NEUROSCIENCE OF SLEEP AND COGNITION: INVESTIGATING THE EFFECTIVENESS OF THE NEW DREAM LUCIDITY INDUCTION PROTOCOL – A PILOT STUDY

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SUMMARY

Background: The lack of standardized, efficient, and dependable lucid dream induction methods is one of the major barriers to studying the clinical and non-clinical applications of dream lucidity. Although the interest in therapeutic usage of lucid dreaming strategies in neuroscience of consciousness studies has increased in recent decades, many of the current induction approaches appear to not be replicable reliably.

Material/Methods: In this study, a new protocol for bringing on lucid dreaming was created, implemented, analyzed, and contrasted with two distinct other approaches. Techniques to induce dream lucidity include reality testing methods, the wake-and-go-to-bed technique, mnemonic initiation, senses-initiation, and a combination of the above. Before beginning their 2 weeks of lucid dream induction new protocol study, a total of 36 participants filled out a pre-test survey, maintained a dream recall diary and sleep log for the duration of the experiment, and completed a final survey.

Results: The findings showed that both the mnemonic induction and senses-initiation techniques were mildly effective in bringing about lucid dreaming. The new hybrid protocol, combining the reality check strategy with dream recall amplification, performed significantly better. For lucid dream induction to work optimally, participants needed to become more proficient at remembering their dreams after waking up, so they were requested to maintain a sleep journal for 7 days before the experiment and throughout the study to enhance their ability to dream recall. There was no correlation found between the quality of one's sleep and the frequency of dream lucidity.

Conclusions: The results demonstrated that the new induction protocol was more successful than the other two investigated methods. There are many clinical applications for dream lucidity, such as treatment of recurring and debilitating nightmares, narcolepsy, and PTSD. Therapeutic potential also includes future usage for anesthesia awareness and locked-in syndrome. As such, further dream lucidity research remains important.

Key words: neuroscience of consciousness, lucid dreaming, dream lucidity, sleep studies

INTRODUCTION

Dream lucidity happens when the dreamer becomes conscious of the dream state itself. 55% of individuals are said to have had a minimum of one lucid dream throughout their lifetime, and 23% report experiencing dream lucidity once a month (Neuhäusler et al., 2018). According to recent studies (Erlacher et al., 2022), about a third of lucid dreams can be further consciously manipulated or altered by the dreamers. Changing one's physical surroundings, replacing dream characters, tweaking plot and events, or waking up on purpose are just a few examples. Some lucid dreamers practice dream lucidity to aid recurring nightmares, some experiment with them to enhance one's physical abilities and competencies via dream rehearsal for sports performance. Personal development of more robust creative problem-solving abilities, attempts at self-healing or simply experiencing more self-indulgence activities for personal fun are other frequent reasons (Schredl et al., 2022).

An American researcher by the name of Gerald M. Endelman proposed a theory of self-awareness that distinguishes between two different levels of consciousness: primary and secondary. The first-level consciousness was characterized as immediate and present, with the individual capacity to react to, as well as comprehend, events occurring at any particular moment. Metacognition, or the ability to focus on one's mental states, willpower, and the ability to think abstractly were proposed as the signs of secondary consciousness. Adopting this distinction, the first form of awareness is common during REM sleep, and is one of the factors that contributes to the fascinating nature of dreams. In this context, lucid dreams are rare occurrences in which a person's primary and secondary levels of consciousness blend into a single cohesive experience (Erlacher et al., 2020a).

It's believed that in dream lucidity, the dorsolateral prefrontal cortex and the cuneus become active during the REM stage of sleep (Dyck et al., 2018). The prefrontal cortex is typically associated with higher-order cognitive abilities such as critical thinking, agency over one's behavior, and the ability to process thoughts. It is believed that the precuneus is responsible for processing an individual's own internal state and meta-cognitive self-reflection. In this context, a lucid dreamer is able to reflect on their own experience and maintain a meta-cognitive sense of agency over the dream's narrative and settings when these two parts of the brain are engaged during periods of lucidity.

MATERIAL AND METHOD

In this study, 36 participants aged 18-43 were enrolled to test the new protocol for lucid dream induction. They were split into 3 separate and equal groups to compare the results between two different induction methods currently used and a third protocol, developed for this study. All volunteers completed the entire study duration. Informed consent was requested and granted, and written assurances of anonymity were delivered to all participants. The study was designed to adhere to the standards of research ethics and data collection and was ap-

proved by the ethics committee of the faculty. The investigation was conducted in alignment with the Declaration of Helsinki. All participants were chosen based on reporting an interest in but having no prior experience with dream lucidity. The exclusion criteria involved any mental or physical condition that might have interfered with the study results, including insomnia or other sleep disorders. Materials included pre-test questionnaires and logbooks for weeks 1 and 2. The pre-test survey, as well as the logbook evaluations for the first and second weeks, were all hosted online. The emails with the instructions were sent to all participants on a daily basis.

RESULTS

There are several methods for triggering dream lucidity. To enhance the possibility of having lucid dreams, cognitive approaches include daytime exercises like various reality check testing (RT) methods or mnemonic pre-induction techniques. For RT, daily checks of one's surroundings are done, to serve as a way to distinguish between awake and dreaming states and realities. The basis of this method is that practicing RT regularly during the day to form a habit will lead to doing so while dreaming as well, which in turn may lead to the dreamer realizing they are within their own dream when noticing the reality test appears distorted.

Mnemonic Induction of Lucid Dreams, also known as MILD, is a popular cognitive technique that urges dreamers to express their desire to be lucid when going to sleep (Erlacher & Stumbrys, 2020). It's simply a repeated to oneself future intention with the goal of being carried into REM sleep to assist practitioners in achieving lucid dreaming. By telling oneself "every time I'm dreaming, I shall recall that I'm dreaming," MILD aims to establish a future memory intention to recall one's dream state. The MILD procedure could also be performed after a brief waking after approximately 5 hours of sleep, which is known as the "wake back to bed" (WBTB) method. The expectation is that the MILD method will cause lucid dreaming the following night because the dreamer pre-programs their own mind towards that intention. In another technique called the Senses Initiated Lucid Dream technique (SSILD), during rapid eye movement (REM) sleep, external initiation methods offer stimuli like flashing lights or auditory mild signals that may be integrated into dreams and serve as cues that may prompt lucidity and emergent self-awareness (Schmid & Erlacher, 2020).

To practice SSILD, one may also awaken after about 5 hours (similar to MILD) and reinforce their lucid intention to pre-program oneself again before falling back to sleep. The Wake Back To Bed technique can be used with the MILD strategy. After a significant amount of time spent sleeping, the practitioner is to wake themselves up with the use of an alarm clock, only to fall back asleep after a brief period of waking activities. An external stimulus interruption technique works on the basis of subtle stimulation, with flashing light being one example, but also olfactory, tactile, or mild auditory cues can be used. When the practitioner is exposed to these pre-agreed cues while dreaming, they act as a trigger to help

them remember they are currently in the dream state. However, it is not supposed to awaken them from the dream. Using this method has led to the creation of lucid dreaming stimulating head bands that are yet to become widely commercially available (Appel et al., 2020).

To induce lucid dreaming, it is also sometimes suggested to use acetylcholinesterase inhibitors like donepezil and galantamine in conjunction with the methods that have been discussed (Aspy, 2020). It is hypothesized that when acetylcholine, which is a neurotransmitter that helps facilitate arousal, becomes more easily accessible in the frontal part of the brain, it may promote lucid dreaming. Transcranial direct current stimulation (tDCS) applied to the dorsolateral prefrontal cortex did not prove to be effective in laboratory tests to induce dream lucidity (Schadow et al., 2018). Among some other ways to make lucid dreams occur, certain substances and medications were also proposed. In 2018, a study discovered that a drug called Galantamine successfully induced lucid dreams in healthy participants (LaBerge et al., 2018). Participants who took 8 mg of galantamine and used the MILD method (plus, in most instances, an external stimulating device) had lucid dreams in 42% of their dreams, according to the study. Success rates for a placebo-pill control group were reported at 14% (LaBerge et al., 2018).

This study was designed to have an equal number of volunteers examine the efficacy of each of the three methods for two weeks. The research was conducted with the assistance of a demographically and ethnically diverse group of international volunteers. Participants were arbitrarily allocated to one of three groups before the start of week 1. Since MILD, WBTB, SSILD and RT are frequently employed in tandem, the study compared the efficacy of two different strategies combined in each group. The first group was only to practice the MILD plus SSILD method, the second MILD plus WBTB, and the third, a new protocol combining RT hands check strategy, enhanced by regular intervals of daily alarm reminder set every 5 hours, plus a dream recall amplification component: daily sleep journaling for dream recall starting 7 days before the study. Contrasting these three distinct approaches and evaluating the efficacy revealed a positive correlation between RT strategy with dream recall amplification and lucid dreaming occurrences and that this effect would hold true both for week 1 and week 2 of the study. It was correctly predicted that the proportion of those having lucid dreams in week 2 would be greater than in week 1. It was speculated that if individuals used lucid dreaming methods and fell asleep in 5 minutes or less, their lucid dreaming frequencies would be much greater than if they waited longer than 5 minutes to fall asleep. This particular prediction did not show conclusive results for any of the three groups.

For this study's new protocol, a specific reality check method was created, being an observation of a visual cue, specifically looking at one's hands for a brief moment, five times throughout the waking day. To ensure the actual delivery of this method, all participants were requested to set a gentle sound of a one second alarm on their phones every 2 hours and exactly 5 times each day. This auditory cue, given every 2 hours, was designed to serve as a signal and a re-

gular daily reminder for the volunteers, prompting them to briefly look at the shape and appearance of their hands and ask themselves a question: "Is this a dream or a reality?". The specificity of the intervals was designed as a habit formation to facilitate a similar, automated habit of hands checking during the dreaming phase as well. This frequent practice of conducting "reality checks" on oneself at regular points during the day had the purpose of making participants more aware of the disparities that exist between one's waking environment and the shapes and colors witnessed in their dreams.

Results revealed that five times daily RT reminder protocol plus dream recall amplification was the most successful induction strategy. Notably, participants said they did not find the phone reminders burdensome or annoying. Keeping a dream journal starting 7 days before the study also resulted in higher dream recall compared with the other 2 techniques. Reports of lucid dreaming increased significantly in the new protocol group, from 8 during the first week to 17 during the second week. The other two approaches have yielded quite similar results to one another when it comes to bringing about lucid dreams and recall. With 12 individuals engaged in MILD plus WBTB, only 3 lucid dream recalls were recorded during week 1, and 7 during week 2. The time needed to fall back asleep for neither strategy turned out to be a successful predictor for dream lucidity in this study.

Some participants reported that they slept better on evenings when they successfully produced lucid dreams than on nights they did not. When comparing weeks 1 and 2, participants reported sleeping longer and waking up feeling more regenerated in week 2. These results suggest that the successful production of lucid dreams did not hurt sleep quality but do not exclude the possibility that unsuccessful efforts may have a negative impact on overall sleep length and quality (Schredl & Bulkeley, 2020). It's been proposed before (Erlacher et al., 2020) that the amount of time needed to fall back asleep after experiencing lucid dreaming might be linked to the effectiveness of a technique used to induce dream lucidity, but this study did not confirm this hypothesis.

Recent research by Vallat and Ruby (Vallat & Ruby, 2019) has brought to light that, because lucid dreaming features a consciousness state that is neurologically different from the non-lucid REM phase, raising the rate of lucid dreams might have unknown adverse effects on the normal processes that take place in the course of regular REM sleep. They expressed worry that the disturbance of sleep, which might be a long term consequence of dream lucidity attempts, especially in the WBTB technique, might have harmful effects on one's health. Similar concerns (Stumbrys, 2021) were voiced about the impact of lucid dreaming and the possible disturbances to reality-fantasy borders, which might be of concern to clinical patients with mental diseases like psychosis. The effects of both lucid dreaming and lucid dream training on the quality of one's REM sleep require more study.

DISCUSSION

It is possible that sci-fi thriller movies like "Inception" and "Vanilla Sky" are to blame for the recent surge in interest in lucid dreaming. Dream lucidity, an altered cognitive condition in which one may change dream reality based on one's own free will, is an experience that comes the closest to immersing oneself in another, self-created world. 23% of people report having lucid dreams once a month on a regular basis (Appel et al., 2018). It should therefore come as no surprise that, in recent years, the popularity of techniques that could intentionally induce lucid dreaming has increased (de Macêdo et al., 2019). These methodologies can be generally put into three groups: mental pre-sleep exercises, the introduction of new stimuli or cues during sleep, or the use of prescription drugs and natural substances. It is possible to generate lucid dreaming using cognitive training designed for this purpose without the use of expensive equipment and technological gadgets that are about to enter the commercial market, like headbands that sense REM sleep phase through detection of eye movement and play auditory signals pre-recorded for oneself on such a device. When deciding if it's worth it to induce lucid dreams for sheer entertainment purposes and the often quoted purpose of experiencing more self-indulgence activities in one's dreams, one should think about the risks that could come from disturbing sleep patterns and the REM phase of it. Some researchers believe (Soffer-Dudek, 2020) that people who experience a lot of lucid dreams do not get as much quality sleep, but any correlation between spontaneous lucid dreaming and poor sleep quality has yet to be scientifically established.

CONCLUSIONS

The findings presented in this study provide new data suggesting that the novel RT technique plus enhanced dream recall approach may be able to effectively produce lucid dreaming. The findings of the research imply that the MILD plus SSILD and MILD plus WBTB methods are equally as effective but were not found to be the most efficient way to induce the highest frequency of lucid sleep in this study.

Because of the convenient use of phone alarm reminders in the new RT daily protocol, the participants did not find the process a disturbance from their daily activities, and unlike in other RT methods, it was not hard for them to remember to regularly practice reality checks since it was a set once and forget type of arrangement. This is in opposition to regular RT techniques, where practitioners are expected to spontaneously remember to practice daily and thus might practice less frequently. This could also serve as evidence that the amount of RT practiced daily increases the likelihood of having lucid dreams. There was no statistically important difference in the occurrence of lucid dreams between the MILD plus WBTB and the MILD plus SSILD. The new protocol combining RT, in particular checking one's own hands and asking oneself a question "Is this reality or is this a dream?", with regular phone reminders set 5 times a day plus a daily

dream journal log for dream recall enhancement component, was found to be the most effective way out of the three strategies to help new practitioners achieve dream lucidity most often.

Outside of the sphere of entertainment, the induction of lucid dreams may have applications in the field of medicine. Dream lucidity has been advocated as a treatment for PTSD and sleep disorders, namely nightmares. Patients might be trained to either become consciously aware that they are having a dream or to further consciously reframe their troubling dreams into more positive ones by exercising agency over the dream's plot and characters, as many lucid dreamers can be trained to do. In addition, lucid dreams are a viable field of study as they might make contributions to our understanding of altered states of consciousness and neuroimaging reflecting awareness states, which would in turn have clinical implications to better detect conditions like anesthesia awareness or locked-in syndrome.

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