

Increased Lucid Dream Frequency in Long-Term Meditators but not Following Mindfulness-Based Stress Reduction Training

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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. In this study, we evaluated the relationship between meditation, mindfulness, and lucid dream frequency using several complementary methods. 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 nonmeditators. Third, using a blinded, randomized controlled design, we evaluated the effect of an 8-week mindfulness course on lucid dreaming frequency. Our results show that lucid dreaming is more frequent in long-term meditators than in meditation-naïve individuals. In addition, lucid dream frequency in meditation-naïve individuals was associated with a tendency to verbalize experience, whereas 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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Lucid dreams are dreams in which one is aware of the fact that one is dreaming while continuing to dream (LaBerge, 1985). Although 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 consciousness across dreaming and waking states, for cultivating lucidity during dreams, 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 Zen 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). In addition, 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. Although 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 than 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 nonsignificant 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 practiced per week (Stumbrys, Erlacher, & Malinowski, 2015).

Stumbrys et al. (2015) also found an intriguing association between dispositional mindfulness (a construct that broadly refers to cultivating awareness of experience in the present moment, e.g., Kabat-Zinn, 1990) during waking states and lucid dream frequency, but only in individuals with prior meditation experience. Although 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 accurately 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 nonmeditators. Third, using a blinded, randomized controlled design, we evaluated whether an 8-week meditation-training course (mindfulness-based stress reduction, or MBSR) would increase lucid dream frequency. We hypothesized that meditation experience would be associated with increased lucid dream frequency, particularly in long-term meditators.

Method

Participants

Participants were 178 individuals (81 men, 97 women, $M_{\text{age}} = 45 \pm 13$, range = 25–66) and 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, e-mail lists, a study website, publicly posted flyers throughout the community, and radio and TV advertisements in the local Madison, Wisconsin area. In addition, meditation and wellness centers distributed study recruitment materials to their members via the center's preferred method of communication (e.g., flyers, posters, e-mail lists). LTMs consisted of individuals local to the Madison 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 that included the consent process and medical history. Nonlocal LTMs completed the consent portion of the in-person screening during their phone screen. Inclusion criteria for all participants included being 25–65 years of age, having a body-mass index of <35 , being a fluent English speaker and reader, and reporting an average total sleep time of ≥ 6 hr and average time to sleep onset of <30 min. Exclusion criteria for all participants included pregnancy, taking prescribed psychotropic or central nervous system altering medications, a history of a diagnosed bipolar disorder, schizophrenia, or

schizoaffective disorder; a diagnosed episode of major depression, eating disorder, or anxiety disorder within the past year; or a currently diagnosed sleep disorder. 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 an MBSR course. LTMs had to have been practicing meditation for a minimum of 5 years, with an average reported practice of at least 200 min per week and a reported 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 (UW) 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 UW. Participants completed three testing blocks in the laboratory. The first block was a baseline (BL) visit, after which point MNPs were assigned to one of three 9-week study interventions: MBSR, waitlist (WL), or an active control group that engaged in 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 postintervention 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 and Erlacher (2004), which has high test–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 subscale: 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 et al. (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 subscale: 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 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 attitude of wanting to learn more about one's experiences” and “awareness of present mo-

ment 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: (a) Observing (“noticing or attending to internal and external experiences”), (b) Describing (“labeling internal experiences with words”), (c) Acting With Awareness (“attending to one's activities of the moment” and “contrasted with behaving mechanically while attention is focused elsewhere - often called automatic pilot”), (d) Nonjudging of Inner Experience (“taking a non-evaluative stance toward thoughts and feelings”), and (e) 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 *Meditation Experience Questionnaire* in [online supplementary materials](#)). LTMs also completed a questionnaire about their history of meditation retreats, 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 *Meditation Retreat Questionnaire* in [online supplementary materials](#)).

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

MBSR. The MBSR program followed the original program developed by Kabat-Zinn, Lipworth, Burney, Sellers, and Brew (1984) and Kabat-Zinn (1990), which has been 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 UW 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, nonaroused state of attention and clear awareness. Participants met in groups of up to 24 participants, for 2.25–2.5-hr sessions, once a week for 8 weeks. An additional all-day session during Week 6 or 7 ran from approximately 9 a.m. to 3 p.m. The total duration of the sessions was approximately 30 hr per subject. Guided instructional audiotapes or compact disks of varying length, but no longer than 45 min, were provided to 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 min per day at the beginning of the program up to 45 min per day by the 8th week of the program. Participants received a weekly e-mail, phone, or text message reminding them to complete the class practice.

HEP. The format of the HEP (MacCoon et al., 2012) was modeled after traditional activity and nutrition programs used in weight management, cardiac rehabilitation, and diabetes prevention programs. The program is designed to increase health and well-being by focusing on four health domains that are interventions regularly practiced at integrative medicine, including Music Therapy, Nutrition, and 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 2.25–2.5-hr sessions once a week for 8 weeks. There was an all-day class during Week 6 or 7, as well as requested practice of 6 days a 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 T2 because they withdrew from the study, and data from an additional 10 participants were unavailable at T3 also because of study withdrawals. Furthermore, data from two participants were unavailable at T2 because they did not complete the questionnaire measure. Finally, data from seven participants were excluded from analysis at T2 and T3 because they attended fewer than three 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 used restricted maximum-likelihood estimation (REML) and included group (MBSR, HEP, WL) and visit (BL, T2, T3) as fixed effects and lucid dreaming frequency as the outcome variable.

As the measure of lucid dreaming frequency 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 using the following steps: (a) constructing a model based on the null hypothesis of no differences between groups (H_0); (b) resampling with replace-

ment the distribution of the response residuals under the H_0 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 (β) under H_0 ; and (c) comparing the observed value of β against the H_0 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, 2015). Mixed-model fixed effects were assessed by means of a bootstrap likelihood ratio test on mixed-effects models (PBmodcomp in R) specified with MLE. Intervariable correlations for dream and lucid dream frequency were measured using the nonparametric Spearman's ρ test.

Results

On average across both MNP and LTM groups, participants reported that they recalled 1.55 ± 1.79 [$M \pm SD$] dreams per week and 0.59 ± 1.53 [$M \pm SD$] lucid dreams per month. Dream recall and lucid dream frequency were correlated ($r_s = 0.38$, $p = .000001$). Age was negatively correlated with dream recall ($r_s = -0.24$, $p = .001$), but was not correlated with lucid dream frequency ($r_s = -0.09$, $p = .25$). LTMs reported a median of 10 years ($SD = 7.17$, range = 2–35) and 2,639 hr of meditation experience in total, with a median meditation practice of 5.9 hr per week ($SD = 2.6$, range = 2.3–14). They also reported a median of 1,140 hr spent meditating in a retreat setting. The meditation style of the participants was varied and included 19 Theravadan practitioners, 12 Tibetan practitioners, four Zen Buddhist practitioners, and one 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, $SD = 2.28$) than MNPs ($M = 0.45$ per month, $SD = 1.22$; $p = .01$, Monte Carlo permutation test, see Table 1). There was no significant difference in dream recall between LTMs ($M = 1.96$ per week, $SD = 1.85$) compared with MNPs ($M = 1.43$ per week, $SD = 1.75$; $p = .11$, 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 than MNPs ($\beta = 0.58$, $p = .03$), whereas no significant effects of gender ($\beta = -0.37$, $p = .11$) or age ($\beta = -0.01$, $p = .48$) were observed.

LTMs who reported frequent lucid dreams (>1 per month) practiced different styles of meditation, and consisted of four Theravadan practitioners (one with secondary practice in Tibetan), three Tibetan practitioners (one with secondary practice in Zen), two Zen practitioners and one Vipassana practitioner. There were no significant differences in lucid dream frequency between different traditions of practice (all $p > .05$), nor was there a significant difference between LTMs who reported frequent lucid dreams and other LTMs in years of meditation experience, $t(34) = -0.17$, $p = .86$, total hours of practice, $t(36) = -0.54$, $p = .59$, total number of retreat hours, $t(36) = -0.53$, $p = .59$ or hours practicing meditation per week, $t(36) = -1.12$, $p = .21$.

Lucid Dreaming and Trait Mindfulness

Both subscales of the TMS (Curiosity and Decentering; Lau et al., 2006) had high internal consistency (Cronbach's $\alpha = .92$ and 0.89, re-

Table 1
Lucid Dream Frequency for LTM and MNP Groups

Group	LD/month M (SD)	Never	>1/month	>1/week	Age M (SD)	n
MNP	.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.

spectively), similar to Lau et al.'s (2006) reports (.86 and .87, respectively). All FFMQ subscales (Baer et al., 2006) also had high internal consistency (Cronbach's α for Observing = .86, Describing = .92, Acting with Awareness = .90, Nonjudgment = .91, Nonreactivity = .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, $t(176) = 2.65, p = .009$. There was also a marginal but not significant increase in the Observing, $t(174) = 1.95, p = .052$ and Acting with Awareness FFMQ subscales, $t(176) = 1.87, p = .062$. There were no other significant differences in trait mindfulness in frequent lucid dreamers across the entire sample (all $ps > .05$). We next evaluated whether frequent lucid dreamers differed in mindfulness traits separately for MNPs and LTMs. Frequent lucid dreamers in the MNP group had higher scores only on the Describing subscale of the FFMQ, whereas no other significant differences were observed (see 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 (see Table 2, right panel). No signifi-

cant differences were observed on any other subscales (all $ps > .05$). Compared with MNPs, LTMs reported higher trait mindfulness on all TMS and FFMQ subscales (all $p \leq .01$). Years of meditation practice was marginally correlated with the Observing subscale of the FFMQ, $r = .33, p = .052$, but no other correlations between meditation practice and trait-mindfulness subscales were observed (all $ps > .05$).

Lucid Dreaming and MBSR Training

As noted above (see Statistical Analysis section), seven participants attended fewer than three classes and were excluded from further analysis. Of the participants who met the minimum participation requirements, course participation was high: Participants attended an average of 8.29 out of nine classes in the HEP (MacCoon et al., 2012) program and an average of 8.05 out of nine classes in the MBSR program. No difference in attendance, $t(79) = 0.90, p = .37$ 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, who had no intervention between time points. The results showed high test-retest reliability of Schredl and Erlacher's (2004) Dream Recall

Table 2
Trait-Mindfulness Scores for Frequent and Nonfrequent Lucid Dreamers for LTM and MNP Groups

Variable	MNP				LTM			
	NFLD <i>M (SD)</i>	FLD <i>M (SD)</i>	<i>t</i>	<i>p</i>	NFLD <i>M (SD)</i>	FLD <i>M (SD)</i>	<i>t</i>	<i>p</i>
FFMQ								
Observing	27.3 (5.2)	27.2 (6.0)	.58	.56	32.4 (3.6)	35.9 (3.6)	2.70	.01*
Describing	28.3 (5.5)	30.1 (5.6)	2.32	.02*	31.9 (5.6)	33.4 (4.5)	.76	.45
Act Awareness	28.0 (5.2)	28.0 (5.9)	.83	.41	29.5 (4.0)	32.8 (5.1)	2.08	.04*
Nonjudgment	31.2 (5.5)	30.2 (7.2)	-.34	.72	34.2 (3.8)	33.1 (3.7)	.80	.42
Nonreactivity	22.8 (4.6)	23.5 (3.9)	.47	.64	27.1 (3.6)	28.4 (1.7)	1.10	.27
TMS								
Decentering	11.8 (5.0)	11.6 (4.4)	-.42	.67	20.6 (4.8)	23.9 (1.9)	2.10	.04*
Curiosity	14.3 (5.0)	14.4 (5.6)	.54	.59	19.1 (4.1)	19.5 (5.6)	.23	.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.

* $p < .05$.

subscale (BL-T2 $r_s = .86, p < .0001$; BL-T3 $r_s = .89, p < .0001$) and Lucid Dream Frequency subscale (BL-T2: $r_s = .96, p < .0001$; BL-T3: $r_s = .72, p < .0001$).

There was no main effect of group (likelihood ratio = 3.15, $p = .20$) or visit (likelihood ratio = 4.20, $p = .12$) on Lucid Dream Frequency and no interaction between group and visit (likelihood ratio = 0.90, $p = .92$). Compared with BL, neither MBSR nor HEP resulted in increases in reported Lucid Dream Frequency postintervention (T2) or at long-term follow-up (T3, approximately 6 months postintervention; all $p > .05$, see 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 postintervention ($r_s = -0.01, p = .94$). There was also no main effect of group (likelihood ratio = 3.82, $p = .15$) or visit (likelihood ratio = 0.08, $p = .96$) on Dream Recall Frequency and no interaction between group and visit (likelihood ratio = 1.04, $p = .90$).

Discussion

The results of the current study indicate that long-term meditators have more frequent lucid dreams than 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, particularly in meditators, supporting

continuity between increased awareness during waking and sleeping states (e.g., Domhoff, 2017; Hall & Lind, 1970; Kahan & LaBerge, 2011). Consistent with Stumbrys et al., 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 (the 8-week 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. Although 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. Although 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

Table 3
Lucid Dream Frequency for MBSR, HEP, and WL Interventions

Intervention	Mean (SD)			T2 > BL		T3 > BL	
	BL	T2	T3	β	p value	β	p value
HEP	.45 (1.29)	.26 (.62)	.29 (.84)	-.19	.21	-.15	.36
MBSR	.66 (1.54)	.47 (1.07)	.42 (1.33)	-.22	.12	-.20	.16
WL	.26 (.66)	.08 (.18)	.20 (.67)	-.16	.11	-.03	.78

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

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. A more direct source of 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 nonjudgmental attitude of acceptance of experiences as they arise (e.g., Kabat-Zinn, 1990, but see, e.g., Dreyfus, 2011 for discussion of whether the nonjudgmental dimension should be regarded as definitional and Wallace, 2012 for a critique of divorcing the term “mindfulness” from its original con-

nection with Buddhist ethics). Recent researchers have sought to categorize subtypes of mindfulness through factor analysis, including, as noted above, observational and awareness components, as well as nonjudgment and nonreactivity 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 FFMQ (Baer et al., 2006), 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 TMS (Lau et al., 2006). The Describing subscale of the FFMQ relates to an individual’s tendency 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 tendency to verbalize one’s experiences and lucid dreaming has not been studied or described before in the literature. Although this finding initially surprised us, it is not difficult to see how the propensity 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, that is, “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 MNPs, 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 nondistraction (e.g., “I don’t pay attention to what I’m doing because I’m daydreaming, worrying, or otherwise distracted;” reverse scored) and nonautomaticity (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 has 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 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 as the “opacity of mental states” (see Metzinger, 2003 for a discussion of the relationship between phenomenal opacity and lucid dreaming). In contrast to the interrelated facets of Observing, Acting with Awareness and Decentering, no relationship was observed between lucid dream frequency and Nonjudgment or Nonreactivity mindfulness traits as measured by the FFMQ. 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 the FFMQ Nonreactivity/Nonjudgment subscales).

As noted above, an intriguing possibility that arises from these findings 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 (Baer et al., 2006). 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 frequency of lucid dreaming are causally connected remains unclear from the current results. Consistent with Stumbrys et al. (2015), although we observed significantly increased lucid dream 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). In addition, as noted above, our 8-week MBSR intervention did not increase the frequency of lucid dreams in this sample.

Although 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 also to 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 predominantly 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 concluding from this null result 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 effect 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 as-

signing MNPs of both high and low lucid dream frequency to a mindfulness-meditation intervention and evaluating pre- and postchanges in mindfulness and meditation persistence.

Another related possibility is that lucid dreaming could be influenced by specific styles of meditation practice more than others. Although we did not observe differences in lucid dream frequency between meditators from different traditions (e.g., Theravada, Tibetan, or Zen), it is important to note that 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). Both FA and OM practices are hypothesized to train meta-awareness, and 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, whereas 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, and 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. 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 (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 frequency of lucid dreaming. 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/practices, including FA and OM practice. Comparing meditation-training interventions that target specific meditation-practice styles on the frequency lucid dreams 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. Therefore, 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*. Even though 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 who 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 stud-

ies 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 in which an individual is able to experience prolonged lucidity in the dream state, to peak experiences that can have a transformational influence 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).

Although 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 investigating the 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 hr 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 influence of more intensive meditation training on lucid dreaming (i.e., intensive meditation retreats).

Future studies might also include evaluation of 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.

References

- Aviram, L., & Soffer-Dudek, N. (2018). Lucid dreaming: Intensity, but not frequency, is inversely related to psychopathology. *Frontiers in Psychology: Psychopathology*. Advance online publication. <http://dx.doi.org/10.3389/fpsyg.2018.00384>
- Baer, R. A., Smith, G. T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment, 13*, 27–45. <http://dx.doi.org/10.1177/1073191105283504>
- Baer, R. A., Smith, G. T., Lykins, E., Button, D., Krietemeyer, J., Sauer, S., . . . Williams, J. M. G. (2008). Construct validity of the five facet mindfulness questionnaire in meditating and nonmeditating samples. *Assessment, 15*, 329–342. <http://dx.doi.org/10.1177/1073191107313003>
- Baird, B., Mrazek, M. D., Phillips, D. T., & Schooler, J. W. (2014). Domain-specific enhancement of metacognitive ability following meditation training. *Journal of Experimental Psychology: General, 143*, 1972–1979. <http://dx.doi.org/10.1037/a0036882>
- Barrett, D. (1992). Just how lucid are lucid dreams? *Dreaming, 2*, 221–228. <http://dx.doi.org/10.1037/h0094362>
- Bates, D., Mächler, M., Bolker, B., & Walker, S. (2014). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software, 67*, 1–48.

- Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., . . . Devins, G. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice, 11*, 230–241. <http://dx.doi.org/10.1093/clipsy.bph077>
- Davidson, R. J., & Kaszniak, A. W. (2015). Conceptual and methodological issues in research on mindfulness and meditation. *American Psychologist, 70*, 581–592. <http://dx.doi.org/10.1037/a0039512>
- Domhoff, G. W. (2017). The invasion of the concept snatchers: The origins, distortions, and future of the continuity hypothesis. *Dreaming, 27*, 14–39. <http://dx.doi.org/10.1037/drm0000047>
- Dreyfus, G. (2011). Is mindfulness present-centred and non-judgmental? A discussion of the cognitive dimensions of mindfulness. *Contemporary Buddhism, 12*, 41–54. <http://dx.doi.org/10.1080/14639947.2011.564815>
- Ferrarelli, F., Smith, R., Denticò, D., Riedner, B. A., Zennig, C., Benca, R. M., . . . Tononi, G. (2013). Experienced mindfulness meditators exhibit higher parietal–occipital EEG gamma activity during NREM sleep. *PLoS ONE, 8*, e73417. <http://dx.doi.org/10.1371/journal.pone.0073417>
- Fox, K. C., Zakarauskas, P., Dixon, M., Ellamil, M., Thompson, E., & Christoff, K. (2012). Meditation experience predicts introspective accuracy. *PLoS ONE, 7*, e45370. <http://dx.doi.org/10.1371/journal.pone.0045370>
- Gackenbach, J. (1991). A developmental model of consciousness in sleep: From sleep consciousness to pure consciousness. In J. Gackenbach & A. Sheikh (Eds.), *Dream images: A call to mental arms* (pp. 287–308). New York, NY: Baywood.
- Gackenbach, J., Cranson, R., & Alexander, C. (1986). Lucid dreaming, witnessing dreaming, and the transcendental meditation technique: A developmental relationship. *Lucidity Letter, 5*, 34–40.
- Gillespie, G. (1988). Lucid dreams in Tibetan Buddhism. In S. LaBerge & J. Gackenbach (Eds.), *Conscious mind, sleeping brain* (pp. 27–35). New York, NY: Plenum Press. http://dx.doi.org/10.1007/978-1-4757-0423-5_3
- Hall, C. S., & Lind, R. E. (1970). *Dreams, life, and literature: A study of Franz Kafka*. Chapel Hill: University of North Carolina Press.
- Hunt, H. T., & Ogilvie, R. D. (1988). Lucid dreams in their natural series. In S. LaBerge & J. Gackenbach (Eds.), *Conscious mind, sleeping brain* (pp. 389–417). New York, NY: Plenum Press. http://dx.doi.org/10.1007/978-1-4757-0423-5_17
- Kabat-Zinn, J. (1990). *Full catastrophe living: The program of the Stress Reduction Clinic at the University of Massachusetts Medical Center*. New York, NY: Delta.
- Kabat-Zinn, J., Lipworth, L., & Burney, R. (1985). The clinical use of mindfulness meditation for the self-regulation of chronic pain. *Journal of Behavioral Medicine, 8*, 163–190. <http://dx.doi.org/10.1007/BF00845519>
- Kabat-Zinn, J., Lipworth, L., Burney, R., & Sellers, W. (1987). Four-year follow-up of a meditation-based program for the self-regulation of chronic pain: Treatment outcomes and compliance. *The Clinical Journal of Pain, 3*, 159–173. <http://dx.doi.org/10.1097/00002508-198703010-00010>
- Kabat-Zinn, J., Lipworth, L., Burney, R., Sellers, W., & Brew, M. (1984). Reproducibility and four year follow-up of a training program in mindfulness meditation for the self-regulation of chronic pain. *Pain, 18*, S303. [http://dx.doi.org/10.1016/0304-3959\(84\)90584-0](http://dx.doi.org/10.1016/0304-3959(84)90584-0)
- Kahan, T. L., & LaBerge, S. P. (2011). Dreaming and waking: Similarities and differences revisited. *Consciousness and Cognition: An International Journal, 20*, 494–514. <http://dx.doi.org/10.1016/j.concog.2010.09.002>
- Khalsa, S. S., Rudrauf, D., Damasio, A. R., Davidson, R. J., Lutz, A., & Tranel, D. (2008). Interoceptive awareness in experienced meditators. *Psychophysiology, 45*, 671–677. <http://dx.doi.org/10.1111/j.1469-8986.2008.00666.x>
- Kjellgren, A., & Taylor, S. (2008). Mapping Zen meditation as a developmental process: Exploring the experiences of experienced and inexperienced meditators. *Journal of Transpersonal Psychology, 2*, 224–250.
- LaBerge, S. (1985). *Lucid dreaming: The power of being awake and aware in your dreams*. Los Angeles, CA: Tarcher.
- LaBerge, S. (2003). Lucid dreaming and the yoga of the dream state: A psychophysiological perspective. In B. A. Wallace (Ed.), *Buddhism & science: Breaking new ground* (pp. 233–258). New York, NY: Columbia University Press.
- LaBerge, S. (2014). Lucid dreaming: Paradoxes of dreaming consciousness. In E. Cardeña, S. J. Lynn, & S. Krippner (Eds.), *Varieties of anomalous experience: Examining the scientific evidence* (2nd ed., pp. 145–173). Washington, DC: American Psychological Association. <http://dx.doi.org/10.1037/14258-006>
- LaBerge, S., & Rheingold, H. (1990). *Exploring the world of lucid dreaming*. New York, NY: Ballantine Books.
- Lau, M. A., Bishop, S. R., Segal, Z. V., Buis, T., Anderson, N. D., Carlson, L., . . . Devins, G. (2006). The Toronto Mindfulness Scale: Development and validation. *Journal of Clinical Psychology, 62*, 1445–1467. <http://dx.doi.org/10.1002/jclp.20326>
- Lutz, A., Brefczynski-Lewis, J., Johnstone, T., & Davidson, R. J. (2008). Regulation of the neural

- circuitry of emotion by compassion meditation: Effects of meditative expertise. *PLoS ONE*, 3, e1897. <http://dx.doi.org/10.1371/journal.pone.0001897>
- Lutz, A., Jha, A. P., Dunne, J. D., & Saron, C. D. (2015). Investigating the phenomenological matrix of mindfulness-related practices from a neurocognitive perspective. *American Psychologist*, 70, 632–658. <http://dx.doi.org/10.1037/a0039585>
- Lutz, A., Slagter, H. A., Dunne, J. D., & Davidson, R. J. (2008). Attention regulation and monitoring in meditation. *Trends in Cognitive Sciences*, 12, 163–169. <http://dx.doi.org/10.1016/j.tics.2008.01.005>
- Lutz, A., Slagter, H. A., Rawlings, N. B., Francis, A. D., Greischar, L. L., & Davidson, R. J. (2009). Mental training enhances attentional stability: Neural and behavioral evidence. *The Journal of Neuroscience*, 29, 13418–13427. <http://dx.doi.org/10.1523/JNEUROSCI.1614-09.2009>
- MacCoon, D. G., Imel, Z. E., Rosenkranz, M. A., Sheftel, J. G., Weng, H. Y., Sullivan, J. C., . . . Lutz, A. (2012). The validation of an active control intervention for mindfulness based stress reduction (MBSR). *Behaviour Research and Therapy*, 50, 3–12. <http://dx.doi.org/10.1016/j.brat.2011.10.011>
- Manly, B. F. (2006). *Randomization, bootstrap and Monte Carlo methods in biology*. London, UK: Chapman & Hall/CRC press.
- Metzinger, T. (2003). *Being no one: The self-model theory of subjectivity*. Cambridge, MA: MIT Press.
- Miller, J. J., Fletcher, K., & Kabat-Zinn, J. (1995). Three-year follow-up and clinical implications of a mindfulness meditation-based stress reduction intervention in the treatment of anxiety disorders. *General Hospital Psychiatry*, 17, 192–200. [http://dx.doi.org/10.1016/0163-8343\(95\)00025-M](http://dx.doi.org/10.1016/0163-8343(95)00025-M)
- Moffitt, A., Hoffmann, R., Mullington, J., Purcell, S., Pigeau, R., & Wells, R. (1988). Dream psychology: Operating in the dark. In J. Gackenbach & S. LaBerge (Eds.), *Conscious mind, sleeping brain* (pp. 429–439). New York, NY: Plenum Press. http://dx.doi.org/10.1007/978-1-4757-0423-5_19
- Norbu, N., & Katz, M. (1992). *Dream yoga and the practice of natural light*. Ithaca, NY: Snow Lion.
- R Core Team. (2015). R: A language and environment for statistical computing [Computer software]. Vienna, Austria: R Foundation for Statistical Computing. Retrieved from <http://www.R-project.org/>
- Reder, L. M., & Schunn, C. D. (1996). Metacognition does not imply awareness: Strategy choice is governed by implicit learning and memory. In L. M. Reder (Ed.), *Implicit memory and metacognition* (pp. 45–77). Mahwah, NJ: Erlbaum.
- Schooler, J. W. (2002). Re-representing consciousness: Dissociations between experience and meta-consciousness. *Trends in Cognitive Sciences*, 6, 339–344. [http://dx.doi.org/10.1016/S1364-6613\(02\)01949-6](http://dx.doi.org/10.1016/S1364-6613(02)01949-6)
- Schooler, J. W., Smallwood, J., Christoff, K., Handy, T. C., Reichle, E. D., & Sayette, M. A. (2011). Meta-awareness, perceptual decoupling and the wandering mind. *Trends in Cognitive Sciences*, 15, 319–326.
- Schredl, M. (2004). Reliability and stability of a Dream Recall Frequency scale. *Perceptual and Motor Skills*, 98, 1422–1426. <http://dx.doi.org/10.2466/pms.98.3c.1422-1426>
- Schredl, M., & Erlacher, D. (2004). Lucid dreaming frequency and personality. *Personality and Individual Differences*, 37, 1463–1473. <http://dx.doi.org/10.1016/j.paid.2004.02.003>
- Scott, R. B., Dienes, Z., Barrett, A. B., Bor, D., & Seth, A. K. (2014). Blind insight: Metacognitive discrimination despite chance task performance. *Psychological Science*, 25, 2199–2208. <http://dx.doi.org/10.1177/0956797614553944>
- Smallwood, J., & Schooler, J. W. (2015). The science of mind wandering: Empirically navigating the stream of consciousness. *Annual Review of Psychology*, 66, 487–518. <http://dx.doi.org/10.1146/annurev-psych-010814-015331>
- Snyder, T. J., & Gackenbach, J. (1988). Individual differences associated with lucid dreaming. In S. LaBerge & J. Gackenbach (Eds.), *Conscious mind, sleeping brain* (pp. 221–259). New York, NY: Plenum Press. http://dx.doi.org/10.1007/978-1-4757-0423-5_10
- Sparrow, G. (1976). A personal testimony: Developing lucidity in my dreams. *Sundance Community Dream Journal*, 1, 4–17.
- Stumbrys, T., Erlacher, D., & Malinowski, P. (2015). Meta-awareness during day and night: The relationship between mindfulness and lucid dreaming. *Imagination, Cognition and Personality*, 34, 415–433. <http://dx.doi.org/10.1177/0276236615572594>
- Stumbrys, T., Erlacher, D., & Schredl, M. (2013). Reliability and stability of lucid dream and nightmare frequency scales. *International Journal of Dream Research*, 6, 123–126.
- Sze, J. A., Gyurak, A., Yuan, J. W., & Levenson, R. W. (2010). Coherence between emotional experience and physiology: Does body awareness training have an impact? *Emotion*, 10, 803–814. <http://dx.doi.org/10.1037/a0020146>
- Teasdale, J. D., Moore, R. G., Hayhurst, H., Pope, M., Williams, S., & Segal, Z. V. (2002). Metacognitive awareness and prevention of relapse in depression: Empirical evidence. *Journal of Consulting and Clinical Psychology*, 70, 275–287. <http://dx.doi.org/10.1037/0022-006X.70.2.275>
- Thompson, E. (2014). *Waking, dreaming, being: Self and consciousness in neuroscience, meditation, and philosophy*. New York, NY: Columbia Uni-

- versity Press. <http://dx.doi.org/10.7312/thom13709>
- Walach, H., Buchheld, N., Buttenmüller, V., Kleinknecht, N., & Schmidt, S. (2006). Measuring mindfulness: The Freiburg Mindfulness Inventory (FMI). *Personality and Individual Differences, 40*, 1543–1555. <http://dx.doi.org/10.1016/j.paid.2005.11.025>
- Wallace, B. A. (2012). *Meditations of a Buddhist skeptic: A manifesto for the mind sciences and contemplative practice*. New York, NY: Columbia University Press.
- Wallace, B. A., & Hodel, B. (2012). *Dreaming yourself awake: Lucid dreaming and Tibetan dream yoga for insight and transformation*. Boston, MA: Shambhala.
- Williams, J. M. G. (2010). Mindfulness and psychological process. *Emotion, 10*, 1–7. <http://dx.doi.org/10.1037/a0018360>
- Windt, J. M., & Metzinger, T. (2007). The philosophy of dreaming and self-consciousness: What happens to the experiential subject during the dream state? In D. Barrett & P. McNamara (Eds.), *The new science of dreaming: Cultural and theoretical perspectives* (pp. 193–247). Westport, CT: Praeger.

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- To select the appropriate reviewers for each manuscript, the editor needs detailed information. Please include with your letter your vita. In the letter, please identify which APA journal(s) you are interested in, and describe your area of expertise. Be as specific as possible. For example, “social psychology” is not sufficient—you would need to specify “social cognition” or “attitude change” as well.
- Reviewing a manuscript takes time (1–4 hours per manuscript reviewed). If you are selected to review a manuscript, be prepared to invest the necessary time to evaluate the manuscript thoroughly.

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