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Research Paper

Decreased PTSD symptoms following a lucid dreaming workshop: A randomized controlled study

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ABSTRACT

Background: Recent investigations into lucid dreaming—a state where individuals achieve self-reflective awareness while asleep and can undertake deliberate actions—suggest potential healing benefits. A pilot study showed significant PTSD symptom reduction among participants following an online lucid dreaming workshop. The workshop, spanning 22 hours over six consecutive days, taught participants lucid dreaming induction techniques and how to use lucid dreaming to transform their nightmares and integrate their trauma.

Methods: We replicated this study using a randomized controlled design. Adults experiencing chronic PTSD symptoms were randomly assigned to either an active workshop group ($n = 49$) or a wait-list control group ($n = 50$).

Results: Roughly half of the participants in both the workshop and control groups experienced at least one lucid dream during the workshop period. Among these, 63 % of workshop participants versus 38 % of controls achieved a healing lucid dream, implementing a pre-devised healing plan. The workshop group exhibited significant reductions in PTSD symptoms and nightmare distress compared to the control group, with sustained improvements at one-month follow-up. Additionally, improved well-being and diminished negative emotions were observed among workshop participants compared to controls. No significant correlation was found between lucid dreams and reductions in PTSD and nightmare symptoms.

Conclusion: The workshop demonstrates efficacy as a viable alternative for individuals with PTSD.

1. Introduction

Posttraumatic stress disorder (PTSD)[1] is a psychiatric condition that can arise after exposure to traumatic events and is characterized by symptoms such as intrusive memories, avoidance, heightened arousal, and disturbing nightmares. The pathogenesis of PTSD is a complex interplay of various factors, including the activation of the hypothalamic–pituitary–adrenal (HPA) axis (Ramos-Cejudo et al., 2021), immune response (Hori & Kim, 2019), and genomic alterations (Duncan et al., 2018), which complicates the therapeutic management of this highly debilitating condition. As a consequence of this complex pathogenesis, clinical treatments for PTSD typically involve multimodal approaches that combine a form of psychotherapy with medication and supportive interventions from healthcare professionals (Coventry et al., 2020). The most common medications prescribed for PTSD are selective serotonin reuptake inhibitors (SSRIs) and serotonin-norepinephrine

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[1] This paper utilizes the following abbreviations: AIOS (Arizona Integrative Outcomes Scale), CBT (Cognitive Behavioral Therapy), DSM-5 (Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition), EMDR (Eye Movement Desensitization and Reprocessing Therapy), FDR (False Discovery Rate), HLD (Healing Lucid Dream), HPA (Hypothalamic-Pituitary-Adrenal Axis), IRT (Image Rehearsal Therapy), LD (Lucid Dream), NExS (Nightmare Experience Scale), NPRS (Numeric Pain Rating Scale), PANAS (Positive and Negative Affect Scale), PCL-5 (PTSD Checklist), PTSD (Posttraumatic Stress Disorder), REM (Rapid Eye Movement), SNRI (Serotonin-Norepinephrine Reuptake Inhibitor), and SSRI (Selective Serotonin Reuptake Inhibitor).

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reuptake inhibitors (SNRIs) based on their efficacy in alleviating symptoms like anxiety, depression, and intrusive thoughts (Huang et al., 2020).

Two of the most common psychotherapeutic approaches for treating PTSD are Cognitive-Behavioral Therapy (CBT) and Group Therapy (Cusack et al., 2015). CBT focuses on processing traumatic memories through exposure therapy and cognitive restructuring. The latter involves identifying challenging negative thought patterns related to the traumatic event and replacing them with more balanced and functional ones. While CBT remains a widely used therapy, it often has high dropout rates (Lewis et al., 2020), and provides lasting benefits for just half of those who undergo treatment (Bryant et al., 2008). Group Therapy is a form of psychotherapy where a small group of individuals meets regularly with a group-dynamics-trained therapist to discuss and explore their thoughts, feelings, and behaviors and share experiences and coping strategies. In addition to providing social support for normalizing traumatic experiences and peer pressure to attend meetings, Group Therapy may be particularly beneficial for PTSD since the group setting counteracts behavioral avoidance, such as social isolation, which is a hallmark symptom of the disorder (Spiller et al., 2023). A multitude of other PTSD interventions have also been employed with positive outcomes, such as Eye Movement Desensitization and Reprocessing Therapy (EMDR) (de Jongh et al., 2019) and yoga (Niles et al., 2018).

Another healing modality proposed to alleviate PTSD symptoms is the use of dreaming as an overnight therapy (Rothbaum & Mellman, 2001). This approach leverages the unique neurochemical state of REM sleep, where neurotransmitters like norepinephrine are inactive or slowed (Siegel, 2004). This state offers significant advantages, given that PTSD is associated with an overactive sympathetic nervous system, which causes persistently high norepinephrine and cortisol levels and results in symptoms like hyper-vigilance, anxiety, and intrusive thoughts (Southwick et al., 1999). This heightened stress response disrupts emotional processing, which is critical for trauma recovery, as it requires safely accessing and reprocessing traumatic memories in a low-arousal context (Foa & Kozak, 1986). The neurochemistry of REM sleep enables emotional memory processing through affective brain homeostasis, allowing the brain to engage with trauma while maintaining emotional detachment and reduced fear responses (Goldstein & Walker, 2014). This mechanism, akin to exposure therapy and EMDR, facilitates cognitive reframing and memory reconsolidation in a safe environment (Hutchison & Rathore, 2015; van Rijn et al., 2015). Theoretically, dreaming as an overnight therapy bypasses the emotional distress often experienced during waking cognitive therapies like CBT (Levin & Nielsen, 2007; van der Helm et al., 2011) and mirrors the action of many PTSD medications, which function by dampening stress-related neurotransmitters (Holder et al., 2021).

Lucid dreaming, a state of consciousness where the dreamers are explicitly aware that they are dreaming while they are in the dream state (LaBerge, 1985), offers a unique opportunity to tap into the healing potential of the dream state deliberately. While lucid dreams (LDs) are not very common, over half of the population have experienced them at least once, while one out of four or five people have them regularly (i.e., once a month or more frequently; Saunders et al., 2016). LDs often occur spontaneously but can also be self-induced through various induction techniques (Stumbrys et al., 2012, 2012; Tan & Fan, 2023). Sleep laboratory research indicates that LDs are primarily a REM sleep phenomenon (LaBerge et al., 1986), although lucidity in non-REM sleep is also possible (Stumbrys & Erlacher, 2012). During lucid REM sleep, there is increased activity in the prefrontal cortex (Dresler et al., 2012; Voss et al., 2009), as well as increased functional connectivity between the frontopolar cortex and temporoparietal regions (Baird et al., 2018), providing a possible mechanism for the observed increase in executive control, goal-directed action, and metacognition during this state (Filevich et al., 2015; Kolb & Whishaw, 2009).

In addition to the aforementioned benefits of REM dreaming in relation to PTSD, lucid dreaming allows the individual to alter the dream narrative, transforming a distressing scenario into one where they feel empowered or safe (Maciejewicz, 2022; Schädlich & Erlacher, 2018). This aligns with trauma recovery techniques like Imagery Rehearsal Therapy (IRT; Albanese et al., 2022), which guide patients in re-scripting nightmares during waking states. Thus, by revisiting, reprocessing, and restructuring these traumatic memories in the lucid dream state, individuals may decouple these memories from their stress responses, promoting cognitive reframing, memory reconsolidation, and emotional healing and recovery (Aspy, 2020; de Macêdo et al., 2019; Hutchison & Rathore, 2015).

The possible benefits of LDs for mental health have been supported by a recent study exploring the healing and transformative potential of LD for clinical depression using a mixed methods design (Sackwild & Stumbrys, 2021). The majority of the respondents in the quantitative survey agreed that LDs helped them when they were depressed or feeling low. At the same time, the qualitative findings from in-depth interviews with lucid dreamers who have been diagnosed with depression showed that LDs empowered these depressed individuals to redefine themselves, re-wire negative thought patterns, and thus enabled them to develop a better relationship with their mental health (Sackwild & Stumbrys, 2021). Furthermore, reductions in anxiety and depression have been observed following LD intervention consisting of six weekly sessions in a study targeting patients with PTSD (Holzinger et al., 2020). This study, however, did not find effects in nightmare severity or PTSD symptom profiles.

Two other lucid dreaming studies, in addition to the research by Holzinger et al. (2020), have incorporated participants with PTSD. The first study was a pilot trial (Spoormaker & van den Bout, 2006), which revealed that individuals suffering from nightmares experienced a reduction in nightmare frequency after a single two-hour LD treatment session, whether conducted individually or in a group. However, no improvement in overall PTSD symptoms was observed. The second study, serving as a pilot for the present research (Yount et al., 2024), employed a more intense immersive online workshop format originally designed for combat veterans, yielding promising outcomes for participants ($n = 49$) who had been experiencing PTSD. In the pilot study, a 6-day online lucid dreaming workshop led to significant improvements in self-reported PTSD symptoms, nightmare distress, and well-being. During the workshop, 76 % of participants achieved at least one lucid dream, and over half of those successfully implemented their planned healing lucid dream – one in which they attributed physical or emotional healing. However, no significant correlation was found between achieving a lucid dream as instructed in the workshop and symptom reduction (Yount et al., 2024). The present study aimed to replicate this pilot study while incorporating a control arm.

2. Method

2.1. Design overview

Adults experiencing chronic PTSD symptoms were recruited and randomly assigned to either an active workshop group or a wait-list control group. The active group participated in the workshop while taking morning surveys about their dream experiences the previous night and surveys measuring well-being and symptomatology before and after the workshop. The wait-list control group took the same surveys but did not participate in the workshop until a few months later. The primary outcome was PTSD symptom severity, and secondary outcome measures included the degree of nightmare distress, pain, well-being, and positive and negative affect. We also examined how fluctuations in dream intensity correlated with PTSD symptoms by using a novel method to calculate cumulative dream intensity during the workshop, anticipating varied dream experiences among participants, including multiple lucid dreams.

2.2. Intervention: lucid dreaming workshop

The intervention was an at-home immersive workshop initially designed to help combat veterans suffering from PTSD to transform trauma through dreamwork and thereby reduce their symptoms. The workshop spanned 22 hours of live instruction and group activities conducted via video conferencing over six days in January 2023. Instructional content included basic neuroscience principles of sleep and dreaming, mindfulness practices for deep relaxation, sleep hygiene principles, practices to increase dream recall, dream planning lessons, and multiple lucid dreaming induction techniques. Lucid dreaming induction techniques were presented in sequence so that the participants could attempt novel techniques each day/night if they chose to do so. The induction techniques included reality checking during the day, attention to dream signs, mnemonic technique, falling asleep consciously, and a wake-up-back-to-bed sleep protocol that involved setting an alarm to wake up multiple times during the night to recall their dreams, after which being encouraged to listen to audio recordings designed to reinforce induction techniques while falling back asleep. A psychotherapist accredited in Mindfulness-based Core Process Psychotherapy was present during the live instruction and available throughout the entire workshop period for private participant consultations. Group activities included guided meditations, dream-sharing circles, and witnessing the exploration and understanding of emotions evoked by dreams through dialogue with the instructor and the psychotherapist in a nurturing group environment.

2.3. Control condition: wait-list

Individuals assigned to the control condition were notified of their grouping and instructed to defer their workshop attendance to a later date. However, they participated in the outcome measures collection concurrently with the intervention group. Following completion of all data collection, the workshop was repeated for the control group to experience.

2.4. Participants

Participants were recruited globally via social media. Eligible participants were at least 18 years of age and experiencing PTSD symptoms as determined through self-report on the PTSD Checklist for DSM-5 (PLC-5) (Blevins et al., 2015) but not necessarily having an official PTSD diagnosis by a clinician. Anyone experiencing self-reported PTSD was permitted to participate in the study, resulting in a heterogeneous population regarding the origin of their PTSD. Both combat and non-combat veterans were eligible, and the range of PCL-5 scores for inclusion in the study was 25–60. Additional inclusion criteria were proficiency in English, the ability to participate in the workshop using the online video platform Zoom, and the flexibility to devote nearly full-time effort toward the workshop for the scheduled six days. Exclusion criteria included pregnancy, regular use of sleeping pills, and past or present psychotic episodes (e.g., visual or auditory hallucinations). It was made clear that flashbacks, typical among PTSD symptoms, were not considered hallucinations and, therefore, not an exclusion criterion.

Interested participants were informed of the study's purpose and returned electronic informed consent for initial screening for potential inclusion. Recruitment was closed in accordance with the scheduled start of the workshop, at which point there were 194 initial respondents. Of those respondents who satisfied the inclusion/exclusion criteria, 118 were invited into the study; 99 accepted the invitation, returned electronic informed study consent, and entered. Participants were randomly assigned to a lucid dreaming workshop ($n = 49$) or a wait-list control group ($n = 50$). Most participants attended the workshop from their homes in the United States, but there were also attendees from the United Kingdom, Ireland, Canada, Sweden, Spain, Australia, Peru, and the Netherlands. All study activities were approved by the Institutional Review Board at the Institute of Noetic Sciences (IORG#0003743), and the study design was pre-registered with Open Science Framework on January 8, 2023 (osf.io/ne78g). Fig. 1 presents an overview of the flow of participant involvement and data collected for analysis.

All 99 participants completed dream surveys upon waking on the mornings following the six days of the workshop and completed the outcome measures shown in Fig. 2 and described in the next section. Participants in the control group did not receive any training while waiting to attend the workshop.

3. Measures

3.1. PTSD checklist for DSM-5 (PCL-5)

The PCL-5 is a 20-item measure that assesses the 20 symptoms of PTSD listed in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (Blevins et al., 2015). Participants rate each item from 0 "not at all," to 4 "extremely," to indicate the degree to which they have been bothered by that particular symptom over the week. The Cronbach's alpha for the present study was 0.93.

3.2. Nightmare experience scale (NExS)

The NExS is a four-item measure that assesses distressing nightmares (Kelly & Mathe, 2019). Participants answer each item using a 4-point rating scale ranging from 0 "strongly disagree" to 4 "strongly agree." The Cronbach's alpha for the present study was 0.94.

3.3. Morning dream survey

Participants recorded any LDs experienced the previous night through a survey completed each morning using their personal devices. The workshop explicitly defined lucid dreaming to ensure a clear understanding of the concept (see Supplementary Materials).

3.4. Dream lucidity questionnaire (DLQ) and dream intensity score

After reporting their LDs, participants recorded the intensity of each dream using the DLQ (Stumbrys et al., 2013). Each LD was rated by 12 items ranging from 0 ("not at all") to 4 ("very much") to indicate the degree to which they experienced that characteristic during the dream. The DLQ evaluates different types of awareness (e.g., the awareness of the physical body's dormancy) and control within the dream (e.g., alteration of dream events). A dream intensity score was computed for each LD as the average of 10 of the 12 DLQ questions (questions #7 and #12 were excluded from scoring because of a previous report that they loaded poorly in factor analysis (i.e., <0.4), and following precedent in the literature (Gott et al., 2021). The dream intensity score was calculated for all LDs each night and then summed over all nights, resulting in a total LD intensity score per person over the entire workshop period. The Cronbach's alpha for the present study was 0.90 (considering the first 12 items rated each night).

3.5. Criterion for a healing lucid dream (HLD)

Question #12 of the DLQ was altered and used to assess the participants' recollection of the intention to heal within the LD; it read: "I clearly remembered my intention that I wanted to do in a lucid dream (i.e., healing)." A non-zero response to this question on the DLQ was used as the sole criterion to identify someone as having an HLD rather than an LD, following precedent in the literature (Yount et al., 2024). Thus, we used the DLQ to categorize LDs into two types: 1) non-healing LD (denoted as LD) and 2) HLD. This process resulted in a binary variable HLD (0,1) for each reported dream. This value was summed over each night and then summed over the entire workshop period, resulting in one value for the HLD count over the entire workshop period. Intensity

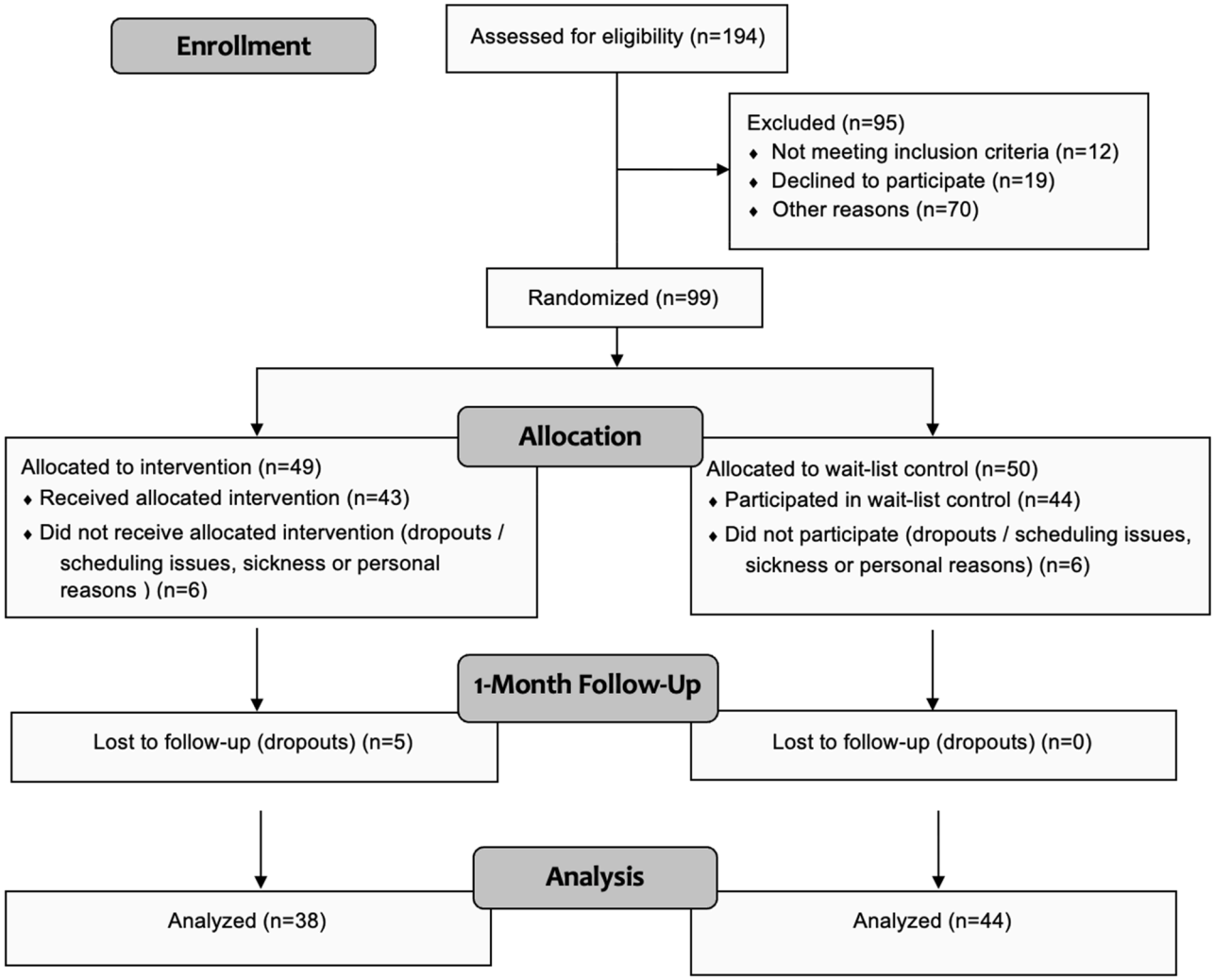

Fig. 1. Participant Recruitment and Randomization Flowchart.

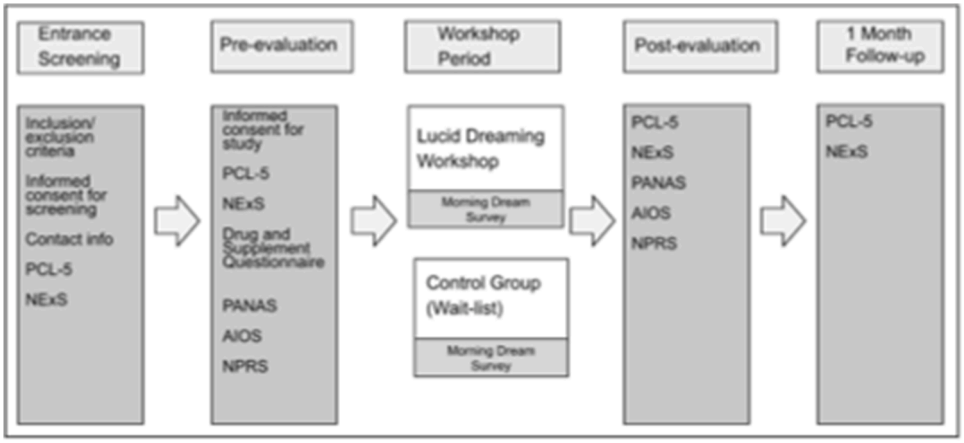

Fig. 2. Time Points for Outcome Measures.

scores for LDs that were HLDs were extracted as a separate variable.

3.6. Positive and negative affect schedule (PANAS)

The PANAS is a 10-item self-report measure that is made up of two mood scales, one for positive (five items) and the other for negative affect (five items). The answer choice is a 5-point Likert Scale ranging from 1 "never" to 5 "always." The scores are obtained by summing the positive items and negative items. The subscale scores range from 5–25, with higher scores representing higher positive or negative affect levels (Thompson, 2007). The Cronbach's alphas for the present study are 0.71 and 0.76 for the baseline and follow-up positive affect subscale,

respectively, and 0.72 and 0.73 for the baseline and follow-up negative affect subscale, respectively.

3.7. Arizona integrative outcomes scale (AIOS)

The AIOS is a one-item, visual analog self-rating scale that evaluates the overall subjective sense of well-being over the past 24 hours. Participants were instructed to consider their physical, mental, emotional, social, and spiritual condition and rate it on a scale of 0–100, with larger values indicating greater well-being (Bell et al., 2004).

3.8. Numeric pain rating scale (NPRS)

The NPRS is a segmented numeric version of the visual analog scale where participants select a whole number (0 = "*No pain*" to 10 = "*Worst possible pain*") that best reflects the intensity of their pain (Farrar et al., 2001).

4. Data analysis

In general, means and standard deviations were calculated for each continuous variable, and counts and percentages were calculated for binary variables. Where applicable, all variables were assessed for normality. Most variables were not normally distributed, so non-parametric versions of statistical tests were used.

Upon review of the data, we identified outliers as values exceeding three standard deviations above the mean. Results are presented both with and without these outliers. To evaluate the number of people who had LDs and HLDs (regardless of the number of dreams throughout the study), the total LD and HLD counts were transformed to binary variables, where any count greater than zero was re-coded as a 1 and zeros coded as 0. If a participant did not record having an LD, they did not have the intensity scores (i.e., the field is missing rather than a 0). Each participant also had an average HLD dream intensity score for the entire workshop period. A Wilcoxon rank-sum test was used to evaluate group differences in the LD and HLDs per person. The four analyses (1 - LD with outliers, 2- LD without outliers, 3- HLD with outliers, and 4- HLD without outliers) were corrected with the False Discovery Rate (FDR) multiple comparison correction (Benjamini & Hochberg, 1995). A chi-square test was used to evaluate group differences in the number of people who experienced LDs and HLDs.

Missing data: Participants were excluded listwise if they had missing data for any time point for the pairwise comparisons. That is, if their Day 6 value was missing but they had Day 28 data, the participant was included in the Day 28-0 analysis but not the Day 6-0 analysis. While two group *t*-tests were pre-registered, repeated measure analysis of variance can handle missing data more efficiently. Thus, we repeated the analyses, where appropriate, using this alternative statistical test.

Building on the methods and data analysis procedures detailed above, the following section presents the results.

5. Results

5.1. Sample characteristics

The demographic characteristics of the sample are shown in Table 1. All of the participants reported the continued use of numerous medications and supplements throughout the week of the workshop (for details, see the online Supplementary Materials). Eighteen percent of the participants were complete novices to lucid dreaming, the remaining had varying degrees of experience with lucid dreaming, and 36 % had previously engaged in some form of training for lucid dreaming. Due to international time zone differences in the global population attending the workshop, calls were recorded, and many participants watched the replay videos. For this reason, it is difficult to gauge the attendance numbers accurately. From our surveys, 20.4 % (n = 10) participants attended all live calls only, 12.2 % (n = 6) participants exclusively watched the replay videos, 53.1 % (n = 26) participants reported attending both live and recorded sessions, and 14.3 % (n = 7) participants did not report their attendance or were marked as dropouts.

Table 1
Sample Demographics and Prior Lucid Dreaming Experience.

Measure	Units / Categories	Workshop Group Values M (SD) or n (%)	Control Group Values M (SD) or n (%)
Age (90)	Years	47.9 (12.6)	46.8 (10.9)
Education (88)	Years	18 (3.5)	16.7 (3.4)
Gender (99)	Female	40 (81.6 %)	37 (74 %)
	Male	9 (18.4 %)	11 (22 %)
	Other	0	2 (4 %)
Race* (88)	Native American	2 (4.8 %)	1 (2.1 %)
	Asian	3 (7.1 %)	3 (6.2 %)
	African	2 (4.8 %)	2 (4.2 %)
	Middle Eastern	1 (2.4 %)	1 (2.1 %)
	Native Pacific Islander	0	2 (4.2 %)
	Latinx/Hispanic	3 (7.1 %)	4 (8.3 %)
	European	31 (73.8 %)	35 (72.9 %)
Relationship (88)	In a relationship	20 (46.5 %)	23 (51.1 %)
	Not in a relationship	23 (53.5 %)	22 (48.9 %)
Overall health (88)	Excellent	2 (4.6 %)	1 (2.2 %)
	Very good	8 (18.6 %)	11 (24.4 %)
	Good	11 (25.6 %)	8 (17.8 %)
	Fair	18 (41.9 %)	16 (35.6 %)
	Poor	4 (9.3 %)	9 (20 %)
PTSD Checklist for DSM-5 (PCL-5) at screening (83)		46.4 (10.1)	49 (10.6)
Arizona Integrative Outcome Scale (85)		44.4 (25.0)	38.1 (23.6)
Lucid Dream Experience (98)	Have never experienced a lucid dream	10 (20.4 %)	8 (16 %)
	One or less per year	11 (22.4 %)	12 (24 %)
	Multiple per year	16 (32.7 %)	16 (32 %)
	Multiple per month	0	8 (16 %)
	Multiple per week	12 (24.5 %)	5 (10 %)
Previous training in lucid dreaming		18 (36.7 %)	18 (36 %)

Note: Numbers of participants completing each measure are in parentheses.
* Participants could check more than one race.

5.2. Dream lucidity

Roughly half of the participants in both the workshop and control groups experienced at least one LD during the workshop period. Among those who experienced any degree of lucidity as described by the DLQ (see Methods Section 3.4), a higher percentage of workshop participants (63 %) achieved an HLD, as indicated by endorsing that they successfully recalled their dream plan for healing during the LD, compared to control participants (38 %). Table 2 depicts the average number of participants experiencing LDs and HLDs for both groups of participants. For the LDs per person, the data had clear outliers exceeding three standard deviations beyond the mean (n = 3, counts = 13, 15, 19). Similarly, there were clear outliers in the HLDs per person n = 2, counts 11, 14). Data with and without these outlier data points are displayed. There were no statistically significant differences between groups in the number of people with LDs and HLDs.

5.3. PTSD and nightmare symptoms

The workshop group reported significant reductions in both PTSD symptom scores (PCL-5) and ratings of nightmare distress (NExS) compared to the control group (see Fig. 3). Table 3 lists the PTSD and NExS means and standard deviations for all time points, change scores,

Table 2
Counts of Lucid Dreams and Healing Lucid Dreams.

Measure	Control	Workshop	Statistics*
Lucid Dreams			
LDs per participant -With outliers Mean (*SD*) Range *n*	2.0 (3.3), 0–15, 44	2.1 (3.4), 0–19, 42	$z = -0.2$, $p = .86$
-Without outliers Mean (*SD*) Range *n*	1.5 (2.0), 0–9, 42	1.7 (2.1), 0–8, 41	$z = -0.4$, $p = .72$
Participants who had LDs *n* (%)	25 (52 %)	23 (48 %)	$X^2 = 0.007$, $p = .94$
Healing Lucid Dreams			
HLDs per participant -With outliers Mean (*SD*) Range *n*	1.1 (3.0), 0–14, 44	1.0 (1.5), 0–6, 42	$z = -1.7$, $p = .09$
-Without outliers Mean (*SD*) Range *n*	0.6 (1.6), 0–9, 42	1.1 (1.6), 0–6, 42	$z = -2.3$, $p = .03$[a]
Participants who had HLDs *n* (%)	12 (38 %)	20 (63 %)	$X^2 = 4.0$, $p = .05$[a]

Note: All values are aggregated over the workshop period. *Wilcoxon Rank-Sum tests were used to evaluate group differences between LD and HLD counts with and without outliers. Chi-square tests were used to evaluate group differences in dreamers versus non-dreamers over the workshop period.
X^2 Conducted without outliers.
[a] While these p-values are .05 or less, they did not remain significant after FDR correction.

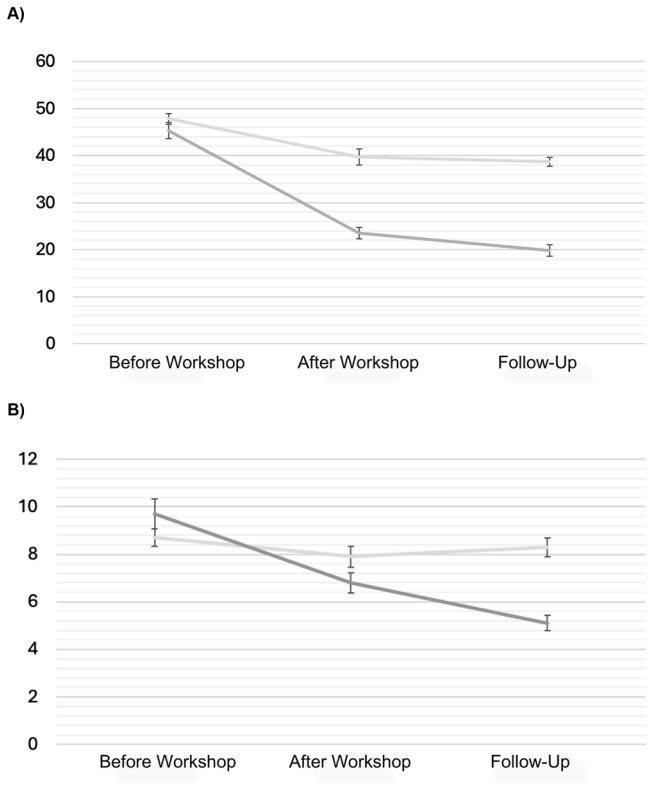

Fig. 3. Changes in PTSD and Nightmare Symptoms **A)** PTSD symptoms (measured by PCL-5) and **B)** the experience of nightmares (measured by NExS) are plotted as lines representing the two groups: the workshop group (black lines) and the control group (gray lines). Each time point includes means and standard error bars. Lower scores on both scales indicate improvement in symptoms.

and FDR-corrected hypothesis tests. The variables were not normally distributed, so a Wilcoxon rank-sum test was used to compare values across the two groups (rather than the pre-registered two-sample dependent groups *t*-test). There were no significant group differences at Day 0 for the PCL-5 or NExS. The workshop group's PCL-5 scores decreased more than the control group's, as reflected by statistically significant change scores from Day 6 to 0 and Day 28 to 0. This supports our hypothesis that the workshop reduces PTSD symptoms by one week, and the gains are maintained one month later. Similarly, the workshop group's NExS scores decreased more than the control group's, although only the Day 28 to Day 0 improvements were statistically significant. This partly supports our hypothesis that the HLD workshop reduces nightmares after one week, and the gains are maintained one month later.

Due to missing participant data and the need to evaluate the timeline of symptom improvement, a post-hoc FDR-corrected repeated measures analysis of variance was conducted for the PCL-5 and NExS. The PCL-5 model was significant ($F(91,156) = 3.7$, $p < .001$) overall, with the main effects of Group ($F(1,156) = 16.7$, $p = .001$) and Time ($F(2,156) = 35.2$, $p < .001$), and the Group x Time interaction ($F(2,156) = 7.1$, $p = .001$) also being significant, confirming significant group differences over time for the PCL-5.

The NExS model was significant ($F(91,156) = 5.7$, $p < .001$) overall, with the main effect of Time ($F(2,156) = 12.0$, $p < .001$), and the Group x Time interaction ($F(2,156) = 7.2$, $p = .001$) also being significant. However, the main effect of group was not ($F(1,156) = 0.93$, $p = .34$). These post hoc analyses support the results generated with the pre-registered analyses demonstrating greater improvements for the workshop group than the control group on PCL and NExS scores over time.

5.4. Lucid dream intensity

The mean dream intensity scores for all LDs were 3.1 (*SD* 6.9, range 0–36.3, $n = 44$) for the control group (without outliers 1.7 *SD* 2.5, range 0–8.9, $n = 42$) and 3.5 (*SD* 6.5; range 0–36.1, $n = 42$) for the workshop group (without outliers 2.7 *SD* 4.1, range 0–15.2, $n = 41$). The mean dream intensity scores for *only* HLDs were 8.1 (*SD* 10.8, range .8–34, $n = 12$) for the control group (without outliers 3.6 *SD* 2.8, range 0.8–8.9, $n = 10$) and 4.6 (*SD* 3.8; range .5–14, $n = 20$) for the workshop group (without outliers 4.6 *SD* 3.8, range 0.5–14.2, $n = 20$). Spearman correlation tests revealed no significant correlations for any pair (all $p's > .05$) examining all participants together and also by groups (see Supplementary Materials). Our hypothesis that dream intensity would be related to PTSD and nightmare symptoms was not supported.

5.5. Pain, well-being, and affect measures

Pain was significantly improved in the workshop group compared to the control group (lower scores reflect less pain). Tukey HSD showed significant differences between Day 0 and Day 6 (mean difference = 0.77, HSD-test = 3.8) but not the other pairwise comparisons. Well-being was significantly higher for the workshop group than the control group, reflecting increased well-being. Tukey HSD showed significant differences between Day 0 and Day 28 (mean difference = 7.0, HSD-test = 3.6) but not the other pairwise comparisons. There was no significant difference between the two groups regarding positive affect. Negative affect was significantly improved in the workshop group versus the control group (lower negative affect). Tukey HSD showed significant differences between Day 0 and Day 6 (mean difference = 1.7, HSD-test = 5.3) and Day 0 and Day 28 (mean difference = 1.3, HSD-test = 4.0). Significant findings remained so after FDR. The values and statistics for pain, well-being, and positive and negative affect are shown in the Supplementary Materials.

These results provide valuable insights into the effectiveness of the immersive online lucid dreaming workshop; the implications of these findings are explored further in the following Discussion section.

6. Discussion

The present findings demonstrate that an intense immersive online lucid dreaming workshop can be effective in reducing PTSD symptoms

Table 3
PTSD and Nightmare Symptom Group Differences.

	PTSD Symptoms (PCL-5) Mean (*SD*)			Nightmares (NExS) Mean (*SD*)				
	Control	Workshop	Statistics (*z, p, Cohen's d*)	Control	Workshop	Statistics	Control n	Workshop n
Day 0	47.8 (15.9)	45.3 (23.0)	$z = 1.4$, $p = .18$	8.7 (4.6)	9.7 (7.9)	$z = -0.44$, $p = .66$	44	39
Day 6	39.7 (22.7)	23.5 (15.5)		7.9 (5.6)	6.8 (5.2)		41	39
Day 28	38.7 (12.5)	19.8 (15.4)		8.3 (5.0)	5.1 (4.2)		43	42
Δ6-0	−8.8 (22.4)	−22.7 (26.6)	$z = 2.7$, $p = .007$*, $d = .57$; 95 % CI [.11–1.03]	−0.7 (3.3)	−3.0 (7.5)	$z = 1.8$, $p = .07$, $d = .40$; 95 % CI [-.06-.85]	41	35
Δ28-0	−9.6 (16.9)	−25.8 (23.1)	$z = 3.9$, $p = .0001$*, $d = .81$; 95 % CI [.35–1.3]	−0.5 (2.9)	−4.5 (6.8)	$z = 3.5$, $p = .0005$*, $d = .78$; 95 % CI [.33–1.2]	42	38

Notes: Values are reported as means and standard deviations *Mean (SD)*. Because there is missing data in the dataset, group *n*s are included for each variable in the last two columns. Δ is the delta change score between the first day values and the second (e.g., Day 6 value minus Day 0 value). Negative values in these change scores represent decreased symptoms after the workshop and subsequent follow-up. Wilcoxon rank-sum tests were used to evaluate group differences. *Represent *p* values that remain statistically significant after FDR correction across the four analyses. Empty cells are intentional, as these comparisons were not included in the pre-registered analyses.

and nightmare intensity for individuals experiencing PTSD. Furthermore, the workshop resulted in decreased pain, improved subjective well-being, and decreased negative affect. All these gains were retained at a one-month follow-up. The occurrence of LDs or HLDs, however, did not directly contribute to the achieved benefits.

These findings closely align with the results from the pilot study (Yount et al., 2024), replicating and confirming them using a randomized controlled design with a control arm. The average PCL-5 score for workshop-engaged participants dropped from well over a standard lower limit cutoff suggesting probable PTSD (Bovin et al., 2016) to well below that threshold following the workshop in our current study (from 45 to 24). Their average PCL-5 scores remained similarly low at the one-month follow-up (20). Moreover, the inclusion of a wait-list control group in our current study strengthens the validity of these results. Specifically, the significant difference in symptom relief between the workshop participants and the wait-list control group immediately following the workshop and at a follow-up one month later provides compelling evidence for the workshop's efficacy in alleviating these symptoms. This degree of symptom relief is in the same range reported for established therapeutic approaches such as CBT (Dossa & Hatem, 2012) and group-based psychotherapies (Castillo et al., 2016; Fredman et al., 2020). Similar effects were observed regarding the experience of nightmares, which also closely aligns with the results of the pilot study (Yount et al., 2024) and corroborates the potential of LD education on nightmare treatment (Spoormaker & van den Bout, 2006). Following the workshop, there was a decrease in distress caused by nightmares in contrast to the wait-list control group. Additionally, workshop participants experienced enhanced well-being and reduced negative emotions and pain compared to the control group, which also aligns with the pilot study's findings (Yount et al., 2024).

Comparing the present results to previous research on lucid dreaming interventions for individuals with PTSD symptoms, the findings align with those of Spoormaker and van den Bout (2006), who also observed reductions in nightmares after lucid dreaming training. Both studies agree in their finding that lucid dreams themselves did not appear to directly cause these changes, suggesting that simply learning about and being exposed to lucid dreaming may be effective in reducing nightmares. The alleviation of symptoms may be attributed to other components of the workshop, such as the mindfulness exercises, which promote deep relaxation and may have mitigated hyperarousal, a core PTSD symptom. Group support, including dream-sharing circles and dialogue with a psychotherapist, provided an environment of psychological safety and normalization of trauma-related experiences, potentially enhancing emotional processing. Sleep hygiene techniques and dream recall practices may have improved sleep quality, which is often disrupted in PTSD and associated with symptom severity. These findings highlight the multifaceted nature of the intervention, where lucid dreaming functions as a central yet not isolated mechanism of change.

The workshop incorporated many elements akin to CBT and Group Therapy, such as structured techniques for cognitive reframing within the dream state, and group discussions that fostered a supportive environment for sharing experiences and normalizing trauma-related symptoms. These elements, commonly associated with effective therapeutic approaches (Celebi, 2022), likely complemented the contribution of lucid dreaming by addressing PTSD symptoms holistically, targeting emotional regulation, cognitive restructuring, and the development of interpersonal connections essential for trauma recovery. Another potential contributing factor to the workshop's effectiveness, as posited by the instructor, is the intrinsic empowerment inherent in learning about and attempting to transform trauma through dream work. The concept is based on the notion that this process facilitates access to the subconscious mind, thereby mitigating the deeply disempowering effects associated with PTSD. Consequently, simply learning about the possibility of and attempting to achieve a healing LD is theorized to play a substantial role in the overall healing trajectory (de Macêdo et al., 2019; Spoormaker & van den Bout, 2006).

The present findings on decreased negative affect and increased well-being are also in line with results by Holzinger et al. (2020), who found a decrease in depression and anxiety levels following lucid dream intervention in PTSD sufferers. On the other hand, in contrast to our pilot study and the present study, previous research by Spoormaker and van den Bout (2006) and Holzinger et al. (2020) did not observe reductions in PTSD symptoms after lucid dreaming training. This discrepancy might be explained by the fact that these previous studies used relatively short lucid dreaming training durations (a single 2-hour session and six weekly 1-hour sessions, respectively), while the current protocol involved a much more intense immersive experience (22 hours over 6 consecutive days) to facilitate deeper changes in trauma recovery.

Our assessment of the potential correlation between fluctuations in dream intensity and their impact on PTSD symptoms did not reveal any significant results. However, interpreting these findings warrants caution due to our use of an unvalidated dream intensity metric. Another constraint in the study design was the skewed composition of participants, as individuals who expressed interest in lucid dreaming practices self-selected into the study. Consequently, the participant pool exhibited a notably higher familiarity with lucid dreaming techniques than the general population (Neuhäusler et al., 2018; Saunders et al., 2016). Merely 18 % of participants were newcomers to lucid dreaming, whereas 36 % had undergone prior training in lucid dreaming practices. This heightened prevalence of lucid dreaming proficiency, coupled with

the daily encouragement provided through morning dream surveys, likely contributed to our observation that the frequency of achieving lucidity did not differ between workshop-engaged participants and those in the wait-list control group. This observation is noteworthy given that one pivotal strategy for inducing LDs involves enhancing dream recall (Stumbrys & Erlacher, 2014). Therefore, it is plausible that individuals predisposed to lucid dreaming and encouraged to reflect on their dream experiences each morning demonstrate a heightened propensity for experiencing lucid dreams, regardless of their participation in a dedicated lucid dreaming workshop. This probability is augmented by the circumstance that randomization occurred after the disclosure of the study's focus, thereby ensuring that participants in the wait-list control group were cognizant that lucid dreams and healing constituted a focal point of investigation. These arguments also provide a plausible explanation for the unexpected observation that participants in the control group exhibited instances of having an HLD. According to the experimental design, no individual in the control group should have experienced an HLD, as they were not provided with the specific instructions necessary for inducing such dreams. More precise wording in the morning dream survey question about the participants' recollection of their intention to heal within the LD may have mitigated the discrepancy.

Another limitation in the study's design arose from the need to rely on self-reporting metrics to determine the occurrence and timing of LDs. Due to participants engaging from their homes, objective confirmation of an LD via eye signaling using sleep recording technology, which would occur under laboratory conditions (LaBerge et al., 1986), was impossible. Participation from home also led to some missing data for the questionnaires. Additionally, accurately tracking attendance was challenging because of varying international time zones and numerous participants choosing to watch the didactic lessons through video recordings. Similarly, assessments of symptoms by clinical staff were outside the scope of the study.

In contrast to conventional interventions for PTSD, only a small minority of workshop participants reported a lack of significant symptom alleviation (3 out of 38; approximately 8 %). This nonresponse rate contrasts notably with the higher prevalence typically observed with standard treatments. Findings from a review encompassing 55 studies on empirically supported PTSD interventions have indicated nonresponse rates reaching as high as 50 % (Kar, 2011). In addition to the apparent high efficacy, the workshop represents a promising therapeutic avenue for individuals disinclined towards medication or who are averse to talking about their trauma with a therapist. Its remote accessibility further enhances its appeal, particularly for those who may encounter barriers to seeking treatment due to mental health stigma or negative encounters within healthcare systems (Hundt et al., 2018; Schottenbauer et al., 2008). To enhance the clinical impact and adaptability of the workshop, future directions include developing a therapist training program with expert-led modules to ensure consistent delivery and creating structured session outlines to support integration across diverse settings.

The findings of our study underscore the potential efficacy of immersive lucid dreaming workshops in reducing PTSD symptoms, closely aligning with the findings of our previous pilot research (Yount et al., 2024), replicating and validating them with a controlled randomized design. The significant decrease in PTSD symptoms and nightmare severity observed immediately post-workshop, sustained at one-month follow-up, and contrasted with the wait-list control group, provides robust evidence of the workshop's therapeutic value. This degree of symptom relief mirrors outcomes reported for established therapeutic approaches like CBT and group-based psychotherapies. The workshop's effectiveness may stem from various components such as mindfulness exercises, sleep hygiene principles, and group activities akin to CBT and Group Therapy, suggesting multifaceted mechanisms at play beyond the experience of intentionally lucid dreaming alone. Regardless of the mechanism of action, the workshop offers a promising alternative for PTSD sufferers, particularly those averse to conventional treatments, highlighting its potential as a widely accessible therapeutic option.

CRediT authorship contribution statement

Garret Yount: Writing – original draft, Project administration, Methodology, Investigation, Funding acquisition, Conceptualization. **Tadas Stumbrys:** Writing – review & editing, Methodology. **Sitara Taddeo:** Writing – review & editing, Investigation. **Cedric Cannard:** Methodology, Data curation. **Arnaud Delorme:** Methodology, Formal analysis. **Michael Kriegsman:** Formal analysis. **Helané Wahbeh:** Writing – review & editing, Supervision, Methodology, Formal analysis, Data curation.

Declaration of competing interest

The authors declare no conflict of interest.

Data availability

Yount, G., Kriegsman, M., & Taddeo, S. (2024, February 5). Dataset for primary outcomes of randomized control study. Retrieved from osf.io/zu89w

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Ethics standards statement

All study activities were approved and overseen by the Institutional Review Board at the Institute of Noetic Sciences (IORG#0003743), and the study design was pre-registered on OSF on January 8, 2023 (osf.io/ne78g).

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ejtd.2025.100510.

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