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Increased lucid dream frequency in long-term meditators but not following MBSR training

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Abstract

Strong conceptual and theoretical connections have been made between meditation practice, mindfulness and lucid dreaming. However, only a handful of empirical studies have evaluated the relationship between lucid dreaming and meditation, and conclusions remain tempered by methodological limitations. Here we evaluate the relationship between meditation, mindfulness and lucid dream frequency using several complementary methods. First, using a cross-sectional design, we evaluate differences in lucid dream frequency between long-term meditators and meditation naïve individuals. Second, we evaluate the relationship between lucid dream frequency and specific facets of trait mindfulness in both meditators and non-meditators. Third, using a blinded randomized-controlled design, we evaluate the impact of an 8-week mindfulness course on lucid dreaming frequency. Our results show that lucid dreaming is more frequent in long-term meditators compared to meditation naïve individuals. Additionally, lucid dream frequency in meditation-naïve individuals was associated with a capacity to verbalize experience, while lucid dream frequency in long-term meditators was associated with observational and decentering facets of trait mindfulness. However, an 8-week mindfulness course did not increase the frequency of lucid dreams. Together these results support a continuity between increased awareness of waking and sleeping states, provide a novel form of evidence linking meditation training to meta-awareness, and support an association between meditation practice and lucid dreaming, but leave open the specific nature of this connection.

Keywords

lucid dreaming; meditation; mindfulness; meta-awareness

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Conflict of interest

Richard Davidson serves as the President of Healthy Minds Innovations, Inc, a non-profit corporation dedicated to cultivating well-being and relieving suffering through a scientific understanding of the mind.

Introduction

Lucid dreams are dreams in which one is aware of the fact that one is dreaming while continuing to dream (LaBerge, 1985). While the scientific study of lucid dreaming is still in its infancy, meditation traditions have been experimenting with cultivating increased awareness of dream and sleep states for millennia (LaBerge, 2003). This has perhaps reached its most elaborated form in the Tibetan Buddhist tradition of “Dream Yoga” (Norbu & Katz, 1992; Wallace & Hodel, 2012), which consists of a set of practices for experiencing the continuity of conscious experiences across dreaming and waking states, for cultivating lucidity during dreams (“apprehending the dream state”), as well as using lucid dreams as a platform for meditation practices during dreams and sleep (e.g., Gillespie, 1988, LaBerge, 2003). Meditation practice in other traditions has also often been associated, albeit anecdotally, with lucid dreaming. For instance, lucid dreams have also been noted to occur in association with Zazen meditation practice in the Zen tradition (Kjellgren & Taylor, 2008) and a number of authors have described increases in the frequency of lucid dreams following meditation practice (e.g., Sparrow, 1976).

Theoretical links between meditation and lucid dreaming have also been made, including a model in which dreaming and waking experiences can be positioned on a continuum of self-awareness, which is hypothesized to be influenced by meditation practice (Gackenbach, 1991; Gackenbach, Cranson, & Alexander, 1986; Moffitt et al., 1988; Thompson, 2014). Additionally, Hunt and Ogilvie (1988) suggested that at least some types of lucid dreams might be regarded as a type of spontaneous meditative state occurring during dreaming sleep. Finally, many of the primary skills cultivated in meditation practice (particularly open monitoring or focused attention meditation), including stability of attention and the ability to monitor one’s current experiential state (meta-awareness), are thought to be useful in having and sustaining lucid dreams (Wallace & Hodel, 2012).

Despite the strong conceptual and qualitative links between meditation practice and lucid dreaming, only a handful of empirical studies have evaluated this relationship. While these preliminary studies appear broadly supportive of a connection between meditation and lucid dreaming, methodological limitations render some of the results, as well as discrepancies among results, difficult to interpret. For example, one study found that practitioners of Transcendental Meditation (TM) reported more frequent lucid dreams compared to controls (Gackenbach et al., 1986). However, the meditator and control groups were comprised of students from two different universities (Maharishi International University and the University of Northern Iowa) and the samples also differed in a number of other traits, including measures of general intelligence, thereby precluding determination of whether the difference in lucid dream frequency between these groups is attributable specifically to meditation rather than some other difference between the groups. In a study of meditators from diverse traditions, Hunt and Ogilvie (1988) found a non-significant increase in lucid dream frequency in the meditation group, but observed that the number of years of meditation practice was positively correlated with the estimated frequency of lucid dreams over the past year. In contrast, a recent large-scale online survey (N=528) found that individuals who reported prior meditation experience reported a significantly higher frequency of lucid dreams, but there was no association between lucid dream frequency and

the number of years of meditation practice or the number of hours of meditation practice per week (Stumbrys, Erlacher, & Malinowski, 2015).

Intriguingly, Stumbrys et al. (2015) also found an association between dispositional mindfulness (a construct that broadly refers to cultivating awareness of experience in the present moment (e.g., Kabat-Zinn, 1990)) during wake and lucid dream frequency, but only in individuals with prior meditation experience. While preliminary, one interpretation of this finding is that at least some types of meditation practices result in changes in trait mindfulness, or cognitive skills associated with specific aspects of mindfulness, that then carry over into sleep and dream states, leading to increases in lucidity. Consistent with this interpretation, research has shown that mindfulness meditation training can improve cognitive skills such as attention (Lutz et al., 2009) and metacognitive ability (the ability to accurate reflect on experience or performance) (Baird, Mrazek, Phillips, & Schooler, 2014), which, as noted above, may be linked to lucid dreaming.

Building on these findings, in the current study we investigated the relationship between lucid dreaming, meditation and mindfulness practice in several complementary ways. First, using a cross-sectional design, we evaluated differences in lucid dream frequency between long-term meditators and meditation-naïve individuals. Second, we evaluated the relationship between lucid dream frequency and specific facets of trait mindfulness in both meditators and non-meditators. Third, using a blinded randomized controlled design, we evaluated whether an 8-week meditation-training course (mindfulness based stress reduction, MBSR) would increase lucid dream frequency. We hypothesized that meditation experience would be associated with increased lucid dream frequency, particularly in long-term meditators.

Methods

Participants

One hundred and seventy-eight individuals (81 males, 97 females, age = 45 ± 13 (mean ± SD), range 25–66) participated in the study. Participants consisted of two groups: long-term meditators (LTMs; N=38) and meditation-naïve participants (MNP; N=140). Participants were recruited through public advertisements in newspapers, email lists, a study website, publicly posted flyers throughout the community, and radio and television advertisements in the local Madison, WI area. Additionally, meditation and wellness centers distributed study recruitment materials to their members via the center’s preferred method of communication (e.g., flyers, posters, email lists). LTMs consisted of individuals both local to the Madison, WI area as well as individuals from other parts of the United States. Participants underwent web and phone screening to verify their eligibility for the study. If eligible, they completed an in-person screening which included the consent process and medical history. Non-local LTMs completed the consent portion of the in-person screening during their phone screen. Inclusion criteria for all participants included the following: 25–65 years old, BMI < 35, fluent English speaker and reader, and reported average total sleep time of >= 6 hours and average time to sleep onset of < 30 minutes. Exclusion criteria for all participants included: pregnancy, taking prescribed psychotropic or central nervous system altering medications, history of a diagnosed Bipolar Disorder, Schizophrenia, or Schizoaffective Disorder,

diagnosed episode of Major Depression within the last year, diagnosed episode of eating disorder or anxiety disorder within the last year, or currently diagnosed sleep disorders. Meditation-naïve participants (MNPs) must not have had significant previous training or significant current practice in meditation or significant daily practice with other mind-body techniques (e.g., daily Yoga or Tai Chi practice), and must not have completed a Mindfulness Based Stress Reduction (MBSR) course. LTMs had to have been practicing meditation for a minimum of 5 years with an average reported practice of at least 200 minutes per week and had to have reported a minimum of 5 weeks experience in meditation retreats. Signed informed consent was obtained from all participants before the experiment, and ethical approval for the study was obtained from the University of Wisconsin – Madison Institutional Review Board.

Study design

Data collection for this study occurred in the context of a large-scale, ongoing study on the psychophysiological effects of meditation practice being jointly conducted by the Center for Healthy Minds (CHM) and Wisconsin Institute for Sleep and Consciousness (WISC) at the University of Wisconsin – Madison. Participants completed three testing blocks in the laboratory. The first block (Baseline, BL) was a baseline visit after which point MNPs were assigned to one of three 9-week study interventions: mindfulness based stress reduction (MBSR), waitlist (WL) or an active control group utilizing the Health Enhancement Program (HEP; MacCoon et al., 2012). Group assignment was initially made using biased coin randomization but was switched to stratified block randomization (stratified on age and gender) at the end of the study to ensure balanced treatment groups. Following completion of the intervention, MNPs returned to the laboratory to complete a post-intervention visit (Time 2, T2) followed approximately 6 months later by a long-term follow-up visit (Time 3, T3). LTMs were not assigned to study interventions.

Dreaming and lucid dreaming frequency

Participants reported their dream recall frequency and lucid dream frequency on a scale developed by Schredl et al. (2004) that has high retest reliability for both dream recall frequency ($r = .85$; $p < .001$; Schredl, 2004) and lucid dream frequency ($r = .89$; $p < .001$; Stumbrys, Erlacher, & Schredl, 2013). Dream recall was estimated with the following 7-point scale: 0 = *never*; 1 = *less than once a month*; 2 = *about once a month*; 3 = *two-three times a month*; 4 = *about once a week*; 5 = *several times a week*; and 6 = *almost every morning*. Following Stumbrys, Erlacher and Malinowski (2015), units of mornings per week were obtained by recoding the scale as follows: 0 → 0, 1 → 0.125, 2 → 0.25, 3 → 0.625, 4 → 1.0, 5 → 3.5, and 6 → 6.5. Lucid dream frequency was measured with an 8-point scale: *0 = never; 1 = less than once a year; 2 = about once a year; 3 = about 2 to 4 times a year; 4 = about once a month; 5 = about 2 to 3 times a month; 6 = about once a week; and 7 = several times a week*. Following Stumbrys et al. (2015), units of frequency per month were obtained by recoding the scale as follows: 0 → 0, 1 → 0.042, 2 → 0.083, 3 → 0.25, 4 → 1.0, 5 → 2.5, 6 → 4.0, and 7 → 8.0. A written definition of lucid dreaming was provided along with the scale as follows: “Lucid dreaming is a special sort of dream in which, while asleep and still in the dream, you have the explicit realization that what you are experiencing is a dream and not waking reality. Thus, during lucid dreaming, one is, while dreaming, explicitly

aware of the fact that one is dreaming. This realization often leads to the ability to deliberately control one's actions or to observe passively the course of the dream with full conscious awareness, similar to the awareness you have while awake."[1] Following a standard convention (e.g. Snyder & Gackenbach, 1988; Stumbrys et al., 2015), participants who reported lucid dreaming once per month or more were classified as frequent lucid dreamers.

Trait mindfulness and meditation experience

Trait mindfulness was measured with the Toronto Mindfulness Scale (TMS; Lau et al., 2006) and Five Facet Mindfulness Questionnaire (FFMQ; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006; Baer et al., 2008). The TMS consists of 13 items scored on a 5-point scale (1 = *not at all*; 2 = *a little*; 3 = *moderately*; 4 = *quite a bit, and* 5 = *very much*) and measures two factor-analytically derived components of mindfulness: Curiosity and Decentering. The Curiosity factor corresponds to an "an attitude of wanting to learn more about one's experiences" and "awareness of present moment experience with a quality of curiosity", whereas the Decentering factor corresponds to "awareness of one's experience with some distance and dis-identification rather than being carried away by one's thoughts and feelings" (Lau et al., 2006) and refers to the capacity to see thoughts or experiences as mental events, similar to decentering as described by Teasdale et al. (2002).

The FFMQ consists of 39 items scored on a 5-point scale (1 = *never or very rarely true*; 2 = *rarely true*; 3 = *sometimes true*; 4 = *often true, and* 5 = *very often or always true*). The scale was constructed through factor analysis of a large sample of responses to five independently developed mindfulness instruments. The FFMQ empirically integrates multiple operationalizations of mindfulness into five empirically derived dimensions: 1) Observing ("noticing or attending to internal and external experiences"), 2) Describing ("labeling internal experiences with words"), 3) Acting with awareness ("attending to one's activities of the moment"; "contrasted with behaving mechanically while attention is focused elsewhere - often called automatic pilot"), 4) Nonjudging of inner experience ("taking a non-evaluative stance toward thoughts and feelings"), 5) Nonreactivity to inner experience ("the tendency to allow thoughts and feelings to come and go, without getting caught up in or carried away by them") (Baer et al., 2008). LTMs also completed a meditation experience questionnaire that measured their lifetime meditation experience/practice, including the number of years of formal meditation practice, time spent in meditation and their practice tradition (see Supplementary Materials: Meditation Experience Questionnaire). LTMs also completed a meditation retreat history questionnaire in which they provided a brief history of meditation retreats attended, including the total number of retreats attended and time spent in meditation during each retreat (see Supplementary Materials: Meditation Retreat Questionnaire).

[1]See Snyder and Gackenbach (1988) for the importance of providing a definition in the assessment of individual differences in lucid dreaming frequency.

MBSR and HEP interventions

Mindfulness Based Stress Reduction (MBSR)—The MBSR program followed the original program developed by Kabat-Zinn, Lipworth, Burney, Sellers, and Brew (1984) and Kabat-Zinn (1990), shown to be effective in reducing anxiety, depression and stress in patients (Kabat-Zinn, Lipworth, & Burney, 1985; Kabat-Zinn, Lipworth, Burney, & Sellers, 1987; Miller, Fletcher, & Kabat-Zinn, 1995). Two current MBSR instructors for the Mindfulness Center at the University of Wisconsin-Madison School of Medicine and Public Health's Division of Integrative Medicine taught the MBSR class. Mindfulness meditation involves systematic training in the development of a sustained, non-aroused state of attention and clear awareness. Participants met in groups of up to 24 participants, for 2 ¼ – 2 ½ hour sessions, once per week for 8-weeks. An additional "all day" session during week 6 or 7 ran from approximately 9 am – 3 pm. The total duration of the sessions was approximately 30 hours per subject. Audiotapes or compact discs of varying length but no longer than 45 min with guided instruction were provided that guide the participants in their formal meditation practices, including body scan, sitting meditation and gentle yoga. Classes involved a review of previously assigned homework with discussion of difficulties participants may have experienced and hands-on practice/experience with mindfulness techniques and skills. Participants progressed in their daily meditation practice from approximately 10 minutes per day at the beginning of the program up to 45 minutes per day by the 8th week of the program. Participants received a weekly email/phone/text message reminding them to complete the class practice.

Health Enhancement Program (HEP)—The format of the health enhancement program was modeled after traditional activity and nutrition programs used in weight management, cardiac rehab and diabetes prevention programs. The program is designed to increase health and well being by focusing on four health domains that impact health and are interventions regularly practiced at integrative medicine, including: music therapy, nutrition, physical activity including walking and stretching and functional movement. A senior clinical exercise physiologist for UW Health Integrative Medicine served as the senior instructor for the training sessions and attended every class along with a co-instructor with specialized knowledge in one of the above four domains. The program was structured similarly to the MBSR program: participants met in groups of up to 24 participants for 2 ¼ – 2 ½ hour sessions once per week for 8 weeks. There was an all-day class during week 6 or 7 as well as requested practice of 6 days per week. Classes involved a review of previously assigned homework with discussion of difficulties participants may have experienced and hands-on practice with techniques or skills related to health enhancement.

Statistical analysis

Shapiro-Wilk tests indicated that both dream recall frequency and lucid dream frequency significantly deviated from a normal distribution (dream recall: Shapiro-Wilk's W=0.75, $P<10^{-14}$); lucid dream frequency: Shapiro-Wilk's W=0.42, $P<10^{-22}$). Significance tests of group differences between LTMs and MNPs in dream recall and lucid dream frequency were therefore assessed with a nonparametric Monte Carlo permutation test (n=10,000 permutations) (Manly, 2006). Data from 13 participants were unavailable at visit 2 (T2) due to the fact that they withdrew from the study, and data from an additional 10 participants

were unavailable at T3 due to study withdraws. Furthermore, data from 2 participants were unavailable at T2 because they did not complete the questionnaire measure. Finally, data from 7 participants were excluded from analysis at T2 and T3 because they attended fewer than 3 classes. To account for varied numbers of repeated observations within subjects we used a linear mixed effects model to evaluate repeated-measures training effects. The model for evaluating the effect of training group (GROUP) on lucid dreaming frequency (LUCID) used restricted maximum likelihood estimation (REML) and included GROUP (*MBSR*, *HEP*, *WL*) and VISIT (*BL, T2, T3*) as fixed effects and LUCID as the outcome variable.

As the measure of lucid dreaming frequency (LUCID) was not normally distributed (see above), we used nonparametric bootstrapping for significance tests of mixed model regression coefficients. Hypothesis testing of regression coefficients (pairwise tests) from the mixed models was obtained by the following steps: *i*) constructing a model based on the null hypothesis of no differences between GROUP (H_0), *ii*) resampling with replacement the distribution of the response residuals under the null model, reconstructing a bootstrap y response vector, and refitting the H_1 model to the bootstrap response vectors to generate 10,000 bootstrap estimates of the regression coefficients ($ß$) under H_0, and *iii*) comparing the observed value of $ß$ against the null bootstrap distribution (two-tailed frequentist p-value). Mixed model construction and mixed model bootstrapping were performed with the lme4 package (Bates, Mächler, Bolker, & Walker, 2014) in the R environment (R Development Core Team, 2006). Mixed model fixed effects were assessed by means of a bootstrap likelihood ratio test on mixed effects models (PBmodcomp in R) specified with maximum likelihood estimation (MLE). Inter-variable correlations for dream and lucid dream frequency were measured using the nonparametric Spearman's Rho test.

Results

On average across both MNP and LTM groups, participants reported that they recalled 1.55 ± 1.79 [M ± SD] dreams per week and 0.59 ± 1.53 [M ± SD] lucid dreams per month. Dream recall and lucid dream frequency were correlated ($r_s = 0.38$, $p=0.000001$). Age was negatively correlated with dream recall ($r_s = -0.24$, $p=0.001$), but was not associated with lucid dream frequency ($r_s = -0.09$, $p=0.25$). LTMs reported a median of 10 years (SD=7.17, range= 2–35) and 2,639 total hours of meditation experience with a median meditation practice of 5.9 hours per week (SD=2.6, range= 2.3–14). They also reported a median of 1,140 hours spent meditating in a retreat setting. The meditation style of the participants was varied and included 19 Theravadan practitioners, 12 Tibetan practitioners, 4 Zen Buddhist practitioners and 1 Vipassana (Insight) practitioner. No participants (LTM or MNP) reported that they were actively training to induce lucid dreams during the study.

Lucid dreaming in long-term meditators (LTMs)

LTMs reported a higher frequency of lucid dreams (M=1.11 per month, SD=2.28) compared to MNPs (M=0.45 per month, SD=1.22) [p=0.01, Monte Carlo permutation test, Table 1]. There was no significant difference in dream recall between LTMs (M=1.96 per week, SD=1.85) compared to MNPs (M=1.43 per week, SD=1.75) [p=0.11, Monte Carlo permutation test]. To account for any potential influence of age or gender we also conducted

a simultaneous multiple linear regression analysis with group (LTM, MNP), age and gender as fixed effects. LTMs had significantly higher lucid dream frequency compared to MNPs (ß=0.58, p=0.03), while no significant effects of gender (ß= −0.37, p=0.11) or age (ß= −0.01, p=0.48) were observed.

LTMs who reported frequent lucid dreams (> 1 per month) practiced different styles of meditation, and consisted of 4 Theravadan practitioners (1 with secondary practice in Tibetan), 3 Tibetan practitioners (1 with secondary practice in Zen), 2 Zen practitioners and 1 Vipassana practitioner. There were no significant differences in lucid dream frequency between different traditions of practice (all $p > 0.05$). There was no significant difference between LTMs who reported frequent lucid dreams and other LTMs in years of meditation experience ($t(34)= -0.17$, p=0.86), total hours of practice ($t(36)= -0.54$, p=0.59), total number of retreat hours ($t(36)= -0.53$, p=0.59) or hours practicing meditation per week ($t(36)= -1.12$, p=0.21).

Lucid dreaming and trait mindfulness

Both subscales of the TMS (Curiosity and Decentering) had high internal consistency (Cronbach's alpha = 0.92 and 0.89, respectively), similar to previous reports (.86 and .87, respectively; Lau et al., 2006). All FFMQ subscales also had high internal consistency (Cronbach's alpha Observing = 0.86, Describing = 0.92, Acting with awareness = 0.90, Non-judgment = 0.91, Non-reactivity = 0.87). After establishing the reliability of TMS and FFMQ subscales, we first analyzed whether frequent lucid dreamers differed in trait mindfulness scores across the entire sample (collapsing across LTM and MNP groups). Across the entire sample, frequent lucid dreamers had higher scores only on the Describing subscale of the FFMQ ($t(176)=2.65$, p=0.009). There was also a marginal but not significant increase in the Observing ($t(174)=1.95$, p=0.052) and Acting with Awareness FFMQ subscales ($t(176)=1.87$, p=0.062). There were no other significant differences in trait mindfulness in frequent lucid dreamers across the entire sample (all $p > 0.05$). We next evaluated whether frequent lucid dreamers differed in trait mindfulness subtypes separately for MNPs and LTMs. Frequent lucid dreamers in the MNP group had higher scores only on the Describing subscale of the FFMQ, while no other significant differences were observed (Table 2, left panel). In contrast, frequent lucid dreamers in the LTM group exhibited higher trait mindfulness on the Observing and Acting with Awareness subscales of the FFMQ as well as on the Decentering subscale of the TMS (Table 2, right panel). No significant differences were observed on any other subscales (all $p > 0.05$). Compared to MNPs, LTMs reported higher trait mindfulness on all TMS and FFMQ subscales (all $p <= 0.01$). Years of meditation practice was marginally correlated with the Observing subscale of the FFMQ (r=0.33, p=0.052), but no other correlations between meditation practice and trait mindfulness subscales were observed (all $p > 0.05$).

Lucid dreaming and MBSR training

As noted above (see Statistical Analysis), 7 participants attended fewer than 3 classes and were excluded from further analysis. Of the participants that met the minimum participation requirements, course participation was high: participants attended an average of 8.29 out of 9 classes in the HEP program and an average of 8.05 out of 9 classes in the MBSR program.

No difference in attendance ($t(79)=0.90$, $p=0.37$) was observed between groups. Participants logged a median of 43 days (SD=18.31) of meditation practice during the MBSR program. We evaluated test-retest reliability of dream recall and lucid dreaming frequency scales by analyzing responses in the WL group in which there was no intervention between time points. The results showed high test-retest reliability of both the dream recall scale (BL-T2: $r_s=0.86$, $p<0.0001$; BL-T3: $r_s=0.89$, $p<0.0001$) and lucid dream frequency scale (BL-T2: $r_s=0.96$, $p<0.0001$; BL-T3: $r_s=0.72$, $p<0.0001$).

There was no main effect of group (likelihood ratio: 3.15, $p=0.20$) or visit (likelihood ratio: 4.20, $p=0.12$) on lucid dream frequency and no interaction between group and visit (likelihood ratio: 0.90, $p=0.92$). Compared to baseline (BL), neither MBSR nor HEP resulted in increases in reported lucid dream frequency post-intervention (T2) or at long-term follow-up (T3, approximate 6 months post-intervention) [all $p > 0.05$, Table 3]. There was no correlation between the number of self-reported days that participants engaged in meditation practice during the intervention and lucid dream frequency post-intervention ($r_s=-0.01$, $p=0.94$). There was also no main effect of group (likelihood ratio: 3.82, $p=0.15$) or visit (likelihood ratio: 0.08, $p=0.96$) on dream recall frequency and no interaction between group and visit (likelihood ratio: 1.04, $p=0.90$).

Discussion

The current study found that long-term meditators have more frequent lucid dreams compared to individuals without meditation experience. These results support other studies that have observed increased lucid dream frequency in meditators (e.g., Gackenbach et al., 1986; Stumbrys et al., 2015), while addressing some methodological limitations of prior work, including online sampling and potentially confounding variables across meditation and control groups. Our findings also indicate that specific aspects of trait mindfulness during waking are associated with increased frequency of lucid dreams, supporting continuity between increased awareness during waking and sleeping states (e.g., Domhoff, 2017; Hall & Lind, 1970; Kahan & LaBerge, 2011). Furthermore, our results suggest that the relationship between trait mindfulness and lucid dreaming depends on whether an individual has prior experience with meditation. However, our results also show that a short meditation training intervention (8-week mindfulness based stress reduction (MBSR) course) does not lead to significant changes in lucid dream frequency. Altogether these results support a relationship between meditation and lucid dreaming but leave open the specific nature of this connection.

One prominent potential link between lucid dreaming and meditation is that meditation training is hypothesized to increase meta-awareness (e.g., Davidson & Kaszniak, 2015), also variously termed metaconsciousness or metacognitive awareness, which refers to the capacity to be aware of one’s conscious thoughts or experiences (Schooler, 2002). In a review of mindfulness and meditation practices, Lutz, Jha, Dunne, and Saron (2015) suggested that meta-awareness is one of three key functional dimensions influenced by meditation. While the relationship between meditation and meta-awareness appears theoretically well motivated, it is difficult to operationalize meta-awareness in a way that allows individual differences to be studied during waking tasks. For instance, meta-

awareness has been studied extensively in the context of individuals 'catching' episodes of mind-wandering during sustained attention tasks. While instances of meta-awareness can be effectively studied with paradigms such as self-caught and probe-caught thought sampling (Smallwood & Schooler, 2015), individual differences in the frequency of meta-awareness of mind-wandering are more difficult to study, as meta-awareness can be confounded with other variables such as the amount of mind-wandering an individual engages in or the temporal duration of mind-wandering episodes (e.g., Schooler et al., 2011).

As a result of the difficulty in empirically operationalizing meta-awareness, few research studies have directly addressed this question, and the empirical evidence for a relationship between meditation and meta-awareness is mostly indirect. For example, several studies have examined introspective accuracy (Fox et al., 2012) and interoceptive awareness in meditators (Khalsa et al., 2008; Sze, Gyurak, Yuan, & Levenson, 2010), but the precise relationship of these constructs to meta-awareness remains unclear, the results of different studies have been mixed, and the confounding influence of sensitivity on the primary task has not always been adequately controlled. Perhaps the most direct evidence that meditation can influence mechanisms related to meta-awareness is the finding that meditation training can enhance metacognitive accuracy on a memory task without changing performance on the primary task (Baird et al., 2014). However, the relationship between meta-awareness and metacognition is also not fully understood, as metacognition typically denotes a functional process whereas meta-awareness specifically refers to a conscious/experiential process (Schooler, 2002), and there is evidence that some metacognitive processes can occur in the absence of awareness (Reder & Schunn, 1996; Scott, Dienes, Barrett, Bor, & Seth, 2014). As the initiation of lucid dreaming by definition requires meta-awareness of the state of consciousness one is in, the current results provide a novel and unique type of evidence linking meditation training to meta-awareness.

A related potential link between meditation and lucid dreaming concerns the relationship between meditation, lucid dreaming and mindfulness. Mindfulness is a complex construct that generally refers to cultivating awareness of experience and actions in the present moment that may also include a non-judgmental attitude of acceptance of experiences as they arise (e.g., Kabat-Zinn, 1990, but see e.g., Dreyfus, 2011 for discussion of whether the non-judgmental dimension should be regarded as definitional and Wallace, 2012 for a critique of divorcing the term mindfulness from its original connection with Buddhist ethics). Recent research has sought to categorize subtypes of mindfulness through factor analysis, including, as noted above, observational and awareness components as well as non-judgment and non-reactivity as separate dimensions (e.g., Baer et al., 2006; Lau et al., 2006; Walach, Buchheld, Buttenmüller, Kleinknecht, & Schmidt, 2006), and in the present work we evaluated whether these specific facets of mindfulness are related to lucid dream frequency and meditation.

Consistent with a recent study by Stumbrys et al. (2015), we found that lucid dreaming was related to specific aspects of mindfulness, which differed depending on whether an individual had meditation experience. Specifically, while frequent lucid dreamers without prior meditation experience scored higher on the "Describing" subscale of the five facet mindfulness questionnaire (FFMQ), frequent lucid dreamers in the long-term meditation

group displayed higher scores on “Observing” and “Acting with awareness” of the FFMQ and the “Decentering” subscale of the Toronto mindfulness scale (TMS). The Describing subscale of the FFMQ relates to an individual’s ability to verbalize his or her experience, and includes items such as “My natural tendency is to put my experiences into words” and “It’s hard for me to find the words to describe what I’m thinking” (reverse scored). To our knowledge, a relationship between the ability to verbalize one’s experiences and lucid dreaming has not been studied or described before in the literature. While this finding initially surprised us, it is not difficult to see how the capacity to verbalize is related to lucid dreaming when one considers that for “typical” lucid dreams in order to become explicitly lucid one has to verbalize to oneself the nature of one’s experiential state, i.e. “This is a dream!” It is unclear whether this skill is best conceived as a mindfulness subtype in this context, however, or as part of a more general verbalization ability. Nevertheless, we find the connection between lucid dreaming and verbalization to be intriguing and deserving of further study.

In contradistinction to the relationship between mindfulness subtypes and lucidity in meditation naïve individuals, our results suggest that lucid dream frequency in meditators relates to different mindfulness traits, namely Observing, Acting with awareness and Decentering. Observing indexes careful noticing and attention to one’s ongoing experience (e.g., “When I’m walking, I deliberately notice the sensations of my body moving” and “When I take a shower or bath, I stay alert to the sensations of water on my body”), whereas Acting with awareness encompasses both non-distraction (e.g., “I don’t pay attention to what I’m doing because I’m daydreaming, worrying, or otherwise distracted” (reverse scored)) and non-automaticity (e.g., “It seems I am “running on automatic” without much awareness of what I’m doing” (reverse scored)). Both of these facets connect directly to meta-awareness in terms of noticing and attending to one’s experiences. Decentering refers to a related but distinct construct, namely the capacity to see thoughts or experiences as mental events (Williams, 2010) and had been suggested to fall within a “general domain of constructs that describe the ability to observe the temporal stream of thoughts and feelings” (Bishop et al., 2004).

There are multiple ways that decentering could relate to lucid dream frequency in meditators, including increased awareness of one’s experiential states, or, perhaps more directly, the capacity to be able to recognize mental events as mental. In the context of lucid dreaming, this connects with the primary aim of recognizing the dream *as a dream*, or recognizing content in dreams *as dream content* (in the philosophical literature experiencing mental content as being constructed by one’s mind has been referred to the opacity of mental states; see Metzinger (2003) for a discussion of the relationship between phenomenal opacity and lucid dreaming). In contrast to the inter-related facets of observing, acting with awareness and decentering, no relationship was observed between lucid dream frequency and non-judgment or non-reactivity mindfulness traits. These results are broadly consistent with Stumbrys et al. (2015), who observed that lucid dream frequency could be predicted by scores on the mindful presence subscale of the Freiburg Mindfulness Inventory (FMI; Walach et al., 2006), which indexes the ability to be aware of one’s experience, similar to the FFMQ observing and awareness subscales, but not the FMI mindful acceptance subscale (which is similar to FFMQ nonreactivity/nonjudgement subscales).

As noted above, an intriguing possibility that arises from these finding is that at least some types of meditation practice lead to alterations in mindfulness traits that then carry over into sleep and dream states. Consistent with this, we observed that meditation experience in years was associated with higher trait mindfulness scores on the Observing subscale of the FFMQ. However, other mindfulness dimensions did not correlate with either the total amount of meditation experience or intensity of current practice, and overall the question of whether meditation training and lucid dreaming frequency are causally connected remains unclear from the current results. Consistent with Stumbrys et al. (2015), while we observed significantly increased lucid dreaming frequency in meditators, we did not observe a correlation between lucid dream frequency and the number of years of meditation experience, the amount of time spent in meditation retreat or the frequency of an individual's meditation practice (hours of practice per week). Additionally, as noted above, our 8-week mindfulness meditation-training (MBSR) intervention did not increase the frequency of lucid dreams in this sample.

While we do not find this interpretation to be the most likely, given this pattern of results it remains possible that the link between meditation and lucid dreaming is indirect, and is caused by some other variable such as personality differences or interests, which drive certain individuals to engage in meditation practice and to also be more likely to have lucid dreams. However, it is worth emphasizing that our meditation intervention only provided a cursory introduction to meditation practice, and predominately included only short meditation sessions throughout the intervention, and it is plausible that more intensive immersion in meditation may be required for changes in lucid dreaming to occur. Thus, we urge caution in over-interpreting this null result to indicate that there is no causal link between meditation and lucid dreaming. It will be important in future studies to further investigate the causal connection between training in meditation and lucid dreaming, for example by evaluating longitudinal effects of more extensive meditation training or the impact of intensive meditation retreats on the frequency of lucid dreams. Future research could also specifically examine whether frequent lucid dreams are a manifestation of a trait that correlates with both mindfulness and a predilection for engaging in meditation practice, for example by assigning meditation naïve participants of both high and low lucid dream frequency to a mindfulness meditation intervention and evaluating pre and post changes in mindfulness and meditation persistence.

Another related possibility is that lucid dreaming could be influenced by specific styles of meditation practice more than others. While we did not observe differences in lucid dream frequency between meditators from different traditions (e.g., Theravadan, Tibetan or Zen), all these traditions encompass varying styles of practice. One major distinction in practice styles that has been made is between focused attention (FA) practices, in which an individual sustains selective attention on a specific object, and open monitoring (OM) practices, in which an individual aims to remain in a monitoring state without any specific object of attention (e.g., Lutz, Slagter, Dunne, & Davidson, 2008). While both FA and OM practices are hypothesized to train meta-awareness, it is plausible that they could exert this influence in different ways (Lutz et al., 2015). Specifically, in FA practice meta-awareness is cultivated primarily in the context of detecting distractions of attention as they arise so that one can redirect attention to the object of attention, while in OM one seeks to continuously remain in

an ongoing monitoring state. Moreover, OM is thought to cultivate meta-awareness more explicitly and to a larger degree, while it has been suggested that an excess of meta-awareness may actually be counterproductive in FA practice (Lutz et al., 2015).

These differences in practice styles and the different ways in which meta-awareness is trained could possibly influence the relationship between meditation practice and lucid dreaming. Overall, the relationship between different styles of meditation practice and lucid dreaming has not been empirically investigated and remains an open question. However, we find it plausible that, given the link to meta-awareness, both FA and OM could lead to increased lucid dream frequency, whereas it is less evident how increased lucid dream frequency might result from other practices such as loving kindness practice. In the current study we did not measure either total lifetime experience or the amount of time individuals currently engaged in specific styles of meditation practice (i.e., FA, OM, loving kindness practices, or other practice styles). It therefore remains possible that either lifetime experience or current amount of practice in specific types of meditation could be associated with increased lucid dreaming frequency. Given our results, it will be important in future studies to measure the specific type of meditation practice individuals are engaged in when obtaining estimates of total hours of practice as well as hours of current meditation practice. Furthermore, the MBSR meditation-training intervention used in the current study incorporated elements of different styles or practice, including both FA and OM practice. Comparing meditation-training interventions that target specific meditation practice styles on lucid dream frequency could also help to inform our understanding of the relationship between meditation and lucid dreaming.

The measurement of individual differences in lucid dream frequency has been done in inconsistent ways across studies and could be improved in future research. A measure used in several previous studies, and the one used here, is an 8-point scale that asks individuals to self-rate the frequency with which they experience lucid dreams, ranging from “never” to “several times per week” (Schredl & Erlacher, 2004). This method provides a straightforward coarse assessment of an individual’s estimated frequency of lucid dreams that has shown good test-retest reliability (Stumbrys et al., 2013), and high correlations with diary measures and sleep laboratory recordings of lucid dreams (Schredl & Erlacher, 2004). However, one limitation is that the scale as currently designed does not measure differences in lucid dream frequency greater than several times per week, and thus variance at the high end of the scale may be missed. The scale could be improved by including additional categories on the higher end of the measure, including, for example, “Every night” and “Multiple times per night.” While individuals who experience lucid dreams on a nightly basis represent a very small percentage of respondents, this refinement would enable researchers to distinguish individuals who have lucid dreams nightly from individuals that have lucid dreams several times a week, which is likely to be an important distinction. Indeed, these “virtuoso” lucid dreamers represent perhaps one of the most interesting targets for psychological and cognitive neuroscience studies of individual differences in lucid dream frequency.

A further limitation of current individual difference measures is that they do not measure variation in the length or degree of lucid dreams. Lucid dreams can range from a mere

fleeting thought about the fact that one is dreaming followed by an immediate loss of lucidity or awakening, to extended lucid dreams where an individual is able to experience prolonged lucidity in the dream state, to peak experiences that can have a transformational impact on the individual (LaBerge & Rheingold, 1990). Distinguishing between these different “levels” of lucid dreams will likely be valuable to understanding observed differences (or lack of differences) in cognitive or neurophysiological measures associated with lucid dream frequency (see e.g., Barrett, 1992; for a recent attempt to separately quantify frequency, intensity and duration of lucid dreaming see Aviram & Soffer-Dudek, 2018). Relatedly, in future work it would be informative to examine the influence of meditation practice on different aspects of consciousness related to lucidity in dreams, such as control of attention and action and short and long-term memory function (e.g., Windt & Metzinger, 2007).

While the current study advances our understanding of the relationship between lucid dreaming, meditation and mindfulness, it has only scratched the surface in terms of understanding how these processes are linked, or in understanding the full potentials of mental training on the plasticity of consciousness and self-awareness during sleep. An intriguing direction for future work will be to investigate changes in lucid dreaming in highly advanced meditators or monks, such as expert practitioners with >10,000 hours of meditation practice (e.g., Lutz, Brefczynski-Lewis, Johnstone, & Davidson, 2008), as well as meditators that specifically train in methods of dream yoga for enhancing awareness during sleep and dream states (Wallace & Hodel, 2012). As noted above, long-term longitudinal studies evaluating the effectiveness of meditation practices would be particularly valuable as well as the impact of more intensive meditation training on lucid dreaming (i.e., intensive meditation retreats).

Future studies might also consider evaluating the relationship between lucid dreaming and meditation using complementary measures of lucid dream frequency, such as sleep diaries, over long time intervals. Using this method, nightly measures of lucid dreaming and various components of lucid dreams as described above could be measured and changes over the course of the intervention could be assessed, enabling a fine-grained measurement of lucid dreams that could lead to more insight into the effect of meditation training on lucid dreaming. It would also be informative to study the acute effects of specific types of meditation practice on lucid dreams in meditators, particularly when combined with the mental set for lucid dream induction (LaBerge, 2014). Finally, given preliminary evidence that meditators have increased gamma activity in parietal regions during sleep (Ferrarelli et al., 2013), another interesting direction for future work will be to explore whether these neurophysiological changes could be partly related to changes in awareness or meta-awareness associated with meditation training.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Lucid dream frequency for LTM and MNP groups

	LD/month *M* (*SD*)	Never	> 1/month	> 1/week	Age *M* (*SD*)	*N*
MNP	0.45 (1.22)	48.6%	17.1%	5.0%	44.7 (12.5)	140
LTM	1.11 (2.28)	23.6%	26.3%	13.2%	44.9 (12.3)	38

Note. MNP = meditation-naïve participant; LTM = long-term meditator; LD = lucid dream

Table 2

Trait mindfulness scores for frequent and non-frequent lucid dreamers for LTM and MNP groups

	MNP				LTM			
	NFLD *M* (*SD*)	FLD *M* (*SD*)	*t*	*p*	NFLD *M* (*SD*)	FLD *M* (*SD*)	*t*	*p*
FFMQ								
Observing	27.3 (5.2)	27.2 (6.0)	0.58	0.56	32.4 (3.6)	35.9 (3.6)	2.70	0.01*
Describing	28.3 (5.5)	30.1 (5.6)	2.32	0.02*	31.9 (5.6)	33.4 (4.5)	0.76	0.45
Act Awareness	28.0 (5.2)	28.0 (5.9)	0.83	0.41	29.5 (4.0)	32.8 (5.1)	2.08	0.04*
Non-judgment	31.2 (5.5)	30.2 (7.2)	−0.34	0.72	34.2 (3.8)	33.1 (3.7)	0.80	0.42
Non-reactivity	22.8 (4.6)	23.5 (3.9)	0.47	0.64	27.1 (3.6)	28.4 (1.7)	1.10	0.27
TMS								
Decentering	11.8 (5.0)	11.6 (4.4)	−0.42	0.67	20.6 (4.8)	23.9 (1.9)	2.10	0.04*
Curiosity	14.3 (5.0)	14.4 (5.6)	0.54	0.59	19.1 (4.1)	19.5 (5.6)	0.23	0.81

Note. MNP = meditation-naïve participant; LTM = long-term meditator; NFLD = non-frequent lucid dreamer; FLD = frequent lucid dreamer; FFMQ = Five Facet Mindfulness Questionnaire; TMS = Toronto Mindfulness Scale

* $p<0.05$

Table 3

Lucid dream frequency for MBSR, HEP and WL interventions

	Mean (SD)			T2 > BL		T3 > BL	
Intervention	**BL**	**T2**	**T3**	***Beta***	***p-value***	***Beta***	***p*-value**
HEP	0.45 (1.29)	0.26 (0.62)	0.29 (0.84)	−0.19	0.21	−0.15	0.36
MBSR	0.66 (1.54)	0.47 (1.07)	0.42 (1.33)	−0.22	0.12	−0.20	0.16
WL	0.26 (0.66)	0.08 (0.18)	0.20 (0.67)	−0.16	0.11	−0.03	0.78

Note. HEP = health enhancement program; MBSR = mindfulness-based stress reduction; WL = waitlist control; BL = first study visit (baseline); T2 = second study visit (post-intervention); T3 = third study visit (long-term follow-up)