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Original Article

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Targeted dream incubation and dream self-efficacy

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Abstract

This preliminary study investigates the potential for a technique that enables purposeful guiding of dream content (Targeted Dream Incubation; TDI) to change the degree to which an individual feels in control of their dreams (Dream Self-Efficacy; DSE). DSE is a subset of a larger concept of self-efficacy relating to one's belief in their own abilities and competencies. Examining DSE may be quite important, as past research has demonstrated that DSE may be linked to positive treatment outcomes in specific therapies, such as interventions for trauma-related nightmares. Furthermore, prior research has found that decreasing feelings of helplessness related to sleep has been shown to improve insomnia symptoms and daytime fatigue. Thus, our study sought to examine the relationship between TDI and DSE. We enrolled $N = 25$ participants in a TDI protocol conducted during a predominantly N1 sleep nap, where participants completed surveys before and after a TDI paradigm. Our results revealed that TDI was linked to DSE, with individuals reporting significantly higher levels of DSE after the TDI protocol. These results provide preliminary evidence for a technique (TDI) that could increase DSE with the overall aim of improving the efficacy of specific sleep-related interventions, such as treatments for trauma-related nightmares. Future research should aim to further confirm these results with a control condition and examine the effects of TDI within the context of behavioral sleep interventions.

Key words: dreaming; targeted dream incubation; self-efficacy

Statement of Significance

This manuscript provides the first evidence that a novel sleep paradigm (Targeted Dream Incubation; TDI) may lead to increases in Dream Self-Efficacy (DSE), even within a sample that experiences frequent nightmares. These preliminary results are significant because past research has demonstrated that perceptions of self-efficacy directly impact treatment success and adherence, especially in interventions that target sleep-related disorders, such as Cognitive behavioral Therapy for Insomnia. Additionally, the results of this paper provide further meaning, as they provide rationale for future studies to further explore the relationship between the TDI protocol and DSE. In sum, the results of this manuscript provide novel findings that may be able to impact sleep-related treatments.

Trauma-related nightmares (TRNs) are one of the most distressing and treatment-resistant features of posttraumatic stress disorder (PTSD), with intensely negative dream content causing debilitating daytime stress [1]. Furthermore, TRNs are quite problematic clinically, having been linked to substance abuse, depression, suicide, and many other negative outcomes [1, 2]. The leading TRNs treatments are rescripting-based therapies, such as Imagery Rehearsal Therapy (IRT) and Exposure, Relaxation, and Rescripting Therapy (ERRT). Rescripting therapies focus primarily on behavioral sleep practices (such as sleep hygiene and stimulus control) and nightmare rescription (the process of rewriting a nightmare into a changed version of the dream and then reading/rehearsing this new version throughout the day and prior to falling asleep) [3]. Rescripting-based therapies have

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produced positive results, with some studies showing significant reductions in nightmare distress and frequency following treatment completion [4]. However, other studies have found no significant difference in outcomes between IRT, ERRT, and active controls [5]. In addition to mixed efficacy, previous research has demonstrated high levels of treatment dropout with rescripting therapies such as IRT [6]. With evidence of varying levels of effectiveness, research is needed in order to improve the efficacy of rescripting-oriented therapies, with the overall goal of reducing the effects of TRNs.

Dream self-efficacy

One particular mechanism that could impact response to rescripting-based therapies is patient confidence in their ability to have control and mastery over their dream content, also referred to as dream self-efficacy (DSE). DSE was first demonstrated by Miller et al., who reported that after a successful completion of a rescripting therapy, individuals' internal self-efficacy (belief that one has control over what happens) centered around their dreams significantly increased [7]. This aligns with results from Rousseau et al. who demonstrated a significant relationship between nightmare reductions following IRT and an increase in perceived mastery over their dreams [6]. According to Rousseau, "The most frequently cited mechanism of action for IRT's effectiveness was an increased sense of mastery. Sense of mastery is defined as the conviction patients have that they can control their dreams and nightmares; this feeling would be gained through concrete experiences of control" [6]. Additionally, Rousseau reported that dropout from IRT was often related to the client's belief that they could not actually control or rescript elements of a dream.

In addition to the link between rescripting therapies and DSE, prior research has reported that insomnia severity, dysfunctional beliefs about sleep, and depressive symptoms are all negatively correlated with one's belief in their mastery of sleep [8]. There is also evidence that self-efficacy centered around sleep is negatively correlated with anxiety symptoms and positively correlated with subjective sleep quality [9]. Furthermore, it has been reported that perceived lack of control over nocturnal thoughts and lack of control over sleep are related to higher insomnia symptoms [10]. Aligned with this idea, alteration of small details in an otherwise traumatic dream, giving participants a sense of control over the dream state, has been shown to alleviate repetitive nightmares in a small case study [11]. Lastly, in veteran populations, reducing feelings of helplessness related to sleep has been shown to improve insomnia symptoms and daytime fatigue [12]. This background research provides ample evidence supporting the idea that improving a subject's sense of control and mastery over their sleep and dreaming could impact the effectiveness of rescripting-based therapies.

Targeted dream incubation and DSE

Importantly, it should be noted that situation-specific self-efficacy (e.g. mastery over work, control over health) is not considered trait-like and stable but instead can change with new experiences [13]. When considering ways to change DSE, one potential method could be targeted dream incubation (TDI). TDI is a technique that induces dreams during sleep onset that incorporate targeted information, repeatedly presenting audio cues containing the targeted information, which is then incubated during the sleep onset hypnagogic period and incorporated into dreams. TDI research has demonstrated that a high percentage of subjects (up to 92 per cent) report dreaming of the cued subject while undergoing the incubation protocol [13, 14]. Considering these results, it is possible that TDI could be a technique used to increase DSE via concrete experiences of dream control.

With the aforementioned in mind, our key aim was to provide preliminary evidence on the relationship between TDI and DSE, with the ultimate goal as serving as pilot data for future more in-depth explorations between said variables. Specifically, we investigate whether firsthand experience of TDI is related to higher ratings on scales of DSE. If TDI is in fact successful at modulating DSE, it could be used to modulate sleep-related beliefs before rescripting-oriented treatment begins and hopefully improve clinical outcomes.

Materials and methods

Participants

We enrolled $N = 28$ participants (M age = 31.55, $SD = 16.37$) to participate in a daytime napping study. Gender composition of our sample was nearly equally split (female, $n = 13$; 52 per cent & male, $n = 12$; 48 per cent). Nearly half of our sample ($n = 11$; 44 per cent) reported frequent nightmares (ranging from 1 to 7 nightmares per week).

Protocol

Potential participants were recruited via virtual and hard-copy advertisements. Before participating, all candidates were screened for inclusion and exclusion criteria (inclusion: being 18 years old or older; exclusion: not experiencing a current psychotic episode and not currently taking any sleep medications). Once screened, participants arrived at the laboratory in the afternoon between the hours of 12:00 pm and 04:00 pm, optimizing for the postprandial increase in sleepiness. All participants were told the experiment investigated the relationship between rest and cognitive flexibility. After reading and signing consent forms, subjects completed an online battery of questionnaires. All subjects were then asked to put on a sleep mask, the Dormio headworn system, and the Hypnodyne ZMax EEG before lying down and being asked to fall asleep [15]. Subjects were given a 1-h sleep opportunity. Once sleep onset occurred, participants were awakened after 2 epochs of visually scored N1 sleep. During each wakeup, the Dormio device triggered prerecorded audio prompts that requested and then recorded a verbal dream report from the subject. Once subjects finished speaking, the system asked about their sleep state ("And were you asleep?"), to which subjects had been previously instructed to respond "Awake," "Halfway" or "Asleep." Participants were then instructed to "remember to think of a tree" and go back to sleep. After the sleep opportunity, dream reports were confirmed via self-reported confirmations, following methods from Horowitz and Horowitz [14, 16]. Ten minutes after their last verbal report, all subjects completed another battery of questionnaires. Upon completion of these surveys, subjects were instructed to keep and submit a dream journal for 1 week and completed another battery of questionnaires after 1 week.

Subjects completed a collection of assessments at four-time points relative to the study: (1) during recruitment for the study, (2) immediately prior to TDI, (3) directly after TDI, and (4) 1 week after TDI. We refer to these four-time points as "recruitment," "pre-TDI," "post-TDI" and "one-week post-TDI" in our analysis.

TDI methods

During the TDI protocol, all subjects underwent a prompted hypnagogic nap, using auditory incubation delivered via the Dormio system to incubate the chosen dream theme ("tree"). Upon lying down, the

Dormio instructed participants to "think of a tree." Once entry into hypnagogia was determined (immediately after two epochs of visually scored N1 sleep was detected), the Dormio alerted participants they were falling asleep ("You're falling asleep"), asked participants to verbally report the thoughts they were currently having ("Please tell me, what's going through your mind"), and recorded their verbal response. The system then instructed them to think of the dream prompt ("Remember to think of a tree") and to go back to sleep ("You can fall back asleep now"). This loop of events was repeated for a total experiment time of 1 h, facilitating multiple entrances to and exits from N1 (although other stages of sleep may have been experienced). At the end of the last loop, the experimenter instructed the participant to wake up fully. TDI methods based on Horowitz and Horowitz et al. [14, 17].

Measures

Sleep staging.

Sleep was scored using a Hypnodyne ZMax EEG. Hypnodyne streams two EEG channels, F7 and F8, both referenced to Fpz. Performance evaluations of the Zmax relative to polysomnography indicate acceptable levels of sensitivity (68.3 per cent) and inter-rater reliability (Cohen's Kappa = 57.3; with some limitations on staging due to lack of occipital channels) [15, 17]. Visual scoring of N1 sleep was done according to the AASM Manual for Sleep Scoring [18]. Epochs of 30s were used, and awakenings were done after two subsequent epochs of N1 sleep were scored.

Assessing incubation.

For the purposes of assessing incubation, a direct reference to "tree" is defined as an unambiguous mention of any part of a tree (including tree, forest, branch, or root) while indirect references included sensations, objects, locations, or themes related to "tree" (such as plant, bush, or other tree-like objects), adapting methods from Wamsley and Horowitz [17, 19].

Dream self-efficacy.

To assess DSE related to dream content, we used a DSE questionnaire adapted in past research to assess self-efficacy related to dreaming [6]. Both a composite DSE score and two individual items "To what extent do you feel able to control the content of your dreams?" and "When it comes to bad dreams, what will be will be; they are out of my control." were examined to determine which specific aspects of DSE are impacted.

Nightmare frequency.

The frequency of nightmares was assessed by the Nightmare Frequency Questionnaire (NFQ) and nightmare-related distress was assessed via the Nightmare Distress Questionnaire (NDQ) [17, 20]. The NFQ is a 3-item self-report questionnaire that gauges the frequency of nightmare occurrences, while the NDQ is a 13-item self-report scale that assesses distress caused by nightmares [20, 21].

Dream journal.

After the TDI protocol, participants were asked to keep an electronic dream journal. Participants were asked to write (electronically) down their dreams in a journal each morning immediately after awakening. After writing their dream(s) they were then asked to report if the dreams were related to a "tree" in any way. After completing the journal for a week, participants copy and pasted the contents of their dream journal into the electronically sent survey (that included the 1-week postsurvey battery).

Analyses

Descriptive analyses were used to examine sample characteristics, as well as percentage of successful dream incubation (for total TDI sessions, not individual attempts). Using linear regressions, success of incubations will be examined as a predictor of changes in DSE following TDI (both immediately and 1-week follow-up). In order to examine our primary aim (the effect of TDI on DSE) one-way repeated measure ANOVA analyses were used (while controlling for gender and age differences) to examine the differences in DSE scores across three time-points (pre-TDI, post-TDI, 1-week post-TDI). To further examine what aspects of DSE were being impacted, when examining DSE pre-TDI, post-TDI, and 1-week post-TDI we examined both a composite DSE score and from the two aforementioned individual items. Lastly, pairwise comparison analyses were used to examine differences in DSE scores between different time points. For post hoc analyses, nonparametric analyses were used to examine participants who reported frequent nightmares and participants who did not report frequent nightmares (all while controlling for gender and age differences).

Results

Dream incorporation

Three subjects were excluded from analyses for failure to fall asleep. Of the 25 participants included in the analysis, 23 of them (92 per cent) reported at least one direct incorporation of the theme "Tree" during N1 sleep. On average, participants reported 1.96 incorporations in 4.83 N1 episodes during the 1-h nap; 40.6 per cent of awakenings were accompanied by direct incorporations of a tree into a dream report. Of the 25 participants included in the analysis, 10 (42 per cent) reported direct incorporation in the week following TDI (assessed via dream journal reports). This success rate is similar to past studies using the Dormio [14, 16, 22].

Primary analyses

Results showed that the time relative to the period of TDI (pre-TDI, post-TDI, and 1-week post-TDI) led to statistically significant differences in DSE responses (F (2, 46) = 5.31, p = .008). Analyses indicated a significant increase in DSE composite responses immediately after the period of TDI (pre-TDI vs. post-TDI; DSE = 1.02; p = .003; Figure 1), with no further significant change in responses 1 week later (post-TDI vs 1 week later, p = .86). Additionally, we found a significant difference between pre-TDI and 1-week post-TDI in the DSE composite score (μ = 0.50, p = .042). However, we did not find a significant difference between the pre-TDI and 1-week post-TDI with either of the individual items ($p > .05$). For differences on individual DSE items between pre, post, and 1-week post-TDI see Figures 2 and 3.

Post hoc analyses demonstrate that the effect of TDI on DSE correlates with the degree of direct incorporation of incubation themes into dreams, wherein more effective incubation increases postsleep DSE incrementally. The degree of success of the TDI protocol is predictive of the change in DSE from the pre-TDI period to both immediately after the TDI period (β = 0.6, $p < .05$, R^2 = 0.19) and 1-week following the TDI period (β = 0.35, $p < .05$, R^2 = 0.12).

Nightmares

Subjects reporting a nightmare frequency of ≥1 nightmare/week at recruitment (n = 11) did not have any significant differences

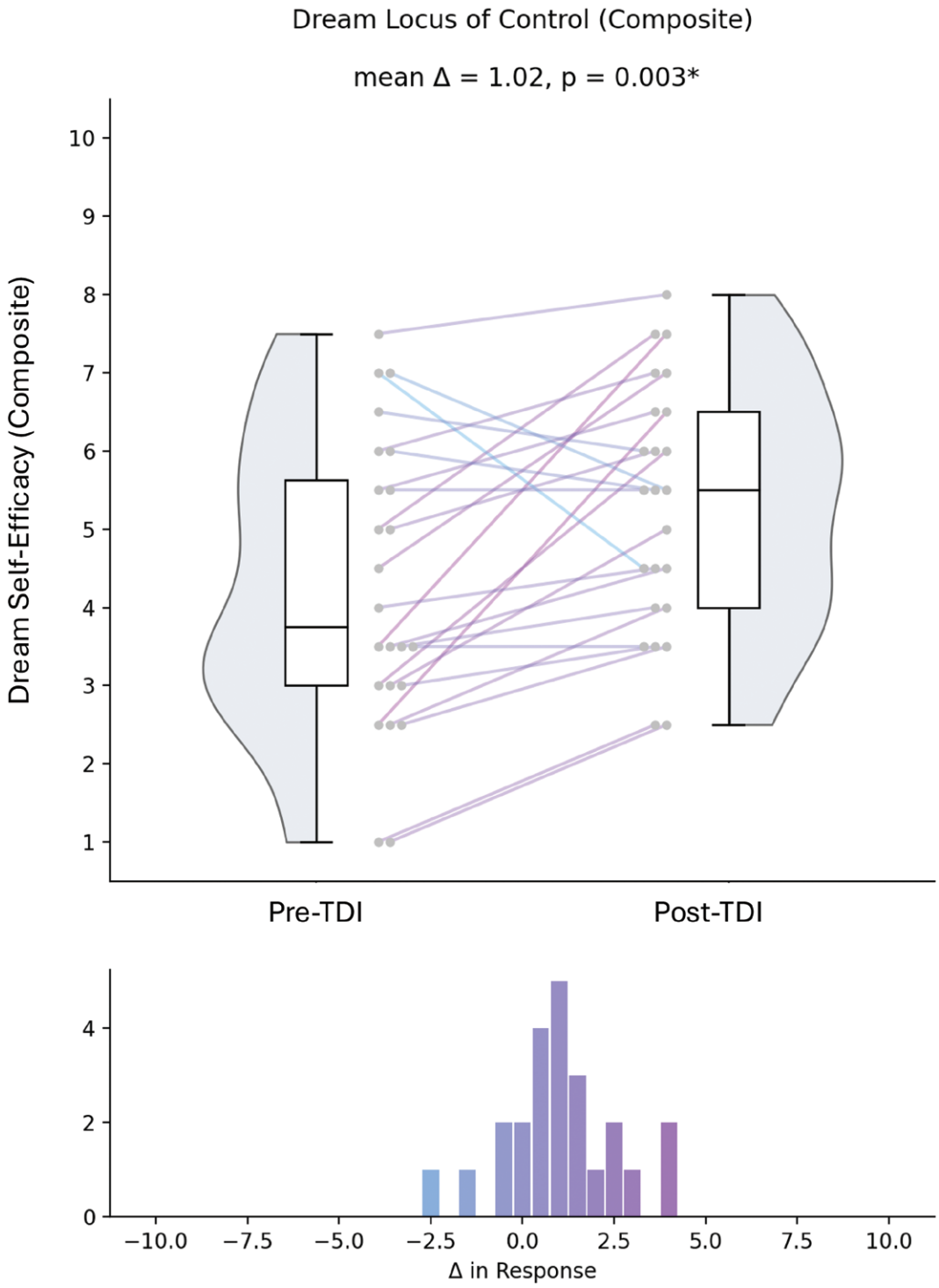

Figure 1. DSE composite immediately pre- and post-TDI.

across pre, post, and 1-week post-TDI analyses versus individuals not reporting nightmares.

Discussion

The TDI protocol used in this study was effective; 92 per cent of participants (23/25) reported at least one direct incorporation of the theme "Tree" into N1 dreams during the TDI protocol. This aligns with past research that has demonstrated a similar TDI success rate [13, 14]. Furthermore, 10 participants (42 per cent) reported direct incorporation of the TDI stimuli 1 week following in-person TDI session. The experience of successfully controlling one's dreams, evidenced in these recalled dreams which incorporate chosen themes directly, was accompanied by a post-TDI increase in perceived control over dream content and decreases in the belief that bad dreams cannot be controlled. These results are the first of their kind to suggest that TDI may be able to effectively impact DSE.

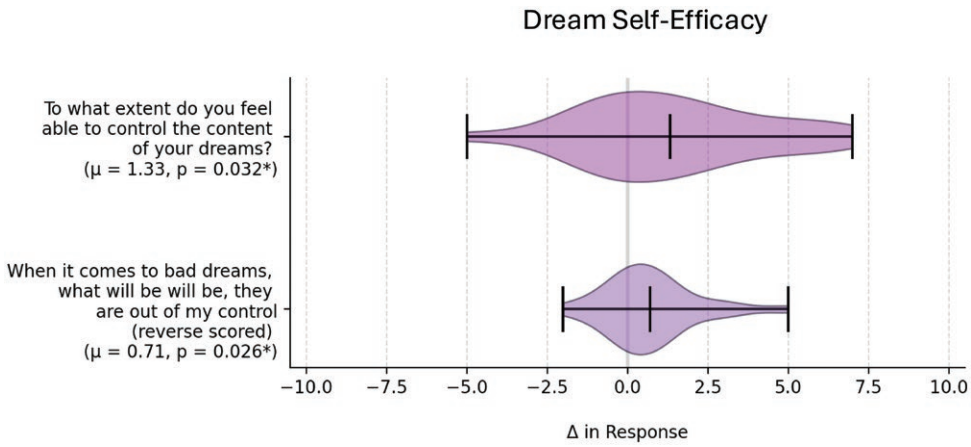

Figure 2. DSE pre vs. post-TDI individual questions.

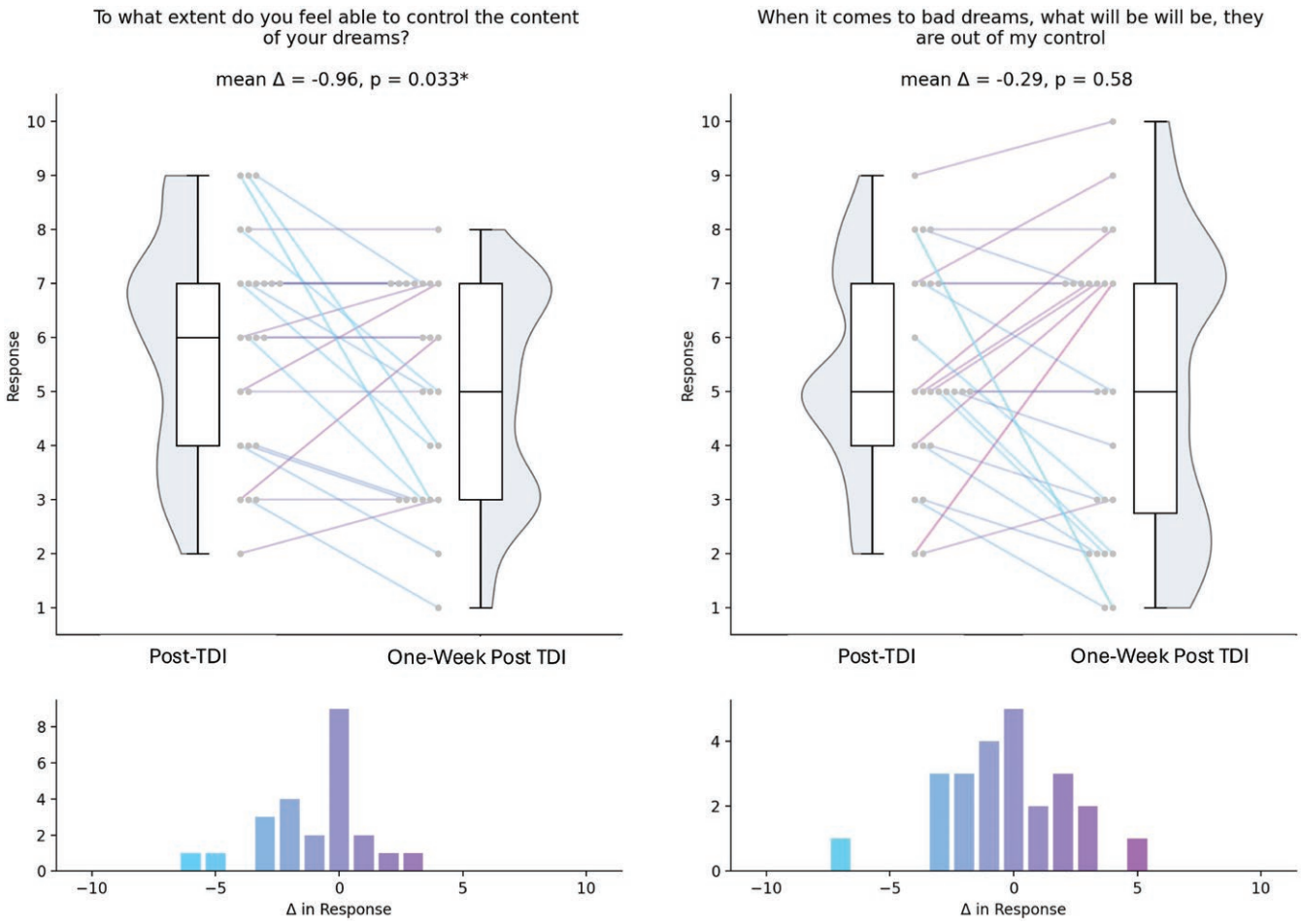

Figure 3. One-week post-TDI results.

One-week post-TDI

Our analyses looking at long-term effects revealed a significant difference between pre-TDI DSE and 1-week post-TDI. Additionally, we found that there was no difference between post-TDI and one-week post on the question, "When it comes to bad dreams, what will be will be, they are out of my control" (see Figure 3). However, it should be noted that the DSE individual items showed no significant difference between pre-TDI and 1-week post, that the power behind these results is low, and that we had no control group, thus overall limiting our strength in interpretation. With our results and limitations in mind, future research should aim to further explore the long-term effects of TDI within a larger sample and with a control group.

While this work was carried out on a nonclinical population, nearly half of our participants (11 of 25) reported nightmares at a high frequency (ranging from one to seven nightmares per week)

that would potentially fit criteria for diagnosis of nightmare disorder. The high percentage of participants that experience nightmares supports that TDI could increase DSE in individuals experiencing TRNs (although nightmare type was not assessed here). It should also be noted that our sample did consist of an abnormally high proportion of nightmare sufferers for a random sample, suggesting that future studies should take care to control for selection bias as subjects with more nightmares may be more interested in studies that offer techniques to change dream content.

Limitations

Although our results provide initial evidence linking TDI to increases in DSE, our study was not without its limitations. One of our largest limitations was the lack of a control group. Without a control group, we cannot completely rule out confounding variables, such as the effects of a nap on DSE. Future research should examine the effects of TDI on DSE, while incorporating a control group to compare to. In addition to the lack of a control group, our sample size was relatively small and somewhat homogenous (all participants recruited from one location). Thus, when considering the long-term goal of such research (impacting trauma-informed interventions) a larger and more diverse sample should be used. Aligned with sample size, our mean comparison analyses were also limited in their ability to examine effect and change. Future endeavors should incorporate Bayesian methods further explore changes.

Another limitation was the short follow-up period (1 week). A longer postassessment period would have allowed us an opportunity to better assess the long-term sustainability of changes in DSE. Additionally, our study did not blind participants or experimenters to the protocol, thus opening the possibility for confirmation bias. Moving forward, future research should have a control group and be sure to use a double-blind protocol. Lastly, the choice of incubations during N1 sleep is also a potential limitation, as sleeper sometimes perceive N1 sleep as being awake, and incubation effects may not be generalizable to other stages of sleep. Future research should continue to examine the feasibility of TDI throughout different stages of sleep.

Conclusion

Taken as a whole, these data are the first to indicate that TDI may enhance DSE (see Figures 1 and 2), even within a sample that experiences frequent nightmares. These results provide supporting evidence to the idea that TDI could be used to augment sleep-related interventions that benefit from increased levels of DSE, such as rescripting-based therapies. For example, TDI could be implemented within a treatment protocol such as IRT (a rescripting-based therapy), with the idea that increased DSE may lead to improved therapy effectiveness, such as a reduction in TRNs or a reduction in IRT dropout rates (although further data on TDI within a sample of nightmare suffers is needed). However, before treatments could implement TDI, research would need to examine the feasibility of applying TDI within a trauma-exposed sample.

Disclosure Statement

Financial and *Nonfinancial Disclosure*: None declared.

Author Contributions

Westley Youngren (Conceptualization [equal], Writing—original draft [lead], Writing—review & editing [lead]), Adam Haar Horowitz (Conceptualization [equal], Data curation [equal], Investigation [equal], Methodology [equal], Writing—review & editing [equal]), Victoria West Staples (Writing—review & editing [equal]), Robert Stickgold (Conceptualization [equal], Investigation [equal], Methodology [equal], Writing—review & editing [equal]), Michelle Carr (Conceptualization [equal], Writing—review & editing [equal]), and Pattie Maes (Conceptualization [equal], Investigation [equal], Writing—review & editing [equal])

Data Availability

Data may be made available upon request.

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