations warrant consideration. Starting with the small sample size, the remaining participants (final N = 11 in the aggregated dataset) limited statistical power, increasing the risk of Type II errors and reducing the robustness of inferences. With so few participants completing all phases, even moderate effects may have gone undetected.

Secondly, the short duration of the intervention which is approximately two weeks may have limited its capacity to alter habit-like or stable strategies (e.g., suppression, acceptance). Such strategies often require more prolonged interventions or targeted training before meaningful changes emerge.

A third limitation arises from the study's reliance on subjective, self-report measures, primarily through daily ecological momentary assessments (EMAs). While repeated EMAs can capture in-the-moment experiences, they remain susceptible to biases such as over-reporting, participant fatigue, and social desirability. Missing prompts compound these issues: descriptive analyses revealed 0.8% to 2.5% missing data in some cases from SPSS across emotion regulation subscales—rumination (735 valid responses), suppression (738), acceptance (748), and reappraisal (736). Nonresponses may reduce power and introduce systematic bias if participants with missing data differ meaningfully from those who complied fully.

Fourth, generalizability is limited. The sample consisted solely of young adults who habitually slept <6.5 hours per night, and the strict inclusion/exclusion criteria may not reflect the broader population. Factors such as age, health, or lifestyle may influence how much individuals benefit from sleep extension.

Finally, converting daily EMA data into phase-level means left only 11 usable cases per variable. While this facilitated clean comparisons, it reduced the resolution of within-person changes across time, potentially masking more nuanced trends. Taken together, these limitations suggest that future research should use larger, more diverse samples, extend intervention duration, and incorporate multi-method approaches to better determine whether sleep extension reliably influences emotion regulation and reactivity across broader populations.

4.6 Conclusion

This study highlights the feasibility and effectiveness of a brief behavioral sleep extension intervention in increasing both objectively and subjectively measured sleep duration. Notably, the intervention also improved key emotion regulation strategies, specifically by reducing rumination and enhancing reappraisal, among chronically sleep-deprived young adults. Although changes in emotional reactivity did not reach statistical significance, consistent trends in the expected direction point to promising effects. These findings underscore the potential value of integrating sleep-focused interventions into broader emotional health initiatives. Further research with larger samples and longer durations is necessary to confirm these outcomes and guide real-world implementation across clinical, educational, and public health domains.

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Appendix A: PSQI (for screening only)

Appendix. Pittsburgh Sleep Quality Index (PSQI)

Name ______________________ ID # __________ Date __________ Age ______

Instructions:

The following questions relate to your usual sleep habits during the past month *only*. Your answers should indicate the most accurate reply for the *majority* of days and nights in the past month. Please answer all questions.

1. During the past month, when have you usually gone to bed at night?
   USUAL BED TIME __________
2. During the past month, how long (in minutes) has it usually take you to fall asleep each night?
   NUMBER OF MINUTES __________
3. During the past month, when have you usually gotten up in the morning?
   USUAL GETTING UP TIME __________
4. During the past month, how many hours of *actual sleep* did you get at night? (This may be different than the number of hours you spend in bed.)
   HOURS OF SLEEP PER NIGHT __________

For each of the remaining questions, check the one best response. Please answer *all* questions.

5. During the past month, how often have you had trouble sleeping because you...

(a) Cannot get to sleep within 30 minutes

Not during the past month ____	Less than once a week ____	Once or twice a week ____	Three or more times a week ____

(b) Wake up in the middle of the night or early morning

Not during the past month ____	Less than once a week ____	Once or twice a week ____	Three or more times a week ____

(c) Have to get up to use the bathroom

Not during the past month ____	Less than once a week ____	Once or twice a week ____	Three or more times a week ____

(d) Cannot breathe comfortably

Not during the past month ____	Less than once a week ____	Once or twice a week ____	Three or more times a week ____

(e) Cough or snore loudly

Not during the past month ____	Less than once a week ____	Once or twice a week ____	Three or more times a week ____

(f) Feel too cold

Not during the past month ____	Less than once a week ____	Once or twice a week ____	Three or more times a week ____

(g) Feel too hot

Not during the past month ____	Less than once a week ____	Once or twice a week ____	Three or more times a week ____

(h) Had bad dreams

Not during the past month ____	Less than once a week ____	Once or twice a week ____	Three or more times a week ____

(i) Have pain

Not during the past month ____	Less than once a week ____	Once or twice a week ____	Three or more times a week ____

(j) Other reason(s), please describe ____

____

How often during the past month have you had trouble sleeping because of this?

Not during the past month _____ Less than once a week _____ Once or twice a week _____ Three or more times a week _____

6. During the past month, how would you rate your sleep quality overall?

Very good _____
Fairly good _____
Fairly bad _____
Very bad _____

7. During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?

Not during the past month _____ Less than once a week _____ Once or twice a week _____ Three or more times a week _____

8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

Not during the past month _____ Less than once a week _____ Once or twice a week _____ Three or more times a week _____

9. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?

No problem at all _____
Only a very slight problem _____
Somewhat of a problem _____
A very big problem _____

10. Do you have a bed partner or roommate?

No bed partner or roommate _____
Partner/roommate in other room _____
Partner in same room, but not same bed _____
Partner in same bed _____

If you have a roommate or bed partner, ask him/her how often in the past month you have had...

(a) Loud snoring

Not during the past month _____ Less than once a week _____ Once or twice a week _____ Three or more times a week _____

(b) Long pauses between breaths while asleep

Not during the past month _____ Less than once a week _____ Once or twice a week _____ Three or more times a week _____

(c) Legs twitching or jerking while you sleep

Not during the past month _____ Less than once a week _____ Once or twice a week _____ Three or more times a week _____

(d) Episodes of disorientation or confusion during sleep

Not during the past month _____ Less than once a week _____ Once or twice a week _____ Three or more times a week _____

(e) Other restlessness while you sleep; please describe

____

Not during the past month _____ Less than once a week _____ Once or twice a week _____ Three or more times a week _____

Appendix B: GSAQ (for screening only)

During the past 4 weeks, how often did you have difficulty falling asleep, staying asleep, or feeling poorly rested in the morning?

1. Never
2. Sometimes
3. Usually
4. Always

During the past 4 weeks, how often did you hold your breath, have breathing pauses, or stop breathing in your sleep?

1. Never
2. Sometimes
3. Usually
4. Always

During the past 4 weeks, how often did you have repeated rhythmic leg jerks or leg twitches during your sleep?

1. Never
2. Sometimes
3. Usually
4. Always

A full copy of this questionnaire can be obtained through the senior author.

Appendix C: Consensus Sleep Diary (Q8 & Q9)

Consensus Sleep Diary-M (Please Complete Upon Awakening) **ID/NAME: ____________________**

Sample

Today's Date	4/5/11							
1. What time did you get into bed?	10:15 p.m.							
2. What time did you try to go to sleep?	11:30 p.m.							
3. How long did it take you to fall asleep?	55 min.							
4. How many times did you wake up, not counting your final awakening?	6 times							
5. In total, how long did these awakenings last?	2 hours 5 min.							
6a. What time was your final awakening?	6:35 a.m.							
6b. After your final awakening, how long did you spend in bed trying to sleep?	45 min.							
6c. Did you wake up earlier than you planned?	☒ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
6d. If yes, how much earlier?	1 hour							
7. What time did you get out of bed for the day?	7:20 a.m.							
8. In total, how long did you sleep?	4 hours 10 min.							
9. How would you rate the quality of your sleep?	☐ Very poor ☒ Poor ☐ Fair ☐ Good ☐ Very good	☐ Very poor ☐ Poor ☐ Fair ☐ Good ☐ Very good	☐ Very poor ☐ Poor ☐ Fair ☐ Good ☐ Very good	☐ Very poor ☐ Poor ☐ Fair ☐ Good ☐ Very good	☐ Very poor ☐ Poor ☐ Fair ☐ Good ☐ Very good	☐ Very poor ☐ Poor ☐ Fair ☐ Good ☐ Very good	☐ Very poor ☐ Poor ☐ Fair ☐ Good ☐ Very good	☐ Very poor ☐ Poor ☐ Fair ☐ Good ☐ Very good
10. How rested or refreshed did you feel when you woke-up for the day?	☐ Not at all rested ☒ Slightly rested ☐ Somewhat rested ☐ Well-rested ☐ Very well-rested	☐ Not at all rested ☐ Slightly rested ☐ Somewhat rested ☐ Well-rested ☐ Very well-rested	☐ Not at all rested ☐ Slightly rested ☐ Somewhat rested ☐ Well-rested ☐ Very well-rested	☐ Not at all rested ☐ Slightly rested ☐ Somewhat rested ☐ Well-rested ☐ Very well-rested	☐ Not at all rested ☐ Slightly rested ☐ Somewhat rested ☐ Well-rested ☐ Very well-rested	☐ Not at all rested ☐ Slightly rested ☐ Somewhat rested ☐ Well-rested ☐ Very well-rested	☐ Not at all rested ☐ Slightly rested ☐ Somewhat rested ☐ Well-rested ☐ Very well-rested	☐ Not at all rested ☐ Slightly rested ☐ Somewhat rested ☐ Well-rested ☐ Very well-rested

Figure 2 *(continued)*—Sleep Diary Instructions (CSD-M)

Figure 2 continues on the following page

Appendix D: Adapted EMA Emotion Regulation Items

Note: Below is a screenshot of the EMA items, as adapted by the SENA research team, and administered via Pro Diary to assess daily fluctuations in emotion regulation strategies. Confidential information has been redacted.

	A	B	C	D	E
1	SENA_EMA_supp	Emotion Reguat Daily EMA	Suppression	I suppress and avoid expressing my feelings.	1 - 5 (1= Strongly Disagree 5= Strongly Agree)
2	SENA_EMA_rumi	Emotion Reguat Daily EMA	Rumination	I can't stop thinking about my feelings.	1 - 5 (1= Strongly Disagree 5= Strongly Agree)
3	SENA_EMA_reapp	Emotion Reguations Daily EMA	Reappraise	I change my perspective on things.	1 - 5 (1= Strongly Disagree 5= Strongly Agree)
4	SENA_EMA_ER_acc	Emotion Reguations Daily EMA	Acceptance	I accept my feelings without judgment.	1 - 5 (1= Strongly Disagree 5= Strongly Agree)
5					